SAMPLE_SIZE=10000

优化器的选择：

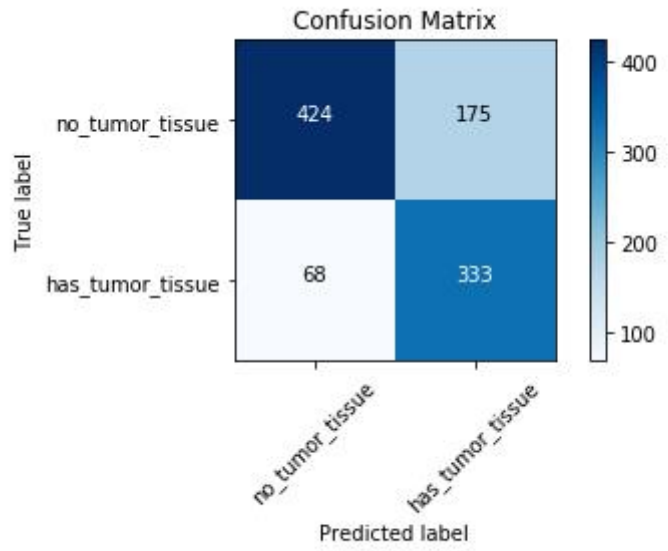
Adam(lr=0.0001), loss = binary_crossentropy, metrics = ['accuracy']

1epoch

```
WARNING:tensorflow:From /opt/conda/lib/python3.6/site-packages/tensorflow/python/ops/math_ops.py:3066: to_int32 (from tensorflow.python.ops.m
ath_ops) is deprecated and will be removed in a future version.
Instructions for updating:
Use tf.cast instead.
100/100 [==============================] - 1s 13ms/step - loss: 0.5382 - acc: 0.7570

Epoch 00001: val_acc improved from -inf to 0.75700, saving model to model.h5
900/900 [==============================] - 25s 27ms/step - loss: 0.5562 - acc: 0.7112 - val_loss: 0.5382 - val_acc: 0.7570
```

```
val_loss: 0.5381553820371627
val_acc: 0.757
```



SGD(lr=0.0001, decay=1e-6, momentum=0.9, nesterov=True)

1 epoch

```
100/100 [==============================] - 1s 12ms/step - loss: 6.4281 - acc: 0.5990

Epoch 00001: val_acc improved from -inf to 0.59900, saving model to model.h5
900/900 [==============================] - 25s 28ms/step - loss: 6.4299 - acc: 0.5989 - val_loss: 6.4281 - val_acc: 0.5990
```

10 epoch,准确率没有得到提高

```
Epoch 00001: val_acc improved from -inf to 0.59900, saving model to model.h5
900/900 [==============================] - 23s 25ms/step - loss: 6.4299 - acc: 0.5989 - val_loss: 6.4281 - val_acc: 0.5990
Epoch 2/10
100/100 [==============================] - 1s 12ms/step - loss: 6.4281 - acc: 0.5990

Epoch 00002: val_acc did not improve from 0.59900
900/900 [==============================] - 23s 25ms/step - loss: 6.4299 - acc: 0.5989 - val_loss: 6.4281 - val_acc: 0.5990
Epoch 3/10
100/100 [==============================] - 1s 12ms/step - loss: 6.4281 - acc: 0.5990
```

```
Epoch 00008: val_acc did not improve from 0.59900
900/900 [==============================] - 22s 25ms/step - loss: 6.4299 - acc: 0.5989 - val_loss: 6.4281 - val_acc: 0.5990
Epoch 9/10
100/100 [==============================] - 1s 12ms/step - loss: 6.4281 - acc: 0.5990

Epoch 00009: val_acc did not improve from 0.59900

Epoch 00009: ReduceLROnPlateau reducing learning rate to 1e-05.
900/900 [==============================] - 23s 26ms/step - loss: 6.4299 - acc: 0.5989 - val_loss: 6.4281 - val_acc: 0.5990
Epoch 10/10
100/100 [==============================] - 1s 12ms/step - loss: 6.4281 - acc: 0.5990
```

