

Convolutional Neural Network is a state of the art for image detection NN architecture. The idea is to take an image, convert it into grid of pixel data. Basic CNN structure is as follows: Convolution -> Pooling -> Convolution -> Pooling -> Fully Connected Layer -> Output. Convolution means taking the original data, and creating feature maps from it. Pooling means down-sampling, like "max-pooling," where we select a region, and then take the maximum value in that region, and that becomes the new value for the entire region. we select a window for convolution and slide it across the image and perform pooling on the way. Each convolution and pooling step is a hidden layer. After this, we have a fully connected layer, followed by the output layer. The fully connected layer is your typical neural network (multilayer perceptron) type of layer, and same with the output layer.

```
In [1]: import tensorflow as tf
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Dropout, Activation, Flatten
from tensorflow.keras.layers import Conv2D, MaxPooling2D
from tensorflow.keras.callbacks import TensorBoard
import time
```

```
In [2]: NAME = "play-vs-unplay-CNN-{}".format(int(time.time()))
tensorboard = TensorBoard(log_dir="logs/{}".format(NAME))
```

```
In [3]: # Assume that you have 12GB of GPU memory and want to allocate ~4GB:
#gpu_options = tf.GPUOptions(per_process_gpu_memory_fraction=0.333)

#sess = tf.Session(config=tf.ConfigProto(gpu_options=gpu_options))
```

```
In [4]: import pickle

pickle_in = open("X.pickle", "rb")
X = pickle.load(pickle_in)

pickle_in = open("y.pickle", "rb")
y = pickle.load(pickle_in)
#normalize the data
X = X/255.0
```

```
In [5]: dense_layers = [4, 5]
layer_sizes = [16, 32, 64]
conv_layers = [4, 5]

for dense_layer in dense_layers:
    for layer_size in layer_sizes:
        for conv_layer in conv_layers:
            NAME = "{}-conv-{}-nodes-{}-dense-{}".format(conv_layer, layer_size, dense_layer, int(time.time()))
            print(NAME)

model = Sequential()

model.add(Conv2D(layer_size, (3, 3), input_shape=X.shape[1:]))
model.add(Activation('relu'))
model.add(MaxPooling2D(pool_size=(2, 2)))

for l in range(conv_layer-1):
    model.add(Conv2D(layer_size, (3, 3)))
    model.add(Activation('relu'))
    model.add(MaxPooling2D(pool_size=(2, 2)))

model.add(Flatten())

for _ in range(dense_layer):
    model.add(Dense(layer_size))
    model.add(Activation('relu'))
    #model.add(Dropout(0.2))

model.add(Dense(1))
model.add(Activation('sigmoid'))

tensorboard = TensorBoard(log_dir="logs/{}".format(NAME))
model.summary()
model.compile(loss='binary_crossentropy',
              optimizer='adam',
              metrics=['accuracy'],
              )

model.fit(X, y,
           batch_size=32,
           epochs=10,
           validation_split=0.3,
           callbacks=[tensorboard])
```

4-conv-16-nodes-4-dense-1593482345

Model: "sequential"

Layer (type)	Output Shape	Param #
<hr/>		
conv2d (Conv2D)	(None, 98, 98, 16)	160
activation (Activation)	(None, 98, 98, 16)	0
max_pooling2d (MaxPooling2D)	(None, 49, 49, 16)	0
conv2d_1 (Conv2D)	(None, 47, 47, 16)	2320
activation_1 (Activation)	(None, 47, 47, 16)	0
max_pooling2d_1 (MaxPooling2D)	(None, 23, 23, 16)	0
conv2d_2 (Conv2D)	(None, 21, 21, 16)	2320
activation_2 (Activation)	(None, 21, 21, 16)	0
max_pooling2d_2 (MaxPooling2D)	(None, 10, 10, 16)	0
conv2d_3 (Conv2D)	(None, 8, 8, 16)	2320
activation_3 (Activation)	(None, 8, 8, 16)	0
max_pooling2d_3 (MaxPooling2D)	(None, 4, 4, 16)	0
flatten (Flatten)	(None, 256)	0
dense (Dense)	(None, 16)	4112
activation_4 (Activation)	(None, 16)	0
dense_1 (Dense)	(None, 16)	272
activation_5 (Activation)	(None, 16)	0
dense_2 (Dense)	(None, 16)	272
activation_6 (Activation)	(None, 16)	0
dense_3 (Dense)	(None, 16)	272
activation_7 (Activation)	(None, 16)	0
dense_4 (Dense)	(None, 1)	17
activation_8 (Activation)	(None, 1)	0
<hr/>		
Total params: 12,065		
Trainable params: 12,065		
Non-trainable params: 0		
<hr/>		
Train on 1412 samples, validate on 606 samples		
Epoch 1/10		

1412/1412 [=====] - 12s 9ms/sample - loss: 0.6932 - accuracy: 0.4972 - val\_loss: 0.6929 - val\_accuracy: 0.5330  
 Epoch 2/10  
 1412/1412 [=====] - 8s 5ms/sample - loss: 0.6924 - accuracy: 0.5269 - val\_loss: 0.6914 - val\_accuracy: 0.5149  
 Epoch 3/10  
 1412/1412 [=====] - 8s 5ms/sample - loss: 0.6916 - accuracy: 0.5241 - val\_loss: 0.6924 - val\_accuracy: 0.5050  
 Epoch 4/10  
 1412/1412 [=====] - 8s 5ms/sample - loss: 0.6915 - accuracy: 0.5283 - val\_loss: 0.6911 - val\_accuracy: 0.5809  
 Epoch 5/10  
 1412/1412 [=====] - 8s 5ms/sample - loss: 0.6901 - accuracy: 0.5729 - val\_loss: 0.6915 - val\_accuracy: 0.4950  
 Epoch 6/10  
 1412/1412 [=====] - 9s 6ms/sample - loss: 0.6893 - accuracy: 0.5432 - val\_loss: 0.6857 - val\_accuracy: 0.5924  
 Epoch 7/10  
 1412/1412 [=====] - 8s 6ms/sample - loss: 0.6843 - accuracy: 0.5737 - val\_loss: 0.6803 - val\_accuracy: 0.5842  
 Epoch 8/10  
 1412/1412 [=====] - 9s 7ms/sample - loss: 0.6721 - accuracy: 0.6147 - val\_loss: 0.6639 - val\_accuracy: 0.6271  
 Epoch 9/10  
 1412/1412 [=====] - 8s 6ms/sample - loss: 0.6470 - accuracy: 0.6445 - val\_loss: 0.6233 - val\_accuracy: 0.6716  
 Epoch 10/10  
 1412/1412 [=====] - 8s 6ms/sample - loss: 0.6084 - accuracy: 0.6898 - val\_loss: 0.7674 - val\_accuracy: 0.4950  
 5-conv-16-nodes-4-dense-1593482430  
 Model: "sequential\_1"

