05_how_to_optimize_a_NN_architecture

September 29, 2021

1 Train a Deep NN to predict Asset Price movements

In practice, we need to explore variations of the design options outlined above because we can rarely be sure from the outset which network architecture best suits the data.

The GridSearchCV class provided by scikit-learn that we encountered in Chapter 6, The Machine Learning Workflow conveniently automates this process. Just be mindful of the risk of false discoveries and keep track of how many experiments you are running to adjust the results accordingly.

In this section, we will explore various options to build a simple feedforward Neural Network to predict asset price moves for a one-month horizon.

1.1 Setup Docker for GPU acceleration

```
docker run -it -p 8889:8888 -v /path/to/machine-learning-for-trading/16_convolutions_neural_net
--name tensorflow tensorflow/tensorflow:latest-gpu-py3 bash
```

1.2 Imports & Settings

[1]:
```
import warnings
warnings.filterwarnings('ignore')
```

[10]:
```
import os
from pathlib import Path
from importlib import reload
from joblib import dump, load

import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from matplotlib.gridspec import GridSpec
import seaborn as sns

from sklearn.model_selection import train_test_split, GridSearchCV,␣
↪StratifiedKFold
from sklearn.metrics import roc_auc_score

import tensorflow as tf
from keras.models import Sequential
```

```
from keras import backend as K
from keras.wrappers.scikit_learn import KerasClassifier
from keras.layers import Dense, Dropout, Activation
from keras.models import load_model
from keras.callbacks import Callback, EarlyStopping, TensorBoard,␣
 ↪ModelCheckpoint
```

[2]:
```
np.random.seed(42)
```

1.3 Create a stock return series to predict asset price moves

We will use the last 24 monthly returns and dummy variables for the month and the year to predict whether the price will go up or down the following month. We use the daily Quandl stock price dataset (see GitHub for instructions on how to source the data).

[3]:
```
prices = (pd.read_hdf('../data/assets.h5', 'quandl/wiki/prices')
          .adj_close
          .unstack().loc['2007':])
prices.info()
```

```
<class 'pandas.core.frame.DataFrame'>
DatetimeIndex: 2896 entries, 2007-01-01 to 2018-03-27
Columns: 3199 entries, A to ZUMZ
dtypes: float64(3199)
memory usage: 70.7 MB
```

We will work with monthly returns to keep the size of the dataset manageable and remove some of the noise contained in daily returns, which leaves us with almost 2,500 stocks with 120 monthly returns each:

[4]:
```
returns = (prices
           .resample('M')
           .last()
           .pct_change()
           .loc['2008': '2017']
           .dropna(axis=1)
           .sort_index(ascending=False))
returns.info()
```

```
<class 'pandas.core.frame.DataFrame'>
DatetimeIndex: 120 entries, 2017-12-31 to 2008-01-31
Freq: -1M
Columns: 2489 entries, A to ZUMZ
dtypes: float64(2489)
memory usage: 2.3 MB
```

[5]:
```
returns.head().append(returns.tail())
```

[5]:
ticker	A	AAL	AAN	AAON	AAP	AAPL	\
date							
2017-12-31	-0.032785	0.030501	0.056469	0.006859	-0.012970	-0.015246	
2017-11-30	0.017786	0.078385	0.025000	0.041429	0.235625	0.016623	
2017-10-31	0.061814	-0.014108	-0.156544	0.015228	-0.176008	0.096808	
2017-09-30	-0.008035	0.061466	-0.013832	0.057515	0.013928	-0.060244	
2017-08-31	0.082455	-0.111179	-0.043431	-0.035503	-0.125971	0.106251	
2008-05-31	0.237670	-0.538999	-0.122768	0.162611	0.162053	0.085082	
2008-04-30	0.012739	-0.035915	0.178947	-0.097354	0.018502	0.212195	
2008-03-31	-0.025482	-0.281452	0.041991	0.213204	0.017068	0.147816	
2008-02-29	-0.095983	-0.104046	0.067251	-0.072472	-0.062605	-0.076389	
2008-01-31	-0.078389	-0.059143	-0.009270	-0.101917	-0.058173	-0.316640	

ticker	AAWW	ABAX	ABC	ABCB	…	ZEUS	ZIGO	\
date					…			
2017-12-31	0.015584	0.016003	0.082528	-0.028226	…	0.078815	0.000000	
2017-11-30	-0.058680	0.007025	0.107587	0.035491	…	0.055085	0.000000	
2017-10-31	-0.067629	0.083987	-0.070091	-0.001043	…	-0.141818	0.000000	
2017-09-30	-0.014970	-0.033968	0.031153	0.090808	…	0.205479	0.000000	
2017-08-31	0.124579	-0.013579	-0.140733	-0.038210	…	0.069057	0.000000	
2008-05-31	0.020105	0.153454	0.021099	-0.073431	…	0.269937	0.026587	
2008-04-30	0.103273	0.099698	-0.010493	-0.067248	…	0.135255	-0.062701	
2008-03-31	0.086957	-0.204873	-0.017737	0.139290	…	0.092010	-0.023548	
2008-02-29	0.013216	-0.104762	-0.102822	-0.098859	…	0.223413	0.086104	
2008-01-31	-0.078938	-0.092303	0.038110	-0.063501	…	0.065594	-0.058587	

ticker	ZINC	ZION	ZIOP	ZIXI	ZLC	ZMH	\
date							
2017-12-31	0.000000	0.025832	-0.094092	-0.004545	0.000000	0.000000	
2017-11-30	0.000000	0.066509	-0.019313	-0.092784	0.000000	0.000000	
2017-10-31	0.000000	-0.015261	-0.241042	-0.008180	0.000000	0.000000	
2017-09-30	0.000000	0.080623	-0.039124	-0.079096	0.000000	0.000000	
2017-08-31	0.000000	-0.034067	0.155515	-0.003752	0.000000	0.000000	
2008-05-31	0.002140	-0.062060	-0.163399	-0.321053	0.051158	-0.018339	
2008-04-30	0.210708	0.017563	0.040816	-0.018088	0.048583	-0.047521	
2008-03-31	-0.262420	-0.046073	-0.048544	-0.012755	0.022774	0.034135	
2008-02-29	0.047365	-0.120684	-0.063636	0.101124	0.180929	-0.036473	
2008-01-31	-0.116676	0.172414	-0.067797	-0.226087	0.018680	0.181255	

ticker	ZQK	ZUMZ
date		
2017-12-31	0.000000	-0.044725
2017-11-30	0.000000	0.235127
2017-10-31	0.000000	-0.024862
2017-09-30	0.000000	0.453815
2017-08-31	0.000000	-0.019685
2008-05-31	-0.122302	0.000477

```
2008-04-30 -0.008155  0.335245
2008-03-31  0.090000 -0.107509
2008-02-29 -0.055614 -0.085803
2008-01-31  0.110723 -0.210591

[10 rows x 2489 columns]
```

[6]:
```
n = len(returns)
T = 24
tcols = list(range(25))
```

[7]:
```
data = pd.DataFrame()
for i in range(n-T-1):
    df = returns.iloc[i:i+T+1]
    data = pd.concat([data, (df.reset_index(drop=True).T
                             .assign(year=df.index[0].year,
                                     month=df.index[0].month))],
                     ignore_index=True)
data[tcols] = (data[tcols].apply(lambda x: x.clip(lower=x.quantile(.01),
                                                  upper=x.quantile(.99))))
data['label'] = (data[0] > 0).astype(int)
data['date'] = pd.to_datetime(data.assign(day=1)[['year', 'month', 'day']])
data = pd.get_dummies((data.drop(0, axis=1)
                       .set_index('date')
                       .apply(pd.to_numeric)),
                      columns=['year', 'month']).sort_index()
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
DatetimeIndex: 236455 entries, 2010-02-01 to 2017-12-01
Data columns (total 45 columns):
1            236455 non-null float64
2            236455 non-null float64
3            236455 non-null float64
4            236455 non-null float64
5            236455 non-null float64
6            236455 non-null float64
7            236455 non-null float64
8            236455 non-null float64
9            236455 non-null float64
10           236455 non-null float64
11           236455 non-null float64
12           236455 non-null float64
13           236455 non-null float64
14           236455 non-null float64
15           236455 non-null float64
16           236455 non-null float64
```

```
17           236455 non-null float64
18           236455 non-null float64
19           236455 non-null float64
20           236455 non-null float64
21           236455 non-null float64
22           236455 non-null float64
23           236455 non-null float64
24           236455 non-null float64
label        236455 non-null int64
year_2010    236455 non-null uint8
year_2011    236455 non-null uint8
year_2012    236455 non-null uint8
year_2013    236455 non-null uint8
year_2014    236455 non-null uint8
year_2015    236455 non-null uint8
year_2016    236455 non-null uint8
year_2017    236455 non-null uint8
month_1      236455 non-null uint8
month_2      236455 non-null uint8
month_3      236455 non-null uint8
month_4      236455 non-null uint8
month_5      236455 non-null uint8
month_6      236455 non-null uint8
month_7      236455 non-null uint8
month_8      236455 non-null uint8
month_9      236455 non-null uint8
month_10     236455 non-null uint8
month_11     236455 non-null uint8
month_12     236455 non-null uint8
dtypes: float64(24), int64(1), uint8(20)
memory usage: 51.4 MB
```

[8]:
```
data.to_hdf('data.h5', 'returns')
```

```
/home/stefan/.pyenv/versions/miniconda3-latest/envs/ml4t/lib/python3.6/site-
packages/pandas/io/pytables.py:274: PerformanceWarning:
your performance may suffer as PyTables will pickle object types that it cannot
map directly to c-types [inferred_type->mixed-integer,key->axis0] [items->None]

  f(store)
```

[9]:
```
data.shape
```

[9]:
```
(236455, 45)
```

[12]:
```
class OneStepTimeSeriesSplit:
    """Generates tuples of train_idx, test_idx pairs
```

```
    Assumes the index contains a level labeled 'date'"""

    def __init__(self, n_splits=3, test_period_length=1, shuffle=False):
        self.n_splits = n_splits
        self.test_period_length = test_period_length
        self.shuffle = shuffle
        self.test_end = n_splits * test_period_length

    @staticmethod
    def chunks(l, chunk_size):
        for i in range(0, len(l), chunk_size):
            yield l[i:i + chunk_size]

    def split(self, X, y=None, groups=None):
        unique_dates = (X.index
                            .get_level_values('date')
                            .unique()
                            .sort_values(ascending=False)[:self.test_end])

        dates = X.reset_index()[['date']]
        for test_date in self.chunks(unique_dates, self.test_period_length):
            train_idx = dates[dates.date < min(test_date)].index
            test_idx = dates[dates.date.isin(test_date)].index
            if self.shuffle:
                np.random.shuffle(list(train_idx))
            yield train_idx, test_idx

    def get_n_splits(self, X, y, groups=None):
        return self.n_splits
```

1.4 Define Network Architecture

1.4.1 Custom AUC Loss Metric

For binary classification, AUC is an excellent metric because it assesses performance irrespective of the threshold chosen to convert probabilities into positive predictions. Unfortunately, Keras does not provide it 'out-of-the-box' because it focuses on metrics that help gradient descent optimized based on batches of samples during training. However, we can define a custom loss metric for use with the early stopping callback as follows (included in the compile step):

[20]:
```
def auc_roc(y_true, y_pred):
    # any tensorflow metric
    value, update_op = tf.metrics.auc(y_true, y_pred)

    # find all variables created for this metric
    metric_vars = [i for i in tf.local_variables() if 'auc_roc' in i.name.
↪split('/')[1]]
```

```
    # Add metric variables to GLOBAL_VARIABLES collection.
    # They will be initialized for new session.
    for v in metric_vars:
        tf.add_to_collection(tf.GraphKeys.GLOBAL_VARIABLES, v)

    # force to update metric values
    with tf.control_dependencies([update_op]):
        value = tf.identity(value)
        return value
```

1.4.2 Set up `build_fn` for `keras.wrappers.scikit_learn.KerasClassifier`

Keras contains a wrapper that we can use with the sklearn GridSearchCV class. It requires a build_fn that constructs and compiles the model based on arguments that can later be passed during the GridSearchCV iterations.

The following `make_model` function illustrates how to flexibly define various architectural elements for the search process. The dense_layers argument defines both the depth and width of the network as a list of integers. We also use dropout for regularization, expressed as a float in the range [0, 1] to define the probability that a given unit will be excluded from a training iteration.

[78]:
```
def make_model(dense_layers, activation, dropout):
    '''Creates a multi-layer perceptron model

    dense_layers: List of layer sizes; one number per layer
    '''

    model = Sequential()
    for i, layer_size in enumerate(dense_layers, 1):
        if i == 1:
            model.add(Dense(layer_size, input_dim=input_dim))
            model.add(Activation(activation))
        else:
            model.add(Dense(layer_size))
            model.add(Activation(activation))
    model.add(Dropout(dropout))
    model.add(Dense(1))
    model.add(Activation('sigmoid'))

    model.compile(loss='binary_crossentropy',
                  optimizer='Adam',
                  metrics=['binary_accuracy', auc_roc])

    return model
```

1.5 Run Keras with GridSearchCV

1.5.1 Train-Test Split

We split the data into a training set for cross-validation, and keep the last 12 months with data as holdout test:

[9]:
```
data = pd.read_hdf('data.h5', 'returns')
```

[6]:
```
X_train = data[:'2016'].drop('label', axis=1)
y_train = data[:'2016'].label
```

[7]:
```
X_test = data['2017':].drop('label', axis=1)
y_test = data['2017':].label
```

1.5.2 Define GridSearch inputs

Now we just need to define our Keras classifier using the make_model function, set cross-validation (see chapter 6 on The Machine Learning Process and following for the OneStepTimeSeriesSplit), and the parameters that we would like to explore.

We pick several one- and two-layer configurations, relu and tanh activation functions, and different dropout rates. We could also try out different optimizers (but did not run this experiment to limit what is already a computationally intensive effort):

[ ]:
```
input_dim = X_train.shape[1]
```

[62]:
```
clf = KerasClassifier(make_model, epochs=10, batch_size=32)
```

[13]:
```
n_splits = 12
```

[14]:
```
cv = OneStepTimeSeriesSplit(n_splits=n_splits)
```

[60]:
```
param_grid = {'dense_layers': [[32], [32, 32], [64], [64, 64], [64, 64, 32],␣
 ↪[64, 32], [128]],
              'activation'   : ['relu', 'tanh'],
              'dropout'      : [.25, .5, .75],
              }
```

To trigger the parameter search, we instantiate a GridSearchCV object, define the fit_params that will be passed to the Keras model's fit method, and provide the training data to the GridSearchCV fit method:

[64]:
```
gs = GridSearchCV(estimator=clf,
                  param_grid=param_grid,
                  scoring='roc_auc',
                  cv=cv,
                  refit=True,
                  return_train_score=True,
                  n_jobs=-1,
```

```
                    verbose=1,
                    iid=False,
                    error_score=np.nan)
```

[ ]:
```
fit_params = dict(callbacks=[EarlyStopping(monitor='auc_roc',
                                           patience=300,
                                           verbose=1, mode='max')],
                  verbose=2,
                  epochs=50)
```

[ ]:
```
gs.fit(X=X_train.astype(float), y=y_train, **fit_params)
print('\nBest Score: {:.2%}'.format(gs.best_score_))
print('Best Params:\n', pd.Series(gs.best_params_))
```

1.5.3 Persist best model and training data

[ ]:
```
gs.best_estimator_.model.save('best_model.h5')
```

[ ]:
```
pd.DataFrame(gs.cv_results_).to_csv('cv_results.csv', index=False)
```

[ ]:
```
y_pred = gs.best_estimator_.model.predict(test_data.drop('label', axis=1))
roc_auc_score(y_true=test_data.label, y_score=y_pred)
```

[9]:
```
with pd.HDFStore('data.h5') as store:
    store.put('X_train', X_train)
    store.put('X_test', X_test)
    store.put('y_train', y_train)
    store.put('y_test', y_test)
```

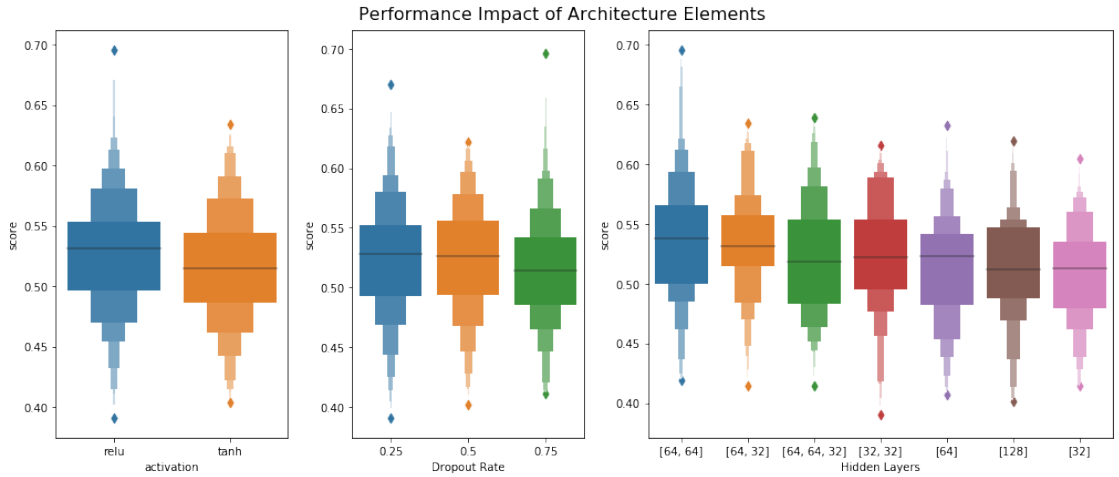
[94]:
```
cv_results = pd.read_csv('gridsearch/cv_results.csv')
cv_results = (cv_results.filter(like='param_')
              .join(cv_results
                    .filter(like='_test_score')
                    .filter(like='split'))
             .rename(columns = lambda x: x.replace('param_', '')))
cv_results =pd.melt(id_vars=['activation', 'dense_layers', 'dropout'],
                    frame=cv_results,
                   value_name='score',
                   var_name='split')
cv_results.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 504 entries, 0 to 503
Data columns (total 5 columns):
activation      504 non-null object
dense_layers    504 non-null object
dropout         504 non-null float64
```

```
split           504 non-null object
score           504 non-null float64
dtypes: float64(2), object(3)
memory usage: 19.8+ KB
```

The following chart shows the range of cross-validation results for the various elements of the Neural Network architectures that we tested in our experiment. It shows that the settings that performed best in combination, when evaluated individually, tended to do as good as or better than the alternatives.

[119]:
```
fig = plt.figure(constrained_layout=True, figsize=(14, 6))
gs = GridSpec(nrows=1, ncols=4, figure=fig)
ax1 = fig.add_subplot(gs[0, 0])
ax1.set_xlabel('Activation Functon')
sns.boxenplot(x='activation', y='score', data=cv_results, ax=ax1)
ax2 = fig.add_subplot(gs[0, 1])
sns.boxenplot(x='dropout', y='score', data=cv_results, ax=ax2);
ax2.set_xlabel('Dropout Rate')
ax3 = fig.add_subplot(gs[0, 2:])
sns.boxenplot(x='dense_layers', y='score', data=cv_results, ax=ax3)
ax3.set_xlabel('Hidden Layers')
fig.suptitle('Performance Impact of Architecture Elements', fontsize=16)
fig.savefig('parameter_impact', dpi=300);
```



1.6 Load best model

[8]:
```
model = load_model('gridsearch/best_model.h5', custom_objects={'auc_roc':␣
↪auc_roc})
```

[9]:
```
model.summary()
```

```
Layer (type)                 Output Shape              Param #
=================================================================
dense_1 (Dense)              (None, 64)                2880
_________________________________________________________________
activation_1 (Activation)    (None, 64)                0
_________________________________________________________________
dense_2 (Dense)              (None, 64)                4160
_________________________________________________________________
activation_2 (Activation)    (None, 64)                0
_________________________________________________________________
dropout_1 (Dropout)          (None, 64)                0
_________________________________________________________________
dense_3 (Dense)              (None, 1)                 65
_________________________________________________________________
activation_3 (Activation)    (None, 1)                 0
=================================================================
Total params: 7,105
Trainable params: 7,105
Non-trainable params: 0
_________________________________________________________________
```

1.6.1 Predict 1 year of price moves

[ ]:
```
y_pred = model.predict(test_data.drop('label', axis=1))
```

[11]:
```
roc_auc_score(y_score=y_pred, y_true=test_data.label)
```

[11]:
```
0.5106585850411519
```

1.7 Retrain with all data

1.7.1 Custom ROC AUC Callback

[7]:
```
class auc_callback(Callback):
    def __init__(self,training_data,validation_data):
        self.x = training_data[0]
        self.y = training_data[1]
        self.x_val = validation_data[0]
        self.y_val = validation_data[1]


    def on_train_begin(self, logs={}):
        return

    def on_train_end(self, logs={}):
        return

    def on_epoch_begin(self, epoch, logs={}):
```

```
        return

    def on_epoch_end(self, epoch, logs={}):
        y_pred = self.model.predict(self.x)
        roc = roc_auc_score(y_true=self.y, y_score=y_pred)
        y_pred_val = self.model.predict_proba(self.x_val)
        roc_val = roc_auc_score(y_true=self.y_val, y_score=y_pred_val)
        print('\rroc-auc: {:.2%} - roc-auc_val: {:.2%}'.format(roc,␣
↪roc_val),end=100*' '+'\n')
        return

    def on_batch_begin(self, batch, logs={}):
        return

    def on_batch_end(self, batch, logs={}):
        return
```

1.7.2 Early Stopping

[18]:
```
early_stopping = EarlyStopping(monitor='val_loss',
                               min_delta=0,
                               patience=5,
                               verbose=0,
                               mode='auto',
                               baseline=None,
                               restore_best_weights=False)
```

1.7.3 Model Checkpoints

[19]:
```
checkpointer = ModelCheckpoint('models/weights.{epoch:02d}-{val_loss:.2f}.hdf5',
                               monitor='val_loss',
                               verbose=0,
                               save_best_only=True,
                               save_weights_only=False,
                               mode='auto',
                               period=1)
```

1.7.4 Tensorboard

[20]:
```
tensorboard = TensorBoard(log_dir='./logs',
                          histogram_freq=1,
                          batch_size=32,
                          write_graph=True,
                          write_grads=True,
                          update_freq='epoch')
```

[10]:
```
data = pd.read_hdf('data.h5', 'returns')
features = data.drop('label', axis=1)
label = data.label
```