二分类结果

这种选择会产生二分类的结果，与这种配置相适应，我们使用`binary_crossentropy`作为损失函数。

全连接层会忽略空间结构特性，不适合用于在方位上找Pattern的任务，比如segmentation

全连接层参数特多，近期一些性能优异的网络模型如ResNet和GoogleLeNet使用全局平均池化（GAP）

batch norm

模型结构

优化器使用的是

SGD:

lr = 0.01, decay = 1e-6, momentum=0.9, nesterov=True.

loss = binary_crossentropy, metrics = accuracy

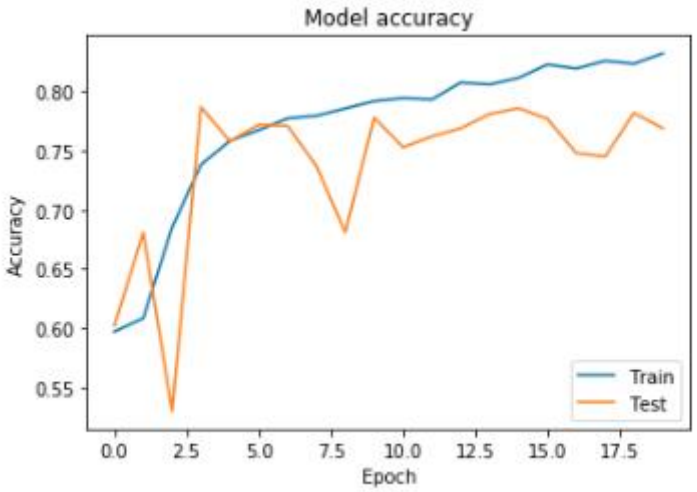
20 epoch,train 900 steps, val 100 steps

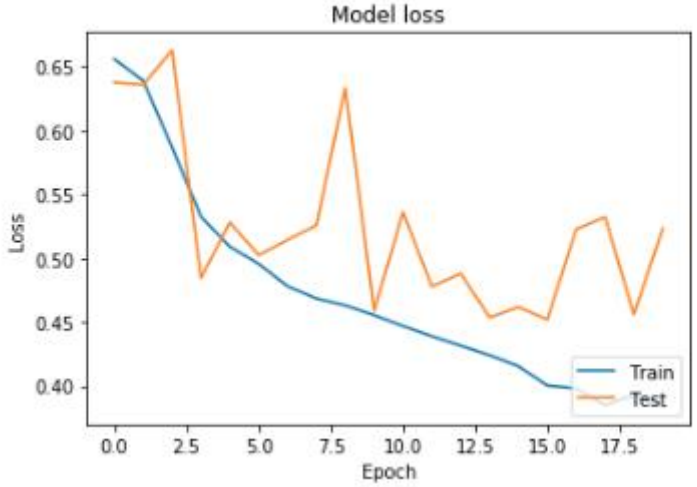
三层神经网络

```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d_45 (Conv2D)           (None, 94, 94, 32)        896
_________________________________________________________________
max_pooling2d_21 (MaxPooling (None, 47, 47, 32)        0
_________________________________________________________________
dropout_28 (Dropout)         (None, 47, 47, 32)        0
_________________________________________________________________
conv2d_46 (Conv2D)           (None, 45, 45, 64)        18496
_________________________________________________________________
max_pooling2d_22 (MaxPooling (None, 22, 22, 64)        0
_________________________________________________________________
dropout_29 (Dropout)         (None, 22, 22, 64)        0
_________________________________________________________________
conv2d_47 (Conv2D)           (None, 20, 20, 128)       73856
_________________________________________________________________
max_pooling2d_23 (MaxPooling (None, 10, 10, 128)       0
_________________________________________________________________
dropout_30 (Dropout)         (None, 10, 10, 128)       0
_________________________________________________________________
flatten_7 (Flatten)          (None, 12800)             0
_________________________________________________________________
dense_14 (Dense)             (None, 64)                819264
_________________________________________________________________
dropout_31 (Dropout)         (None, 64)                0
_________________________________________________________________
dense_15 (Dense)             (None, 2)                 130
=================================================================
Total params: 912,642
Trainable params: 912,642
Non-trainable params: 0
_________________________________________________________________
```

结果：

```
val_loss: 0.48447739620506763
val_acc: 0.787
```


Model accuracy
Accuracy
0.80
0.75
0.70
0.65
0.60
0.55
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
Epoch
Train
Test