Layer (type)	Output Shape	Param #
<hr/>		
conv2d_4 (Conv2D)	(None, 98, 98, 16)	160
activation_9 (Activation)	(None, 98, 98, 16)	0
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max_pooling2d_4 (MaxPooling2D)	(None, 49, 49, 16)	0
conv2d_5 (Conv2D)	(None, 47, 47, 16)	2320
activation_10 (Activation)	(None, 47, 47, 16)	0
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max_pooling2d_5 (MaxPooling2D)	(None, 23, 23, 16)	0
conv2d_6 (Conv2D)	(None, 21, 21, 16)	2320
activation_11 (Activation)	(None, 21, 21, 16)	0
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max_pooling2d_6 (MaxPooling2D)	(None, 10, 10, 16)	0
conv2d_7 (Conv2D)	(None, 8, 8, 16)	2320
activation_12 (Activation)	(None, 8, 8, 16)	0
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max_pooling2d_7 (MaxPooling2D)	(None, 4, 4, 16)	0

conv2d_8 (Conv2D)	(None, 2, 2, 16)	2320
activation_13 (Activation)	(None, 2, 2, 16)	0
max_pooling2d_8 (MaxPooling2D)	(None, 1, 1, 16)	0
flatten_1 (Flatten)	(None, 16)	0
dense_5 (Dense)	(None, 16)	272
activation_14 (Activation)	(None, 16)	0
dense_6 (Dense)	(None, 16)	272
activation_15 (Activation)	(None, 16)	0
dense_7 (Dense)	(None, 16)	272
activation_16 (Activation)	(None, 16)	0
dense_8 (Dense)	(None, 16)	272
activation_17 (Activation)	(None, 16)	0
dense_9 (Dense)	(None, 1)	17
activation_18 (Activation)	(None, 1)	0
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Total params: 10,545

Trainable params: 10,545

Non-trainable params: 0

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Train on 1412 samples, validate on 606 samples

Epoch 1/10

1412/1412 [=====] - 10s 7ms/sample - loss: 0.6931 - accuracy: 0.5064 - val\_loss: 0.6929 - val\_accuracy: 0.5314

Epoch 2/10

1412/1412 [=====] - 7s 5ms/sample - loss: 0.6931 - accuracy: 0.5184 - val\_loss: 0.6932 - val\_accuracy: 0.4851

Epoch 3/10

1412/1412 [=====] - 8s 6ms/sample - loss: 0.6929 - accuracy: 0.5050 - val\_loss: 0.6933 - val\_accuracy: 0.4851

Epoch 4/10

1412/1412 [=====] - 7s 5ms/sample - loss: 0.6923 - accuracy: 0.5198 - val\_loss: 0.6896 - val\_accuracy: 0.5446

Epoch 5/10

1412/1412 [=====] - 7s 5ms/sample - loss: 0.6933 - accuracy: 0.5227 - val\_loss: 0.6921 - val\_accuracy: 0.5000

Epoch 6/10

1412/1412 [=====] - 7s 5ms/sample - loss: 0.6860 - accuracy: 0.5942 - val\_loss: 0.6828 - val\_accuracy: 0.6040

Epoch 7/10

1412/1412 [=====] - 8s 6ms/sample - loss: 0.6783 - accuracy: 0.5864 - val\_loss: 0.6622 - val\_accuracy: 0.6733

Epoch 8/10

1412/1412 [=====] - 7s 5ms/sample - loss: 0.6559 - a

accuracy: 0.6296 - val\_loss: 0.6403 - val\_accuracy: 0.6865  
 Epoch 9/10  
 1412/1412 [=====] - 7s 5ms/sample - loss: 0.6090 - a  
 ccuracy: 0.7025 - val\_loss: 0.5838 - val\_accuracy: 0.7360  
 Epoch 10/10  
 1412/1412 [=====] - 7s 5ms/sample - loss: 0.5419 - a  
 ccuracy: 0.7500 - val\_loss: 0.5409 - val\_accuracy: 0.7178  
 4-conv-32-nodes-4-dense-1593482505  
 Model: "sequential\_2"

Layer (type)	Output Shape	Param #
conv2d_9 (Conv2D)	(None, 98, 98, 32)	320
activation_19 (Activation)	(None, 98, 98, 32)	0
max_pooling2d_9 (MaxPooling2D)	(None, 49, 49, 32)	0
conv2d_10 (Conv2D)	(None, 47, 47, 32)	9248
activation_20 (Activation)	(None, 47, 47, 32)	0
max_pooling2d_10 (MaxPooling2D)	(None, 23, 23, 32)	0
conv2d_11 (Conv2D)	(None, 21, 21, 32)	9248
activation_21 (Activation)	(None, 21, 21, 32)	0
max_pooling2d_11 (MaxPooling2D)	(None, 10, 10, 32)	0
conv2d_12 (Conv2D)	(None, 8, 8, 32)	9248
activation_22 (Activation)	(None, 8, 8, 32)	0
max_pooling2d_12 (MaxPooling2D)	(None, 4, 4, 32)	0
flatten_2 (Flatten)	(None, 512)	0
dense_10 (Dense)	(None, 32)	16416
activation_23 (Activation)	(None, 32)	0
dense_11 (Dense)	(None, 32)	1056
activation_24 (Activation)	(None, 32)	0
dense_12 (Dense)	(None, 32)	1056
activation_25 (Activation)	(None, 32)	0
dense_13 (Dense)	(None, 32)	1056
activation_26 (Activation)	(None, 32)	0
dense_14 (Dense)	(None, 1)	33
activation_27 (Activation)	(None, 1)	0

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Total params: 47,681

Trainable params: 47,681

Non-trainable params: 0

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Train on 1412 samples, validate on 606 samples

Epoch 1/10

1412/1412 [=====] - 20s 14ms/sample - loss: 0.6939 - accuracy: 0.5000 - val\_loss: 0.6936 - val\_accuracy: 0.4851