1.7.5 Run cross-validation

[31]:
```
for fold, (train_idx, test_idx) in enumerate(cv.split(data)):
    checkpointer = ModelCheckpoint('models/weights.{}.hdf5'.format(fold),
                                   monitor='val_loss',
                                   verbose=0,
                                   save_best_only=True,
                                   save_weights_only=False,
                                   mode='auto',
                                   period=1)
    tensorboard = TensorBoard(log_dir='./logs/{}'.format(fold),
                              histogram_freq=1,
                              batch_size=32,
                              write_graph=True,
                              write_grads=True,
                              update_freq='epoch')
    X_train = features.iloc[train_idx]
    X_test = features.iloc[test_idx]
    y_train = label.iloc[train_idx]
    y_test = label.iloc[test_idx]

    training = model.fit(X_train,
                         y_train,
                          batch_size=32,
                          epochs=50,
                          verbose=1,
                          validation_data=(X_test, y_test),
                          callbacks=[checkpointer,
                                     tensorboard,
                                     early_stopping,
                                     auc_callback(training_data=(X_train,␣
↪y_train),
                                                  validation_data=(X_test,␣
↪y_test))])
    history = pd.concat([history, pd.DataFrame(training.history).
↪assign(fold=fold)])
```

```
Train on 233966 samples, validate on 2489 samples
Epoch 1/50
233966/233966 [==============================] - 13s 57us/step - loss: 0.5537 -
binary_accuracy: 0.7110 - auc_roc: 0.7790 - val_loss: 0.6052 -
val_binary_accuracy: 0.6063 - val_auc_roc: 0.7791
roc-auc: 79.44% - roc-auc_val: 66.48%
```

```
Epoch 2/50
233966/233966 [==============================] - 13s 56us/step - loss: 0.5536 -
binary_accuracy: 0.7121 - auc_roc: 0.7792 - val_loss: 0.6026 -
val_binary_accuracy: 0.6268 - val_auc_roc: 0.7793
roc-auc: 79.50% - roc-auc_val: 67.07%
Epoch 3/50
233966/233966 [==============================] - 13s 58us/step - loss: 0.5541 -
binary_accuracy: 0.7119 - auc_roc: 0.7794 - val_loss: 0.6074 -
val_binary_accuracy: 0.6239 - val_auc_roc: 0.7795
roc-auc: 79.51% - roc-auc_val: 65.37%
Epoch 4/50
233966/233966 [==============================] - 13s 57us/step - loss: 0.5537 -
binary_accuracy: 0.7111 - auc_roc: 0.7796 - val_loss: 0.5859 -
val_binary_accuracy: 0.6235 - val_auc_roc: 0.7797
roc-auc: 79.52% - roc-auc_val: 65.90%
Epoch 5/50
233966/233966 [==============================] - 14s 58us/step - loss: 0.5531 -
binary_accuracy: 0.7119 - auc_roc: 0.7798 - val_loss: 0.5977 -
val_binary_accuracy: 0.6312 - val_auc_roc: 0.7799
roc-auc: 79.42% - roc-auc_val: 66.32%
Epoch 6/50
233966/233966 [==============================] - 13s 57us/step - loss: 0.5537 -
binary_accuracy: 0.7130 - auc_roc: 0.7800 - val_loss: 0.6024 -
val_binary_accuracy: 0.6223 - val_auc_roc: 0.7800
roc-auc: 79.61% - roc-auc_val: 65.85%
Epoch 7/50
233966/233966 [==============================] - 13s 57us/step - loss: 0.5529 -
binary_accuracy: 0.7124 - auc_roc: 0.7801 - val_loss: 0.6206 -
val_binary_accuracy: 0.5954 - val_auc_roc: 0.7802
roc-auc: 79.54% - roc-auc_val: 65.76%
Epoch 8/50
233966/233966 [==============================] - 13s 57us/step - loss: 0.5535 -
binary_accuracy: 0.7126 - auc_roc: 0.7802 - val_loss: 0.6131 -
val_binary_accuracy: 0.6095 - val_auc_roc: 0.7803
roc-auc: 79.60% - roc-auc_val: 65.40%
Epoch 9/50
233966/233966 [==============================] - 13s 58us/step - loss: 0.5525 -
binary_accuracy: 0.7124 - auc_roc: 0.7804 - val_loss: 0.6038 -
val_binary_accuracy: 0.6159 - val_auc_roc: 0.7805
roc-auc: 79.57% - roc-auc_val: 65.76%
Epoch 10/50
233966/233966 [==============================] - 14s 59us/step - loss: 0.5530 -
binary_accuracy: 0.7122 - auc_roc: 0.7805 - val_loss: 0.6535 -
val_binary_accuracy: 0.5842 - val_auc_roc: 0.7806
roc-auc: 79.52% - roc-auc_val: 64.36%
Epoch 11/50
233966/233966 [==============================] - 13s 56us/step - loss: 0.5524 -
binary_accuracy: 0.7134 - auc_roc: 0.7807 - val_loss: 0.6469 -
```

```
val_binary_accuracy: 0.5613 - val_auc_roc: 0.7807
roc-auc: 79.59% - roc-auc_val: 63.95%
Epoch 12/50
233966/233966 [==============================] - 13s 56us/step - loss: 0.5526 -
binary_accuracy: 0.7125 - auc_roc: 0.7808 - val_loss: 0.5977 -
val_binary_accuracy: 0.6179 - val_auc_roc: 0.7809
roc-auc: 79.61% - roc-auc_val: 64.73%
Epoch 13/50
233966/233966 [==============================] - 13s 54us/step - loss: 0.5519 -
binary_accuracy: 0.7128 - auc_roc: 0.7809 - val_loss: 0.5924 -
val_binary_accuracy: 0.6103 - val_auc_roc: 0.7810
roc-auc: 79.68% - roc-auc_val: 65.55%
Epoch 14/50
233966/233966 [==============================] - 13s 54us/step - loss: 0.5516 -
binary_accuracy: 0.7132 - auc_roc: 0.7811 - val_loss: 0.5868 -
val_binary_accuracy: 0.6195 - val_auc_roc: 0.7811
roc-auc: 79.67% - roc-auc_val: 65.80%
Epoch 15/50
233966/233966 [==============================] - 13s 56us/step - loss: 0.5515 -
binary_accuracy: 0.7135 - auc_roc: 0.7812 - val_loss: 0.5954 -
val_binary_accuracy: 0.5918 - val_auc_roc: 0.7813
roc-auc: 79.66% - roc-auc_val: 65.20%
Epoch 16/50
233966/233966 [==============================] - 13s 56us/step - loss: 0.5516 -
binary_accuracy: 0.7130 - auc_roc: 0.7813 - val_loss: 0.5753 -
val_binary_accuracy: 0.6364 - val_auc_roc: 0.7814
roc-auc: 79.58% - roc-auc_val: 65.97%
Epoch 17/50
233966/233966 [==============================] - 13s 57us/step - loss: 0.5521 -
binary_accuracy: 0.7125 - auc_roc: 0.7815 - val_loss: 0.5823 -
val_binary_accuracy: 0.6175 - val_auc_roc: 0.7815
roc-auc: 79.68% - roc-auc_val: 65.53%
Epoch 18/50
233966/233966 [==============================] - 14s 59us/step - loss: 0.5508 -
binary_accuracy: 0.7139 - auc_roc: 0.7816 - val_loss: 0.6029 -
val_binary_accuracy: 0.5842 - val_auc_roc: 0.7816
roc-auc: 79.72% - roc-auc_val: 65.05%
Epoch 19/50
233966/233966 [==============================] - 13s 57us/step - loss: 0.5518 -
binary_accuracy: 0.7132 - auc_roc: 0.7817 - val_loss: 0.5917 -
val_binary_accuracy: 0.6059 - val_auc_roc: 0.7817
roc-auc: 79.67% - roc-auc_val: 65.45%
Epoch 20/50
233966/233966 [==============================] - 13s 55us/step - loss: 0.5516 -
binary_accuracy: 0.7131 - auc_roc: 0.7818 - val_loss: 0.6021 -
val_binary_accuracy: 0.5934 - val_auc_roc: 0.7818
roc-auc: 79.72% - roc-auc_val: 65.22%
Epoch 21/50
```

```
233966/233966 [==============================] - 13s 55us/step - loss: 0.5513 -
binary_accuracy: 0.7130 - auc_roc: 0.7819 - val_loss: 0.5871 -
val_binary_accuracy: 0.6215 - val_auc_roc: 0.7819
roc-auc: 79.70% - roc-auc_val: 66.23%
Epoch 22/50
233966/233966 [==============================] - 15s 63us/step - loss: 0.5511 -
binary_accuracy: 0.7142 - auc_roc: 0.7820 - val_loss: 0.6219 -
val_binary_accuracy: 0.6071 - val_auc_roc: 0.7820
roc-auc: 79.75% - roc-auc_val: 64.54%
Epoch 23/50
233966/233966 [==============================] - 13s 55us/step - loss: 0.5507 -
binary_accuracy: 0.7134 - auc_roc: 0.7821 - val_loss: 0.5907 -
val_binary_accuracy: 0.6099 - val_auc_roc: 0.7821
roc-auc: 79.75% - roc-auc_val: 64.33%
Epoch 24/50
233966/233966 [==============================] - 14s 61us/step - loss: 0.5508 -
binary_accuracy: 0.7134 - auc_roc: 0.7822 - val_loss: 0.5853 -
val_binary_accuracy: 0.6404 - val_auc_roc: 0.7822
roc-auc: 79.77% - roc-auc_val: 65.56%
Epoch 25/50
233966/233966 [==============================] - 14s 60us/step - loss: 0.5511 -
binary_accuracy: 0.7135 - auc_roc: 0.7823 - val_loss: 0.5729 -
val_binary_accuracy: 0.6364 - val_auc_roc: 0.7823
roc-auc: 79.75% - roc-auc_val: 66.25%
Epoch 26/50
233966/233966 [==============================] - 13s 58us/step - loss: 0.5501 -
binary_accuracy: 0.7141 - auc_roc: 0.7824 - val_loss: 0.6024 -
val_binary_accuracy: 0.6047 - val_auc_roc: 0.7824
roc-auc: 79.73% - roc-auc_val: 64.77%
Epoch 27/50
233966/233966 [==============================] - 13s 57us/step - loss: 0.5502 -
binary_accuracy: 0.7137 - auc_roc: 0.7825 - val_loss: 0.5909 -
val_binary_accuracy: 0.6272 - val_auc_roc: 0.7825
roc-auc: 79.72% - roc-auc_val: 65.44%
Epoch 28/50
233966/233966 [==============================] - 13s 57us/step - loss: 0.5502 -
binary_accuracy: 0.7144 - auc_roc: 0.7826 - val_loss: 0.5718 -
val_binary_accuracy: 0.6167 - val_auc_roc: 0.7826
roc-auc: 79.76% - roc-auc_val: 65.95%
Epoch 29/50
233966/233966 [==============================] - 14s 58us/step - loss: 0.5502 -
binary_accuracy: 0.7130 - auc_roc: 0.7827 - val_loss: 0.6173 -
val_binary_accuracy: 0.6159 - val_auc_roc: 0.7827
roc-auc: 79.79% - roc-auc_val: 64.45%
Epoch 30/50
233966/233966 [==============================] - 13s 57us/step - loss: 0.5508 -
binary_accuracy: 0.7143 - auc_roc: 0.7828 - val_loss: 0.5921 -
val_binary_accuracy: 0.6010 - val_auc_roc: 0.7828
```

```
roc-auc: 79.87% - roc-auc_val: 65.77%
Epoch 31/50
233966/233966 [==============================] - 14s 58us/step - loss: 0.5503 -
binary_accuracy: 0.7141 - auc_roc: 0.7828 - val_loss: 0.6025 -
val_binary_accuracy: 0.5862 - val_auc_roc: 0.7829
roc-auc: 79.84% - roc-auc_val: 65.13%
Epoch 32/50
233966/233966 [==============================] - 13s 57us/step - loss: 0.5502 -
binary_accuracy: 0.7136 - auc_roc: 0.7829 - val_loss: 0.6052 -
val_binary_accuracy: 0.5705 - val_auc_roc: 0.7830
roc-auc: 79.83% - roc-auc_val: 64.10%
Epoch 33/50
233966/233966 [==============================] - 13s 58us/step - loss: 0.5503 -
binary_accuracy: 0.7138 - auc_roc: 0.7830 - val_loss: 0.5782 -
val_binary_accuracy: 0.6163 - val_auc_roc: 0.7830
roc-auc: 79.81% - roc-auc_val: 65.42%
Epoch 34/50
233966/233966 [==============================] - 14s 58us/step - loss: 0.5499 -
binary_accuracy: 0.7141 - auc_roc: 0.7831 - val_loss: 0.6154 -
val_binary_accuracy: 0.5894 - val_auc_roc: 0.7831
roc-auc: 79.85% - roc-auc_val: 64.34%
Epoch 35/50
233966/233966 [==============================] - 14s 58us/step - loss: 0.5500 -
binary_accuracy: 0.7148 - auc_roc: 0.7831 - val_loss: 0.5801 -
val_binary_accuracy: 0.6308 - val_auc_roc: 0.7832
roc-auc: 79.85% - roc-auc_val: 66.07%
Epoch 36/50
233966/233966 [==============================] - 14s 58us/step - loss: 0.5492 -
binary_accuracy: 0.7148 - auc_roc: 0.7832 - val_loss: 0.5955 -
val_binary_accuracy: 0.6087 - val_auc_roc: 0.7833
roc-auc: 79.79% - roc-auc_val: 64.99%
Epoch 37/50
233966/233966 [==============================] - 14s 58us/step - loss: 0.5488 -
binary_accuracy: 0.7142 - auc_roc: 0.7833 - val_loss: 0.6324 -
val_binary_accuracy: 0.5962 - val_auc_roc: 0.7834
roc-auc: 79.88% - roc-auc_val: 64.45%
Epoch 38/50
233966/233966 [==============================] - 14s 58us/step - loss: 0.5500 -
binary_accuracy: 0.7143 - auc_roc: 0.7834 - val_loss: 0.6193 -
val_binary_accuracy: 0.6103 - val_auc_roc: 0.7834
roc-auc: 79.86% - roc-auc_val: 63.82%
Epoch 39/50
233966/233966 [==============================] - 14s 60us/step - loss: 0.5497 -
binary_accuracy: 0.7151 - auc_roc: 0.7835 - val_loss: 0.6100 -
val_binary_accuracy: 0.6179 - val_auc_roc: 0.7835
roc-auc: 79.86% - roc-auc_val: 65.18%
Epoch 40/50
233966/233966 [==============================] - 14s 58us/step - loss: 0.5500 -
```

```
binary_accuracy: 0.7146 - auc_roc: 0.7835 - val_loss: 0.6218 -
val_binary_accuracy: 0.5970 - val_auc_roc: 0.7836
roc-auc: 79.91% - roc-auc_val: 65.95%
Epoch 41/50
233966/233966 [==============================] - 13s 57us/step - loss: 0.5497 -
binary_accuracy: 0.7142 - auc_roc: 0.7836 - val_loss: 0.6496 -
val_binary_accuracy: 0.6135 - val_auc_roc: 0.7836
roc-auc: 79.88% - roc-auc_val: 62.27%
Epoch 42/50
233966/233966 [==============================] - 13s 57us/step - loss: 0.5491 -
binary_accuracy: 0.7147 - auc_roc: 0.7837 - val_loss: 0.6386 -
val_binary_accuracy: 0.5950 - val_auc_roc: 0.7837
roc-auc: 79.79% - roc-auc_val: 63.07%
Epoch 43/50
233966/233966 [==============================] - 13s 56us/step - loss: 0.5491 -
binary_accuracy: 0.7140 - auc_roc: 0.7837 - val_loss: 0.6006 -
val_binary_accuracy: 0.6139 - val_auc_roc: 0.7838
roc-auc: 79.93% - roc-auc_val: 64.58%
Epoch 44/50
233966/233966 [==============================] - 13s 57us/step - loss: 0.5487 -
binary_accuracy: 0.7155 - auc_roc: 0.7838 - val_loss: 0.6363 -
val_binary_accuracy: 0.5842 - val_auc_roc: 0.7838
roc-auc: 79.96% - roc-auc_val: 63.40%
Epoch 45/50
233966/233966 [==============================] - 13s 57us/step - loss: 0.5489 -
binary_accuracy: 0.7143 - auc_roc: 0.7839 - val_loss: 0.6019 -
val_binary_accuracy: 0.6328 - val_auc_roc: 0.7839
roc-auc: 79.94% - roc-auc_val: 64.84%
Epoch 46/50
233966/233966 [==============================] - 13s 56us/step - loss: 0.5492 -
binary_accuracy: 0.7143 - auc_roc: 0.7839 - val_loss: 0.6273 -
val_binary_accuracy: 0.5982 - val_auc_roc: 0.7840
roc-auc: 79.94% - roc-auc_val: 63.96%
Epoch 47/50
233966/233966 [==============================] - 13s 57us/step - loss: 0.5487 -
binary_accuracy: 0.7147 - auc_roc: 0.7840 - val_loss: 0.6383 -
val_binary_accuracy: 0.6227 - val_auc_roc: 0.7840
roc-auc: 79.91% - roc-auc_val: 62.70%
Epoch 48/50
233966/233966 [==============================] - 13s 57us/step - loss: 0.5486 -
binary_accuracy: 0.7147 - auc_roc: 0.7841 - val_loss: 0.6810 -
val_binary_accuracy: 0.5685 - val_auc_roc: 0.7841
roc-auc: 79.93% - roc-auc_val: 56.54%
Epoch 49/50
233966/233966 [==============================] - 13s 56us/step - loss: 0.5482 -
binary_accuracy: 0.7147 - auc_roc: 0.7841 - val_loss: 0.6690 -
val_binary_accuracy: 0.5914 - val_auc_roc: 0.7841
roc-auc: 79.93% - roc-auc_val: 58.56%
```

```
Epoch 50/50
233966/233966 [==============================] - 13s 56us/step - loss: 0.5483 -
binary_accuracy: 0.7149 - auc_roc: 0.7842 - val_loss: 0.6080 -
val_binary_accuracy: 0.6123 - val_auc_roc: 0.7842
roc-auc: 79.96% - roc-auc_val: 63.88%
Train on 231477 samples, validate on 2489 samples
Epoch 1/50
231477/231477 [==============================] - 13s 56us/step - loss: 0.5499 -
binary_accuracy: 0.7142 - auc_roc: 0.7842 - val_loss: 0.4909 -
val_binary_accuracy: 0.7513 - val_auc_roc: 0.7843
roc-auc: 79.94% - roc-auc_val: 80.20%
Epoch 2/50
231477/231477 [==============================] - 13s 56us/step - loss: 0.5487 -
binary_accuracy: 0.7151 - auc_roc: 0.7843 - val_loss: 0.4940 -
val_binary_accuracy: 0.7489 - val_auc_roc: 0.7843
roc-auc: 79.99% - roc-auc_val: 79.57%
Epoch 3/50
231477/231477 [==============================] - 13s 56us/step - loss: 0.5489 -
binary_accuracy: 0.7139 - auc_roc: 0.7844 - val_loss: 0.4928 -
val_binary_accuracy: 0.7477 - val_auc_roc: 0.7844
roc-auc: 79.92% - roc-auc_val: 79.59%
Epoch 4/50
231477/231477 [==============================] - 13s 56us/step - loss: 0.5485 -
binary_accuracy: 0.7144 - auc_roc: 0.7844 - val_loss: 0.5015 -
val_binary_accuracy: 0.7473 - val_auc_roc: 0.7845
roc-auc: 79.95% - roc-auc_val: 79.05%
Epoch 5/50
231477/231477 [==============================] - 13s 56us/step - loss: 0.5486 -
binary_accuracy: 0.7150 - auc_roc: 0.7845 - val_loss: 0.4990 -
val_binary_accuracy: 0.7477 - val_auc_roc: 0.7845
roc-auc: 79.96% - roc-auc_val: 78.99%
Epoch 6/50
231477/231477 [==============================] - 13s 56us/step - loss: 0.5489 -
binary_accuracy: 0.7147 - auc_roc: 0.7845 - val_loss: 0.5020 -
val_binary_accuracy: 0.7469 - val_auc_roc: 0.7846
roc-auc: 79.96% - roc-auc_val: 79.07%
Epoch 7/50
231477/231477 [==============================] - 13s 57us/step - loss: 0.5484 -
binary_accuracy: 0.7143 - auc_roc: 0.7846 - val_loss: 0.5076 -
val_binary_accuracy: 0.7453 - val_auc_roc: 0.7846
roc-auc: 79.98% - roc-auc_val: 78.32%
Epoch 8/50
231477/231477 [==============================] - 13s 57us/step - loss: 0.5493 -
binary_accuracy: 0.7142 - auc_roc: 0.7847 - val_loss: 0.5062 -
val_binary_accuracy: 0.7389 - val_auc_roc: 0.7847
roc-auc: 80.01% - roc-auc_val: 78.50%
Epoch 9/50
231477/231477 [==============================] - 13s 57us/step - loss: 0.5489 -
```

```
binary_accuracy: 0.7152 - auc_roc: 0.7847 - val_loss: 0.5052 -
val_binary_accuracy: 0.7409 - val_auc_roc: 0.7847
roc-auc: 79.96% - roc-auc_val: 77.79%
Epoch 10/50
231477/231477 [==============================] - 13s 57us/step - loss: 0.5481 -
binary_accuracy: 0.7149 - auc_roc: 0.7848 - val_loss: 0.5057 -
val_binary_accuracy: 0.7421 - val_auc_roc: 0.7848
roc-auc: 79.94% - roc-auc_val: 77.99%
Epoch 11/50
231477/231477 [==============================] - 13s 56us/step - loss: 0.5486 -
binary_accuracy: 0.7145 - auc_roc: 0.7848 - val_loss: 0.5025 -
val_binary_accuracy: 0.7425 - val_auc_roc: 0.7848
roc-auc: 79.97% - roc-auc_val: 78.02%
Epoch 12/50
231477/231477 [==============================] - 13s 56us/step - loss: 0.5482 -
binary_accuracy: 0.7149 - auc_roc: 0.7849 - val_loss: 0.5104 -
val_binary_accuracy: 0.7441 - val_auc_roc: 0.7849
roc-auc: 79.94% - roc-auc_val: 77.48%
Epoch 13/50
231477/231477 [==============================] - 13s 57us/step - loss: 0.5486 -
binary_accuracy: 0.7145 - auc_roc: 0.7849 - val_loss: 0.5060 -
val_binary_accuracy: 0.7457 - val_auc_roc: 0.7850
roc-auc: 79.96% - roc-auc_val: 77.77%
Epoch 14/50
231477/231477 [==============================] - 13s 57us/step - loss: 0.5479 -
binary_accuracy: 0.7153 - auc_roc: 0.7850 - val_loss: 0.5108 -
val_binary_accuracy: 0.7409 - val_auc_roc: 0.7850
roc-auc: 79.96% - roc-auc_val: 77.73%
Epoch 15/50
231477/231477 [==============================] - 13s 56us/step - loss: 0.5486 -
binary_accuracy: 0.7141 - auc_roc: 0.7850 - val_loss: 0.5103 -
val_binary_accuracy: 0.7352 - val_auc_roc: 0.7851
roc-auc: 79.98% - roc-auc_val: 77.14%
Epoch 16/50
231477/231477 [==============================] - 13s 57us/step - loss: 0.5486 -
binary_accuracy: 0.7144 - auc_roc: 0.7851 - val_loss: 0.5091 -
val_binary_accuracy: 0.7376 - val_auc_roc: 0.7851
roc-auc: 79.99% - roc-auc_val: 77.43%
Epoch 17/50
231477/231477 [==============================] - 13s 57us/step - loss: 0.5482 -
binary_accuracy: 0.7150 - auc_roc: 0.7851 - val_loss: 0.5070 -
val_binary_accuracy: 0.7453 - val_auc_roc: 0.7852
roc-auc: 79.95% - roc-auc_val: 77.64%
Epoch 18/50
231477/231477 [==============================] - 13s 57us/step - loss: 0.5477 -
binary_accuracy: 0.7156 - auc_roc: 0.7852 - val_loss: 0.5134 -
val_binary_accuracy: 0.7409 - val_auc_roc: 0.7852
roc-auc: 80.01% - roc-auc_val: 77.25%
```

```
Epoch 19/50
231477/231477 [==============================] - 13s 57us/step - loss: 0.5481 -
binary_accuracy: 0.7151 - auc_roc: 0.7852 - val_loss: 0.5093 -
val_binary_accuracy: 0.7405 - val_auc_roc: 0.7853
roc-auc: 79.98% - roc-auc_val: 77.55%
Epoch 20/50
231477/231477 [==============================] - 13s 57us/step - loss: 0.5473 -
binary_accuracy: 0.7153 - auc_roc: 0.7853 - val_loss: 0.5144 -
val_binary_accuracy: 0.7376 - val_auc_roc: 0.7853
roc-auc: 80.00% - roc-auc_val: 76.70%
Epoch 21/50
231477/231477 [==============================] - 13s 57us/step - loss: 0.5479 -
binary_accuracy: 0.7153 - auc_roc: 0.7853 - val_loss: 0.5122 -
val_binary_accuracy: 0.7425 - val_auc_roc: 0.7854
roc-auc: 80.05% - roc-auc_val: 76.72%
Epoch 22/50
231477/231477 [==============================] - 13s 57us/step - loss: 0.5477 -
binary_accuracy: 0.7153 - auc_roc: 0.7854 - val_loss: 0.5127 -
val_binary_accuracy: 0.7421 - val_auc_roc: 0.7854
roc-auc: 80.07% - roc-auc_val: 76.88%
Epoch 23/50
231477/231477 [==============================] - 13s 56us/step - loss: 0.5481 -
binary_accuracy: 0.7153 - auc_roc: 0.7854 - val_loss: 0.5123 -
val_binary_accuracy: 0.7433 - val_auc_roc: 0.7855
roc-auc: 80.06% - roc-auc_val: 76.86%
Epoch 24/50
231477/231477 [==============================] - 13s 56us/step - loss: 0.5483 -
binary_accuracy: 0.7157 - auc_roc: 0.7855 - val_loss: 0.5124 -
val_binary_accuracy: 0.7437 - val_auc_roc: 0.7855
roc-auc: 80.04% - roc-auc_val: 76.63%
Epoch 25/50
231477/231477 [==============================] - 13s 57us/step - loss: 0.5478 -
binary_accuracy: 0.7148 - auc_roc: 0.7855 - val_loss: 0.5121 -
val_binary_accuracy: 0.7445 - val_auc_roc: 0.7855
roc-auc: 80.06% - roc-auc_val: 77.23%
Epoch 26/50
231477/231477 [==============================] - 13s 57us/step - loss: 0.5481 -
binary_accuracy: 0.7157 - auc_roc: 0.7856 - val_loss: 0.5159 -
val_binary_accuracy: 0.7401 - val_auc_roc: 0.7856
roc-auc: 80.03% - roc-auc_val: 76.75%
Epoch 27/50
231477/231477 [==============================] - 13s 56us/step - loss: 0.5482 -
binary_accuracy: 0.7146 - auc_roc: 0.7856 - val_loss: 0.5163 -
val_binary_accuracy: 0.7433 - val_auc_roc: 0.7856
roc-auc: 80.08% - roc-auc_val: 76.83%
Epoch 28/50
231477/231477 [==============================] - 13s 56us/step - loss: 0.5476 -
binary_accuracy: 0.7148 - auc_roc: 0.7856 - val_loss: 0.5146 -
```

```
val_binary_accuracy: 0.7360 - val_auc_roc: 0.7857
roc-auc: 80.08% - roc-auc_val: 76.59%
Epoch 29/50
231477/231477 [==============================] - 13s 56us/step - loss: 0.5479 -
binary_accuracy: 0.7154 - auc_roc: 0.7857 - val_loss: 0.5120 -
val_binary_accuracy: 0.7413 - val_auc_roc: 0.7857
roc-auc: 80.06% - roc-auc_val: 76.80%
Epoch 30/50
231477/231477 [==============================] - 13s 57us/step - loss: 0.5479 -
binary_accuracy: 0.7149 - auc_roc: 0.7857 - val_loss: 0.5124 -
val_binary_accuracy: 0.7417 - val_auc_roc: 0.7857
roc-auc: 80.09% - roc-auc_val: 76.80%
Epoch 31/50
231477/231477 [==============================] - 13s 57us/step - loss: 0.5473 -
binary_accuracy: 0.7158 - auc_roc: 0.7858 - val_loss: 0.5154 -
val_binary_accuracy: 0.7397 - val_auc_roc: 0.7858
roc-auc: 80.08% - roc-auc_val: 76.59%
Epoch 32/50
231477/231477 [==============================] - 13s 57us/step - loss: 0.5478 -
binary_accuracy: 0.7156 - auc_roc: 0.7858 - val_loss: 0.5181 -
val_binary_accuracy: 0.7433 - val_auc_roc: 0.7858
roc-auc: 80.10% - roc-auc_val: 76.57%
Epoch 33/50
231477/231477 [==============================] - 13s 56us/step - loss: 0.5471 -
binary_accuracy: 0.7159 - auc_roc: 0.7858 - val_loss: 0.5141 -
val_binary_accuracy: 0.7441 - val_auc_roc: 0.7859
roc-auc: 80.05% - roc-auc_val: 76.66%
Epoch 34/50
231477/231477 [==============================] - 13s 57us/step - loss: 0.5476 -
binary_accuracy: 0.7151 - auc_roc: 0.7859 - val_loss: 0.5160 -
val_binary_accuracy: 0.7421 - val_auc_roc: 0.7859
roc-auc: 80.12% - roc-auc_val: 76.58%
Epoch 35/50
231477/231477 [==============================] - 13s 56us/step - loss: 0.5478 -
binary_accuracy: 0.7155 - auc_roc: 0.7859 - val_loss: 0.5130 -
val_binary_accuracy: 0.7425 - val_auc_roc: 0.7859
roc-auc: 79.99% - roc-auc_val: 76.72%
Epoch 36/50
231477/231477 [==============================] - 13s 56us/step - loss: 0.5474 -
binary_accuracy: 0.7149 - auc_roc: 0.7860 - val_loss: 0.5173 -
val_binary_accuracy: 0.7376 - val_auc_roc: 0.7860
roc-auc: 80.14% - roc-auc_val: 76.47%
Epoch 37/50
231477/231477 [==============================] - 13s 56us/step - loss: 0.5475 -
binary_accuracy: 0.7155 - auc_roc: 0.7860 - val_loss: 0.5135 -
val_binary_accuracy: 0.7469 - val_auc_roc: 0.7860
roc-auc: 80.13% - roc-auc_val: 76.92%
Epoch 38/50
```

```
231477/231477 [==============================] - 13s 57us/step - loss: 0.5472 -
binary_accuracy: 0.7148 - auc_roc: 0.7860 - val_loss: 0.5120 -
val_binary_accuracy: 0.7401 - val_auc_roc: 0.7861
roc-auc: 80.10% - roc-auc_val: 76.86%
Epoch 39/50
231477/231477 [==============================] - 13s 57us/step - loss: 0.5473 -
binary_accuracy: 0.7155 - auc_roc: 0.7861 - val_loss: 0.5146 -
val_binary_accuracy: 0.7473 - val_auc_roc: 0.7861
roc-auc: 80.11% - roc-auc_val: 76.46%
Epoch 40/50
231477/231477 [==============================] - 13s 57us/step - loss: 0.5467 -
binary_accuracy: 0.7152 - auc_roc: 0.7861 - val_loss: 0.5188 -
val_binary_accuracy: 0.7433 - val_auc_roc: 0.7861
roc-auc: 80.17% - roc-auc_val: 76.03%
Epoch 41/50
231477/231477 [==============================] - 13s 57us/step - loss: 0.5470 -
binary_accuracy: 0.7144 - auc_roc: 0.7862 - val_loss: 0.5176 -
val_binary_accuracy: 0.7393 - val_auc_roc: 0.7862
roc-auc: 80.11% - roc-auc_val: 76.28%
Epoch 42/50
231477/231477 [==============================] - 13s 57us/step - loss: 0.5466 -
binary_accuracy: 0.7157 - auc_roc: 0.7862 - val_loss: 0.5155 -
val_binary_accuracy: 0.7405 - val_auc_roc: 0.7862
roc-auc: 80.09% - roc-auc_val: 76.55%
Epoch 43/50
231477/231477 [==============================] - 13s 57us/step - loss: 0.5468 -
binary_accuracy: 0.7152 - auc_roc: 0.7862 - val_loss: 0.5253 -
val_binary_accuracy: 0.7401 - val_auc_roc: 0.7863
roc-auc: 80.07% - roc-auc_val: 75.74%
Epoch 44/50
231477/231477 [==============================] - 13s 57us/step - loss: 0.5470 -
binary_accuracy: 0.7149 - auc_roc: 0.7863 - val_loss: 0.5161 -
val_binary_accuracy: 0.7437 - val_auc_roc: 0.7863
roc-auc: 80.15% - roc-auc_val: 76.21%
Epoch 45/50
231477/231477 [==============================] - 13s 57us/step - loss: 0.5465 -
binary_accuracy: 0.7159 - auc_roc: 0.7863 - val_loss: 0.5193 -
val_binary_accuracy: 0.7417 - val_auc_roc: 0.7863
roc-auc: 80.16% - roc-auc_val: 75.84%
Epoch 46/50
231477/231477 [==============================] - 13s 58us/step - loss: 0.5466 -
binary_accuracy: 0.7152 - auc_roc: 0.7864 - val_loss: 0.5197 -
val_binary_accuracy: 0.7421 - val_auc_roc: 0.7864
roc-auc: 80.20% - roc-auc_val: 76.09%
Epoch 47/50
231477/231477 [==============================] - 13s 56us/step - loss: 0.5465 -
binary_accuracy: 0.7153 - auc_roc: 0.7864 - val_loss: 0.5197 -
val_binary_accuracy: 0.7413 - val_auc_roc: 0.7864
```

```
roc-auc: 80.12% - roc-auc_val: 76.30%
Epoch 48/50
231477/231477 [==============================] - 13s 56us/step - loss: 0.5472 -
binary_accuracy: 0.7149 - auc_roc: 0.7864 - val_loss: 0.5241 -
val_binary_accuracy: 0.7304 - val_auc_roc: 0.7864
roc-auc: 80.13% - roc-auc_val: 76.15%
Epoch 49/50
231477/231477 [==============================] - 13s 56us/step - loss: 0.5465 -
binary_accuracy: 0.7159 - auc_roc: 0.7865 - val_loss: 0.5142 -
val_binary_accuracy: 0.7437 - val_auc_roc: 0.7865
roc-auc: 80.11% - roc-auc_val: 76.45%
Epoch 50/50
231477/231477 [==============================] - 13s 57us/step - loss: 0.5470 -
binary_accuracy: 0.7156 - auc_roc: 0.7865 - val_loss: 0.5183 -
val_binary_accuracy: 0.7453 - val_auc_roc: 0.7865
roc-auc: 80.23% - roc-auc_val: 76.28%
Train on 228988 samples, validate on 2489 samples
Epoch 1/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5464 -
binary_accuracy: 0.7163 - auc_roc: 0.7865 - val_loss: 0.5229 -
val_binary_accuracy: 0.6910 - val_auc_roc: 0.7865
roc-auc: 80.17% - roc-auc_val: 77.98%
Epoch 2/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5465 -
binary_accuracy: 0.7165 - auc_roc: 0.7866 - val_loss: 0.5304 -
val_binary_accuracy: 0.6910 - val_auc_roc: 0.7866
roc-auc: 80.16% - roc-auc_val: 77.60%
Epoch 3/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5467 -
binary_accuracy: 0.7166 - auc_roc: 0.7866 - val_loss: 0.5303 -
