

Practice Exercise – Model Training and Evaluation

Problem 1: Spam email classification

In this example, you will work on classifying emails as spam or not spam.

You will use the [Spambase Data Set \(https://archive.ics.uci.edu/ml/datasets/Spambase\)](https://archive.ics.uci.edu/ml/datasets/Spambase) from the University of California, Irvine (UCI) Machine Learning Repository.

Source information:

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The data has 57 attributes and 1 target. They are described below.

- 48 continuous real [0,100] attributes of type word_freq_WORD = percentage of words in the e-mail that match WORD, i.e. $100 * (\text{number of times the WORD appears in the e-mail}) / \text{total number of words in e-mail}$. A "word" in this case is any string of alphanumeric characters bounded by non-alphanumeric characters or end-of-string.
- 6 continuous real [0,100] attributes of type char_freq_CHAR = percentage of characters in the e-mail that match CHAR, i.e. $100 * (\text{number of CHAR occurrences}) / \text{total characters in e-mail}$
- 1 continuous real [1,...] attribute of type capital_run_length_average = average length of uninterrupted sequences of capital letters
- 1 continuous integer [1,...] attribute of type capital_run_length_longest = length of longest uninterrupted sequence of capital letters
- 1 continuous integer [1,...] attribute of type capital_run_length_total = sum of length of uninterrupted sequences of capital letters = total number of capital letters in the e-mail
- 1 nominal {0,1} class attribute of type spam = denotes whether the e-mail was considered spam (1) or not (0), i.e. unsolicited commercial e-mail.

1. Getting the data

```
In [1]: import subprocess
import os

# Check whether the file is already in the desired path or if it needs to be d
ownloaded
# File downloaded from source : https://archive.ics.uci.edu/ml/machine-Learnin
g-databases/spambase/spambase.data

base_path = '/home/ec2-user/SageMaker/data/'
file_path = 'spambase.data'

if not os.path.isfile(base_path + file_path):
    subprocess.run(['mkdir', '-p', base_path])
    subprocess.run(['aws', 's3', 'cp',
                    's3://aws-tc-largeobjects/ILT-TF-200-MLDWTS/lab3/',
                    base_path, '--recursive'])
else:
    print('File already downloaded!')
```

```
In [2]: import csv
import numpy as np

data = []

f = open('/home/ec2-user/SageMaker/data/spambase.data')
reader = csv.reader(f)
next(reader, None)
for row in reader:
    data.append(row)
f.close()
```

Write the data into a DataFrame for easier visualization and analysis. Also, add the attribute names, which are from the "spambase.names" file in the dataset package.

In [3]: `import pandas as pd`

```
df = pd.DataFrame(data=np.array(data).astype(np.float), columns=["word_freq_ma
ke",
    "word_freq_address",
    "word_freq_all",
    "word_freq_3d",
    "word_freq_our",
    "word_freq_over",
    "word_freq_remove",
    "word_freq_internet",
    "word_freq_order",
    "word_freq_mail",
    "word_freq_receive",
    "word_freq_will",
    "word_freq_people",
    "word_freq_report",
    "word_freq_addresses",
    "word_freq_free",
    "word_freq_business",
    "word_freq_email",
    "word_freq_you",
    "word_freq_credit",
    "word_freq_your",
    "word_freq_font",
    "word_freq_000",
    "word_freq_money",
    "word_freq_hp",
    "word_freq_hpl",
    "word_freq_george",
    "word_freq_650",
    "word_freq_lab",
    "word_freq_labs",
    "word_freq_telnet",
    "word_freq_857",
    "word_freq_data",
    "word_freq_415",
    "word_freq_85",
    "word_freq_technology",
    "word_freq_1999",
    "word_freq_parts",
    "word_freq_pm",
    "word_freq_direct",
    "word_freq_cs",
    "word_freq_meeting",
    "word_freq_original",
    "word_freq_project",
    "word_freq_re",
    "word_freq_edu",
    "word_freq_table",
    "word_freq_conference",
    "char_freq;",
    "char_freq(",
    "char_freq[",
    "char_freq!",
```

```

"char_freq_$",
"char_freq_#",
"capital_run_length_average",
"capital_run_length_longest",
"capital_run_length_total",
"target"]
)

```

Look at the shape of the data. There are 58 columns (including the target) as expected.

```
In [4]: df.head()
```

Out[4]:

	word_freq_make	word_freq_address	word_freq_all	word_freq_3d	word_freq_our	word_freq_c
0	0.21	0.28	0.50	0.0	0.14	(
1	0.06	0.00	0.71	0.0	1.23	(
2	0.00	0.00	0.00	0.0	0.63	(
3	0.00	0.00	0.00	0.0	0.63	(
4	0.00	0.00	0.00	0.0	1.85	(

5 rows × 58 columns

The `df.describe()` function presents a statistical summary of the features.

```
In [5]: df.describe()
```

Out[5]:

	word_freq_make	word_freq_address	word_freq_all	word_freq_3d	word_freq_our	word_fr
count	4600.000000	4600.000000	4600.000000	4600.000000	4600.000000	4600.000000
mean	0.104576	0.212922	0.280578	0.065439	0.312222	(
std	0.305387	1.290700	0.504170	1.395303	0.672586	(
min	0.000000	0.000000	0.000000	0.000000	0.000000	(
25%	0.000000	0.000000	0.000000	0.000000	0.000000	(
50%	0.000000	0.000000	0.000000	0.000000	0.000000	(
75%	0.000000	0.000000	0.420000	0.000000	0.382500	(
max	4.540000	14.280000	5.100000	42.810000	10.000000	†

8 rows × 58 columns

2. Training the model

In this section, you will do the following:

- Split the dataset into training, validation, and test subsets
- Use the Amazon SageMaker linear learner algorithm to train the model

Question 1 - Train-test-validation split

An important part of training a machine learning model is splitting the data into training, validation, and test subsets. You will use the `train_test_split()` function from the `sklearn` library ([documentation \(https://scikit-learn.org/stable/modules/generated/sklearn.model_selection.train_test_split.html\)](https://scikit-learn.org/stable/modules/generated/sklearn.model_selection.train_test_split.html)).

Look at this example:

```
train_features, test_features, train_labels, test_labels =  
train_test_split(X, y, test_size=0.2)
```

This function splits input feature `X` and target `y` pairs by a given ratio (`test_size`). This specific example splits the data into training (80%) and test (20%) subsets.

Use this function **twice** to split the data into **training (80%)**, **validation (10%)**, and **test (10%)** subsets.

```
In [6]: from sklearn.model_selection import train_test_split

# Get the feature values until the target column (not included)
X = df.values[:, :-1].astype(np.float32)

# Get the target column
y = df.values[:, -1].astype(np.float32)

# Get 80% of the data for training; the remaining 20% will be for validation and test
train_features, test_features, train_labels, test_labels = train_test_split(X,
y, test_size=0.2)

# Split the remaining 20% of data as 10% test and 10% validation
test_features, val_features, test_labels, val_labels = train_test_split(test_f
eatures, test_labels, test_size=0.5)

print(f"Length of train_features is: {train_features.shape}")
print(f"Length of train_labels is: {train_labels.shape}")
print(f"Length of val_features is: {val_features.shape}")
print(f"Length of val_labels is: {val_labels.shape}")
print(f"Length of test_features is: {test_features.shape}")
print(f"Length of test_labels is: {test_labels.shape}")
```

```
Length of train_features is: (3680, 57)
Length of train_labels is: (3680,)
Length of val_features is: (460, 57)
Length of val_labels is: (460,)
Length of test_features is: (460, 57)
Length of test_labels is: (460,)
```

Now, call the Amazon SageMaker `LinearLearner()` algorithm. This example uses an `m1.m4.xlarge` instance for training. `predictor_type` is set to `'binary_classifier'` because there are two classes: "spam" and "not spam".

```
In [7]: import sagemaker

# Call the LinearLearner estimator object
binary_estimator = sagemaker.LinearLearner(role=sagemaker.get_execution_role
(),
                                           instance_count=1,
                                           instance_type='m1.m4.xlarge',
                                           predictor_type='binary_classifi
er')
```

Use the `record_set()` function of the `binary_estimator` to set the training, validation, and test parts of the estimator.

```
In [8]: train_records = binary_estimator.record_set(train_features, train_labels, channel='train')
val_records = binary_estimator.record_set(val_features, val_labels, channel='validation')
test_records = binary_estimator.record_set(test_features, test_labels, channel='test')
```

The `fit()` function applies a distributed version of the Stochastic Gradient Descent (SGD) algorithm, and we are sending the data to it.

```
In [9]: binary_estimator.fit([train_records, val_records, test_records])
```

Defaulting to the only supported framework/algorithm version: 1. Ignoring framework/algorithm version: 1.

Defaulting to the only supported framework/algorithm version: 1. Ignoring framework/algorithm version: 1.

```
2020-11-11 14:35:36 Starting - Starting the training job...
2020-11-11 14:35:38 Starting - Launching requested ML instances.....
2020-11-11 14:36:49 Starting - Preparing the instances for training.....
2020-11-11 14:37:58 Downloading - Downloading input data.....
2020-11-11 14:39:01 Training - Training image download completed. Training in
progress..Docker entrypoint called with argument(s): train
Running default environment configuration script
[11/11/2020 14:39:06 INFO 140570661291840] Reading default configuration from
/opt/amazon/lib/python2.7/site-packages/algorithm/resources/default-input.js
on: {u'loss_insensitivity': u'0.01', u'epochs': u'15', u'feature_dim': u'aut
o', u'init_bias': u'0.0', u'lr_scheduler_factor': u'auto', u'num_calibration
samples': u'1000000', u'accuracy_top_k': u'3', u'_num_kv_servers': u'auto',
  u'use_bias': u'true', u'num_point_for_scaler': u'10000', u'_log_level': u'in
fo', u'quantile': u'0.5', u'bias_lr_mult': u'auto', u'lr_scheduler_step': u'a
uto', u'init_method': u'uniform', u'init_sigma': u'0.01', u'lr_scheduler_mini
mum_lr': u'auto', u'target_recall': u'0.8', u'num_models': u'auto', u'early_s
topping_patience': u'3', u'momentum': u'auto', u'unbias_label': u'auto', u'w
d': u'auto', u'optimizer': u'auto', u'_tuning_objective_metric': u'', u'early
_stopping_tolerance': u'0.001', u'learning_rate': u'auto', u'_kvstore': u'aut
o', u'normalize_data': u'true', u'binary_classifier_model_selection_criteri
a': u'accuracy', u'use_lr_scheduler': u'true', u'target_precision': u'0.8',
  u'unbias_data': u'auto', u'init_scale': u'0.07', u'bias_wd_mult': u'auto',
  u'f_beta': u'1.0', u'mini_batch_size': u'1000', u'huber_delta': u'1.0', u'nu
m_classes': u'1', u'beta_1': u'auto', u'loss': u'auto', u'beta_2': u'auto',
  u'_enable_profiler': u'false', u'normalize_label': u'auto', u'_num_gpus':
  u'auto', u'balance_multiclass_weights': u'false', u'positive_example_weight
_mult': u'1.0', u'l1': u'auto', u'margin': u'1.0'}
[11/11/2020 14:39:06 INFO 140570661291840] Merging with provided configuratio
n from /opt/ml/input/config/hyperparameters.json: {u'feature_dim': u'57', u'm
ini_batch_size': u'1000', u'predictor_type': u'binary_classifier'}
[11/11/2020 14:39:06 INFO 140570661291840] Final configuration: {u'loss_insen
sitivity': u'0.01', u'epochs': u'15', u'feature_dim': u'57', u'init_bias':
  u'0.0', u'lr_scheduler_factor': u'auto', u'num_calibration_samples': u'10000
000', u'accuracy_top_k': u'3', u'_num_kv_servers': u'auto', u'use_bias': u'tr
ue', u'num_point_for_scaler': u'10000', u'_log_level': u'info', u'quantile':
  u'0.5', u'bias_lr_mult': u'auto', u'lr_scheduler_step': u'auto', u'init_meth
od': u'uniform', u'init_sigma': u'0.01', u'lr_scheduler_minimum_lr': u'auto',
u'target_recall': u'0.8', u'num_models': u'auto', u'early_stopping_patience':
u'3', u'momentum': u'auto', u'unbias_label': u'auto', u'wd': u'auto', u'optim
izer': u'auto', u'_tuning_objective_metric': u'', u'early_stopping_toleranc
e': u'0.001', u'learning_rate': u'auto', u'_kvstore': u'auto', u'normalize_da
ta': u'true', u'binary_classifier_model_selection_criteria': u'accuracy', u'u
se_lr_scheduler': u'true', u'target_precision': u'0.8', u'unbias_data': u'aut
o', u'init_scale': u'0.07', u'bias_wd_mult': u'auto', u'f_beta': u'1.0', u'mi
ni_batch_size': u'1000', u'huber_delta': u'1.0', u'num_classes': u'1', u'pred
ictor_type': u'binary_classifier', u'beta_1': u'auto', u'loss': u'auto', u'be
ta_2': u'auto', u'_enable_profiler': u'false', u'normalize_label': u'auto',
  u'_num_gpus': u'auto', u'balance_multiclass_weights': u'false', u'positive_e
xample_weight_mult': u'1.0', u'l1': u'auto', u'margin': u'1.0'}
[11/11/2020 14:39:06 WARNING 140570661291840] Loggers have already been setu
p.
Process 1 is a worker.
[11/11/2020 14:39:06 INFO 140570661291840] Using default worker.
[11/11/2020 14:39:06 INFO 140570661291840] Checkpoint loading and saving are
disabled.
```

```

[2020-11-11 14:39:06.540] [tensorio] [warning] TensorIO is already initialize
d; ignoring the initialization routine.
[2020-11-11 14:39:06.543] [tensorio] [warning] TensorIO is already initialize
d; ignoring the initialization routine.
[2020-11-11 14:39:06.565] [tensorio] [info] epoch_stats={"data_pipeline": "/o
pt/ml/input/data/train", "epoch": 0, "duration": 28, "num_examples": 1, "num_
bytes": 276000}
[11/11/2020 14:39:06 INFO 140570661291840] Create Store: local
[2020-11-11 14:39:06.610] [tensorio] [info] epoch_stats={"data_pipeline": "/o
pt/ml/input/data/train", "epoch": 1, "duration": 44, "num_examples": 4, "num_
bytes": 1015680}
[11/11/2020 14:39:06 INFO 140570661291840] Scaler algorithm parameters
<algorithm.scaler.ScalerAlgorithmStable object at 0x7fd8c9a85750>
[11/11/2020 14:39:06 INFO 140570661291840] Scaling model computed with parame
ters:
{'stdev_weight':
[3.0811292e-01 1.3013469e+00 4.8761535e-01 1.0709046e+00 6.9179302e-01
2.8718919e-01 3.5308143e-01 3.7613577e-01 2.7019387e-01 6.1753744e-01
1.9342145e-01 8.7927783e-01 3.1609657e-01 3.4705788e-01 2.7393606e-01
8.4166121e-01 4.3678418e-01 5.4855633e-01 1.7715774e+00 5.2222133e-01
1.2074115e+00 1.0266762e+00 3.6122438e-01 4.4305483e-01 1.8684738e+00
8.6773890e-01 3.3515129e+00 5.3175473e-01 6.5058708e-01 4.7774097e-01
3.6570948e-01 3.3036590e-01 6.0236651e-01 3.3148775e-01 5.7246566e-01
4.1706234e-01 4.2213407e-01 1.7373802e-01 4.1935676e-01 3.6192173e-01
3.8777530e-01 8.0453688e-01 2.1158254e-01 6.1547530e-01 1.0836428e+00
9.4533724e-01 6.6270582e-02 2.2460566e-01 2.7303916e-01 2.3547012e-01
1.2278782e-01 6.9646877e-01 2.5294870e-01 3.6324766e-01 3.5370014e+01
1.3351813e+02 5.3927051e+02]
<NDArray 57 @cpu(0)>, 'stdev_label': None, 'mean_label': None, 'mean_weight':
[1.05406672e-01 2.08563343e-01 2.77276695e-01 4.46566679e-02
3.09289992e-01 9.68333334e-02 1.04346670e-01 9.84566733e-02
8.66599977e-02 2.41019994e-01 5.65300025e-02 5.49360037e-01
9.26300064e-02 5.58333360e-02 5.23233339e-02 2.46976659e-01
1.42570019e-01 1.86803326e-01 1.63968349e+00 8.03500041e-02
7.92909980e-01 1.20090008e-01 1.04616672e-01 9.20533389e-02
5.96500039e-01 2.63853371e-01 7.59506643e-01 1.21533342e-01
1.08656675e-01 1.07086673e-01 6.10866696e-02 4.60533351e-02
1.06163330e-01 4.69966680e-02 1.05973333e-01 9.90433395e-02
1.32403344e-01 9.12000053e-03 7.05500022e-02 6.52500093e-02
4.41466719e-02 1.35740012e-01 4.15900014e-02 8.06166679e-02
3.09963346e-01 1.87663347e-01 4.72333375e-03 2.88600028e-02
4.30646650e-02 1.35182679e-01 1.69286653e-02 2.67755330e-01
7.82846659e-02 4.08609994e-02 5.25463390e+00 4.95849991e+01
2.73466339e+02]
<NDArray 57 @cpu(0)>}]
[11/11/2020 14:39:06 INFO 140570661291840] nvidia-smi took: 0.025242805481 se
cs to identify 0 gpus
[11/11/2020 14:39:06 INFO 140570661291840] Number of GPUs being used: 0
#metrics {"Metrics": {"Max Batches Seen Between Resets": {"count": 1, "max":
4, "sum": 4.0, "min": 4}, "Number of Batches Since Last Reset": {"count": 1,
"max": 0, "sum": 0.0, "min": 0}, "Number of Records Since Last Reset": {"coun
t": 1, "max": 0, "sum": 0.0, "min": 0}, "Total Batches Seen": {"count": 1, "m
ax": 5, "sum": 5.0, "min": 5}, "Total Records Seen": {"count": 1, "max": 468
0, "sum": 4680.0, "min": 4680}, "Max Records Seen Between Resets": {"count":
1, "max": 3680, "sum": 3680.0, "min": 3680}, "Reset Count": {"count": 1, "ma
x": 2, "sum": 2.0, "min": 2}}, "EndTime": 1605105546.724363, "Dimensions":

```

```
{"Host": "algo-1", "Meta": "init_train_data_iter", "Operation": "training",  
"Algorithm": "Linear Learner"}, "StartTime": 1605105546.724318}
```

```
[2020-11-11 14:39:06.851] [tensorio] [info] epoch_stats={"data_pipeline": "/o  
pt/ml/input/data/train", "epoch": 4, "duration": 126, "num_examples": 4, "num  
_bytes": 1015680}
```

```
#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":  
{"count": 1, "max": 0.6648816731770834, "sum": 0.6648816731770834, "min": 0.  
6648816731770834}}, "EndTime": 1605105546.851499, "Dimensions": {"model": 0,  
"Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "e  
poch": 0}, "StartTime": 1605105546.851392}
```

```
#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":  
{"count": 1, "max": 0.6857946980794271, "sum": 0.6857946980794271, "min": 0.  
6857946980794271}}, "EndTime": 1605105546.851594, "Dimensions": {"model": 1,  
"Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "e  
poch": 0}, "StartTime": 1605105546.851573}
```

```
#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":  
{"count": 1, "max": 0.7384564615885416, "sum": 0.7384564615885416, "min": 0.  
7384564615885416}}, "EndTime": 1605105546.851668, "Dimensions": {"model": 2,  
"Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "e  
poch": 0}, "StartTime": 1605105546.85165}
```

```
#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":  
{"count": 1, "max": 0.7331268310546875, "sum": 0.7331268310546875, "min": 0.  
7331268310546875}}, "EndTime": 1605105546.851742, "Dimensions": {"model": 3,  
"Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "e  
poch": 0}, "StartTime": 1605105546.851722}
```

```
#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":  
{"count": 1, "max": 0.4914309895833333, "sum": 0.4914309895833333, "min": 0.  
4914309895833333}}, "EndTime": 1605105546.851814, "Dimensions": {"model": 4,  
"Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "e  
poch": 0}, "StartTime": 1605105546.851796}
```

```
#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":  
{"count": 1, "max": 0.4809212849934896, "sum": 0.4809212849934896, "min": 0.  
4809212849934896}}, "EndTime": 1605105546.85189, "Dimensions": {"model": 5,  
"Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "e  
poch": 0}, "StartTime": 1605105546.851871}
```

```
#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":  
{"count": 1, "max": 0.48336067708333336, "sum": 0.48336067708333336, "min":  
0.48336067708333336}}, "EndTime": 1605105546.851966, "Dimensions": {"model":  
6, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner",  
"epoch": 0}, "StartTime": 1605105546.851947}
```

```
#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":  
{"count": 1, "max": 0.5233609008789063, "sum": 0.5233609008789063, "min": 0.  
5233609008789063}}, "EndTime": 1605105546.852041, "Dimensions": {"model": 7,  
"Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "e  
poch": 0}, "StartTime": 1605105546.852022}
```

```
#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":  
{"count": 1, "max": 0.693765157063802, "sum": 0.693765157063802, "min": 0.69
```

```
3765157063802}}, "EndTime": 1605105546.852116, "Dimensions": {"model": 8, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105546.852097}
```

```
#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.7109463907877605, "sum": 0.7109463907877605, "min": 0.7109463907877605}}, "EndTime": 1605105546.85219, "Dimensions": {"model": 9, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105546.852172}
```

```
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.5171372680664063, "sum": 0.5171372680664063, "min": 0.5171372680664063}}, "EndTime": 1605105546.852551, "Dimensions": {"model": 15, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105546.852536}
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
  {"count": 1, "max": 0.5275778503417968, "sum": 0.5275778503417968, "min": 0.
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  "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "ep
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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  "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "ep
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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  rtTime": 1605105546.853144}

#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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  t": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoc
  h": 0}, "StartTime": 1605105546.853215}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6687818603515625, "sum": 0.6687818603515625, "min": 0.6687818603515625}}, "EndTime": 1605105546.8533, "Dimensions": {"model": 27, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105546.853284}
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6936051025390625, "sum": 0.6936051025390625, "min": 0.6936051025390625}}, "EndTime": 1605105546.853364, "Dimensions": {"model": 28, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105546.853347}
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.7100109252929687, "sum": 0.7100109252929687, "min": 0.7100109252929687}}, "EndTime": 1605105546.853424, "Dimensions": {"model": 29, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105546.853407}
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```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.7384425659179688, "sum": 0.7384425659179688, "min": 0.7384425659179688}}, "EndTime": 1605105546.853537, "Dimensions": {"model": 31, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105546.853521}
```

```
[11/11/2020 14:39:06 INFO 140570661291840] #quality_metric: host=algo-1, epoch=0, train binary_classification_cross_entropy_objective <loss>=0.664881673177
```

```
[2020-11-11 14:39:06.871] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/validation", "epoch": 0, "duration": 330, "num_examples": 1, "num_bytes": 126960}
```

```
[2020-11-11 14:39:07.005] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/validation", "epoch": 2, "duration": 134, "num_examples": 1, "num_bytes": 126960}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6208137180494225, "sum": 0.6208137180494225, "min": 0.6208137180494225}}, "EndTime": 1605105547.239703, "Dimensions": {"model": 0, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105547.239569}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6306782598080842, "sum": 0.6306782598080842, "min": 0.6306782598080842}}, "EndTime": 1605105547.23984, "Dimensions": {"model": 1, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105547.239813}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6795264202615489, "sum": 0.6795264202615489, "min": 0.6795264202615489}}, "EndTime": 1605105547.239919, "Dimensions": {"model": 2, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105547.239897}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6656039694081182, "sum": 0.6656039694081182, "min": 0.6656039694081182}}, "EndTime": 1605105547.239992, "Dimensions": {"model": 3, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105547.239972}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.27099013950513756, "sum": 0.27099013950513756, "min": 0.27099013950513756}}, "EndTime": 1605105547.240062, "Dimensions": {"model": 4, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105547.240043}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.27456412937330166, "sum": 0.27456412937330166, "min": 0.27456412937330166}}, "EndTime": 1605105547.24013, "Dimensions": {"model": 5, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105547.240111}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.27502932341202446, "sum": 0.27502932341202446, "min": 0.27502932341202446}}, "EndTime": 1605105547.240198, "Dimensions": {"model": 6, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105547.24018}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.27908298658288044, "sum": 0.27908298658288044, "min": 0.27908298658288044}}, "EndTime": 1605105547.240262, "Dimensions": {"model": 7, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105547.240244}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6353551449983016, "sum": 0.6353551449983016, "min": 0.6353551449983016}}, "EndTime": 1605105547.24033, "Dimensions": {"model": 8, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105547.240311}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6420788308848505, "sum": 0.6420788308848505, "min": 0.6420788308848505}}, "EndTime": 1605105547.240394, "Dimensions": {"model": 9, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105547.240376}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6203114385190217, "sum": 0.6203114385190217, "min": 0.6203114385190217}}, "EndTime": 1605105547.240459, "Dimensions": {"model": 10, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105547.24044}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6318774679432745, "sum": 0.6318774679432745, "min": 0.6318774679432745}}, "EndTime": 1605105547.240525, "Dimensions": {"model": 11, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105547.240507}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6318774679432745, "sum": 0.6318774679432745, "min": 0.6318774679432745}}, "EndTime": 1605105547.240525, "Dimensions": {"model": 11, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105547.240507}
```

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ve": {"count": 1, "max": 0.27253728120223336, "sum": 0.27253728120223336, "min": 0.27253728120223336}}, "EndTime": 1605105547.24059, "Dimensions": {"model": 12, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105547.240572}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.26481532221255094, "sum": 0.26481532221255094, "min": 0.26481532221255094}}, "EndTime": 1605105547.240652, "Dimensions": {"model": 13, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105547.240635}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.2768918908160666, "sum": 0.2768918908160666, "min": 0.2768918908160666}}, "EndTime": 1605105547.24071, "Dimensions": {"model": 14, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105547.240695}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.27375392084536343, "sum": 0.27375392084536343, "min": 0.27375392084536343}}, "EndTime": 1605105547.240771, "Dimensions": {"model": 15, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105547.240754}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6022633428158968, "sum": 0.6022633428158968, "min": 0.6022633428158968}}, "EndTime": 1605105547.240836, "Dimensions": {"model": 16, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105547.240817}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6301988684612772, "sum": 0.6301988684612772, "min": 0.6301988684612772}}, "EndTime": 1605105547.240901, "Dimensions": {"model": 17, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105547.240882}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6625938083814538, "sum": 0.6625938083814538, "min": 0.6625938083814538}}, "EndTime": 1605105547.240966, "Dimensions": {"model": 18, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105547.240948}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.4016651319420856, "sum": 0.4016651319420856, "min": 0.4016651319420856}}, "EndTime": 1605105547.241099, "Dimensions": {"model": 20, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105547.241081}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.38518716563349187, "sum": 0.38518716563349187, "min": 0.38518716563349187}}, "EndTime": 1605105547.241163, "Dimensions": {"model": 21, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105547.241145}
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```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.41296671991762907, "sum": 0.41296671991762907, "min": 0.41296671991762907}}, "EndTime": 1605105547.241229, "Dimensions": {"model": 22, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105547.241211}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.3831335316533628, "sum": 0.3831335316533628, "min": 0.3831335316533628}}, "EndTime": 1605105547.241294, "Dimensions": {"model": 23, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105547.241276}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6980310854704483, "sum": 0.6980310854704483, "min": 0.6980310854704483}}, "EndTime": 1605105547.241358, "Dimensions": {"model": 24, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105547.241341}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6833498747452446, "sum": 0.6833498747452446, "min": 0.6833498747452446}}, "EndTime": 1605105547.241423, "Dimensions": {"model": 25, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105547.241404}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6656954557999321, "sum": 0.6656954557999321, "min": 0.6656954557999321}}, "EndTime": 1605105547.241489, "Dimensions": {"model": 26, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105547.24147}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6619648145592731, "sum": 0.6619648145592731, "min": 0.6619648145592731}}, "EndTime": 1605105547.241555, "Dimensions": {"model": 27, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105547.241536}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.663563404912534, "sum": 0.663563404912534, "min": 0.663563404912534}}, "EndTime": 1605105547.241622, "Dimensions": {"model": 28, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105547.241604}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6681123153023097, "sum": 0.6681123153023097, "min": 0.6681123153023097}}, "EndTime": 1605105547.241686, "Dimensions": {"model": 29, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105547.241668}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.7105030225670856, "sum": 0.7105030225670856, "min": 0.7105030225670856}}, "EndTime": 1605105547.241751, "Dimensions": {"model": 30, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105547.241732}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6516081436820652, "sum": 0.6516081436820652, "min": 0.6516081436820652}}, "EndTime": 1605105547.241818, "Dimensions": {"model": 31, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 0}, "StartTime": 1605105547.241798}
```