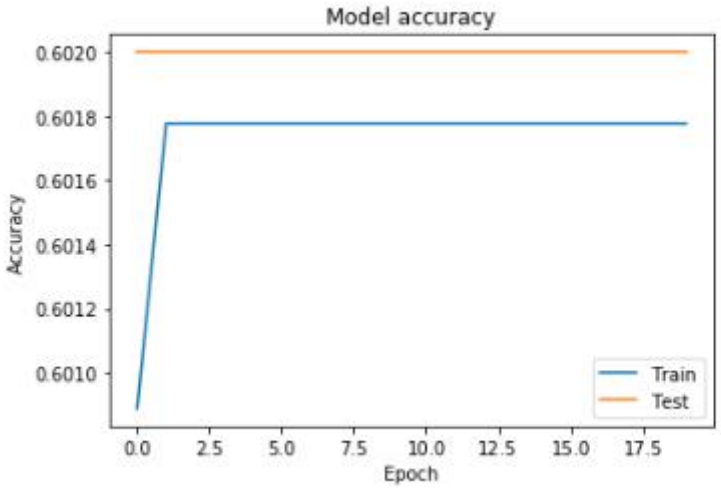

Model loss
Loss
0.65
0.60
0.55
0.50
0.45
0.40
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5
Epoch
Train
Test

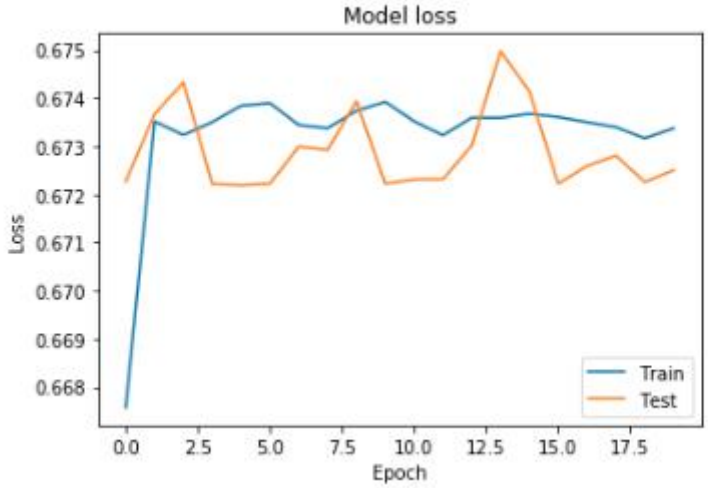
四层神经网络

```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d_3 (Conv2D)            (None, 94, 94, 32)        896
_________________________________________________________________
max_pooling2d_3 (MaxPooling2 (None, 47, 47, 32)        0
_________________________________________________________________
dropout_4 (Dropout)          (None, 47, 47, 32)        0
_________________________________________________________________
conv2d_4 (Conv2D)            (None, 45, 45, 64)        18496
_________________________________________________________________
conv2d_5 (Conv2D)            (None, 43, 43, 64)        36928
_________________________________________________________________
max_pooling2d_4 (MaxPooling2 (None, 21, 21, 64)        0
_________________________________________________________________
dropout_5 (Dropout)          (None, 21, 21, 64)        0
_________________________________________________________________
conv2d_6 (Conv2D)            (None, 19, 19, 128)       73856
_________________________________________________________________
max_pooling2d_5 (MaxPooling2 (None, 9, 9, 128)         0
_________________________________________________________________
dropout_6 (Dropout)          (None, 9, 9, 128)         0
_________________________________________________________________
flatten_1 (Flatten)          (None, 10368)             0
_________________________________________________________________
dense_2 (Dense)              (None, 64)                663616
_________________________________________________________________
dropout_7 (Dropout)          (None, 64)                0
_________________________________________________________________
dense_3 (Dense)              (None, 2)                 130
=================================================================
Total params: 793,922
Trainable params: 793,922
Non-trainable params: 0
_________________________________________________________________
```

结果

```
val_loss: 0.6722687927484512
val_acc: 0.602
```


Model accuracy
Accuracy
Epoch
Train
Test
0.6020
0.6018
0.6016
0.6014
0.6012
0.6010
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5