Epoch 2/10

1412/1412 [=====] - 15s 11ms/sample - loss: 0.6932 - accuracy: 0.4936 - val\_loss: 0.6930 - val\_accuracy: 0.4851

Epoch 3/10

1412/1412 [=====] - 16s 11ms/sample - loss: 0.6935 - accuracy: 0.5050 - val\_loss: 0.6929 - val\_accuracy: 0.4851

Epoch 4/10

1412/1412 [=====] - 15s 11ms/sample - loss: 0.6921 - accuracy: 0.5482 - val\_loss: 0.6910 - val\_accuracy: 0.5000

Epoch 5/10

1412/1412 [=====] - 15s 11ms/sample - loss: 0.6882 - accuracy: 0.5467 - val\_loss: 0.6851 - val\_accuracy: 0.5380

Epoch 6/10

1412/1412 [=====] - 16s 11ms/sample - loss: 0.6769 - accuracy: 0.5892 - val\_loss: 0.6636 - val\_accuracy: 0.5990

Epoch 7/10

1412/1412 [=====] - 16s 11ms/sample - loss: 0.6441 - accuracy: 0.6473 - val\_loss: 0.5891 - val\_accuracy: 0.7096

Epoch 8/10

1412/1412 [=====] - 17s 12ms/sample - loss: 0.5725 - accuracy: 0.7082 - val\_loss: 0.5173 - val\_accuracy: 0.7459

Epoch 9/10

1412/1412 [=====] - 17s 12ms/sample - loss: 0.4930 - accuracy: 0.7720 - val\_loss: 0.4394 - val\_accuracy: 0.7970

Epoch 10/10

1412/1412 [=====] - 18s 13ms/sample - loss: 0.4459 - accuracy: 0.7868 - val\_loss: 0.4255 - val\_accuracy: 0.8069

5-conv-32-nodes-4-dense-1593482669

Model: "sequential\_3"

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Layer (type)	Output Shape	Param #
<hr/>		
conv2d_13 (Conv2D)	(None, 98, 98, 32)	320
activation_28 (Activation)	(None, 98, 98, 32)	0
max_pooling2d_13 (MaxPooling)	(None, 49, 49, 32)	0
conv2d_14 (Conv2D)	(None, 47, 47, 32)	9248
activation_29 (Activation)	(None, 47, 47, 32)	0
max_pooling2d_14 (MaxPooling)	(None, 23, 23, 32)	0
conv2d_15 (Conv2D)	(None, 21, 21, 32)	9248
activation_30 (Activation)	(None, 21, 21, 32)	0

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max_pooling2d_15 (MaxPooling (None, 10, 10, 32))	0
conv2d_16 (Conv2D)	(None, 8, 8, 32) 9248
activation_31 (Activation)	(None, 8, 8, 32) 0
max_pooling2d_16 (MaxPooling (None, 4, 4, 32))	0
conv2d_17 (Conv2D)	(None, 2, 2, 32) 9248
activation_32 (Activation)	(None, 2, 2, 32) 0
max_pooling2d_17 (MaxPooling (None, 1, 1, 32))	0
flatten_3 (Flatten)	(None, 32) 0
dense_15 (Dense)	(None, 32) 1056
activation_33 (Activation)	(None, 32) 0
dense_16 (Dense)	(None, 32) 1056
activation_34 (Activation)	(None, 32) 0
dense_17 (Dense)	(None, 32) 1056
activation_35 (Activation)	(None, 32) 0
dense_18 (Dense)	(None, 32) 1056
activation_36 (Activation)	(None, 32) 0
dense_19 (Dense)	(None, 1) 33
activation_37 (Activation)	(None, 1) 0
<hr/>	
Total params:	41,569
Trainable params:	41,569
Non-trainable params:	0
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Train on 1412 samples, validate on 606 samples	
Epoch 1/10	
1412/1412 [=====] - 19s 14ms/sample - loss: 0.6937 - accuracy: 0.4887 - val_loss: 0.6931 - val_accuracy: 0.4851	
Epoch 2/10	
1412/1412 [=====] - 15s 10ms/sample - loss: 0.6930 - accuracy: 0.5135 - val_loss: 0.6920 - val_accuracy: 0.5149	
Epoch 3/10	
1412/1412 [=====] - 15s 10ms/sample - loss: 0.6928 - accuracy: 0.5092 - val_loss: 0.6939 - val_accuracy: 0.4851	
Epoch 4/10	
1412/1412 [=====] - 15s 10ms/sample - loss: 0.6927 - accuracy: 0.5184 - val_loss: 0.6907 - val_accuracy: 0.5462	
Epoch 5/10	
1412/1412 [=====] - 14s 10ms/sample - loss: 0.6885 - accuracy: 0.5382 - val_loss: 0.6932 - val_accuracy: 0.4901	
Epoch 6/10	

1412/1412 [=====] - 15s 11ms/sample - loss: 0.6937 -  
accuracy: 0.5064 - val\_loss: 0.6951 - val\_accuracy: 0.4851  
Epoch 7/10  
1412/1412 [=====] - 13s 9ms/sample - loss: 0.6933 -  
accuracy: 0.5064 - val\_loss: 0.6942 - val\_accuracy: 0.4851  
Epoch 8/10  
1412/1412 [=====] - 14s 10ms/sample - loss: 0.6932 -  
accuracy: 0.5064 - val\_loss: 0.6936 - val\_accuracy: 0.4851  
Epoch 9/10  
1412/1412 [=====] - 13s 9ms/sample - loss: 0.6932 -  
accuracy: 0.5064 - val\_loss: 0.6938 - val\_accuracy: 0.4851  
Epoch 10/10  
1412/1412 [=====] - 13s 9ms/sample - loss: 0.6932 -  
accuracy: 0.5064 - val\_loss: 0.6941 - val\_accuracy: 0.4851  
4-conv-64-nodes-4-dense-1593482815  
Model: "sequential\_4"