```
[11/11/2020 14:39:07 INFO 140570661291840] #quality_metric: host=algo-1, epoch=0, validation binary_classification_cross_entropy_objective <loss>=0.620813718049
```

```
[11/11/2020 14:39:07 INFO 140570661291840] #early_stopping_criteria_metric: host=algo-1, epoch=0, criteria=sampled_accuracy, value=0.926086956522
```

```
[11/11/2020 14:39:07 INFO 140570661291840] Epoch 0: Loss improved. Updating best model
```

```
[11/11/2020 14:39:07 INFO 140570661291840] Saving model for epoch: 0
```

```
[11/11/2020 14:39:07 INFO 140570661291840] Saved checkpoint to "/tmp/tmp99iGn/mx-mod-0000.params"
```

```
[11/11/2020 14:39:07 INFO 140570661291840] #progress_metric: host=algo-1, completed 6 % of epochs
```

```
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```

```
[11/11/2020 14:39:07 INFO 140570661291840] #throughput_metric: host=algo-1, train throughput=6959.11500658 records/second
```

```
[2020-11-11 14:39:07.360] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/train", "epoch": 6, "duration": 106, "num_examples": 4, "num_bytes": 1015680}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.5957144368489583, "sum": 0.5957144368489583, "min": 0.5957144368489583}}, "EndTime": 1605105547.360843, "Dimensions": {"model": 0, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 1}, "StartTime": 1605105547.360753}
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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  ost": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoc
  h": 1}, "StartTime": 1605105547.361337}

#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.4845602722167969, "sum": 0.4845602722167969, "min": 0.4845602722167969}}, "EndTime": 1605105547.361887, "Dimensions": {"model": 22, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 1}, "StartTime": 1605105547.361875}
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.46097829182942707, "sum": 0.46097829182942707, "min": 0.46097829182942707}}, "EndTime": 1605105547.361931, "Dimensions": {"model": 23, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 1}, "StartTime": 1605105547.36192}
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6729713541666666, "sum": 0.6729713541666666, "min": 0.6729713541666666}}, "EndTime": 1605105547.362065, "Dimensions": {"model": 26, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 1}, "StartTime": 1605105547.362053}
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.7029233601888021, "sum": 0.7029233601888021, "min": 0.7029233601888021}}, "EndTime": 1605105547.362153, "Dimensions": {"model": 28, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 1}, "StartTime": 1605105547.362142}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.690083231608073, "sum": 0.690083231608073, "min": 0.690083231608073}}, "EndTime": 1605105547.362197, "Dimensions": {"model": 29, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 1}, "StartTime": 1605105547.362186}
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.7591775105794271, "sum": 0.7591775105794271, "min": 0.7591775105794271}}, "EndTime": 1605105547.362242, "Dimensions": {"model": 30, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 1}, "StartTime": 1605105547.36223}
```

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6471427408854167}}, "EndTime": 1605105547.362286, "Dimensions": {"model": 31, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 1}, "StartTime": 1605105547.362274}
```

```
[11/11/2020 14:39:07 INFO 140570661291840] #quality_metric: host=algo-1, epoch=1, train binary_classification_cross_entropy_objective <loss>=0.595714436849
```

```
[2020-11-11 14:39:07.547] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/validation", "epoch": 5, "duration": 157, "num_examples": 1, "num_bytes": 126960}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.5567102846891984, "sum": 0.5567102846891984, "min": 0.5567102846891984}}, "EndTime": 1605105547.84158, "Dimensions": {"model": 0, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 1}, "StartTime": 1605105547.84145}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.5659186321756114, "sum": 0.5659186321756114, "min": 0.5659186321756114}}, "EndTime": 1605105547.841719, "Dimensions": {"model": 1, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 1}, "StartTime": 1605105547.841691}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6087175452190897, "sum": 0.6087175452190897, "min": 0.6087175452190897}}, "EndTime": 1605105547.842026, "Dimensions": {"model": 2, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 1}, "StartTime": 1605105547.841999}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.25869794099227245, "sum": 0.25869794099227245, "min": 0.25869794099227245}}, "EndTime": 1605105547.842839, "Dimensions": {"model": 5, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 1}, "StartTime": 1605105547.842652}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.2570014124331267, "sum": 0.2570014124331267, "min": 0.2570014124331267}}, "EndTime": 1605105547.842931, "Dimensions": {"model": 6, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 1}, "StartTime": 1605105547.84291}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.2616989799167799, "sum": 0.2616989799167799, "min": 0.2616989799167799}}, "EndTime": 1605105547.843127, "Dimensions": {"model": 7, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 1}, "StartTime": 1605105547.843107}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.5724824988323709, "sum": 0.5724824988323709, "min": 0.5724824988323709}}, "EndTime": 1605105547.843448, "Dimensions": {"mode": 8, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 1}, "StartTime": 1605105547.843316}

#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.5766372017238451, "sum": 0.5766372017238451, "min": 0.5766372017238451}}, "EndTime": 1605105547.843637, "Dimensions": {"mode": 9, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 1}, "StartTime": 1605105547.843517}

#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.5567906255307404, "sum": 0.5567906255307404, "min": 0.5567906255307404}}, "EndTime": 1605105547.843729, "Dimensions": {"mode": 10, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 1}, "StartTime": 1605105547.843706}

#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.5679292761761209, "sum": 0.5679292761761209, "min": 0.5679292761761209}}, "EndTime": 1605105547.843919, "Dimensions": {"mode": 11, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 1}, "StartTime": 1605105547.843897}

#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.25522645038107167, "sum": 0.25522645038107167, "min": 0.25522645038107167}}, "EndTime": 1605105547.844108, "Dimensions": {"mode": 12, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 1}, "StartTime": 1605105547.844083}

#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.2506391774053159, "sum": 0.2506391774053159, "min": 0.2506391774053159}}, "EndTime": 1605105547.844184, "Dimensions": {"mode": 13, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 1}, "StartTime": 1605105547.844164}

#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.25830683500870416, "sum": 0.25830683500870416, "min": 0.25830683500870416}}, "EndTime": 1605105547.84425, "Dimensions": {"mode": 14, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 1}, "StartTime": 1605105547.844231}

#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.25741777834684954, "sum": 0.25741777834684954, "min": 0.25741777834684954}}, "EndTime": 1605105547.844317, "Dimensions": {"mode": 15, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 1}, "StartTime": 1605105547.844298}

#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.5536600195843241, "sum": 0.5536600195843241, "min": 0.5536600195843241}}, "EndTime": 1605105547.844381, "Dimensions": {"mode": 16, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 1}, "StartTime": 1605105547.844363}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.5769854338272759, "sum": 0.5769854338272759, "min": 0.5769854338272759}}, "EndTime": 1605105547.844442, "Dimensions": {"model": 17, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 1}, "StartTime": 1605105547.844425}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.5962038786514946, "sum": 0.5962038786514946, "min": 0.5962038786514946}}, "EndTime": 1605105547.844507, "Dimensions": {"model": 18, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 1}, "StartTime": 1605105547.844489}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6207835321841033, "sum": 0.6207835321841033, "min": 0.6207835321841033}}, "EndTime": 1605105547.844569, "Dimensions": {"model": 19, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 1}, "StartTime": 1605105547.844552}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.5574606853982677, "sum": 0.5574606853982677, "min": 0.5574606853982677}}, "EndTime": 1605105547.84463, "Dimensions": {"model": 20, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 1}, "StartTime": 1605105547.844613}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.5718330715013586, "sum": 0.5718330715013586, "min": 0.5718330715013586}}, "EndTime": 1605105547.844691, "Dimensions": {"model": 21, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 1}, "StartTime": 1605105547.844674}
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"epoch": 1}, "StartTime": 1605105547.845282}
```

```
[11/11/2020 14:39:07 INFO 140570661291840] #quality_metric: host=algo-1, epoc
h=1, validation binary_classification_cross_entropy_objective <loss>=0.556710
284689
```

```
[11/11/2020 14:39:07 INFO 140570661291840] #early_stopping_criteria_metric: h
ost=algo-1, epoch=1, criteria=sampled_accuracy, value=0.928260869565
```

```
[11/11/2020 14:39:07 INFO 140570661291840] Epoch 1: Loss improved. Updating b
est model
```

```
[11/11/2020 14:39:07 INFO 140570661291840] Saving model for epoch: 1
```

```
[11/11/2020 14:39:07 INFO 140570661291840] Saved checkpoint to "/tmp/tmpGv1M
m/mx-mod-0000.params"
```

```
[11/11/2020 14:39:07 INFO 140570661291840] #progress_metric: host=algo-1, com
pleted 13 % of epochs
```

```
#metrics {"Metrics": {"Max Batches Seen Between Resets": {"count": 1, "max":
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```

53601}

```
[11/11/2020 14:39:07 INFO 140570661291840] #throughput_metric: host=algo-1, train throughput=6143.19385579 records/second
```

```
[2020-11-11 14:39:07.967] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/train", "epoch": 8, "duration": 114, "num_examples": 4, "num_bytes": 1015680}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.5428616536458334, "sum": 0.5428616536458334, "min": 0.5428616536458334}}, "EndTime": 1605105547.967338, "Dimensions": {"model": 0, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 2}, "StartTime": 1605105547.967264}
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```

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```

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```

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```

```
[11/11/2020 14:39:07 INFO 140570661291840] #quality_metric: host=algo-1, epoch=2, train binary_classification_cross_entropy_objective <loss>=0.542861653646
```

```
[2020-11-11 14:39:08.130] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/validation", "epoch": 8, "duration": 139, "num_examples": 1, "num_bytes": 126960}
```

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```

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```

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```

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```
[11/11/2020 14:39:08 INFO 140570661291840] #quality_metric: host=algo-1, epoch=2, validation binary_classification_cross_entropy_objective <loss>=0.507389002261
```

```
[11/11/2020 14:39:08 INFO 140570661291840] #early_stopping_criteria_metric: host=algo-1, epoch=2, criteria=sampled_accuracy, value=0.932608695652
```

```
[11/11/2020 14:39:08 INFO 140570661291840] Epoch 2: Loss improved. Updating best model
```

```
[11/11/2020 14:39:08 INFO 140570661291840] Saving model for epoch: 2
```

```
[11/11/2020 14:39:08 INFO 140570661291840] Saved checkpoint to "/tmp/tmpbHLWZx/mx-mod-0000.params"
```

```
[11/11/2020 14:39:08 INFO 140570661291840] #progress_metric: host=algo-1, completed 20 % of epochs
```

```
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```

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[11/11/2020 14:39:08 INFO 140570661291840] #throughput_metric: host=algo-1, train throughput=6164.47288398 records/second
```

```
[2020-11-11 14:39:08.580] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/train", "epoch": 10, "duration": 129, "num_examples": 4, "num_bytes": 1015680}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.7094658406575521, "sum": 0.7094658406575521, "min": 0.7094658406575521}}, "EndTime": 1605105548.581916, "Dimensions": {"model": 31, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605105548.581901}
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och": 3}, "StartTime": 1605105548.581901}
```

```
[11/11/2020 14:39:08 INFO 140570661291840] #quality_metric: host=algo-1, epoch=3, train binary_classification_cross_entropy_objective <loss>=0.502478322347
```

```
[2020-11-11 14:39:08.769] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/validation", "epoch": 11, "duration": 167, "num_examples": 1, "num_bytes": 126960}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.46946955141813856, "sum": 0.46946955141813856, "min": 0.46946955141813856}}, "EndTime": 1605105549.063051, "Dimensions": {"model": 0, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605105549.062967}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.4755595995032269, "sum": 0.4755595995032269, "min": 0.4755595995032269}}, "EndTime": 1605105549.063143, "Dimensions": {"model": 1, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605105549.063128}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.5103801229725713, "sum": 0.5103801229725713, "min": 0.5103801229725713}}, "EndTime": 1605105549.063228, "Dimensions": {"model": 2, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605105549.063208}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.49800534455672557, "sum": 0.49800534455672557, "min": 0.49800534455672557}}, "EndTime": 1605105549.063302, "Dimensions": {"model": 3, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605105549.063284}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.2231427068295686, "sum": 0.2231427068295686, "min": 0.2231427068295686}}, "EndTime": 1605105549.063459, "Dimensions": {"model": 5, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605105549.063439}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.2200754912003227, "sum": 0.2200754912003227, "min": 0.2200754912003227}}, "EndTime": 1605105549.063532, "Dimensions": {"model": 6, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605105549.063514}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.2213625203008237, "sum": 0.2213625203008237, "min": 0.2213625203008237}}, "EndTime": 1605105549.0636, "Dimensions": {"model": 7, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605105549.063583}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.484844506305197, "sum": 0.484844506305197, "min": 0.484844506305197}}, "EndTime": 1605105549.063666, "Dimensions": {"model": 8, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605105549.063649}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.48404929119607676, "sum": 0.48404929119607676, "min": 0.48404929119607676}}, "EndTime": 1605105549.063719, "Dimensions": {"model": 9, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605105549.063703}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.46855415675951084, "sum": 0.46855415675951084, "min": 0.46855415675951084}}, "EndTime": 1605105549.063777, "Dimensions": {"model": 10, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605105549.06376}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.47951560642408286, "sum": 0.47951560642408286, "min": 0.47951560642408286}}, "EndTime": 1605105549.063834, "Dimensions": {"model": 11, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605105549.063818}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.2194812940514606, "sum": 0.2194812940514606, "min": 0.2194812940514606}}, "EndTime": 1605105549.06391, "Dimensions": {"model": 12, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605105549.063877}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.2225618777067765, "sum": 0.2225618777067765, "min": 0.2225618777067765}}, "EndTime": 1605105549.064008, "Dimensions": {"model": 14, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605105549.063994}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.22179422793181047, "sum": 0.22179422793181047, "min": 0.22179422793181047}}, "EndTime": 1605105549.064068, "Dimensions": {"model": 15, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605105549.064051}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.49487961478855297, "sum": 0.49487961478855297, "min": 0.49487961478855297}}, "EndTime": 1605105549.064186, "Dimensions": {"model": 16, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605105549.064108}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.5075004245923913, "sum": 0.5075004245923913, "min": 0.5075004245923913, "epoch": 3}, "StartTime": 1605105549.064245}}
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n": 0.5075004245923913}}, "EndTime": 1605105549.064239, "Dimensions": {"model": 17, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605105549.064224}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.5157021563986074, "sum": 0.5157021563986074, "min": 0.5157021563986074}}, "EndTime": 1605105549.064294, "Dimensions": {"model": 18, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605105549.06428}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.5438743259595789, "sum": 0.5438743259595789, "min": 0.5438743259595789}}, "EndTime": 1605105549.064347, "Dimensions": {"model": 19, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605105549.064334}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.44515297931173575, "sum": 0.44515297931173575, "min": 0.44515297931173575}}, "EndTime": 1605105549.064396, "Dimensions": {"model": 20, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605105549.064382}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.4212963933530061, "sum": 0.4212963933530061, "min": 0.4212963933530061}}, "EndTime": 1605105549.064467, "Dimensions": {"model": 21, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605105549.064452}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.4490165710449219, "sum": 0.4490165710449219, "min": 0.4490165710449219}}, "EndTime": 1605105549.064517, "Dimensions": {"model": 22, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605105549.064503}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.4203887939453125, "sum": 0.4203887939453125, "min": 0.4203887939453125}}, "EndTime": 1605105549.064567, "Dimensions": {"model": 23, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605105549.064553}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.660319651728091, "sum": 0.660319651728091, "min": 0.660319651728091}}, "EndTime": 1605105549.064616, "Dimensions": {"model": 24, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605105549.064603}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6526842863663384, "sum": 0.6526842863663384, "min": 0.6526842863663384}}, "EndTime": 1605105549.064666, "Dimensions": {"model": 25, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605105549.064653}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.662251613451087, "sum": 0.662251613451087, "min": 0.662251613451087}}, "EndTime": 1605105549.064715, "Dimensions": {"model": 26, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605105549.064702}
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"epoch": 3}, "StartTime": 1605105549.064702}

#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6592533277428668, "sum": 0.6592533277428668, "min": 0.6592533277428668}}, "EndTime": 1605105549.064763, "Dimensions": {"mode": 27, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605105549.064751}

#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6695851201596468, "sum": 0.6695851201596468, "min": 0.6695851201596468}}, "EndTime": 1605105549.064816, "Dimensions": {"mode": 28, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605105549.064803}

#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6681231291397758, "sum": 0.6681231291397758, "min": 0.6681231291397758}}, "EndTime": 1605105549.064874, "Dimensions": {"mode": 29, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605105549.064858}

#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6673112952190897, "sum": 0.6673112952190897, "min": 0.6673112952190897}}, "EndTime": 1605105549.064937, "Dimensions": {"mode": 30, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605105549.06492}

#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6529067993164063, "sum": 0.6529067993164063, "min": 0.6529067993164063}}, "EndTime": 1605105549.064992, "Dimensions": {"mode": 31, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605105549.064976}

[11/11/2020 14:39:09 INFO 140570661291840] #quality_metric: host=algo-1, epoch=3, validation binary_classification_cross_entropy_objective <loss>=0.469469551418
[11/11/2020 14:39:09 INFO 140570661291840] #early_stopping_criteria_metric: host=algo-1, epoch=3, criteria=sampled_accuracy, value=0.939130434783
[11/11/2020 14:39:09 INFO 140570661291840] Epoch 3: Loss improved. Updating best model
[11/11/2020 14:39:09 INFO 140570661291840] Saving model for epoch: 3
[11/11/2020 14:39:09 INFO 140570661291840] Saved checkpoint to "/tmp/tmphSLrdL/mx-mod-0000.params"
[11/11/2020 14:39:09 INFO 140570661291840] #progress_metric: host=algo-1, completed 26 % of epochs
#metrics {"Metrics": {"Max Batches Seen Between Resets": {"count": 1, "max": 4, "sum": 4.0, "min": 4}, "Number of Batches Since Last Reset": {"count": 1, "max": 4, "sum": 4.0, "min": 4}, "Number of Records Since Last Reset": {"count": 1, "max": 3680, "sum": 3680.0, "min": 3680}, "Total Batches Seen": {"count": 1, "max": 21, "sum": 21.0, "min": 21}, "Total Records Seen": {"count": 1, "max": 19400, "sum": 19400.0, "min": 19400}, "Max Records Seen Between Resets": {"count": 1, "max": 3680, "sum": 3680.0, "min": 3680}, "Reset Count": {"count": 1, "max": 6, "sum": 6.0, "min": 6}}, "EndTime": 1605105549.07173, "Dimensions": {"Host": "algo-1", "Meta": "training_data_iter", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605105548.449949}

```

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[11/11/2020 14:39:09 INFO 140570661291840] #throughput_metric: host=algo-1, t
rain throughput=5917.40826219 records/second
[2020-11-11 14:39:09.175] [tensorio] [info] epoch_stats={"data_pipeline": "/o
pt/ml/input/data/train", "epoch": 12, "duration": 103, "num_examples": 4, "nu
m_bytes": 1015680}
#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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poch": 4}, "StartTime": 1605105549.176437}

#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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poch": 4}, "StartTime": 1605105549.176528}

#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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  0.48536949666341145}}, "EndTime": 1605105549.176637, "Dimensions": {"model":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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  0.26302304077148436}}, "EndTime": 1605105549.176813, "Dimensions": {"model":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.5180813395182292, "sum": 0.5180813395182292, "min": 0.5180813395182292}}, "EndTime": 1605105549.176948, "Dimensions": {"model": 18, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 4}, "StartTime": 1605105549.176936}
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.5513203531901042, "sum": 0.5513203531901042, "min": 0.5513203531901042}}, "EndTime": 1605105549.176991, "Dimensions": {"model": 19, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 4}, "StartTime": 1605105549.17698}
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.4534907430013021, "sum": 0.4534907430013021, "min": 0.4534907430013021}}, "EndTime": 1605105549.177166, "Dimensions": {"model": 23, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 4}, "StartTime": 1605105549.177154}
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6623216145833334, "sum": 0.6623216145833334, "min": 0.6623216145833334}}, "EndTime": 1605105549.177252, "Dimensions": {"model": 25, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 4}, "StartTime": 1605105549.177241}
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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  }
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```

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  "min": 0.684079833984375,
  "EndTime": 1605105549.177393,
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  }
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```

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  "sum": 0.6749272664388021,
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  "EndTime": 1605105549.177444,
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  }
}
```

```
#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {
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  "sum": 0.700467041015625,
  "min": 0.700467041015625,
  "EndTime": 1605105549.177495,
  "Dimensions": {
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    "Algorithm": "Linear Learner",
    "epoch": 4,
    "StartTime": 1605105549.177483
  }
}
```

```
#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {
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  "max": 0.6512530924479166,
  "sum": 0.6512530924479166,
  "min": 0.6512530924479166,
  "EndTime": 1605105549.177542,
  "Dimensions": {
    "model": 31,
    "Host": "algo-1",
    "Operation": "training",
    "Algorithm": "Linear Learner",
    "epoch": 4,
    "StartTime": 1605105549.17753
  }
}
```

```
[11/11/2020 14:39:09 INFO 140570661291840] #quality_metric: host=algo-1, epoch=4, train binary_classification_cross_entropy_objective <loss>=0.471220041911
```

```
[2020-11-11 14:39:09.304] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/validation", "epoch": 14, "duration": 111, "num_examples": 1, "num_bytes": 126960}
```

```
#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.4395827915357507, "sum": 0.4395827915357507, "min": 0.4395827915357507, "EndTime": 1605105549.486785, "Dimensions": {"model": 0, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 4, "StartTime": 1605105549.486705}
```

```
#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.44397247977878734, "sum": 0.44397247977878734, "min": 0.44397247977878734, "EndTime": 1605105549.486872, "Dimensions": {"model": 1, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 4, "StartTime": 1605105549.486857}
```

```
#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.475481481137483, "sum": 0.475481481137483, "min": 0.475481481137483, "EndTime": 1605105549.486933, "Dimensions": {"model": 2, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 4, "StartTime": 1605105549.486916}
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```
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```

```
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.22073760654615318, "sum": 0.22073760654615318, "min": 0.22073760654615318}}, "EndTime": 1605105549.487123, "Dimensions": {"model": 5, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 4}, "StartTime": 1605105549.487105}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.21741979847783627, "sum": 0.21741979847783627, "min": 0.21741979847783627}}, "EndTime": 1605105549.487191, "Dimensions": {"model": 6, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 4}, "StartTime": 1605105549.487173}
```

```
#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.21691652380901835, "sum": 0.21691652380901835, "min": 0.21691652380901835}}, "EndTime": 1605105549.487257, "Dimensions": {"model": 7, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 4}, "StartTime": 1605105549.48724}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.454004602846892, "sum": 0.454004602846892, "min": 0.454004602846892}}, "EndTime": 1605105549.487319, "Dimensions": {"model": 8, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 4}, "StartTime": 1605105549.487303}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.45155225007430366, "sum": 0.45155225007430366, "min": 0.45155225007430366}}, "EndTime": 1605105549.487382, "Dimensions": {"model": 9, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 4}, "StartTime": 1605105549.487365}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.43809930552606996, "sum": 0.43809930552606996, "min": 0.43809930552606996}}, "EndTime": 1605105549.487436, "Dimensions": {"model": 10, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 4}, "StartTime": 1605105549.48742}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.44830743540888246, "sum": 0.44830743540888246, "min": 0.44830743540888246}}, "EndTime": 1605105549.487505, "Dimensions": {"model": 11, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 4}, "StartTime": 1605105549.487487}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.21782186756963315, "sum": 0.21782186756963315, "min": 0.21782186756963315}}, "EndTime": 1605105549.48757, "Dimensions": {"model": 12, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 4}, "StartTime": 1605105549.487553}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.21910058726435122, "sum": 0.21910058726435122, "min": 0.21910058726435122}}, "EndTime": 1605105549.487636, "Dimensions": {"model": 13, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 4}, "StartTime": 1605105549.48762}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.21950690228006114, "sum": 0.21950690228006114, "min": 0.21950690228006114}}, "EndTime": 1605105549.487706, "Dimensions": {"model": 14, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 4}, "StartTime": 1605105549.487688}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.2191552203634511, "sum": 0.2191552203634511, "min": 0.2191552203634511}}, "EndTime": 1605105549.487769, "Dimensions": {"model": 15, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 4}, "StartTime": 1605105549.487751}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.47847163988196334, "sum": 0.47847163988196334, "min": 0.47847163988196334}}, "EndTime": 1605105549.487829, "Dimensions": {"model": 16, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 4}, "StartTime": 1605105549.487812}
```

```
#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.48661528877590016, "sum": 0.48661528877590016, "min": 0.48661528877590016}}, "EndTime": 1605105549.487892, "Dimensions": {"model": 17, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 4}, "StartTime": 1605105549.487875}
```

```
#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.49258867346722146, "sum": 0.49258867346722146, "min": 0.49258867346722146}}, "EndTime": 1605105549.487954, "Dimensions": {"model": 18, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 4}, "StartTime": 1605105549.487937}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.5184147378672724, "sum": 0.5184147378672724, "min": 0.5184147378672724}}, "EndTime": 1605105549.488015, "Dimensions": {"model": 19, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 4}, "StartTime": 1605105549.487998}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.508184350055197, "sum": 0.508184350055197, "min": 0.508184350055197}}, "EndTime": 1605105549.488075, "Dimensions": {"model": 20, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 4}, "StartTime": 1605105549.488059}
```

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```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.48390499612559446, "sum": 0.48390499612559446, "min": 0.48390499612559446}}, "EndTime": 1605105549.48814, "Dimensions": {"model": 21, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 4}, "StartTime": 1605105549.488123}
```

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```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objecti  
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```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objecti  
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```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objecti  
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```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objecti  
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er", "epoch": 4}, "StartTime": 1605105549.488447}
```

```
#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objecti  
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```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objecti  
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```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objecti  
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```

```
#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objecti  
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er", "epoch": 4}, "StartTime": 1605105549.488667}
```