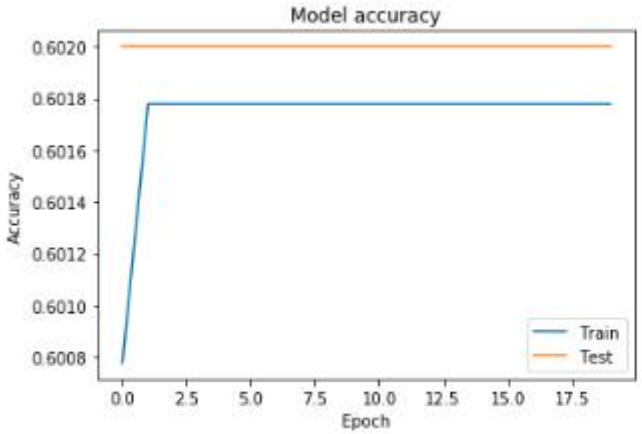

Model loss
Loss
Epoch
Train
Test
0.675
0.674
0.673
0.672
0.671
0.670
0.669
0.668
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5

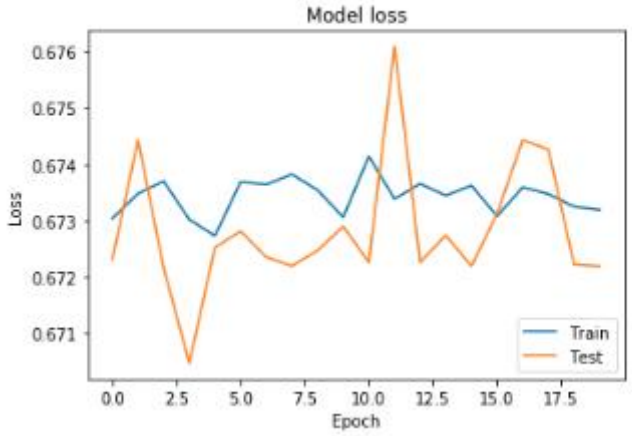
六层神经网络

```
=================================================================
conv2d_7 (Conv2D)            (None, 94, 94, 32)        896
_________________________________________________________________
conv2d_8 (Conv2D)            (None, 92, 92, 32)        9248
_________________________________________________________________
max_pooling2d_6 (MaxPooling2 (None, 46, 46, 32)        0
_________________________________________________________________
dropout_8 (Dropout)          (None, 46, 46, 32)        0
_________________________________________________________________
conv2d_9 (Conv2D)            (None, 44, 44, 64)        18496
_________________________________________________________________
conv2d_10 (Conv2D)           (None, 42, 42, 64)        36928
_________________________________________________________________
max_pooling2d_7 (MaxPooling2 (None, 21, 21, 64)        0
_________________________________________________________________
dropout_9 (Dropout)          (None, 21, 21, 64)        0
_________________________________________________________________
conv2d_11 (Conv2D)           (None, 19, 19, 128)       73856
_________________________________________________________________
conv2d_12 (Conv2D)           (None, 17, 17, 128)       147584
_________________________________________________________________
max_pooling2d_8 (MaxPooling2 (None, 8, 8, 128)         0
_________________________________________________________________
dropout_10 (Dropout)         (None, 8, 8, 128)         0
_________________________________________________________________
flatten_2 (Flatten)          (None, 8192)              0
_________________________________________________________________
dense_4 (Dense)              (None, 64)                524352
_________________________________________________________________
dropout_11 (Dropout)         (None, 64)                0
_________________________________________________________________
dense_5 (Dense)              (None, 2)                 130
=================================================================
Total params: 811,490
Trainable params: 811,490
Non-trainable params: 0
```

结果

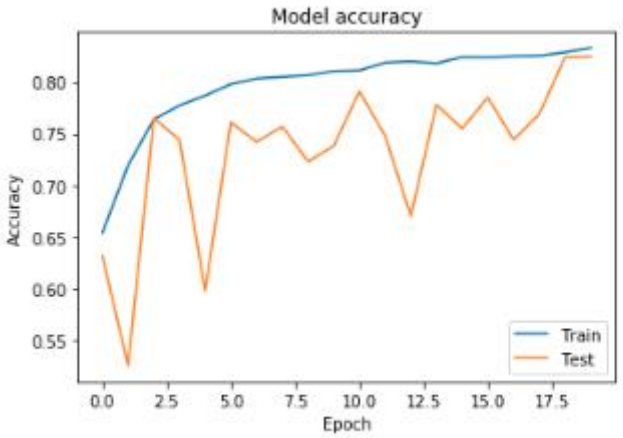
```
val_loss: 0.6723102186620236
val_acc: 0.602
```