val_binary_accuracy: 0.6914 - val_auc_roc: 0.7866
roc-auc: 80.17% - roc-auc_val: 77.56%
Epoch 4/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5466 -
binary_accuracy: 0.7160 - auc_roc: 0.7866 - val_loss: 0.5262 -
val_binary_accuracy: 0.6886 - val_auc_roc: 0.7866
roc-auc: 80.24% - roc-auc_val: 77.81%
Epoch 5/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5467 -
binary_accuracy: 0.7155 - auc_roc: 0.7867 - val_loss: 0.5294 -
val_binary_accuracy: 0.6890 - val_auc_roc: 0.7867
roc-auc: 80.21% - roc-auc_val: 77.50%
Epoch 6/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5466 -
binary_accuracy: 0.7159 - auc_roc: 0.7867 - val_loss: 0.5479 -
val_binary_accuracy: 0.6894 - val_auc_roc: 0.7867
roc-auc: 80.16% - roc-auc_val: 77.45%
Epoch 7/50
```

```
228988/228988 [==============================] - 13s 56us/step - loss: 0.5460 -
binary_accuracy: 0.7162 - auc_roc: 0.7867 - val_loss: 0.5337 -
val_binary_accuracy: 0.6918 - val_auc_roc: 0.7867
roc-auc: 80.18% - roc-auc_val: 77.25%
Epoch 8/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5462 -
binary_accuracy: 0.7158 - auc_roc: 0.7868 - val_loss: 0.5333 -
val_binary_accuracy: 0.6838 - val_auc_roc: 0.7868
roc-auc: 80.25% - roc-auc_val: 77.23%
Epoch 9/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5467 -
binary_accuracy: 0.7163 - auc_roc: 0.7868 - val_loss: 0.5378 -
val_binary_accuracy: 0.6894 - val_auc_roc: 0.7868
roc-auc: 80.22% - roc-auc_val: 77.26%
Epoch 10/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5463 -
binary_accuracy: 0.7159 - auc_roc: 0.7868 - val_loss: 0.5363 -
val_binary_accuracy: 0.6935 - val_auc_roc: 0.7868
roc-auc: 80.23% - roc-auc_val: 77.23%
Epoch 11/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5464 -
binary_accuracy: 0.7159 - auc_roc: 0.7869 - val_loss: 0.5299 -
val_binary_accuracy: 0.6878 - val_auc_roc: 0.7869
roc-auc: 80.06% - roc-auc_val: 77.32%
Epoch 12/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5465 -
binary_accuracy: 0.7159 - auc_roc: 0.7869 - val_loss: 0.5319 -
val_binary_accuracy: 0.6798 - val_auc_roc: 0.7869
roc-auc: 80.17% - roc-auc_val: 76.90%
Epoch 13/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5467 -
binary_accuracy: 0.7155 - auc_roc: 0.7869 - val_loss: 0.5317 -
val_binary_accuracy: 0.6814 - val_auc_roc: 0.7869
roc-auc: 80.20% - roc-auc_val: 77.05%
Epoch 14/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5465 -
binary_accuracy: 0.7170 - auc_roc: 0.7870 - val_loss: 0.5314 -
val_binary_accuracy: 0.6822 - val_auc_roc: 0.7870
roc-auc: 80.22% - roc-auc_val: 77.01%
Epoch 15/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5466 -
binary_accuracy: 0.7162 - auc_roc: 0.7870 - val_loss: 0.5467 -
val_binary_accuracy: 0.6886 - val_auc_roc: 0.7870
roc-auc: 80.21% - roc-auc_val: 76.76%
Epoch 16/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5463 -
binary_accuracy: 0.7164 - auc_roc: 0.7870 - val_loss: 0.5422 -
val_binary_accuracy: 0.6830 - val_auc_roc: 0.7870
```

```
roc-auc: 80.16% - roc-auc_val: 76.69%
Epoch 17/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5459 -
binary_accuracy: 0.7167 - auc_roc: 0.7870 - val_loss: 0.5349 -
val_binary_accuracy: 0.6882 - val_auc_roc: 0.7871
roc-auc: 80.22% - roc-auc_val: 77.24%
Epoch 18/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5464 -
binary_accuracy: 0.7162 - auc_roc: 0.7871 - val_loss: 0.5326 -
val_binary_accuracy: 0.6910 - val_auc_roc: 0.7871
roc-auc: 80.23% - roc-auc_val: 77.29%
Epoch 19/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5459 -
binary_accuracy: 0.7164 - auc_roc: 0.7871 - val_loss: 0.5427 -
val_binary_accuracy: 0.6798 - val_auc_roc: 0.7871
roc-auc: 80.20% - roc-auc_val: 76.56%
Epoch 20/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5463 -
binary_accuracy: 0.7157 - auc_roc: 0.7871 - val_loss: 0.5351 -
val_binary_accuracy: 0.6770 - val_auc_roc: 0.7871
roc-auc: 80.24% - roc-auc_val: 76.76%
Epoch 21/50
228988/228988 [==============================] - 13s 57us/step - loss: 0.5463 -
binary_accuracy: 0.7165 - auc_roc: 0.7872 - val_loss: 0.5516 -
val_binary_accuracy: 0.6770 - val_auc_roc: 0.7872
roc-auc: 80.22% - roc-auc_val: 76.24%
Epoch 22/50
228988/228988 [==============================] - 13s 58us/step - loss: 0.5462 -
binary_accuracy: 0.7156 - auc_roc: 0.7872 - val_loss: 0.5336 -
val_binary_accuracy: 0.6850 - val_auc_roc: 0.7872
roc-auc: 80.21% - roc-auc_val: 76.85%
Epoch 23/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5464 -
binary_accuracy: 0.7166 - auc_roc: 0.7872 - val_loss: 0.5422 -
val_binary_accuracy: 0.6874 - val_auc_roc: 0.7872
roc-auc: 80.25% - roc-auc_val: 76.80%
Epoch 24/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5467 -
binary_accuracy: 0.7165 - auc_roc: 0.7872 - val_loss: 0.5535 -
val_binary_accuracy: 0.6810 - val_auc_roc: 0.7872
roc-auc: 80.25% - roc-auc_val: 76.37%
Epoch 25/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5459 -
binary_accuracy: 0.7160 - auc_roc: 0.7873 - val_loss: 0.5440 -
val_binary_accuracy: 0.6810 - val_auc_roc: 0.7873
roc-auc: 80.25% - roc-auc_val: 76.41%
Epoch 26/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5467 -
```

```
binary_accuracy: 0.7165 - auc_roc: 0.7873 - val_loss: 0.5381 -
val_binary_accuracy: 0.6790 - val_auc_roc: 0.7873
roc-auc: 80.23% - roc-auc_val: 76.77%
Epoch 27/50
228988/228988 [==============================] - 13s 55us/step - loss: 0.5461 -
binary_accuracy: 0.7163 - auc_roc: 0.7873 - val_loss: 0.5531 -
val_binary_accuracy: 0.6794 - val_auc_roc: 0.7873
roc-auc: 80.25% - roc-auc_val: 76.49%
Epoch 28/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5458 -
binary_accuracy: 0.7168 - auc_roc: 0.7873 - val_loss: 0.5354 -
val_binary_accuracy: 0.6774 - val_auc_roc: 0.7874
roc-auc: 80.28% - roc-auc_val: 76.86%
Epoch 29/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5461 -
binary_accuracy: 0.7171 - auc_roc: 0.7874 - val_loss: 0.5420 -
val_binary_accuracy: 0.6854 - val_auc_roc: 0.7874
roc-auc: 80.27% - roc-auc_val: 77.05%
Epoch 30/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5458 -
binary_accuracy: 0.7166 - auc_roc: 0.7874 - val_loss: 0.5332 -
val_binary_accuracy: 0.6830 - val_auc_roc: 0.7874
roc-auc: 80.30% - roc-auc_val: 76.98%
Epoch 31/50
228988/228988 [==============================] - 13s 55us/step - loss: 0.5458 -
binary_accuracy: 0.7160 - auc_roc: 0.7874 - val_loss: 0.5464 -
val_binary_accuracy: 0.6874 - val_auc_roc: 0.7874
roc-auc: 80.26% - roc-auc_val: 76.90%
Epoch 32/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5461 -
binary_accuracy: 0.7167 - auc_roc: 0.7875 - val_loss: 0.5721 -
val_binary_accuracy: 0.6838 - val_auc_roc: 0.7875
roc-auc: 80.32% - roc-auc_val: 76.35%
Epoch 33/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5458 -
binary_accuracy: 0.7170 - auc_roc: 0.7875 - val_loss: 0.5368 -
val_binary_accuracy: 0.6842 - val_auc_roc: 0.7875
roc-auc: 80.23% - roc-auc_val: 76.86%
Epoch 34/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5456 -
binary_accuracy: 0.7168 - auc_roc: 0.7875 - val_loss: 0.5401 -
val_binary_accuracy: 0.6842 - val_auc_roc: 0.7875
roc-auc: 80.28% - roc-auc_val: 76.75%
Epoch 35/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5459 -
binary_accuracy: 0.7172 - auc_roc: 0.7875 - val_loss: 0.5382 -
val_binary_accuracy: 0.6818 - val_auc_roc: 0.7875
roc-auc: 80.27% - roc-auc_val: 76.77%
```

```
Epoch 36/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5460 -
binary_accuracy: 0.7165 - auc_roc: 0.7876 - val_loss: 0.5602 -
val_binary_accuracy: 0.6838 - val_auc_roc: 0.7876
roc-auc: 80.32% - roc-auc_val: 76.57%
Epoch 37/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5456 -
binary_accuracy: 0.7166 - auc_roc: 0.7876 - val_loss: 0.5593 -
val_binary_accuracy: 0.6854 - val_auc_roc: 0.7876
roc-auc: 80.29% - roc-auc_val: 76.61%
Epoch 38/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5464 -
binary_accuracy: 0.7165 - auc_roc: 0.7876 - val_loss: 0.5419 -
val_binary_accuracy: 0.6834 - val_auc_roc: 0.7876
roc-auc: 80.29% - roc-auc_val: 76.66%
Epoch 39/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5459 -
binary_accuracy: 0.7162 - auc_roc: 0.7876 - val_loss: 0.5450 -
val_binary_accuracy: 0.6822 - val_auc_roc: 0.7876
roc-auc: 80.28% - roc-auc_val: 76.54%
Epoch 40/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5459 -
binary_accuracy: 0.7170 - auc_roc: 0.7877 - val_loss: 0.5576 -
val_binary_accuracy: 0.6854 - val_auc_roc: 0.7877
roc-auc: 80.29% - roc-auc_val: 76.18%
Epoch 41/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5454 -
binary_accuracy: 0.7169 - auc_roc: 0.7877 - val_loss: 0.5486 -
val_binary_accuracy: 0.6830 - val_auc_roc: 0.7877
roc-auc: 80.29% - roc-auc_val: 76.51%
Epoch 42/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5460 -
binary_accuracy: 0.7174 - auc_roc: 0.7877 - val_loss: 0.5454 -
val_binary_accuracy: 0.6842 - val_auc_roc: 0.7877
roc-auc: 80.31% - roc-auc_val: 76.88%
Epoch 43/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5454 -
binary_accuracy: 0.7168 - auc_roc: 0.7877 - val_loss: 0.5455 -
val_binary_accuracy: 0.6806 - val_auc_roc: 0.7877
roc-auc: 80.31% - roc-auc_val: 76.49%
Epoch 44/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5456 -
binary_accuracy: 0.7168 - auc_roc: 0.7878 - val_loss: 0.5409 -
val_binary_accuracy: 0.6810 - val_auc_roc: 0.7878
roc-auc: 80.31% - roc-auc_val: 76.54%
Epoch 45/50
228988/228988 [==============================] - 13s 55us/step - loss: 0.5456 -
binary_accuracy: 0.7169 - auc_roc: 0.7878 - val_loss: 0.5380 -
```

```
val_binary_accuracy: 0.6834 - val_auc_roc: 0.7878
roc-auc: 80.34% - roc-auc_val: 76.80%
Epoch 46/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5455 -
binary_accuracy: 0.7173 - auc_roc: 0.7878 - val_loss: 0.5386 -
val_binary_accuracy: 0.6802 - val_auc_roc: 0.7878
roc-auc: 80.32% - roc-auc_val: 76.40%
Epoch 47/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5456 -
binary_accuracy: 0.7173 - auc_roc: 0.7878 - val_loss: 0.5477 -
val_binary_accuracy: 0.6762 - val_auc_roc: 0.7878
roc-auc: 80.35% - roc-auc_val: 76.63%
Epoch 48/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5457 -
binary_accuracy: 0.7167 - auc_roc: 0.7878 - val_loss: 0.5348 -
val_binary_accuracy: 0.6814 - val_auc_roc: 0.7879
roc-auc: 80.27% - roc-auc_val: 76.67%
Epoch 49/50
228988/228988 [==============================] - 13s 56us/step - loss: 0.5458 -
binary_accuracy: 0.7165 - auc_roc: 0.7879 - val_loss: 0.5443 -
val_binary_accuracy: 0.6770 - val_auc_roc: 0.7879
roc-auc: 80.32% - roc-auc_val: 76.10%
Epoch 50/50
228988/228988 [==============================] - 13s 55us/step - loss: 0.5458 -
binary_accuracy: 0.7170 - auc_roc: 0.7879 - val_loss: 0.5480 -
val_binary_accuracy: 0.6798 - val_auc_roc: 0.7879
roc-auc: 80.31% - roc-auc_val: 76.32%
Train on 226499 samples, validate on 2489 samples
Epoch 1/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5475 -
binary_accuracy: 0.7153 - auc_roc: 0.7879 - val_loss: 0.3950 -
val_binary_accuracy: 0.8043 - val_auc_roc: 0.7879
roc-auc: 80.23% - roc-auc_val: 87.58%
Epoch 2/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5469 -
binary_accuracy: 0.7159 - auc_roc: 0.7879 - val_loss: 0.4031 -
val_binary_accuracy: 0.8003 - val_auc_roc: 0.7879
roc-auc: 80.20% - roc-auc_val: 86.76%
Epoch 3/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5477 -
binary_accuracy: 0.7158 - auc_roc: 0.7880 - val_loss: 0.4333 -
val_binary_accuracy: 0.7847 - val_auc_roc: 0.7880
roc-auc: 80.19% - roc-auc_val: 85.24%
Epoch 4/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5469 -
binary_accuracy: 0.7159 - auc_roc: 0.7880 - val_loss: 0.4360 -
val_binary_accuracy: 0.7798 - val_auc_roc: 0.7880
roc-auc: 80.22% - roc-auc_val: 85.06%
```

```
Epoch 5/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5473 -
binary_accuracy: 0.7160 - auc_roc: 0.7880 - val_loss: 0.4177 -
val_binary_accuracy: 0.7895 - val_auc_roc: 0.7880
roc-auc: 80.26% - roc-auc_val: 85.62%
Epoch 6/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5463 -
binary_accuracy: 0.7158 - auc_roc: 0.7880 - val_loss: 0.4236 -
val_binary_accuracy: 0.7923 - val_auc_roc: 0.7880
roc-auc: 80.19% - roc-auc_val: 85.57%
Epoch 7/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5461 -
binary_accuracy: 0.7163 - auc_roc: 0.7880 - val_loss: 0.4237 -
val_binary_accuracy: 0.7907 - val_auc_roc: 0.7881
roc-auc: 80.20% - roc-auc_val: 85.39%
Epoch 8/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5470 -
binary_accuracy: 0.7162 - auc_roc: 0.7881 - val_loss: 0.4666 -
val_binary_accuracy: 0.7626 - val_auc_roc: 0.7881
roc-auc: 80.26% - roc-auc_val: 83.26%
Epoch 9/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5459 -
binary_accuracy: 0.7164 - auc_roc: 0.7881 - val_loss: 0.4249 -
val_binary_accuracy: 0.7879 - val_auc_roc: 0.7881
roc-auc: 80.24% - roc-auc_val: 85.24%
Epoch 10/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5464 -
binary_accuracy: 0.7157 - auc_roc: 0.7881 - val_loss: 0.4240 -
val_binary_accuracy: 0.7887 - val_auc_roc: 0.7881
roc-auc: 80.24% - roc-auc_val: 85.24%
Epoch 11/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5464 -
binary_accuracy: 0.7156 - auc_roc: 0.7881 - val_loss: 0.4280 -
val_binary_accuracy: 0.7899 - val_auc_roc: 0.7881
roc-auc: 80.19% - roc-auc_val: 85.07%
Epoch 12/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5465 -
binary_accuracy: 0.7162 - auc_roc: 0.7881 - val_loss: 0.4347 -
val_binary_accuracy: 0.7875 - val_auc_roc: 0.7882
roc-auc: 80.25% - roc-auc_val: 85.04%
Epoch 13/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5464 -
binary_accuracy: 0.7166 - auc_roc: 0.7882 - val_loss: 0.4362 -
val_binary_accuracy: 0.7867 - val_auc_roc: 0.7882
roc-auc: 80.25% - roc-auc_val: 84.89%
Epoch 14/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5461 -
binary_accuracy: 0.7166 - auc_roc: 0.7882 - val_loss: 0.4625 -
```

```
val_binary_accuracy: 0.7690 - val_auc_roc: 0.7882
roc-auc: 80.21% - roc-auc_val: 83.62%
Epoch 15/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5464 -
binary_accuracy: 0.7159 - auc_roc: 0.7882 - val_loss: 0.4414 -
val_binary_accuracy: 0.7830 - val_auc_roc: 0.7882
roc-auc: 80.26% - roc-auc_val: 84.48%
Epoch 16/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5465 -
binary_accuracy: 0.7159 - auc_roc: 0.7882 - val_loss: 0.4443 -
val_binary_accuracy: 0.7802 - val_auc_roc: 0.7882
roc-auc: 80.19% - roc-auc_val: 84.26%
Epoch 17/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5465 -
binary_accuracy: 0.7165 - auc_roc: 0.7883 - val_loss: 0.4341 -
val_binary_accuracy: 0.7859 - val_auc_roc: 0.7883
roc-auc: 80.25% - roc-auc_val: 84.32%
Epoch 18/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5462 -
binary_accuracy: 0.7154 - auc_roc: 0.7883 - val_loss: 0.4449 -
val_binary_accuracy: 0.7790 - val_auc_roc: 0.7883
roc-auc: 80.23% - roc-auc_val: 83.63%
Epoch 19/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5461 -
binary_accuracy: 0.7167 - auc_roc: 0.7883 - val_loss: 0.4521 -
val_binary_accuracy: 0.7762 - val_auc_roc: 0.7883
roc-auc: 80.18% - roc-auc_val: 83.66%
Epoch 20/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5456 -
binary_accuracy: 0.7161 - auc_roc: 0.7883 - val_loss: 0.4701 -
val_binary_accuracy: 0.7654 - val_auc_roc: 0.7883
roc-auc: 80.28% - roc-auc_val: 82.93%
Epoch 21/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5461 -
binary_accuracy: 0.7170 - auc_roc: 0.7883 - val_loss: 0.4334 -
val_binary_accuracy: 0.7871 - val_auc_roc: 0.7883
roc-auc: 80.25% - roc-auc_val: 84.76%
Epoch 22/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5462 -
binary_accuracy: 0.7167 - auc_roc: 0.7884 - val_loss: 0.4349 -
val_binary_accuracy: 0.7867 - val_auc_roc: 0.7884
roc-auc: 80.31% - roc-auc_val: 84.51%
Epoch 23/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5461 -
binary_accuracy: 0.7165 - auc_roc: 0.7884 - val_loss: 0.4528 -
val_binary_accuracy: 0.7778 - val_auc_roc: 0.7884
roc-auc: 80.29% - roc-auc_val: 83.15%
Epoch 24/50
```

```
226499/226499 [==============================] - 13s 56us/step - loss: 0.5460 -
binary_accuracy: 0.7159 - auc_roc: 0.7884 - val_loss: 0.4494 -
val_binary_accuracy: 0.7802 - val_auc_roc: 0.7884
roc-auc: 80.27% - roc-auc_val: 83.20%
Epoch 25/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5467 -
binary_accuracy: 0.7157 - auc_roc: 0.7884 - val_loss: 0.4512 -
val_binary_accuracy: 0.7822 - val_auc_roc: 0.7884
roc-auc: 80.26% - roc-auc_val: 83.53%
Epoch 26/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5456 -
binary_accuracy: 0.7158 - auc_roc: 0.7884 - val_loss: 0.4542 -
val_binary_accuracy: 0.7770 - val_auc_roc: 0.7884
roc-auc: 80.26% - roc-auc_val: 84.07%
Epoch 27/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5458 -
binary_accuracy: 0.7161 - auc_roc: 0.7885 - val_loss: 0.4519 -
val_binary_accuracy: 0.7762 - val_auc_roc: 0.7885
roc-auc: 80.19% - roc-auc_val: 83.27%
Epoch 28/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5461 -
binary_accuracy: 0.7157 - auc_roc: 0.7885 - val_loss: 0.4503 -
val_binary_accuracy: 0.7810 - val_auc_roc: 0.7885
roc-auc: 80.31% - roc-auc_val: 83.48%
Epoch 29/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5460 -
binary_accuracy: 0.7157 - auc_roc: 0.7885 - val_loss: 0.4431 -
val_binary_accuracy: 0.7826 - val_auc_roc: 0.7885
roc-auc: 80.25% - roc-auc_val: 83.98%
Epoch 30/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5457 -
binary_accuracy: 0.7164 - auc_roc: 0.7885 - val_loss: 0.4529 -
val_binary_accuracy: 0.7778 - val_auc_roc: 0.7885
roc-auc: 80.29% - roc-auc_val: 83.79%
Epoch 31/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5466 -
binary_accuracy: 0.7164 - auc_roc: 0.7885 - val_loss: 0.4627 -
val_binary_accuracy: 0.7762 - val_auc_roc: 0.7885
roc-auc: 80.27% - roc-auc_val: 83.31%
Epoch 32/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5461 -
binary_accuracy: 0.7164 - auc_roc: 0.7885 - val_loss: 0.4740 -
val_binary_accuracy: 0.7622 - val_auc_roc: 0.7886
roc-auc: 80.32% - roc-auc_val: 82.17%
Epoch 33/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5459 -
binary_accuracy: 0.7165 - auc_roc: 0.7886 - val_loss: 0.4634 -
val_binary_accuracy: 0.7646 - val_auc_roc: 0.7886
```

```
roc-auc: 80.29% - roc-auc_val: 82.73%
Epoch 34/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5459 -
binary_accuracy: 0.7163 - auc_roc: 0.7886 - val_loss: 0.4647 -
val_binary_accuracy: 0.7738 - val_auc_roc: 0.7886
roc-auc: 80.28% - roc-auc_val: 82.90%
Epoch 35/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5458 -
binary_accuracy: 0.7163 - auc_roc: 0.7886 - val_loss: 0.4580 -
val_binary_accuracy: 0.7722 - val_auc_roc: 0.7886
roc-auc: 80.25% - roc-auc_val: 82.66%
Epoch 36/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5463 -
binary_accuracy: 0.7169 - auc_roc: 0.7886 - val_loss: 0.4622 -
val_binary_accuracy: 0.7686 - val_auc_roc: 0.7886
roc-auc: 80.27% - roc-auc_val: 82.65%
Epoch 37/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5465 -
binary_accuracy: 0.7167 - auc_roc: 0.7886 - val_loss: 0.4850 -
val_binary_accuracy: 0.7646 - val_auc_roc: 0.7886
roc-auc: 80.28% - roc-auc_val: 81.60%
Epoch 38/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5460 -
binary_accuracy: 0.7168 - auc_roc: 0.7886 - val_loss: 0.4763 -
val_binary_accuracy: 0.7650 - val_auc_roc: 0.7887
roc-auc: 80.28% - roc-auc_val: 81.48%
Epoch 39/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5461 -
binary_accuracy: 0.7158 - auc_roc: 0.7887 - val_loss: 0.4947 -
val_binary_accuracy: 0.7670 - val_auc_roc: 0.7887
roc-auc: 80.33% - roc-auc_val: 81.40%
Epoch 40/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5456 -
binary_accuracy: 0.7163 - auc_roc: 0.7887 - val_loss: 0.4583 -
val_binary_accuracy: 0.7802 - val_auc_roc: 0.7887
roc-auc: 80.35% - roc-auc_val: 82.70%
Epoch 41/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5458 -
binary_accuracy: 0.7165 - auc_roc: 0.7887 - val_loss: 0.5330 -
val_binary_accuracy: 0.7425 - val_auc_roc: 0.7887
roc-auc: 80.29% - roc-auc_val: 79.25%
Epoch 42/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5461 -
binary_accuracy: 0.7169 - auc_roc: 0.7887 - val_loss: 0.5322 -
val_binary_accuracy: 0.7485 - val_auc_roc: 0.7887
roc-auc: 80.34% - roc-auc_val: 79.42%
Epoch 43/50
226499/226499 [==============================] - 13s 55us/step - loss: 0.5458 -
```

```
binary_accuracy: 0.7160 - auc_roc: 0.7887 - val_loss: 0.4732 -
val_binary_accuracy: 0.7690 - val_auc_roc: 0.7887
roc-auc: 80.36% - roc-auc_val: 81.88%
Epoch 44/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5461 -
binary_accuracy: 0.7165 - auc_roc: 0.7887 - val_loss: 0.4661 -
val_binary_accuracy: 0.7662 - val_auc_roc: 0.7887
roc-auc: 80.27% - roc-auc_val: 82.35%
Epoch 45/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5460 -
binary_accuracy: 0.7162 - auc_roc: 0.7888 - val_loss: 0.4829 -
val_binary_accuracy: 0.7618 - val_auc_roc: 0.7888
roc-auc: 80.35% - roc-auc_val: 81.51%
Epoch 46/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5462 -
binary_accuracy: 0.7168 - auc_roc: 0.7888 - val_loss: 0.4600 -
val_binary_accuracy: 0.7734 - val_auc_roc: 0.7888
roc-auc: 80.28% - roc-auc_val: 82.30%
Epoch 47/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5459 -
binary_accuracy: 0.7168 - auc_roc: 0.7888 - val_loss: 0.4510 -
val_binary_accuracy: 0.7826 - val_auc_roc: 0.7888
roc-auc: 80.26% - roc-auc_val: 83.39%
Epoch 48/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5458 -
binary_accuracy: 0.7165 - auc_roc: 0.7888 - val_loss: 0.4677 -
val_binary_accuracy: 0.7698 - val_auc_roc: 0.7888
roc-auc: 80.34% - roc-auc_val: 82.90%
Epoch 49/50
226499/226499 [==============================] - 13s 56us/step - loss: 0.5462 -
binary_accuracy: 0.7161 - auc_roc: 0.7888 - val_loss: 0.4646 -
val_binary_accuracy: 0.7710 - val_auc_roc: 0.7888
roc-auc: 80.22% - roc-auc_val: 82.74%
Epoch 50/50
226499/226499 [==============================] - 13s 55us/step - loss: 0.5459 -
binary_accuracy: 0.7160 - auc_roc: 0.7888 - val_loss: 0.4672 -
val_binary_accuracy: 0.7690 - val_auc_roc: 0.7888
roc-auc: 80.29% - roc-auc_val: 82.49%
Train on 224010 samples, validate on 2489 samples
Epoch 1/50
224010/224010 [==============================] - 13s 56us/step - loss: 0.5457 -
binary_accuracy: 0.7168 - auc_roc: 0.7889 - val_loss: 0.5059 -
val_binary_accuracy: 0.7224 - val_auc_roc: 0.7889
roc-auc: 80.30% - roc-auc_val: 78.19%
Epoch 2/50
224010/224010 [==============================] - 13s 56us/step - loss: 0.5464 -
binary_accuracy: 0.7160 - auc_roc: 0.7889 - val_loss: 0.5121 -
val_binary_accuracy: 0.7204 - val_auc_roc: 0.7889
```

```
roc-auc: 80.28% - roc-auc_val: 77.42%
Epoch 3/50
224010/224010 [==============================] - 12s 56us/step - loss: 0.5463 -
binary_accuracy: 0.7153 - auc_roc: 0.7889 - val_loss: 0.5125 -
val_binary_accuracy: 0.7172 - val_auc_roc: 0.7889
roc-auc: 80.28% - roc-auc_val: 77.35%
Epoch 4/50
224010/224010 [==============================] - 12s 56us/step - loss: 0.5455 -
binary_accuracy: 0.7173 - auc_roc: 0.7889 - val_loss: 0.5244 -
val_binary_accuracy: 0.7107 - val_auc_roc: 0.7889
roc-auc: 80.29% - roc-auc_val: 77.37%
Epoch 5/50
224010/224010 [==============================] - 12s 56us/step - loss: 0.5462 -
binary_accuracy: 0.7158 - auc_roc: 0.7889 - val_loss: 0.5332 -
val_binary_accuracy: 0.6750 - val_auc_roc: 0.7889
roc-auc: 80.28% - roc-auc_val: 76.71%
Epoch 6/50
224010/224010 [==============================] - 12s 56us/step - loss: 0.5460 -
binary_accuracy: 0.7169 - auc_roc: 0.7889 - val_loss: 0.5233 -
val_binary_accuracy: 0.7051 - val_auc_roc: 0.7889
roc-auc: 80.23% - roc-auc_val: 76.63%
Epoch 7/50
224010/224010 [==============================] - 12s 56us/step - loss: 0.5462 -
binary_accuracy: 0.7172 - auc_roc: 0.7889 - val_loss: 0.5269 -
val_binary_accuracy: 0.6951 - val_auc_roc: 0.7889
roc-auc: 80.31% - roc-auc_val: 75.75%
Epoch 8/50
224010/224010 [==============================] - 12s 56us/step - loss: 0.5465 -
binary_accuracy: 0.7152 - auc_roc: 0.7889 - val_loss: 0.5239 -
val_binary_accuracy: 0.7019 - val_auc_roc: 0.7889
roc-auc: 80.25% - roc-auc_val: 76.15%
Epoch 9/50
224010/224010 [==============================] - 13s 56us/step - loss: 0.5458 -
binary_accuracy: 0.7167 - auc_roc: 0.7890 - val_loss: 0.5293 -
val_binary_accuracy: 0.6995 - val_auc_roc: 0.7890
roc-auc: 80.25% - roc-auc_val: 76.05%
Epoch 10/50
224010/224010 [==============================] - 12s 56us/step - loss: 0.5455 -
binary_accuracy: 0.7168 - auc_roc: 0.7890 - val_loss: 0.5293 -
val_binary_accuracy: 0.7015 - val_auc_roc: 0.7890
roc-auc: 80.30% - roc-auc_val: 76.33%
Epoch 11/50
224010/224010 [==============================] - 13s 56us/step - loss: 0.5463 -
binary_accuracy: 0.7160 - auc_roc: 0.7890 - val_loss: 0.5316 -
val_binary_accuracy: 0.6967 - val_auc_roc: 0.7890
roc-auc: 80.30% - roc-auc_val: 76.32%
Epoch 12/50
224010/224010 [==============================] - 12s 56us/step - loss: 0.5460 -
```

```
binary_accuracy: 0.7167 - auc_roc: 0.7890 - val_loss: 0.5327 -
val_binary_accuracy: 0.6975 - val_auc_roc: 0.7890
roc-auc: 80.29% - roc-auc_val: 75.80%
Epoch 13/50
224010/224010 [==============================] - 13s 56us/step - loss: 0.5454 -
binary_accuracy: 0.7173 - auc_roc: 0.7890 - val_loss: 0.5395 -
val_binary_accuracy: 0.6878 - val_auc_roc: 0.7890
roc-auc: 80.30% - roc-auc_val: 75.94%
Epoch 14/50
224010/224010 [==============================] - 12s 56us/step - loss: 0.5464 -
binary_accuracy: 0.7165 - auc_roc: 0.7890 - val_loss: 0.5376 -
val_binary_accuracy: 0.6706 - val_auc_roc: 0.7890
roc-auc: 80.30% - roc-auc_val: 75.72%
Epoch 15/50
224010/224010 [==============================] - 13s 56us/step - loss: 0.5453 -
binary_accuracy: 0.7168 - auc_roc: 0.7890 - val_loss: 0.5314 -
val_binary_accuracy: 0.6914 - val_auc_roc: 0.7890
roc-auc: 80.31% - roc-auc_val: 76.13%
Epoch 16/50
224010/224010 [==============================] - 13s 56us/step - loss: 0.5452 -
binary_accuracy: 0.7171 - auc_roc: 0.7890 - val_loss: 0.5394 -
val_binary_accuracy: 0.6770 - val_auc_roc: 0.7890
roc-auc: 80.32% - roc-auc_val: 75.61%
Epoch 17/50
224010/224010 [==============================] - 12s 56us/step - loss: 0.5454 -
binary_accuracy: 0.7164 - auc_roc: 0.7891 - val_loss: 0.5387 -
val_binary_accuracy: 0.6802 - val_auc_roc: 0.7891
roc-auc: 80.31% - roc-auc_val: 75.85%
Epoch 18/50
224010/224010 [==============================] - 12s 55us/step - loss: 0.5456 -
binary_accuracy: 0.7163 - auc_roc: 0.7891 - val_loss: 0.5480 -
val_binary_accuracy: 0.6794 - val_auc_roc: 0.7891
roc-auc: 80.31% - roc-auc_val: 75.35%
Epoch 19/50
224010/224010 [==============================] - 12s 56us/step - loss: 0.5455 -
binary_accuracy: 0.7167 - auc_roc: 0.7891 - val_loss: 0.5427 -
val_binary_accuracy: 0.6770 - val_auc_roc: 0.7891
roc-auc: 80.30% - roc-auc_val: 75.01%
Epoch 20/50
224010/224010 [==============================] - 12s 55us/step - loss: 0.5453 -
binary_accuracy: 0.7169 - auc_roc: 0.7891 - val_loss: 0.5425 -