```
#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objecti  
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n": 0.6440504654594089}}, "EndTime": 1605105549.488732, "Dimensions": {"mode
```

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l": 31, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 4}, "StartTime": 1605105549.488716}
```

```
[11/11/2020 14:39:09 INFO 140570661291840] #quality_metric: host=algo-1, epoch=4, validation binary_classification_cross_entropy_objective <loss>=0.439582791536
```

```
[11/11/2020 14:39:09 INFO 140570661291840] #early_stopping_criteria_metric: host=algo-1, epoch=4, criteria=sampled_accuracy, value=0.941304347826
```

```
[11/11/2020 14:39:09 INFO 140570661291840] Epoch 4: Loss improved. Updating best model
```

```
[11/11/2020 14:39:09 INFO 140570661291840] Saving model for epoch: 4
```

```
[11/11/2020 14:39:09 INFO 140570661291840] Saved checkpoint to "/tmp/tmpV5asKA/mx-mod-0000.params"
```

```
[11/11/2020 14:39:09 INFO 140570661291840] #progress_metric: host=algo-1, completed 33 % of epochs
```

```
#metrics {"Metrics": {"Max Batches Seen Between Resets": {"count": 1, "max": 4, "sum": 4.0, "min": 4}, "Number of Batches Since Last Reset": {"count": 1, "max": 4, "sum": 4.0, "min": 4}, "Number of Records Since Last Reset": {"count": 1, "max": 3680, "sum": 3680.0, "min": 3680}, "Total Batches Seen": {"count": 1, "max": 25, "sum": 25.0, "min": 25}, "Total Records Seen": {"count": 1, "max": 23080, "sum": 23080.0, "min": 23080}, "Max Records Seen Between Resets": {"count": 1, "max": 3680, "sum": 3680.0, "min": 3680}, "Reset Count": {"count": 1, "max": 7, "sum": 7.0, "min": 7}}, "EndTime": 1605105549.494655, "Dimensions": {"Host": "algo-1", "Meta": "training_data_iter", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 4}, "StartTime": 1605105549.71993}
```

```
[11/11/2020 14:39:09 INFO 140570661291840] #throughput_metric: host=algo-1, train throughput=8703.69598548 records/second
```

```
[2020-11-11 14:39:09.598] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/train", "epoch": 14, "duration": 103, "num_examples": 4, "num_bytes": 1015680}
```

```
#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.4459789123535156, "sum": 0.4459789123535156, "min": 0.4459789123535156}}, "EndTime": 1605105549.598506, "Dimensions": {"model": 0, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 5}, "StartTime": 1605105549.598401}
```

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```

```
#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.4878426208496094, "sum": 0.4878426208496094, "min": 0.4878426208496094}}, "EndTime": 1605105549.598722, "Dimensions": {"model": 2, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 5}, "StartTime": 1605105549.598699}
```

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```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":  
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[11/11/2020 14:39:09 INFO 140570661291840] #quality_metric: host=algo-1, epoch=5, train binary_classification_cross_entropy_objective <loss>=0.445978912354  
[2020-11-11 14:39:09.740] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/validation", "epoch": 17, "duration": 122, "num_examples": 1, "num_bytes": 126960}  
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[11/11/2020 14:39:09 INFO 140570661291840] #quality_metric: host=algo-1, epoch=5, validation_binary_classification_cross_entropy_objective <loss>=0.415295741869
```

```
[11/11/2020 14:39:09 INFO 140570661291840] #early_stopping_criteria_metric: host=algo-1, epoch=5, criteria=sampled_accuracy, value=0.94347826087
```

```
[11/11/2020 14:39:09 INFO 140570661291840] Epoch 5: Loss improved. Updating best model
```

```
[11/11/2020 14:39:09 INFO 140570661291840] Saving model for epoch: 5
```

```
[11/11/2020 14:39:09 INFO 140570661291840] Saved checkpoint to "/tmp/tmp3bgRKx/mx-mod-0000.params"
```

```
[11/11/2020 14:39:09 INFO 140570661291840] #progress_metric: host=algo-1, completed 40 % of epochs
```

```
#metrics {"Metrics": {"Max Batches Seen Between Resets": {"count": 1, "max": 4, "sum": 4.0, "min": 4}, "Number of Batches Since Last Reset": {"count": 1, "max": 4, "sum": 4.0, "min": 4}, "Number of Records Since Last Reset": {"count": 1, "max": 3680, "sum": 3680.0, "min": 3680}, "Total Batches Seen": {"count": 1, "max": 29, "sum": 29.0, "min": 29}, "Total Records Seen": {"count": 1, "max": 26760, "sum": 26760.0, "min": 26760}, "Max Records Seen Between Resets": {"count": 1, "max": 3680, "sum": 3680.0, "min": 3680}, "Reset Count": {"count": 1, "max": 8, "sum": 8.0, "min": 8}}, "EndTime": 1605105549.948362, "Dimensions": {"Host": "algo-1", "Meta": "training_data_iter", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 5}, "StartTime": 1605105549.94972}
```

```
[11/11/2020 14:39:09 INFO 140570661291840] #throughput_metric: host=algo-1, train throughput=8114.14697845 records/second
```

```
[2020-11-11 14:39:10.053] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/train", "epoch": 16, "duration": 104, "num_examples": 4, "num_bytes": 1015680}
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.4622270100911458, "sum": 0.4622270100911458, "min": 0.4622270100911458}}, "EndTime": 1605105550.053571, "Dimensions": {"model": 2, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 6}, "StartTime": 1605105550.053558}

#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.45097943115234373, "sum": 0.45097943115234373, "min": 0.45097943115234373}}, "EndTime": 1605105550.053618, "Dimensions": {"model": 3, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 6}, "StartTime": 1605105550.053606}

#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.24681481424967447, "sum": 0.24681481424967447, "min": 0.24681481424967447}}, "EndTime": 1605105550.053666, "Dimensions": {"model": 4, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 6}, "StartTime": 1605105550.053654}

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.25017379760742187, "sum": 0.25017379760742187, "min": 0.25017379760742187}}, "EndTime": 1605105550.053805, "Dimensions": {"model": 7, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 6}, "StartTime": 1605105550.053793}

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.24472632344563802, "sum": 0.24472632344563802, "min": 0.24472632344563802}}, "EndTime": 1605105550.054115, "Dimensions": {"model": 14, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 6}, "StartTime": 1605105550.054103}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.24559226481119792, "sum": 0.24559226481119792, "min": 0.24559226481119792}}, "EndTime": 1605105550.054159, "Dimensions": {"model": 15, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 6}, "StartTime": 1605105550.054147}
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```

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```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.46793318684895835, "sum": 0.46793318684895835, "min": 0.46793318684895835}}, "EndTime": 1605105550.054383, "Dimensions": {"model": 20, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 6}, "StartTime": 1605105550.054372}
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```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.665890625, "sum": 0.665890625, "min": 0.665890625}}, "EndTime": 1605105550.054652, "Dimensions": {"model": 26, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 6}, "StartTime": 1605105550.054641}
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```

```
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```

```
#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.669472676595052, "sum": 0.669472676595052, "min": 0.669472676595052}}, "EndTime": 1605105550.054814, "Dimensions": {"model": 29, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 6}, "StartTime": 1605105550.054803}
```

```
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```

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```

```
[11/11/2020 14:39:10 INFO 140570661291840] #quality_metric: host=algo-1, epoch=6, train binary_classification_cross_entropy_objective <loss>=0.424897684733
```

```
[2020-11-11 14:39:10.187] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/validation", "epoch": 20, "duration": 111, "num_examples": 1, "num_bytes": 126960}
```

```
#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.39529893294624663, "sum": 0.39529893294624663, "min": 0.39529893294624663}}, "EndTime": 1605105550.369932, "Dimensions": {"model": 0, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 6}, "StartTime": 1605105550.369852}
```

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```

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```

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```

```
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```

```
#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.22440543796705162, "sum": 0.22440543796705162, "min": 0.22440543796705162}}, "EndTime": 1605105550.37049, "Dimensions": {"model": 5, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 6}, "StartTime": 1605105550.370477}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.22029072305430536, "sum": 0.22029072305430536, "min": 0.22029072305430536}}, "EndTime": 1605105550.370527, "Dimensions": {"model": 6, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 6}, "StartTime": 1605105550.370518}
```

```
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```

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```

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```

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```

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```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.22765678737474523, "sum": 0.22765678737474523, "min": 0.22765678737474523}}, "EndTime": 1605105550.370968, "Dimensions": {"model": 12, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 6}, "StartTime": 1605105550.370952}
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ve": {"count": 1, "max": 0.22881851196289063, "sum": 0.22881851196289063, "min": 0.22881851196289063}}, "EndTime": 1605105550.371032, "Dimensions": {"model": 13, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 6}, "StartTime": 1605105550.371014}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.4626273777173913, "sum": 0.4626273777173913, "min": 0.4626273777173913}}, "EndTime": 1605105550.3713, "Dimensions": {"model": 17, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 6}, "StartTime": 1605105550.371283}
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```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.44743479853091034, "sum": 0.44743479853091034, "min": 0.44743479853091034}}, "EndTime": 1605105550.371575, "Dimensions": {"model": 21, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 6}, "StartTime": 1605105550.371558}
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[11/11/2020 14:39:10 INFO 140570661291840] #quality_metric: host=algo-1, epoch=6, validation binary_classification_cross_entropy_objective <loss>=0.395298932946
[11/11/2020 14:39:10 INFO 140570661291840] #early_stopping_criteria_metric: host=algo-1, epoch=6, criteria=sampled_accuracy, value=0.939130434783
[11/11/2020 14:39:10 INFO 140570661291840] Epoch 6: Loss improved. Updating best model
[11/11/2020 14:39:10 INFO 140570661291840] Saving model for epoch: 6
[11/11/2020 14:39:10 INFO 140570661291840] Saved checkpoint to "/tmp/tmpAFLsMY/mx-mod-0000.params"
[11/11/2020 14:39:10 INFO 140570661291840] #progress_metric: host=algo-1, completed 46 % of epochs
#metrics {"Metrics": {"Max Batches Seen Between Resets": {"count": 1, "max": 4, "sum": 4.0, "min": 4}, "Number of Batches Since Last Reset": {"count": 1, "max": 4, "sum": 4.0, "min": 4}, "Number of Records Since Last Reset": {"count": 1, "max": 3680, "sum": 3680.0, "min": 3680}, "Total Batches Seen": {"count": 1, "max": 33, "sum": 33.0, "min": 33}, "Total Records Seen": {"count": 1, "max": 30440, "sum": 30440.0, "min": 30440}, "Max Records Seen Between Resets": {"count": 1, "max": 3680, "sum": 3680.0, "min": 3680}, "Reset Count": {"count": 1, "max": 9, "sum": 9.0, "min": 9}}, "EndTime": 1605105550.378682, "Dimensions": {"Host": "algo-1", "Meta": "training_data_iter", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 6}, "StartTime": 1605105549.948679}

[11/11/2020 14:39:10 INFO 140570661291840] #throughput_metric: host=algo-1, train throughput=8555.11660647 records/second
[2020-11-11 14:39:10.474] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/train", "epoch": 18, "duration": 95, "num_examples": 4, "num_bytes": 1015680}
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.4405202331542969, "sum": 0.4405202331542969, "min": 0.4405202331542969}}, "EndTime": 1605105550.475307, "Dimensions": {"model": 2, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 7}, "StartTime": 1605105550.475294}

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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  "epoch": 7}, "StartTime": 1605105550.47588}

#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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  "epoch": 7}, "StartTime": 1605105550.475948}

#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.45835186767578123, "sum": 0.45835186767578123, "min": 0.45835186767578123}}, "EndTime": 1605105550.476785, "Dimensions": {"model": 23, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 7}, "StartTime": 1605105550.476768}
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[11/11/2020 14:39:10 INFO 140570661291840] #quality_metric: host=algo-1, epoch=7, train_binary_classification_cross_entropy_objective <loss>=0.40715684000
```

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7
[2020-11-11 14:39:10.612] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/validation", "epoch": 23, "duration": 116, "num_examples": 1, "num_bytes": 126960}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.3794483350670856, "sum": 0.3794483350670856, "min": 0.3794483350670856}}, "EndTime": 1605105550.806423, "Dimensions": {"model": 1, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 7}, "StartTime": 1605105550.806402}

#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.4021739793860394, "sum": 0.4021739793860394, "min": 0.4021739793860394}}, "EndTime": 1605105550.806488, "Dimensions": {"model": 2, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 7}, "StartTime": 1605105550.80647}

#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.39304540882939876, "sum": 0.39304540882939876, "min": 0.39304540882939876}}, "EndTime": 1605105550.806556, "Dimensions": {"model": 3, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 7}, "StartTime": 1605105550.806542}

#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.22548493095066235, "sum": 0.22548493095066235, "min": 0.22548493095066235}}, "EndTime": 1605105550.806616, "Dimensions": {"model": 4, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 7}, "StartTime": 1605105550.8066}

#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.2259292104969854, "sum": 0.2259292104969854, "min": 0.2259292104969854}}, "EndTime": 1605105550.806655, "Dimensions": {"model": 5, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 7}, "StartTime": 1605105550.806646}

#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.2222616776176121, "sum": 0.2222616776176121, "min": 0.2222616776176121}}, "EndTime": 1605105550.806729, "Dimensions": {"model": 6, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 7}, "StartTime": 1605105550.806713}

#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.2245160310164742, "sum": 0.2245160310164742, "min": 0.2245160310164742}}, "EndTime": 1605105550.806788, "Dimensions": {"model": 7, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 7}, "StartTime": 1605105550.806774}

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r", "epoch": 7}, "StartTime": 1605105550.806814}

#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.3858336075492527, "sum": 0.3858336075492527, "min": 0.3858336075492527}}, "EndTime": 1605105550.806853, "Dimensions": {"model": 9, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 7}, "StartTime": 1605105550.806845}

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```

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[11/11/2020 14:39:10 INFO 140570661291840] #quality_metric: host=algo-1, epoc
h=7, validation binary_classification_cross_entropy_objective <loss>=0.378855
23257
```

```
[11/11/2020 14:39:10 INFO 140570661291840] #early_stopping_criteria_metric: h
ost=algo-1, epoch=7, criteria=sampled_accuracy, value=0.939130434783
```

```
[11/11/2020 14:39:10 INFO 140570661291840] Epoch 7: Loss improved. Updating b
est model
```

```
[11/11/2020 14:39:10 INFO 140570661291840] Saving model for epoch: 7
```

```
[11/11/2020 14:39:10 INFO 140570661291840] Saved checkpoint to "/tmp/tmpCCGVQ
c/mx-mod-0000.params"
```

```
[11/11/2020 14:39:10 INFO 140570661291840] #progress_metric: host=algo-1, com
pleted 53 % of epochs
```

```
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[11/11/2020 14:39:10 INFO 140570661291840] #throughput_metric: host=algo-1, t
rain throughput=8448.85661284 records/second
```

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[2020-11-11 14:39:10.915] [tensorio] [info] epoch_stats={"data_pipeline": "/o
pt/ml/input/data/train", "epoch": 20, "duration": 101, "num_examples": 4, "nu
```

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m_bytes": 1015680}
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6566878865559895, "sum": 0.6566878865559895, "min": 0.6566878865559895}}, "EndTime": 1605105550.917126, "Dimensions": {"model": 31, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105550.917118}
```

```
[11/11/2020 14:39:10 INFO 140570661291840] #quality_metric: host=algo-1, epoch=8, train binary_classification_cross_entropy_objective <loss>=0.392217061361
```

```
[2020-11-11 14:39:11.052] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/validation", "epoch": 26, "duration": 113, "num_examples": 1, "num_bytes": 126960}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.3652885768724524, "sum": 0.3652885768724524, "min": 0.3652885768724524}}, "EndTime": 1605105551.235978, "Dimensions": {"model": 0, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105551.235896}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.36497006623641304, "sum": 0.36497006623641304, "min": 0.36497006623641304}}, "EndTime": 1605105551.236065, "Dimensions": {"model": 1, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105551.23605}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.38541505233101225, "sum": 0.38541505233101225, "min": 0.38541505233101225}}, "EndTime": 1605105551.236117, "Dimensions": {"model": 2, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105551.236101}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.37719965395720106, "sum": 0.37719965395720106, "min": 0.37719965395720106}}, "EndTime": 1605105551.236178, "Dimensions": {"model": 3, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105551.236161}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.37719965395720106, "sum": 0.37719965395720106, "min": 0.37719965395720106}}, "EndTime": 1605105551.236178, "Dimensions": {"model": 3, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105551.236161}
```

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ve": {"count": 1, "max": 0.22306754070779553, "sum": 0.22306754070779553, "min": 0.22306754070779553}}, "EndTime": 1605105551.236245, "Dimensions": {"model": 4, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105551.236228}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.2255399289338485, "sum": 0.2255399289338485, "min": 0.2255399289338485}}, "EndTime": 1605105551.236309, "Dimensions": {"model": 5, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105551.236292}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.22346339018448538, "sum": 0.22346339018448538, "min": 0.22346339018448538}}, "EndTime": 1605105551.236382, "Dimensions": {"model": 6, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105551.236364}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.22635551120923914, "sum": 0.22635551120923914, "min": 0.22635551120923914}}, "EndTime": 1605105551.236455, "Dimensions": {"model": 7, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105551.236437}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.3754445615022079, "sum": 0.3754445615022079, "min": 0.3754445615022079}}, "EndTime": 1605105551.23655, "Dimensions": {"model": 8, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105551.2365}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.3713347725246264, "sum": 0.3713347725246264, "min": 0.3713347725246264}}, "EndTime": 1605105551.23662, "Dimensions": {"model": 9, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105551.236603}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.362639452063519, "sum": 0.362639452063519, "min": 0.362639452063519}}, "EndTime": 1605105551.23666, "Dimensions": {"model": 10, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105551.236651}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.36894889499830164, "sum": 0.36894889499830164, "min": 0.36894889499830164}}, "EndTime": 1605105551.236695, "Dimensions": {"model": 11, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105551.236683}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.23264025812563688, "sum": 0.23264025812563688, "min": 0.23264025812563688}}, "EndTime": 1605105551.236759, "Dimensions": {"model": 12, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105551.236743}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.23244839543881624, "sum": 0.23244839543881624, "min": 0.23244839543881624}}, "EndTime": 1605105551.236818, "Dimensions": {"model": 13, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105551.236806}
```

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l": 13, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105551.236802}
```

```
#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.23515303238578464, "sum": 0.23515303238578464, "min": 0.23515303238578464}}, "EndTime": 1605105551.23687, "Dimensions": {"model": 14, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105551.236854}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.23478244283924932, "sum": 0.23478244283924932, "min": 0.23478244283924932}}, "EndTime": 1605105551.236932, "Dimensions": {"model": 15, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105551.236914}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.4518063752547554, "sum": 0.4518063752547554, "min": 0.4518063752547554}}, "EndTime": 1605105551.237002, "Dimensions": {"model": 16, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105551.236984}
```

```
#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.45566392981487774, "sum": 0.45566392981487774, "min": 0.45566392981487774}}, "EndTime": 1605105551.237056, "Dimensions": {"model": 17, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105551.23704}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.454400866964589, "sum": 0.454400866964589, "min": 0.454400866964589}}, "EndTime": 1605105551.237108, "Dimensions": {"model": 18, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105551.237093}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.4628639884617018, "sum": 0.4628639884617018, "min": 0.4628639884617018}}, "EndTime": 1605105551.237192, "Dimensions": {"model": 19, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105551.237174}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.486170826787534, "sum": 0.486170826787534, "min": 0.486170826787534}}, "EndTime": 1605105551.237256, "Dimensions": {"model": 20, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105551.237239}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.48281979768172556, "sum": 0.48281979768172556, "min": 0.48281979768172556}}, "EndTime": 1605105551.237309, "Dimensions": {"model": 21, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105551.237293}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.49326765640922215, "sum": 0.49326765640922215, "min": 0.49326765640922215}}, "EndTime": 1605105551.237363, "Dimensions": {"model": 22, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105551.237347}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.4864484704059103, "sum": 0.4864484704059103, "min": 0.4864484704059103}}, "EndTime": 1605105551.237463, "Dimensions": {"model": 23, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105551.237429}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6531835141389266, "sum": 0.6531835141389266, "min": 0.6531835141389266}}, "EndTime": 1605105551.23752, "Dimensions": {"model": 24, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105551.237504}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6567177150560461, "sum": 0.6567177150560461, "min": 0.6567177150560461}}, "EndTime": 1605105551.237577, "Dimensions": {"model": 25, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105551.237561}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.658588575280231, "sum": 0.658588575280231, "min": 0.658588575280231}}, "EndTime": 1605105551.237632, "Dimensions": {"model": 26, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105551.237616}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6594025985054348, "sum": 0.6594025985054348, "min": 0.6594025985054348}}, "EndTime": 1605105551.237687, "Dimensions": {"model": 27, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105551.237671}
```

```
#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6459166153617527, "sum": 0.6459166153617527, "min": 0.6459166153617527}}, "EndTime": 1605105551.237752, "Dimensions": {"model": 28, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105551.237734}
```

```
#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6516253927479619, "sum": 0.6516253927479619, "min": 0.6516253927479619}}, "EndTime": 1605105551.237816, "Dimensions": {"model": 29, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105551.237799}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.662125297214674, "sum": 0.662125297214674, "min": 0.662125297214674}}, "EndTime": 1605105551.237879, "Dimensions": {"model": 30, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105551.237862}
```

```
#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6616498864215353, "sum": 0.6616498864215353, "min": 0.6616498864215353}}, "EndTime": 1605105551.237969, "Dimensions": {"model": 31, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105551.237951}
```

```
[11/11/2020 14:39:11 INFO 140570661291840] #quality_metric: host=algo-1, epoch
```

```
h=8, validation binary_classification_cross_entropy_objective <loss>=0.365288
576872
[11/11/2020 14:39:11 INFO 140570661291840] #early_stopping_criteria_metric: h
ost=algo-1, epoch=8, criteria=sampled_accuracy, value=0.939130434783
[11/11/2020 14:39:11 INFO 140570661291840] Epoch 8: Loss improved. Updating b
est model
[11/11/2020 14:39:11 INFO 140570661291840] Saving model for epoch: 8
[11/11/2020 14:39:11 INFO 140570661291840] Saved checkpoint to "/tmp/tmpIijcY
b/mx-mod-0000.params"
[11/11/2020 14:39:11 INFO 140570661291840] #progress_metric: host=algo-1, com
pleted 60 % of epochs
#metrics {"Metrics": {"Max Batches Seen Between Resets": {"count": 1, "max":
  4, "sum": 4.0, "min": 4}, "Number of Batches Since Last Reset": {"count": 1,
  "max": 4, "sum": 4.0, "min": 4}, "Number of Records Since Last Reset": {"coun
t": 1, "max": 3680, "sum": 3680.0, "min": 3680}, "Total Batches Seen": {"coun
t": 1, "max": 41, "sum": 41.0, "min": 41}, "Total Records Seen": {"count": 1,
  "max": 37800, "sum": 37800.0, "min": 37800}, "Max Records Seen Between Reset
s": {"count": 1, "max": 3680, "sum": 3680.0, "min": 3680}, "Reset Count": {"c
ount": 1, "max": 11, "sum": 11.0, "min": 11}}, "EndTime": 1605105551.245005,
  "Dimensions": {"Host": "algo-1", "Meta": "training_data_iter", "Operation":
  "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605105
550.814736}

[11/11/2020 14:39:11 INFO 140570661291840] #throughput_metric: host=algo-1, t
rain throughput=8549.61016977 records/second
[2020-11-11 14:39:11.342] [tensorio] [info] epoch_stats={"data_pipeline": "/o
pt/ml/input/data/train", "epoch": 22, "duration": 96, "num_examples": 4, "num
_bytes": 1015680}
#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
  {"count": 1, "max": 0.3796904093424479, "sum": 0.3796904093424479, "min": 0.
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  "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "e
poch": 9}, "StartTime": 1605105551.342235}

#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
  {"count": 1, "max": 0.3825049743652344, "sum": 0.3825049743652344, "min": 0.
3825049743652344}}, "EndTime": 1605105551.342419, "Dimensions": {"model": 1,
  "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "e
poch": 9}, "StartTime": 1605105551.342397}

#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
  {"count": 1, "max": 0.4067413330078125, "sum": 0.4067413330078125, "min": 0.
4067413330078125}}, "EndTime": 1605105551.342498, "Dimensions": {"model": 2,
  "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "e
poch": 9}, "StartTime": 1605105551.342479}

#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
  {"count": 1, "max": 0.39607916259765624, "sum": 0.39607916259765624, "min":
  0.39607916259765624}}, "EndTime": 1605105551.342566, "Dimensions": {"model":
  3, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner",
  "epoch": 9}, "StartTime": 1605105551.342547}

#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
  {"count": 1, "max": 0.22772371419270834, "sum": 0.22772371419270834, "min":
  0.22772371419270834}}, "EndTime": 1605105551.342634, "Dimensions": {"model":
  4, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner",
```

```
"epoch": 9}, "StartTime": 1605105551.342616}

#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
{"count": 1, "max": 0.22784223937988282, "sum": 0.22784223937988282, "min":
0.22784223937988282}}, "EndTime": 1605105551.342732, "Dimensions": {"model":
5, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner",
"epoch": 9}, "StartTime": 1605105551.342713}

#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
{"count": 1, "max": 0.22826133728027342, "sum": 0.22826133728027342, "min":
0.22826133728027342}}, "EndTime": 1605105551.342798, "Dimensions": {"model":
6, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner",
"epoch": 9}, "StartTime": 1605105551.342781}

#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
{"count": 1, "max": 0.23040614827473957, "sum": 0.23040614827473957, "min":
0.23040614827473957}}, "EndTime": 1605105551.342864, "Dimensions": {"model":
7, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner",
"epoch": 9}, "StartTime": 1605105551.342847}

#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
{"count": 1, "max": 0.3927376810709635, "sum": 0.3927376810709635, "min": 0.
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"Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "e
poch": 9}, "StartTime": 1605105551.342912}

#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
{"count": 1, "max": 0.3925374552408854, "sum": 0.3925374552408854, "min": 0.
3925374552408854}}, "EndTime": 1605105551.342993, "Dimensions": {"model": 9,
"Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "e
poch": 9}, "StartTime": 1605105551.342976}

#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
{"count": 1, "max": 0.3820269775390625, "sum": 0.3820269775390625, "min": 0.
3820269775390625}}, "EndTime": 1605105551.343058, "Dimensions": {"model": 10,
"Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "ep
och": 9}, "StartTime": 1605105551.34304}

#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
{"count": 1, "max": 0.3854771626790365, "sum": 0.3854771626790365, "min": 0.
3854771626790365}}, "EndTime": 1605105551.343123, "Dimensions": {"model": 11,
"Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "ep
och": 9}, "StartTime": 1605105551.343105}

#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
{"count": 1, "max": 0.24184886169433595, "sum": 0.24184886169433595, "min":
0.24184886169433595}}, "EndTime": 1605105551.343187, "Dimensions": {"model":
12, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner",
"epoch": 9}, "StartTime": 1605105551.34317}

#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
{"count": 1, "max": 0.24279407246907553, "sum": 0.24279407246907553, "min":
0.24279407246907553}}, "EndTime": 1605105551.343252, "Dimensions": {"model":
13, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner",
"epoch": 9}, "StartTime": 1605105551.343234}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.24261145528157552, "sum": 0.24261145528157552, "min": 0.24261145528157552}}, "EndTime": 1605105551.343316, "Dimensions": {"model": 14, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 9}, "StartTime": 1605105551.343298}
```

```
#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.24241951497395833, "sum": 0.24241951497395833, "min": 0.24241951497395833}}, "EndTime": 1605105551.343381, "Dimensions": {"model": 15, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 9}, "StartTime": 1605105551.343363}
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.46639728800455726, "sum": 0.46639728800455726, "min": 0.46639728800455726}}, "EndTime": 1605105551.343448, "Dimensions": {"model": 16, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 9}, "StartTime": 1605105551.34343}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.4712849527994792, "sum": 0.4712849527994792, "min": 0.4712849527994792}}, "EndTime": 1605105551.343512, "Dimensions": {"model": 17, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 9}, "StartTime": 1605105551.343495}
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.46674539184570313, "sum": 0.46674539184570313, "min": 0.46674539184570313}}, "EndTime": 1605105551.343578, "Dimensions": {"model": 18, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 9}, "StartTime": 1605105551.34356}
```