Layer (type)	Output Shape	Param #
<hr/>		
conv2d_18 (Conv2D)	(None, 98, 98, 64)	640
activation_38 (Activation)	(None, 98, 98, 64)	0
max_pooling2d_18 (MaxPooling)	(None, 49, 49, 64)	0
conv2d_19 (Conv2D)	(None, 47, 47, 64)	36928
activation_39 (Activation)	(None, 47, 47, 64)	0
max_pooling2d_19 (MaxPooling)	(None, 23, 23, 64)	0
conv2d_20 (Conv2D)	(None, 21, 21, 64)	36928
activation_40 (Activation)	(None, 21, 21, 64)	0
max_pooling2d_20 (MaxPooling)	(None, 10, 10, 64)	0
conv2d_21 (Conv2D)	(None, 8, 8, 64)	36928
activation_41 (Activation)	(None, 8, 8, 64)	0
max_pooling2d_21 (MaxPooling)	(None, 4, 4, 64)	0
flatten_4 (Flatten)	(None, 1024)	0
dense_20 (Dense)	(None, 64)	65600
activation_42 (Activation)	(None, 64)	0
dense_21 (Dense)	(None, 64)	4160
activation_43 (Activation)	(None, 64)	0
dense_22 (Dense)	(None, 64)	4160
activation_44 (Activation)	(None, 64)	0

dense_23 (Dense)	(None, 64)	4160
activation_45 (Activation)	(None, 64)	0
dense_24 (Dense)	(None, 1)	65
activation_46 (Activation)	(None, 1)	0
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Total params: 189,569		
Trainable params: 189,569		
Non-trainable params: 0		

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Train on 1412 samples, validate on 606 samples  
Epoch 1/10  
1412/1412 [=====] - 40s 29ms/sample - loss: 0.6936 -  
accuracy: 0.4972 - val\_loss: 0.6937 - val\_accuracy: 0.4851  
Epoch 2/10  
1412/1412 [=====] - 35s 24ms/sample - loss: 0.6933 -  
accuracy: 0.5064 - val\_loss: 0.6936 - val\_accuracy: 0.4851  
Epoch 3/10  
1412/1412 [=====] - 39s 28ms/sample - loss: 0.6932 -  
accuracy: 0.5064 - val\_loss: 0.6934 - val\_accuracy: 0.4851  
Epoch 4/10  
1412/1412 [=====] - 37s 26ms/sample - loss: 0.6932 -  
accuracy: 0.5064 - val\_loss: 0.6936 - val\_accuracy: 0.4851  
Epoch 5/10  
1412/1412 [=====] - 34s 24ms/sample - loss: 0.6931 -  
accuracy: 0.5064 - val\_loss: 0.6935 - val\_accuracy: 0.4851  
Epoch 6/10  
1412/1412 [=====] - 36s 25ms/sample - loss: 0.6931 -  
accuracy: 0.5064 - val\_loss: 0.6937 - val\_accuracy: 0.4851  
Epoch 7/10  
1412/1412 [=====] - 39s 28ms/sample - loss: 0.6932 -  
accuracy: 0.5064 - val\_loss: 0.6937 - val\_accuracy: 0.4851  
Epoch 8/10  
1412/1412 [=====] - 33s 23ms/sample - loss: 0.6932 -  
accuracy: 0.5064 - val\_loss: 0.6937 - val\_accuracy: 0.4851  
Epoch 9/10  
1412/1412 [=====] - 37s 26ms/sample - loss: 0.6932 -  
accuracy: 0.5064 - val\_loss: 0.6939 - val\_accuracy: 0.4851  
Epoch 10/10  
1412/1412 [=====] - 37s 26ms/sample - loss: 0.6948 -  
accuracy: 0.4915 - val\_loss: 0.6915 - val\_accuracy: 0.4851  
5-conv-64-nodes-4-dense-1593483182  
Model: "sequential\_5"

Layer (type)	Output Shape	Param #
<hr/>		
conv2d_22 (Conv2D)	(None, 98, 98, 64)	640
activation_47 (Activation)	(None, 98, 98, 64)	0
max_pooling2d_22 (MaxPooling)	(None, 49, 49, 64)	0
conv2d_23 (Conv2D)	(None, 47, 47, 64)	36928
activation_48 (Activation)	(None, 47, 47, 64)	0

max_pooling2d_23 (MaxPooling)	(None, 23, 23, 64)	0
conv2d_24 (Conv2D)	(None, 21, 21, 64)	36928
activation_49 (Activation)	(None, 21, 21, 64)	0
max_pooling2d_24 (MaxPooling)	(None, 10, 10, 64)	0
conv2d_25 (Conv2D)	(None, 8, 8, 64)	36928
activation_50 (Activation)	(None, 8, 8, 64)	0
max_pooling2d_25 (MaxPooling)	(None, 4, 4, 64)	0
conv2d_26 (Conv2D)	(None, 2, 2, 64)	36928
activation_51 (Activation)	(None, 2, 2, 64)	0
max_pooling2d_26 (MaxPooling)	(None, 1, 1, 64)	0
flatten_5 (Flatten)	(None, 64)	0
dense_25 (Dense)	(None, 64)	4160
activation_52 (Activation)	(None, 64)	0
dense_26 (Dense)	(None, 64)	4160
activation_53 (Activation)	(None, 64)	0
dense_27 (Dense)	(None, 64)	4160
activation_54 (Activation)	(None, 64)	0
dense_28 (Dense)	(None, 64)	4160
activation_55 (Activation)	(None, 64)	0
dense_29 (Dense)	(None, 1)	65
activation_56 (Activation)	(None, 1)	0

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Total params: 165,057

Trainable params: 165,057

Non-trainable params: 0

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Train on 1412 samples, validate on 606 samples

Epoch 1/10

1412/1412 [=====] - 44s 31ms/sample - loss: 0.6936 - accuracy: 0.4979 - val\_loss: 0.6933 - val\_accuracy: 0.4851

Epoch 2/10

1412/1412 [=====] - 38s 27ms/sample - loss: 0.6932 - accuracy: 0.5064 - val\_loss: 0.6935 - val\_accuracy: 0.4851

Epoch 3/10

1412/1412 [=====] - 38s 27ms/sample - loss: 0.6933 - accuracy: 0.5064 - val\_loss: 0.6935 - val\_accuracy: 0.4851