val_binary_accuracy: 0.6926 - val_auc_roc: 0.7891
roc-auc: 80.29% - roc-auc_val: 75.04%
Epoch 21/50
224010/224010 [==============================] - 12s 55us/step - loss: 0.5458 -
binary_accuracy: 0.7169 - auc_roc: 0.7891 - val_loss: 0.5414 -
val_binary_accuracy: 0.6782 - val_auc_roc: 0.7891
roc-auc: 80.29% - roc-auc_val: 74.86%
```

```
Epoch 22/50
224010/224010 [==============================] - 12s 56us/step - loss: 0.5457 -
binary_accuracy: 0.7175 - auc_roc: 0.7891 - val_loss: 0.5432 -
val_binary_accuracy: 0.6790 - val_auc_roc: 0.7891
roc-auc: 80.30% - roc-auc_val: 74.52%
Epoch 23/50
224010/224010 [==============================] - 12s 56us/step - loss: 0.5462 -
binary_accuracy: 0.7167 - auc_roc: 0.7891 - val_loss: 0.5542 -
val_binary_accuracy: 0.6472 - val_auc_roc: 0.7891
roc-auc: 80.32% - roc-auc_val: 74.25%
Epoch 24/50
224010/224010 [==============================] - 12s 56us/step - loss: 0.5453 -
binary_accuracy: 0.7168 - auc_roc: 0.7891 - val_loss: 0.5547 -
val_binary_accuracy: 0.6260 - val_auc_roc: 0.7891
roc-auc: 80.33% - roc-auc_val: 74.10%
Epoch 25/50
224010/224010 [==============================] - 12s 56us/step - loss: 0.5458 -
binary_accuracy: 0.7173 - auc_roc: 0.7891 - val_loss: 0.5464 -
val_binary_accuracy: 0.6786 - val_auc_roc: 0.7891
roc-auc: 80.25% - roc-auc_val: 74.40%
Epoch 26/50
224010/224010 [==============================] - 12s 56us/step - loss: 0.5459 -
binary_accuracy: 0.7164 - auc_roc: 0.7892 - val_loss: 0.5497 -
val_binary_accuracy: 0.6641 - val_auc_roc: 0.7892
roc-auc: 80.36% - roc-auc_val: 74.58%
Epoch 27/50
224010/224010 [==============================] - 12s 56us/step - loss: 0.5452 -
binary_accuracy: 0.7166 - auc_roc: 0.7892 - val_loss: 0.5506 -
val_binary_accuracy: 0.6521 - val_auc_roc: 0.7892
roc-auc: 80.32% - roc-auc_val: 74.56%
Epoch 28/50
224010/224010 [==============================] - 12s 56us/step - loss: 0.5452 -
binary_accuracy: 0.7161 - auc_roc: 0.7892 - val_loss: 0.5495 -
val_binary_accuracy: 0.6621 - val_auc_roc: 0.7892
roc-auc: 80.31% - roc-auc_val: 73.32%
Epoch 29/50
224010/224010 [==============================] - 12s 56us/step - loss: 0.5451 -
binary_accuracy: 0.7168 - auc_roc: 0.7892 - val_loss: 0.5419 -
val_binary_accuracy: 0.6902 - val_auc_roc: 0.7892
roc-auc: 80.32% - roc-auc_val: 74.34%
Epoch 30/50
224010/224010 [==============================] - 12s 56us/step - loss: 0.5458 -
binary_accuracy: 0.7165 - auc_roc: 0.7892 - val_loss: 0.5540 -
val_binary_accuracy: 0.6609 - val_auc_roc: 0.7892
roc-auc: 80.32% - roc-auc_val: 73.92%
Epoch 31/50
224010/224010 [==============================] - 12s 56us/step - loss: 0.5451 -
binary_accuracy: 0.7167 - auc_roc: 0.7892 - val_loss: 0.5503 -
```

```
val_binary_accuracy: 0.6609 - val_auc_roc: 0.7892
roc-auc: 80.36% - roc-auc_val: 74.39%
Epoch 32/50
224010/224010 [==============================] - 12s 56us/step - loss: 0.5456 -
binary_accuracy: 0.7156 - auc_roc: 0.7892 - val_loss: 0.5488 -
val_binary_accuracy: 0.6786 - val_auc_roc: 0.7892
roc-auc: 80.40% - roc-auc_val: 74.62%
Epoch 33/50
224010/224010 [==============================] - 13s 56us/step - loss: 0.5453 -
binary_accuracy: 0.7165 - auc_roc: 0.7892 - val_loss: 0.5487 -
val_binary_accuracy: 0.6625 - val_auc_roc: 0.7892
roc-auc: 80.35% - roc-auc_val: 74.68%
Epoch 34/50
224010/224010 [==============================] - 13s 56us/step - loss: 0.5459 -
binary_accuracy: 0.7170 - auc_roc: 0.7892 - val_loss: 0.5401 -
val_binary_accuracy: 0.6951 - val_auc_roc: 0.7892
roc-auc: 80.29% - roc-auc_val: 74.51%
Epoch 35/50
224010/224010 [==============================] - 13s 56us/step - loss: 0.5458 -
binary_accuracy: 0.7170 - auc_roc: 0.7893 - val_loss: 0.5473 -
val_binary_accuracy: 0.6874 - val_auc_roc: 0.7893
roc-auc: 80.32% - roc-auc_val: 74.71%
Epoch 36/50
224010/224010 [==============================] - 13s 56us/step - loss: 0.5452 -
binary_accuracy: 0.7174 - auc_roc: 0.7893 - val_loss: 0.5445 -
val_binary_accuracy: 0.6693 - val_auc_roc: 0.7893
roc-auc: 80.32% - roc-auc_val: 74.18%
Epoch 37/50
224010/224010 [==============================] - 12s 56us/step - loss: 0.5455 -
binary_accuracy: 0.7172 - auc_roc: 0.7893 - val_loss: 0.5475 -
val_binary_accuracy: 0.6842 - val_auc_roc: 0.7893
roc-auc: 80.30% - roc-auc_val: 73.68%
Epoch 38/50
224010/224010 [==============================] - 13s 56us/step - loss: 0.5453 -
binary_accuracy: 0.7159 - auc_roc: 0.7893 - val_loss: 0.5545 -
val_binary_accuracy: 0.6428 - val_auc_roc: 0.7893
roc-auc: 80.35% - roc-auc_val: 74.10%
Epoch 39/50
224010/224010 [==============================] - 13s 56us/step - loss: 0.5460 -
binary_accuracy: 0.7170 - auc_roc: 0.7893 - val_loss: 0.5469 -
val_binary_accuracy: 0.6669 - val_auc_roc: 0.7893
roc-auc: 80.32% - roc-auc_val: 74.09%
Epoch 40/50
224010/224010 [==============================] - 13s 56us/step - loss: 0.5453 -
binary_accuracy: 0.7170 - auc_roc: 0.7893 - val_loss: 0.5480 -
val_binary_accuracy: 0.6649 - val_auc_roc: 0.7893
roc-auc: 80.35% - roc-auc_val: 73.86%
Epoch 41/50
```

```
224010/224010 [==============================] - 12s 55us/step - loss: 0.5456 -
binary_accuracy: 0.7163 - auc_roc: 0.7893 - val_loss: 0.5499 -
val_binary_accuracy: 0.6685 - val_auc_roc: 0.7893
roc-auc: 80.31% - roc-auc_val: 74.28%
Epoch 42/50
224010/224010 [==============================] - 12s 55us/step - loss: 0.5454 -
binary_accuracy: 0.7166 - auc_roc: 0.7893 - val_loss: 0.5489 -
val_binary_accuracy: 0.6786 - val_auc_roc: 0.7893
roc-auc: 80.32% - roc-auc_val: 73.96%
Epoch 43/50
224010/224010 [==============================] - 12s 56us/step - loss: 0.5453 -
binary_accuracy: 0.7169 - auc_roc: 0.7893 - val_loss: 0.5439 -
val_binary_accuracy: 0.6734 - val_auc_roc: 0.7893
roc-auc: 80.33% - roc-auc_val: 75.23%
Epoch 44/50
224010/224010 [==============================] - 12s 56us/step - loss: 0.5456 -
binary_accuracy: 0.7172 - auc_roc: 0.7893 - val_loss: 0.5593 -
val_binary_accuracy: 0.6107 - val_auc_roc: 0.7893
roc-auc: 80.37% - roc-auc_val: 73.81%
Epoch 45/50
224010/224010 [==============================] - 12s 56us/step - loss: 0.5455 -
binary_accuracy: 0.7173 - auc_roc: 0.7894 - val_loss: 0.5581 -
val_binary_accuracy: 0.6537 - val_auc_roc: 0.7894
roc-auc: 80.33% - roc-auc_val: 73.50%
Epoch 46/50
224010/224010 [==============================] - 12s 56us/step - loss: 0.5459 -
binary_accuracy: 0.7155 - auc_roc: 0.7894 - val_loss: 0.5538 -
val_binary_accuracy: 0.6593 - val_auc_roc: 0.7894
roc-auc: 80.33% - roc-auc_val: 74.33%
Epoch 47/50
224010/224010 [==============================] - 12s 56us/step - loss: 0.5455 -
binary_accuracy: 0.7165 - auc_roc: 0.7894 - val_loss: 0.5478 -
val_binary_accuracy: 0.6677 - val_auc_roc: 0.7894
roc-auc: 80.34% - roc-auc_val: 74.55%
Epoch 48/50
224010/224010 [==============================] - 12s 56us/step - loss: 0.5455 -
binary_accuracy: 0.7169 - auc_roc: 0.7894 - val_loss: 0.5537 -
val_binary_accuracy: 0.6814 - val_auc_roc: 0.7894
roc-auc: 80.32% - roc-auc_val: 74.14%
Epoch 49/50
224010/224010 [==============================] - 12s 56us/step - loss: 0.5451 -
binary_accuracy: 0.7178 - auc_roc: 0.7894 - val_loss: 0.5568 -
val_binary_accuracy: 0.6573 - val_auc_roc: 0.7894
roc-auc: 80.38% - roc-auc_val: 74.58%
Epoch 50/50
224010/224010 [==============================] - 12s 56us/step - loss: 0.5447 -
binary_accuracy: 0.7174 - auc_roc: 0.7894 - val_loss: 0.5437 -
val_binary_accuracy: 0.6983 - val_auc_roc: 0.7894
```

```
roc-auc: 80.32% - roc-auc_val: 74.52%
Train on 221521 samples, validate on 2489 samples
Epoch 1/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5451 -
binary_accuracy: 0.7180 - auc_roc: 0.7894 - val_loss: 0.5560 -
val_binary_accuracy: 0.6589 - val_auc_roc: 0.7894
roc-auc: 80.44% - roc-auc_val: 74.16%
Epoch 2/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5452 -
binary_accuracy: 0.7177 - auc_roc: 0.7894 - val_loss: 0.5674 -
val_binary_accuracy: 0.6545 - val_auc_roc: 0.7894
roc-auc: 80.41% - roc-auc_val: 73.31%
Epoch 3/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5445 -
binary_accuracy: 0.7177 - auc_roc: 0.7894 - val_loss: 0.5624 -
val_binary_accuracy: 0.6569 - val_auc_roc: 0.7894
roc-auc: 80.42% - roc-auc_val: 73.39%
Epoch 4/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5455 -
binary_accuracy: 0.7163 - auc_roc: 0.7894 - val_loss: 0.5572 -
val_binary_accuracy: 0.6541 - val_auc_roc: 0.7894
roc-auc: 80.39% - roc-auc_val: 73.67%
Epoch 5/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5457 -
binary_accuracy: 0.7166 - auc_roc: 0.7895 - val_loss: 0.5703 -
val_binary_accuracy: 0.6513 - val_auc_roc: 0.7895
roc-auc: 80.40% - roc-auc_val: 73.37%
Epoch 6/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5450 -
binary_accuracy: 0.7176 - auc_roc: 0.7895 - val_loss: 0.5613 -
val_binary_accuracy: 0.6541 - val_auc_roc: 0.7895
roc-auc: 80.34% - roc-auc_val: 73.24%
Epoch 7/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5448 -
binary_accuracy: 0.7180 - auc_roc: 0.7895 - val_loss: 0.5730 -
val_binary_accuracy: 0.6501 - val_auc_roc: 0.7895
roc-auc: 80.42% - roc-auc_val: 72.96%
Epoch 8/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5445 -
binary_accuracy: 0.7179 - auc_roc: 0.7895 - val_loss: 0.5660 -
val_binary_accuracy: 0.6509 - val_auc_roc: 0.7895
roc-auc: 80.44% - roc-auc_val: 73.19%
Epoch 9/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5454 -
binary_accuracy: 0.7172 - auc_roc: 0.7895 - val_loss: 0.5609 -
val_binary_accuracy: 0.6485 - val_auc_roc: 0.7895
roc-auc: 80.40% - roc-auc_val: 73.07%
Epoch 10/50
```

```
221521/221521 [==============================] - 12s 56us/step - loss: 0.5456 -
binary_accuracy: 0.7174 - auc_roc: 0.7895 - val_loss: 0.5651 -
val_binary_accuracy: 0.6472 - val_auc_roc: 0.7895
roc-auc: 80.37% - roc-auc_val: 72.78%
Epoch 11/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5449 -
binary_accuracy: 0.7172 - auc_roc: 0.7895 - val_loss: 0.5659 -
val_binary_accuracy: 0.6464 - val_auc_roc: 0.7895
roc-auc: 80.44% - roc-auc_val: 72.67%
Epoch 12/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5448 -
binary_accuracy: 0.7170 - auc_roc: 0.7895 - val_loss: 0.5742 -
val_binary_accuracy: 0.6485 - val_auc_roc: 0.7895
roc-auc: 80.40% - roc-auc_val: 72.34%
Epoch 13/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5451 -
binary_accuracy: 0.7180 - auc_roc: 0.7895 - val_loss: 0.5618 -
val_binary_accuracy: 0.6489 - val_auc_roc: 0.7895
roc-auc: 80.43% - roc-auc_val: 72.59%
Epoch 14/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5457 -
binary_accuracy: 0.7173 - auc_roc: 0.7895 - val_loss: 0.5710 -
val_binary_accuracy: 0.6456 - val_auc_roc: 0.7895
roc-auc: 80.41% - roc-auc_val: 72.55%
Epoch 15/50
221521/221521 [==============================] - 12s 55us/step - loss: 0.5450 -
binary_accuracy: 0.7171 - auc_roc: 0.7895 - val_loss: 0.5721 -
val_binary_accuracy: 0.6432 - val_auc_roc: 0.7895
roc-auc: 80.37% - roc-auc_val: 72.37%
Epoch 16/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5453 -
binary_accuracy: 0.7174 - auc_roc: 0.7895 - val_loss: 0.5738 -
val_binary_accuracy: 0.6440 - val_auc_roc: 0.7895
roc-auc: 80.40% - roc-auc_val: 72.25%
Epoch 17/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5447 -
binary_accuracy: 0.7178 - auc_roc: 0.7896 - val_loss: 0.5713 -
val_binary_accuracy: 0.6501 - val_auc_roc: 0.7896
roc-auc: 80.36% - roc-auc_val: 72.53%
Epoch 18/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5449 -
binary_accuracy: 0.7174 - auc_roc: 0.7896 - val_loss: 0.5737 -
val_binary_accuracy: 0.6481 - val_auc_roc: 0.7896
roc-auc: 80.38% - roc-auc_val: 72.58%
Epoch 19/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5449 -
binary_accuracy: 0.7186 - auc_roc: 0.7896 - val_loss: 0.5820 -
val_binary_accuracy: 0.6489 - val_auc_roc: 0.7896
```

```
roc-auc: 80.40% - roc-auc_val: 72.34%
Epoch 20/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5449 -
binary_accuracy: 0.7179 - auc_roc: 0.7896 - val_loss: 0.5651 -
val_binary_accuracy: 0.6509 - val_auc_roc: 0.7896
roc-auc: 80.45% - roc-auc_val: 72.88%
Epoch 21/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5454 -
binary_accuracy: 0.7170 - auc_roc: 0.7896 - val_loss: 0.5666 -
val_binary_accuracy: 0.6529 - val_auc_roc: 0.7896
roc-auc: 80.40% - roc-auc_val: 72.47%
Epoch 22/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5445 -
binary_accuracy: 0.7178 - auc_roc: 0.7896 - val_loss: 0.5953 -
val_binary_accuracy: 0.6396 - val_auc_roc: 0.7896
roc-auc: 80.48% - roc-auc_val: 71.68%
Epoch 23/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5448 -
binary_accuracy: 0.7178 - auc_roc: 0.7896 - val_loss: 0.5820 -
val_binary_accuracy: 0.6472 - val_auc_roc: 0.7896
roc-auc: 80.42% - roc-auc_val: 71.64%
Epoch 24/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5451 -
binary_accuracy: 0.7171 - auc_roc: 0.7896 - val_loss: 0.5795 -
val_binary_accuracy: 0.6456 - val_auc_roc: 0.7896
roc-auc: 80.39% - roc-auc_val: 71.95%
Epoch 25/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5450 -
binary_accuracy: 0.7176 - auc_roc: 0.7896 - val_loss: 0.5986 -
val_binary_accuracy: 0.6392 - val_auc_roc: 0.7896
roc-auc: 80.37% - roc-auc_val: 71.41%
Epoch 26/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5453 -
binary_accuracy: 0.7181 - auc_roc: 0.7896 - val_loss: 0.5746 -
val_binary_accuracy: 0.6448 - val_auc_roc: 0.7896
roc-auc: 80.41% - roc-auc_val: 71.97%
Epoch 27/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5447 -
binary_accuracy: 0.7178 - auc_roc: 0.7896 - val_loss: 0.5930 -
val_binary_accuracy: 0.6408 - val_auc_roc: 0.7896
roc-auc: 80.39% - roc-auc_val: 71.68%
Epoch 28/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5449 -
binary_accuracy: 0.7176 - auc_roc: 0.7896 - val_loss: 0.5987 -
val_binary_accuracy: 0.6440 - val_auc_roc: 0.7896
roc-auc: 80.41% - roc-auc_val: 71.83%
Epoch 29/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5448 -
```

```
binary_accuracy: 0.7177 - auc_roc: 0.7897 - val_loss: 0.6196 -
val_binary_accuracy: 0.6380 - val_auc_roc: 0.7897
roc-auc: 80.41% - roc-auc_val: 71.36%
Epoch 30/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5450 -
binary_accuracy: 0.7176 - auc_roc: 0.7897 - val_loss: 0.5879 -
val_binary_accuracy: 0.6388 - val_auc_roc: 0.7897
roc-auc: 80.43% - roc-auc_val: 71.49%
Epoch 31/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5447 -
binary_accuracy: 0.7173 - auc_roc: 0.7897 - val_loss: 0.5980 -
val_binary_accuracy: 0.6408 - val_auc_roc: 0.7897
roc-auc: 80.48% - roc-auc_val: 71.19%
Epoch 32/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5447 -
binary_accuracy: 0.7184 - auc_roc: 0.7897 - val_loss: 0.6142 -
val_binary_accuracy: 0.6380 - val_auc_roc: 0.7897
roc-auc: 80.45% - roc-auc_val: 70.88%
Epoch 33/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5448 -
binary_accuracy: 0.7175 - auc_roc: 0.7897 - val_loss: 0.6016 -
val_binary_accuracy: 0.6396 - val_auc_roc: 0.7897
roc-auc: 80.45% - roc-auc_val: 71.11%
Epoch 34/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5447 -
binary_accuracy: 0.7171 - auc_roc: 0.7897 - val_loss: 0.5836 -
val_binary_accuracy: 0.6420 - val_auc_roc: 0.7897
roc-auc: 80.45% - roc-auc_val: 71.58%
Epoch 35/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5444 -
binary_accuracy: 0.7183 - auc_roc: 0.7897 - val_loss: 0.6249 -
val_binary_accuracy: 0.6344 - val_auc_roc: 0.7897
roc-auc: 80.43% - roc-auc_val: 71.49%
Epoch 36/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5450 -
binary_accuracy: 0.7176 - auc_roc: 0.7897 - val_loss: 0.5832 -
val_binary_accuracy: 0.6352 - val_auc_roc: 0.7897
roc-auc: 80.49% - roc-auc_val: 71.46%
Epoch 37/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5454 -
binary_accuracy: 0.7177 - auc_roc: 0.7897 - val_loss: 0.6079 -
val_binary_accuracy: 0.6420 - val_auc_roc: 0.7897
roc-auc: 80.43% - roc-auc_val: 71.28%
Epoch 38/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5450 -
binary_accuracy: 0.7166 - auc_roc: 0.7897 - val_loss: 0.5935 -
val_binary_accuracy: 0.6336 - val_auc_roc: 0.7897
roc-auc: 80.45% - roc-auc_val: 71.49%
```

```
Epoch 39/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5453 -
binary_accuracy: 0.7173 - auc_roc: 0.7897 - val_loss: 0.6254 -
val_binary_accuracy: 0.6400 - val_auc_roc: 0.7897
roc-auc: 80.46% - roc-auc_val: 71.06%
Epoch 40/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5451 -
binary_accuracy: 0.7175 - auc_roc: 0.7897 - val_loss: 0.6080 -
val_binary_accuracy: 0.6428 - val_auc_roc: 0.7897
roc-auc: 80.42% - roc-auc_val: 71.15%
Epoch 41/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5450 -
binary_accuracy: 0.7178 - auc_roc: 0.7897 - val_loss: 0.6257 -
val_binary_accuracy: 0.6340 - val_auc_roc: 0.7897
roc-auc: 80.44% - roc-auc_val: 70.76%
Epoch 42/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5452 -
binary_accuracy: 0.7173 - auc_roc: 0.7897 - val_loss: 0.6283 -
val_binary_accuracy: 0.6408 - val_auc_roc: 0.7898
roc-auc: 80.45% - roc-auc_val: 71.02%
Epoch 43/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5447 -
binary_accuracy: 0.7176 - auc_roc: 0.7898 - val_loss: 0.6193 -
val_binary_accuracy: 0.6372 - val_auc_roc: 0.7898
roc-auc: 80.43% - roc-auc_val: 71.34%
Epoch 44/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5448 -
binary_accuracy: 0.7171 - auc_roc: 0.7898 - val_loss: 0.6500 -
val_binary_accuracy: 0.6328 - val_auc_roc: 0.7898
roc-auc: 80.44% - roc-auc_val: 71.41%
Epoch 45/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5442 -
binary_accuracy: 0.7180 - auc_roc: 0.7898 - val_loss: 0.6188 -
val_binary_accuracy: 0.6352 - val_auc_roc: 0.7898
roc-auc: 80.44% - roc-auc_val: 71.48%
Epoch 46/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5444 -
binary_accuracy: 0.7175 - auc_roc: 0.7898 - val_loss: 0.5901 -
val_binary_accuracy: 0.6436 - val_auc_roc: 0.7898
roc-auc: 80.43% - roc-auc_val: 71.22%
Epoch 47/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5445 -
binary_accuracy: 0.7181 - auc_roc: 0.7898 - val_loss: 0.6215 -
val_binary_accuracy: 0.6396 - val_auc_roc: 0.7898
roc-auc: 80.43% - roc-auc_val: 70.75%
Epoch 48/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5449 -
binary_accuracy: 0.7173 - auc_roc: 0.7898 - val_loss: 0.6314 -
```

```
val_binary_accuracy: 0.6372 - val_auc_roc: 0.7898
roc-auc: 80.43% - roc-auc_val: 71.12%
Epoch 49/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5447 -
binary_accuracy: 0.7176 - auc_roc: 0.7898 - val_loss: 0.6201 -
val_binary_accuracy: 0.6400 - val_auc_roc: 0.7898
roc-auc: 80.50% - roc-auc_val: 70.62%
Epoch 50/50
221521/221521 [==============================] - 12s 56us/step - loss: 0.5445 -
binary_accuracy: 0.7185 - auc_roc: 0.7898 - val_loss: 0.6330 -
val_binary_accuracy: 0.6340 - val_auc_roc: 0.7898
roc-auc: 80.46% - roc-auc_val: 70.80%
Train on 219032 samples, validate on 2489 samples
Epoch 1/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5454 -
binary_accuracy: 0.7178 - auc_roc: 0.7898 - val_loss: 0.4998 -
val_binary_accuracy: 0.7437 - val_auc_roc: 0.7898
roc-auc: 80.45% - roc-auc_val: 82.11%
Epoch 2/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5454 -
binary_accuracy: 0.7174 - auc_roc: 0.7898 - val_loss: 0.4998 -
val_binary_accuracy: 0.7384 - val_auc_roc: 0.7898
roc-auc: 80.37% - roc-auc_val: 81.72%
Epoch 3/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5455 -
binary_accuracy: 0.7173 - auc_roc: 0.7898 - val_loss: 0.5055 -
val_binary_accuracy: 0.7332 - val_auc_roc: 0.7898
roc-auc: 80.44% - roc-auc_val: 81.29%
Epoch 4/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5456 -
binary_accuracy: 0.7179 - auc_roc: 0.7898 - val_loss: 0.5025 -
val_binary_accuracy: 0.7308 - val_auc_roc: 0.7898
roc-auc: 80.47% - roc-auc_val: 81.27%
Epoch 5/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5450 -
binary_accuracy: 0.7183 - auc_roc: 0.7898 - val_loss: 0.5145 -
val_binary_accuracy: 0.7268 - val_auc_roc: 0.7899
roc-auc: 80.44% - roc-auc_val: 81.00%
Epoch 6/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5452 -
binary_accuracy: 0.7173 - auc_roc: 0.7899 - val_loss: 0.5079 -
val_binary_accuracy: 0.7288 - val_auc_roc: 0.7899
roc-auc: 80.50% - roc-auc_val: 80.67%
Epoch 7/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5450 -
binary_accuracy: 0.7168 - auc_roc: 0.7899 - val_loss: 0.5152 -
val_binary_accuracy: 0.7348 - val_auc_roc: 0.7899
roc-auc: 80.47% - roc-auc_val: 80.60%
```

```
Epoch 8/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5451 -
binary_accuracy: 0.7177 - auc_roc: 0.7899 - val_loss: 0.5277 -
val_binary_accuracy: 0.7252 - val_auc_roc: 0.7899
roc-auc: 80.46% - roc-auc_val: 80.07%
Epoch 9/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5450 -
binary_accuracy: 0.7184 - auc_roc: 0.7899 - val_loss: 0.5284 -
val_binary_accuracy: 0.7240 - val_auc_roc: 0.7899
roc-auc: 80.45% - roc-auc_val: 80.06%
Epoch 10/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5451 -
binary_accuracy: 0.7180 - auc_roc: 0.7899 - val_loss: 0.5162 -
val_binary_accuracy: 0.7220 - val_auc_roc: 0.7899
roc-auc: 80.45% - roc-auc_val: 80.34%
Epoch 11/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5446 -
binary_accuracy: 0.7180 - auc_roc: 0.7899 - val_loss: 0.5246 -
val_binary_accuracy: 0.7208 - val_auc_roc: 0.7899
roc-auc: 80.52% - roc-auc_val: 80.06%
Epoch 12/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5445 -
binary_accuracy: 0.7177 - auc_roc: 0.7899 - val_loss: 0.5369 -
val_binary_accuracy: 0.7172 - val_auc_roc: 0.7899
roc-auc: 80.51% - roc-auc_val: 79.21%
Epoch 13/50
219032/219032 [==============================] - 12s 55us/step - loss: 0.5452 -
binary_accuracy: 0.7175 - auc_roc: 0.7899 - val_loss: 0.5512 -
val_binary_accuracy: 0.7155 - val_auc_roc: 0.7899
roc-auc: 80.46% - roc-auc_val: 79.06%
Epoch 14/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5443 -
binary_accuracy: 0.7184 - auc_roc: 0.7899 - val_loss: 0.5139 -
val_binary_accuracy: 0.7244 - val_auc_roc: 0.7899
roc-auc: 80.52% - roc-auc_val: 79.91%
Epoch 15/50
219032/219032 [==============================] - 12s 55us/step - loss: 0.5446 -
binary_accuracy: 0.7174 - auc_roc: 0.7899 - val_loss: 0.5209 -
val_binary_accuracy: 0.7216 - val_auc_roc: 0.7899
roc-auc: 80.46% - roc-auc_val: 79.19%
Epoch 16/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5444 -
binary_accuracy: 0.7172 - auc_roc: 0.7899 - val_loss: 0.5261 -
val_binary_accuracy: 0.7143 - val_auc_roc: 0.7899
roc-auc: 80.49% - roc-auc_val: 79.16%
Epoch 17/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5451 -
binary_accuracy: 0.7178 - auc_roc: 0.7900 - val_loss: 0.5182 -
```

```
val_binary_accuracy: 0.7220 - val_auc_roc: 0.7900
roc-auc: 80.49% - roc-auc_val: 79.39%
Epoch 18/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5451 -
binary_accuracy: 0.7169 - auc_roc: 0.7900 - val_loss: 0.5268 -
val_binary_accuracy: 0.7160 - val_auc_roc: 0.7900
roc-auc: 80.44% - roc-auc_val: 79.45%
Epoch 19/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5453 -
binary_accuracy: 0.7166 - auc_roc: 0.7900 - val_loss: 0.5291 -
val_binary_accuracy: 0.7172 - val_auc_roc: 0.7900
roc-auc: 80.39% - roc-auc_val: 79.21%
Epoch 20/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5445 -
binary_accuracy: 0.7174 - auc_roc: 0.7900 - val_loss: 0.5264 -
val_binary_accuracy: 0.7200 - val_auc_roc: 0.7900
roc-auc: 80.51% - roc-auc_val: 79.53%
Epoch 21/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5449 -
binary_accuracy: 0.7180 - auc_roc: 0.7900 - val_loss: 0.5222 -
val_binary_accuracy: 0.7164 - val_auc_roc: 0.7900
roc-auc: 80.46% - roc-auc_val: 79.36%
Epoch 22/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5446 -
binary_accuracy: 0.7179 - auc_roc: 0.7900 - val_loss: 0.5301 -
val_binary_accuracy: 0.7091 - val_auc_roc: 0.7900
roc-auc: 80.43% - roc-auc_val: 78.83%
Epoch 23/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5443 -
binary_accuracy: 0.7178 - auc_roc: 0.7900 - val_loss: 0.5292 -
val_binary_accuracy: 0.7164 - val_auc_roc: 0.7900
roc-auc: 80.47% - roc-auc_val: 79.03%
Epoch 24/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5451 -
binary_accuracy: 0.7181 - auc_roc: 0.7900 - val_loss: 0.5458 -
val_binary_accuracy: 0.7107 - val_auc_roc: 0.7900
roc-auc: 80.53% - roc-auc_val: 78.86%
Epoch 25/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5451 -
binary_accuracy: 0.7170 - auc_roc: 0.7900 - val_loss: 0.5651 -
val_binary_accuracy: 0.7051 - val_auc_roc: 0.7900
roc-auc: 80.47% - roc-auc_val: 78.02%
Epoch 26/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5451 -
binary_accuracy: 0.7177 - auc_roc: 0.7900 - val_loss: 0.5402 -
val_binary_accuracy: 0.7143 - val_auc_roc: 0.7900
roc-auc: 80.40% - roc-auc_val: 78.67%
Epoch 27/50
```

```
219032/219032 [==============================] - 12s 56us/step - loss: 0.5442 -
binary_accuracy: 0.7178 - auc_roc: 0.7900 - val_loss: 0.5416 -
val_binary_accuracy: 0.7127 - val_auc_roc: 0.7900
roc-auc: 80.43% - roc-auc_val: 78.58%
Epoch 28/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5443 -
binary_accuracy: 0.7179 - auc_roc: 0.7900 - val_loss: 0.5282 -
val_binary_accuracy: 0.7184 - val_auc_roc: 0.7900
roc-auc: 80.50% - roc-auc_val: 79.11%
Epoch 29/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5437 -
binary_accuracy: 0.7176 - auc_roc: 0.7900 - val_loss: 0.5283 -
val_binary_accuracy: 0.7151 - val_auc_roc: 0.7901
roc-auc: 80.46% - roc-auc_val: 78.87%
Epoch 30/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5444 -
binary_accuracy: 0.7171 - auc_roc: 0.7901 - val_loss: 0.5436 -
val_binary_accuracy: 0.7119 - val_auc_roc: 0.7901
roc-auc: 80.48% - roc-auc_val: 78.07%
Epoch 31/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5447 -
binary_accuracy: 0.7183 - auc_roc: 0.7901 - val_loss: 0.5301 -
val_binary_accuracy: 0.7119 - val_auc_roc: 0.7901
roc-auc: 80.52% - roc-auc_val: 78.58%
Epoch 32/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5442 -
binary_accuracy: 0.7188 - auc_roc: 0.7901 - val_loss: 0.5440 -
val_binary_accuracy: 0.7143 - val_auc_roc: 0.7901
roc-auc: 80.48% - roc-auc_val: 78.73%
Epoch 33/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5444 -
binary_accuracy: 0.7179 - auc_roc: 0.7901 - val_loss: 0.5543 -
val_binary_accuracy: 0.7063 - val_auc_roc: 0.7901
roc-auc: 80.42% - roc-auc_val: 77.92%
Epoch 34/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5448 -
binary_accuracy: 0.7177 - auc_roc: 0.7901 - val_loss: 0.5427 -
val_binary_accuracy: 0.7115 - val_auc_roc: 0.7901
roc-auc: 80.51% - roc-auc_val: 78.11%
Epoch 35/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5448 -
binary_accuracy: 0.7176 - auc_roc: 0.7901 - val_loss: 0.5539 -
val_binary_accuracy: 0.7139 - val_auc_roc: 0.7901
roc-auc: 80.46% - roc-auc_val: 78.26%
Epoch 36/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5444 -
binary_accuracy: 0.7177 - auc_roc: 0.7901 - val_loss: 0.5412 -
val_binary_accuracy: 0.7164 - val_auc_roc: 0.7901
```

```
roc-auc: 80.46% - roc-auc_val: 78.62%
Epoch 37/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5447 -