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```

```
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```

```
[11/11/2020 14:39:11 INFO 140570661291840] #quality_metric: host=algo-1, epoch=9, train binary_classification_cross_entropy_objective <loss>=0.379690409342
```

```
[2020-11-11 14:39:11.473] [tensorio] [info] epoch_stats={"data_pipeline": "/o
```

```
pt/ml/input/data/validation", "epoch": 29, "duration": 112, "num_examples":
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objecti
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.4524506610372792, "sum": 0.4524506610372792, "min": 0.4524506610372792}}, "EndTime": 1605105551.661591, "Dimensions": {"model": 16, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 9}, "StartTime": 1605105551.661582}
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n": 0.4538790495499321}}, "EndTime": 1605105551.661695, "Dimensions": {"mode  
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```

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```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objecti  
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objecti  
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```

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```

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```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6491626241932744, "sum": 0.6491626241932744, "min": 0.6491626241932744}}, "EndTime": 1605105551.662309, "Dimensions": {"mode": 30, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 9}, "StartTime": 1605105551.662301}
```

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```

```
[11/11/2020 14:39:11 INFO 140570661291840] #quality_metric: host=algo-1, epoch=9, validation binary_classification_cross_entropy_objective <loss>=0.354065936545
```

```
[11/11/2020 14:39:11 INFO 140570661291840] #early_stopping_criteria_metric: host=algo-1, epoch=9, criteria=sampled_accuracy, value=0.939130434783
```

```
[11/11/2020 14:39:11 INFO 140570661291840] Epoch 9: Loss improved. Updating best model
```

```
[11/11/2020 14:39:11 INFO 140570661291840] Saving model for epoch: 9
```

```
[11/11/2020 14:39:11 INFO 140570661291840] Saved checkpoint to "/tmp/tmpVVMiQT/mx-mod-0000.params"
```

```
[11/11/2020 14:39:11 INFO 140570661291840] #progress_metric: host=algo-1, completed 66 % of epochs
```

```
#metrics {"Metrics": {"Max Batches Seen Between Resets": {"count": 1, "max": 4, "sum": 4.0, "min": 4}, "Number of Batches Since Last Reset": {"count": 1, "max": 4, "sum": 4.0, "min": 4}, "Number of Records Since Last Reset": {"count": 1, "max": 3680, "sum": 3680.0, "min": 3680}, "Total Batches Seen": {"count": 1, "max": 45, "sum": 45.0, "min": 45}, "Total Records Seen": {"count": 1, "max": 41480, "sum": 41480.0, "min": 41480}, "Max Records Seen Between Resets": {"count": 1, "max": 3680, "sum": 3680.0, "min": 3680}, "Reset Count": {"count": 1, "max": 12, "sum": 12.0, "min": 12}}, "EndTime": 1605105551.669093, "Dimensions": {"Host": "algo-1", "Meta": "training_data_iter", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 9}, "StartTime": 1605105551.245327}
```

```
[11/11/2020 14:39:11 INFO 140570661291840] #throughput_metric: host=algo-1, train throughput=8681.20714315 records/second
```

```
[2020-11-11 14:39:11.786] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/train", "epoch": 24, "duration": 116, "num_examples": 4, "num_bytes": 1015680}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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{"count": 1, "max": 0.3692361043294271, "sum": 0.3692361043294271, "min": 0.3692361043294271}}, "EndTime": 1605105551.786377, "Dimensions": {"model": 0, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105551.786272}
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```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.393803466796875, "sum": 0.393803466796875, "min": 0.393803466796875}}, "EndTime": 1605105551.78658, "Dimensions": {"model": 2, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105551.786561}
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```

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```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.2250040283203125, "sum": 0.2250040283203125, "min": 0.2250040283203125}}, "EndTime": 1605105551.786815, "Dimensions": {"model": 5, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105551.786797}
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.22593008422851563, "sum": 0.22593008422851563, "min": 0.22593008422851563}}, "EndTime": 1605105551.786878, "Dimensions": {"model": 6, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105551.786861}
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.22708590189615885, "sum": 0.22708590189615885, "min": 0.22708590189615885}}, "EndTime": 1605105551.786942, "Dimensions": {"model": 7, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105551.786924}
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.24357559204101562, "sum": 0.24357559204101562, "min": 0.24357559204101562}}, "EndTime": 1605105551.787459, "Dimensions": {"model": 15, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105551.787444}
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.4710249735514323, "sum": 0.4710249735514323, "min": 0.4710249735514323}}, "EndTime": 1605105551.787692, "Dimensions": {"model": 19, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105551.787676}
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6655227661132812, "sum": 0.6655227661132812, "min": 0.6655227661132812}}, "EndTime": 1605105551.788168, "Dimensions": {"model": 27, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105551.788152}
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```

```
[11/11/2020 14:39:11 INFO 140570661291840] #quality_metric: host=algo-1, epoch=10, train binary_classification_cross_entropy_objective <loss>=0.369236104329
```

```
[2020-11-11 14:39:11.947] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/validation", "epoch": 32, "duration": 136, "num_examples": 1, "num_bytes": 126960}
```

```
#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.3447150188943614, "sum": 0.3447150188943614, "min": 0.3447150188943614}}, "EndTime": 1605105552.151918, "Dimensions": {"model": 0, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105552.151837}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.34295375658118205, "sum": 0.34295375658118205, "min": 0.34295375658118205}}, "EndTime": 1605105552.152006, "Dimensions": {"model": 1, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105552.15199}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.35970949919327444, "sum": 0.35970949919327444, "min": 0.35970949919327444}}, "EndTime": 1605105552.152074, "Dimensions": {"model": 2, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105552.152056}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.35299337635869565, "sum": 0.35299337635869565, "min": 0.35299337635869565}}, "EndTime": 1605105552.152146, "Dimensions": {"model": 3, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105552.152127}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.22137557319972825, "sum": 0.22137557319972825, "min": 0.22137557319972825}}, "EndTime": 1605105552.152213, "Dimensions": {"model": 4, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105552.152194}
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l": 4, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105552.152195}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.22073720849078635, "sum": 0.22073720849078635, "min": 0.22073720849078635}}, "EndTime": 1605105552.152278, "Dimensions": {"model": 5, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105552.152261}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.21980811409328294, "sum": 0.21980811409328294, "min": 0.21980811409328294}}, "EndTime": 1605105552.152343, "Dimensions": {"model": 6, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105552.152325}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.22350288059400475, "sum": 0.22350288059400475, "min": 0.22350288059400475}}, "EndTime": 1605105552.152418, "Dimensions": {"model": 7, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105552.152399}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.3530510943868886, "sum": 0.3530510943868886, "min": 0.3530510943868886}}, "EndTime": 1605105552.152486, "Dimensions": {"model": 8, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105552.152468}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.3417462556258492, "sum": 0.3417462556258492, "min": 0.3417462556258492}}, "EndTime": 1605105552.152614, "Dimensions": {"model": 10, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105552.152597}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.3465907884680707, "sum": 0.3465907884680707, "min": 0.3465907884680707}}, "EndTime": 1605105552.152684, "Dimensions": {"model": 11, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105552.152666}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.22963659866996433, "sum": 0.22963659866996433, "min": 0.22963659866996433}}, "EndTime": 1605105552.152821, "Dimensions": {"model": 13, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105552.152802}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.2272736756697945, "sum": 0.2272736756697945, "min": 0.2272736756697945}}, "EndTime": 1605105552.152887, "Dimensions": {"model": 14, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105552.152869}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.2312977998153023, "sum": 0.2312977998153023, "min": 0.2312977998153023}}, "EndTime": 1605105552.152953, "Dimensions": {"model": 15, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105552.152935}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.45472067128057064, "sum": 0.45472067128057064, "min": 0.45472067128057064}}, "EndTime": 1605105552.153021, "Dimensions": {"model": 16, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105552.153003}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.45854677946671196, "sum": 0.45854677946671196, "min": 0.45854677946671196}}, "EndTime": 1605105552.15309, "Dimensions": {"model": 17, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105552.15307}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.45527157990828804, "sum": 0.45527157990828804, "min": 0.45527157990828804}}, "EndTime": 1605105552.153162, "Dimensions": {"model": 18, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105552.153145}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.45714622165845786, "sum": 0.45714622165845786, "min": 0.45714622165845786}}, "EndTime": 1605105552.153227, "Dimensions": {"model": 19, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105552.15321}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.4576240871263587, "sum": 0.4576240871263587, "min": 0.4576240871263587}}, "EndTime": 1605105552.153291, "Dimensions": {"model": 20, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105552.153274}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.4539584615956182, "sum": 0.4539584615956182, "min": 0.4539584615956182}}, "EndTime": 1605105552.153355, "Dimensions": {"model": 21, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105552.153338}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.4524335114852242, "sum": 0.4524335114852242, "min": 0.4524335114852242}}, "EndTime": 1605105552.153418, "Dimensions": {"model": 22, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105552.153401}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.4524335114852242, "sum": 0.4524335114852242, "min": 0.4524335114852242}}, "EndTime": 1605105552.153418, "Dimensions": {"model": 22, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105552.153401}
```

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ve": {"count": 1, "max": 0.4558814007302989, "sum": 0.4558814007302989, "min": 0.4558814007302989}}, "EndTime": 1605105552.153481, "Dimensions": {"model": 23, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105552.153463}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.657039675505265, "sum": 0.657039675505265, "min": 0.657039675505265}}, "EndTime": 1605105552.153556, "Dimensions": {"model": 24, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105552.153537}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.659527587890625, "sum": 0.659527587890625, "min": 0.659527587890625}}, "EndTime": 1605105552.15363, "Dimensions": {"model": 25, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105552.153612}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6595436427904212, "sum": 0.6595436427904212, "min": 0.6595436427904212}}, "EndTime": 1605105552.153705, "Dimensions": {"model": 26, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105552.153686}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6580434384553329, "sum": 0.6580434384553329, "min": 0.6580434384553329}}, "EndTime": 1605105552.153764, "Dimensions": {"model": 27, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105552.15375}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6666091255519702, "sum": 0.6666091255519702, "min": 0.6666091255519702}}, "EndTime": 1605105552.153798, "Dimensions": {"model": 28, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105552.153789}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6606848675271739, "sum": 0.6606848675271739, "min": 0.6606848675271739}}, "EndTime": 1605105552.153858, "Dimensions": {"model": 29, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105552.15384}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6598799995754077, "sum": 0.6598799995754077, "min": 0.6598799995754077}}, "EndTime": 1605105552.15393, "Dimensions": {"model": 30, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105552.153912}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6537183678668478, "sum": 0.6537183678668478, "min": 0.6537183678668478}}, "EndTime": 1605105552.153993, "Dimensions": {"model": 31, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105552.153975}
```

```
[11/11/2020 14:39:12 INFO 140570661291840] #quality_metric: host=algo-1, epoch=10, validation binary_classification_cross_entropy_objective <loss>=0.344715018894
```

```
[11/11/2020 14:39:12 INFO 140570661291840] #early_stopping_criteria_metric: host=algo-1, epoch=10, criteria=sampled_accuracy, value=0.936956521739
[11/11/2020 14:39:12 INFO 140570661291840] Epoch 10: Loss improved. Updating best model
[11/11/2020 14:39:12 INFO 140570661291840] Saving model for epoch: 10
[11/11/2020 14:39:12 INFO 140570661291840] Saved checkpoint to "/tmp/tmpso1xjv/mx-mod-0000.params"
[11/11/2020 14:39:12 INFO 140570661291840] #progress_metric: host=algo-1, completed 73 % of epochs
#metrics {"Metrics": {"Max Batches Seen Between Resets": {"count": 1, "max": 4, "sum": 4.0, "min": 4}, "Number of Batches Since Last Reset": {"count": 1, "max": 4, "sum": 4.0, "min": 4}, "Number of Records Since Last Reset": {"count": 1, "max": 3680, "sum": 3680.0, "min": 3680}, "Total Batches Seen": {"count": 1, "max": 49, "sum": 49.0, "min": 49}, "Total Records Seen": {"count": 1, "max": 45160, "sum": 45160.0, "min": 45160}, "Max Records Seen Between Resets": {"count": 1, "max": 3680, "sum": 3680.0, "min": 3680}, "Reset Count": {"count": 1, "max": 13, "sum": 13.0, "min": 13}}, "EndTime": 1605105552.160837, "Dimensions": {"Host": "algo-1", "Meta": "training_data_iter", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 10}, "StartTime": 1605105551.669382}

[11/11/2020 14:39:12 INFO 140570661291840] #throughput_metric: host=algo-1, train throughput=7486.17049025 records/second
[2020-11-11 14:39:12.303] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/train", "epoch": 26, "duration": 141, "num_examples": 4, "num_bytes": 1015680}
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[11/11/2020 14:39:12 INFO 140570661291840] #quality_metric: host=algo-1, epoc
h=11, train binary_classification_cross_entropy_objective <loss>=0.3604488525
39
[2020-11-11 14:39:12.437] [tensorio] [info] epoch_stats={"data_pipeline": "/o
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1, "num_bytes": 126960}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.47616321729577105, "sum": 0.47616321729577105, "min": 0.47616321729577105}}, "EndTime": 1605105552.646448, "Dimensions": {"model": 23, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 11}, "StartTime": 1605105552.646429}

#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6585719896399457, "sum": 0.6585719896399457, "min": 0.6585719896399457}}, "EndTime": 1605105552.646513, "Dimensions": {"model": 24, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 11}, "StartTime": 1605105552.646496}

#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6603842030400815, "sum": 0.6603842030400815, "min": 0.6603842030400815}}, "EndTime": 1605105552.646585, "Dimensions": {"model": 25, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 11}, "StartTime": 1605105552.646568}

#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6586745552394702, "sum": 0.6586745552394702, "min": 0.6586745552394702}}, "EndTime": 1605105552.646648, "Dimensions": {"model": 26, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 11}, "StartTime": 1605105552.646631}

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.649805616295856, "sum": 0.649805616295856, "min": 0.649805616295856}}, "EndTime": 1605105552.646795, "Dimensions": {"model": 28, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 11}, "StartTime": 1605105552.646777}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6546340278957201, "sum": 0.6546340278957201, "min": 0.6546340278957201}}, "EndTime": 1605105552.646863, "Dimensions": {"model": 29, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 11}, "StartTime": 1605105552.646846}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6568364682404891, "sum": 0.6568364682404891, "min": 0.6568364682404891}}, "EndTime": 1605105552.646931, "Dimensions": {"model": 30, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 11}, "StartTime": 1605105552.646913}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6599225251570991, "sum": 0.6599225251570991, "min": 0.6599225251570991}}, "EndTime": 1605105552.647006, "Dimensions": {"model": 31, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 11}, "StartTime": 1605105552.646988}
```

```
[11/11/2020 14:39:12 INFO 140570661291840] #quality_metric: host=algo-1, epoch=11, validation binary_classification_cross_entropy_objective <loss>=0.336614028267
```

```
[11/11/2020 14:39:12 INFO 140570661291840] #early_stopping_criteria_metric: host=algo-1, epoch=11, criteria=sampled_accuracy, value=0.939130434783
```

```
[11/11/2020 14:39:12 INFO 140570661291840] Epoch 11: Loss improved. Updating best model
```

```
[11/11/2020 14:39:12 INFO 140570661291840] Saving model for epoch: 11
```

```
[11/11/2020 14:39:12 INFO 140570661291840] Saved checkpoint to "/tmp/tmpXWxrWg/mx-mod-0000.params"
```

```
[11/11/2020 14:39:12 INFO 140570661291840] #progress_metric: host=algo-1, completed 80 % of epochs
```

```
#metrics {"Metrics": {"Max Batches Seen Between Resets": {"count": 1, "max": 4, "sum": 4.0, "min": 4}, "Number of Batches Since Last Reset": {"count": 1, "max": 4, "sum": 4.0, "min": 4}, "Number of Records Since Last Reset": {"count": 1, "max": 3680, "sum": 3680.0, "min": 3680}, "Total Batches Seen": {"count": 1, "max": 53, "sum": 53.0, "min": 53}, "Total Records Seen": {"count": 1, "max": 48840, "sum": 48840.0, "min": 48840}, "Max Records Seen Between Resets": {"count": 1, "max": 3680, "sum": 3680.0, "min": 3680}, "Reset Count": {"count": 1, "max": 14, "sum": 14.0, "min": 14}}, "EndTime": 1605105552.653467, "Dimensions": {"Host": "algo-1", "Meta": "training_data_iter", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 11}, "StartTime": 1605105552.161131}
```

```
[11/11/2020 14:39:12 INFO 140570661291840] #throughput_metric: host=algo-1, train throughput=7472.4745036 records/second
```

```
[2020-11-11 14:39:12.757] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/train", "epoch": 28, "duration": 103, "num_examples": 4, "num_bytes": 1015680}
```

```
#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.3528691101074219, "sum": 0.3528691101074219, "min": 0.3528691101074219}}, "EndTime": 1605105552.757655, "Dimensions": {"model": 0,
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"Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105552.757559}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.3536480712890625, "sum": 0.3536480712890625, "min": 0.3536480712890625}}, "EndTime": 1605105552.757733, "Dimensions": {"model": 1, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105552.757712}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.3734146016438802, "sum": 0.3734146016438802, "min": 0.3734146016438802}}, "EndTime": 1605105552.757805, "Dimensions": {"model": 2, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105552.757785}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.3638227233886719, "sum": 0.3638227233886719, "min": 0.3638227233886719}}, "EndTime": 1605105552.757874, "Dimensions": {"model": 3, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105552.757854}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.22235275268554688, "sum": 0.22235275268554688, "min": 0.22235275268554688}}, "EndTime": 1605105552.757943, "Dimensions": {"model": 4, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105552.757927}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.22111090087890625, "sum": 0.22111090087890625, "min": 0.22111090087890625}}, "EndTime": 1605105552.758009, "Dimensions": {"model": 5, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105552.757991}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.2215352783203125, "sum": 0.2215352783203125, "min": 0.2215352783203125}}, "EndTime": 1605105552.758077, "Dimensions": {"model": 6, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105552.758059}
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.22256758117675782, "sum": 0.22256758117675782, "min": 0.22256758117675782}}, "EndTime": 1605105552.75814, "Dimensions": {"model": 7, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105552.758123}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.3632233378092448, "sum": 0.3632233378092448, "min": 0.3632233378092448}}, "EndTime": 1605105552.758211, "Dimensions": {"model": 8, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105552.758188}
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.3623753153483073, "sum": 0.3623753153483073, "min": 0.3623753153483073}}, "EndTime": 1605105552.758278, "Dimensions": {"model": 9, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105552.758259}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.35416015625, "sum": 0.35416015625, "min": 0.35416015625}}, "EndTime": 1605105552.758344, "Dimensions": {"model": 10, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105552.758326}
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.3564889831542969, "sum": 0.3564889831542969, "min": 0.3564889831542969}}, "EndTime": 1605105552.758409, "Dimensions": {"model": 11, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105552.75839}
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.24533919779459634, "sum": 0.24533919779459634, "min": 0.24533919779459634}}, "EndTime": 1605105552.758475, "Dimensions": {"model": 12, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105552.758456}
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.2456165059407552, "sum": 0.2456165059407552, "min": 0.2456165059407552}}, "EndTime": 1605105552.75854, "Dimensions": {"model": 13, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105552.758522}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.24472606913248698, "sum": 0.24472606913248698, "min": 0.24472606913248698}}, "EndTime": 1605105552.758605, "Dimensions": {"model": 14, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105552.758586}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.24569820149739582, "sum": 0.24569820149739582, "min": 0.24569820149739582}}, "EndTime": 1605105552.758693, "Dimensions": {"model": 15, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105552.758653}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.47089511108398435, "sum": 0.47089511108398435, "min": 0.47089511108398435}}, "EndTime": 1605105552.758761, "Dimensions": {"model": 16, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105552.758743}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.4735521036783854, "sum": 0.4735521036783854, "min": 0.4735521036783854}}, "EndTime": 1605105552.758826, "Dimensions": {"model": 17, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105552.758809}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.47001019287109375, "sum": 0.47001019287109375, "min": 0.47001019287109375}}, "EndTime": 1605105552.758891, "Dimensions": {"model": 18, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105552.758873}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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{ "count": 1, "max": 0.46809710693359374, "sum": 0.46809710693359374, "min": 0.46809710693359374}}, "EndTime": 1605105552.758957, "Dimensions": {"model": 19, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105552.758938}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.4891051839192708, "sum": 0.4891051839192708, "min": 0.4891051839192708}}, "EndTime": 1605105552.759022, "Dimensions": {"model": 20, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105552.759004}
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.4850899963378906, "sum": 0.4850899963378906, "min": 0.4850899963378906}}, "EndTime": 1605105552.759087, "Dimensions": {"model": 21, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105552.759069}
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.4871034952799479, "sum": 0.4871034952799479, "min": 0.4871034952799479}}, "EndTime": 1605105552.759149, "Dimensions": {"model": 22, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105552.759133}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.48651437377929685, "sum": 0.48651437377929685, "min": 0.48651437377929685}}, "EndTime": 1605105552.759212, "Dimensions": {"model": 23, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105552.759195}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6661292928059895, "sum": 0.6661292928059895, "min": 0.6661292928059895}}, "EndTime": 1605105552.759278, "Dimensions": {"model": 24, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105552.75926}
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6669147338867187, "sum": 0.6669147338867187, "min": 0.6669147338867187}}, "EndTime": 1605105552.759344, "Dimensions": {"model": 25, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105552.759325}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6642910970052084, "sum": 0.6642910970052084, "min": 0.6642910970052084}}, "EndTime": 1605105552.759407, "Dimensions": {"model": 26, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105552.759389}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.663868631998698, "sum": 0.663868631998698, "min": 0.663868631998698}}, "EndTime": 1605105552.759469, "Dimensions": {"model": 27, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105552.759452}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.66049609375, "sum": 0.66049609375, "min": 0.66049609375}}, "EndTime": 1605105552.759529, "Dimensions": {"model": 28, "Host": "algo-
```

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```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6658765869140625, "sum": 0.6658765869140625, "min": 0.6658765869140625}}, "EndTime": 1605105552.759591, "Dimensions": {"model": 29, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105552.759573}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6659376220703125, "sum": 0.6659376220703125, "min": 0.6659376220703125}}, "EndTime": 1605105552.75966, "Dimensions": {"model": 30, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105552.759635}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6680583902994792, "sum": 0.6680583902994792, "min": 0.6680583902994792}}, "EndTime": 1605105552.759723, "Dimensions": {"model": 31, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105552.759706}
```

```
[11/11/2020 14:39:12 INFO 140570661291840] #quality_metric: host=algo-1, epoch=12, train binary_classification_cross_entropy_objective <loss>=0.352869110107
```

```
[2020-11-11 14:39:12.928] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/validation", "epoch": 38, "duration": 149, "num_examples": 1, "num_bytes": 126960}
```

```
#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.32939108143682067, "sum": 0.32939108143682067, "min": 0.32939108143682067}}, "EndTime": 1605105553.121722, "Dimensions": {"model": 0, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105553.121632}
```