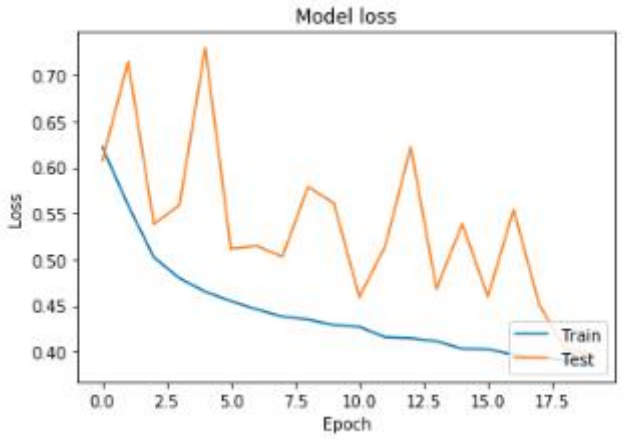




改变学习率至0.001

```
val_loss: 0.3976273346829694
val_acc: 0.825
```

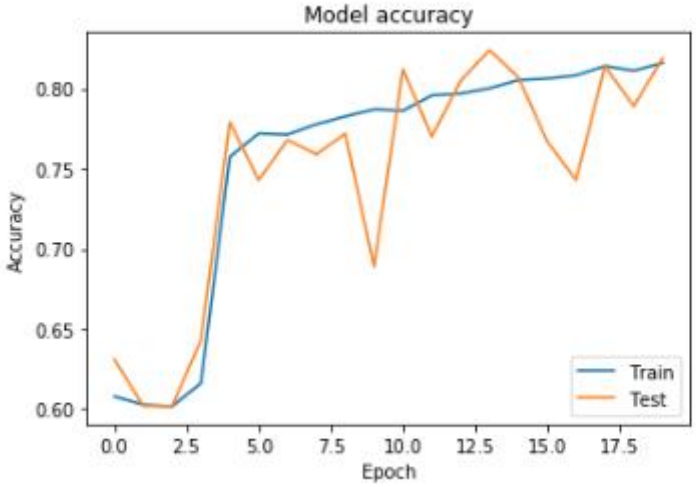


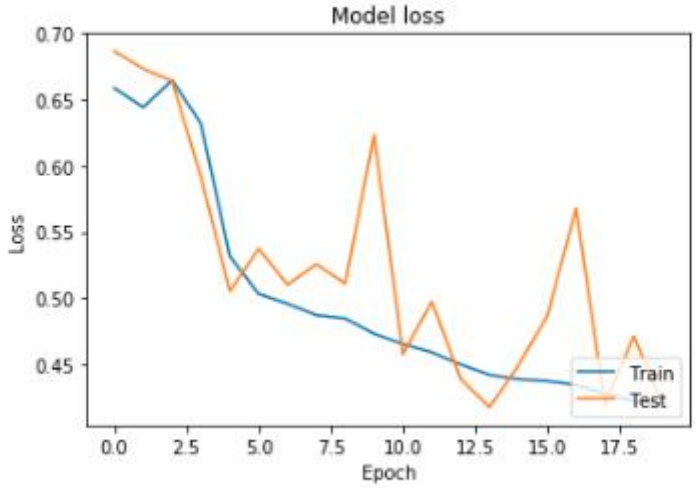


九层神经网络

```
_________________________________________________________________
max_pooling2d_5 (MaxPooling2 (None, 6, 6, 128)         0
_________________________________________________________________
dropout_6 (Dropout)          (None, 6, 6, 128)         0
_________________________________________________________________
flatten_1 (Flatten)          (None, 4608)              0
_________________________________________________________________
dense_2 (Dense)              (None, 64)                294976
_________________________________________________________________
dropout_7 (Dropout)          (None, 64)                0
_________________________________________________________________
dense_3 (Dense)              (None, 2)                 130
=================================================================
Total params: 775,874
Trainable params: 775,874
Non-trainable params: 0
_________________________________________________________________
```

```
val_loss: 0.41767312338016926
val_acc: 0.824
```