binary_accuracy: 0.7178 - auc_roc: 0.7901 - val_loss: 0.5431 -
val_binary_accuracy: 0.7176 - val_auc_roc: 0.7901
roc-auc: 80.48% - roc-auc_val: 78.32%
Epoch 38/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5448 -
binary_accuracy: 0.7178 - auc_roc: 0.7901 - val_loss: 0.5416 -
val_binary_accuracy: 0.7095 - val_auc_roc: 0.7901
roc-auc: 80.49% - roc-auc_val: 78.14%
Epoch 39/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5448 -
binary_accuracy: 0.7181 - auc_roc: 0.7901 - val_loss: 0.5663 -
val_binary_accuracy: 0.7079 - val_auc_roc: 0.7901
roc-auc: 80.49% - roc-auc_val: 77.64%
Epoch 40/50
219032/219032 [==============================] - 12s 55us/step - loss: 0.5446 -
binary_accuracy: 0.7177 - auc_roc: 0.7901 - val_loss: 0.5329 -
val_binary_accuracy: 0.7103 - val_auc_roc: 0.7901
roc-auc: 80.52% - roc-auc_val: 78.27%
Epoch 41/50
219032/219032 [==============================] - 12s 55us/step - loss: 0.5445 -
binary_accuracy: 0.7177 - auc_roc: 0.7901 - val_loss: 0.5438 -
val_binary_accuracy: 0.7059 - val_auc_roc: 0.7901
roc-auc: 80.48% - roc-auc_val: 78.00%
Epoch 42/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5449 -
binary_accuracy: 0.7175 - auc_roc: 0.7902 - val_loss: 0.5386 -
val_binary_accuracy: 0.7131 - val_auc_roc: 0.7902
roc-auc: 80.48% - roc-auc_val: 78.18%
Epoch 43/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5439 -
binary_accuracy: 0.7174 - auc_roc: 0.7902 - val_loss: 0.5405 -
val_binary_accuracy: 0.7099 - val_auc_roc: 0.7902
roc-auc: 80.52% - roc-auc_val: 78.23%
Epoch 44/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5449 -
binary_accuracy: 0.7175 - auc_roc: 0.7902 - val_loss: 0.5487 -
val_binary_accuracy: 0.7095 - val_auc_roc: 0.7902
roc-auc: 80.52% - roc-auc_val: 78.03%
Epoch 45/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5448 -
binary_accuracy: 0.7175 - auc_roc: 0.7902 - val_loss: 0.5346 -
val_binary_accuracy: 0.7099 - val_auc_roc: 0.7902
roc-auc: 80.52% - roc-auc_val: 78.03%
Epoch 46/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5439 -
```

```
binary_accuracy: 0.7179 - auc_roc: 0.7902 - val_loss: 0.5426 -
val_binary_accuracy: 0.7003 - val_auc_roc: 0.7902
roc-auc: 80.55% - roc-auc_val: 77.62%
Epoch 47/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5443 -
binary_accuracy: 0.7180 - auc_roc: 0.7902 - val_loss: 0.5381 -
val_binary_accuracy: 0.7123 - val_auc_roc: 0.7902
roc-auc: 80.53% - roc-auc_val: 78.31%
Epoch 48/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5442 -
binary_accuracy: 0.7178 - auc_roc: 0.7902 - val_loss: 0.5371 -
val_binary_accuracy: 0.7079 - val_auc_roc: 0.7902
roc-auc: 80.53% - roc-auc_val: 77.93%
Epoch 49/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5441 -
binary_accuracy: 0.7175 - auc_roc: 0.7902 - val_loss: 0.5497 -
val_binary_accuracy: 0.7027 - val_auc_roc: 0.7902
roc-auc: 80.51% - roc-auc_val: 77.13%
Epoch 50/50
219032/219032 [==============================] - 12s 56us/step - loss: 0.5448 -
binary_accuracy: 0.7178 - auc_roc: 0.7902 - val_loss: 0.5471 -
val_binary_accuracy: 0.7115 - val_auc_roc: 0.7902
roc-auc: 80.54% - roc-auc_val: 78.01%
Train on 216543 samples, validate on 2489 samples
Epoch 1/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5448 -
binary_accuracy: 0.7176 - auc_roc: 0.7902 - val_loss: 0.4927 -
val_binary_accuracy: 0.7389 - val_auc_roc: 0.7902
roc-auc: 80.40% - roc-auc_val: 80.53%
Epoch 2/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5445 -
binary_accuracy: 0.7177 - auc_roc: 0.7902 - val_loss: 0.4974 -
val_binary_accuracy: 0.7380 - val_auc_roc: 0.7902
roc-auc: 80.44% - roc-auc_val: 80.32%
Epoch 3/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5452 -
binary_accuracy: 0.7176 - auc_roc: 0.7902 - val_loss: 0.5091 -
val_binary_accuracy: 0.7304 - val_auc_roc: 0.7902
roc-auc: 80.42% - roc-auc_val: 79.46%
Epoch 4/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5449 -
binary_accuracy: 0.7175 - auc_roc: 0.7902 - val_loss: 0.5117 -
val_binary_accuracy: 0.7272 - val_auc_roc: 0.7902
roc-auc: 80.45% - roc-auc_val: 79.57%
Epoch 5/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5445 -
binary_accuracy: 0.7183 - auc_roc: 0.7903 - val_loss: 0.5163 -
val_binary_accuracy: 0.7276 - val_auc_roc: 0.7903
```

```
roc-auc: 80.47% - roc-auc_val: 78.90%
Epoch 6/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5442 -
binary_accuracy: 0.7175 - auc_roc: 0.7903 - val_loss: 0.5082 -
val_binary_accuracy: 0.7280 - val_auc_roc: 0.7903
roc-auc: 80.54% - roc-auc_val: 78.77%
Epoch 7/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5446 -
binary_accuracy: 0.7178 - auc_roc: 0.7903 - val_loss: 0.5201 -
val_binary_accuracy: 0.7212 - val_auc_roc: 0.7903
roc-auc: 80.48% - roc-auc_val: 78.33%
Epoch 8/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5444 -
binary_accuracy: 0.7185 - auc_roc: 0.7903 - val_loss: 0.5112 -
val_binary_accuracy: 0.7192 - val_auc_roc: 0.7903
roc-auc: 80.44% - roc-auc_val: 78.45%
Epoch 9/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5446 -
binary_accuracy: 0.7178 - auc_roc: 0.7903 - val_loss: 0.5154 -
val_binary_accuracy: 0.7212 - val_auc_roc: 0.7903
roc-auc: 80.51% - roc-auc_val: 78.54%
Epoch 10/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5449 -
binary_accuracy: 0.7176 - auc_roc: 0.7903 - val_loss: 0.5194 -
val_binary_accuracy: 0.7192 - val_auc_roc: 0.7903
roc-auc: 80.53% - roc-auc_val: 78.05%
Epoch 11/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5452 -
binary_accuracy: 0.7180 - auc_roc: 0.7903 - val_loss: 0.5204 -
val_binary_accuracy: 0.7172 - val_auc_roc: 0.7903
roc-auc: 80.46% - roc-auc_val: 78.02%
Epoch 12/50
216543/216543 [==============================] - 12s 55us/step - loss: 0.5449 -
binary_accuracy: 0.7180 - auc_roc: 0.7903 - val_loss: 0.5281 -
val_binary_accuracy: 0.7188 - val_auc_roc: 0.7903
roc-auc: 80.45% - roc-auc_val: 77.33%
Epoch 13/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5450 -
binary_accuracy: 0.7177 - auc_roc: 0.7903 - val_loss: 0.5231 -
val_binary_accuracy: 0.7123 - val_auc_roc: 0.7903
roc-auc: 80.46% - roc-auc_val: 77.20%
Epoch 14/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5452 -
binary_accuracy: 0.7173 - auc_roc: 0.7903 - val_loss: 0.5251 -
val_binary_accuracy: 0.7180 - val_auc_roc: 0.7903
roc-auc: 80.46% - roc-auc_val: 77.54%
Epoch 15/50
216543/216543 [==============================] - 12s 55us/step - loss: 0.5447 -
```

```
binary_accuracy: 0.7180 - auc_roc: 0.7903 - val_loss: 0.5217 -
val_binary_accuracy: 0.7204 - val_auc_roc: 0.7903
roc-auc: 80.41% - roc-auc_val: 77.88%
Epoch 16/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5442 -
binary_accuracy: 0.7174 - auc_roc: 0.7903 - val_loss: 0.5275 -
val_binary_accuracy: 0.7103 - val_auc_roc: 0.7903
roc-auc: 80.45% - roc-auc_val: 77.05%
Epoch 17/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5446 -
binary_accuracy: 0.7185 - auc_roc: 0.7903 - val_loss: 0.5210 -
val_binary_accuracy: 0.7115 - val_auc_roc: 0.7903
roc-auc: 80.46% - roc-auc_val: 77.29%
Epoch 18/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5447 -
binary_accuracy: 0.7175 - auc_roc: 0.7903 - val_loss: 0.5332 -
val_binary_accuracy: 0.7111 - val_auc_roc: 0.7904
roc-auc: 80.46% - roc-auc_val: 76.73%
Epoch 19/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5451 -
binary_accuracy: 0.7172 - auc_roc: 0.7904 - val_loss: 0.5380 -
val_binary_accuracy: 0.6943 - val_auc_roc: 0.7904
roc-auc: 80.50% - roc-auc_val: 77.06%
Epoch 20/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5443 -
binary_accuracy: 0.7188 - auc_roc: 0.7904 - val_loss: 0.5209 -
val_binary_accuracy: 0.7091 - val_auc_roc: 0.7904
roc-auc: 80.50% - roc-auc_val: 77.42%
Epoch 21/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5446 -
binary_accuracy: 0.7177 - auc_roc: 0.7904 - val_loss: 0.5235 -
val_binary_accuracy: 0.7079 - val_auc_roc: 0.7904
roc-auc: 80.44% - roc-auc_val: 77.24%
Epoch 22/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5442 -
binary_accuracy: 0.7175 - auc_roc: 0.7904 - val_loss: 0.5272 -
val_binary_accuracy: 0.7103 - val_auc_roc: 0.7904
roc-auc: 80.52% - roc-auc_val: 77.32%
Epoch 23/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5448 -
binary_accuracy: 0.7181 - auc_roc: 0.7904 - val_loss: 0.5337 -
val_binary_accuracy: 0.7067 - val_auc_roc: 0.7904
roc-auc: 80.50% - roc-auc_val: 76.68%
Epoch 24/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5451 -
binary_accuracy: 0.7173 - auc_roc: 0.7904 - val_loss: 0.5279 -
val_binary_accuracy: 0.7023 - val_auc_roc: 0.7904
roc-auc: 80.43% - roc-auc_val: 76.22%
```

```
Epoch 25/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5453 -
binary_accuracy: 0.7176 - auc_roc: 0.7904 - val_loss: 0.5295 -
val_binary_accuracy: 0.7047 - val_auc_roc: 0.7904
roc-auc: 80.50% - roc-auc_val: 76.42%
Epoch 26/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5448 -
binary_accuracy: 0.7173 - auc_roc: 0.7904 - val_loss: 0.5290 -
val_binary_accuracy: 0.7055 - val_auc_roc: 0.7904
roc-auc: 80.48% - roc-auc_val: 76.39%
Epoch 27/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5443 -
binary_accuracy: 0.7179 - auc_roc: 0.7904 - val_loss: 0.5419 -
val_binary_accuracy: 0.7043 - val_auc_roc: 0.7904
roc-auc: 80.44% - roc-auc_val: 76.49%
Epoch 28/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5446 -
binary_accuracy: 0.7174 - auc_roc: 0.7904 - val_loss: 0.5297 -
val_binary_accuracy: 0.7039 - val_auc_roc: 0.7904
roc-auc: 80.47% - roc-auc_val: 76.17%
Epoch 29/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5450 -
binary_accuracy: 0.7179 - auc_roc: 0.7904 - val_loss: 0.5378 -
val_binary_accuracy: 0.7015 - val_auc_roc: 0.7904
roc-auc: 80.44% - roc-auc_val: 75.91%
Epoch 30/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5446 -
binary_accuracy: 0.7179 - auc_roc: 0.7904 - val_loss: 0.5349 -
val_binary_accuracy: 0.6930 - val_auc_roc: 0.7904
roc-auc: 80.45% - roc-auc_val: 75.66%
Epoch 31/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5446 -
binary_accuracy: 0.7177 - auc_roc: 0.7904 - val_loss: 0.5352 -
val_binary_accuracy: 0.7027 - val_auc_roc: 0.7904
roc-auc: 80.51% - roc-auc_val: 75.81%
Epoch 32/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5442 -
binary_accuracy: 0.7186 - auc_roc: 0.7904 - val_loss: 0.5424 -
val_binary_accuracy: 0.6947 - val_auc_roc: 0.7904
roc-auc: 80.45% - roc-auc_val: 75.96%
Epoch 33/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5443 -
binary_accuracy: 0.7181 - auc_roc: 0.7904 - val_loss: 0.5396 -
val_binary_accuracy: 0.6910 - val_auc_roc: 0.7904
roc-auc: 80.52% - roc-auc_val: 75.81%
Epoch 34/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5444 -
binary_accuracy: 0.7188 - auc_roc: 0.7905 - val_loss: 0.5412 -
```

```
val_binary_accuracy: 0.6939 - val_auc_roc: 0.7905
roc-auc: 80.51% - roc-auc_val: 75.98%
Epoch 35/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5446 -
binary_accuracy: 0.7174 - auc_roc: 0.7905 - val_loss: 0.5397 -
val_binary_accuracy: 0.6995 - val_auc_roc: 0.7905
roc-auc: 80.52% - roc-auc_val: 76.09%
Epoch 36/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5442 -
binary_accuracy: 0.7178 - auc_roc: 0.7905 - val_loss: 0.5437 -
val_binary_accuracy: 0.6862 - val_auc_roc: 0.7905
roc-auc: 80.50% - roc-auc_val: 75.82%
Epoch 37/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5448 -
binary_accuracy: 0.7183 - auc_roc: 0.7905 - val_loss: 0.5415 -
val_binary_accuracy: 0.6955 - val_auc_roc: 0.7905
roc-auc: 80.43% - roc-auc_val: 76.06%
Epoch 38/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5441 -
binary_accuracy: 0.7176 - auc_roc: 0.7905 - val_loss: 0.5493 -
val_binary_accuracy: 0.6922 - val_auc_roc: 0.7905
roc-auc: 80.48% - roc-auc_val: 75.39%
Epoch 39/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5445 -
binary_accuracy: 0.7180 - auc_roc: 0.7905 - val_loss: 0.5592 -
val_binary_accuracy: 0.6782 - val_auc_roc: 0.7905
roc-auc: 80.52% - roc-auc_val: 75.17%
Epoch 40/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5442 -
binary_accuracy: 0.7183 - auc_roc: 0.7905 - val_loss: 0.5417 -
val_binary_accuracy: 0.6995 - val_auc_roc: 0.7905
roc-auc: 80.49% - roc-auc_val: 75.30%
Epoch 41/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5440 -
binary_accuracy: 0.7182 - auc_roc: 0.7905 - val_loss: 0.5454 -
val_binary_accuracy: 0.6983 - val_auc_roc: 0.7905
roc-auc: 80.53% - roc-auc_val: 75.58%
Epoch 42/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5444 -
binary_accuracy: 0.7187 - auc_roc: 0.7905 - val_loss: 0.5400 -
val_binary_accuracy: 0.6967 - val_auc_roc: 0.7905
roc-auc: 80.49% - roc-auc_val: 75.17%
Epoch 43/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5444 -
binary_accuracy: 0.7171 - auc_roc: 0.7905 - val_loss: 0.5456 -
val_binary_accuracy: 0.6910 - val_auc_roc: 0.7905
roc-auc: 80.49% - roc-auc_val: 75.10%
Epoch 44/50
```

```
216543/216543 [==============================] - 12s 56us/step - loss: 0.5445 -
binary_accuracy: 0.7181 - auc_roc: 0.7905 - val_loss: 0.5603 -
val_binary_accuracy: 0.6882 - val_auc_roc: 0.7905
roc-auc: 80.51% - roc-auc_val: 74.05%
Epoch 45/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5441 -
binary_accuracy: 0.7175 - auc_roc: 0.7905 - val_loss: 0.5492 -
val_binary_accuracy: 0.6866 - val_auc_roc: 0.7905
roc-auc: 80.51% - roc-auc_val: 75.35%
Epoch 46/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5444 -
binary_accuracy: 0.7186 - auc_roc: 0.7905 - val_loss: 0.5465 -
val_binary_accuracy: 0.6794 - val_auc_roc: 0.7905
roc-auc: 80.52% - roc-auc_val: 75.12%
Epoch 47/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5447 -
binary_accuracy: 0.7177 - auc_roc: 0.7905 - val_loss: 0.5539 -
val_binary_accuracy: 0.6758 - val_auc_roc: 0.7905
roc-auc: 80.51% - roc-auc_val: 74.04%
Epoch 48/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5450 -
binary_accuracy: 0.7178 - auc_roc: 0.7905 - val_loss: 0.5421 -
val_binary_accuracy: 0.6866 - val_auc_roc: 0.7905
roc-auc: 80.48% - roc-auc_val: 74.72%
Epoch 49/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5446 -
binary_accuracy: 0.7183 - auc_roc: 0.7905 - val_loss: 0.5405 -
val_binary_accuracy: 0.6983 - val_auc_roc: 0.7905
roc-auc: 80.51% - roc-auc_val: 74.94%
Epoch 50/50
216543/216543 [==============================] - 12s 56us/step - loss: 0.5443 -
binary_accuracy: 0.7182 - auc_roc: 0.7906 - val_loss: 0.5499 -
val_binary_accuracy: 0.6922 - val_auc_roc: 0.7906
roc-auc: 80.43% - roc-auc_val: 74.38%
Train on 214054 samples, validate on 2489 samples
Epoch 1/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5446 -
binary_accuracy: 0.7180 - auc_roc: 0.7906 - val_loss: 0.5659 -
val_binary_accuracy: 0.6697 - val_auc_roc: 0.7906
roc-auc: 80.47% - roc-auc_val: 74.42%
Epoch 2/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5438 -
binary_accuracy: 0.7189 - auc_roc: 0.7906 - val_loss: 0.5786 -
val_binary_accuracy: 0.6645 - val_auc_roc: 0.7906
roc-auc: 80.54% - roc-auc_val: 74.11%
Epoch 3/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5438 -
binary_accuracy: 0.7190 - auc_roc: 0.7906 - val_loss: 0.5632 -
```

```
val_binary_accuracy: 0.6657 - val_auc_roc: 0.7906
roc-auc: 80.58% - roc-auc_val: 74.19%
Epoch 4/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5448 -
binary_accuracy: 0.7182 - auc_roc: 0.7906 - val_loss: 0.5609 -
val_binary_accuracy: 0.6641 - val_auc_roc: 0.7906
roc-auc: 80.55% - roc-auc_val: 74.21%
Epoch 5/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5432 -
binary_accuracy: 0.7196 - auc_roc: 0.7906 - val_loss: 0.5728 -
val_binary_accuracy: 0.6601 - val_auc_roc: 0.7906
roc-auc: 80.52% - roc-auc_val: 73.85%
Epoch 6/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5441 -
binary_accuracy: 0.7192 - auc_roc: 0.7906 - val_loss: 0.5665 -
val_binary_accuracy: 0.6641 - val_auc_roc: 0.7906
roc-auc: 80.56% - roc-auc_val: 73.38%
Epoch 7/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5442 -
binary_accuracy: 0.7193 - auc_roc: 0.7906 - val_loss: 0.5848 -
val_binary_accuracy: 0.6601 - val_auc_roc: 0.7906
roc-auc: 80.53% - roc-auc_val: 73.56%
Epoch 8/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5436 -
binary_accuracy: 0.7189 - auc_roc: 0.7906 - val_loss: 0.5878 -
val_binary_accuracy: 0.6545 - val_auc_roc: 0.7906
roc-auc: 80.51% - roc-auc_val: 73.13%
Epoch 9/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5442 -
binary_accuracy: 0.7179 - auc_roc: 0.7906 - val_loss: 0.5847 -
val_binary_accuracy: 0.6589 - val_auc_roc: 0.7906
roc-auc: 80.55% - roc-auc_val: 73.34%
Epoch 10/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5445 -
binary_accuracy: 0.7183 - auc_roc: 0.7906 - val_loss: 0.5828 -
val_binary_accuracy: 0.6557 - val_auc_roc: 0.7906
roc-auc: 80.54% - roc-auc_val: 72.73%
Epoch 11/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5441 -
binary_accuracy: 0.7184 - auc_roc: 0.7906 - val_loss: 0.5779 -
val_binary_accuracy: 0.6585 - val_auc_roc: 0.7906
roc-auc: 80.55% - roc-auc_val: 73.19%
Epoch 12/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5434 -
binary_accuracy: 0.7188 - auc_roc: 0.7906 - val_loss: 0.5860 -
val_binary_accuracy: 0.6565 - val_auc_roc: 0.7906
roc-auc: 80.59% - roc-auc_val: 73.08%
Epoch 13/50
```

```
214054/214054 [==============================] - 12s 56us/step - loss: 0.5436 -
binary_accuracy: 0.7190 - auc_roc: 0.7906 - val_loss: 0.5957 -
val_binary_accuracy: 0.6609 - val_auc_roc: 0.7906
roc-auc: 80.54% - roc-auc_val: 72.91%
Epoch 14/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5431 -
binary_accuracy: 0.7199 - auc_roc: 0.7906 - val_loss: 0.6153 -
val_binary_accuracy: 0.6476 - val_auc_roc: 0.7906
roc-auc: 80.54% - roc-auc_val: 72.43%
Epoch 15/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5444 -
binary_accuracy: 0.7186 - auc_roc: 0.7906 - val_loss: 0.5850 -
val_binary_accuracy: 0.6541 - val_auc_roc: 0.7906
roc-auc: 80.56% - roc-auc_val: 72.68%
Epoch 16/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5439 -
binary_accuracy: 0.7193 - auc_roc: 0.7906 - val_loss: 0.5972 -
val_binary_accuracy: 0.6605 - val_auc_roc: 0.7906
roc-auc: 80.54% - roc-auc_val: 72.07%
Epoch 17/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5440 -
binary_accuracy: 0.7183 - auc_roc: 0.7907 - val_loss: 0.5974 -
val_binary_accuracy: 0.6541 - val_auc_roc: 0.7907
roc-auc: 80.54% - roc-auc_val: 72.04%
Epoch 18/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5444 -
binary_accuracy: 0.7183 - auc_roc: 0.7907 - val_loss: 0.6049 -
val_binary_accuracy: 0.6569 - val_auc_roc: 0.7907
roc-auc: 80.54% - roc-auc_val: 72.78%
Epoch 19/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5440 -
binary_accuracy: 0.7186 - auc_roc: 0.7907 - val_loss: 0.5975 -
val_binary_accuracy: 0.6460 - val_auc_roc: 0.7907
roc-auc: 80.53% - roc-auc_val: 72.44%
Epoch 20/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5443 -
binary_accuracy: 0.7191 - auc_roc: 0.7907 - val_loss: 0.6145 -
val_binary_accuracy: 0.6444 - val_auc_roc: 0.7907
roc-auc: 80.55% - roc-auc_val: 71.80%
Epoch 21/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5442 -
binary_accuracy: 0.7181 - auc_roc: 0.7907 - val_loss: 0.5888 -
val_binary_accuracy: 0.6517 - val_auc_roc: 0.7907
roc-auc: 80.54% - roc-auc_val: 72.53%
Epoch 22/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5440 -
binary_accuracy: 0.7189 - auc_roc: 0.7907 - val_loss: 0.5971 -
val_binary_accuracy: 0.6513 - val_auc_roc: 0.7907
```

```
roc-auc: 80.65% - roc-auc_val: 72.56%
Epoch 23/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5438 -
binary_accuracy: 0.7189 - auc_roc: 0.7907 - val_loss: 0.5968 -
val_binary_accuracy: 0.6513 - val_auc_roc: 0.7907
roc-auc: 80.52% - roc-auc_val: 72.11%
Epoch 24/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5443 -
binary_accuracy: 0.7182 - auc_roc: 0.7907 - val_loss: 0.6076 -
val_binary_accuracy: 0.6464 - val_auc_roc: 0.7907
roc-auc: 80.52% - roc-auc_val: 72.26%
Epoch 25/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5434 -
binary_accuracy: 0.7193 - auc_roc: 0.7907 - val_loss: 0.5917 -
val_binary_accuracy: 0.6501 - val_auc_roc: 0.7907
roc-auc: 80.61% - roc-auc_val: 72.05%
Epoch 26/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5445 -
binary_accuracy: 0.7183 - auc_roc: 0.7907 - val_loss: 0.6034 -
val_binary_accuracy: 0.6509 - val_auc_roc: 0.7907
roc-auc: 80.56% - roc-auc_val: 72.67%
Epoch 27/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5437 -
binary_accuracy: 0.7184 - auc_roc: 0.7907 - val_loss: 0.6073 -
val_binary_accuracy: 0.6517 - val_auc_roc: 0.7907
roc-auc: 80.53% - roc-auc_val: 72.28%
Epoch 28/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5440 -
binary_accuracy: 0.7183 - auc_roc: 0.7907 - val_loss: 0.6140 -
val_binary_accuracy: 0.6513 - val_auc_roc: 0.7907
roc-auc: 80.59% - roc-auc_val: 72.06%
Epoch 29/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5437 -
binary_accuracy: 0.7191 - auc_roc: 0.7907 - val_loss: 0.5933 -
val_binary_accuracy: 0.6525 - val_auc_roc: 0.7907
roc-auc: 80.58% - roc-auc_val: 72.31%
Epoch 30/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5441 -
binary_accuracy: 0.7187 - auc_roc: 0.7907 - val_loss: 0.6046 -
val_binary_accuracy: 0.6549 - val_auc_roc: 0.7907
roc-auc: 80.54% - roc-auc_val: 71.95%
Epoch 31/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5439 -
binary_accuracy: 0.7188 - auc_roc: 0.7907 - val_loss: 0.6063 -
val_binary_accuracy: 0.6452 - val_auc_roc: 0.7907
roc-auc: 80.59% - roc-auc_val: 71.46%
Epoch 32/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5439 -
```

```
binary_accuracy: 0.7176 - auc_roc: 0.7907 - val_loss: 0.6139 -
val_binary_accuracy: 0.6541 - val_auc_roc: 0.7907
roc-auc: 80.56% - roc-auc_val: 71.94%
Epoch 33/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5434 -
binary_accuracy: 0.7186 - auc_roc: 0.7907 - val_loss: 0.6128 -
val_binary_accuracy: 0.6517 - val_auc_roc: 0.7907
roc-auc: 80.55% - roc-auc_val: 71.79%
Epoch 34/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5438 -
binary_accuracy: 0.7189 - auc_roc: 0.7907 - val_loss: 0.6038 -
val_binary_accuracy: 0.6529 - val_auc_roc: 0.7907
roc-auc: 80.56% - roc-auc_val: 72.16%
Epoch 35/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5444 -
binary_accuracy: 0.7182 - auc_roc: 0.7907 - val_loss: 0.6257 -
val_binary_accuracy: 0.6485 - val_auc_roc: 0.7907
roc-auc: 80.53% - roc-auc_val: 71.51%
Epoch 36/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5446 -
binary_accuracy: 0.7190 - auc_roc: 0.7907 - val_loss: 0.6090 -
val_binary_accuracy: 0.6476 - val_auc_roc: 0.7907
roc-auc: 80.54% - roc-auc_val: 71.72%
Epoch 37/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5434 -
binary_accuracy: 0.7195 - auc_roc: 0.7907 - val_loss: 0.5944 -
val_binary_accuracy: 0.6513 - val_auc_roc: 0.7908
roc-auc: 80.54% - roc-auc_val: 72.09%
Epoch 38/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5442 -
binary_accuracy: 0.7187 - auc_roc: 0.7908 - val_loss: 0.6165 -
val_binary_accuracy: 0.6444 - val_auc_roc: 0.7908
roc-auc: 80.53% - roc-auc_val: 71.26%
Epoch 39/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5434 -
binary_accuracy: 0.7191 - auc_roc: 0.7908 - val_loss: 0.6289 -
val_binary_accuracy: 0.6476 - val_auc_roc: 0.7908
roc-auc: 80.55% - roc-auc_val: 72.01%
Epoch 40/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5436 -
binary_accuracy: 0.7190 - auc_roc: 0.7908 - val_loss: 0.6460 -
val_binary_accuracy: 0.6444 - val_auc_roc: 0.7908
roc-auc: 80.53% - roc-auc_val: 71.30%
Epoch 41/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5434 -
binary_accuracy: 0.7192 - auc_roc: 0.7908 - val_loss: 0.6097 -
val_binary_accuracy: 0.6396 - val_auc_roc: 0.7908
roc-auc: 80.53% - roc-auc_val: 70.91%
```

```
Epoch 42/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5439 -
binary_accuracy: 0.7190 - auc_roc: 0.7908 - val_loss: 0.6178 -
val_binary_accuracy: 0.6436 - val_auc_roc: 0.7908
roc-auc: 80.54% - roc-auc_val: 71.36%
Epoch 43/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5438 -
binary_accuracy: 0.7185 - auc_roc: 0.7908 - val_loss: 0.6159 -
val_binary_accuracy: 0.6376 - val_auc_roc: 0.7908
roc-auc: 80.59% - roc-auc_val: 70.97%
Epoch 44/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5442 -
binary_accuracy: 0.7194 - auc_roc: 0.7908 - val_loss: 0.6148 -
val_binary_accuracy: 0.6404 - val_auc_roc: 0.7908
roc-auc: 80.58% - roc-auc_val: 71.53%
Epoch 45/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5440 -
binary_accuracy: 0.7192 - auc_roc: 0.7908 - val_loss: 0.6456 -
val_binary_accuracy: 0.6400 - val_auc_roc: 0.7908
roc-auc: 80.53% - roc-auc_val: 71.46%
Epoch 46/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5447 -
binary_accuracy: 0.7193 - auc_roc: 0.7908 - val_loss: 0.6045 -
val_binary_accuracy: 0.6432 - val_auc_roc: 0.7908
roc-auc: 80.57% - roc-auc_val: 71.14%
Epoch 47/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5435 -
binary_accuracy: 0.7184 - auc_roc: 0.7908 - val_loss: 0.6246 -
val_binary_accuracy: 0.6456 - val_auc_roc: 0.7908
roc-auc: 80.60% - roc-auc_val: 71.44%
Epoch 48/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5442 -
binary_accuracy: 0.7179 - auc_roc: 0.7908 - val_loss: 0.6442 -
val_binary_accuracy: 0.6537 - val_auc_roc: 0.7908
roc-auc: 80.55% - roc-auc_val: 71.62%
Epoch 49/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5441 -
binary_accuracy: 0.7184 - auc_roc: 0.7908 - val_loss: 0.6691 -
val_binary_accuracy: 0.6517 - val_auc_roc: 0.7908
roc-auc: 80.58% - roc-auc_val: 71.63%
Epoch 50/50
214054/214054 [==============================] - 12s 56us/step - loss: 0.5436 -
binary_accuracy: 0.7192 - auc_roc: 0.7908 - val_loss: 0.7108 -
val_binary_accuracy: 0.6316 - val_auc_roc: 0.7908
roc-auc: 80.56% - roc-auc_val: 70.68%
Train on 211565 samples, validate on 2489 samples
Epoch 1/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5437 -
```

```
binary_accuracy: 0.7201 - auc_roc: 0.7908 - val_loss: 0.5706 -
val_binary_accuracy: 0.6573 - val_auc_roc: 0.7908
roc-auc: 80.57% - roc-auc_val: 73.10%
Epoch 2/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5437 -
binary_accuracy: 0.7190 - auc_roc: 0.7908 - val_loss: 0.5697 -
val_binary_accuracy: 0.6497 - val_auc_roc: 0.7908
roc-auc: 80.66% - roc-auc_val: 72.62%
Epoch 3/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5430 -
binary_accuracy: 0.7197 - auc_roc: 0.7908 - val_loss: 0.5706 -
val_binary_accuracy: 0.6215 - val_auc_roc: 0.7908
roc-auc: 80.60% - roc-auc_val: 71.36%
Epoch 4/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5432 -
binary_accuracy: 0.7199 - auc_roc: 0.7908 - val_loss: 0.5691 -
val_binary_accuracy: 0.6444 - val_auc_roc: 0.7908
roc-auc: 80.63% - roc-auc_val: 71.04%
Epoch 5/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5440 -
binary_accuracy: 0.7206 - auc_roc: 0.7908 - val_loss: 0.5795 -
val_binary_accuracy: 0.6384 - val_auc_roc: 0.7908
roc-auc: 80.58% - roc-auc_val: 70.79%
Epoch 6/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5432 -
binary_accuracy: 0.7203 - auc_roc: 0.7908 - val_loss: 0.5789 -