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```

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```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.3348648403001868, "sum": 0.3348648403001868, "min": 0.3348648403001868}}, "EndTime": 1605105553.121964, "Dimensions": {"model": 3, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105553.121943}
```

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```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.21347493710725204, "sum": 0.21347493710725204, "min": 0.21347493710725204}}, "EndTime": 1605105553.122114, "Dimensions": {"model": 5, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105553.122095}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.2134119116741678, "sum": 0.2134119116741678, "min": 0.2134119116741678}}, "EndTime": 1605105553.122192, "Dimensions": {"model": 6, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105553.122173}
```

```
#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.21505541594132133, "sum": 0.21505541594132133, "min": 0.21505541594132133}}, "EndTime": 1605105553.122267, "Dimensions": {"model": 7, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105553.122249}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.33621925685716714, "sum": 0.33621925685716714, "min": 0.33621925685716714}}, "EndTime": 1605105553.122341, "Dimensions": {"model": 8, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105553.122322}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.3333017763884171, "sum": 0.3333017763884171, "min": 0.3333017763884171}}, "EndTime": 1605105553.122402, "Dimensions": {"model": 9, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105553.122386}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.32631978574006454, "sum": 0.32631978574006454, "min": 0.32631978574006454}}, "EndTime": 1605105553.122478, "Dimensions": {"model": 10, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605105553.122459}
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[11/11/2020 14:39:13 INFO 140570661291840] #quality_metric: host=algo-1, epoch=12, validation binary_classification_cross_entropy_objective <loss>=0.329391081437
```

```
[11/11/2020 14:39:13 INFO 140570661291840] #early_stopping_criteria_metric: host=algo-1, epoch=12, criteria=sampled_accuracy, value=0.939130434783
```

```
[11/11/2020 14:39:13 INFO 140570661291840] Epoch 12: Loss improved. Updating
best model
[11/11/2020 14:39:13 INFO 140570661291840] Saving model for epoch: 12
[11/11/2020 14:39:13 INFO 140570661291840] Saved checkpoint to "/tmp/tmpbZysm
6/mx-mod-0000.params"
[11/11/2020 14:39:13 INFO 140570661291840] #progress_metric: host=algo-1, com
pleted 86 % of epochs
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5552.653766}

[11/11/2020 14:39:13 INFO 140570661291840] #throughput_metric: host=algo-1, t
rain throughput=7714.64179861 records/second
[2020-11-11 14:39:13.222] [tensorio] [info] epoch_stats={"data_pipeline": "/o
pt/ml/input/data/train", "epoch": 30, "duration": 91, "num_examples": 4, "num
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6629278157552083, "sum": 0.6629278157552083, "min": 0.6629278157552083}}, "EndTime": 1605105553.224857, "Dimensions": {"model": 31, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605105553.224839}
```

```
[11/11/2020 14:39:13 INFO 140570661291840] #quality_metric: host=algo-1, epoch=13, train binary_classification_cross_entropy_objective <loss>=0.346213389079
```

```
[2020-11-11 14:39:13.353] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/validation", "epoch": 41, "duration": 112, "num_examples": 1, "num_bytes": 126960}
```

```
#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.32287299114724866, "sum": 0.32287299114724866, "mi
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.21260551784349524, "sum": 0.21260551784349524, "min": 0.21260551784349524}}, "EndTime": 1605105553.559089, "Dimensions": {"model": 4, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605105553.55907}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.20852037512737773, "sum": 0.20852037512737773, "min": 0.20852037512737773}}, "EndTime": 1605105553.559165, "Dimensions": {"model": 5, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605105553.559147}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.2095738120701002, "sum": 0.2095738120701002, "min": 0.2095738120701002}}, "EndTime": 1605105553.559246, "Dimensions": {"model": 6, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605105553.559224}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.21243415500806725, "sum": 0.21243415500806725, "min": 0.21243415500806725}}, "EndTime": 1605105553.55932, "Dimensions": {"model": 7, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605105553.559301}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.3290771152662194, "sum": 0.3290771152662194, "min": 0.3290771152662194}}, "EndTime": 1605105553.559392, "Dimensions": {"model": 8, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605105553.559373}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.3264696867569633, "sum": 0.3264696867569633, "min": 0.3264696867569633}}, "EndTime": 1605105553.559454, "Dimensions": {"model": 9, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605105553.559435}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.319829393469769, "sum": 0.319829393469769, "min": 0.319829393469769}}, "EndTime": 1605105553.559512, "Dimensions": {"model": 10, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605105553.559494}

#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.3229359502377717, "sum": 0.3229359502377717, "min": 0.3229359502377717}}, "EndTime": 1605105553.559575, "Dimensions": {"model": 11, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605105553.559556}

#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.22372373498004416, "sum": 0.22372373498004416, "min": 0.22372373498004416}}, "EndTime": 1605105553.559649, "Dimensions": {"model": 12, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605105553.55963}

#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.22419453496518343, "sum": 0.22419453496518343, "min": 0.22419453496518343}}, "EndTime": 1605105553.559716, "Dimensions": {"model": 13, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605105553.559698}

#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.22085067085597826, "sum": 0.22085067085597826, "min": 0.22085067085597826}}, "EndTime": 1605105553.559793, "Dimensions": {"model": 14, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605105553.559774}

#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.2222475300664487, "sum": 0.2222475300664487, "min": 0.2222475300664487}}, "EndTime": 1605105553.559862, "Dimensions": {"model": 15, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605105553.559843}

#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.4622482963230299, "sum": 0.4622482963230299, "min": 0.4622482963230299}}, "EndTime": 1605105553.559927, "Dimensions": {"model": 16, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605105553.559908}

#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.4649942812712296, "sum": 0.4649942812712296, "min": 0.4649942812712296}}, "EndTime": 1605105553.559991, "Dimensions": {"model": 17, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605105553.559973}

#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.46155176577360735, "sum": 0.46155176577360735, "min": 0.46155176577360735}}, "EndTime": 1605105553.560055, "Dimensions": {"model": 18, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605105553.560037}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.45843081266983693, "sum": 0.45843081266983693, "min": 0.45843081266983693}}, "EndTime": 1605105553.560312, "Dimensions": {"model": 23, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605105553.560297}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.658385301672894, "sum": 0.658385301672894, "min": 0.658385301672894}}, "EndTime": 1605105553.560385, "Dimensions": {"model": 24, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605105553.560366}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6580584982167119, "sum": 0.6580584982167119, "min": 0.6580584982167119}}, "EndTime": 1605105553.560453, "Dimensions": {"model": 25, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605105553.560434}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6556064771569293, "sum": 0.6556064771569293, "min": 0.6556064771569293}}, "EndTime": 1605105553.560517, "Dimensions": {"model": 26, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605105553.5605}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6627254320227581, "sum": 0.6627254320227581, "mi
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.656781005859375, "sum": 0.656781005859375, "min": 0.656781005859375}}, "EndTime": 1605105553.560699, "Dimensions": {"model": 29, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605105553.560683}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6578081213909647, "sum": 0.6578081213909647, "min": 0.6578081213909647}}, "EndTime": 1605105553.560734, "Dimensions": {"model": 30, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605105553.560725}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6546986455502717, "sum": 0.6546986455502717, "min": 0.6546986455502717}}, "EndTime": 1605105553.560764, "Dimensions": {"model": 31, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605105553.560756}
```

```
[11/11/2020 14:39:13 INFO 140570661291840] #quality_metric: host=algo-1, epoch=13, validation binary_classification_cross_entropy_objective <loss>=0.322872991147
```

```
[11/11/2020 14:39:13 INFO 140570661291840] #early_stopping_criteria_metric: host=algo-1, epoch=13, criteria=sampled_accuracy, value=0.94347826087
```

```
[11/11/2020 14:39:13 INFO 140570661291840] Epoch 13: Loss improved. Updating best model
```

```
[11/11/2020 14:39:13 INFO 140570661291840] Saving model for epoch: 13
```

```
[11/11/2020 14:39:13 INFO 140570661291840] Saved checkpoint to "/tmp/tmp98NZxJ/mx-mod-0000.params"
```

```
[11/11/2020 14:39:13 INFO 140570661291840] #progress_metric: host=algo-1, completed 93 % of epochs
```

```
#metrics {"Metrics": {"Max Batches Seen Between Resets": {"count": 1, "max": 4, "sum": 4.0, "min": 4}, "Number of Batches Since Last Reset": {"count": 1, "max": 4, "sum": 4.0, "min": 4}, "Number of Records Since Last Reset": {"count": 1, "max": 3680, "sum": 3680.0, "min": 3680}, "Total Batches Seen": {"count": 1, "max": 61, "sum": 61.0, "min": 61}, "Total Records Seen": {"count": 1, "max": 56200, "sum": 56200.0, "min": 56200}, "Max Records Seen Between Resets": {"count": 1, "max": 3680, "sum": 3680.0, "min": 3680}, "Reset Count": {"count": 1, "max": 16, "sum": 16.0, "min": 16}}, "EndTime": 1605105553.567539, "Dimensions": {"Host": "algo-1", "Meta": "training_data_iter", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605105553.130937}
```

```
[11/11/2020 14:39:13 INFO 140570661291840] #throughput_metric: host=algo-1, train throughput=8426.1455626 records/second
```

```
[2020-11-11 14:39:13.665] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/train", "epoch": 32, "duration": 97, "num_examples": 4, "num_bytes": 1015680}
```

```
#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.3403326822916667, "sum": 0.3403326822916667, "min": 0.3403326822916667}}, "EndTime": 1605105553.666116, "Dimensions": {"model": 0, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105553.666022}
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":  
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":  
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poch": 14}, "StartTime": 1605105553.666521}  
  
#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":  
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":  
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":  
  {"count": 1, "max": 0.4758219909667969, "sum": 0.4758219909667969, "min": 0.  
4758219909667969}}, "EndTime": 1605105553.667484, "Dimensions": {"model": 20,  
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och": 14}, "StartTime": 1605105553.667467}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":  
  {"count": 1, "max": 0.4730494588216146, "sum": 0.4730494588216146, "min": 0.  
4730494588216146}}, "EndTime": 1605105553.667542, "Dimensions": {"model": 21,  
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och": 14}, "StartTime": 1605105553.667525}
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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":  
  {"count": 1, "max": 0.47492887369791664, "sum": 0.47492887369791664, "min":  
0.47492887369791664}}, "EndTime": 1605105553.667601, "Dimensions": {"model":  
22, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner",  
"epoch": 14}, "StartTime": 1605105553.667584}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":  
  {"count": 1, "max": 0.47486925252278644, "sum": 0.47486925252278644, "min":  
0.47486925252278644}}, "EndTime": 1605105553.667656, "Dimensions": {"model":  
23, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner",  
"epoch": 14}, "StartTime": 1605105553.667639}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":  
  {"count": 1, "max": 0.6661902872721354, "sum": 0.6661902872721354, "min": 0.  
6661902872721354}}, "EndTime": 1605105553.667713, "Dimensions": {"model": 24,  
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```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":  
  {"count": 1, "max": 0.6647772623697916, "sum": 0.6647772623697916, "min": 0.  
6647772623697916}}, "EndTime": 1605105553.667774, "Dimensions": {"model": 25,  
"Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "ep  
och": 14}, "StartTime": 1605105553.667757}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":  
  {"count": 1, "max": 0.662562520345052, "sum": 0.662562520345052, "min": 0.66  
2562520345052}}, "EndTime": 1605105553.66783, "Dimensions": {"model": 26, "Ho  
st": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoc  
h": 14}, "StartTime": 1605105553.667813}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":  
  {"count": 1, "max": 0.6627428385416667, "sum": 0.6627428385416667, "min": 0.  
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"Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "ep  
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```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective":  
  {"count": 1, "max": 0.665958760579427, "sum": 0.665958760579427, "min": 0.66  
5958760579427}}, "EndTime": 1605105553.667946, "Dimensions": {"model": 28, "H  
ost": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoc  
h": 14}, "StartTime": 1605105553.667929}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6635025227864584, "sum": 0.6635025227864584, "min": 0.6635025227864584}}, "EndTime": 1605105553.668004, "Dimensions": {"model": 29, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105553.667986}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6616432495117187, "sum": 0.6616432495117187, "min": 0.6616432495117187}}, "EndTime": 1605105553.668067, "Dimensions": {"model": 30, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105553.66805}
```

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#metrics {"Metrics": {"train_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6640331217447917, "sum": 0.6640331217447917, "min": 0.6640331217447917}}, "EndTime": 1605105553.668131, "Dimensions": {"model": 31, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105553.668114}
```

```
[11/11/2020 14:39:13 INFO 140570661291840] #quality_metric: host=algo-1, epoch=14, train binary_classification_cross_entropy_objective <loss>=0.340332682292
```

```
[2020-11-11 14:39:13.798] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/validation", "epoch": 44, "duration": 113, "num_examples": 1, "num_bytes": 126960}
```

```
#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.31693878173828127, "sum": 0.31693878173828127, "min": 0.31693878173828127}}, "EndTime": 1605105554.035195, "Dimensions": {"model": 0, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105554.035112}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.31348621534264604, "sum": 0.31348621534264604, "min": 0.31348621534264604}}, "EndTime": 1605105554.035289, "Dimensions": {"model": 1, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105554.035273}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.3251054183296535, "sum": 0.3251054183296535, "min": 0.3251054183296535}}, "EndTime": 1605105554.035351, "Dimensions": {"model": 2, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105554.035331}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.3203062969705333, "sum": 0.3203062969705333, "min": 0.3203062969705333}}, "EndTime": 1605105554.035425, "Dimensions": {"model": 3, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105554.035406}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.20743537571119225, "sum": 0.20743537571119225, "min": 0.20743537571119225}}, "EndTime": 1605105554.035496, "Dimensions": {"model": 4, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105554.035478}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.20743537571119225, "sum": 0.20743537571119225, "min": 0.20743537571119225}}, "EndTime": 1605105554.03557, "Dimensions": {"model": 5, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105554.035552}
```

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ve": {"count": 1, "max": 0.20323831309442936, "sum": 0.20323831309442936, "min": 0.20323831309442936}}, "EndTime": 1605105554.035567, "Dimensions": {"model": 5, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105554.035549}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.20511393339737602, "sum": 0.20511393339737602, "min": 0.20511393339737602}}, "EndTime": 1605105554.035635, "Dimensions": {"model": 6, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105554.035616}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.20842441061268682, "sum": 0.20842441061268682, "min": 0.20842441061268682}}, "EndTime": 1605105554.035699, "Dimensions": {"model": 7, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105554.035682}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.32260088713272755, "sum": 0.32260088713272755, "min": 0.32260088713272755}}, "EndTime": 1605105554.035751, "Dimensions": {"model": 8, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105554.035735}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.3202981700067935, "sum": 0.3202981700067935, "min": 0.3202981700067935}}, "EndTime": 1605105554.035811, "Dimensions": {"model": 9, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105554.035797}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.31395661727241847, "sum": 0.31395661727241847, "min": 0.31395661727241847}}, "EndTime": 1605105554.035846, "Dimensions": {"model": 10, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105554.035838}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.31658683445142666, "sum": 0.31658683445142666, "min": 0.31658683445142666}}, "EndTime": 1605105554.035901, "Dimensions": {"model": 11, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105554.035884}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.22490018761676292, "sum": 0.22490018761676292, "min": 0.22490018761676292}}, "EndTime": 1605105554.035959, "Dimensions": {"model": 12, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105554.035945}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.2246209186056386, "sum": 0.2246209186056386, "min": 0.2246209186056386}}, "EndTime": 1605105554.03602, "Dimensions": {"model": 13, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105554.036003}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.2219456548276155, "sum": 0.2219456548276155, "min": 0.2219456548276155}}, "EndTime": 1605105554.03609, "Dimensions": {"model": 14, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105554.036076}
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l": 14, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105554.036075}
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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.2216539134149966, "sum": 0.2216539134149966, "min": 0.2216539134149966}}, "EndTime": 1605105554.036161, "Dimensions": {"model": 15, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105554.036142}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.4636550239894701, "sum": 0.4636550239894701, "min": 0.4636550239894701}}, "EndTime": 1605105554.036224, "Dimensions": {"model": 16, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105554.036207}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.465715623938519, "sum": 0.465715623938519, "min": 0.465715623938519}}, "EndTime": 1605105554.036288, "Dimensions": {"model": 17, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105554.03627}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.4627171392026155, "sum": 0.4627171392026155, "min": 0.4627171392026155}}, "EndTime": 1605105554.036347, "Dimensions": {"model": 18, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105554.036334}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.458631299889606, "sum": 0.458631299889606, "min": 0.458631299889606}}, "EndTime": 1605105554.036381, "Dimensions": {"model": 19, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105554.036373}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.4704252823539402, "sum": 0.4704252823539402, "min": 0.4704252823539402}}, "EndTime": 1605105554.03644, "Dimensions": {"model": 20, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105554.036422}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.465855540399966, "sum": 0.465855540399966, "min": 0.465855540399966}}, "EndTime": 1605105554.036513, "Dimensions": {"model": 21, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105554.036494}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.47030506963315216, "sum": 0.47030506963315216, "min": 0.47030506963315216}}, "EndTime": 1605105554.036585, "Dimensions": {"model": 22, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105554.036567}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.4695480678392493, "sum": 0.4695480678392493, "min": 0.4695480678392493}}, "EndTime": 1605105554.03665, "Dimensions": {"model": 23, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105554.036633}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6577839063561481, "sum": 0.6577839063561481, "min": 0.6577839063561481}}, "EndTime": 1605105554.036726, "Dimensions": {"model": 24, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105554.036707}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6561564569887908, "sum": 0.6561564569887908, "min": 0.6561564569887908}}, "EndTime": 1605105554.036794, "Dimensions": {"model": 25, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105554.036776}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6551262896993886, "sum": 0.6551262896993886, "min": 0.6551262896993886}}, "EndTime": 1605105554.036867, "Dimensions": {"model": 26, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105554.036849}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6557566767153533, "sum": 0.6557566767153533, "min": 0.6557566767153533}}, "EndTime": 1605105554.036941, "Dimensions": {"model": 27, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105554.036923}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6535424937372623, "sum": 0.6535424937372623, "min": 0.6535424937372623}}, "EndTime": 1605105554.036999, "Dimensions": {"model": 28, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105554.036984}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.656745313561481, "sum": 0.656745313561481, "min": 0.656745313561481}}, "EndTime": 1605105554.037062, "Dimensions": {"model": 29, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105554.037045}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6515617038892663, "sum": 0.6515617038892663, "min": 0.6515617038892663}}, "EndTime": 1605105554.037113, "Dimensions": {"model": 30, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105554.037114}
```

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#metrics {"Metrics": {"validation_binary_classification_cross_entropy_objective": {"count": 1, "max": 0.6601997707201087, "sum": 0.6601997707201087, "min": 0.6601997707201087}}, "EndTime": 1605105554.037188, "Dimensions": {"model": 31, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 1605105554.037171}
```

```
[11/11/2020 14:39:14 INFO 140570661291840] #quality_metric: host=algo-1, epoch=14, validation binary_classification_cross_entropy_objective <loss>=0.316938781738
```

```
[11/11/2020 14:39:14 INFO 140570661291840] #early_stopping_criteria_metric: host=algo-1, epoch=14, criteria=sampled_accuracy, value=0.94347826087
```

```
[11/11/2020 14:39:14 INFO 140570661291840] Epoch 14: Loss improved. Updating best model
```

```
[11/11/2020 14:39:14 INFO 140570661291840] Saving model for epoch: 14
[11/11/2020 14:39:14 INFO 140570661291840] Saved checkpoint to "/tmp/tmpk1179
m/mx-mod-0000.params"
[11/11/2020 14:39:14 INFO 140570661291840] #progress_metric: host=algo-1, com
pleted 100 % of epochs
#metrics {"Metrics": {"Max Batches Seen Between Resets": {"count": 1, "max":
  4, "sum": 4.0, "min": 4}, "Number of Batches Since Last Reset": {"count": 1,
  "max": 4, "sum": 4.0, "min": 4}, "Number of Records Since Last Reset": {"coun
t": 1, "max": 3680, "sum": 3680.0, "min": 3680}, "Total Batches Seen": {"coun
t": 1, "max": 65, "sum": 65.0, "min": 65}, "Total Records Seen": {"count": 1,
  "max": 59880, "sum": 59880.0, "min": 59880}, "Max Records Seen Between Reset
s": {"count": 1, "max": 3680, "sum": 3680.0, "min": 3680}, "Reset Count": {"c
ount": 1, "max": 17, "sum": 17.0, "min": 17}}, "EndTime": 1605105554.043903,
  "Dimensions": {"Host": "algo-1", "Meta": "training_data_iter", "Operation":
  "training", "Algorithm": "Linear Learner", "epoch": 14}, "StartTime": 160510
5553.56784}

[11/11/2020 14:39:14 INFO 140570661291840] #throughput_metric: host=algo-1, t
rain throughput=7727.7818543 records/second
[11/11/2020 14:39:14 WARNING 140570661291840] wait_for_all_workers will not s
ync workers since the kv store is not running distributed
[11/11/2020 14:39:14 WARNING 140570661291840] wait_for_all_workers will not s
ync workers since the kv store is not running distributed
[2020-11-11 14:39:14.185] [tensorio] [info] epoch_stats={"data_pipeline": "/o
pt/ml/input/data/validation", "epoch": 47, "duration": 122, "num_examples":
  1, "num_bytes": 126960}
[11/11/2020 14:39:14 INFO 140570661291840] #early_stopping_criteria_metric: h
ost=algo-1, epoch=14, criteria=sampled_accuracy, value=0.94347826087
[11/11/2020 14:39:14 INFO 140570661291840] Epoch 14: Loss improved. Updating
  best model
[2020-11-11 14:39:14.376] [tensorio] [info] epoch_stats={"data_pipeline": "/o
pt/ml/input/data/validation", "epoch": 49, "duration": 6, "num_examples": 1,
  "num_bytes": 126960}
[11/11/2020 14:39:14 INFO 140570661291840] #validation_score (algo-1) : ('bin
ary_classification_cross_entropy_objective', 0.20743537571119225)
[11/11/2020 14:39:14 INFO 140570661291840] #validation_score (algo-1) : ('bin
ary_classification_accuracy', 0.941304347826087)
[11/11/2020 14:39:14 INFO 140570661291840] #validation_score (algo-1) : ('bin
ary_f_1.000', 0.9203539823008849)
[11/11/2020 14:39:14 INFO 140570661291840] #validation_score (algo-1) : ('pre
cision', 0.9341317365269461)
[11/11/2020 14:39:14 INFO 140570661291840] #validation_score (algo-1) : ('rec
all', 0.9069767441860465)
[11/11/2020 14:39:14 INFO 140570661291840] #validation_score (algo-1) : ('roc
_auc_score', 0.9769662467700259)
[11/11/2020 14:39:14 INFO 140570661291840] #quality_metric: host=algo-1, vali
dation binary_classification_cross_entropy_objective <loss>=0.207435375711
[11/11/2020 14:39:14 INFO 140570661291840] #quality_metric: host=algo-1, vali
dation binary_classification_accuracy <score>=0.941304347826
[11/11/2020 14:39:14 INFO 140570661291840] #quality_metric: host=algo-1, vali
dation binary_f_1.000 <score>=0.920353982301
[11/11/2020 14:39:14 INFO 140570661291840] #quality_metric: host=algo-1, vali
dation precision <score>=0.934131736527
[11/11/2020 14:39:14 INFO 140570661291840] #quality_metric: host=algo-1, vali
dation recall <score>=0.906976744186
[11/11/2020 14:39:14 INFO 140570661291840] #quality_metric: host=algo-1, vali
```

```

dation roc_auc_score <score>=0.97696624677
[11/11/2020 14:39:14 INFO 140570661291840] Best model found for hyperparameters: {"lr_scheduler_step": 10, "wd": 0.0001, "optimizer": "adam", "lr_scheduler_factor": 0.99, "l1": 0.0, "learning_rate": 0.1, "lr_scheduler_minimum_lr": 1e-05}
[11/11/2020 14:39:14 INFO 140570661291840] Saved checkpoint to "/tmp/tmpHJRGj/mx-mod-0000.params"
[2020-11-11 14:39:14.383] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/test", "epoch": 0, "duration": 7840, "num_examples": 1, "num_bytes": 126960}
[2020-11-11 14:39:14.388] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/test", "epoch": 1, "duration": 4, "num_examples": 1, "num_bytes": 126960}
#metrics {"Metrics": {"Max Batches Seen Between Resets": {"count": 1, "max": 1, "sum": 1.0, "min": 1}, "Number of Batches Since Last Reset": {"count": 1, "max": 1, "sum": 1.0, "min": 1}, "Number of Records Since Last Reset": {"count": 1, "max": 460, "sum": 460.0, "min": 460}, "Total Batches Seen": {"count": 1, "max": 1, "sum": 1.0, "min": 1}, "Total Records Seen": {"count": 1, "max": 460, "sum": 460.0, "min": 460}, "Max Records Seen Between Resets": {"count": 1, "max": 460, "sum": 460.0, "min": 460}, "Reset Count": {"count": 1, "max": 1, "sum": 1.0, "min": 1}}, "EndTime": 1605105554.390163, "Dimensions": {"Host": "algo-1", "Meta": "test_data_iter", "Operation": "training", "Algorithm": "Linear Learner"}, "StartTime": 1605105554.383736}

[11/11/2020 14:39:14 INFO 140570661291840] #test_score (algo-1) : ('binary_classification_cross_entropy_objective', 0.21904874055281928)
[11/11/2020 14:39:14 INFO 140570661291840] #test_score (algo-1) : ('binary_classification_accuracy', 0.9391304347826087)
[11/11/2020 14:39:14 INFO 140570661291840] #test_score (algo-1) : ('binary_f1.000', 0.9204545454545454)
[11/11/2020 14:39:14 INFO 140570661291840] #test_score (algo-1) : ('precision', 0.9529411764705882)
[11/11/2020 14:39:14 INFO 140570661291840] #test_score (algo-1) : ('recall', 0.8901098901098901)
[11/11/2020 14:39:14 INFO 140570661291840] #test_score (algo-1) : ('roc_auc_score', 0.978278915329275)
[11/11/2020 14:39:14 INFO 140570661291840] #quality_metric: host=algo-1, test binary_classification_cross_entropy_objective <loss>=0.219048740553
[11/11/2020 14:39:14 INFO 140570661291840] #quality_metric: host=algo-1, test binary_classification_accuracy <score>=0.939130434783
[11/11/2020 14:39:14 INFO 140570661291840] #quality_metric: host=algo-1, test binary_f1.000 <score>=0.920454545455
[11/11/2020 14:39:14 INFO 140570661291840] #quality_metric: host=algo-1, test precision <score>=0.952941176471
[11/11/2020 14:39:14 INFO 140570661291840] #quality_metric: host=algo-1, test recall <score>=0.89010989011
[11/11/2020 14:39:14 INFO 140570661291840] #quality_metric: host=algo-1, test roc_auc_score <score>=0.978278915329
#metrics {"Metrics": {"totaltime": {"count": 1, "max": 8220.31021118164, "sum": 8220.31021118164, "min": 8220.31021118164}, "finalize.time": {"count": 1, "max": 337.1460437774658, "sum": 337.1460437774658, "min": 337.1460437774658}, "initialize.time": {"count": 1, "max": 179.05020713806152, "sum": 179.05020713806152, "min": 179.05020713806152}, "check_early_stopping.time": {"count": 16, "max": 1.31988525390625, "sum": 16.762733459472656, "min": 0.946044921875}, "setuptime": {"count": 1, "max": 26.83711051940918, "sum": 26.83711051940918, "min": 26.83711051940918}, "update.time": {"count": 15, "max": 619.27

```

```
60467529297, "sum": 7272.989511489868, "min": 420.34220695495605}, "epochs":
{"count": 1, "max": 15, "sum": 15.0, "min": 15}}, "EndTime": 1605105554.3948
93, "Dimensions": {"Host": "algo-1", "Operation": "training", "Algorithm": "L
inear Learner"}, "StartTime": 1605105546.535347}
```

2020-11-11 14:39:24 Uploading - Uploading generated training model

2020-11-11 14:39:24 Completed - Training job completed

Training seconds: 86

Billable seconds: 86

3. Evaluating the model

In this section, you will look at how the model performs with the test dataset.

Amazon SageMaker analytics

You can use `sagemaker.analytics` to get some performance metrics. This doesn't require deploying the model. Because this is a classification problem, you can check accuracy, precision, and recall.

```
In [10]: sagemaker.analytics.TrainingJobAnalytics(binary_estimator._current_job_name,
                                                metric_names = ['test:binary_classifi
cation_accuracy',
                                                                'test:precision',
                                                                'test:recall']
                                                ).dataframe()
```

Out[10]:

	timestamp	metric_name	value
0	0.0	test:binary_classification_accuracy	0.939130
1	0.0	test:precision	0.952941
2	0.0	test:recall	0.890110

Deploying the model

To deploy the model, run the following cell.

Note: This takes some time to complete. While you are waiting, think about the answer to question 2.

```
In [11]: binary_predictor = binary_estimator.deploy(initial_instance_count=1, instance_
type='ml.m4.xlarge')
```

Defaulting to the only supported framework/algorithm version: 1. Ignoring fra
mework/algorithm version: 1.

-----!

Question 2 - Evaluation metric selection

You need to consider the business and its related restrictions when selecting the evaluation metric. In this case, spam detection requires being careful about false positives. A false positive means a good email is classified as a spam email. Because spam emails usually go to a spam folder, a user could lose important information from a false positive.

Some well-known evaluation metrics include the following:

- Accuracy = $(TP + TN) / (TP + FP + FN + TN)$
- Precision = $(TP) / (TP + FP)$
- Recall = $(TP) / (TP + FN)$

In light of the provided information, which of the provided metrics do you think is the best to consider?

Answer: Precision is the choice of metric here as it accounts for the false positives. High precision means high TP and low FP.

Now that you have a hosted endpoint running, you can make real-time predictions from the model easily, simply by making an http POST request. First, you need to set up serializers and deserializers for passing the `test_features` NumPy arrays to the model behind the endpoint. You will also calculate the confusion matrix for the model to evaluate how it has done on the test data.

Question 3 - Calculate metrics

In this question, you are asked to calculate some important evaluation metrics. The accuracy calculation is used as an example. Calculate the precision and recall after accuracy.

Hint: You can check your calculated values with the `sagemaker.analytics` results you got in the beginning of this section.

