1D-CNN

January 24, 2020

1 CNN 1D IoT Classification Model

[1]:
```
from __future__ import print_function
import h5py
import numpy as np
import matplotlib.pyplot as plt
from sklearn.utils import class_weight
from sklearn.metrics import classification_report
import keras
from keras.models import Sequential
from keras.layers import Dense, Dropout, Flatten, Input, Concatenate
from keras.layers import Conv1D, MaxPooling1D, AveragePooling1D
from keras.utils import plot_model
from keras.models import Model
from hyperopt import Trials, STATUS_OK, tpe
from hyperas import optim
from hyperas.distributions import choice, uniform
from keras.utils import multi_gpu_model
from PIL import Image
import matplotlib.pyplot as plt
import pandas as pd
import copy
import tensorflow as tf
%matplotlib inline
```

```
Using TensorFlow backend.
c:\users\mrathbun2018\.conda\envs\mattwork\lib\site-
packages\tensorflow\python\framework\dtypes.py:516: FutureWarning: Passing
(type, 1) or '1type' as a synonym of type is deprecated; in a future version of
numpy, it will be understood as (type, (1,)) / '(1,)type'.
  _np_qint8 = np.dtype([("qint8", np.int8, 1)])
c:\users\mrathbun2018\.conda\envs\mattwork\lib\site-
packages\tensorflow\python\framework\dtypes.py:517: FutureWarning: Passing
(type, 1) or '1type' as a synonym of type is deprecated; in a future version of
numpy, it will be understood as (type, (1,)) / '(1,)type'.
  _np_quint8 = np.dtype([("quint8", np.uint8, 1)])
c:\users\mrathbun2018\.conda\envs\mattwork\lib\site-
packages\tensorflow\python\framework\dtypes.py:518: FutureWarning: Passing
```

```
(type, 1) or '1type' as a synonym of type is deprecated; in a future version of
numpy, it will be understood as (type, (1,)) / '(1,)type'.
  _np_qint16 = np.dtype([("qint16", np.int16, 1)])
c:\users\mrathbun2018\.conda\envs\mattwork\lib\site-
packages\tensorflow\python\framework\dtypes.py:519: FutureWarning: Passing
(type, 1) or '1type' as a synonym of type is deprecated; in a future version of
numpy, it will be understood as (type, (1,)) / '(1,)type'.
  _np_quint16 = np.dtype([("quint16", np.uint16, 1)])
c:\users\mrathbun2018\.conda\envs\mattwork\lib\site-
packages\tensorflow\python\framework\dtypes.py:520: FutureWarning: Passing
(type, 1) or '1type' as a synonym of type is deprecated; in a future version of
numpy, it will be understood as (type, (1,)) / '(1,)type'.
  _np_qint32 = np.dtype([("qint32", np.int32, 1)])
c:\users\mrathbun2018\.conda\envs\mattwork\lib\site-
packages\tensorflow\python\framework\dtypes.py:525: FutureWarning: Passing
(type, 1) or '1type' as a synonym of type is deprecated; in a future version of
numpy, it will be understood as (type, (1,)) / '(1,)type'.
  np_resource = np.dtype([("resource", np.ubyte, 1)])
c:\users\mrathbun2018\.conda\envs\mattwork\lib\site-
packages\tensorboard\compat\tensorflow_stub\dtypes.py:541: FutureWarning:
Passing (type, 1) or '1type' as a synonym of type is deprecated; in a future
version of numpy, it will be understood as (type, (1,)) / '(1,)type'.
  _np_qint8 = np.dtype([("qint8", np.int8, 1)])
c:\users\mrathbun2018\.conda\envs\mattwork\lib\site-
packages\tensorboard\compat\tensorflow_stub\dtypes.py:542: FutureWarning:
Passing (type, 1) or '1type' as a synonym of type is deprecated; in a future
version of numpy, it will be understood as (type, (1,)) / '(1,)type'.
  _np_quint8 = np.dtype([("quint8", np.uint8, 1)])
c:\users\mrathbun2018\.conda\envs\mattwork\lib\site-
packages\tensorboard\compat\tensorflow_stub\dtypes.py:543: FutureWarning:
Passing (type, 1) or '1type' as a synonym of type is deprecated; in a future
version of numpy, it will be understood as (type, (1,)) / '(1,)type'.
  _np_qint16 = np.dtype([("qint16", np.int16, 1)])
c:\users\mrathbun2018\.conda\envs\mattwork\lib\site-
packages\tensorboard\compat\tensorflow_stub\dtypes.py:544: FutureWarning:
Passing (type, 1) or '1type' as a synonym of type is deprecated; in a future
version of numpy, it will be understood as (type, (1,)) / '(1,)type'.
  _np_quint16 = np.dtype([("quint16", np.uint16, 1)])
c:\users\mrathbun2018\.conda\envs\mattwork\lib\site-
packages\tensorboard\compat\tensorflow_stub\dtypes.py:545: FutureWarning:
Passing (type, 1) or '1type' as a synonym of type is deprecated; in a future
version of numpy, it will be understood as (type, (1,)) / '(1,)type'.
  _np_qint32 = np.dtype([("qint32", np.int32, 1)])
c:\users\mrathbun2018\.conda\envs\mattwork\lib\site-
packages\tensorboard\compat\tensorflow_stub\dtypes.py:550: FutureWarning:
Passing (type, 1) or '1type' as a synonym of type is deprecated; in a future
version of numpy, it will be understood as (type, (1,)) / '(1,)type'.
  np_resource = np.dtype([("resource", np.ubyte, 1)])
```

1.1 Open and Read Data

[2]:
```
def data():
    hdf5_path = 'Data/dataset.hdf5'
    subtract_mean = True

    hdf5_file = h5py.File(hdf5_path, "r")

    if subtract_mean:
        mm = hdf5_file["train_mean"][...,0]
        mm = mm[np.newaxis, ...]

    data_num = hdf5_file["train_flow"].shape[0]

    num_classes = 2
    epochs = 30

    flow_rows, flow_cols = 298, 17

    x_train = hdf5_file["train_flow"][...,0]
    if subtract_mean:
        x_train -= mm

    y_train = hdf5_file["train_labels"][:,...]
    hdf5_file.close()

    hdf5_path = 'Data/dataset-IoT.hdf5'
    hdf5_file = h5py.File(hdf5_path, "r")


    x_test = hdf5_file["IoT_flow"][...,0]
    if subtract_mean:
        x_test -= mm

    y_test = hdf5_file["labels"][:,...]

    hdf5_file.close()

    class_weights = class_weight.compute_class_weight('balanced',
                                                      np.unique(y_train),
                                                      y_train)
    d_class_weights = dict(enumerate(class_weights))

    input_shape = (x_train.shape[1], x_train.shape[2])


    y_train = keras.utils.to_categorical(y_train, num_classes)
```

```
    y_test = keras.utils.to_categorical(y_test, num_classes)
    return x_train, y_train, x_test, y_test
```

1.2 Build Model

[3]:
```
def create_model(x_train, y_train, x_test, y_test):
    size = {{choice([2,4,8,16,32,64])}}
    nb_filters = {{choice([32,64,128])}}
    num_classes = 2
    epochs=30
    activations={{choice(['relu', 'sigmoid', 'tanh'])}}
    maxlen=298
    dropout = {{uniform(0.1, 0.3)}}
    batch_size = {{choice([256,512,1024])}}
    pool_size = {{choice([2,3])}}
    lr = {{uniform(0.0009, 0.00225)}}
    adam = keras.optimizers.Adam(lr=lr)
    rmsprop = keras.optimizers.RMSprop(lr=lr)
    sgd = keras.optimizers.SGD(lr=lr)

    choiceval = {{choice(['adam', 'sgd', 'rmsprop'])}}
    if choiceval == 'adam':
        optim = adam
    elif choiceval == 'rmsprop':
        optim = rmsprop
    else:
        optim = sgd
    layers = {{choice([1,2,3,4])}}
    model = Sequential()
    model.
↪add(Conv1D(filters=nb_filters,kernel_size=size,input_shape=(input_shape),padding="valid",ac
    for i in range(layers-1):
        model.
↪add(Conv1D(filters=nb_filters,kernel_size=size,padding="valid",activation=activations,strid

    model.add(MaxPooling1D(pool_size= pool_size))
    model.add(Flatten())
    model.add(Dropout(dropout))
    model.add(Dense(64, activation='relu'))
    model.add(Dense(32, activation='relu'))
    model.add(Dropout(dropout))
    model.add(Dense(num_classes, activation='softmax'))
    model.summary()
    try:
        model = multi_gpu_model(model, gpus = 4)
    except:
        pass
```

```
    model.compile(loss='binary_crossentropy', optimizer=optim,␣
↪metrics=['accuracy'])
    model.fit(x_train,y_train, batch_size=batch_size, epochs=epochs, verbose=0,␣
↪validation_split=0.2, class_weight=class_weights, shuffle=True)
    score = model.evaluate(x_test, y_test, verbose=0)
    loss = score[0]
    return {'loss': loss, 'status': STATUS_OK, 'model': model}
```

1.3 Run Model

[ ]:
```
x_train, y_train, x_test, y_test = data()
best_run, best_model = optim.minimize(model=create_model, data=data, algo=tpe.
↪suggest, max_evals=100, trials=Trials(), eval_space=True,␣
↪notebook_name='1D-CNN')

print("Evalutation of best performing model:")
print(best_model.evaluate(x_test, y_test))
print("Best performing model chosen hyper-parameters:")
print(best_run)
```

```
>>> Imports:
#coding=utf-8

from __future__ import print_function

try:
    import h5py
except:
    pass

try:
    import numpy as np
except:
    pass

try:
    import matplotlib.pyplot as plt
except:
    pass

try:
    from sklearn.utils import class_weight
except:
    pass
```

```
try:
    from sklearn.metrics import classification_report
except:
    pass

try:
    import keras
except:
    pass

try:
    from keras.models import Sequential
except:
    pass

try:
    from keras.layers import Dense, Dropout, Flatten, Input, Concatenate
except:
    pass

try:
    from keras.layers import Conv1D, MaxPooling1D, AveragePooling1D
except:
    pass

try:
    from keras.utils import plot_model
except:
    pass

try:
    from keras.models import Model
except:
    pass

try:
    from hyperopt import Trials, STATUS_OK, tpe
except:
    pass

try:
    from hyperas import optim
except:
    pass

try:
    from hyperas.distributions import choice, uniform
except:
```

```
    pass

try:
    from keras.utils import multi_gpu_model
except:
    pass

try:
    from PIL import Image
except:
    pass

try:
    import matplotlib.pyplot as plt
except:
    pass

try:
    import pandas as pd
except:
    pass

try:
    import copy
except:
    pass

try:
    import tensorflow as tf
except:
    pass

try:
    from sklearn.metrics import confusion_matrix
except:
    pass

try:
    from sklearn.metrics import roc_curve
except:
    pass

try:
    from sklearn.metrics import auc
except:
    pass

try:
```

```
    from sklearn.metrics import precision_recall_curve
except:
    pass

try:
    from sklearn.metrics import f1_score
except:
    pass

try:
    from sklearn.metrics import auc
except:
    pass

try:
    from sklearn.metrics import average_precision_score
except:
    pass

>>> Hyperas search space:

def get_space():
    return {
        'size': hp.choice('size', [2,4,8,16,32,64]),
        'nb_filters': hp.choice('nb_filters', [32,64,128]),
        'activations': hp.choice('activations', ['relu', 'sigmoid', 'tanh']),
        'dropout': hp.uniform('dropout', 0.1, 0.3),
        'batch_size': hp.choice('batch_size', [256,512,1024]),
        'pool_size': hp.choice('pool_size', [2,3]),
        'lr': hp.uniform('lr', 0.0009, 0.00225),
        'choiceval': hp.choice('choiceval', ['adam', 'sgd', 'rmsprop']),
        'layers': hp.choice('layers', [1,2,3,4]),
    }

>>> Data
   1:
   2: hdf5_path = 'Data/dataset.hdf5'
   3: subtract_mean = True
   4:
   5: hdf5_file = h5py.File(hdf5_path, "r")
   6:
   7: if subtract_mean:
   8:     mm = hdf5_file["train_mean"][…,0]
   9:     mm = mm[np.newaxis, …]
  10:
  11: data_num = hdf5_file["train_flow"].shape[0]
  12:
  13: num_classes = 2
```

```
epochs = 30

flow_rows, flow_cols = 298, 17

x_train = hdf5_file["train_flow"][…,0]
if subtract_mean:
    x_train -= mm

y_train = hdf5_file["train_labels"][:,…]
hdf5_file.close()

hdf5_path = 'Data/dataset-IoT.hdf5'
hdf5_file = h5py.File(hdf5_path, "r")


x_test = hdf5_file["IoT_flow"][…,0]
if subtract_mean:
    x_test -= mm

y_test = hdf5_file["labels"][:,…]

hdf5_file.close()

class_weights = class_weight.compute_class_weight('balanced',
                                                  np.unique(y_train),
                                                  y_train)
d_class_weights = dict(enumerate(class_weights))

input_shape = (x_train.shape[1], x_train.shape[2])


y_train = keras.utils.to_categorical(y_train, num_classes)
y_test = keras.utils.to_categorical(y_test, num_classes)