val_binary_accuracy: 0.6276 - val_auc_roc: 0.7908
roc-auc: 80.62% - roc-auc_val: 70.45%
Epoch 7/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5431 -
binary_accuracy: 0.7199 - auc_roc: 0.7908 - val_loss: 0.5884 -
val_binary_accuracy: 0.6231 - val_auc_roc: 0.7908
roc-auc: 80.58% - roc-auc_val: 70.51%
Epoch 8/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5432 -
binary_accuracy: 0.7196 - auc_roc: 0.7909 - val_loss: 0.5756 -
val_binary_accuracy: 0.6276 - val_auc_roc: 0.7909
roc-auc: 80.64% - roc-auc_val: 69.87%
Epoch 9/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5433 -
binary_accuracy: 0.7204 - auc_roc: 0.7909 - val_loss: 0.5755 -
val_binary_accuracy: 0.6227 - val_auc_roc: 0.7909
roc-auc: 80.66% - roc-auc_val: 70.24%
Epoch 10/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5428 -
binary_accuracy: 0.7196 - auc_roc: 0.7909 - val_loss: 0.5771 -
val_binary_accuracy: 0.6336 - val_auc_roc: 0.7909
roc-auc: 80.67% - roc-auc_val: 70.26%
```

```
Epoch 11/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5435 -
binary_accuracy: 0.7197 - auc_roc: 0.7909 - val_loss: 0.5848 -
val_binary_accuracy: 0.6336 - val_auc_roc: 0.7909
roc-auc: 80.62% - roc-auc_val: 69.99%
Epoch 12/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5440 -
binary_accuracy: 0.7194 - auc_roc: 0.7909 - val_loss: 0.5776 -
val_binary_accuracy: 0.6256 - val_auc_roc: 0.7909
roc-auc: 80.67% - roc-auc_val: 69.45%
Epoch 13/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5431 -
binary_accuracy: 0.7208 - auc_roc: 0.7909 - val_loss: 0.5821 -
val_binary_accuracy: 0.6103 - val_auc_roc: 0.7909
roc-auc: 80.67% - roc-auc_val: 68.48%
Epoch 14/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5429 -
binary_accuracy: 0.7196 - auc_roc: 0.7909 - val_loss: 0.5800 -
val_binary_accuracy: 0.6195 - val_auc_roc: 0.7909
roc-auc: 80.56% - roc-auc_val: 69.52%
Epoch 15/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5434 -
binary_accuracy: 0.7200 - auc_roc: 0.7909 - val_loss: 0.5887 -
val_binary_accuracy: 0.6119 - val_auc_roc: 0.7909
roc-auc: 80.61% - roc-auc_val: 69.54%
Epoch 16/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5435 -
binary_accuracy: 0.7199 - auc_roc: 0.7909 - val_loss: 0.5942 -
val_binary_accuracy: 0.6123 - val_auc_roc: 0.7909
roc-auc: 80.62% - roc-auc_val: 68.65%
Epoch 17/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5432 -
binary_accuracy: 0.7193 - auc_roc: 0.7909 - val_loss: 0.6013 -
val_binary_accuracy: 0.6099 - val_auc_roc: 0.7909
roc-auc: 80.63% - roc-auc_val: 68.49%
Epoch 18/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5431 -
binary_accuracy: 0.7197 - auc_roc: 0.7909 - val_loss: 0.5883 -
val_binary_accuracy: 0.6107 - val_auc_roc: 0.7909
roc-auc: 80.64% - roc-auc_val: 68.65%
Epoch 19/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5434 -
binary_accuracy: 0.7200 - auc_roc: 0.7909 - val_loss: 0.5997 -
val_binary_accuracy: 0.6027 - val_auc_roc: 0.7909
roc-auc: 80.61% - roc-auc_val: 68.13%
Epoch 20/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5430 -
binary_accuracy: 0.7198 - auc_roc: 0.7909 - val_loss: 0.6106 -
```

```
val_binary_accuracy: 0.6171 - val_auc_roc: 0.7909
roc-auc: 80.61% - roc-auc_val: 69.18%
Epoch 21/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5433 -
binary_accuracy: 0.7206 - auc_roc: 0.7909 - val_loss: 0.5900 -
val_binary_accuracy: 0.6035 - val_auc_roc: 0.7909
roc-auc: 80.54% - roc-auc_val: 69.09%
Epoch 22/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5436 -
binary_accuracy: 0.7199 - auc_roc: 0.7909 - val_loss: 0.5976 -
val_binary_accuracy: 0.6087 - val_auc_roc: 0.7909
roc-auc: 80.63% - roc-auc_val: 68.65%
Epoch 23/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5434 -
binary_accuracy: 0.7199 - auc_roc: 0.7909 - val_loss: 0.5950 -
val_binary_accuracy: 0.6091 - val_auc_roc: 0.7909
roc-auc: 80.63% - roc-auc_val: 68.89%
Epoch 24/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5431 -
binary_accuracy: 0.7205 - auc_roc: 0.7909 - val_loss: 0.6008 -
val_binary_accuracy: 0.6115 - val_auc_roc: 0.7909
roc-auc: 80.57% - roc-auc_val: 68.62%
Epoch 25/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5438 -
binary_accuracy: 0.7192 - auc_roc: 0.7909 - val_loss: 0.5959 -
val_binary_accuracy: 0.6095 - val_auc_roc: 0.7909
roc-auc: 80.66% - roc-auc_val: 68.35%
Epoch 26/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5434 -
binary_accuracy: 0.7198 - auc_roc: 0.7910 - val_loss: 0.5992 -
val_binary_accuracy: 0.6099 - val_auc_roc: 0.7910
roc-auc: 80.62% - roc-auc_val: 68.69%
Epoch 27/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5427 -
binary_accuracy: 0.7197 - auc_roc: 0.7910 - val_loss: 0.5989 -
val_binary_accuracy: 0.6075 - val_auc_roc: 0.7910
roc-auc: 80.63% - roc-auc_val: 68.22%
Epoch 28/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5434 -
binary_accuracy: 0.7199 - auc_roc: 0.7910 - val_loss: 0.6195 -
val_binary_accuracy: 0.6039 - val_auc_roc: 0.7910
roc-auc: 80.63% - roc-auc_val: 68.29%
Epoch 29/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5432 -
binary_accuracy: 0.7204 - auc_roc: 0.7910 - val_loss: 0.5938 -
val_binary_accuracy: 0.6027 - val_auc_roc: 0.7910
roc-auc: 80.61% - roc-auc_val: 67.37%
Epoch 30/50
```

```
211565/211565 [==============================] - 12s 56us/step - loss: 0.5432 -
binary_accuracy: 0.7199 - auc_roc: 0.7910 - val_loss: 0.6162 -
val_binary_accuracy: 0.6127 - val_auc_roc: 0.7910
roc-auc: 80.56% - roc-auc_val: 67.86%
Epoch 31/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5433 -
binary_accuracy: 0.7195 - auc_roc: 0.7910 - val_loss: 0.5966 -
val_binary_accuracy: 0.6075 - val_auc_roc: 0.7910
roc-auc: 80.58% - roc-auc_val: 67.98%
Epoch 32/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5433 -
binary_accuracy: 0.7201 - auc_roc: 0.7910 - val_loss: 0.5984 -
val_binary_accuracy: 0.5978 - val_auc_roc: 0.7910
roc-auc: 80.56% - roc-auc_val: 68.29%
Epoch 33/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5432 -
binary_accuracy: 0.7201 - auc_roc: 0.7910 - val_loss: 0.6438 -
val_binary_accuracy: 0.6123 - val_auc_roc: 0.7910
roc-auc: 80.60% - roc-auc_val: 68.46%
Epoch 34/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5431 -
binary_accuracy: 0.7195 - auc_roc: 0.7910 - val_loss: 0.6018 -
val_binary_accuracy: 0.6083 - val_auc_roc: 0.7910
roc-auc: 80.65% - roc-auc_val: 67.48%
Epoch 35/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5432 -
binary_accuracy: 0.7195 - auc_roc: 0.7910 - val_loss: 0.6353 -
val_binary_accuracy: 0.6071 - val_auc_roc: 0.7910
roc-auc: 80.69% - roc-auc_val: 66.95%
Epoch 36/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5434 -
binary_accuracy: 0.7196 - auc_roc: 0.7910 - val_loss: 0.6243 -
val_binary_accuracy: 0.6071 - val_auc_roc: 0.7910
roc-auc: 80.55% - roc-auc_val: 67.79%
Epoch 37/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5433 -
binary_accuracy: 0.7195 - auc_roc: 0.7910 - val_loss: 0.6199 -
val_binary_accuracy: 0.6014 - val_auc_roc: 0.7910
roc-auc: 80.66% - roc-auc_val: 68.09%
Epoch 38/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5432 -
binary_accuracy: 0.7196 - auc_roc: 0.7910 - val_loss: 0.6595 -
val_binary_accuracy: 0.6022 - val_auc_roc: 0.7910
roc-auc: 80.60% - roc-auc_val: 67.36%
Epoch 39/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5433 -
binary_accuracy: 0.7197 - auc_roc: 0.7910 - val_loss: 0.6253 -
val_binary_accuracy: 0.6006 - val_auc_roc: 0.7910
```

```
roc-auc: 80.67% - roc-auc_val: 67.45%
Epoch 40/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5435 -
binary_accuracy: 0.7198 - auc_roc: 0.7910 - val_loss: 0.6337 -
val_binary_accuracy: 0.6071 - val_auc_roc: 0.7910
roc-auc: 80.64% - roc-auc_val: 67.13%
Epoch 41/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5427 -
binary_accuracy: 0.7205 - auc_roc: 0.7910 - val_loss: 0.6444 -
val_binary_accuracy: 0.6006 - val_auc_roc: 0.7910
roc-auc: 80.62% - roc-auc_val: 67.16%
Epoch 42/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5433 -
binary_accuracy: 0.7210 - auc_roc: 0.7910 - val_loss: 0.6306 -
val_binary_accuracy: 0.5886 - val_auc_roc: 0.7910
roc-auc: 80.61% - roc-auc_val: 67.40%
Epoch 43/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5426 -
binary_accuracy: 0.7216 - auc_roc: 0.7910 - val_loss: 0.6175 -
val_binary_accuracy: 0.5870 - val_auc_roc: 0.7910
roc-auc: 80.72% - roc-auc_val: 67.74%
Epoch 44/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5429 -
binary_accuracy: 0.7196 - auc_roc: 0.7910 - val_loss: 0.6647 -
val_binary_accuracy: 0.5954 - val_auc_roc: 0.7910
roc-auc: 80.65% - roc-auc_val: 66.81%
Epoch 45/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5427 -
binary_accuracy: 0.7208 - auc_roc: 0.7910 - val_loss: 0.6504 -
val_binary_accuracy: 0.5930 - val_auc_roc: 0.7911
roc-auc: 80.57% - roc-auc_val: 66.78%
Epoch 46/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5433 -
binary_accuracy: 0.7203 - auc_roc: 0.7911 - val_loss: 0.6756 -
val_binary_accuracy: 0.6014 - val_auc_roc: 0.7911
roc-auc: 80.61% - roc-auc_val: 66.92%
Epoch 47/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5432 -
binary_accuracy: 0.7204 - auc_roc: 0.7911 - val_loss: 0.6625 -
val_binary_accuracy: 0.5994 - val_auc_roc: 0.7911
roc-auc: 80.70% - roc-auc_val: 65.76%
Epoch 48/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5430 -
binary_accuracy: 0.7200 - auc_roc: 0.7911 - val_loss: 0.6882 -
val_binary_accuracy: 0.5958 - val_auc_roc: 0.7911
roc-auc: 80.63% - roc-auc_val: 65.91%
Epoch 49/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5433 -
```

```
binary_accuracy: 0.7203 - auc_roc: 0.7911 - val_loss: 0.7204 -
val_binary_accuracy: 0.5974 - val_auc_roc: 0.7911
roc-auc: 80.68% - roc-auc_val: 66.29%
Epoch 50/50
211565/211565 [==============================] - 12s 56us/step - loss: 0.5433 -
binary_accuracy: 0.7207 - auc_roc: 0.7911 - val_loss: 0.6961 -
val_binary_accuracy: 0.6031 - val_auc_roc: 0.7911
roc-auc: 80.61% - roc-auc_val: 66.81%
Train on 209076 samples, validate on 2489 samples
Epoch 1/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5433 -
binary_accuracy: 0.7191 - auc_roc: 0.7911 - val_loss: 0.5067 -
val_binary_accuracy: 0.7180 - val_auc_roc: 0.7911
roc-auc: 80.69% - roc-auc_val: 81.26%
Epoch 2/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5439 -
binary_accuracy: 0.7201 - auc_roc: 0.7911 - val_loss: 0.5061 -
val_binary_accuracy: 0.7172 - val_auc_roc: 0.7911
roc-auc: 80.61% - roc-auc_val: 80.78%
Epoch 3/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5429 -
binary_accuracy: 0.7193 - auc_roc: 0.7911 - val_loss: 0.5147 -
val_binary_accuracy: 0.7168 - val_auc_roc: 0.7911
roc-auc: 80.66% - roc-auc_val: 80.71%
Epoch 4/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5433 -
binary_accuracy: 0.7199 - auc_roc: 0.7911 - val_loss: 0.5162 -
val_binary_accuracy: 0.7160 - val_auc_roc: 0.7911
roc-auc: 80.65% - roc-auc_val: 80.27%
Epoch 5/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5434 -
binary_accuracy: 0.7202 - auc_roc: 0.7911 - val_loss: 0.5187 -
val_binary_accuracy: 0.7135 - val_auc_roc: 0.7911
roc-auc: 80.62% - roc-auc_val: 80.22%
Epoch 6/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5438 -
binary_accuracy: 0.7200 - auc_roc: 0.7911 - val_loss: 0.5255 -
val_binary_accuracy: 0.7143 - val_auc_roc: 0.7911
roc-auc: 80.68% - roc-auc_val: 79.52%
Epoch 7/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5433 -
binary_accuracy: 0.7207 - auc_roc: 0.7911 - val_loss: 0.5206 -
val_binary_accuracy: 0.7139 - val_auc_roc: 0.7911
roc-auc: 80.68% - roc-auc_val: 79.74%
Epoch 8/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5434 -
binary_accuracy: 0.7195 - auc_roc: 0.7911 - val_loss: 0.5301 -
val_binary_accuracy: 0.7151 - val_auc_roc: 0.7911
```

```
roc-auc: 80.67% - roc-auc_val: 79.03%
Epoch 9/50
209076/209076 [==============================] - 12s 55us/step - loss: 0.5438 -
binary_accuracy: 0.7194 - auc_roc: 0.7911 - val_loss: 0.5221 -
val_binary_accuracy: 0.7127 - val_auc_roc: 0.7911
roc-auc: 80.64% - roc-auc_val: 79.38%
Epoch 10/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5430 -
binary_accuracy: 0.7206 - auc_roc: 0.7911 - val_loss: 0.5313 -
val_binary_accuracy: 0.7115 - val_auc_roc: 0.7911
roc-auc: 80.71% - roc-auc_val: 78.42%
Epoch 11/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5432 -
binary_accuracy: 0.7203 - auc_roc: 0.7911 - val_loss: 0.5346 -
val_binary_accuracy: 0.7075 - val_auc_roc: 0.7911
roc-auc: 80.67% - roc-auc_val: 78.17%
Epoch 12/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5432 -
binary_accuracy: 0.7205 - auc_roc: 0.7911 - val_loss: 0.5315 -
val_binary_accuracy: 0.7047 - val_auc_roc: 0.7911
roc-auc: 80.59% - roc-auc_val: 78.37%
Epoch 13/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5437 -
binary_accuracy: 0.7199 - auc_roc: 0.7912 - val_loss: 0.5344 -
val_binary_accuracy: 0.6983 - val_auc_roc: 0.7912
roc-auc: 80.64% - roc-auc_val: 78.51%
Epoch 14/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5430 -
binary_accuracy: 0.7203 - auc_roc: 0.7912 - val_loss: 0.5390 -
val_binary_accuracy: 0.7051 - val_auc_roc: 0.7912
roc-auc: 80.71% - roc-auc_val: 77.83%
Epoch 15/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5435 -
binary_accuracy: 0.7207 - auc_roc: 0.7912 - val_loss: 0.5413 -
val_binary_accuracy: 0.6991 - val_auc_roc: 0.7912
roc-auc: 80.64% - roc-auc_val: 78.07%
Epoch 16/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5429 -
binary_accuracy: 0.7196 - auc_roc: 0.7912 - val_loss: 0.5528 -
val_binary_accuracy: 0.6999 - val_auc_roc: 0.7912
roc-auc: 80.63% - roc-auc_val: 76.95%
Epoch 17/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5431 -
binary_accuracy: 0.7205 - auc_roc: 0.7912 - val_loss: 0.5406 -
val_binary_accuracy: 0.7027 - val_auc_roc: 0.7912
roc-auc: 80.68% - roc-auc_val: 77.83%
Epoch 18/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5437 -
```

```
binary_accuracy: 0.7201 - auc_roc: 0.7912 - val_loss: 0.5447 -
val_binary_accuracy: 0.6967 - val_auc_roc: 0.7912
roc-auc: 80.69% - roc-auc_val: 77.04%
Epoch 19/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5430 -
binary_accuracy: 0.7209 - auc_roc: 0.7912 - val_loss: 0.5509 -
val_binary_accuracy: 0.7051 - val_auc_roc: 0.7912
roc-auc: 80.72% - roc-auc_val: 76.51%
Epoch 20/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5433 -
binary_accuracy: 0.7198 - auc_roc: 0.7912 - val_loss: 0.5706 -
val_binary_accuracy: 0.6967 - val_auc_roc: 0.7912
roc-auc: 80.68% - roc-auc_val: 75.26%
Epoch 21/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5432 -
binary_accuracy: 0.7205 - auc_roc: 0.7912 - val_loss: 0.6411 -
val_binary_accuracy: 0.6119 - val_auc_roc: 0.7912
roc-auc: 80.67% - roc-auc_val: 66.81%
Epoch 22/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5434 -
binary_accuracy: 0.7203 - auc_roc: 0.7912 - val_loss: 0.6098 -
val_binary_accuracy: 0.6774 - val_auc_roc: 0.7912
roc-auc: 80.68% - roc-auc_val: 72.54%
Epoch 23/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5430 -
binary_accuracy: 0.7203 - auc_roc: 0.7912 - val_loss: 0.5641 -
val_binary_accuracy: 0.7003 - val_auc_roc: 0.7912
roc-auc: 80.68% - roc-auc_val: 75.76%
Epoch 24/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5432 -
binary_accuracy: 0.7198 - auc_roc: 0.7912 - val_loss: 0.6370 -
val_binary_accuracy: 0.6095 - val_auc_roc: 0.7912
roc-auc: 80.68% - roc-auc_val: 68.82%
Epoch 25/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5438 -
binary_accuracy: 0.7201 - auc_roc: 0.7912 - val_loss: 0.6322 -
val_binary_accuracy: 0.6143 - val_auc_roc: 0.7912
roc-auc: 80.74% - roc-auc_val: 69.04%
Epoch 26/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5432 -
binary_accuracy: 0.7199 - auc_roc: 0.7912 - val_loss: 0.6358 -
val_binary_accuracy: 0.6111 - val_auc_roc: 0.7912
roc-auc: 80.61% - roc-auc_val: 68.03%
Epoch 27/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5435 -
binary_accuracy: 0.7202 - auc_roc: 0.7912 - val_loss: 0.5951 -
val_binary_accuracy: 0.6826 - val_auc_roc: 0.7912
roc-auc: 80.66% - roc-auc_val: 74.70%
```

```
Epoch 28/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5431 -
binary_accuracy: 0.7197 - auc_roc: 0.7912 - val_loss: 0.5644 -
val_binary_accuracy: 0.6951 - val_auc_roc: 0.7912
roc-auc: 80.71% - roc-auc_val: 75.47%
Epoch 29/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5435 -
binary_accuracy: 0.7206 - auc_roc: 0.7912 - val_loss: 0.5651 -
val_binary_accuracy: 0.6926 - val_auc_roc: 0.7912
roc-auc: 80.63% - roc-auc_val: 75.03%
Epoch 30/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5430 -
binary_accuracy: 0.7216 - auc_roc: 0.7912 - val_loss: 0.6008 -
val_binary_accuracy: 0.6882 - val_auc_roc: 0.7912
roc-auc: 80.67% - roc-auc_val: 73.51%
Epoch 31/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5432 -
binary_accuracy: 0.7194 - auc_roc: 0.7912 - val_loss: 0.6457 -
val_binary_accuracy: 0.6051 - val_auc_roc: 0.7912
roc-auc: 80.61% - roc-auc_val: 67.57%
Epoch 32/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5432 -
binary_accuracy: 0.7212 - auc_roc: 0.7912 - val_loss: 0.5895 -
val_binary_accuracy: 0.6842 - val_auc_roc: 0.7912
roc-auc: 80.73% - roc-auc_val: 73.87%
Epoch 33/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5434 -
binary_accuracy: 0.7212 - auc_roc: 0.7912 - val_loss: 0.6543 -
val_binary_accuracy: 0.5870 - val_auc_roc: 0.7912
roc-auc: 80.65% - roc-auc_val: 63.89%
Epoch 34/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5435 -
binary_accuracy: 0.7202 - auc_roc: 0.7913 - val_loss: 0.6065 -
val_binary_accuracy: 0.6742 - val_auc_roc: 0.7913
roc-auc: 80.74% - roc-auc_val: 73.14%
Epoch 35/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5434 -
binary_accuracy: 0.7204 - auc_roc: 0.7913 - val_loss: 0.6553 -
val_binary_accuracy: 0.5950 - val_auc_roc: 0.7913
roc-auc: 80.66% - roc-auc_val: 66.00%
Epoch 36/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5428 -
binary_accuracy: 0.7204 - auc_roc: 0.7913 - val_loss: 0.6513 -
val_binary_accuracy: 0.6079 - val_auc_roc: 0.7913
roc-auc: 80.65% - roc-auc_val: 64.17%
Epoch 37/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5429 -
binary_accuracy: 0.7206 - auc_roc: 0.7913 - val_loss: 0.6574 -
```

```
val_binary_accuracy: 0.5942 - val_auc_roc: 0.7913
roc-auc: 80.68% - roc-auc_val: 65.50%
Epoch 38/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5433 -
binary_accuracy: 0.7204 - auc_roc: 0.7913 - val_loss: 0.6498 -
val_binary_accuracy: 0.5894 - val_auc_roc: 0.7913
roc-auc: 80.74% - roc-auc_val: 64.83%
Epoch 39/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5427 -
binary_accuracy: 0.7201 - auc_roc: 0.7913 - val_loss: 0.6612 -
val_binary_accuracy: 0.5950 - val_auc_roc: 0.7913
roc-auc: 80.66% - roc-auc_val: 63.33%
Epoch 40/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5431 -
binary_accuracy: 0.7206 - auc_roc: 0.7913 - val_loss: 0.6467 -
val_binary_accuracy: 0.6002 - val_auc_roc: 0.7913
roc-auc: 80.72% - roc-auc_val: 65.94%
Epoch 41/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5435 -
binary_accuracy: 0.7200 - auc_roc: 0.7913 - val_loss: 0.6228 -
val_binary_accuracy: 0.6738 - val_auc_roc: 0.7913
roc-auc: 80.67% - roc-auc_val: 71.15%
Epoch 42/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5433 -
binary_accuracy: 0.7200 - auc_roc: 0.7913 - val_loss: 0.6591 -
val_binary_accuracy: 0.6035 - val_auc_roc: 0.7913
roc-auc: 80.66% - roc-auc_val: 64.07%
Epoch 43/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5433 -
binary_accuracy: 0.7201 - auc_roc: 0.7913 - val_loss: 0.6088 -
val_binary_accuracy: 0.6714 - val_auc_roc: 0.7913
roc-auc: 80.68% - roc-auc_val: 72.55%
Epoch 44/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5431 -
binary_accuracy: 0.7198 - auc_roc: 0.7913 - val_loss: 0.6608 -
val_binary_accuracy: 0.6018 - val_auc_roc: 0.7913
roc-auc: 80.62% - roc-auc_val: 63.66%
Epoch 45/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5431 -
binary_accuracy: 0.7202 - auc_roc: 0.7913 - val_loss: 0.6269 -
val_binary_accuracy: 0.6714 - val_auc_roc: 0.7913
roc-auc: 80.68% - roc-auc_val: 70.58%
Epoch 46/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5438 -
binary_accuracy: 0.7204 - auc_roc: 0.7913 - val_loss: 0.6284 -
val_binary_accuracy: 0.6657 - val_auc_roc: 0.7913
roc-auc: 80.63% - roc-auc_val: 70.55%
Epoch 47/50
```

```
209076/209076 [==============================] - 12s 56us/step - loss: 0.5431 -
binary_accuracy: 0.7199 - auc_roc: 0.7913 - val_loss: 0.6628 -
val_binary_accuracy: 0.5870 - val_auc_roc: 0.7913
roc-auc: 80.68% - roc-auc_val: 62.12%
Epoch 48/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5427 -
binary_accuracy: 0.7203 - auc_roc: 0.7913 - val_loss: 0.6564 -
val_binary_accuracy: 0.6135 - val_auc_roc: 0.7913
roc-auc: 80.68% - roc-auc_val: 64.24%
Epoch 49/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5434 -
binary_accuracy: 0.7206 - auc_roc: 0.7913 - val_loss: 0.6659 -
val_binary_accuracy: 0.5962 - val_auc_roc: 0.7913
roc-auc: 80.69% - roc-auc_val: 62.63%
Epoch 50/50
209076/209076 [==============================] - 12s 56us/step - loss: 0.5423 -
binary_accuracy: 0.7205 - auc_roc: 0.7913 - val_loss: 0.6345 -
val_binary_accuracy: 0.6179 - val_auc_roc: 0.7913
roc-auc: 80.69% - roc-auc_val: 69.34%
Train on 206587 samples, validate on 2489 samples
Epoch 1/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5428 -
binary_accuracy: 0.7205 - auc_roc: 0.7913 - val_loss: 0.5526 -
val_binary_accuracy: 0.6818 - val_auc_roc: 0.7913
roc-auc: 80.75% - roc-auc_val: 76.33%
Epoch 2/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5433 -
binary_accuracy: 0.7211 - auc_roc: 0.7913 - val_loss: 0.5594 -
val_binary_accuracy: 0.6862 - val_auc_roc: 0.7913
roc-auc: 80.68% - roc-auc_val: 76.11%
Epoch 3/50
206587/206587 [==============================] - 11s 55us/step - loss: 0.5429 -
binary_accuracy: 0.7204 - auc_roc: 0.7913 - val_loss: 0.5697 -
val_binary_accuracy: 0.6798 - val_auc_roc: 0.7913
roc-auc: 80.70% - roc-auc_val: 75.71%
Epoch 4/50
206587/206587 [==============================] - 11s 56us/step - loss: 0.5427 -
binary_accuracy: 0.7204 - auc_roc: 0.7913 - val_loss: 0.5649 -
val_binary_accuracy: 0.6778 - val_auc_roc: 0.7913
roc-auc: 80.72% - roc-auc_val: 75.54%
Epoch 5/50
206587/206587 [==============================] - 11s 55us/step - loss: 0.5430 -
binary_accuracy: 0.7210 - auc_roc: 0.7913 - val_loss: 0.5623 -
val_binary_accuracy: 0.6693 - val_auc_roc: 0.7913
roc-auc: 80.75% - roc-auc_val: 75.38%
Epoch 6/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5427 -
binary_accuracy: 0.7203 - auc_roc: 0.7913 - val_loss: 0.5738 -
```

```
val_binary_accuracy: 0.6782 - val_auc_roc: 0.7913
roc-auc: 80.70% - roc-auc_val: 75.54%
Epoch 7/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5430 -
binary_accuracy: 0.7209 - auc_roc: 0.7913 - val_loss: 0.5708 -
val_binary_accuracy: 0.6778 - val_auc_roc: 0.7913
roc-auc: 80.73% - roc-auc_val: 75.25%
Epoch 8/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5431 -
binary_accuracy: 0.7213 - auc_roc: 0.7913 - val_loss: 0.5855 -
val_binary_accuracy: 0.6697 - val_auc_roc: 0.7914
roc-auc: 80.69% - roc-auc_val: 74.93%
Epoch 9/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5418 -
binary_accuracy: 0.7212 - auc_roc: 0.7914 - val_loss: 0.5701 -
val_binary_accuracy: 0.6798 - val_auc_roc: 0.7914
roc-auc: 80.71% - roc-auc_val: 75.34%
Epoch 10/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5433 -
binary_accuracy: 0.7205 - auc_roc: 0.7914 - val_loss: 0.5726 -
val_binary_accuracy: 0.6677 - val_auc_roc: 0.7914
roc-auc: 80.76% - roc-auc_val: 74.81%
Epoch 11/50
206587/206587 [==============================] - 11s 56us/step - loss: 0.5425 -
binary_accuracy: 0.7209 - auc_roc: 0.7914 - val_loss: 0.5828 -
val_binary_accuracy: 0.6738 - val_auc_roc: 0.7914
roc-auc: 80.71% - roc-auc_val: 75.17%
Epoch 12/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5429 -
binary_accuracy: 0.7211 - auc_roc: 0.7914 - val_loss: 0.5724 -
val_binary_accuracy: 0.6693 - val_auc_roc: 0.7914
roc-auc: 80.73% - roc-auc_val: 74.84%
Epoch 13/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5426 -
binary_accuracy: 0.7218 - auc_roc: 0.7914 - val_loss: 0.5878 -
val_binary_accuracy: 0.6738 - val_auc_roc: 0.7914
roc-auc: 80.70% - roc-auc_val: 75.11%
Epoch 14/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5426 -
binary_accuracy: 0.7212 - auc_roc: 0.7914 - val_loss: 0.5736 -
val_binary_accuracy: 0.6701 - val_auc_roc: 0.7914
roc-auc: 80.72% - roc-auc_val: 75.02%
Epoch 15/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5426 -
binary_accuracy: 0.7206 - auc_roc: 0.7914 - val_loss: 0.5959 -
val_binary_accuracy: 0.6665 - val_auc_roc: 0.7914
roc-auc: 80.72% - roc-auc_val: 74.63%
Epoch 16/50
```

```
206587/206587 [==============================] - 12s 56us/step - loss: 0.5424 -
binary_accuracy: 0.7206 - auc_roc: 0.7914 - val_loss: 0.5838 -
val_binary_accuracy: 0.6750 - val_auc_roc: 0.7914
roc-auc: 80.80% - roc-auc_val: 74.90%
Epoch 17/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5429 -
binary_accuracy: 0.7201 - auc_roc: 0.7914 - val_loss: 0.5821 -
val_binary_accuracy: 0.6545 - val_auc_roc: 0.7914
roc-auc: 80.75% - roc-auc_val: 74.39%
Epoch 18/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5416 -
binary_accuracy: 0.7212 - auc_roc: 0.7914 - val_loss: 0.5871 -
val_binary_accuracy: 0.6533 - val_auc_roc: 0.7914
roc-auc: 80.72% - roc-auc_val: 74.81%
Epoch 19/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5425 -
binary_accuracy: 0.7203 - auc_roc: 0.7914 - val_loss: 0.5848 -
val_binary_accuracy: 0.6589 - val_auc_roc: 0.7914
roc-auc: 80.72% - roc-auc_val: 74.63%
Epoch 20/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5425 -
binary_accuracy: 0.7203 - auc_roc: 0.7914 - val_loss: 0.5890 -
val_binary_accuracy: 0.6541 - val_auc_roc: 0.7914
roc-auc: 80.76% - roc-auc_val: 74.05%
Epoch 21/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5422 -
binary_accuracy: 0.7203 - auc_roc: 0.7914 - val_loss: 0.5831 -
val_binary_accuracy: 0.6722 - val_auc_roc: 0.7914
roc-auc: 80.77% - roc-auc_val: 74.60%
Epoch 22/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5427 -
binary_accuracy: 0.7212 - auc_roc: 0.7914 - val_loss: 0.5889 -
val_binary_accuracy: 0.6505 - val_auc_roc: 0.7914
roc-auc: 80.77% - roc-auc_val: 73.99%
Epoch 23/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5421 -
binary_accuracy: 0.7207 - auc_roc: 0.7914 - val_loss: 0.5911 -
val_binary_accuracy: 0.6468 - val_auc_roc: 0.7914
roc-auc: 80.75% - roc-auc_val: 73.93%
Epoch 24/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5418 -
binary_accuracy: 0.7211 - auc_roc: 0.7914 - val_loss: 0.5919 -
val_binary_accuracy: 0.6509 - val_auc_roc: 0.7914
roc-auc: 80.74% - roc-auc_val: 73.70%
Epoch 25/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5429 -
binary_accuracy: 0.7206 - auc_roc: 0.7914 - val_loss: 0.5989 -
val_binary_accuracy: 0.6621 - val_auc_roc: 0.7914
```