```
In [12]: import matplotlib.pyplot as plt
import seaborn as sns

# Get predictions for each batch with size of 25
def predict_batches(predictor, features, labels):
    prediction_batches = [predictor.predict(batch) for batch in np.array_split
(features, 25)]
    # Parse protobuf responses to extract predicted labels
    extract_label = lambda x: x.label['predicted_label'].float32_tensor.values
    preds = np.concatenate([np.array([extract_label(x) for x in batch]) for batch
in prediction_batches])
    preds = preds.reshape((-1,))

    # Calculate accuracy, precision, and recall
    accuracy = (preds == labels).sum() / len(labels)
    print(f'Accuracy: {accuracy}')

    # Calculate precision
    precision = (preds[preds == 1] == labels[preds == 1]).sum() / len(preds[pr
eds == 1])
    print(f'Precision: {precision}')

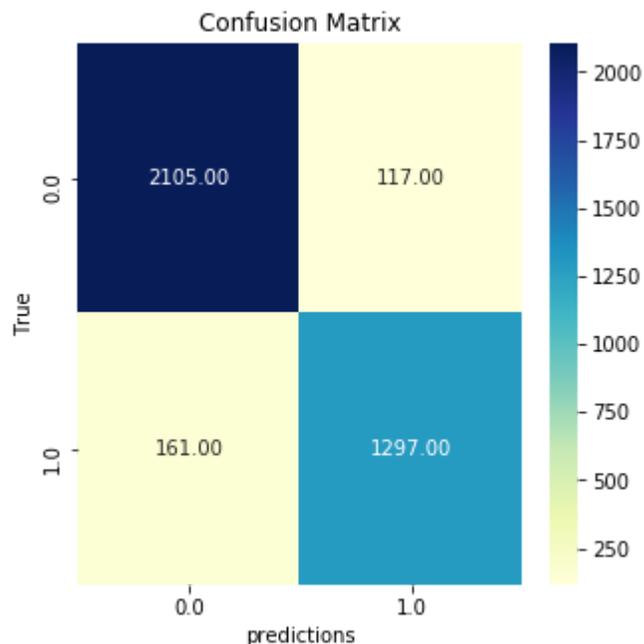
    # Calculate recall
    recall = (preds[preds == 1] == labels[preds == 1]).sum() / len(labels[labe
ls == 1])
    print(f'Recall: {recall}')

    confusion_matrix = pd.crosstab(index=labels, columns=np.round(preds), rowna
mes=['True'], colnames=['predictions']).astype(int)
    plt.figure(figsize = (5,5))
    sns.heatmap(confusion_matrix, annot=True, fmt='.2f', cmap="YlGnBu").set_tit
le('Confusion Matrix')
```

Get training performance

```
In [13]: predict_batches(binary_predictor, train_features, train_labels)
```

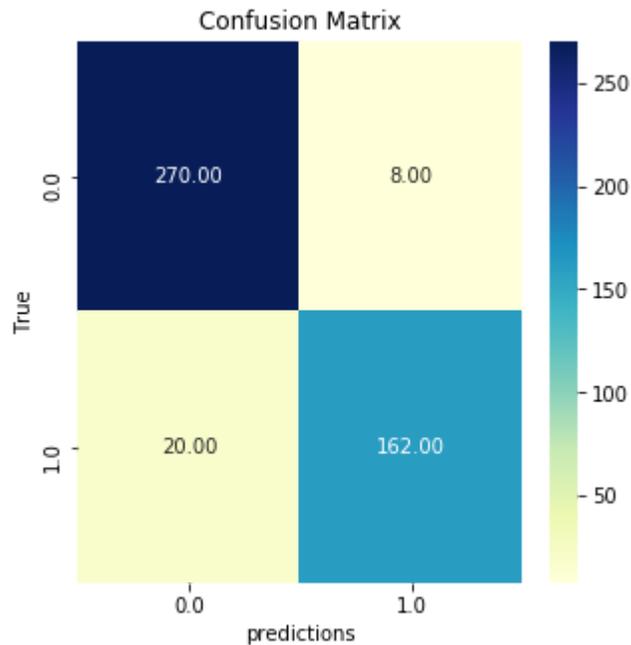
Accuracy: 0.9244565217391304
Precision: 0.9172560113154172
Recall: 0.8895747599451304



Get test performance

```
In [14]: predict_batches(binary_predictor, test_features, test_labels)
```

Accuracy: 0.9391304347826087
Precision: 0.9529411764705882
Recall: 0.8901098901098901



Question 4 - Compare training-test results

Do you see a big difference between training and test performance?

Answer: The two performances look very similar. We didn't experience overfitting here.

4. Conclusion

In this exercise, you developed a binary classifier using the linear learning algorithm in Amazon SageMaker. You also reviewed important concepts such as training, validation, and test splits; confusion matrices; and classification metrics. Overall, the model resulted in over 90% in the accuracy, precision, and recall metrics.

Problem 2: Diabetes progression prediction (regression)

For regression, you will work with a health-related dataset to predict diabetes.

You will use the [Diabetes Data \(https://www4.stat.ncsu.edu/~boos/var.select/diabetes.html\)](https://www4.stat.ncsu.edu/~boos/var.select/diabetes.html).

The **Scikit-learn** library hosts this data as well. You will use this library to load the dataset.

Fields in this dataset:

Input:

- 1 - age
- 2 - sex
- 3 - bmi (Body mass index)
- 4 - bp (Blood pressure)
- 5 - s1 (Serum measurement 1)
- 6 - s2 (Serum measurement 2)
- 7 - s3 (Serum measurement 3)
- 8 - s4 (Serum measurement 4)
- 9 - s5 (Serum measurement 5)
- 10 - s6 (Serum measurement 6)

Output:

- 11 - y (A quantitative measure of disease progression one year after baseline)

1. Getting the data

```
In [15]: import numpy as np
from sklearn.datasets import load_diabetes

diabetes = load_diabetes()
X, y = diabetes.data.astype(np.float32), diabetes.target.astype(np.float32)

print("X shape:", X.shape)
print("Y shape:", y.shape)
```

X shape: (442, 10)
Y shape: (442,)

```
In [16]: import pandas as pd

df = pd.DataFrame(data=np.column_stack((X, y)),
                  columns=['age', 'sex', 'bmi', 'bp', 's1', 's2', 's3', 's4',
                           's5', 's6', 'y']
                  )
```

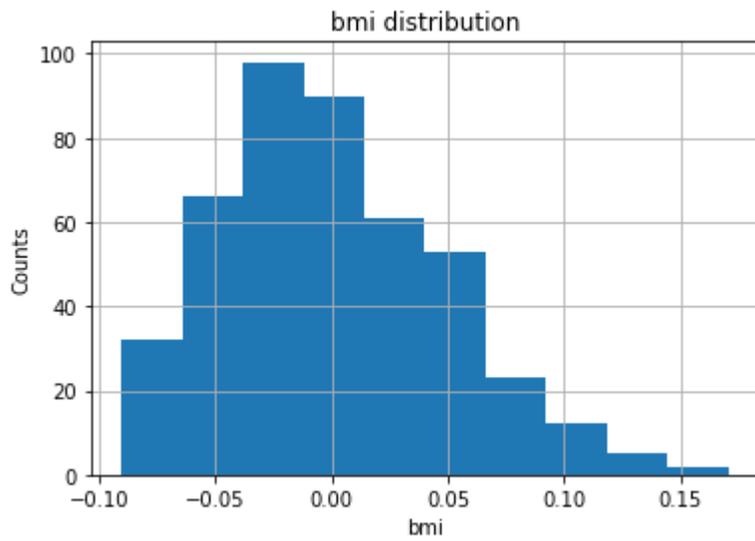
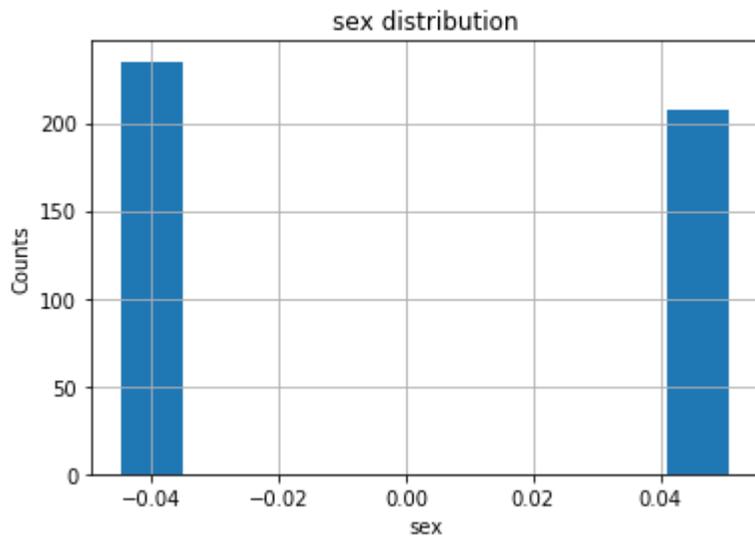
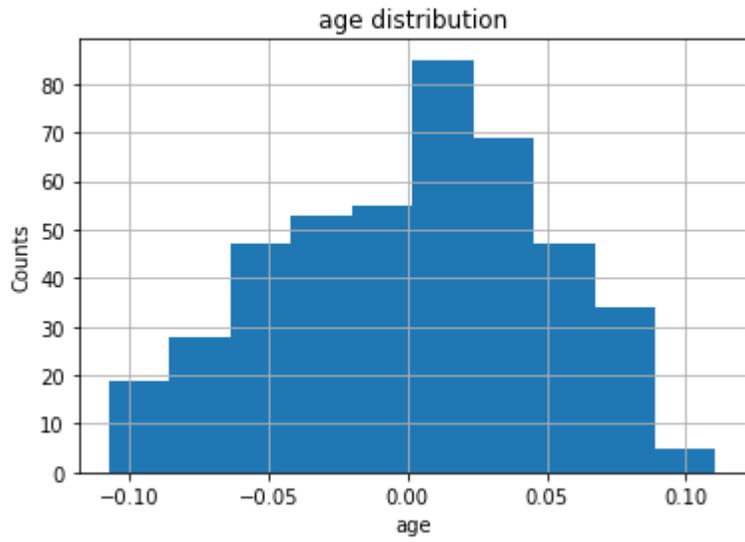
Note: The features are normalized and scaled beforehand.

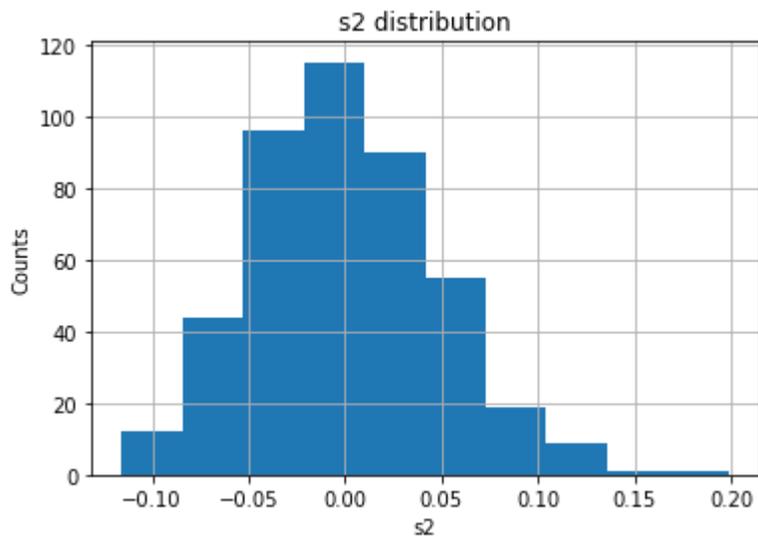
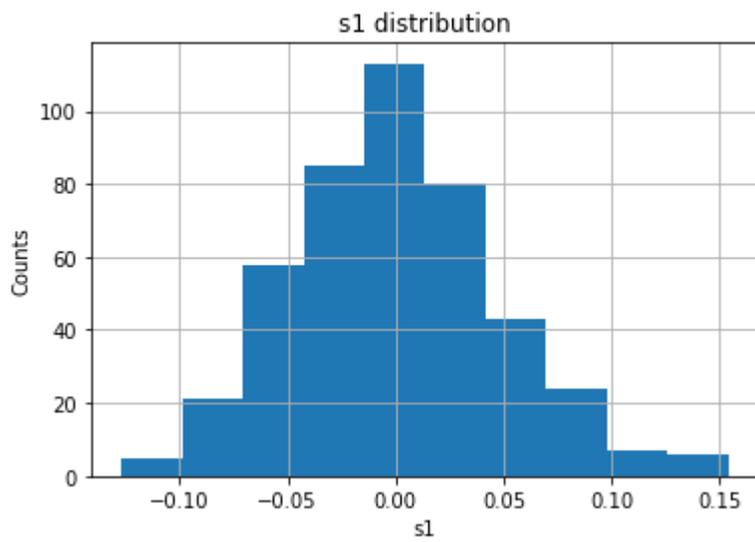
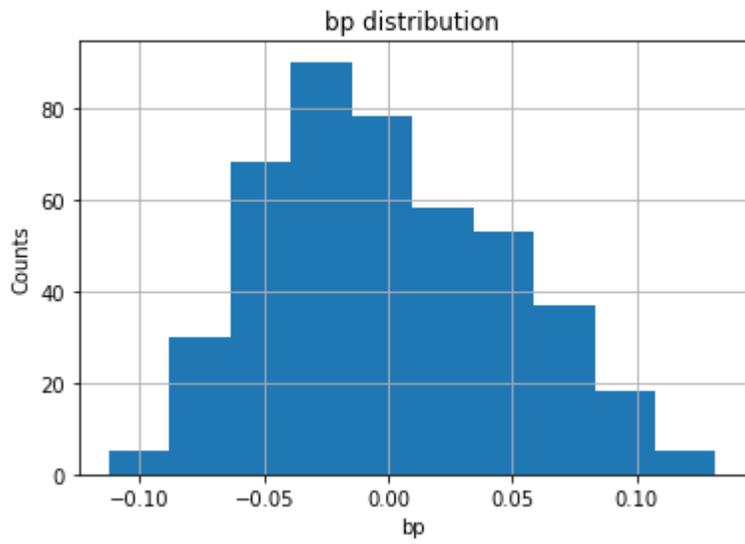
```
In [17]: df.head()
```

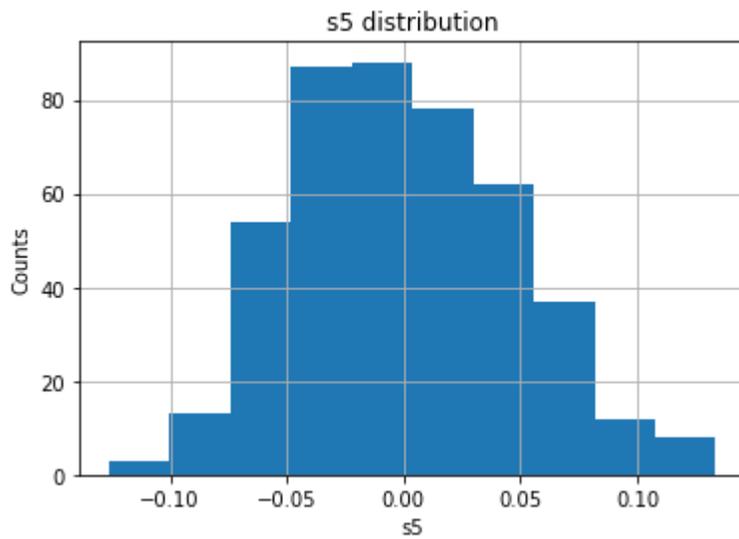
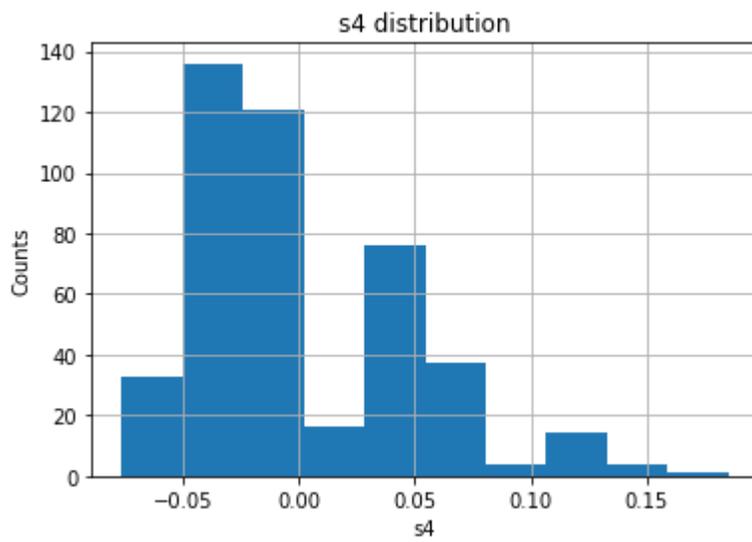
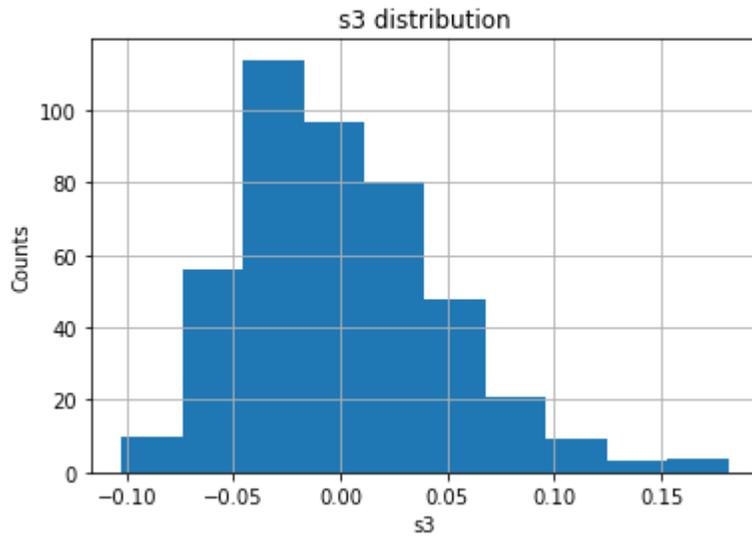
Out[17]:

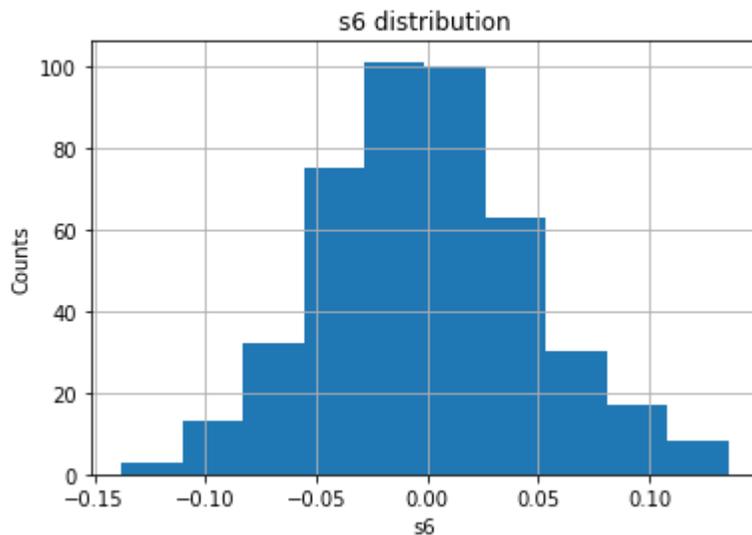
	age	sex	bmi	bp	s1	s2	s3	s4	s5	s6	y
0	0.038076	0.050680	0.061696	0.021872	-0.044223	-0.034821	-0.043401	-0.002592	0.01990	0.000000	25
1	-0.001882	-0.044642	-0.051474	-0.026328	-0.008449	-0.019163	0.074412	-0.039493	-0.06830	0.000000	25
2	0.085299	0.050680	0.044451	-0.005671	-0.045599	-0.034194	-0.032356	-0.002592	0.00280	0.000000	25
3	-0.089063	-0.044642	-0.011595	-0.036656	0.012191	0.024991	-0.036038	0.034309	0.02260	0.000000	25
4	0.005383	-0.044642	-0.036385	0.021872	0.003935	0.015596	0.008142	-0.002592	-0.03190	0.000000	25

```
In [18]: import matplotlib.pyplot as plt
          %%matplotlib inline
          for col in ['age', 'sex', 'bmi', 'bp', 's1', 's2', 's3', 's4', 's5', 's6']:
              plt.hist(df[col].values)
              plt.title(col + ' distribution')
              plt.xlabel(col)
              plt.ylabel('Counts')
              plt.grid(True)
              plt.show()
```

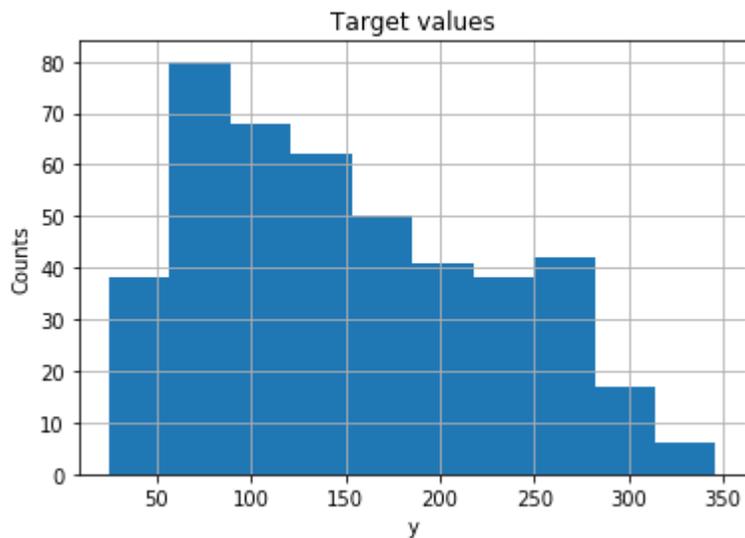








```
In [19]: import matplotlib.pyplot as plt
         %%matplotlib inline
         plt.hist(y)
         plt.title('Target values')
         plt.xlabel('y')
         plt.ylabel('Counts')
         plt.grid(True)
         plt.show()
```



2. Training the model

In this section, you will do the following:

- Split the dataset into training, validation, and test subsets
- Use the Amazon SageMaker linear learner algorithm to train the model

Question 1 - Train-test-validation split

An important part of training a machine learning model is splitting the data into training, validation, and test subsets. You will use the `train_test_split()` function from the `sklearn` library [documentation \(https://scikit-learn.org/stable/modules/generated/sklearn.model_selection.train_test_split.html\)](https://scikit-learn.org/stable/modules/generated/sklearn.model_selection.train_test_split.html).

Look at this example:

```
train_features, test_features, train_labels, test_labels =
train_test_split(X, y, test_size=0.2)
```

This function splits input feature `X` and target `y` pairs by a given ratio (`test_size`). This specific example splits the data into training (80%) and test (20%) subsets.

Use this function **twice** to split the data into **training (80%)**, **validation (10%)**, and **test (10%)** subsets.

```
In [20]: from sklearn.model_selection import train_test_split

# Get 80% of the data for training; the remaining 20% will be for validation a
nd test
train_features, test_features, train_labels, test_labels = train_test_split(X,
y, test_size=0.2)

# Split the remaining 20% of data as 10% test and 10% validation
test_features, val_features, test_labels, val_labels = train_test_split(test_f
eatures, test_labels, test_size=0.5)

print(f"Length of train_features is: {train_features.shape}")
print(f"Length of train_labels is: {train_labels.shape}")
print(f"Length of val_features is: {val_features.shape}")
print(f"Length of val_labels is: {val_labels.shape}")
print(f"Length of test_features is: {test_features.shape}")
print(f"Length of test_labels is: {test_labels.shape}")
```

```
Length of train_features is: (353, 10)
Length of train_labels is: (353,)
Length of val_features is: (45, 10)
Length of val_labels is: (45,)
Length of test_features is: (44, 10)
Length of test_labels is: (44,)
```

Now, call the Amazon SageMaker `LinearLearner()` algorithm. This example uses an `m1.m4.xlarge` instance for training. `predictor_type` is set to **'regressor'** because this is a regression problem.

```
In [21]: import sagemaker

# Call the LinearLearner estimator object
regression_model = sagemaker.LinearLearner(role=sagemaker.get_execution_role
(),
                                           instance_count=1,
                                           instance_type='ml.m4.xlarge',
                                           predictor_type='regressor')
```

Use the `record_set()` function of the `regression_model` to set the training, validation, and test parts of the estimator.

```
In [22]: train_records = regression_model.record_set(train_features, train_labels, channel='train')
val_records = regression_model.record_set(val_features, val_labels, channel='validation')
test_records = regression_model.record_set(test_features, test_labels, channel='test')
```

The `fit()` function applies regression on this data.

```
In [23]: regression_model.fit([train_records, val_records, test_records])
```

Defaulting to the only supported framework/algorithm version: 1. Ignoring framework/algorithm version: 1.

Defaulting to the only supported framework/algorithm version: 1. Ignoring framework/algorithm version: 1.

```
2020-11-11 14:47:29 Starting - Starting the training job...
2020-11-11 14:47:32 Starting - Launching requested ML instances.....
2020-11-11 14:48:56 Starting - Preparing the instances for training.....
2020-11-11 14:50:14 Downloading - Downloading input data...
2020-11-11 14:51:00 Training - Downloading the training image...
2020-11-11 14:51:31 Uploading - Uploading generated training model
Docker entrypoint called with argument(s): train
Running default environment configuration script
[11/11/2020 14:51:25 INFO 140470689392448] Reading default configuration from
/opt/amazon/lib/python2.7/site-packages/algorithm/resources/default-input.js
on: {u'loss_insensitivity': u'0.01', u'epochs': u'15', u'feature_dim': u'aut
o', u'init_bias': u'0.0', u'lr_scheduler_factor': u'auto', u'num_calibration
samples': u'1000000', u'accuracy_top_k': u'3', u'_num_kv_servers': u'auto',
u'use_bias': u'true', u'num_point_for_scaler': u'10000', u'_log_level': u'in
fo', u'quantile': u'0.5', u'bias_lr_mult': u'auto', u'lr_scheduler_step': u'a
uto', u'init_method': u'uniform', u'init_sigma': u'0.01', u'lr_scheduler_mini
mum_lr': u'auto', u'target_recall': u'0.8', u'num_models': u'auto', u'early_s
topping_patience': u'3', u'momentum': u'auto', u'unbias_label': u'auto', u'w
d': u'auto', u'optimizer': u'auto', u'_tuning_objective_metric': u'', u'early
_stopping_tolerance': u'0.001', u'learning_rate': u'auto', u'_kvstore': u'aut
o', u'normalize_data': u'true', u'binary_classifier_model_selection_criteri
a': u'accuracy', u'use_lr_scheduler': u'true', u'target_precision': u'0.8',
u'unbias_data': u'auto', u'init_scale': u'0.07', u'bias_wd_mult': u'auto',
u'f_beta': u'1.0', u'mini_batch_size': u'1000', u'huber_delta': u'1.0', u'nu
m_classes': u'1', u'beta_1': u'auto', u'loss': u'auto', u'beta_2': u'auto',
u'_enable_profiler': u'false', u'normalize_label': u'auto', u'_num_gpus':
u'auto', u'balance_multiclass_weights': u'false', u'positive_example_weight
_mult': u'1.0', u'l1': u'auto', u'margin': u'1.0'}
[11/11/2020 14:51:25 INFO 140470689392448] Merging with provided configuratio
n from /opt/ml/input/config/hyperparameters.json: {u'feature_dim': u'10', u'm
ini_batch_size': u'353', u'predictor_type': u'regressor'}
[11/11/2020 14:51:25 INFO 140470689392448] Final configuration: {u'loss_insen
sitivity': u'0.01', u'epochs': u'15', u'feature_dim': u'10', u'init_bias':
u'0.0', u'lr_scheduler_factor': u'auto', u'num_calibration_samples': u'10000
000', u'accuracy_top_k': u'3', u'_num_kv_servers': u'auto', u'use_bias': u'tr
ue', u'num_point_for_scaler': u'10000', u'_log_level': u'info', u'quantile':
u'0.5', u'bias_lr_mult': u'auto', u'lr_scheduler_step': u'auto', u'init_meth
od': u'uniform', u'init_sigma': u'0.01', u'lr_scheduler_minimum_lr': u'auto',
u'target_recall': u'0.8', u'num_models': u'auto', u'early_stopping_patience':
u'3', u'momentum': u'auto', u'unbias_label': u'auto', u'wd': u'auto', u'optim
izer': u'auto', u'_tuning_objective_metric': u'', u'early_stopping_toleranc
e': u'0.001', u'learning_rate': u'auto', u'_kvstore': u'auto', u'normalize_da
ta': u'true', u'binary_classifier_model_selection_criteria': u'accuracy', u'u
se_lr_scheduler': u'true', u'target_precision': u'0.8', u'unbias_data': u'aut
o', u'init_scale': u'0.07', u'bias_wd_mult': u'auto', u'f_beta': u'1.0', u'mi
ni_batch_size': u'353', u'huber_delta': u'1.0', u'num_classes': u'1', u'predi
ctor_type': u'regressor', u'beta_1': u'auto', u'loss': u'auto', u'beta_2':
u'auto', u'_enable_profiler': u'false', u'normalize_label': u'auto', u'_num_
gpus': u'auto', u'balance_multiclass_weights': u'false', u'positive_example_w
eight_mult': u'1.0', u'l1': u'auto', u'margin': u'1.0'}
[11/11/2020 14:51:25 WARNING 140470689392448] Loggers have already been setu
p.
Process 1 is a worker.
[11/11/2020 14:51:25 INFO 140470689392448] Using default worker.
[11/11/2020 14:51:26 INFO 140470689392448] Checkpoint loading and saving are
```