```

>>> Resulting replaced keras model:

```
def keras_fmin_fnct(space):

    size = space['size']
    nb_filters = space['nb_filters']
    num_classes = 2
    epochs=30
    activations=space['activations']
    maxlen=298
    dropout = space['dropout']
    batch_size = space['batch_size']
```

```
  11:     pool_size = space['pool_size']
  12:     lr = space['lr']
  13:     adam = keras.optimizers.Adam(lr=lr)
  14:     rmsprop = keras.optimizers.RMSprop(lr=lr)
  15:     sgd = keras.optimizers.SGD(lr=lr)
  16:
  17:     choiceval = space['choiceval']
  18:     if choiceval == 'adam':
  19:         optim = adam
  20:     elif choiceval == 'rmsprop':
  21:         optim = rmsprop
  22:     else:
  23:         optim = sgd
  24:     layers = space['layers']
  25:     model = Sequential()
  26:     model.add(Conv1D(filters=nb_filters,kernel_size=size,input_shape=(inpu
t_shape),padding="valid",activation=activations,strides=1))
  27:     for i in range(layers-1):
  28:         model.add(Conv1D(filters=nb_filters,kernel_size=size,padding="vali
d",activation=activations,strides=1))
  29:
  30:     model.add(MaxPooling1D(pool_size= pool_size))
  31:     model.add(Flatten())
  32:     model.add(Dropout(dropout))
  33:     model.add(Dense(64, activation='relu'))
  34:     model.add(Dense(32, activation='relu'))
  35:     model.add(Dropout(dropout))
  36:     model.add(Dense(num_classes, activation='softmax'))
  37:     model.summary()
  38:     try:
  39:         model = multi_gpu_model(model, gpus = 4)
  40:     except:
  41:         pass
  42:     model.compile(loss='binary_crossentropy', optimizer=optim,
metrics=['accuracy'])
  43:     model.fit(x_train,y_train, batch_size=batch_size, epochs=epochs,
verbose=0, validation_split=0.2, class_weight=class_weights, shuffle=True)
  44:     score = model.evaluate(x_test, y_test, verbose=0)
  45:     loss = score[0]
  46:     return {'loss': loss, 'status': STATUS_OK, 'model': model}
  47:
  0%|
| 0/100 [00:00<?, ?it/s, best loss: ?]WARNING:tensorflow:From
c:\users\mrathbun2018\.conda\envs\mattwork\lib\site-
packages\keras\backend\tensorflow_backend.py:4070: The name tf.nn.max_pool is
deprecated. Please use tf.nn.max_pool2d instead.

Model: "sequential_1"
```

```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_1 (Conv1D)            (None, 295, 128)          8832
_________________________________________________________________
conv1d_2 (Conv1D)            (None, 292, 128)          65664
_________________________________________________________________
max_pooling1d_1 (MaxPooling1 (None, 146, 128)          0
_________________________________________________________________
flatten_1 (Flatten)          (None, 18688)             0
_________________________________________________________________
dropout_1 (Dropout)          (None, 18688)             0
_________________________________________________________________
dense_1 (Dense)              (None, 64)                1196096
_________________________________________________________________
dense_2 (Dense)              (None, 32)                2080
_________________________________________________________________
dropout_2 (Dropout)          (None, 32)                0
_________________________________________________________________
dense_3 (Dense)              (None, 2)                 66
=================================================================
Total params: 1,272,738
Trainable params: 1,272,738
Non-trainable params: 0
_________________________________________________________________
  0%|
| 0/100 [00:00<?, ?it/s, best loss: ?]WARNING:tensorflow:From
c:\users\mrathbun2018\.conda\envs\mattwork\lib\site-
packages\tensorflow\python\ops\math_grad.py:1250:
add_dispatch_support.<locals>.wrapper (from tensorflow.python.ops.array_ops) is
deprecated and will be removed in a future version.
Instructions for updating:
Use tf.where in 2.0, which has the same broadcast rule as np.where
WARNING:tensorflow:From c:\users\mrathbun2018\.conda\envs\mattwork\lib\site-
packages\keras\backend\tensorflow_backend.py:422: The name tf.global_variables
is deprecated. Please use tf.compat.v1.global_variables instead.

Model: "sequential_2"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_3 (Conv1D)            (None, 267, 64)           34880
_________________________________________________________________
conv1d_4 (Conv1D)            (None, 236, 64)           131136
_________________________________________________________________
max_pooling1d_2 (MaxPooling1 (None, 118, 64)           0
_________________________________________________________________
flatten_2 (Flatten)          (None, 7552)              0
```

```
_________________________________________________________________
dropout_3 (Dropout)          (None, 7552)              0
_________________________________________________________________
dense_4 (Dense)              (None, 64)                483392
_________________________________________________________________
dense_5 (Dense)              (None, 32)                2080
_________________________________________________________________
dropout_4 (Dropout)          (None, 32)                0
_________________________________________________________________
dense_6 (Dense)              (None, 2)                 66
=================================================================
Total params: 651,554
Trainable params: 651,554
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_3"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_5 (Conv1D)            (None, 235, 128)          139392
_________________________________________________________________
conv1d_6 (Conv1D)            (None, 172, 128)          1048704
_________________________________________________________________
max_pooling1d_3 (MaxPooling1 (None, 86, 128)           0
_________________________________________________________________
flatten_3 (Flatten)          (None, 11008)             0
_________________________________________________________________
dropout_5 (Dropout)          (None, 11008)             0
_________________________________________________________________
dense_7 (Dense)              (None, 64)                704576
_________________________________________________________________
dense_8 (Dense)              (None, 32)                2080
_________________________________________________________________
dropout_6 (Dropout)          (None, 32)                0
_________________________________________________________________
dense_9 (Dense)              (None, 2)                 66
=================================================================
Total params: 1,894,818
Trainable params: 1,894,818
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_4"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_7 (Conv1D)            (None, 235, 64)           69696
_________________________________________________________________
conv1d_8 (Conv1D)            (None, 172, 64)           262208
```

```
_________________________________________________________________
conv1d_9 (Conv1D)            (None, 109, 64)           262208
_________________________________________________________________
conv1d_10 (Conv1D)           (None, 46, 64)            262208
_________________________________________________________________
max_pooling1d_4 (MaxPooling1 (None, 15, 64)            0
_________________________________________________________________
flatten_4 (Flatten)          (None, 960)               0
_________________________________________________________________
dropout_7 (Dropout)          (None, 960)               0
_________________________________________________________________
dense_10 (Dense)             (None, 64)                61504
_________________________________________________________________
dense_11 (Dense)             (None, 32)                2080
_________________________________________________________________
dropout_8 (Dropout)          (None, 32)                0
_________________________________________________________________
dense_12 (Dense)             (None, 2)                 66
=================================================================
Total params: 919,970
Trainable params: 919,970
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_5"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_11 (Conv1D)           (None, 283, 128)          34944
_________________________________________________________________
conv1d_12 (Conv1D)           (None, 268, 128)          262272
_________________________________________________________________
conv1d_13 (Conv1D)           (None, 253, 128)          262272
_________________________________________________________________
max_pooling1d_5 (MaxPooling1 (None, 126, 128)          0
_________________________________________________________________
flatten_5 (Flatten)          (None, 16128)             0
_________________________________________________________________
dropout_9 (Dropout)          (None, 16128)             0
_________________________________________________________________
dense_13 (Dense)             (None, 64)                1032256
_________________________________________________________________
dense_14 (Dense)             (None, 32)                2080
_________________________________________________________________
dropout_10 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_15 (Dense)             (None, 2)                 66
=================================================================
Total params: 1,593,890
```

```
Trainable params: 1,593,890
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_6"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_14 (Conv1D)           (None, 291, 128)          17536
_________________________________________________________________
conv1d_15 (Conv1D)           (None, 284, 128)          131200
_________________________________________________________________
conv1d_16 (Conv1D)           (None, 277, 128)          131200
_________________________________________________________________
conv1d_17 (Conv1D)           (None, 270, 128)          131200
_________________________________________________________________
max_pooling1d_6 (MaxPooling1 (None, 90, 128)           0
_________________________________________________________________
flatten_6 (Flatten)          (None, 11520)             0
_________________________________________________________________
dropout_11 (Dropout)         (None, 11520)             0
_________________________________________________________________
dense_16 (Dense)             (None, 64)                737344
_________________________________________________________________
dense_17 (Dense)             (None, 32)                2080
_________________________________________________________________
dropout_12 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_18 (Dense)             (None, 2)                 66
=================================================================
Total params: 1,150,626
Trainable params: 1,150,626
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_7"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_18 (Conv1D)           (None, 283, 32)           8736
_________________________________________________________________
conv1d_19 (Conv1D)           (None, 268, 32)           16416
_________________________________________________________________
conv1d_20 (Conv1D)           (None, 253, 32)           16416
_________________________________________________________________
max_pooling1d_7 (MaxPooling1 (None, 84, 32)            0
_________________________________________________________________
flatten_7 (Flatten)          (None, 2688)              0
_________________________________________________________________
dropout_13 (Dropout)         (None, 2688)              0
```

```
_________________________________________________________________
dense_19 (Dense)             (None, 64)                172096
_________________________________________________________________
dense_20 (Dense)             (None, 32)                2080
_________________________________________________________________
dropout_14 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_21 (Dense)             (None, 2)                 66
=================================================================
Total params: 215,810
Trainable params: 215,810
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_8"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_21 (Conv1D)           (None, 291, 64)           8768
_________________________________________________________________
max_pooling1d_8 (MaxPooling1 (None, 97, 64)            0
_________________________________________________________________
flatten_8 (Flatten)          (None, 6208)              0
_________________________________________________________________
dropout_15 (Dropout)         (None, 6208)              0
_________________________________________________________________
dense_22 (Dense)             (None, 64)                397376
_________________________________________________________________
dense_23 (Dense)             (None, 32)                2080
_________________________________________________________________
dropout_16 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_24 (Dense)             (None, 2)                 66
=================================================================
Total params: 408,290
Trainable params: 408,290
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_9"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_22 (Conv1D)           (None, 267, 128)          69760
_________________________________________________________________
conv1d_23 (Conv1D)           (None, 236, 128)          524416
_________________________________________________________________
max_pooling1d_9 (MaxPooling1 (None, 78, 128)           0
_________________________________________________________________
flatten_9 (Flatten)          (None, 9984)              0
```

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_________________________________________________________________
dropout_17 (Dropout)         (None, 9984)              0
_________________________________________________________________
dense_25 (Dense)             (None, 64)                639040
_________________________________________________________________
dense_26 (Dense)             (None, 32)                2080
_________________________________________________________________
dropout_18 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_27 (Dense)             (None, 2)                 66
=================================================================
Total params: 1,235,362
Trainable params: 1,235,362
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_10"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_24 (Conv1D)           (None, 235, 64)           69696
_________________________________________________________________
max_pooling1d_10 (MaxPooling (None, 117, 64)           0
_________________________________________________________________
flatten_10 (Flatten)         (None, 7488)              0
_________________________________________________________________
dropout_19 (Dropout)         (None, 7488)              0
_________________________________________________________________
dense_28 (Dense)             (None, 64)                479296
_________________________________________________________________
dense_29 (Dense)             (None, 32)                2080
_________________________________________________________________
dropout_20 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_30 (Dense)             (None, 2)                 66
=================================================================
Total params: 551,138
Trainable params: 551,138
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_11"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_25 (Conv1D)           (None, 295, 128)          8832
_________________________________________________________________
conv1d_26 (Conv1D)           (None, 292, 128)          65664
_________________________________________________________________
max_pooling1d_11 (MaxPooling (None, 97, 128)           0
```

```
_________________________________________________________________
flatten_11 (Flatten)         (None, 12416)             0
_________________________________________________________________
dropout_21 (Dropout)         (None, 12416)             0
_________________________________________________________________
dense_31 (Dense)             (None, 64)                794688
_________________________________________________________________
dense_32 (Dense)             (None, 32)                2080
_________________________________________________________________
dropout_22 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_33 (Dense)             (None, 2)                 66
=================================================================
Total params: 871,330
Trainable params: 871,330
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_12"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_27 (Conv1D)           (None, 295, 32)           2208
_________________________________________________________________
conv1d_28 (Conv1D)           (None, 292, 32)           4128
_________________________________________________________________
conv1d_29 (Conv1D)           (None, 289, 32)           4128
_________________________________________________________________
conv1d_30 (Conv1D)           (None, 286, 32)           4128
_________________________________________________________________
max_pooling1d_12 (MaxPooling (None, 143, 32)           0
_________________________________________________________________
flatten_12 (Flatten)         (None, 4576)              0
_________________________________________________________________
dropout_23 (Dropout)         (None, 4576)              0
_________________________________________________________________
dense_34 (Dense)             (None, 64)                292928
_________________________________________________________________
dense_35 (Dense)             (None, 32)                2080
_________________________________________________________________
dropout_24 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_36 (Dense)             (None, 2)                 66
=================================================================
Total params: 309,666
Trainable params: 309,666
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_13"
```