Epoch 4/10  
1412/1412 [=====] - 35s 25ms/sample - loss: 0.6932 -  
accuracy: 0.5064 - val\_loss: 0.6934 - val\_accuracy: 0.4851  
Epoch 5/10  
1412/1412 [=====] - 35s 25ms/sample - loss: 0.6932 -  
accuracy: 0.5064 - val\_loss: 0.6934 - val\_accuracy: 0.4851  
Epoch 6/10  
1412/1412 [=====] - 36s 25ms/sample - loss: 0.6932 -  
accuracy: 0.5064 - val\_loss: 0.6933 - val\_accuracy: 0.4851  
Epoch 7/10  
1412/1412 [=====] - 38s 27ms/sample - loss: 0.6931 -  
accuracy: 0.5064 - val\_loss: 0.6934 - val\_accuracy: 0.4851  
Epoch 8/10  
1412/1412 [=====] - 38s 27ms/sample - loss: 0.6931 -  
accuracy: 0.5064 - val\_loss: 0.6935 - val\_accuracy: 0.4851  
Epoch 9/10  
1412/1412 [=====] - 40s 29ms/sample - loss: 0.6931 -  
accuracy: 0.5064 - val\_loss: 0.6935 - val\_accuracy: 0.4851  
Epoch 10/10  
1412/1412 [=====] - 38s 27ms/sample - loss: 0.6933 -  
accuracy: 0.5064 - val\_loss: 0.6936 - val\_accuracy: 0.4851  
4-conv-16-nodes-5-dense-1593483562  
Model: "sequential\_6"

Layer (type)	Output Shape	Param #
conv2d_27 (Conv2D)	(None, 98, 98, 16)	160
activation_57 (Activation)	(None, 98, 98, 16)	0
max_pooling2d_27 (MaxPooling)	(None, 49, 49, 16)	0
conv2d_28 (Conv2D)	(None, 47, 47, 16)	2320
activation_58 (Activation)	(None, 47, 47, 16)	0
max_pooling2d_28 (MaxPooling)	(None, 23, 23, 16)	0
conv2d_29 (Conv2D)	(None, 21, 21, 16)	2320
activation_59 (Activation)	(None, 21, 21, 16)	0
max_pooling2d_29 (MaxPooling)	(None, 10, 10, 16)	0
conv2d_30 (Conv2D)	(None, 8, 8, 16)	2320
activation_60 (Activation)	(None, 8, 8, 16)	0
max_pooling2d_30 (MaxPooling)	(None, 4, 4, 16)	0
flatten_6 (Flatten)	(None, 256)	0
dense_30 (Dense)	(None, 16)	4112
activation_61 (Activation)	(None, 16)	0
dense_31 (Dense)	(None, 16)	272

activation_62 (Activation)	(None, 16)	0
dense_32 (Dense)	(None, 16)	272
activation_63 (Activation)	(None, 16)	0
dense_33 (Dense)	(None, 16)	272
activation_64 (Activation)	(None, 16)	0
dense_34 (Dense)	(None, 16)	272
activation_65 (Activation)	(None, 16)	0
dense_35 (Dense)	(None, 1)	17
activation_66 (Activation)	(None, 1)	0
<hr/>		
Total params:	12,337	
Trainable params:	12,337	
Non-trainable params:	0	
<hr/>		
Train on 1412 samples, validate on 606 samples		
Epoch 1/10		
1412/1412 [=====] - 15s 11ms/sample - loss: 0.6935 - accuracy: 0.4950 - val_loss: 0.6933 - val_accuracy: 0.4851		
Epoch 2/10		
1412/1412 [=====] - 9s 6ms/sample - loss: 0.6930 - accuracy: 0.5064 - val_loss: 0.6918 - val_accuracy: 0.5149		
Epoch 3/10		
1412/1412 [=====] - 10s 7ms/sample - loss: 0.6929 - accuracy: 0.5014 - val_loss: 0.6934 - val_accuracy: 0.4851		
Epoch 4/10		
1412/1412 [=====] - 8s 6ms/sample - loss: 0.6928 - accuracy: 0.5156 - val_loss: 0.6899 - val_accuracy: 0.5957		
Epoch 5/10		
1412/1412 [=====] - 9s 6ms/sample - loss: 0.6916 - accuracy: 0.5269 - val_loss: 0.6944 - val_accuracy: 0.4851		
Epoch 6/10		
1412/1412 [=====] - 9s 6ms/sample - loss: 0.6932 - accuracy: 0.5064 - val_loss: 0.6939 - val_accuracy: 0.4851		
Epoch 7/10		
1412/1412 [=====] - 8s 6ms/sample - loss: 0.6923 - accuracy: 0.5057 - val_loss: 0.6893 - val_accuracy: 0.4851		
Epoch 8/10		
1412/1412 [=====] - 9s 6ms/sample - loss: 0.6758 - accuracy: 0.5800 - val_loss: 0.6808 - val_accuracy: 0.5561		
Epoch 9/10		
1412/1412 [=====] - 9s 6ms/sample - loss: 0.6701 - accuracy: 0.5786 - val_loss: 0.6520 - val_accuracy: 0.6353		
Epoch 10/10		
1412/1412 [=====] - 9s 6ms/sample - loss: 0.6517 - accuracy: 0.6232 - val_loss: 0.6973 - val_accuracy: 0.5710		
5-conv-16-nodes-5-dense-1593483659		
Model: "sequential_7"		

Layer (type)	Output Shape	Param #
<hr/>		
conv2d_31 (Conv2D)	(None, 98, 98, 16)	160
activation_67 (Activation)	(None, 98, 98, 16)	0
max_pooling2d_31 (MaxPooling)	(None, 49, 49, 16)	0
conv2d_32 (Conv2D)	(None, 47, 47, 16)	2320
activation_68 (Activation)	(None, 47, 47, 16)	0
max_pooling2d_32 (MaxPooling)	(None, 23, 23, 16)	0
conv2d_33 (Conv2D)	(None, 21, 21, 16)	2320
activation_69 (Activation)	(None, 21, 21, 16)	0
max_pooling2d_33 (MaxPooling)	(None, 10, 10, 16)	0
conv2d_34 (Conv2D)	(None, 8, 8, 16)	2320
activation_70 (Activation)	(None, 8, 8, 16)	0
max_pooling2d_34 (MaxPooling)	(None, 4, 4, 16)	0
conv2d_35 (Conv2D)	(None, 2, 2, 16)	2320
activation_71 (Activation)	(None, 2, 2, 16)	0
max_pooling2d_35 (MaxPooling)	(None, 1, 1, 16)	0
flatten_7 (Flatten)	(None, 16)	0
dense_36 (Dense)	(None, 16)	272
activation_72 (Activation)	(None, 16)	0
dense_37 (Dense)	(None, 16)	272
activation_73 (Activation)	(None, 16)	0
dense_38 (Dense)	(None, 16)	272
activation_74 (Activation)	(None, 16)	0
dense_39 (Dense)	(None, 16)	272
activation_75 (Activation)	(None, 16)	0
dense_40 (Dense)	(None, 16)	272
activation_76 (Activation)	(None, 16)	0
dense_41 (Dense)	(None, 1)	17
activation_77 (Activation)	(None, 1)	0