```

disabled.
[2020-11-11 14:51:26.051] [tensorio] [warning] TensorIO is already initialize
d; ignoring the initialization routine.
[2020-11-11 14:51:26.052] [tensorio] [warning] TensorIO is already initialize
d; ignoring the initialization routine.
[2020-11-11 14:51:26.069] [tensorio] [info] epoch_stats={"data_pipeline": "/o
pt/ml/input/data/train", "epoch": 0, "duration": 19, "num_examples": 1, "num_
bytes": 29652}
[11/11/2020 14:51:26 INFO 140470689392448] Create Store: local
[2020-11-11 14:51:26.100] [tensorio] [info] epoch_stats={"data_pipeline": "/o
pt/ml/input/data/train", "epoch": 1, "duration": 30, "num_examples": 1, "num_
bytes": 29652}
[11/11/2020 14:51:26 INFO 140470689392448] Scaler algorithm parameters
<algorithm.scaler.ScalerAlgorithmStable object at 0x7fc182dcb750>
[11/11/2020 14:51:26 INFO 140470689392448] Scaling model computed with parame
ters:
{'stdev_weight':
[0.04729188 0.04749977 0.04791651 0.04816476 0.04812084 0.04781667
0.04715475 0.04773587 0.04747206 0.04735379]
<NDArray 10 @cpu(0)>, 'stdev_label':
[78.414955]
<NDArray 1 @cpu(0)>, 'mean_label':
[153.9405]
<NDArray 1 @cpu(0)>, 'mean_weight':
[-2.6641157e-04 -8.9624163e-04 -9.1154559e-04 1.4817175e-03
5.7848920e-06 -2.5156778e-04 -9.4728527e-04 3.4519241e-04
1.5125292e-03 1.6610813e-04]
<NDArray 10 @cpu(0)>}
[11/11/2020 14:51:26 INFO 140470689392448] nvidia-smi took: 0.0251970291138 s
ecs to identify 0 gpus
[11/11/2020 14:51:26 INFO 140470689392448] Number of GPUs being used: 0
#metrics {"Metrics": {"Max Batches Seen Between Resets": {"count": 1, "max":
1, "sum": 1.0, "min": 1}, "Number of Batches Since Last Reset": {"count": 1,
"max": 0, "sum": 0.0, "min": 0}, "Number of Records Since Last Reset": {"coun
t": 1, "max": 0, "sum": 0.0, "min": 0}, "Total Batches Seen": {"count": 1, "m
ax": 2, "sum": 2.0, "min": 2}, "Total Records Seen": {"count": 1, "max": 706,
"sum": 706.0, "min": 706}, "Max Records Seen Between Resets": {"count": 1, "m
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[2020-11-11 14:51:26.286] [tensorio] [info] epoch_stats={"data_pipeline": "/o
pt/ml/input/data/train", "epoch": 4, "duration": 52, "num_examples": 1, "num_
bytes": 29652}
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6.286285}

#metrics {"Metrics": {"train_mse_objective": {"count": 1, "max": 1.0413810578
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06286.286506, "Dimensions": {"model": 1, "Host": "algo-1", "Operation": "trai
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6485}

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```

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```
[11/11/2020 14:51:26 INFO 140470689392448] #quality_metric: host=algo-1, epoch=0, train mse_objective <loss>=0.882497900944
```

```
[2020-11-11 14:51:26.316] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/validation", "epoch": 0, "duration": 265, "num_examples": 1, "num_bytes": 3780}
```

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[2020-11-11 14:51:26.327] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/validation", "epoch": 2, "duration": 10, "num_examples": 1, "num_bytes": 3780}
```

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106286.334419}

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```

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```

```
[11/11/2020 14:51:26 INFO 140470689392448] #quality_metric: host=algo-1, epoc
h=0, validation mse_objective <loss>=4527.68298611
```

```
[11/11/2020 14:51:26 INFO 140470689392448] #early_stopping_criteria_metric: h
ost=algo-1, epoch=0, criteria=mse_objective, value=3479.50694444
```

```
[11/11/2020 14:51:26 INFO 140470689392448] Epoch 0: Loss improved. Updating b
est model
```

```
[11/11/2020 14:51:26 INFO 140470689392448] Saving model for epoch: 0
```

```
[11/11/2020 14:51:26 INFO 140470689392448] Saved checkpoint to "/tmp/tmpSzWk3
V/mx-mod-0000.params"
```

```
[11/11/2020 14:51:26 INFO 140470689392448] #progress_metric: host=algo-1, com
pleted 6 % of epochs
```

```
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```
[11/11/2020 14:51:26 INFO 140470689392448] #throughput_metric: host=algo-1, train throughput=3073.52200015 records/second
```

```
[2020-11-11 14:51:26.375] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/train", "epoch": 6, "duration": 26, "num_examples": 1, "num_bytes": 29652}
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```

```
[11/11/2020 14:51:26 INFO 140470689392448] #quality_metric: host=algo-1, epoch=1, train mse_objective <loss>=0.857183180855
```

```
[2020-11-11 14:51:26.418] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/validation", "epoch": 5, "duration": 15, "num_examples": 1, "num_bytes": 3780}
```

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```

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```

```
[11/11/2020 14:51:26 INFO 140470689392448] #quality_metric: host=algo-1, epoch=1, validation mse_objective <loss>=4313.40486111
```

```
[11/11/2020 14:51:26 INFO 140470689392448] #early_stopping_criteria_metric: host=algo-1, epoch=1, criteria=mse_objective, value=3881.71527778
```

```
[11/11/2020 14:51:26 INFO 140470689392448] Saving model for epoch: 1
```

```
[11/11/2020 14:51:26 INFO 140470689392448] Saved checkpoint to "/tmp/tmpaFg6p1/mx-mod-0000.params"
```

```
[11/11/2020 14:51:26 INFO 140470689392448] #progress_metric: host=algo-1, completed 13 % of epochs
```

```
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[11/11/2020 14:51:26 INFO 140470689392448] #throughput_metric: host=algo-1, train throughput=4013.32901078 records/second
```

```
[2020-11-11 14:51:26.460] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/train", "epoch": 8, "duration": 23, "num_examples": 1, "num_bytes": 29652}
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```

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[11/11/2020 14:51:26 INFO 140470689392448] #quality_metric: host=algo-1, epoch=2, train mse_objective <loss>=0.834303901824
[2020-11-11 14:51:26.509] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/validation", "epoch": 8, "duration": 13, "num_examples": 1, "num_bytes": 3780}
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[11/11/2020 14:51:26 INFO 140470689392448] #quality_metric: host=algo-1, epoc
h=2, validation mse_objective <loss>=4231.10208333
```

```
[11/11/2020 14:51:26 INFO 140470689392448] #early_stopping_criteria_metric: h
ost=algo-1, epoch=2, criteria=mse_objective, value=2731.68246528
```

```
[11/11/2020 14:51:26 INFO 140470689392448] Epoch 2: Loss improved. Updating b
est model
```

```
[11/11/2020 14:51:26 INFO 140470689392448] Saving model for epoch: 2
```

```
[11/11/2020 14:51:26 INFO 140470689392448] Saved checkpoint to "/tmp/tmpnJ5eE
h/mx-mod-0000.params"
```

```
[11/11/2020 14:51:26 INFO 140470689392448] #progress_metric: host=algo-1, com
pleted 20 % of epochs
```

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[11/11/2020 14:51:26 INFO 140470689392448] #throughput_metric: host=algo-1, t
rain throughput=3671.88705009 records/second
```

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[2020-11-11 14:51:26.565] [tensorio] [info] epoch_stats={"data_pipeline": "/o
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#metrics {"Metrics": {"train_mse_objective": {"count": 1, "max": 0.9456643598950956, "sum": 0.9456643598950956, "min": 0.9456643598950956}}, "EndTime": 1605106286.56782, "Dimensions": {"model": 30, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605106286.567801}
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```

```
[11/11/2020 14:51:26 INFO 140470689392448] #quality_metric: host=algo-1, epoch=3, train mse_objective <loss>=0.811312840275
```

```
[2020-11-11 14:51:26.609] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/validation", "epoch": 11, "duration": 13, "num_examples": 1, "num_bytes": 3780}
```

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#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 4166.65625, "sum": 4166.65625, "min": 4166.65625}}, "EndTime": 1605106286.660769, "Dimensions": {"model": 0, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605106286.660687}
```

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```

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```

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#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 4573.750347222222, "sum": 4573.750347222222, "min": 4573.750347222222}}, "EndTime": 1605106286.661128, "Dimensions": {"model": 5, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605106286.661111}
```

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```

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#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 4392.235069444445, "sum": 4392.235069444445, "min": 4392.235069444445}}, "EndTime": 1605106286.661248, "Dimensions": {"model": 7, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605106286.661231}
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```

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```

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```

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```

```
[11/11/2020 14:51:26 INFO 140470689392448] #quality_metric: host=algo-1, epoch=3, validation mse_objective <loss>=4166.65625
```

```
[11/11/2020 14:51:26 INFO 140470689392448] #early_stopping_criteria_metric: host=algo-1, epoch=3, criteria=mse_objective, value=3717.10833333
```

```
[11/11/2020 14:51:26 INFO 140470689392448] Saving model for epoch: 3
```

```
[11/11/2020 14:51:26 INFO 140470689392448] Saved checkpoint to "/tmp/tmpvAQBym/mx-mod-0000.params"
```

```
[11/11/2020 14:51:26 INFO 140470689392448] #progress_metric: host=algo-1, completed 26 % of epochs
#metrics {"Metrics": {"Max Batches Seen Between Resets": {"count": 1, "max": 1, "sum": 1.0, "min": 1}, "Number of Batches Since Last Reset": {"count": 1, "max": 1, "sum": 1.0, "min": 1}, "Number of Records Since Last Reset": {"count": 1, "max": 353, "sum": 353.0, "min": 353}, "Total Batches Seen": {"count": 1, "max": 6, "sum": 6.0, "min": 6}, "Total Records Seen": {"count": 1, "max": 2118, "sum": 2118.0, "min": 2118}, "Max Records Seen Between Resets": {"count": 1, "max": 353, "sum": 353.0, "min": 353}, "Reset Count": {"count": 1, "max": 6, "sum": 6.0, "min": 6}}, "EndTime": 1605106286.669736, "Dimensions": {"Host": "algo-1", "Meta": "training_data_iter", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 3}, "StartTime": 1605106286.53304}
```

```
[11/11/2020 14:51:26 INFO 140470689392448] #throughput_metric: host=algo-1, train throughput=2579.61713508 records/second
```

```
[2020-11-11 14:51:26.699] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/train", "epoch": 12, "duration": 29, "num_examples": 1, "num_bytes": 29652}
```

```
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```

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```

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```

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```

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```

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```

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```

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06023}
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```

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[11/11/2020 14:51:26 INFO 140470689392448] #quality_metric: host=algo-1, epoch=4, train mse_objective <loss>=0.791005596561  
[2020-11-11 14:51:26.770] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/validation", "epoch": 14, "duration": 20, "num_examples": 1, "num_bytes": 3780}
```

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#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 5208.367013888889, "sum": 5208.367013888889, "min": 5208.367013888889}}, "EndTime": 1605106286.783108, "Dimensions": {"model": 23, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 4}, "StartTime": 1605106286.78309}
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#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 5280.473263888889, "sum": 5280.473263888889, "min": 5280.473263888889}}, "EndTime": 1605106286.783228, "Dimensions": {"model": 25, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 4}, "StartTime": 1605106286.783212}
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```

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#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 6217.321527777778, "sum": 6217.321527777778, "min": 6217.321527777778}}, "EndTime": 1605106286.783346, "Dimensions": {"model": 27, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 4}, "StartTime": 1605106286.783331}
```

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```

```
[11/11/2020 14:51:26 INFO 140470689392448] #quality_metric: host=algo-1, epoch=4, validation mse_objective <loss>=4065.54618056
```

```
[11/11/2020 14:51:26 INFO 140470689392448] #early_stopping_criteria_metric: host=algo-1, epoch=4, criteria=mse_objective, value=3615.76041667
```

```
[11/11/2020 14:51:26 INFO 140470689392448] Saving model for epoch: 4
```

```
[11/11/2020 14:51:26 INFO 140470689392448] Saved checkpoint to "/tmp/tmpRGJNFx/mx-mod-0000.params"
```

```
[11/11/2020 14:51:26 INFO 140470689392448] #progress_metric: host=algo-1, completed 33 % of epochs
```

```
#metrics {"Metrics": {"Max Batches Seen Between Resets": {"count": 1, "max": 1, "sum": 1.0, "min": 1}, "Number of Batches Since Last Reset": {"count": 1, "max": 1, "sum": 1.0, "min": 1}, "Number of Records Since Last Reset": {"count": 1, "max": 353, "sum": 353.0, "min": 353}, "Total Batches Seen": {"count": 1, "max": 7, "sum": 7.0, "min": 7}, "Total Records Seen": {"count": 1, "max": 2471, "sum": 2471.0, "min": 2471}, "Max Records Seen Between Resets": {"count": 1, "max": 353, "sum": 353.0, "min": 353}, "Reset Count": {"count": 1, "max": 7, "sum": 7.0, "min": 7}}, "EndTime": 1605106286.790756, "Dimensions": {"Host": "algo-1", "Meta": "training_data_iter", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 4}, "StartTime": 1605106286.670052}
```

```
[11/11/2020 14:51:26 INFO 140470689392448] #throughput_metric: host=algo-1, train throughput=2921.02619788 records/second
```

```
[2020-11-11 14:51:26.825] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/train", "epoch": 14, "duration": 34, "num_examples": 1, "num_bytes": 29652}
```

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```

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```

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```

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```

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```

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```

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```

```
[11/11/2020 14:51:26 INFO 140470689392448] #quality_metric: host=algo-1, epoch=5, train mse_objective <loss>=0.771788945617
[2020-11-11 14:51:26.881] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/validation", "epoch": 17, "duration": 12, "num_examples": 1, "num_bytes": 3780}
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#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 3571.1086805555556, "sum": 3571.1086805555556, "min": 3571.1086805555556}}, "EndTime": 1605106286.892311, "Dimensions": {"model": 2, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 5}, "StartTime": 1605106286.892288}

#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 5417.983333333334, "sum": 5417.983333333334, "min": 5417.983333333334}}, "EndTime": 1605106286.89239, "Dimensions": {"model": 3, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 5}, "StartTime": 1605106286.89237}

#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 4181.2586805555556, "sum": 4181.2586805555556, "min": 4181.2586805555556}}, "EndTime": 1605106286.892456, "Dimensions": {"model": 4, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 5}, "StartTime": 1605106286.892439}

#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 4132.9989583333334, "sum": 4132.9989583333334, "min": 4132.9989583333334}}, "EndTime": 1605106286.89251, "Dimensions": {"model": 5, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 5}, "StartTime": 1605106286.892497}

#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 4100.3805555555555, "sum": 4100.3805555555555, "min": 4100.3805555555555}}, "EndTime": 1605106286.892561, "Dimensions": {"model": 6, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 5}, "StartTime": 1605106286.892547}

#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 4147.226041666667, "sum": 4147.226041666667, "min": 4147.226041666667}}, "EndTime": 1605106286.892614, "Dimensions": {"model": 7, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 5}, "StartTime": 1605106286.892599}

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```

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#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 5476.9170138888885, "sum": 5476.9170138888885, "min": 5476.9170138888885}}, "EndTime": 1605106286.892764, "Dimensions": {"model": 10, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 5}, "StartTime": 1605106286.892755}
```

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```

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```

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```

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```

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```

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```

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#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 3728.0989583333335, "sum": 3728.0989583333335, "min": 3728.0989583333335}}, "EndTime": 1605106286.893511, "Dimensions": {"model": 22, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 5}, "StartTime": 1605106286.893494}
```

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```

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```

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```

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```
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```

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```

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```

```
[11/11/2020 14:51:26 INFO 140470689392448] #quality_metric: host=algo-1, epoch=5, validation mse_objective <loss>=3938.95138889
```

```
[11/11/2020 14:51:26 INFO 140470689392448] #early_stopping_criteria_metric: host=algo-1, epoch=5, criteria=mse_objective, value=3496.76666667
```

```
[11/11/2020 14:51:26 INFO 140470689392448] Saving model for epoch: 5
```

```
[11/11/2020 14:51:26 INFO 140470689392448] Saved checkpoint to "/tmp/tmpmhldaI/mx-mod-0000.params"
```

```
[11/11/2020 14:51:26 INFO 140470689392448] #progress_metric: host=algo-1, completed 40 % of epochs
```

```
#metrics {"Metrics": {"Max Batches Seen Between Resets": {"count": 1, "max": 1, "sum": 1.0, "min": 1}, "Number of Batches Since Last Reset": {"count": 1, "max": 1, "sum": 1.0, "min": 1}, "Number of Records Since Last Reset": {"count": 1, "max": 353, "sum": 353.0, "min": 353}, "Total Batches Seen": {"count": 1, "max": 8, "sum": 8.0, "min": 8}, "Total Records Seen": {"count": 1, "max": 2824, "sum": 2824.0, "min": 2824}, "Max Records Seen Between Resets": {"count": 1, "max": 353, "sum": 353.0, "min": 353}, "Reset Count": {"count": 1, "max": 8, "sum": 8.0, "min": 8}}, "EndTime": 1605106286.917722, "Dimensions": {"Host": "algo-1", "Meta": "training_data_iter", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 5}, "StartTime": 1605106286.791073}
```

```
[11/11/2020 14:51:26 INFO 140470689392448] #throughput_metric: host=algo-1, train throughput=2783.49688391 records/second
```

```
[2020-11-11 14:51:26.959] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/train", "epoch": 16, "duration": 41, "num_examples": 1, "num_bytes": 29652}
```

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#metrics {"Metrics": {"train_mse_objective": {"count": 1, "max": 0.7531553273835871, "sum": 0.7531553273835871, "min": 0.7531553273835871}}, "EndTime": 1605106286.960207, "Dimensions": {"model": 0, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 6}, "StartTime": 160510628
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6.960031}

```
#metrics {"Metrics": {"train_mse_objective": {"count": 1, "max": 0.8541185416851098, "sum": 0.8541185416851098, "min": 0.8541185416851098}}, "EndTime": 1605106286.960515, "Dimensions": {"model": 1, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 6}, "StartTime": 1605106286.960442}
```

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```

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```

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```

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[11/11/2020 14:51:26 INFO 140470689392448] #quality_metric: host=algo-1, epoch=6, train mse_objective <loss>=0.753155327384
```

```
[2020-11-11 14:51:27.016] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/validation", "epoch": 20, "duration": 16, "num_examples": 1, "num_bytes": 3780}
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```

```
[11/11/2020 14:51:27 INFO 140470689392448] #quality_metric: host=algo-1, epoch=6, validation mse_objective <loss>=3811.92326389
```

```
[11/11/2020 14:51:27 INFO 140470689392448] #early_stopping_criteria_metric: host=algo-1, epoch=6, criteria=mse_objective, value=2919.98402778
```

```
[11/11/2020 14:51:27 INFO 140470689392448] Epoch 6: Loss has not improved for 0 epochs.
```

```
[11/11/2020 14:51:27 INFO 140470689392448] Saving model for epoch: 6
```

```
[11/11/2020 14:51:27 INFO 140470689392448] Saved checkpoint to "/tmp/tmp_CxSP/mx-mod-0000.params"
```

```
[11/11/2020 14:51:27 INFO 140470689392448] #progress_metric: host=algo-1, completed 46 % of epochs
#metrics {"Metrics": {"Max Batches Seen Between Resets": {"count": 1, "max": 1, "sum": 1.0, "min": 1}, "Number of Batches Since Last Reset": {"count": 1, "max": 1, "sum": 1.0, "min": 1}, "Number of Records Since Last Reset": {"count": 1, "max": 353, "sum": 353.0, "min": 353}, "Total Batches Seen": {"count": 1, "max": 9, "sum": 9.0, "min": 9}, "Total Records Seen": {"count": 1, "max": 3177, "sum": 3177.0, "min": 3177}, "Max Records Seen Between Resets": {"count": 1, "max": 353, "sum": 353.0, "min": 353}, "Reset Count": {"count": 1, "max": 9, "sum": 9.0, "min": 9}}, "EndTime": 1605106287.036251, "Dimensions": {"Host": "algo-1", "Meta": "training_data_iter", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 6}, "StartTime": 1605106286.918064}
```

```
[11/11/2020 14:51:27 INFO 140470689392448] #throughput_metric: host=algo-1, train throughput=2982.80395266 records/second
```

```
[2020-11-11 14:51:27.068] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/train", "epoch": 18, "duration": 30, "num_examples": 1, "num_bytes": 29652}
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[11/11/2020 14:51:27 INFO 140470689392448] #quality_metric: host=algo-1, epoch=7, train mse_objective <loss>=0.735824801091
```

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[2020-11-11 14:51:27.122] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/validation", "epoch": 23, "duration": 13, "num_examples": 1, "num_bytes": 3780}
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#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 6406.707638888889, "sum": 6406.707638888889, "min": 6406.707638888889}}, "EndTime": 1605106287.136092, "Dimensions": {"model": 29, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 7}, "StartTime": 1605106287.136075}
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```

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```

```
[11/11/2020 14:51:27 INFO 140470689392448] #quality_metric: host=algo-1, epoch=7, validation mse_objective <loss>=3703.09166667
```

```
[11/11/2020 14:51:27 INFO 140470689392448] #early_stopping_criteria_metric: host=algo-1, epoch=7, criteria=mse_objective, value=3009.81666667
```

```
[11/11/2020 14:51:27 INFO 140470689392448] Saving model for epoch: 7
```

```
[11/11/2020 14:51:27 INFO 140470689392448] Saved checkpoint to "/tmp/tmpqe2_hu/mx-mod-0000.params"
```

```
[11/11/2020 14:51:27 INFO 140470689392448] #progress_metric: host=algo-1, completed 53 % of epochs
```

```
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```

```
[11/11/2020 14:51:27 INFO 140470689392448] #throughput_metric: host=algo-1, train throughput=3272.03504104 records/second
```

```
[2020-11-11 14:51:27.171] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/train", "epoch": 20, "duration": 26, "num_examples": 1, "num_bytes": 29652}
```

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```

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```

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```

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```

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```

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```

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```

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```

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```

```
[11/11/2020 14:51:27 INFO 140470689392448] #quality_metric: host=algo-1, epoch=8, train mse_objective <loss>=0.719829526907
```

```
[2020-11-11 14:51:27.219] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/validation", "epoch": 26, "duration": 18, "num_examples": 1, "num_bytes": 3780}
```

```
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```

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```

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```

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```

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```

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```

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```

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```

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#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 3157.5152777777776, "sum": 3157.5152777777776, "min": 3157.5152777777776}}, "EndTime": 1605106287.229556, "Dimensions": {"model": 21, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605106287.229551}
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```

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```

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#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 5325.6125, "sum": 5325.6125, "min": 5325.6125}}, "EndTime": 1605106287.229709, "Dimensions": {"model": 26, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605106287.229701}
```

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```

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```

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#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 6930.615277777778, "sum": 6930.615277777778, "min": 6930.615277777778}}, "EndTime": 1605106287.229801, "Dimensions": {"model": 29, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605106287.229792}
```

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```

```
[11/11/2020 14:51:27 INFO 140470689392448] #quality_metric: host=algo-1, epoch=8, validation mse_objective <loss>=3619.72534722
```

```
[11/11/2020 14:51:27 INFO 140470689392448] #early_stopping_criteria_metric: host=algo-1, epoch=8, criteria=mse_objective, value=3018.25659722
```

```
[11/11/2020 14:51:27 INFO 140470689392448] Saving model for epoch: 8
```

```
[11/11/2020 14:51:27 INFO 140470689392448] Saved checkpoint to "/tmp/tmpCeOStz/mx-mod-0000.params"
```

```
[11/11/2020 14:51:27 INFO 140470689392448] #progress_metric: host=algo-1, completed 60 % of epochs
```

```
#metrics {"Metrics": {"Max Batches Seen Between Resets": {"count": 1, "max": 1, "sum": 1.0, "min": 1}, "Number of Batches Since Last Reset": {"count": 1, "max": 1, "sum": 1.0, "min": 1}, "Number of Records Since Last Reset": {"count": 1, "max": 353, "sum": 353.0, "min": 353}, "Total Batches Seen": {"count": 1, "max": 11, "sum": 11.0, "min": 11}, "Total Records Seen": {"count": 1, "max": 3883, "sum": 3883.0, "min": 3883}, "Max Records Seen Between Resets": {"count": 1, "max": 353, "sum": 353.0, "min": 353}, "Reset Count": {"count": 1, "max": 11, "sum": 11.0, "min": 11}}, "EndTime": 1605106287.2369, "Dimensions": {"Host": "algo-1", "Meta": "training_data_iter", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 8}, "StartTime": 1605106287.144626}
```

```
[11/11/2020 14:51:27 INFO 140470689392448] #throughput_metric: host=algo-1, train throughput=3820.47141335 records/second
```

```
[2020-11-11 14:51:27.263] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/train", "epoch": 22, "duration": 26, "num_examples": 1, "num_bytes": 29652}
```

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```

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```

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```

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```

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```

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```

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```

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```

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```

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```

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287.264765}

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```

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```

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```

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#metrics {"Metrics": {"train_mse_objective": {"count": 1, "max": 0.6815220559960384, "sum": 0.6815220559960384, "min": 0.6815220559960384}}, "EndTime": 1605106287.26496, "Dimensions": {"model": 22, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 9}, "StartTime": 1605106287.264948}
```

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```

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```

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```

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```

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```

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```

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```

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```

```
[11/11/2020 14:51:27 INFO 140470689392448] #quality_metric: host=algo-1, epoch=9, train mse_objective <loss>=0.704574109475
```

```
[2020-11-11 14:51:27.307] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/validation", "epoch": 29, "duration": 12, "num_examples": 1, "num_bytes": 3780}
```

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#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 3557.3680555555557, "sum": 3557.3680555555557, "min": 3557.3680555555557}}, "EndTime": 1605106287.316131, "Dimensions": {"model": 0, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 9}, "StartTime": 1605106287.316057}
```

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```

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```

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```

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```

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```

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```

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```

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```

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```

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```

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```
[11/11/2020 14:51:27 INFO 140470689392448] #quality_metric: host=algo-1, epoc  
h=9, validation mse_objective <loss>=3557.36805556
```

```
[11/11/2020 14:51:27 INFO 140470689392448] #early_stopping_criteria_metric: h  
ost=algo-1, epoch=9, criteria=mse_objective, value=2720.19270833
```

```
[11/11/2020 14:51:27 INFO 140470689392448] Epoch 9: Loss improved. Updating b  
est model
```

```
[11/11/2020 14:51:27 INFO 140470689392448] Saving model for epoch: 9
```

```
[11/11/2020 14:51:27 INFO 140470689392448] Saved checkpoint to "/tmp/tmpbrVm_  
k/mx-mod-0000.params"
```

```
[11/11/2020 14:51:27 INFO 140470689392448] #progress_metric: host=algo-1, completed 66 % of epochs
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[11/11/2020 14:51:27 INFO 140470689392448] #throughput_metric: host=algo-1, train throughput=3896.62605437 records/second
[2020-11-11 14:51:27.354] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/train", "epoch": 24, "duration": 26, "num_examples": 1, "num_bytes": 29652}
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```
[11/11/2020 14:51:27 INFO 140470689392448] #quality_metric: host=algo-1, epoch=10, train mse_objective <loss>=0.689932847496
```