```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_31 (Conv1D)           (None, 283, 128)          34944
_________________________________________________________________
conv1d_32 (Conv1D)           (None, 268, 128)          262272
_________________________________________________________________
conv1d_33 (Conv1D)           (None, 253, 128)          262272
_________________________________________________________________
max_pooling1d_13 (MaxPooling (None, 84, 128)           0
_________________________________________________________________
flatten_13 (Flatten)         (None, 10752)             0
_________________________________________________________________
dropout_25 (Dropout)         (None, 10752)             0
_________________________________________________________________
dense_37 (Dense)             (None, 64)                688192
_________________________________________________________________
dense_38 (Dense)             (None, 32)                2080
_________________________________________________________________
dropout_26 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_39 (Dense)             (None, 2)                 66
=================================================================
Total params: 1,249,826
Trainable params: 1,249,826
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_14"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_34 (Conv1D)           (None, 297, 32)           1120
_________________________________________________________________
conv1d_35 (Conv1D)           (None, 296, 32)           2080
_________________________________________________________________
conv1d_36 (Conv1D)           (None, 295, 32)           2080
_________________________________________________________________
max_pooling1d_14 (MaxPooling (None, 98, 32)            0
_________________________________________________________________
flatten_14 (Flatten)         (None, 3136)              0
_________________________________________________________________
dropout_27 (Dropout)         (None, 3136)              0
_________________________________________________________________
dense_40 (Dense)             (None, 64)                200768
_________________________________________________________________
dense_41 (Dense)             (None, 32)                2080
_________________________________________________________________
dropout_28 (Dropout)         (None, 32)                0
```

```
_________________________________________________________________
dense_42 (Dense)             (None, 2)                 66
=================================================================
Total params: 208,194
Trainable params: 208,194
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_15"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_37 (Conv1D)           (None, 295, 32)           2208
_________________________________________________________________
conv1d_38 (Conv1D)           (None, 292, 32)           4128
_________________________________________________________________
max_pooling1d_15 (MaxPooling (None, 97, 32)            0
_________________________________________________________________
flatten_15 (Flatten)         (None, 3104)              0
_________________________________________________________________
dropout_29 (Dropout)         (None, 3104)              0
_________________________________________________________________
dense_43 (Dense)             (None, 64)                198720
_________________________________________________________________
dense_44 (Dense)             (None, 32)                2080
_________________________________________________________________
dropout_30 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_45 (Dense)             (None, 2)                 66
=================================================================
Total params: 207,202
Trainable params: 207,202
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_16"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_39 (Conv1D)           (None, 295, 32)           2208
_________________________________________________________________
conv1d_40 (Conv1D)           (None, 292, 32)           4128
_________________________________________________________________
max_pooling1d_16 (MaxPooling (None, 97, 32)            0
_________________________________________________________________
flatten_16 (Flatten)         (None, 3104)              0
_________________________________________________________________
dropout_31 (Dropout)         (None, 3104)              0
_________________________________________________________________
dense_46 (Dense)             (None, 64)                198720
```

```
_________________________________________________________________
dense_47 (Dense)             (None, 32)                2080
_________________________________________________________________
dropout_32 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_48 (Dense)             (None, 2)                 66
=================================================================
Total params: 207,202
Trainable params: 207,202
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_17"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_41 (Conv1D)           (None, 295, 64)           4416
_________________________________________________________________
max_pooling1d_17 (MaxPooling (None, 98, 64)            0
_________________________________________________________________
flatten_17 (Flatten)         (None, 6272)              0
_________________________________________________________________
dropout_33 (Dropout)         (None, 6272)              0
_________________________________________________________________
dense_49 (Dense)             (None, 64)                401472
_________________________________________________________________
dense_50 (Dense)             (None, 32)                2080
_________________________________________________________________
dropout_34 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_51 (Dense)             (None, 2)                 66
=================================================================
Total params: 408,034
Trainable params: 408,034
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_18"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_42 (Conv1D)           (None, 283, 32)           8736
_________________________________________________________________
conv1d_43 (Conv1D)           (None, 268, 32)           16416
_________________________________________________________________
max_pooling1d_18 (MaxPooling (None, 134, 32)           0
_________________________________________________________________
flatten_18 (Flatten)         (None, 4288)              0
_________________________________________________________________
dropout_35 (Dropout)         (None, 4288)              0
```

```
_________________________________________________________________
dense_52 (Dense)             (None, 64)                274496
_________________________________________________________________
dense_53 (Dense)             (None, 32)                2080
_________________________________________________________________
dropout_36 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_54 (Dense)             (None, 2)                 66
=================================================================
Total params: 301,794
Trainable params: 301,794
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_19"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_44 (Conv1D)           (None, 267, 32)           17440
_________________________________________________________________
conv1d_45 (Conv1D)           (None, 236, 32)           32800
_________________________________________________________________
conv1d_46 (Conv1D)           (None, 205, 32)           32800
_________________________________________________________________
max_pooling1d_19 (MaxPooling (None, 68, 32)            0
_________________________________________________________________
flatten_19 (Flatten)         (None, 2176)              0
_________________________________________________________________
dropout_37 (Dropout)         (None, 2176)              0
_________________________________________________________________
dense_55 (Dense)             (None, 64)                139328
_________________________________________________________________
dense_56 (Dense)             (None, 32)                2080
_________________________________________________________________
dropout_38 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_57 (Dense)             (None, 2)                 66
=================================================================
Total params: 224,514
Trainable params: 224,514
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_20"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_47 (Conv1D)           (None, 295, 32)           2208
_________________________________________________________________
conv1d_48 (Conv1D)           (None, 292, 32)           4128
```

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_________________________________________________________________
conv1d_49 (Conv1D)           (None, 289, 32)           4128
_________________________________________________________________
max_pooling1d_20 (MaxPooling (None, 144, 32)           0
_________________________________________________________________
flatten_20 (Flatten)         (None, 4608)              0
_________________________________________________________________
dropout_39 (Dropout)         (None, 4608)              0
_________________________________________________________________
dense_58 (Dense)             (None, 64)                294976
_________________________________________________________________
dense_59 (Dense)             (None, 32)                2080
_________________________________________________________________
dropout_40 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_60 (Dense)             (None, 2)                 66
=================================================================
Total params: 307,586
Trainable params: 307,586
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_21"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_50 (Conv1D)           (None, 235, 128)          139392
_________________________________________________________________
conv1d_51 (Conv1D)           (None, 172, 128)          1048704
_________________________________________________________________
conv1d_52 (Conv1D)           (None, 109, 128)          1048704
_________________________________________________________________
max_pooling1d_21 (MaxPooling (None, 54, 128)           0
_________________________________________________________________
flatten_21 (Flatten)         (None, 6912)              0
_________________________________________________________________
dropout_41 (Dropout)         (None, 6912)              0
_________________________________________________________________
dense_61 (Dense)             (None, 64)                442432
_________________________________________________________________
dense_62 (Dense)             (None, 32)                2080
_________________________________________________________________
dropout_42 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_63 (Dense)             (None, 2)                 66
=================================================================
Total params: 2,681,378
Trainable params: 2,681,378
Non-trainable params: 0
```

```
_________________________________________________________________
Model: "sequential_22"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_53 (Conv1D)           (None, 297, 128)          4480
_________________________________________________________________
conv1d_54 (Conv1D)           (None, 296, 128)          32896
_________________________________________________________________
conv1d_55 (Conv1D)           (None, 295, 128)          32896
_________________________________________________________________
max_pooling1d_22 (MaxPooling (None, 147, 128)          0
_________________________________________________________________
flatten_22 (Flatten)         (None, 18816)             0
_________________________________________________________________
dropout_43 (Dropout)         (None, 18816)             0
_________________________________________________________________
dense_64 (Dense)             (None, 64)                1204288
_________________________________________________________________
dense_65 (Dense)             (None, 32)                2080
_________________________________________________________________
dropout_44 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_66 (Dense)             (None, 2)                 66
=================================================================
Total params: 1,276,706
Trainable params: 1,276,706
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_23"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_56 (Conv1D)           (None, 283, 32)           8736
_________________________________________________________________
max_pooling1d_23 (MaxPooling (None, 141, 32)           0
_________________________________________________________________
flatten_23 (Flatten)         (None, 4512)              0
_________________________________________________________________
dropout_45 (Dropout)         (None, 4512)              0
_________________________________________________________________
dense_67 (Dense)             (None, 64)                288832
_________________________________________________________________
dense_68 (Dense)             (None, 32)                2080
_________________________________________________________________
dropout_46 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_69 (Dense)             (None, 2)                 66
```

```
=================================================================
Total params: 299,714
Trainable params: 299,714
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_24"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_57 (Conv1D)           (None, 235, 128)          139392
_________________________________________________________________
conv1d_58 (Conv1D)           (None, 172, 128)          1048704
_________________________________________________________________
conv1d_59 (Conv1D)           (None, 109, 128)          1048704
_________________________________________________________________
conv1d_60 (Conv1D)           (None, 46, 128)           1048704
_________________________________________________________________
max_pooling1d_24 (MaxPooling (None, 23, 128)           0
_________________________________________________________________
flatten_24 (Flatten)         (None, 2944)              0
_________________________________________________________________
dropout_47 (Dropout)         (None, 2944)              0
_________________________________________________________________
dense_70 (Dense)             (None, 64)                188480
_________________________________________________________________
dense_71 (Dense)             (None, 32)                2080
_________________________________________________________________
dropout_48 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_72 (Dense)             (None, 2)                 66
=================================================================
Total params: 3,476,130
Trainable params: 3,476,130
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_25"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_61 (Conv1D)           (None, 283, 32)           8736
_________________________________________________________________
conv1d_62 (Conv1D)           (None, 268, 32)           16416
_________________________________________________________________
max_pooling1d_25 (MaxPooling (None, 89, 32)            0
_________________________________________________________________
flatten_25 (Flatten)         (None, 2848)              0
_________________________________________________________________
dropout_49 (Dropout)         (None, 2848)              0
```

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_________________________________________________________________
dense_73 (Dense)             (None, 64)                182336
_________________________________________________________________
dense_74 (Dense)             (None, 32)                2080
_________________________________________________________________
dropout_50 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_75 (Dense)             (None, 2)                 66
=================================================================
Total params: 209,634
Trainable params: 209,634
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_26"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_63 (Conv1D)           (None, 235, 128)          139392
_________________________________________________________________
conv1d_64 (Conv1D)           (None, 172, 128)          1048704
_________________________________________________________________
conv1d_65 (Conv1D)           (None, 109, 128)          1048704
_________________________________________________________________
max_pooling1d_26 (MaxPooling (None, 54, 128)           0
_________________________________________________________________
flatten_26 (Flatten)         (None, 6912)              0
_________________________________________________________________
dropout_51 (Dropout)         (None, 6912)              0
_________________________________________________________________
dense_76 (Dense)             (None, 64)                442432
_________________________________________________________________
dense_77 (Dense)             (None, 32)                2080
_________________________________________________________________
dropout_52 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_78 (Dense)             (None, 2)                 66
=================================================================
Total params: 2,681,378
Trainable params: 2,681,378
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_27"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_66 (Conv1D)           (None, 291, 32)           4384
_________________________________________________________________
conv1d_67 (Conv1D)           (None, 284, 32)           8224
```

```
_________________________________________________________________
max_pooling1d_27 (MaxPooling (None, 142, 32)           0
_________________________________________________________________
flatten_27 (Flatten)         (None, 4544)              0
_________________________________________________________________
dropout_53 (Dropout)         (None, 4544)              0
_________________________________________________________________
dense_79 (Dense)             (None, 64)                290880
_________________________________________________________________
dense_80 (Dense)             (None, 32)                2080
_________________________________________________________________
dropout_54 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_81 (Dense)             (None, 2)                 66
=================================================================
Total params: 305,634
Trainable params: 305,634
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_28"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_68 (Conv1D)           (None, 297, 128)          4480
_________________________________________________________________
conv1d_69 (Conv1D)           (None, 296, 128)          32896
_________________________________________________________________
conv1d_70 (Conv1D)           (None, 295, 128)          32896
_________________________________________________________________
max_pooling1d_28 (MaxPooling (None, 98, 128)           0
_________________________________________________________________
flatten_28 (Flatten)         (None, 12544)             0
_________________________________________________________________
dropout_55 (Dropout)         (None, 12544)             0
_________________________________________________________________
dense_82 (Dense)             (None, 64)                802880
_________________________________________________________________
dense_83 (Dense)             (None, 32)                2080
_________________________________________________________________
dropout_56 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_84 (Dense)             (None, 2)                 66
=================================================================
Total params: 875,298
Trainable params: 875,298
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_29"
```

```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_71 (Conv1D)           (None, 283, 32)           8736
_________________________________________________________________
conv1d_72 (Conv1D)           (None, 268, 32)           16416
_________________________________________________________________
max_pooling1d_29 (MaxPooling (None, 134, 32)           0
_________________________________________________________________
flatten_29 (Flatten)         (None, 4288)              0
_________________________________________________________________
dropout_57 (Dropout)         (None, 4288)              0
_________________________________________________________________
dense_85 (Dense)             (None, 64)                274496
_________________________________________________________________
dense_86 (Dense)             (None, 32)                2080
_________________________________________________________________
dropout_58 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_87 (Dense)             (None, 2)                 66
=================================================================
Total params: 301,794
Trainable params: 301,794
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_30"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_73 (Conv1D)           (None, 235, 128)          139392
_________________________________________________________________
max_pooling1d_30 (MaxPooling (None, 78, 128)           0
_________________________________________________________________
flatten_30 (Flatten)         (None, 9984)              0
_________________________________________________________________
dropout_59 (Dropout)         (None, 9984)              0
_________________________________________________________________
dense_88 (Dense)             (None, 64)                639040
_________________________________________________________________
dense_89 (Dense)             (None, 32)                2080
_________________________________________________________________
dropout_60 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_90 (Dense)             (None, 2)                 66
=================================================================
Total params: 780,578
Trainable params: 780,578
Non-trainable params: 0
```