---

Total params: 10,817

Trainable params: 10,817

Non-trainable params: 0

---

Train on 1412 samples, validate on 606 samples

Epoch 1/10

1412/1412 [=====] - 11s 8ms/sample - loss: 0.6932 - accuracy: 0.4816 - val\_loss: 0.6929 - val\_accuracy: 0.5215

Epoch 2/10

1412/1412 [=====] - 7s 5ms/sample - loss: 0.6928 - accuracy: 0.5205 - val\_loss: 0.6910 - val\_accuracy: 0.5149

Epoch 3/10

1412/1412 [=====] - 7s 5ms/sample - loss: 0.6925 - accuracy: 0.5099 - val\_loss: 0.6912 - val\_accuracy: 0.5908

Epoch 4/10

1412/1412 [=====] - 8s 5ms/sample - loss: 0.6936 - accuracy: 0.5099 - val\_loss: 0.6940 - val\_accuracy: 0.4851

Epoch 5/10

1412/1412 [=====] - 8s 5ms/sample - loss: 0.6932 - accuracy: 0.5064 - val\_loss: 0.6941 - val\_accuracy: 0.4851

Epoch 6/10

1412/1412 [=====] - 7s 5ms/sample - loss: 0.6931 - accuracy: 0.5064 - val\_loss: 0.6938 - val\_accuracy: 0.4851

Epoch 7/10

1412/1412 [=====] - 7s 5ms/sample - loss: 0.6931 - accuracy: 0.5064 - val\_loss: 0.6938 - val\_accuracy: 0.4851

Epoch 8/10

1412/1412 [=====] - 8s 5ms/sample - loss: 0.6931 - accuracy: 0.5064 - val\_loss: 0.6935 - val\_accuracy: 0.4851

Epoch 9/10

1412/1412 [=====] - 7s 5ms/sample - loss: 0.6931 - accuracy: 0.5064 - val\_loss: 0.6936 - val\_accuracy: 0.4851

Epoch 10/10

1412/1412 [=====] - 7s 5ms/sample - loss: 0.6932 - accuracy: 0.5064 - val\_loss: 0.6935 - val\_accuracy: 0.4851

4-conv-32-nodes-5-dense-1593483736

Model: "sequential\_8"

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Layer (type)	Output Shape	Param #
<hr/>		
conv2d_36 (Conv2D)	(None, 98, 98, 32)	320
<hr/>		
activation_78 (Activation)	(None, 98, 98, 32)	0
<hr/>		
max_pooling2d_36 (MaxPooling)	(None, 49, 49, 32)	0
<hr/>		
conv2d_37 (Conv2D)	(None, 47, 47, 32)	9248
<hr/>		
activation_79 (Activation)	(None, 47, 47, 32)	0
<hr/>		
max_pooling2d_37 (MaxPooling)	(None, 23, 23, 32)	0
<hr/>		
conv2d_38 (Conv2D)	(None, 21, 21, 32)	9248
<hr/>		
activation_80 (Activation)	(None, 21, 21, 32)	0
<hr/>		

max_pooling2d_38 (MaxPooling (None, 10, 10, 32))	0
conv2d_39 (Conv2D)	(None, 8, 8, 32) 9248
activation_81 (Activation)	(None, 8, 8, 32) 0
max_pooling2d_39 (MaxPooling (None, 4, 4, 32))	0
flatten_8 (Flatten)	(None, 512) 0
dense_42 (Dense)	(None, 32) 16416
activation_82 (Activation)	(None, 32) 0
dense_43 (Dense)	(None, 32) 1056
activation_83 (Activation)	(None, 32) 0
dense_44 (Dense)	(None, 32) 1056
activation_84 (Activation)	(None, 32) 0
dense_45 (Dense)	(None, 32) 1056
activation_85 (Activation)	(None, 32) 0
dense_46 (Dense)	(None, 32) 1056
activation_86 (Activation)	(None, 32) 0
dense_47 (Dense)	(None, 1) 33
activation_87 (Activation)	(None, 1) 0
<hr/>	
Total params:	48,737
Trainable params:	48,737
Non-trainable params:	0
<hr/>	
Train on 1412 samples, validate on 606 samples	
Epoch 1/10	
1412/1412 [=====] - 23s 16ms/sample - loss: 0.6934 - accuracy: 0.4993 - val_loss: 0.6931 - val_accuracy: 0.4851	
Epoch 2/10	
1412/1412 [=====] - 17s 12ms/sample - loss: 0.6936 - accuracy: 0.4965 - val_loss: 0.6929 - val_accuracy: 0.5215	
Epoch 3/10	
1412/1412 [=====] - 15s 11ms/sample - loss: 0.6924 - accuracy: 0.5135 - val_loss: 0.6922 - val_accuracy: 0.4983	
Epoch 4/10	
1412/1412 [=====] - 15s 11ms/sample - loss: 0.6903 - accuracy: 0.5467 - val_loss: 0.6883 - val_accuracy: 0.6337	
Epoch 5/10	
1412/1412 [=====] - 15s 11ms/sample - loss: 0.6803 - accuracy: 0.5843 - val_loss: 0.6542 - val_accuracy: 0.6370	
Epoch 6/10	
1412/1412 [=====] - 16s 11ms/sample - loss: 0.6509 - accuracy: 0.6204 - val_loss: 0.7422 - val_accuracy: 0.4851	

```

Epoch 7/10
1412/1412 [=====] - 17s 12ms/sample - loss: 0.6314 -
accuracy: 0.6516 - val_loss: 0.7094 - val_accuracy: 0.5462
Epoch 8/10
1412/1412 [=====] - 16s 11ms/sample - loss: 0.5730 -
accuracy: 0.7018 - val_loss: 0.4926 - val_accuracy: 0.7673
Epoch 9/10
1412/1412 [=====] - 15s 11ms/sample - loss: 0.4801 -
accuracy: 0.7663 - val_loss: 0.4811 - val_accuracy: 0.7475
Epoch 10/10
1412/1412 [=====] - 16s 11ms/sample - loss: 0.4397 -
accuracy: 0.7868 - val_loss: 0.4260 - val_accuracy: 0.8069
5-conv-32-nodes-5-dense-1593483902
Model: "sequential_9"