```
[2020-11-11 14:51:27.397] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/validation", "epoch": 32, "duration": 13, "num_examples": 1, "num_bytes": 3780}
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[11/11/2020 14:51:27 INFO 140470689392448] #quality_metric: host=algo-1, epoch=10, validation mse_objective <loss>=3508.65555556
```

```
[11/11/2020 14:51:27 INFO 140470689392448] #early_stopping_criteria_metric: host=algo-1, epoch=10, criteria=mse_objective, value=2774.73802083
```

```
[11/11/2020 14:51:27 INFO 140470689392448] Saving model for epoch: 10
```

```
[11/11/2020 14:51:27 INFO 140470689392448] Saved checkpoint to "/tmp/tmpqmEtE0/mx-mod-0000.params"
```

```
[11/11/2020 14:51:27 INFO 140470689392448] #progress_metric: host=algo-1, completed 73 % of epochs
```

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```

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[11/11/2020 14:51:27 INFO 140470689392448] #throughput_metric: host=algo-1, train throughput=3905.51701653 records/second
```

```
[2020-11-11 14:51:27.445] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/train", "epoch": 26, "duration": 26, "num_examples": 1, "num_bytes": 29652}
```

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```

```
[11/11/2020 14:51:27 INFO 140470689392448] #quality_metric: host=algo-1, epoc  
h=11, train mse_objective <loss>=0.676324039276
```

```
[2020-11-11 14:51:27.494] [tensorio] [info] epoch_stats={"data_pipeline": "/o  
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```

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```

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```

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```

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```

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```

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```

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```

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```

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```

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```

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```

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```

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```

```
[11/11/2020 14:51:27 INFO 140470689392448] #quality_metric: host=algo-1, epoch=11, validation mse_objective <loss>=3463.02673611
```

```
[11/11/2020 14:51:27 INFO 140470689392448] #early_stopping_criteria_metric: host=algo-1, epoch=11, criteria=mse_objective, value=3114.77083333
```

```
[11/11/2020 14:51:27 INFO 140470689392448] Saving model for epoch: 11
```

```
[11/11/2020 14:51:27 INFO 140470689392448] Saved checkpoint to "/tmp/tmpJiw0Cn/mx-mod-0000.params"
```

```
[11/11/2020 14:51:27 INFO 140470689392448] #progress_metric: host=algo-1, completed 80 % of epochs
```

```
#metrics {"Metrics": {"Max Batches Seen Between Resets": {"count": 1, "max": 1, "sum": 1.0, "min": 1}, "Number of Batches Since Last Reset": {"count": 1, "max": 1, "sum": 1.0, "min": 1}, "Number of Records Since Last Reset": {"count": 1, "max": 353, "sum": 353.0, "min": 353}, "Total Batches Seen": {"count": 1, "max": 14, "sum": 14.0, "min": 14}, "Total Records Seen": {"count": 1, "max": 4942, "sum": 4942.0, "min": 4942}, "Max Records Seen Between Resets": {"count": 1, "max": 353, "sum": 353.0, "min": 353}, "Reset Count": {"count": 1, "max": 14, "sum": 14.0, "min": 14}}, "EndTime": 1605106287.515465, "Dimensions": {"Host": "algo-1", "Meta": "training_data_iter", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 11}, "StartTime": 1605106287.418526}
```

```
[11/11/2020 14:51:27 INFO 140470689392448] #throughput_metric: host=algo-1, train throughput=3635.98911602 records/second
```

```
[2020-11-11 14:51:27.547] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/train", "epoch": 28, "duration": 31, "num_examples": 1, "num_bytes": 29652}
```

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```

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7.548569}

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```

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```

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```

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```

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```

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```

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```

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```

```
[11/11/2020 14:51:27 INFO 140470689392448] #quality_metric: host=algo-1, epoc  
h=12, train mse_objective <loss>=0.663679819945
```

```
[2020-11-11 14:51:27.595] [tensorio] [info] epoch_stats={"data_pipeline": "/o  
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```

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```

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```

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```

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```

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```

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```

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```

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```

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```

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```

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```

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```

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```

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```

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```

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#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 4314.3069444444445, "sum": 4314.3069444444445, "min": 4314.3069444444445}}, "EndTime": 1605106287.60935, "Dimensions": {"model": 22, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605106287.609333}
```

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#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 3717.9861111111113, "sum": 3717.9861111111113, "min": 3717.9861111111113}}, "EndTime": 1605106287.609424, "Dimensions": {"model": 23, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605106287.609404}
```

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```

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```

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```

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#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 5349.880555555555, "sum": 5349.880555555555, "min": 5349.880555555555}}, "EndTime": 1605106287.609695, "Dimensions": {"model": 27, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605106287.609676}
```

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```

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```

```
[11/11/2020 14:51:27 INFO 140470689392448] #quality_metric: host=algo-1, epoch=12, validation mse_objective <loss>=3410.73819444
```

```
[11/11/2020 14:51:27 INFO 140470689392448] #early_stopping_criteria_metric: host=algo-1, epoch=12, criteria=mse_objective, value=3086.50173611
```

```
[11/11/2020 14:51:27 INFO 140470689392448] Saving model for epoch: 12
```

```
[11/11/2020 14:51:27 INFO 140470689392448] Saved checkpoint to "/tmp/tmp8UupMd/mx-mod-0000.params"
```

```
[11/11/2020 14:51:27 INFO 140470689392448] #progress_metric: host=algo-1, com
```

```
pleted 86 % of epochs
#metrics {"Metrics": {"Max Batches Seen Between Resets": {"count": 1, "max": 1, "sum": 1.0, "min": 1}, "Number of Batches Since Last Reset": {"count": 1, "max": 1, "sum": 1.0, "min": 1}, "Number of Records Since Last Reset": {"count": 1, "max": 353, "sum": 353.0, "min": 353}, "Total Batches Seen": {"count": 1, "max": 15, "sum": 15.0, "min": 15}, "Total Records Seen": {"count": 1, "max": 5295, "sum": 5295.0, "min": 5295}, "Max Records Seen Between Resets": {"count": 1, "max": 353, "sum": 353.0, "min": 353}, "Reset Count": {"count": 1, "max": 15, "sum": 15.0, "min": 15}}, "EndTime": 1605106287.618397, "Dimensions": {"Host": "algo-1", "Meta": "training_data_iter", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 12}, "StartTime": 1605106287.515784}
```

```
[11/11/2020 14:51:27 INFO 140470689392448] #throughput_metric: host=algo-1, train throughput=3434.98698937 records/second
```

```
[2020-11-11 14:51:27.645] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/train", "epoch": 30, "duration": 26, "num_examples": 1, "num_bytes": 29652}
```

```
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```

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```

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6287.646401}

```
#metrics {"Metrics": {"train_mse_objective": {"count": 1, "max": 0.7106176273680949, "sum": 0.7106176273680949, "min": 0.7106176273680949}}, "EndTime": 1605106287.646485, "Dimensions": {"model": 16, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605106287.646466}
```

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```

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```

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```

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```

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```

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```

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```

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```

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```

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#metrics {"Metrics": {"train_mse_objective": {"count": 1, "max": 0.9749734246359331, "sum": 0.9749734246359331, "min": 0.9749734246359331}}, "EndTime": 1605106287.647195, "Dimensions": {"model": 27, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605106287.647178}
```

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#metrics {"Metrics": {"train_mse_objective": {"count": 1, "max": 1.0701905161395626, "sum": 1.0701905161395626, "min": 1.0701905161395626}}, "EndTime": 1605106287.647259, "Dimensions": {"model": 28, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605106287.647241}
```

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```

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```

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```

```
[11/11/2020 14:51:27 INFO 140470689392448] #quality_metric: host=algo-1, epoch=13, train mse_objective <loss>=0.651742259774
```

```
[2020-11-11 14:51:27.709] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/validation", "epoch": 41, "duration": 17, "num_examples": 1, "num_bytes": 3780}
```

```
#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 3349.056597222222, "sum": 3349.056597222222, "min": 3349.056597222222}}, "EndTime": 1605106287.722199, "Dimensions": {"model": 0, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605106287.722085}
```

```
#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 3489.354861111111, "sum": 3489.354861111111, "min": 3489.354861111111}}, "EndTime": 1605106287.722327, "Dimensions": {"model": 1, "Host": "algo-1", "Operation":
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```
"training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605106287.722305}
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```
#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 3076.8777777777777, "sum": 3076.8777777777777, "min": 3076.8777777777777}}, "EndTime": 1605106287.722451, "Dimensions": {"model": 2, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605106287.722426}
```

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#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 4312.8847222222222, "sum": 4312.8847222222222, "min": 4312.8847222222222}}, "EndTime": 1605106287.722538, "Dimensions": {"model": 3, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605106287.72251}
```

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#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 3812.8125, "sum": 3812.8125, "min": 3812.8125}}, "EndTime": 1605106287.722603, "Dimensions": {"model": 4, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605106287.722585}
```

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#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 4004.3479166666666, "sum": 4004.3479166666666, "min": 4004.3479166666666}}, "EndTime": 1605106287.722664, "Dimensions": {"model": 5, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605106287.722647}
```

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#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 3985.2260416666667, "sum": 3985.2260416666667, "min": 3985.2260416666667}}, "EndTime": 1605106287.722732, "Dimensions": {"model": 6, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605106287.722713}
```

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#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 4068.7069444444446, "sum": 4068.7069444444446, "min": 4068.7069444444446}}, "EndTime": 1605106287.722803, "Dimensions": {"model": 7, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605106287.722785}
```

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#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 3977.5736111111111, "sum": 3977.5736111111111, "min": 3977.5736111111111}}, "EndTime": 1605106287.722865, "Dimensions": {"model": 8, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605106287.72285}
```

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#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 3996.0673611111111, "sum": 3996.0673611111111, "min": 3996.0673611111111}}, "EndTime": 1605106287.722922, "Dimensions": {"model": 9, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605106287.722906}
```

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#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 4343.3104166666666, "sum": 4343.3104166666666, "min": 4343.3104166666666}}, "EndTime": 1605106287.722991, "Dimensions": {"model": 10, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605106287.722972}
```

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#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 4088.273611111111, "sum": 4088.273611111111, "min": 4088.273611111111}}, "EndTime": 1605106287.72306, "Dimensions": {"model": 11, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605106287.723041}
```

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```

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#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 3791.5138888888887, "sum": 3791.5138888888887, "min": 3791.5138888888887}}, "EndTime": 1605106287.723178, "Dimensions": {"model": 13, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605106287.723161}
```

```
#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 3828.0954861111113, "sum": 3828.0954861111113, "min": 3828.0954861111113}}, "EndTime": 1605106287.723243, "Dimensions": {"model": 14, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605106287.723225}
```

```
#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 4153.8909722222222, "sum": 4153.8909722222222, "min": 4153.8909722222222}}, "EndTime": 1605106287.723311, "Dimensions": {"model": 15, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605106287.723293}
```

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#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 3686.1027777777776, "sum": 3686.1027777777776, "min": 3686.1027777777776}}, "EndTime": 1605106287.723376, "Dimensions": {"model": 16, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605106287.723358}
```

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#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 3051.9472222222222, "sum": 3051.9472222222222, "min": 3051.9472222222222}}, "EndTime": 1605106287.723437, "Dimensions": {"model": 17, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605106287.723421}
```

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```

```
#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 3455.4072916666667, "sum": 3455.4072916666667, "min": 3455.4072916666667}}, "EndTime": 1605106287.723561, "Dimensions": {"model": 19, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605106287.723543}
```

```
#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 3832.3701388888889, "sum": 3832.3701388888889, "min": 3832.3701388888889}}, "EndTime":
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```

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#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 3734.5256944444445, "sum": 3734.5256944444445, "min": 3734.5256944444445}}, "EndTime": 1605106287.723695, "Dimensions": {"model": 21, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605106287.723678}
```

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#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 4107.7711805555555, "sum": 4107.7711805555555, "min": 4107.7711805555555}}, "EndTime": 1605106287.723761, "Dimensions": {"model": 22, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605106287.723742}
```

```
#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 3493.246875, "sum": 3493.246875, "min": 3493.246875}}, "EndTime": 1605106287.723828, "Dimensions": {"model": 23, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605106287.723809}
```

```
#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 5344.692013888889, "sum": 5344.692013888889, "min": 5344.692013888889}}, "EndTime": 1605106287.72389, "Dimensions": {"model": 24, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605106287.723872}
```

```
#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 5410.409722222223, "sum": 5410.409722222223, "min": 5410.409722222223}}, "EndTime": 1605106287.723951, "Dimensions": {"model": 25, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605106287.723934}
```

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#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 5276.014583333334, "sum": 5276.014583333334, "min": 5276.014583333334}}, "EndTime": 1605106287.724019, "Dimensions": {"model": 26, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605106287.724}
```

```
#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 5293.860763888889, "sum": 5293.860763888889, "min": 5293.860763888889}}, "EndTime": 1605106287.72408, "Dimensions": {"model": 27, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605106287.724064}
```

```
#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 6524.6201388888885, "sum": 6524.6201388888885, "min": 6524.6201388888885}}, "EndTime": 1605106287.724139, "Dimensions": {"model": 28, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605106287.724123}
```

```
#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 5382.349652777778, "sum": 5382.349652777778, "min": 5382.349652777778}}, "EndTime": 1605106287.724232, "Dimensions": {"model": 29, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605106287.72421}
```

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#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 5857.740972222222, "sum": 5857.740972222222, "min": 5857.740972222222}}, "EndTime": 1605106287.724299, "Dimensions": {"model": 30, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605106287.724281}
```

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#metrics {"Metrics": {"validation_mse_objective": {"count": 1, "max": 6787.96875, "sum": 6787.96875, "min": 6787.96875}}, "EndTime": 1605106287.724363, "Dimensions": {"model": 31, "Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605106287.724347}
```

```
[11/11/2020 14:51:27 INFO 140470689392448] #quality_metric: host=algo-1, epoch=13, validation mse_objective <loss>=3349.05659722
```

```
[11/11/2020 14:51:27 INFO 140470689392448] #early_stopping_criteria_metric: host=algo-1, epoch=13, criteria=mse_objective, value=3051.94722222
```

```
[11/11/2020 14:51:27 INFO 140470689392448] Saving model for epoch: 13
```

```
[11/11/2020 14:51:27 INFO 140470689392448] Saved checkpoint to "/tmp/tmpxFLd7K/mx-mod-0000.params"
```

```
[11/11/2020 14:51:27 INFO 140470689392448] Early stop condition met. Stopping training.
```

```
[11/11/2020 14:51:27 INFO 140470689392448] #progress_metric: host=algo-1, completed 100 % epochs
```

```
#metrics {"Metrics": {"Max Batches Seen Between Resets": {"count": 1, "max": 1, "sum": 1.0, "min": 1}, "Number of Batches Since Last Reset": {"count": 1, "max": 1, "sum": 1.0, "min": 1}, "Number of Records Since Last Reset": {"count": 1, "max": 353, "sum": 353.0, "min": 353}, "Total Batches Seen": {"count": 1, "max": 16, "sum": 16.0, "min": 16}, "Total Records Seen": {"count": 1, "max": 5648, "sum": 5648.0, "min": 5648}, "Max Records Seen Between Resets": {"count": 1, "max": 353, "sum": 353.0, "min": 353}, "Reset Count": {"count": 1, "max": 16, "sum": 16.0, "min": 16}}, "EndTime": 1605106287.73461, "Dimensions": {"Host": "algo-1", "Meta": "training_data_iter", "Operation": "training", "Algorithm": "Linear Learner", "epoch": 13}, "StartTime": 1605106287.618718}
```

```
[11/11/2020 14:51:27 INFO 140470689392448] #throughput_metric: host=algo-1, train throughput=3042.02968908 records/second
```

```
[11/11/2020 14:51:27 WARNING 140470689392448] wait_for_all_workers will not sync workers since the kv store is not running distributed
```

```
[11/11/2020 14:51:27 WARNING 140470689392448] wait_for_all_workers will not sync workers since the kv store is not running distributed
```

```
[2020-11-11 14:51:27.799] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/validation", "epoch": 44, "duration": 19, "num_examples": 1, "num_bytes": 3780}
```

```
[11/11/2020 14:51:27 INFO 140470689392448] #early_stopping_criteria_metric: host=algo-1, epoch=13, criteria=mse_objective, value=3051.94722222
```

```
[2020-11-11 14:51:27.817] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/validation", "epoch": 46, "duration": 2, "num_examples": 1, "num_bytes": 3780}
```

```
[11/11/2020 14:51:27 INFO 140470689392448] #validation_score (algo-1) : ('mse_objective', 2720.1927083333335)
```

```
[11/11/2020 14:51:27 INFO 140470689392448] #validation_score (algo-1) : ('mse', 2720.1927083333335)
```

```
[11/11/2020 14:51:27 INFO 140470689392448] #validation_score (algo-1) : ('absolute_loss', 44.81302083333333)
```

```
[11/11/2020 14:51:27 INFO 140470689392448] #quality_metric: host=algo-1, validation mse_objective <loss>=2720.19270833
```

```

[11/11/2020 14:51:27 INFO 140470689392448] #quality_metric: host=algo-1, validation mse <loss>=2720.19270833
[11/11/2020 14:51:27 INFO 140470689392448] #quality_metric: host=algo-1, validation absolute_loss <loss>=44.8130208333
[11/11/2020 14:51:27 INFO 140470689392448] Best model found for hyperparameters: {"lr_scheduler_step": 10, "wd": 1, "optimizer": "adam", "lr_scheduler_factor": 0.99, "l1": 0.0, "learning_rate": 0.1, "lr_scheduler_minimum_lr": 1e-05}
[11/11/2020 14:51:27 INFO 140470689392448] Saved checkpoint to "/tmp/tmpooV5eB/mx-mod-0000.params"
[2020-11-11 14:51:27.823] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/test", "epoch": 0, "duration": 1771, "num_examples": 1, "num_bytes": 3696}
[2020-11-11 14:51:27.840] [tensorio] [info] epoch_stats={"data_pipeline": "/opt/ml/input/data/test", "epoch": 1, "duration": 17, "num_examples": 1, "num_bytes": 3696}
#metrics {"Metrics": {"Max Batches Seen Between Resets": {"count": 1, "max": 1, "sum": 1.0, "min": 1}, "Number of Batches Since Last Reset": {"count": 1, "max": 1, "sum": 1.0, "min": 1}, "Number of Records Since Last Reset": {"count": 1, "max": 44, "sum": 44.0, "min": 44}, "Total Batches Seen": {"count": 1, "max": 1, "sum": 1.0, "min": 1}, "Total Records Seen": {"count": 1, "max": 44, "sum": 44.0, "min": 44}, "Max Records Seen Between Resets": {"count": 1, "max": 44, "sum": 44.0, "min": 44}, "Reset Count": {"count": 1, "max": 1, "sum": 1.0, "min": 1}}, "EndTime": 1605106287.841217, "Dimensions": {"Host": "algo-1", "Meta": "test_data_iter", "Operation": "training", "Algorithm": "Linear Learner"}, "StartTime": 1605106287.823063}

[11/11/2020 14:51:27 INFO 140470689392448] #test_score (algo-1) : ('mse_objective', 3496.8938210227275)
[11/11/2020 14:51:27 INFO 140470689392448] #test_score (algo-1) : ('mse', 3496.8938210227275)
[11/11/2020 14:51:27 INFO 140470689392448] #test_score (algo-1) : ('absolute_loss', 47.56033602627841)
[11/11/2020 14:51:27 INFO 140470689392448] #quality_metric: host=algo-1, test mse_objective <loss>=3496.89382102
[11/11/2020 14:51:27 INFO 140470689392448] #quality_metric: host=algo-1, test mse <loss>=3496.89382102
[11/11/2020 14:51:27 INFO 140470689392448] #quality_metric: host=algo-1, test absolute_loss <loss>=47.5603360263
#metrics {"Metrics": {"totaltime": {"count": 1, "max": 2037.9700660705566, "sum": 2037.9700660705566, "min": 2037.9700660705566}, "finalize.time": {"count": 1, "max": 84.28311347961426, "sum": 84.28311347961426, "min": 84.28311347961426}, "initialize.time": {"count": 1, "max": 180.24706840515137, "sum": 180.24706840515137, "min": 180.24706840515137}, "check_early_stopping.time": {"count": 15, "max": 1.5909671783447266, "sum": 7.072210311889648, "min": 0.164031982421875}, "setuptime": {"count": 1, "max": 33.605098724365234, "sum": 33.605098724365234, "min": 33.605098724365234}, "update.time": {"count": 14, "max": 133.71014595031738, "sum": 1427.3040294647217, "min": 84.81478691101074}, "epochs": {"count": 1, "max": 15, "sum": 15.0, "min": 15}}, "EndTime": 1605106287.847419, "Dimensions": {"Host": "algo-1", "Operation": "training", "Algorithm": "Linear Learner"}, "StartTime": 1605106286.049067}

```

```

2020-11-11 14:51:38 Completed - Training job completed
Training seconds: 84
Billable seconds: 84

```

3. Evaluating the model

In this section, you will look at how your model performs with the test dataset.

Amazon SageMaker analytics

You can use `sagemaker.analytics` to get some performance metrics. This doesn't require deploying the model. Because this is a regression problem, you can check the **mean squared error**.

```
In [24]: sagemaker.analytics.TrainingJobAnalytics(regression_model._current_job_name,
                                                metric_names = ['test:mse']
                                                ).dataframe()
```

Out[24]:

	timestamp	metric_name	value
0	0.0	test:mse	3496.893821

Deploying the model

To deploy the model, run the following cell.

Note: This takes some time to complete. While you are waiting, think about the answer to question 2.

```
In [25]: regression_predictor = regression_model.deploy(initial_instance_count=1, instance_type='ml.m4.xlarge')
```

Defaulting to the only supported framework/algorithm version: 1. Ignoring framework/algorithm version: 1.

-----!

Question 2 - Calculate mean squared error

In this question, you will calculate the mean squared error. It is given by this equation:

$$\text{mean squared error} = \frac{1}{n} \sum_{t=1}^n (\text{pred}_t - \text{target}_t)^2$$

Calculate the mean squared error using the **preds** and **labels** variables and print it.

```
In [26]: import matplotlib.pyplot as plt

# Get predictions for each batch with size of 25
def predict_regression_batches(predictor, features, labels):
    prediction_batches = [predictor.predict(batch) for batch in np.array_split
                           (features, 25)]

    # Parse protobuf responses to extract predicted labels
    extract_score = lambda x: x.label['score'].float32_tensor.values
    preds = np.concatenate([np.array([extract_score(x) for x in batch]) for batch
                             in prediction_batches])
    preds = preds.reshape((-1,))

    # Calculate mean squared error
    mse = sum((preds - labels)**2) / len(preds)
    print(mse)

    return preds
```

Now, get the results on the training and test subsets.

```
In [27]: train_predictions = predict_regression_batches(regression_predictor, train_features,
                                                       train_labels)
```

```
3405.6895263421357
```

```
In [28]: test_predictions = predict_regression_batches(regression_predictor, test_features,
                                                       test_labels)
```

```
3496.893861337385
```

Plotting results

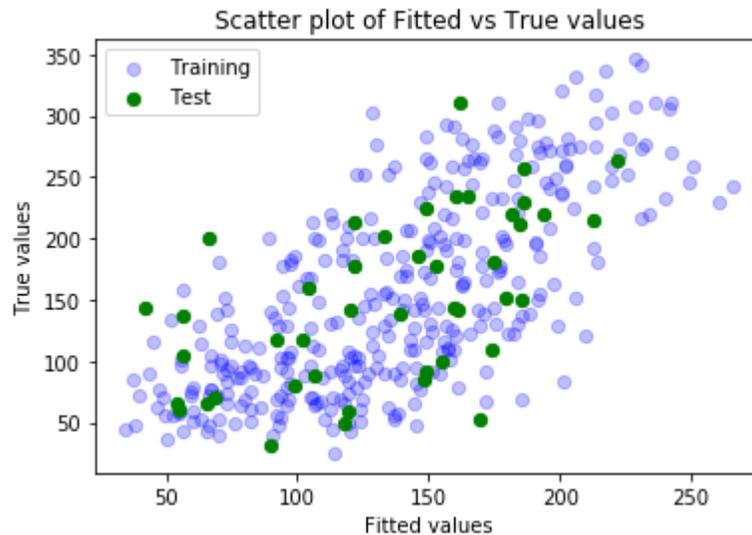
Let's look at some plots. Even though you calculated the mean squared error, it is still a good idea to examine the results visually.

Scatter plot

With the scatter plot, you look at the fitted (predicted) values vs. true values. From the following plot, you can see that the predicted and true values followed a similar pattern overall.

```
In [29]: import matplotlib.pyplot as plt
          %%matplotlib inline

          plt.scatter(train_predictions, train_labels, c='b', s=40, alpha=0.25, label='Training')
          plt.scatter(test_predictions, test_labels, c='g', s=40, label='Test')
          plt.title("Scatter plot of Fitted vs True values")
          plt.ylabel("True values")
          plt.xlabel("Fitted values")
          plt.legend(loc='best')
          plt.show()
```



Residual plot

Every data point has a residual. It is the difference between the real value and the predicted value. Residuals are calculated like this:

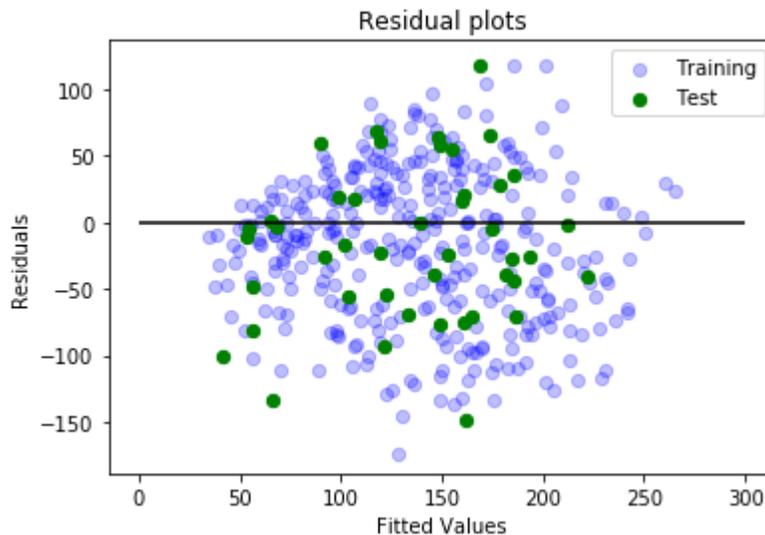
$$e = y - \hat{y}$$

A positive residual means a higher prediction than true value, and a negative residual means a lower prediction than true value.

Take a look at the residual plot from running the following block. There is a random pattern in residuals, which is good. Other patterns you might see are the U-shape or inverted U-shape patterns. These two patterns point out some non-linearity in the data, which needs to be fixed. In this case case, we don't have that problem.

```
In [30]: import matplotlib.pyplot as plt
         %%matplotlib inline

         plt.scatter(train_predictions, train_predictions-train_labels, c='b', s=40, alpha=0.25, label='Training')
         plt.scatter(test_predictions, test_predictions-test_labels, c='g', s=40, label='Test')
         plt.hlines(y=0, xmin=0, xmax=300)
         plt.title("Residual plots")
         plt.ylabel("Residuals")
         plt.xlabel("Fitted Values")
         plt.legend(loc='best')
         plt.show()
```



Question 3: Residual plot assessment

In general, looking at a residual plot allows you to realize a pattern. Patterns include:

- Random: This means the data is linear.
- U or inverse U shape: This points out some non-linearity in the data.

What can you conclude from the residual plot?

Answer: The plot shows random residuals, meaning the data is linear.

4. Conclusion

In this exercise, you developed a regression model using the linear learning algorithm in Amazon SageMaker. You also covered important concepts, such as training, validation, and test splits; the mean squared error regression metric; and analysis of residual error.