```
_________________________________________________________________
Model: "sequential_31"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_74 (Conv1D)           (None, 235, 64)           69696
_________________________________________________________________
conv1d_75 (Conv1D)           (None, 172, 64)           262208
_________________________________________________________________
max_pooling1d_31 (MaxPooling (None, 86, 64)            0
_________________________________________________________________
flatten_31 (Flatten)         (None, 5504)              0
_________________________________________________________________
dropout_61 (Dropout)         (None, 5504)              0
_________________________________________________________________
dense_91 (Dense)             (None, 64)                352320
_________________________________________________________________
dense_92 (Dense)             (None, 32)                2080
_________________________________________________________________
dropout_62 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_93 (Dense)             (None, 2)                 66
=================================================================
Total params: 686,370
Trainable params: 686,370
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_32"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_76 (Conv1D)           (None, 267, 32)           17440
_________________________________________________________________
conv1d_77 (Conv1D)           (None, 236, 32)           32800
_________________________________________________________________
conv1d_78 (Conv1D)           (None, 205, 32)           32800
_________________________________________________________________
conv1d_79 (Conv1D)           (None, 174, 32)           32800
_________________________________________________________________
max_pooling1d_32 (MaxPooling (None, 87, 32)            0
_________________________________________________________________
flatten_32 (Flatten)         (None, 2784)              0
_________________________________________________________________
dropout_63 (Dropout)         (None, 2784)              0
_________________________________________________________________
dense_94 (Dense)             (None, 64)                178240
_________________________________________________________________
dense_95 (Dense)             (None, 32)                2080
```