```

Layer (type)	Output Shape	Param #
conv2d_40 (Conv2D)	(None, 98, 98, 32)	320
activation_88 (Activation)	(None, 98, 98, 32)	0
max_pooling2d_40 (MaxPooling)	(None, 49, 49, 32)	0
conv2d_41 (Conv2D)	(None, 47, 47, 32)	9248
activation_89 (Activation)	(None, 47, 47, 32)	0
max_pooling2d_41 (MaxPooling)	(None, 23, 23, 32)	0
conv2d_42 (Conv2D)	(None, 21, 21, 32)	9248
activation_90 (Activation)	(None, 21, 21, 32)	0
max_pooling2d_42 (MaxPooling)	(None, 10, 10, 32)	0
conv2d_43 (Conv2D)	(None, 8, 8, 32)	9248
activation_91 (Activation)	(None, 8, 8, 32)	0
max_pooling2d_43 (MaxPooling)	(None, 4, 4, 32)	0
conv2d_44 (Conv2D)	(None, 2, 2, 32)	9248
activation_92 (Activation)	(None, 2, 2, 32)	0
max_pooling2d_44 (MaxPooling)	(None, 1, 1, 32)	0
flatten_9 (Flatten)	(None, 32)	0
dense_48 (Dense)	(None, 32)	1056
activation_93 (Activation)	(None, 32)	0
dense_49 (Dense)	(None, 32)	1056
activation_94 (Activation)	(None, 32)	0

dense_50 (Dense)	(None, 32)	1056
activation_95 (Activation)	(None, 32)	0
dense_51 (Dense)	(None, 32)	1056
activation_96 (Activation)	(None, 32)	0
dense_52 (Dense)	(None, 32)	1056
activation_97 (Activation)	(None, 32)	0
dense_53 (Dense)	(None, 1)	33
activation_98 (Activation)	(None, 1)	0
<hr/>		
Total params:	42,625	
Trainable params:	42,625	
Non-trainable params:	0	

---

Train on 1412 samples, validate on 606 samples  
Epoch 1/10  
1412/1412 [=====] - 18s 12ms/sample - loss: 0.6935 -  
accuracy: 0.5064 - val\_loss: 0.6934 - val\_accuracy: 0.4851  
Epoch 2/10  
1412/1412 [=====] - 13s 9ms/sample - loss: 0.6932 -  
accuracy: 0.5064 - val\_loss: 0.6932 - val\_accuracy: 0.4851  
Epoch 3/10  
1412/1412 [=====] - 13s 9ms/sample - loss: 0.6932 -  
accuracy: 0.4865 - val\_loss: 0.6934 - val\_accuracy: 0.4851  
Epoch 4/10  
1412/1412 [=====] - 13s 9ms/sample - loss: 0.6933 -  
accuracy: 0.4901 - val\_loss: 0.6935 - val\_accuracy: 0.4851  
Epoch 5/10  
1412/1412 [=====] - 15s 11ms/sample - loss: 0.6931 -  
accuracy: 0.5064 - val\_loss: 0.6936 - val\_accuracy: 0.4851  
Epoch 6/10  
1412/1412 [=====] - 15s 11ms/sample - loss: 0.6933 -  
accuracy: 0.5064 - val\_loss: 0.6936 - val\_accuracy: 0.4851  
Epoch 7/10  
1412/1412 [=====] - 13s 9ms/sample - loss: 0.6934 -  
accuracy: 0.4950 - val\_loss: 0.6936 - val\_accuracy: 0.4851  
Epoch 8/10  
1412/1412 [=====] - 14s 10ms/sample - loss: 0.6935 -  
accuracy: 0.5064 - val\_loss: 0.6940 - val\_accuracy: 0.4851  
Epoch 9/10  
1412/1412 [=====] - 13s 9ms/sample - loss: 0.6932 -  
accuracy: 0.5064 - val\_loss: 0.6940 - val\_accuracy: 0.4851  
Epoch 10/10  
1412/1412 [=====] - 15s 11ms/sample - loss: 0.6932 -  
accuracy: 0.5064 - val\_loss: 0.6939 - val\_accuracy: 0.4851  
4-conv-64-nodes-5-dense-1593484045  
Model: "sequential\_10"

Layer (type)	Output Shape	Param #
conv2d_45 (Conv2D)	(None, 98, 98, 64)	640

activation_99 (Activation)	(None, 98, 98, 64)	0
max_pooling2d_45 (MaxPooling)	(None, 49, 49, 64)	0
conv2d_46 (Conv2D)	(None, 47, 47, 64)	36928
activation_100 (Activation)	(None, 47, 47, 64)	0
max_pooling2d_46 (MaxPooling)	(None, 23, 23, 64)	0
conv2d_47 (Conv2D)	(None, 21, 21, 64)	36928
activation_101 (Activation)	(None, 21, 21, 64)	0
max_pooling2d_47 (MaxPooling)	(None, 10, 10, 64)	0
conv2d_48 (Conv2D)	(None, 8, 8, 64)	36928
activation_102 (Activation)	(None, 8, 8, 64)	0
max_pooling2d_48 (MaxPooling)	(None, 4, 4, 64)	0
flatten_10 (Flatten)	(None, 1024)	0
dense_54 (Dense)	(None, 64)	65600
activation_103 (Activation)	(None, 64)	0
dense_55 (Dense)	(None, 64)	4160
activation_104 (Activation)	(None, 64)	0
dense_56 (Dense)	(None, 64)	4160
activation_105 (Activation)	(None, 64)	0
dense_57 (Dense)	(None, 64)	4160
activation_106 (Activation)	(None, 64)	0
dense_58 (Dense)	(None, 64)	4160
activation_107 (Activation)	(None, 64)	0
dense_59 (Dense)	(None, 1)	65
activation_108 (Activation)	(None, 1)	0

=====

Total params: 193,729

Trainable params: 193,729

Non-trainable params: 0

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Train on 1412 samples, validate on 606 samples

Epoch 1/10

1412/1412 [=====] - 39s 28ms/sample - loss: 0.6938 - accuracy: 0.5000 - val\_loss: 0.6935 - val\_accuracy: 0.4851