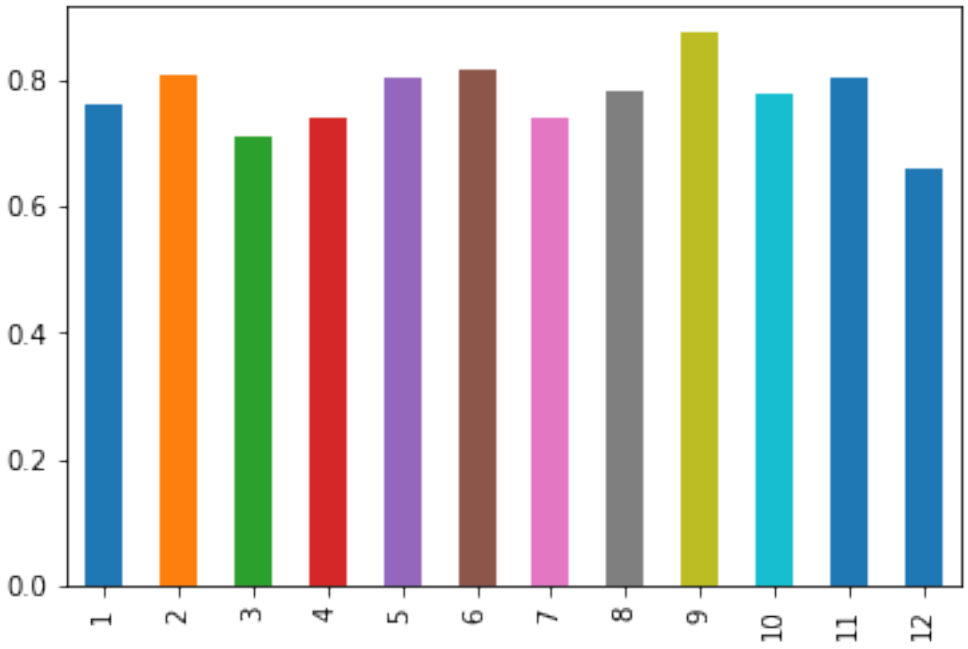
```
roc-auc: 80.70% - roc-auc_val: 73.64%
Epoch 26/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5425 -
binary_accuracy: 0.7210 - auc_roc: 0.7914 - val_loss: 0.5931 -
val_binary_accuracy: 0.6408 - val_auc_roc: 0.7914
roc-auc: 80.71% - roc-auc_val: 73.32%
Epoch 27/50
206587/206587 [==============================] - 11s 56us/step - loss: 0.5424 -
binary_accuracy: 0.7218 - auc_roc: 0.7914 - val_loss: 0.5871 -
val_binary_accuracy: 0.6521 - val_auc_roc: 0.7915
roc-auc: 80.77% - roc-auc_val: 73.69%
Epoch 28/50
206587/206587 [==============================] - 11s 56us/step - loss: 0.5434 -
binary_accuracy: 0.7213 - auc_roc: 0.7915 - val_loss: 0.5938 -
val_binary_accuracy: 0.6581 - val_auc_roc: 0.7915
roc-auc: 80.75% - roc-auc_val: 72.85%
Epoch 29/50
206587/206587 [==============================] - 11s 56us/step - loss: 0.5432 -
binary_accuracy: 0.7204 - auc_roc: 0.7915 - val_loss: 0.5974 -
val_binary_accuracy: 0.6501 - val_auc_roc: 0.7915
roc-auc: 80.74% - roc-auc_val: 73.52%
Epoch 30/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5426 -
binary_accuracy: 0.7211 - auc_roc: 0.7915 - val_loss: 0.5948 -
val_binary_accuracy: 0.6376 - val_auc_roc: 0.7915
roc-auc: 80.78% - roc-auc_val: 71.82%
Epoch 31/50
206587/206587 [==============================] - 11s 56us/step - loss: 0.5423 -
binary_accuracy: 0.7213 - auc_roc: 0.7915 - val_loss: 0.5899 -
val_binary_accuracy: 0.6416 - val_auc_roc: 0.7915
roc-auc: 80.77% - roc-auc_val: 72.75%
Epoch 32/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5426 -
binary_accuracy: 0.7207 - auc_roc: 0.7915 - val_loss: 0.5954 -
val_binary_accuracy: 0.6505 - val_auc_roc: 0.7915
roc-auc: 80.75% - roc-auc_val: 72.82%
Epoch 33/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5429 -
binary_accuracy: 0.7210 - auc_roc: 0.7915 - val_loss: 0.5896 -
val_binary_accuracy: 0.6489 - val_auc_roc: 0.7915
roc-auc: 80.71% - roc-auc_val: 72.92%
Epoch 34/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5428 -
binary_accuracy: 0.7205 - auc_roc: 0.7915 - val_loss: 0.5953 -
val_binary_accuracy: 0.6472 - val_auc_roc: 0.7915
roc-auc: 80.72% - roc-auc_val: 73.09%
Epoch 35/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5420 -
```

```
binary_accuracy: 0.7212 - auc_roc: 0.7915 - val_loss: 0.5969 -
val_binary_accuracy: 0.6501 - val_auc_roc: 0.7915
roc-auc: 80.80% - roc-auc_val: 73.23%
Epoch 36/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5421 -
binary_accuracy: 0.7210 - auc_roc: 0.7915 - val_loss: 0.5936 -
val_binary_accuracy: 0.6424 - val_auc_roc: 0.7915
roc-auc: 80.76% - roc-auc_val: 72.91%
Epoch 37/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5428 -
binary_accuracy: 0.7206 - auc_roc: 0.7915 - val_loss: 0.5920 -
val_binary_accuracy: 0.6577 - val_auc_roc: 0.7915
roc-auc: 80.79% - roc-auc_val: 73.01%
Epoch 38/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5422 -
binary_accuracy: 0.7214 - auc_roc: 0.7915 - val_loss: 0.5921 -
val_binary_accuracy: 0.6493 - val_auc_roc: 0.7915
roc-auc: 80.71% - roc-auc_val: 72.42%
Epoch 39/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5426 -
binary_accuracy: 0.7207 - auc_roc: 0.7915 - val_loss: 0.5979 -
val_binary_accuracy: 0.6388 - val_auc_roc: 0.7915
roc-auc: 80.72% - roc-auc_val: 72.30%
Epoch 40/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5424 -
binary_accuracy: 0.7213 - auc_roc: 0.7915 - val_loss: 0.5910 -
val_binary_accuracy: 0.6440 - val_auc_roc: 0.7915
roc-auc: 80.72% - roc-auc_val: 72.70%
Epoch 41/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5425 -
binary_accuracy: 0.7201 - auc_roc: 0.7915 - val_loss: 0.5939 -
val_binary_accuracy: 0.6485 - val_auc_roc: 0.7915
roc-auc: 80.72% - roc-auc_val: 72.49%
Epoch 42/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5423 -
binary_accuracy: 0.7206 - auc_roc: 0.7915 - val_loss: 0.5886 -
val_binary_accuracy: 0.6549 - val_auc_roc: 0.7915
roc-auc: 80.76% - roc-auc_val: 73.02%
Epoch 43/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5424 -
binary_accuracy: 0.7208 - auc_roc: 0.7915 - val_loss: 0.5926 -
val_binary_accuracy: 0.6444 - val_auc_roc: 0.7915
roc-auc: 80.76% - roc-auc_val: 72.61%
Epoch 44/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5421 -
binary_accuracy: 0.7206 - auc_roc: 0.7915 - val_loss: 0.5886 -
val_binary_accuracy: 0.6513 - val_auc_roc: 0.7915
roc-auc: 80.74% - roc-auc_val: 72.78%
```

```
Epoch 45/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5420 -
binary_accuracy: 0.7217 - auc_roc: 0.7915 - val_loss: 0.5933 -
val_binary_accuracy: 0.6420 - val_auc_roc: 0.7915
roc-auc: 80.79% - roc-auc_val: 72.75%
Epoch 46/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5430 -
binary_accuracy: 0.7203 - auc_roc: 0.7915 - val_loss: 0.5891 -
val_binary_accuracy: 0.6448 - val_auc_roc: 0.7915
roc-auc: 80.77% - roc-auc_val: 72.88%
Epoch 47/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5423 -
binary_accuracy: 0.7213 - auc_roc: 0.7915 - val_loss: 0.5888 -
val_binary_accuracy: 0.6472 - val_auc_roc: 0.7915
roc-auc: 80.73% - roc-auc_val: 73.00%
Epoch 48/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5428 -
binary_accuracy: 0.7213 - auc_roc: 0.7915 - val_loss: 0.5913 -
val_binary_accuracy: 0.6468 - val_auc_roc: 0.7916
roc-auc: 80.75% - roc-auc_val: 72.68%
Epoch 49/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5434 -
binary_accuracy: 0.7209 - auc_roc: 0.7916 - val_loss: 0.5949 -
val_binary_accuracy: 0.6464 - val_auc_roc: 0.7916
roc-auc: 80.75% - roc-auc_val: 72.80%
Epoch 50/50
206587/206587 [==============================] - 12s 56us/step - loss: 0.5430 -
binary_accuracy: 0.7212 - auc_roc: 0.7916 - val_loss: 0.5925 -
val_binary_accuracy: 0.6456 - val_auc_roc: 0.7916
roc-auc: 80.76% - roc-auc_val: 72.47%
```