```
_________________________________________________________________
dropout_64 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_96 (Dense)             (None, 2)                 66
=================================================================
Total params: 296,226
Trainable params: 296,226
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_33"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_80 (Conv1D)           (None, 283, 64)           17472
_________________________________________________________________
conv1d_81 (Conv1D)           (None, 268, 64)           65600
_________________________________________________________________
conv1d_82 (Conv1D)           (None, 253, 64)           65600
_________________________________________________________________
max_pooling1d_33 (MaxPooling (None, 84, 64)            0
_________________________________________________________________
flatten_33 (Flatten)         (None, 5376)              0
_________________________________________________________________
dropout_65 (Dropout)         (None, 5376)              0
_________________________________________________________________
dense_97 (Dense)             (None, 64)                344128
_________________________________________________________________
dense_98 (Dense)             (None, 32)                2080
_________________________________________________________________
dropout_66 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_99 (Dense)             (None, 2)                 66
=================================================================
Total params: 494,946
Trainable params: 494,946
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_34"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_83 (Conv1D)           (None, 235, 128)          139392
_________________________________________________________________
conv1d_84 (Conv1D)           (None, 172, 128)          1048704
_________________________________________________________________
max_pooling1d_34 (MaxPooling (None, 86, 128)           0
_________________________________________________________________
flatten_34 (Flatten)         (None, 11008)             0
```

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_________________________________________________________________
dropout_67 (Dropout)         (None, 11008)             0
_________________________________________________________________
dense_100 (Dense)            (None, 64)                704576
_________________________________________________________________
dense_101 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_68 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_102 (Dense)            (None, 2)                 66
=================================================================
Total params: 1,894,818
Trainable params: 1,894,818
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_35"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_85 (Conv1D)           (None, 291, 128)          17536
_________________________________________________________________
conv1d_86 (Conv1D)           (None, 284, 128)          131200
_________________________________________________________________
conv1d_87 (Conv1D)           (None, 277, 128)          131200
_________________________________________________________________
conv1d_88 (Conv1D)           (None, 270, 128)          131200
_________________________________________________________________
max_pooling1d_35 (MaxPooling (None, 90, 128)           0
_________________________________________________________________
flatten_35 (Flatten)         (None, 11520)             0
_________________________________________________________________
dropout_69 (Dropout)         (None, 11520)             0
_________________________________________________________________
dense_103 (Dense)            (None, 64)                737344
_________________________________________________________________
dense_104 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_70 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_105 (Dense)            (None, 2)                 66
=================================================================
Total params: 1,150,626
Trainable params: 1,150,626
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_36"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
```

```
=================================================================
conv1d_89 (Conv1D)           (None, 283, 64)           17472
_________________________________________________________________
conv1d_90 (Conv1D)           (None, 268, 64)           65600
_________________________________________________________________
conv1d_91 (Conv1D)           (None, 253, 64)           65600
_________________________________________________________________
max_pooling1d_36 (MaxPooling (None, 84, 64)            0
_________________________________________________________________
flatten_36 (Flatten)         (None, 5376)              0
_________________________________________________________________
dropout_71 (Dropout)         (None, 5376)              0
_________________________________________________________________
dense_106 (Dense)            (None, 64)                344128
_________________________________________________________________
dense_107 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_72 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_108 (Dense)            (None, 2)                 66
=================================================================
Total params: 494,946
Trainable params: 494,946
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_37"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_92 (Conv1D)           (None, 267, 128)          69760
_________________________________________________________________
conv1d_93 (Conv1D)           (None, 236, 128)          524416
_________________________________________________________________
max_pooling1d_37 (MaxPooling (None, 118, 128)          0
_________________________________________________________________
flatten_37 (Flatten)         (None, 15104)             0
_________________________________________________________________
dropout_73 (Dropout)         (None, 15104)             0
_________________________________________________________________
dense_109 (Dense)            (None, 64)                966720
_________________________________________________________________
dense_110 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_74 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_111 (Dense)            (None, 2)                 66
=================================================================
Total params: 1,563,042
```

```
Trainable params: 1,563,042
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_38"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_94 (Conv1D)           (None, 297, 32)           1120
_________________________________________________________________
max_pooling1d_38 (MaxPooling (None, 99, 32)            0
_________________________________________________________________
flatten_38 (Flatten)         (None, 3168)              0
_________________________________________________________________
dropout_75 (Dropout)         (None, 3168)              0
_________________________________________________________________
dense_112 (Dense)            (None, 64)                202816
_________________________________________________________________
dense_113 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_76 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_114 (Dense)            (None, 2)                 66
=================================================================
Total params: 206,082
Trainable params: 206,082
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_39"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_95 (Conv1D)           (None, 291, 64)           8768
_________________________________________________________________
conv1d_96 (Conv1D)           (None, 284, 64)           32832
_________________________________________________________________
conv1d_97 (Conv1D)           (None, 277, 64)           32832
_________________________________________________________________
conv1d_98 (Conv1D)           (None, 270, 64)           32832
_________________________________________________________________
max_pooling1d_39 (MaxPooling (None, 135, 64)           0
_________________________________________________________________
flatten_39 (Flatten)         (None, 8640)              0
_________________________________________________________________
dropout_77 (Dropout)         (None, 8640)              0
_________________________________________________________________
dense_115 (Dense)            (None, 64)                553024
_________________________________________________________________
dense_116 (Dense)            (None, 32)                2080
```

```
_________________________________________________________________
dropout_78 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_117 (Dense)            (None, 2)                 66
=================================================================
Total params: 662,434
Trainable params: 662,434
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_40"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_99 (Conv1D)           (None, 235, 128)          139392
_________________________________________________________________
conv1d_100 (Conv1D)          (None, 172, 128)          1048704
_________________________________________________________________
conv1d_101 (Conv1D)          (None, 109, 128)          1048704
_________________________________________________________________
max_pooling1d_40 (MaxPooling (None, 36, 128)           0
_________________________________________________________________
flatten_40 (Flatten)         (None, 4608)              0
_________________________________________________________________
dropout_79 (Dropout)         (None, 4608)              0
_________________________________________________________________
dense_118 (Dense)            (None, 64)                294976
_________________________________________________________________
dense_119 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_80 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_120 (Dense)            (None, 2)                 66
=================================================================
Total params: 2,533,922
Trainable params: 2,533,922
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_41"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_102 (Conv1D)          (None, 283, 128)          34944
_________________________________________________________________
conv1d_103 (Conv1D)          (None, 268, 128)          262272
_________________________________________________________________
max_pooling1d_41 (MaxPooling (None, 134, 128)          0
_________________________________________________________________
flatten_41 (Flatten)         (None, 17152)             0
```

```
_________________________________________________________________
dropout_81 (Dropout)         (None, 17152)             0
_________________________________________________________________
dense_121 (Dense)            (None, 64)                1097792
_________________________________________________________________
dense_122 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_82 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_123 (Dense)            (None, 2)                 66
=================================================================
Total params: 1,397,154
Trainable params: 1,397,154
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_42"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_104 (Conv1D)          (None, 235, 32)           34848
_________________________________________________________________
conv1d_105 (Conv1D)          (None, 172, 32)           65568
_________________________________________________________________
conv1d_106 (Conv1D)          (None, 109, 32)           65568
_________________________________________________________________
max_pooling1d_42 (MaxPooling (None, 36, 32)            0
_________________________________________________________________
flatten_42 (Flatten)         (None, 1152)              0
_________________________________________________________________
dropout_83 (Dropout)         (None, 1152)              0
_________________________________________________________________
dense_124 (Dense)            (None, 64)                73792
_________________________________________________________________
dense_125 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_84 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_126 (Dense)            (None, 2)                 66
=================================================================
Total params: 241,922
Trainable params: 241,922
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_43"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_107 (Conv1D)          (None, 235, 32)           34848
```

```
_________________________________________________________________
conv1d_108 (Conv1D)          (None, 172, 32)           65568
_________________________________________________________________
conv1d_109 (Conv1D)          (None, 109, 32)           65568
_________________________________________________________________
max_pooling1d_43 (MaxPooling (None, 36, 32)            0
_________________________________________________________________
flatten_43 (Flatten)         (None, 1152)              0
_________________________________________________________________
dropout_85 (Dropout)         (None, 1152)              0
_________________________________________________________________
dense_127 (Dense)            (None, 64)                73792
_________________________________________________________________
dense_128 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_86 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_129 (Dense)            (None, 2)                 66
=================================================================
Total params: 241,922
Trainable params: 241,922
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_44"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_110 (Conv1D)          (None, 283, 32)           8736
_________________________________________________________________
conv1d_111 (Conv1D)          (None, 268, 32)           16416
_________________________________________________________________
conv1d_112 (Conv1D)          (None, 253, 32)           16416
_________________________________________________________________
max_pooling1d_44 (MaxPooling (None, 84, 32)            0
_________________________________________________________________
flatten_44 (Flatten)         (None, 2688)              0
_________________________________________________________________
dropout_87 (Dropout)         (None, 2688)              0
_________________________________________________________________
dense_130 (Dense)            (None, 64)                172096
_________________________________________________________________
dense_131 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_88 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_132 (Dense)            (None, 2)                 66
=================================================================
Total params: 215,810
```

```
Trainable params: 215,810
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_45"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_113 (Conv1D)          (None, 267, 32)           17440
_________________________________________________________________
conv1d_114 (Conv1D)          (None, 236, 32)           32800
_________________________________________________________________
conv1d_115 (Conv1D)          (None, 205, 32)           32800
_________________________________________________________________
max_pooling1d_45 (MaxPooling (None, 68, 32)            0
_________________________________________________________________
flatten_45 (Flatten)         (None, 2176)              0
_________________________________________________________________
dropout_89 (Dropout)         (None, 2176)              0
_________________________________________________________________
dense_133 (Dense)            (None, 64)                139328
_________________________________________________________________
dense_134 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_90 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_135 (Dense)            (None, 2)                 66
=================================================================
Total params: 224,514
Trainable params: 224,514
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_46"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_116 (Conv1D)          (None, 291, 32)           4384
_________________________________________________________________
conv1d_117 (Conv1D)          (None, 284, 32)           8224
_________________________________________________________________
conv1d_118 (Conv1D)          (None, 277, 32)           8224
_________________________________________________________________
max_pooling1d_46 (MaxPooling (None, 92, 32)            0
_________________________________________________________________
flatten_46 (Flatten)         (None, 2944)              0
_________________________________________________________________
dropout_91 (Dropout)         (None, 2944)              0
_________________________________________________________________
dense_136 (Dense)            (None, 64)                188480
```

```
_________________________________________________________________
dense_137 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_92 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_138 (Dense)            (None, 2)                 66
=================================================================
Total params: 211,458
Trainable params: 211,458
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_47"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_119 (Conv1D)          (None, 297, 32)           1120
_________________________________________________________________
conv1d_120 (Conv1D)          (None, 296, 32)           2080
_________________________________________________________________
conv1d_121 (Conv1D)          (None, 295, 32)           2080
_________________________________________________________________
max_pooling1d_47 (MaxPooling (None, 98, 32)            0
_________________________________________________________________
flatten_47 (Flatten)         (None, 3136)              0
_________________________________________________________________
dropout_93 (Dropout)         (None, 3136)              0
_________________________________________________________________
dense_139 (Dense)            (None, 64)                200768
_________________________________________________________________
dense_140 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_94 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_141 (Dense)            (None, 2)                 66
=================================================================
Total params: 208,194
Trainable params: 208,194
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_48"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_122 (Conv1D)          (None, 283, 32)           8736
_________________________________________________________________
conv1d_123 (Conv1D)          (None, 268, 32)           16416
_________________________________________________________________
conv1d_124 (Conv1D)          (None, 253, 32)           16416
```

```
_________________________________________________________________
max_pooling1d_48 (MaxPooling (None, 84, 32)            0
_________________________________________________________________
flatten_48 (Flatten)         (None, 2688)              0
_________________________________________________________________
dropout_95 (Dropout)         (None, 2688)              0
_________________________________________________________________
dense_142 (Dense)            (None, 64)                172096
_________________________________________________________________
dense_143 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_96 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_144 (Dense)            (None, 2)                 66
=================================================================
Total params: 215,810
Trainable params: 215,810
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_49"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_125 (Conv1D)          (None, 235, 32)           34848
_________________________________________________________________
max_pooling1d_49 (MaxPooling (None, 78, 32)            0
_________________________________________________________________
flatten_49 (Flatten)         (None, 2496)              0
_________________________________________________________________
dropout_97 (Dropout)         (None, 2496)              0
_________________________________________________________________
dense_145 (Dense)            (None, 64)                159808
_________________________________________________________________
dense_146 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_98 (Dropout)         (None, 32)                0
_________________________________________________________________
dense_147 (Dense)            (None, 2)                 66
=================================================================
Total params: 196,802
Trainable params: 196,802
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_50"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_126 (Conv1D)          (None, 295, 32)           2208
```

```
_________________________________________________________________
conv1d_127 (Conv1D)          (None, 292, 32)           4128
_________________________________________________________________
conv1d_128 (Conv1D)          (None, 289, 32)           4128
_________________________________________________________________
max_pooling1d_50 (MaxPooling (None, 96, 32)            0
_________________________________________________________________
flatten_50 (Flatten)         (None, 3072)              0
_________________________________________________________________
dropout_99 (Dropout)         (None, 3072)              0
_________________________________________________________________
dense_148 (Dense)            (None, 64)                196672
_________________________________________________________________
dense_149 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_100 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_150 (Dense)            (None, 2)                 66
=================================================================
Total params: 209,282
Trainable params: 209,282
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_51"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_129 (Conv1D)          (None, 267, 32)           17440
_________________________________________________________________
conv1d_130 (Conv1D)          (None, 236, 32)           32800
_________________________________________________________________
conv1d_131 (Conv1D)          (None, 205, 32)           32800
_________________________________________________________________
conv1d_132 (Conv1D)          (None, 174, 32)           32800
_________________________________________________________________
max_pooling1d_51 (MaxPooling (None, 58, 32)            0
_________________________________________________________________
flatten_51 (Flatten)         (None, 1856)              0
_________________________________________________________________
dropout_101 (Dropout)        (None, 1856)              0
_________________________________________________________________
dense_151 (Dense)            (None, 64)                118848
_________________________________________________________________
dense_152 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_102 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_153 (Dense)            (None, 2)                 66
```

```
=================================================================
Total params: 236,834
Trainable params: 236,834
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_52"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_133 (Conv1D)          (None, 283, 64)           17472
_________________________________________________________________
conv1d_134 (Conv1D)          (None, 268, 64)           65600
_________________________________________________________________
conv1d_135 (Conv1D)          (None, 253, 64)           65600
_________________________________________________________________
max_pooling1d_52 (MaxPooling (None, 84, 64)            0
_________________________________________________________________
flatten_52 (Flatten)         (None, 5376)              0
_________________________________________________________________
dropout_103 (Dropout)        (None, 5376)              0
_________________________________________________________________
dense_154 (Dense)            (None, 64)                344128
_________________________________________________________________
dense_155 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_104 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_156 (Dense)            (None, 2)                 66
=================================================================
Total params: 494,946
Trainable params: 494,946
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_53"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_136 (Conv1D)          (None, 235, 32)           34848
_________________________________________________________________
conv1d_137 (Conv1D)          (None, 172, 32)           65568
_________________________________________________________________
conv1d_138 (Conv1D)          (None, 109, 32)           65568
_________________________________________________________________
max_pooling1d_53 (MaxPooling (None, 36, 32)            0
_________________________________________________________________
flatten_53 (Flatten)         (None, 1152)              0
_________________________________________________________________
dropout_105 (Dropout)        (None, 1152)              0
```

```
_________________________________________________________________
dense_157 (Dense)            (None, 64)                73792
_________________________________________________________________
dense_158 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_106 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_159 (Dense)            (None, 2)                 66
=================================================================
Total params: 241,922
Trainable params: 241,922
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_54"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_139 (Conv1D)          (None, 295, 32)           2208
_________________________________________________________________
max_pooling1d_54 (MaxPooling (None, 98, 32)            0
_________________________________________________________________
flatten_54 (Flatten)         (None, 3136)              0
_________________________________________________________________
dropout_107 (Dropout)        (None, 3136)              0
_________________________________________________________________
dense_160 (Dense)            (None, 64)                200768
_________________________________________________________________
dense_161 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_108 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_162 (Dense)            (None, 2)                 66
=================================================================
Total params: 205,122
Trainable params: 205,122
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_55"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_140 (Conv1D)          (None, 297, 32)           1120
_________________________________________________________________
conv1d_141 (Conv1D)          (None, 296, 32)           2080
_________________________________________________________________
conv1d_142 (Conv1D)          (None, 295, 32)           2080
_________________________________________________________________
max_pooling1d_55 (MaxPooling (None, 98, 32)            0
```

```
_________________________________________________________________
flatten_55 (Flatten)         (None, 3136)              0
_________________________________________________________________
dropout_109 (Dropout)        (None, 3136)              0
_________________________________________________________________
dense_163 (Dense)            (None, 64)                200768
_________________________________________________________________
dense_164 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_110 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_165 (Dense)            (None, 2)                 66
=================================================================
Total params: 208,194
Trainable params: 208,194
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_56"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_143 (Conv1D)          (None, 291, 64)           8768
_________________________________________________________________
conv1d_144 (Conv1D)          (None, 284, 64)           32832
_________________________________________________________________
conv1d_145 (Conv1D)          (None, 277, 64)           32832
_________________________________________________________________
conv1d_146 (Conv1D)          (None, 270, 64)           32832
_________________________________________________________________
max_pooling1d_56 (MaxPooling (None, 90, 64)            0
_________________________________________________________________
flatten_56 (Flatten)         (None, 5760)              0
_________________________________________________________________
dropout_111 (Dropout)        (None, 5760)              0
_________________________________________________________________
dense_166 (Dense)            (None, 64)                368704
_________________________________________________________________
dense_167 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_112 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_168 (Dense)            (None, 2)                 66
=================================================================
Total params: 478,114
Trainable params: 478,114
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_57"
```

```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_147 (Conv1D)          (None, 283, 32)           8736
_________________________________________________________________
conv1d_148 (Conv1D)          (None, 268, 32)           16416
_________________________________________________________________
conv1d_149 (Conv1D)          (None, 253, 32)           16416
_________________________________________________________________
max_pooling1d_57 (MaxPooling (None, 84, 32)            0
_________________________________________________________________
flatten_57 (Flatten)         (None, 2688)              0
_________________________________________________________________
dropout_113 (Dropout)        (None, 2688)              0
_________________________________________________________________
dense_169 (Dense)            (None, 64)                172096
_________________________________________________________________
dense_170 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_114 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_171 (Dense)            (None, 2)                 66
=================================================================
Total params: 215,810
Trainable params: 215,810
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_58"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_150 (Conv1D)          (None, 235, 32)           34848
_________________________________________________________________
max_pooling1d_58 (MaxPooling (None, 78, 32)            0
_________________________________________________________________
flatten_58 (Flatten)         (None, 2496)              0
_________________________________________________________________
dropout_115 (Dropout)        (None, 2496)              0
_________________________________________________________________
dense_172 (Dense)            (None, 64)                159808
_________________________________________________________________
dense_173 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_116 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_174 (Dense)            (None, 2)                 66
=================================================================
Total params: 196,802
```

```
Trainable params: 196,802
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_59"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_151 (Conv1D)          (None, 235, 32)           34848
_________________________________________________________________
max_pooling1d_59 (MaxPooling (None, 78, 32)            0
_________________________________________________________________
flatten_59 (Flatten)         (None, 2496)              0
_________________________________________________________________
dropout_117 (Dropout)        (None, 2496)              0
_________________________________________________________________
dense_175 (Dense)            (None, 64)                159808
_________________________________________________________________
dense_176 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_118 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_177 (Dense)            (None, 2)                 66
=================================================================
Total params: 196,802
Trainable params: 196,802
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_60"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_152 (Conv1D)          (None, 235, 32)           34848
_________________________________________________________________
max_pooling1d_60 (MaxPooling (None, 78, 32)            0
_________________________________________________________________
flatten_60 (Flatten)         (None, 2496)              0
_________________________________________________________________
dropout_119 (Dropout)        (None, 2496)              0
_________________________________________________________________
dense_178 (Dense)            (None, 64)                159808
_________________________________________________________________
dense_179 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_120 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_180 (Dense)            (None, 2)                 66
=================================================================
Total params: 196,802
```

```
Trainable params: 196,802
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_61"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_153 (Conv1D)          (None, 235, 64)           69696
_________________________________________________________________
max_pooling1d_61 (MaxPooling (None, 78, 64)            0
_________________________________________________________________
flatten_61 (Flatten)         (None, 4992)              0
_________________________________________________________________
dropout_121 (Dropout)        (None, 4992)              0
_________________________________________________________________
dense_181 (Dense)            (None, 64)                319552
_________________________________________________________________
dense_182 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_122 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_183 (Dense)            (None, 2)                 66
=================================================================
Total params: 391,394
Trainable params: 391,394
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_62"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_154 (Conv1D)          (None, 235, 32)           34848
_________________________________________________________________
max_pooling1d_62 (MaxPooling (None, 78, 32)            0
_________________________________________________________________
flatten_62 (Flatten)         (None, 2496)              0
_________________________________________________________________
dropout_123 (Dropout)        (None, 2496)              0
_________________________________________________________________
dense_184 (Dense)            (None, 64)                159808
_________________________________________________________________
dense_185 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_124 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_186 (Dense)            (None, 2)                 66
=================================================================
Total params: 196,802
```

```
Trainable params: 196,802
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_63"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_155 (Conv1D)          (None, 235, 32)           34848
_________________________________________________________________
max_pooling1d_63 (MaxPooling (None, 78, 32)            0
_________________________________________________________________
flatten_63 (Flatten)         (None, 2496)              0
_________________________________________________________________
dropout_125 (Dropout)        (None, 2496)              0
_________________________________________________________________
dense_187 (Dense)            (None, 64)                159808
_________________________________________________________________
dense_188 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_126 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_189 (Dense)            (None, 2)                 66
=================================================================
Total params: 196,802
Trainable params: 196,802
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_64"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_156 (Conv1D)          (None, 235, 32)           34848
_________________________________________________________________
max_pooling1d_64 (MaxPooling (None, 78, 32)            0
_________________________________________________________________
flatten_64 (Flatten)         (None, 2496)              0
_________________________________________________________________
dropout_127 (Dropout)        (None, 2496)              0
_________________________________________________________________
dense_190 (Dense)            (None, 64)                159808
_________________________________________________________________
dense_191 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_128 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_192 (Dense)            (None, 2)                 66
=================================================================
Total params: 196,802
```

```
Trainable params: 196,802
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_65"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_157 (Conv1D)          (None, 235, 64)           69696
_________________________________________________________________
max_pooling1d_65 (MaxPooling (None, 78, 64)            0
_________________________________________________________________
flatten_65 (Flatten)         (None, 4992)              0
_________________________________________________________________
dropout_129 (Dropout)        (None, 4992)              0
_________________________________________________________________
dense_193 (Dense)            (None, 64)                319552
_________________________________________________________________
dense_194 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_130 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_195 (Dense)            (None, 2)                 66
=================================================================
Total params: 391,394
Trainable params: 391,394
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_66"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_158 (Conv1D)          (None, 295, 32)           2208
_________________________________________________________________
conv1d_159 (Conv1D)          (None, 292, 32)           4128
_________________________________________________________________
conv1d_160 (Conv1D)          (None, 289, 32)           4128
_________________________________________________________________
max_pooling1d_66 (MaxPooling (None, 96, 32)            0
_________________________________________________________________
flatten_66 (Flatten)         (None, 3072)              0
_________________________________________________________________
dropout_131 (Dropout)        (None, 3072)              0
_________________________________________________________________
dense_196 (Dense)            (None, 64)                196672
_________________________________________________________________
dense_197 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_132 (Dropout)        (None, 32)                0
```

```
_________________________________________________________________
dense_198 (Dense)            (None, 2)                 66
=================================================================
Total params: 209,282
Trainable params: 209,282
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_67"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_161 (Conv1D)          (None, 283, 32)           8736
_________________________________________________________________
max_pooling1d_67 (MaxPooling (None, 94, 32)            0
_________________________________________________________________
flatten_67 (Flatten)         (None, 3008)              0
_________________________________________________________________
dropout_133 (Dropout)        (None, 3008)              0
_________________________________________________________________
dense_199 (Dense)            (None, 64)                192576
_________________________________________________________________
dense_200 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_134 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_201 (Dense)            (None, 2)                 66
=================================================================
Total params: 203,458
Trainable params: 203,458
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_68"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_162 (Conv1D)          (None, 267, 32)           17440
_________________________________________________________________
conv1d_163 (Conv1D)          (None, 236, 32)           32800
_________________________________________________________________
conv1d_164 (Conv1D)          (None, 205, 32)           32800
_________________________________________________________________
max_pooling1d_68 (MaxPooling (None, 68, 32)            0
_________________________________________________________________
flatten_68 (Flatten)         (None, 2176)              0
_________________________________________________________________
dropout_135 (Dropout)        (None, 2176)              0
_________________________________________________________________
dense_202 (Dense)            (None, 64)                139328
```

```
_________________________________________________________________
dense_203 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_136 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_204 (Dense)            (None, 2)                 66
=================================================================
Total params: 224,514
Trainable params: 224,514
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_69"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_165 (Conv1D)          (None, 297, 32)           1120
_________________________________________________________________
conv1d_166 (Conv1D)          (None, 296, 32)           2080
_________________________________________________________________
conv1d_167 (Conv1D)          (None, 295, 32)           2080
_________________________________________________________________
conv1d_168 (Conv1D)          (None, 294, 32)           2080
_________________________________________________________________
max_pooling1d_69 (MaxPooling (None, 98, 32)            0
_________________________________________________________________
flatten_69 (Flatten)         (None, 3136)              0
_________________________________________________________________
dropout_137 (Dropout)        (None, 3136)              0
_________________________________________________________________
dense_205 (Dense)            (None, 64)                200768
_________________________________________________________________
dense_206 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_138 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_207 (Dense)            (None, 2)                 66
=================================================================
Total params: 210,274
Trainable params: 210,274
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_70"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_169 (Conv1D)          (None, 235, 32)           34848
_________________________________________________________________
conv1d_170 (Conv1D)          (None, 172, 32)           65568
```

```
_________________________________________________________________
conv1d_171 (Conv1D)          (None, 109, 32)           65568
_________________________________________________________________
max_pooling1d_70 (MaxPooling (None, 36, 32)            0
_________________________________________________________________
flatten_70 (Flatten)         (None, 1152)              0
_________________________________________________________________
dropout_139 (Dropout)        (None, 1152)              0
_________________________________________________________________
dense_208 (Dense)            (None, 64)                73792
_________________________________________________________________
dense_209 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_140 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_210 (Dense)            (None, 2)                 66
=================================================================
Total params: 241,922
Trainable params: 241,922
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_71"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_172 (Conv1D)          (None, 283, 32)           8736
_________________________________________________________________
max_pooling1d_71 (MaxPooling (None, 94, 32)            0
_________________________________________________________________
flatten_71 (Flatten)         (None, 3008)              0
_________________________________________________________________
dropout_141 (Dropout)        (None, 3008)              0
_________________________________________________________________
dense_211 (Dense)            (None, 64)                192576
_________________________________________________________________
dense_212 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_142 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_213 (Dense)            (None, 2)                 66
=================================================================
Total params: 203,458
Trainable params: 203,458
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_72"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
```

```
=================================================================
conv1d_173 (Conv1D)          (None, 235, 32)           34848
_________________________________________________________________
conv1d_174 (Conv1D)          (None, 172, 32)           65568
_________________________________________________________________
conv1d_175 (Conv1D)          (None, 109, 32)           65568
_________________________________________________________________
max_pooling1d_72 (MaxPooling (None, 36, 32)            0
_________________________________________________________________
flatten_72 (Flatten)         (None, 1152)              0
_________________________________________________________________
dropout_143 (Dropout)        (None, 1152)              0
_________________________________________________________________
dense_214 (Dense)            (None, 64)                73792
_________________________________________________________________
dense_215 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_144 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_216 (Dense)            (None, 2)                 66
=================================================================
Total params: 241,922
Trainable params: 241,922
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_73"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_176 (Conv1D)          (None, 291, 32)           4384
_________________________________________________________________
conv1d_177 (Conv1D)          (None, 284, 32)           8224
_________________________________________________________________
conv1d_178 (Conv1D)          (None, 277, 32)           8224
_________________________________________________________________
max_pooling1d_73 (MaxPooling (None, 92, 32)            0
_________________________________________________________________
flatten_73 (Flatten)         (None, 2944)              0
_________________________________________________________________
dropout_145 (Dropout)        (None, 2944)              0
_________________________________________________________________
dense_217 (Dense)            (None, 64)                188480
_________________________________________________________________
dense_218 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_146 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_219 (Dense)            (None, 2)                 66
```

```
=================================================================
Total params: 211,458
Trainable params: 211,458
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_74"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_179 (Conv1D)          (None, 283, 32)           8736
_________________________________________________________________
conv1d_180 (Conv1D)          (None, 268, 32)           16416
_________________________________________________________________
conv1d_181 (Conv1D)          (None, 253, 32)           16416
_________________________________________________________________
conv1d_182 (Conv1D)          (None, 238, 32)           16416
_________________________________________________________________
max_pooling1d_74 (MaxPooling (None, 79, 32)            0
_________________________________________________________________
flatten_74 (Flatten)         (None, 2528)              0
_________________________________________________________________
dropout_147 (Dropout)        (None, 2528)              0
_________________________________________________________________
dense_220 (Dense)            (None, 64)                161856
_________________________________________________________________
dense_221 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_148 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_222 (Dense)            (None, 2)                 66
=================================================================
Total params: 221,986
Trainable params: 221,986
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_75"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_183 (Conv1D)          (None, 235, 32)           34848
_________________________________________________________________
conv1d_184 (Conv1D)          (None, 172, 32)           65568
_________________________________________________________________
conv1d_185 (Conv1D)          (None, 109, 32)           65568
_________________________________________________________________
conv1d_186 (Conv1D)          (None, 46, 32)            65568
_________________________________________________________________
max_pooling1d_75 (MaxPooling (None, 15, 32)            0
```

```
_________________________________________________________________
flatten_75 (Flatten)         (None, 480)               0
_________________________________________________________________
dropout_149 (Dropout)        (None, 480)               0
_________________________________________________________________
dense_223 (Dense)            (None, 64)                30784
_________________________________________________________________
dense_224 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_150 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_225 (Dense)            (None, 2)                 66
=================================================================
Total params: 264,482
Trainable params: 264,482
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_76"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_187 (Conv1D)          (None, 283, 32)           8736
_________________________________________________________________
conv1d_188 (Conv1D)          (None, 268, 32)           16416
_________________________________________________________________
conv1d_189 (Conv1D)          (None, 253, 32)           16416
_________________________________________________________________
conv1d_190 (Conv1D)          (None, 238, 32)           16416
_________________________________________________________________
max_pooling1d_76 (MaxPooling (None, 79, 32)            0
_________________________________________________________________
flatten_76 (Flatten)         (None, 2528)              0
_________________________________________________________________
dropout_151 (Dropout)        (None, 2528)              0
_________________________________________________________________
dense_226 (Dense)            (None, 64)                161856
_________________________________________________________________
dense_227 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_152 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_228 (Dense)            (None, 2)                 66
=================================================================
Total params: 221,986
Trainable params: 221,986
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_77"
```

```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_191 (Conv1D)          (None, 295, 32)           2208
_________________________________________________________________
conv1d_192 (Conv1D)          (None, 292, 32)           4128
_________________________________________________________________
conv1d_193 (Conv1D)          (None, 289, 32)           4128
_________________________________________________________________
conv1d_194 (Conv1D)          (None, 286, 32)           4128
_________________________________________________________________
max_pooling1d_77 (MaxPooling (None, 95, 32)            0
_________________________________________________________________
flatten_77 (Flatten)         (None, 3040)              0
_________________________________________________________________
dropout_153 (Dropout)        (None, 3040)              0
_________________________________________________________________
dense_229 (Dense)            (None, 64)                194624
_________________________________________________________________
dense_230 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_154 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_231 (Dense)            (None, 2)                 66
=================================================================
Total params: 211,362
Trainable params: 211,362
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_78"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_195 (Conv1D)          (None, 267, 64)           34880
_________________________________________________________________
conv1d_196 (Conv1D)          (None, 236, 64)           131136
_________________________________________________________________
conv1d_197 (Conv1D)          (None, 205, 64)           131136
_________________________________________________________________
conv1d_198 (Conv1D)          (None, 174, 64)           131136
_________________________________________________________________
max_pooling1d_78 (MaxPooling (None, 87, 64)            0
_________________________________________________________________
flatten_78 (Flatten)         (None, 5568)              0
_________________________________________________________________
dropout_155 (Dropout)        (None, 5568)              0
_________________________________________________________________
dense_232 (Dense)            (None, 64)                356416
```