Epoch 2/10  
1412/1412 [=====] - 39s 28ms/sample - loss: 0.6932 -  
accuracy: 0.5064 - val\_loss: 0.6936 - val\_accuracy: 0.4851  
Epoch 3/10  
1412/1412 [=====] - 39s 28ms/sample - loss: 0.6933 -  
accuracy: 0.5064 - val\_loss: 0.6936 - val\_accuracy: 0.4851  
Epoch 4/10  
1412/1412 [=====] - 35s 25ms/sample - loss: 0.6931 -  
accuracy: 0.5064 - val\_loss: 0.6933 - val\_accuracy: 0.4851  
Epoch 5/10  
1412/1412 [=====] - 36s 26ms/sample - loss: 0.6932 -  
accuracy: 0.5064 - val\_loss: 0.6934 - val\_accuracy: 0.4851  
Epoch 6/10  
1412/1412 [=====] - 36s 26ms/sample - loss: 0.6931 -  
accuracy: 0.5064 - val\_loss: 0.6934 - val\_accuracy: 0.4851  
Epoch 7/10  
1412/1412 [=====] - 38s 27ms/sample - loss: 0.6932 -  
accuracy: 0.4922 - val\_loss: 0.6931 - val\_accuracy: 0.4934  
Epoch 8/10  
1412/1412 [=====] - 40s 28ms/sample - loss: 0.6936 -  
accuracy: 0.5050 - val\_loss: 0.6937 - val\_accuracy: 0.4851  
Epoch 9/10  
1412/1412 [=====] - 38s 27ms/sample - loss: 0.6935 -  
accuracy: 0.5028 - val\_loss: 0.6934 - val\_accuracy: 0.4851  
Epoch 10/10  
1412/1412 [=====] - 41s 29ms/sample - loss: 0.6924 -  
accuracy: 0.5191 - val\_loss: 0.6873 - val\_accuracy: 0.5149  
5-conv-64-nodes-5-dense-1593484428  
Model: "sequential\_11"

Layer (type)	Output Shape	Param #
<hr/>		
conv2d_49 (Conv2D)	(None, 98, 98, 64)	640
activation_109 (Activation)	(None, 98, 98, 64)	0
max_pooling2d_49 (MaxPooling)	(None, 49, 49, 64)	0
conv2d_50 (Conv2D)	(None, 47, 47, 64)	36928
activation_110 (Activation)	(None, 47, 47, 64)	0
max_pooling2d_50 (MaxPooling)	(None, 23, 23, 64)	0
conv2d_51 (Conv2D)	(None, 21, 21, 64)	36928
activation_111 (Activation)	(None, 21, 21, 64)	0
max_pooling2d_51 (MaxPooling)	(None, 10, 10, 64)	0
conv2d_52 (Conv2D)	(None, 8, 8, 64)	36928
activation_112 (Activation)	(None, 8, 8, 64)	0
max_pooling2d_52 (MaxPooling)	(None, 4, 4, 64)	0
conv2d_53 (Conv2D)	(None, 2, 2, 64)	36928

activation_113 (Activation)	(None, 2, 2, 64)	0
max_pooling2d_53 (MaxPooling)	(None, 1, 1, 64)	0
flatten_11 (Flatten)	(None, 64)	0
dense_60 (Dense)	(None, 64)	4160
activation_114 (Activation)	(None, 64)	0
dense_61 (Dense)	(None, 64)	4160
activation_115 (Activation)	(None, 64)	0
dense_62 (Dense)	(None, 64)	4160
activation_116 (Activation)	(None, 64)	0
dense_63 (Dense)	(None, 64)	4160
activation_117 (Activation)	(None, 64)	0
dense_64 (Dense)	(None, 64)	4160
activation_118 (Activation)	(None, 64)	0
dense_65 (Dense)	(None, 1)	65
activation_119 (Activation)	(None, 1)	0
<hr/>		
Total params: 169,217		
Trainable params: 169,217		
Non-trainable params: 0		

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Train on 1412 samples, validate on 606 samples  
Epoch 1/10  
1412/1412 [=====] - 44s 31ms/sample - loss: 0.6936 -  
accuracy: 0.5014 - val\_loss: 0.6934 - val\_accuracy: 0.4851  
Epoch 2/10  
1412/1412 [=====] - 45s 32ms/sample - loss: 0.6933 -  
accuracy: 0.5085 - val\_loss: 0.6938 - val\_accuracy: 0.4851  
Epoch 3/10  
1412/1412 [=====] - 39s 27ms/sample - loss: 0.6934 -  
accuracy: 0.5064 - val\_loss: 0.6937 - val\_accuracy: 0.4851  
Epoch 4/10  
1412/1412 [=====] - 44s 31ms/sample - loss: 0.6932 -  
accuracy: 0.5064 - val\_loss: 0.6936 - val\_accuracy: 0.4851  
Epoch 5/10  
1412/1412 [=====] - 40s 29ms/sample - loss: 0.6933 -  
accuracy: 0.5064 - val\_loss: 0.6937 - val\_accuracy: 0.4851  
Epoch 6/10  
1412/1412 [=====] - 37s 26ms/sample - loss: 0.6933 -  
accuracy: 0.5064 - val\_loss: 0.6938 - val\_accuracy: 0.4851  
Epoch 7/10  
1412/1412 [=====] - 35s 25ms/sample - loss: 0.6932 -  
accuracy: 0.5064 - val\_loss: 0.6941 - val\_accuracy: 0.4851

```
Epoch 8/10
1412/1412 [=====] - 36s 25ms/sample - loss: 0.6938 -
accuracy: 0.5021 - val_loss: 0.6946 - val_accuracy: 0.4851
Epoch 9/10
1412/1412 [=====] - 37s 26ms/sample - loss: 0.6933 -
accuracy: 0.5064 - val_loss: 0.6938 - val_accuracy: 0.4851
Epoch 10/10
1412/1412 [=====] - 40s 29ms/sample - loss: 0.6934 -
accuracy: 0.4809 - val_loss: 0.6935 - val_accuracy: 0.4851
```

## we save the model with the highest accuracy on validation dataset

```
In [7]: model.save("4-conv-32-nodes-4-dense-1593482505.model")
```

```
WARNING:tensorflow:From /Users/friends/anaconda3/envs/udacity-ehr-env/lib/python3.7/site-packages/tensorflow_core/python/ops/resource_variable_ops.py:178
1: calling BaseResourceVariable.__init__ (from tensorflow.python.ops.resource_variable_ops) with constraint is deprecated and will be removed in a future
version.
Instructions for updating:
If using Keras pass *_constraint arguments to layers.
INFO:tensorflow:Assets written to: 4-conv-32-nodes-4-dense-1593482505.model/assets
```

## Tensorboard : TensorFlow's visualization toolkit

Go to cmd and type the following commands

```
tensorboard --logdir='logs/'  
Copy the link and paste on browser to see the visualizations  
Go to http://localhost:6006/
```

```
In [ ]:
```