[29]:
```
scores, preds = {}, {}
for fold, (train_idx, test_idx) in enumerate(cv.split(data)):
    model = load_model(f'models/weights.{fold}.hdf5', custom_objects={'auc_roc':
 ↪ auc_roc})
    y_test = features.iloc[test_idx]
    month = y_test.index[0].month
    preds[month] = model.predict(y_test)
    scores[month] = roc_auc_score(y_score=preds[month], y_true=label.
 ↪iloc[test_idx])
```

[27]:
```
pd.Series(scores).sort_index().plot.bar();
```



1.7.6 Make Predictions

[38]:
```
predictions = pd.DataFrame({month: data.squeeze() for month, data in preds.
 ↪items()}, index = range(preds[1].shape[0])).sort_index(1)
predictions.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2489 entries, 0 to 2488
Data columns (total 12 columns):
1     2489 non-null float32
2     2489 non-null float32
3     2489 non-null float32
4     2489 non-null float32
5     2489 non-null float32
6     2489 non-null float32
7     2489 non-null float32
8     2489 non-null float32
9     2489 non-null float32
10    2489 non-null float32
11    2489 non-null float32
12    2489 non-null float32
dtypes: float32(12)
memory usage: 116.8 KB
```

1.7.7 Evaluate Results

[123]:
```
from sklearn.metrics import roc_curve, precision_recall_curve,␣
↪average_precision_score
```

[125]:
```
bins = np.arange(0, 1.01, .01)
roc, prc = pd.Series(), pd.Series()
avg_roc, avg_precision = [], []
for month, y_score in predictions.items():
    y_true = label[f'2017{month:02}01']
    avg_roc.append(roc_auc_score(y_true=y_true, y_score=y_score))
    fpr, tpr, _ = roc_curve(y_true=y_true, y_score=y_score)
    df = pd.DataFrame({'fpr': fpr, 'tpr': tpr})
    df.fpr = pd.cut(df.fpr, bins=bins, labels=bins[1:])
    roc = pd.concat([roc, df.groupby('fpr').tpr.mean().bfill().to_frame('tpr').
↪reset_index()])

    precision, recall, _ = precision_recall_curve(y_true=y_true,␣
↪probas_pred=y_score)
    avg_precision.append(average_precision_score(y_true=y_true,␣
↪y_score=y_score))
    df = pd.DataFrame({'precision': precision, 'recall': recall})
    df.recall = pd.cut(df.recall, bins=bins, labels=bins[1:])
    prc = pd.concat([prc, df.groupby('recall').precision.mean().ffill().
↪to_frame('precision').reset_index()])
```

[126]:
```
np.mean(avg_roc), np.mean(avg_precision)
```

[126]:
```
(0.773903996249194, 0.6880594179772762)
```

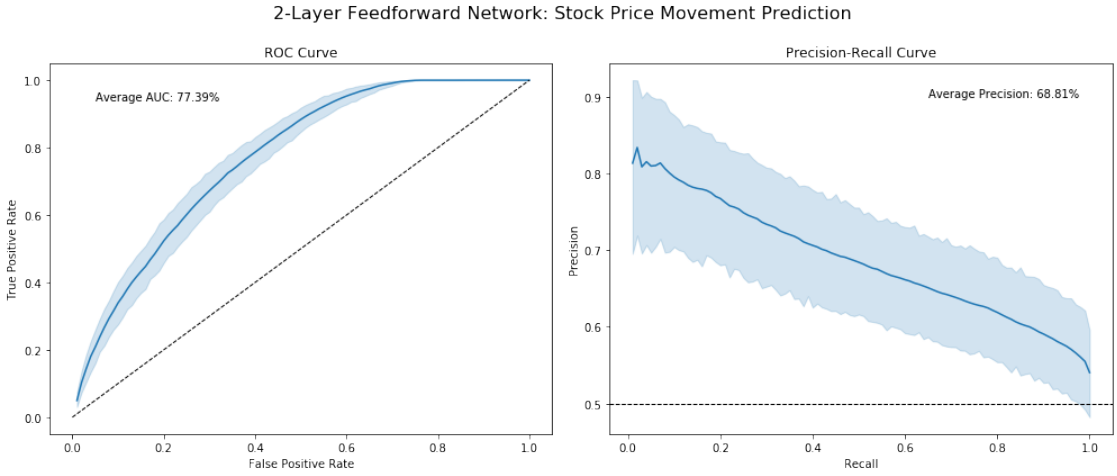
To obtain a measure of the model's generalization error, we evaluate its predictive performance on the hold-out set. To this end, we iteratively predict one month in the test after training the best-performing architecture on all preceding months.

The below ROC and Precision-Recall curves summarize the out-of-sample performance over the 12 months in 2017. The average AUC score is 0.7739, and the average precision is 68.8%, with the full range of the tradeoffs represented by the two graphs.

While the AUC scores underline solid predictive performance, we need to be careful because binary price moves ignore the size of the moves. We would need to deepen our analysis to understand whether good directional predictions would translate into a profitable trading strategy.

[129]:
```
fig, axes = plt.subplots(ncols=2, figsize=(14, 6))
sns.lineplot(x='fpr', y='tpr', data=roc, ax=axes[0])
pd.Series(bins, index=bins).plot(ax=axes[0], ls='--', lw=1, c='k')
axes[0].set_xlabel('False Positive Rate')
axes[0].set_ylabel('True Positive Rate')
axes[0].set_title('ROC Curve')
```

```
axes[0].text(x=.05, y=.94, s=f'Average AUC: {np.mean(avg_roc):.2%}')
sns.lineplot(x='recall', y='precision', data=prc, ax=axes[1])
axes[1].set_title('Precision-Recall Curve')
axes[1].text(x=.65, y=.9, s=f'Average Precision: {np.mean(avg_precision):.2%}')
axes[1].set_xlabel('Recall')
axes[1].set_ylabel('Precision')
axes[1].axhline(.5, ls='--', lw=1, c='k')
fig.suptitle('2-Layer Feedforward Network: Stock Price Movement Prediction',␣
↪fontsize=16)
fig.tight_layout()
fig.subplots_adjust(top=.86)
fig.savefig('figures/roc_prc_curves', dpi=300);
```



1.7.8 How to further improve the results

The relatively simple architecture yields some promising results. To further improve performance, you can - First and foremost, add new features and more data to the model - Expand the set of architectures to explore, including more or wider layers - Inspect the training progress and train for more epochs if the validation error continued to improve at 50 epochs

Finally, you can use more sophisticated architectures, including Recurrent Neural Networks (RNN) and Convolutional Neural Networks that are well suited to sequential data, whereas vanilla feed-forward NNs are not designed to capture the ordered nature of the features.