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_________________________________________________________________
dense_233 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_156 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_234 (Dense)            (None, 2)                 66
=================================================================
Total params: 786,850
Trainable params: 786,850
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_79"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_199 (Conv1D)          (None, 297, 128)          4480
_________________________________________________________________
conv1d_200 (Conv1D)          (None, 296, 128)          32896
_________________________________________________________________
conv1d_201 (Conv1D)          (None, 295, 128)          32896
_________________________________________________________________
conv1d_202 (Conv1D)          (None, 294, 128)          32896
_________________________________________________________________
max_pooling1d_79 (MaxPooling (None, 98, 128)           0
_________________________________________________________________
flatten_79 (Flatten)         (None, 12544)             0
_________________________________________________________________
dropout_157 (Dropout)        (None, 12544)             0
_________________________________________________________________
dense_235 (Dense)            (None, 64)                802880
_________________________________________________________________
dense_236 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_158 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_237 (Dense)            (None, 2)                 66
=================================================================
Total params: 908,194
Trainable params: 908,194
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_80"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_203 (Conv1D)          (None, 235, 32)           34848
_________________________________________________________________
conv1d_204 (Conv1D)          (None, 172, 32)           65568
```

```
_________________________________________________________________
conv1d_205 (Conv1D)          (None, 109, 32)           65568
_________________________________________________________________
conv1d_206 (Conv1D)          (None, 46, 32)            65568
_________________________________________________________________
max_pooling1d_80 (MaxPooling (None, 15, 32)            0
_________________________________________________________________
flatten_80 (Flatten)         (None, 480)               0
_________________________________________________________________
dropout_159 (Dropout)        (None, 480)               0
_________________________________________________________________
dense_238 (Dense)            (None, 64)                30784
_________________________________________________________________
dense_239 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_160 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_240 (Dense)            (None, 2)                 66
=================================================================
Total params: 264,482
Trainable params: 264,482
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_81"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_207 (Conv1D)          (None, 283, 32)           8736
_________________________________________________________________
conv1d_208 (Conv1D)          (None, 268, 32)           16416
_________________________________________________________________
conv1d_209 (Conv1D)          (None, 253, 32)           16416
_________________________________________________________________
conv1d_210 (Conv1D)          (None, 238, 32)           16416
_________________________________________________________________
max_pooling1d_81 (MaxPooling (None, 79, 32)            0
_________________________________________________________________
flatten_81 (Flatten)         (None, 2528)              0
_________________________________________________________________
dropout_161 (Dropout)        (None, 2528)              0
_________________________________________________________________
dense_241 (Dense)            (None, 64)                161856
_________________________________________________________________
dense_242 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_162 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_243 (Dense)            (None, 2)                 66
```

```
=================================================================
Total params: 221,986
Trainable params: 221,986
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_82"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_211 (Conv1D)          (None, 291, 32)           4384
_________________________________________________________________
conv1d_212 (Conv1D)          (None, 284, 32)           8224
_________________________________________________________________
max_pooling1d_82 (MaxPooling (None, 142, 32)           0
_________________________________________________________________
flatten_82 (Flatten)         (None, 4544)              0
_________________________________________________________________
dropout_163 (Dropout)        (None, 4544)              0
_________________________________________________________________
dense_244 (Dense)            (None, 64)                290880
_________________________________________________________________
dense_245 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_164 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_246 (Dense)            (None, 2)                 66
=================================================================
Total params: 305,634
Trainable params: 305,634
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_83"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_213 (Conv1D)          (None, 235, 128)          139392
_________________________________________________________________
conv1d_214 (Conv1D)          (None, 172, 128)          1048704
_________________________________________________________________
conv1d_215 (Conv1D)          (None, 109, 128)          1048704
_________________________________________________________________
conv1d_216 (Conv1D)          (None, 46, 128)           1048704
_________________________________________________________________
max_pooling1d_83 (MaxPooling (None, 15, 128)           0
_________________________________________________________________
flatten_83 (Flatten)         (None, 1920)              0
_________________________________________________________________
dropout_165 (Dropout)        (None, 1920)              0
```

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_________________________________________________________________
dense_247 (Dense)            (None, 64)                122944
_________________________________________________________________
dense_248 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_166 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_249 (Dense)            (None, 2)                 66
=================================================================
Total params: 3,410,594
Trainable params: 3,410,594
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_84"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_217 (Conv1D)          (None, 283, 64)           17472
_________________________________________________________________
max_pooling1d_84 (MaxPooling (None, 94, 64)            0
_________________________________________________________________
flatten_84 (Flatten)         (None, 6016)              0
_________________________________________________________________
dropout_167 (Dropout)        (None, 6016)              0
_________________________________________________________________
dense_250 (Dense)            (None, 64)                385088
_________________________________________________________________
dense_251 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_168 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_252 (Dense)            (None, 2)                 66
=================================================================
Total params: 404,706
Trainable params: 404,706
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_85"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_218 (Conv1D)          (None, 267, 32)           17440
_________________________________________________________________
conv1d_219 (Conv1D)          (None, 236, 32)           32800
_________________________________________________________________
conv1d_220 (Conv1D)          (None, 205, 32)           32800
_________________________________________________________________
conv1d_221 (Conv1D)          (None, 174, 32)           32800
```

```
_________________________________________________________________
max_pooling1d_85 (MaxPooling (None, 58, 32)            0
_________________________________________________________________
flatten_85 (Flatten)         (None, 1856)              0
_________________________________________________________________
dropout_169 (Dropout)        (None, 1856)              0
_________________________________________________________________
dense_253 (Dense)            (None, 64)                118848
_________________________________________________________________
dense_254 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_170 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_255 (Dense)            (None, 2)                 66
=================================================================
Total params: 236,834
Trainable params: 236,834
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_86"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_222 (Conv1D)          (None, 295, 32)           2208
_________________________________________________________________
conv1d_223 (Conv1D)          (None, 292, 32)           4128
_________________________________________________________________
max_pooling1d_86 (MaxPooling (None, 146, 32)           0
_________________________________________________________________
flatten_86 (Flatten)         (None, 4672)              0
_________________________________________________________________
dropout_171 (Dropout)        (None, 4672)              0
_________________________________________________________________
dense_256 (Dense)            (None, 64)                299072
_________________________________________________________________
dense_257 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_172 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_258 (Dense)            (None, 2)                 66
=================================================================
Total params: 307,554
Trainable params: 307,554
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_87"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
```

```
=================================================================
conv1d_224 (Conv1D)          (None, 235, 32)           34848
_________________________________________________________________
max_pooling1d_87 (MaxPooling (None, 78, 32)            0
_________________________________________________________________
flatten_87 (Flatten)         (None, 2496)              0
_________________________________________________________________
dropout_173 (Dropout)        (None, 2496)              0
_________________________________________________________________
dense_259 (Dense)            (None, 64)                159808
_________________________________________________________________
dense_260 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_174 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_261 (Dense)            (None, 2)                 66
=================================================================
Total params: 196,802
Trainable params: 196,802
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_88"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_225 (Conv1D)          (None, 283, 128)          34944
_________________________________________________________________
conv1d_226 (Conv1D)          (None, 268, 128)          262272
_________________________________________________________________
conv1d_227 (Conv1D)          (None, 253, 128)          262272
_________________________________________________________________
conv1d_228 (Conv1D)          (None, 238, 128)          262272
_________________________________________________________________
max_pooling1d_88 (MaxPooling (None, 79, 128)           0
_________________________________________________________________
flatten_88 (Flatten)         (None, 10112)             0
_________________________________________________________________
dropout_175 (Dropout)        (None, 10112)             0
_________________________________________________________________
dense_262 (Dense)            (None, 64)                647232
_________________________________________________________________
dense_263 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_176 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_264 (Dense)            (None, 2)                 66
=================================================================
Total params: 1,471,138
```

```
Trainable params: 1,471,138
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_89"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_229 (Conv1D)          (None, 297, 32)           1120
_________________________________________________________________
max_pooling1d_89 (MaxPooling (None, 99, 32)            0
_________________________________________________________________
flatten_89 (Flatten)         (None, 3168)              0
_________________________________________________________________
dropout_177 (Dropout)        (None, 3168)              0
_________________________________________________________________
dense_265 (Dense)            (None, 64)                202816
_________________________________________________________________
dense_266 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_178 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_267 (Dense)            (None, 2)                 66
=================================================================
Total params: 206,082
Trainable params: 206,082
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_90"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_230 (Conv1D)          (None, 291, 64)           8768
_________________________________________________________________
conv1d_231 (Conv1D)          (None, 284, 64)           32832
_________________________________________________________________
max_pooling1d_90 (MaxPooling (None, 142, 64)           0
_________________________________________________________________
flatten_90 (Flatten)         (None, 9088)              0
_________________________________________________________________
dropout_179 (Dropout)        (None, 9088)              0
_________________________________________________________________
dense_268 (Dense)            (None, 64)                581696
_________________________________________________________________
dense_269 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_180 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_270 (Dense)            (None, 2)                 66
```

```
=================================================================
Total params: 625,442
Trainable params: 625,442
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_91"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_232 (Conv1D)          (None, 235, 32)           34848
_________________________________________________________________
conv1d_233 (Conv1D)          (None, 172, 32)           65568
_________________________________________________________________
conv1d_234 (Conv1D)          (None, 109, 32)           65568
_________________________________________________________________
conv1d_235 (Conv1D)          (None, 46, 32)            65568
_________________________________________________________________
max_pooling1d_91 (MaxPooling (None, 15, 32)            0
_________________________________________________________________
flatten_91 (Flatten)         (None, 480)               0
_________________________________________________________________
dropout_181 (Dropout)        (None, 480)               0
_________________________________________________________________
dense_271 (Dense)            (None, 64)                30784
_________________________________________________________________
dense_272 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_182 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_273 (Dense)            (None, 2)                 66
=================================================================
Total params: 264,482
Trainable params: 264,482
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_92"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_236 (Conv1D)          (None, 235, 32)           34848
_________________________________________________________________
max_pooling1d_92 (MaxPooling (None, 78, 32)            0
_________________________________________________________________
flatten_92 (Flatten)         (None, 2496)              0
_________________________________________________________________
dropout_183 (Dropout)        (None, 2496)              0
_________________________________________________________________
dense_274 (Dense)            (None, 64)                159808
```

```
_________________________________________________________________
dense_275 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_184 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_276 (Dense)            (None, 2)                 66
=================================================================
Total params: 196,802
Trainable params: 196,802
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_93"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_237 (Conv1D)          (None, 283, 128)          34944
_________________________________________________________________
conv1d_238 (Conv1D)          (None, 268, 128)          262272
_________________________________________________________________
conv1d_239 (Conv1D)          (None, 253, 128)          262272
_________________________________________________________________
conv1d_240 (Conv1D)          (None, 238, 128)          262272
_________________________________________________________________
max_pooling1d_93 (MaxPooling (None, 79, 128)           0
_________________________________________________________________
flatten_93 (Flatten)         (None, 10112)             0
_________________________________________________________________
dropout_185 (Dropout)        (None, 10112)             0
_________________________________________________________________
dense_277 (Dense)            (None, 64)                647232
_________________________________________________________________
dense_278 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_186 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_279 (Dense)            (None, 2)                 66
=================================================================
Total params: 1,471,138
Trainable params: 1,471,138
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_94"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_241 (Conv1D)          (None, 295, 32)           2208
_________________________________________________________________
max_pooling1d_94 (MaxPooling (None, 147, 32)           0
```

```
_________________________________________________________________
flatten_94 (Flatten)         (None, 4704)              0
_________________________________________________________________
dropout_187 (Dropout)        (None, 4704)              0
_________________________________________________________________
dense_280 (Dense)            (None, 64)                301120
_________________________________________________________________
dense_281 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_188 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_282 (Dense)            (None, 2)                 66
=================================================================
Total params: 305,474
Trainable params: 305,474
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_95"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_242 (Conv1D)          (None, 267, 32)           17440
_________________________________________________________________
conv1d_243 (Conv1D)          (None, 236, 32)           32800
_________________________________________________________________
max_pooling1d_95 (MaxPooling (None, 78, 32)            0
_________________________________________________________________
flatten_95 (Flatten)         (None, 2496)              0
_________________________________________________________________
dropout_189 (Dropout)        (None, 2496)              0
_________________________________________________________________
dense_283 (Dense)            (None, 64)                159808
_________________________________________________________________
dense_284 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_190 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_285 (Dense)            (None, 2)                 66
=================================================================
Total params: 212,194
Trainable params: 212,194
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_96"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_244 (Conv1D)          (None, 235, 64)           69696
```

```
_________________________________________________________________
max_pooling1d_96 (MaxPooling (None, 78, 64)            0
_________________________________________________________________
flatten_96 (Flatten)         (None, 4992)              0
_________________________________________________________________
dropout_191 (Dropout)        (None, 4992)              0
_________________________________________________________________
dense_286 (Dense)            (None, 64)                319552
_________________________________________________________________
dense_287 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_192 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_288 (Dense)            (None, 2)                 66
=================================================================
Total params: 391,394
Trainable params: 391,394
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_97"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_245 (Conv1D)          (None, 297, 32)           1120
_________________________________________________________________
conv1d_246 (Conv1D)          (None, 296, 32)           2080
_________________________________________________________________
conv1d_247 (Conv1D)          (None, 295, 32)           2080
_________________________________________________________________
conv1d_248 (Conv1D)          (None, 294, 32)           2080
_________________________________________________________________
max_pooling1d_97 (MaxPooling (None, 98, 32)            0
_________________________________________________________________
flatten_97 (Flatten)         (None, 3136)              0
_________________________________________________________________
dropout_193 (Dropout)        (None, 3136)              0
_________________________________________________________________
dense_289 (Dense)            (None, 64)                200768
_________________________________________________________________
dense_290 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_194 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_291 (Dense)            (None, 2)                 66
=================================================================
Total params: 210,274
Trainable params: 210,274
Non-trainable params: 0
```

```
_________________________________________________________________
Model: "sequential_98"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_249 (Conv1D)          (None, 283, 32)           8736
_________________________________________________________________
conv1d_250 (Conv1D)          (None, 268, 32)           16416
_________________________________________________________________
conv1d_251 (Conv1D)          (None, 253, 32)           16416
_________________________________________________________________
max_pooling1d_98 (MaxPooling (None, 84, 32)            0
_________________________________________________________________
flatten_98 (Flatten)         (None, 2688)              0
_________________________________________________________________
dropout_195 (Dropout)        (None, 2688)              0
_________________________________________________________________
dense_292 (Dense)            (None, 64)                172096
_________________________________________________________________
dense_293 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_196 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_294 (Dense)            (None, 2)                 66
=================================================================
Total params: 215,810
Trainable params: 215,810
Non-trainable params: 0
_________________________________________________________________
Model: "sequential_99"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_252 (Conv1D)          (None, 235, 128)          139392
_________________________________________________________________
max_pooling1d_99 (MaxPooling (None, 117, 128)          0
_________________________________________________________________
flatten_99 (Flatten)         (None, 14976)             0
_________________________________________________________________
dropout_197 (Dropout)        (None, 14976)             0
_________________________________________________________________
dense_295 (Dense)            (None, 64)                958528
_________________________________________________________________
dense_296 (Dense)            (None, 32)                2080
_________________________________________________________________
dropout_198 (Dropout)        (None, 32)                0
_________________________________________________________________
dense_297 (Dense)            (None, 2)                 66
```

```
=================================================================
Total params: 1,100,066
Trainable params: 1,100,066
Non-trainable params: 0

_________________________________________________________________
Model: "sequential_100"

_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv1d_253 (Conv1D)          (None, 291, 32)           4384

_________________________________________________________________
conv1d_254 (Conv1D)          (None, 284, 32)           8224

_________________________________________________________________
conv1d_255 (Conv1D)          (None, 277, 32)           8224

_________________________________________________________________
max_pooling1d_100 (MaxPoolin (None, 92, 32)            0

_________________________________________________________________
flatten_100 (Flatten)        (None, 2944)              0

_________________________________________________________________
dropout_199 (Dropout)        (None, 2944)              0

_________________________________________________________________
dense_298 (Dense)            (None, 64)                188480

_________________________________________________________________
dense_299 (Dense)            (None, 32)                2080

_________________________________________________________________
dropout_200 (Dropout)        (None, 32)                0

_________________________________________________________________
dense_300 (Dense)            (None, 2)                 66
=================================================================
Total params: 211,458
Trainable params: 211,458
Non-trainable params: 0

_________________________________________________________________
100%|                          | 100/100 [2:59:16<00:00,
107.57s/it, best loss: 0.24950233573612998]
Evalutation of best performing model:
35136/42167 [=======================>…] - ETA: 3s
```

[5]:
```
print("Evalutation of best performing model:")
print(best_model.evaluate(x_test, y_test))
print("Best performing model chosen hyper-parameters:")
print(best_run)
```

```
Evalutation of best performing model:
42167/42167 [==============================] - 20s 486us/step
[0.24950233573612998, 0.8952735662460327]
Best performing model chosen hyper-parameters:
{'activations': 'tanh', 'batch_size': 512, 'choiceval': 'adam', 'dropout':
```

0.24295335733172563, 'layers': 3, 'lr': 0.0012168203727788032, 'nb_filters': 32, 'pool_size': 3, 'size': 64}

1.4 Model Analysis

Classification Report

Confusion Matrix

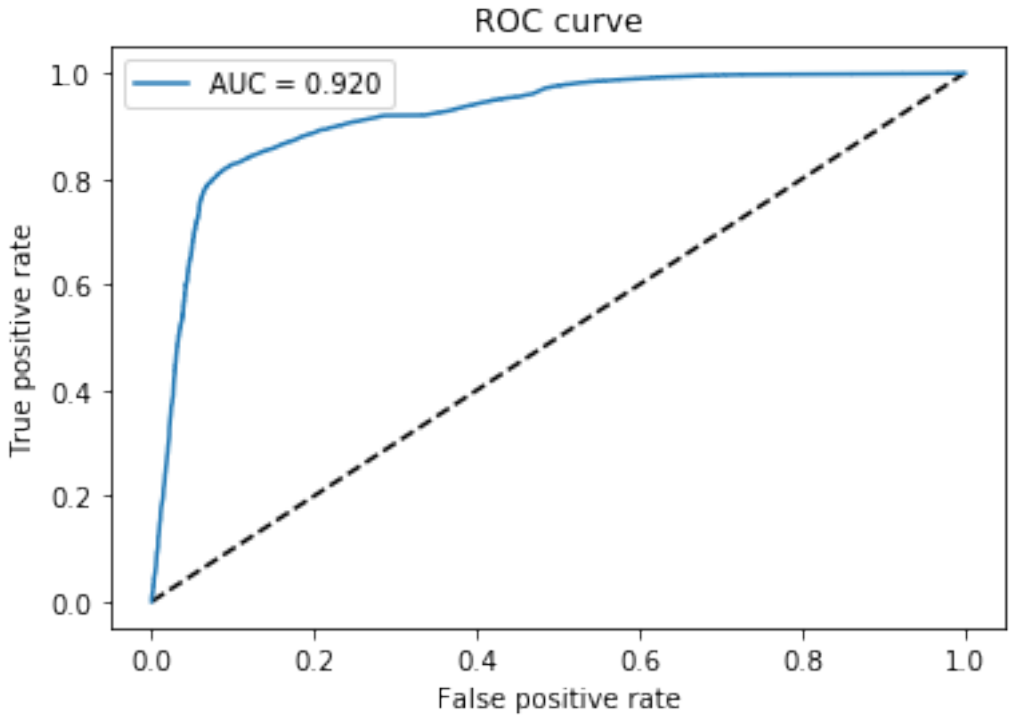
Area Under Reciever Operating Characteristic Curve

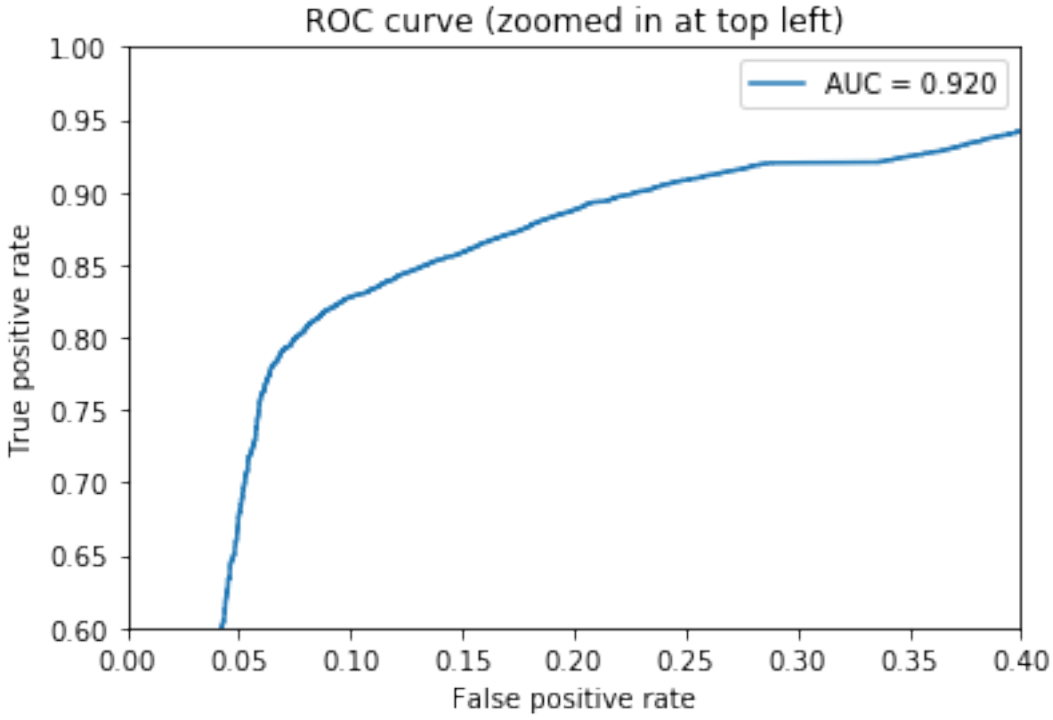
[6]:
```
y_pred = best_model.predict(x_test)
yy_test = [np.argmax(i) for i in y_test]

yy_pred = [np.argmax(i) for i in y_pred]

print(classification_report(yy_test, yy_pred))

new = np.vstack([yy_test,yy_pred])

from sklearn.metrics import confusion_matrix
from sklearn.metrics import roc_curve
from sklearn.metrics import auc

print(confusion_matrix(yy_test, yy_pred))




y_pred_keras = best_model.predict(x_test).ravel()
fpr_keras, tpr_keras, thresholds_keras = roc_curve(yy_test, y_pred[:
 ↪,0],pos_label=0)
auc_keras = auc(fpr_keras, tpr_keras)
print(auc_keras)

f1 = plt.figure()
plt.plot([0, 1], [0, 1], 'k--')
plt.plot(fpr_keras, tpr_keras, label='AUC = {:.3f}'.format(auc_keras))
plt.xlabel('False positive rate')
plt.ylabel('True positive rate')
plt.title('ROC curve')
plt.legend(loc='best')
plt.show()
f1.savefig("ROC-curve-cnn1Dseq.pdf", bbox_inches='tight')

f2 = plt.figure()
plt.xlim(0, 0.4)
plt.ylim(0.6, 1)
```

```
plt.plot([0, 1], [0, 1], 'k--')
plt.plot(fpr_keras, tpr_keras, label='AUC = {:.3f}'.format(auc_keras))
plt.xlabel('False positive rate')
plt.ylabel('True positive rate')
plt.title('ROC curve (zoomed in at top left)')
plt.legend(loc='best')
plt.show()
f2.savefig("ROC-curve-zoomed-cnn1Dseq.pdf", bbox_inches='tight')

from sklearn.metrics import precision_recall_curve
from sklearn.metrics import f1_score
from sklearn.metrics import auc
from sklearn.metrics import average_precision_score

precision, recall, thresholds = precision_recall_curve(yy_test,  y_pred[:
 ↪,0],pos_label=0)
# calculate F1 score
#f1 = f1_score(yy_test, y_pred)
# calculate precision-recall AUC
auc_score = auc(recall, precision)
print(auc_score)
# calculate average precision score
ap = average_precision_score(yy_test, y_pred[:,1])
print(ap)
#print('auc=%.3f ap=%.3f' % (auc, ap))
# plot no skill
f3 = plt.figure()
plt.plot([0, 1], [0, 1], linestyle='--')
# plot the precision-recall curve for the model
plt.plot( recall, precision,marker='.')
plt.xlabel('Recall')
plt.ylabel('Precision')
plt.title('Precision Recall Curve')

# show the plot
plt.show()
f3.savefig("precisionrecall-cnn1Dseq.pdf", bbox_inches='tight')
num_positive = float(np.count_nonzero(yy_test))
num_negative = float(len(yy_test) - num_positive)
pos_weight = num_negative / num_positive
weights = np.ones_like(yy_test)
weights[yy_test != np.float64(0)] = pos_weight


precision_weighted, recall_weighted, thresholds_weighted =␣
 ↪precision_recall_curve(yy_test,  y_pred[:
 ↪,0],pos_label=0,sample_weight=weights)
```

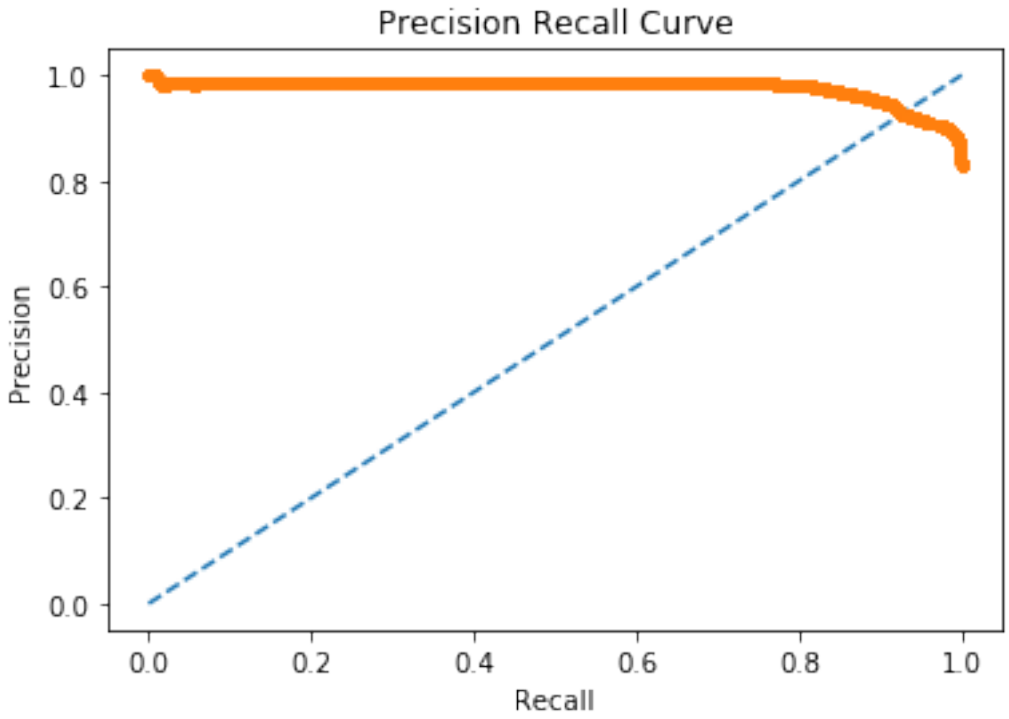
```
#calculate F1 score
#f1 = f1_score(yy_test, y_pred)
# calculate precision-recall AUC
auc_score = auc(recall_weighted, precision_weighted)
print(auc_score)
# calculate average precision score
ap = average_precision_score(yy_test, y_pred[:,1])
print(ap)
#print('auc=%.3f ap=%.3f' % (auc, ap))
# plot no skill
f4 = plt.figure()
plt.plot([0, 1], [0, 1], linestyle='--')
# plot the weighted precision-recall curve for the model
plt.plot( recall_weighted, precision_weighted,marker='.')
plt.xlabel('Recall')
plt.ylabel('Precision')
plt.title('Weighted Precision Recall Curve')
# show the plot
plt.show()
f4.savefig("weightedprecisionrecall-cnn1Dseq.pdf", bbox_inches='tight')
best_model.save('cnn1Dseq.h5')
```

```
              precision    recall  f1-score   support

           0       0.90      0.98      0.94     34974
           1       0.83      0.48      0.61      7193

    accuracy                           0.90     42167
   macro avg       0.87      0.73      0.78     42167
weighted avg       0.89      0.90      0.88     42167

[[34284   690]
 [ 3726  3467]]
0.919679003506893
```

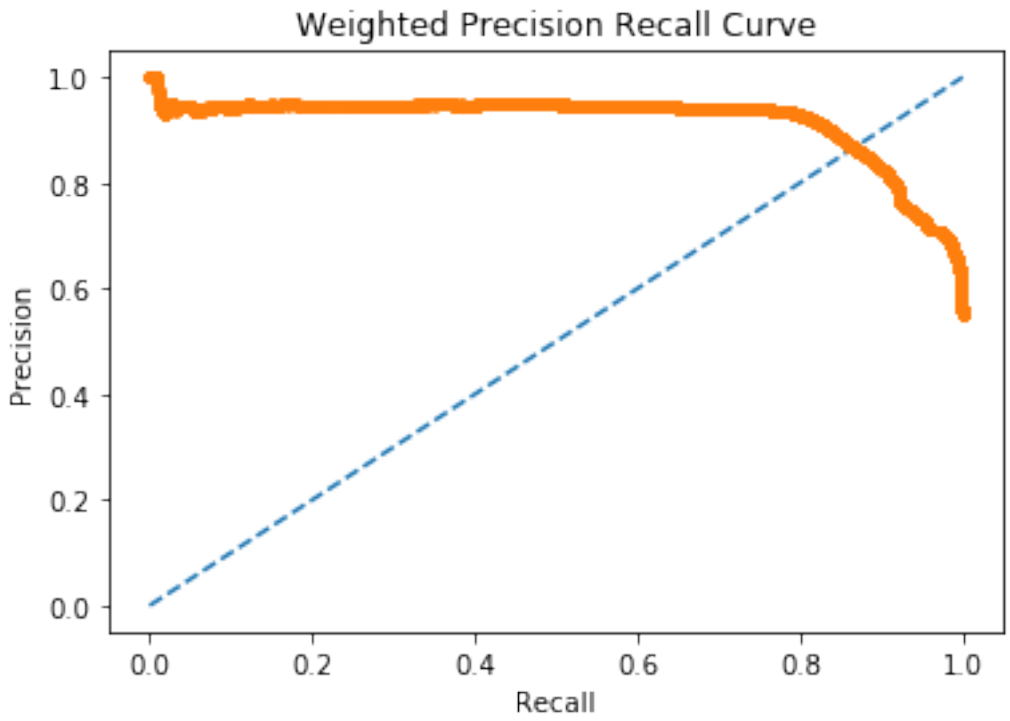

ROC curve
AUC = 0.920
True positive rate
False positive rate
0.0
0.2
0.4
0.6
0.8
1.0


ROC curve (zoomed in at top left)
AUC = 0.920
True positive rate
False positive rate
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.60
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40

0.9769837552131055
0.7521491410966995



0.9181686167433348
0.7521491410966995



1.5 Save Model Analysis Data

[7]:
```
d = {'False Positive Rate': fpr_keras, 'True Positive Rate': tpr_keras ,␣
↪'Thresholds': thresholds_keras}
```

[8]:
```
roc_CNN1Dseq = pd.DataFrame(data=d)
```

[9]:
```
roc_CNN1Dseq.to_csv(path_or_buf ='rocCNN1Dseq.csv', index=False)
```

[10]:
```
conf = confusion_matrix(yy_test, yy_pred)
```

[11]:
```
conf1Dseq=pd.DataFrame(data=conf)
```

[12]:
```
conf1Dseq.to_csv(path_or_buf='ConfusionCNN1Dseq.csv',index=False)
```

[13]:
```
pd.DataFrame({"precision" : precision, "recall" :recall}).
↪to_csv("precisionrecall-1dseq.csv", index=None)
```

[14]:
```
pd.DataFrame({"precision" : precision_weighted, "recall" :recall_weighted}).
↪to_csv("weightedprecisionrecall-1dseq.csv", index=None)
```

[ ]:
```

```