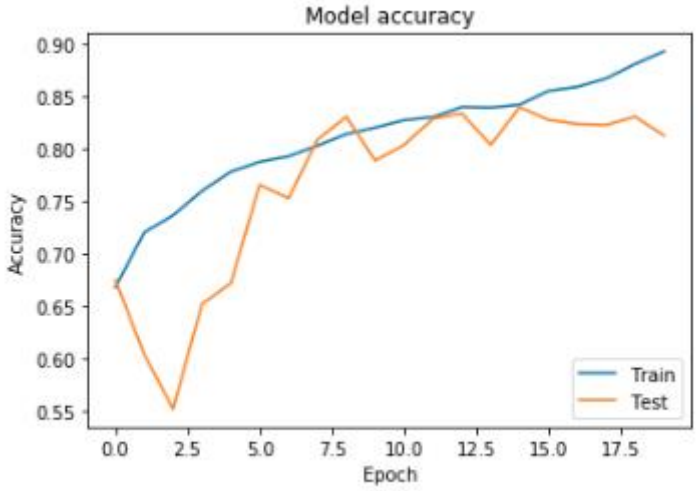
使用预训练好的模型VGG16：

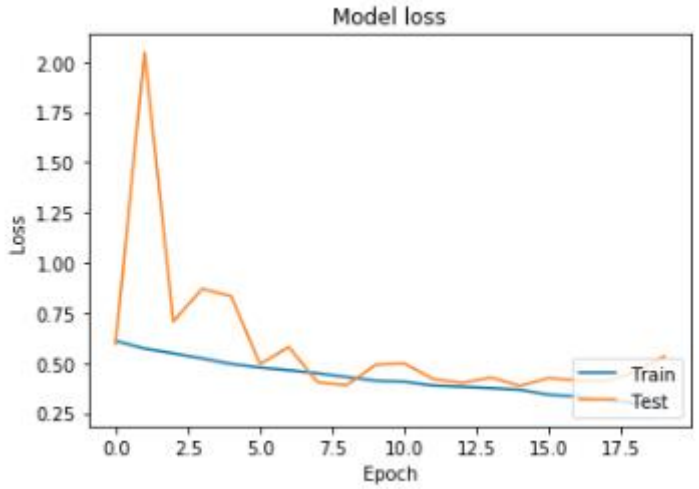
```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
vgg16 (Model)                (None, 3, 3, 512)         14714688
_________________________________________________________________
flatten_2 (Flatten)          (None, 4608)              0
_________________________________________________________________
dense_4 (Dense)              (None, 256)               1179648
_________________________________________________________________
batch_normalization_v1 (Batc (None, 256)               1024
_________________________________________________________________
activation (Activation)      (None, 256)               0
_________________________________________________________________
dropout_8 (Dropout)          (None, 256)               0
_________________________________________________________________
dense_5 (Dense)              (None, 2)                 514
=================================================================
Total params: 15,895,874
Trainable params: 15,895,362
Non-trainable params: 512
```

换个优化器Adam VS sgd

```
model.compile(Adam(lr=0.001), loss='binary_crossentropy',
 metrics=['accuracy'])
```

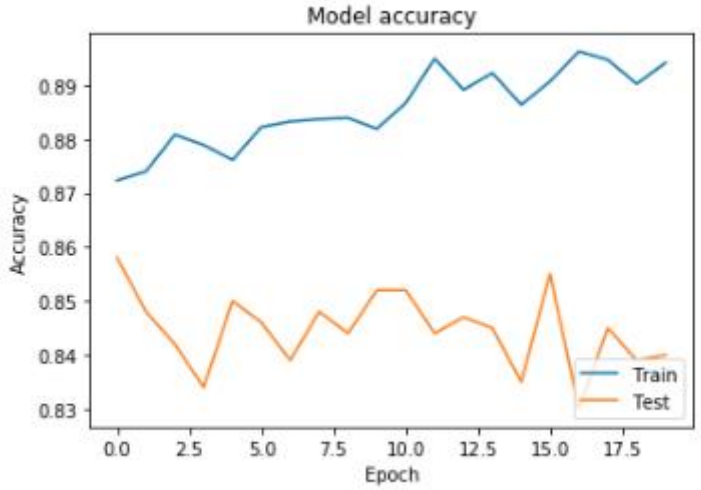
```
val_loss: 0.3844176901624305
val_acc: 0.84
```

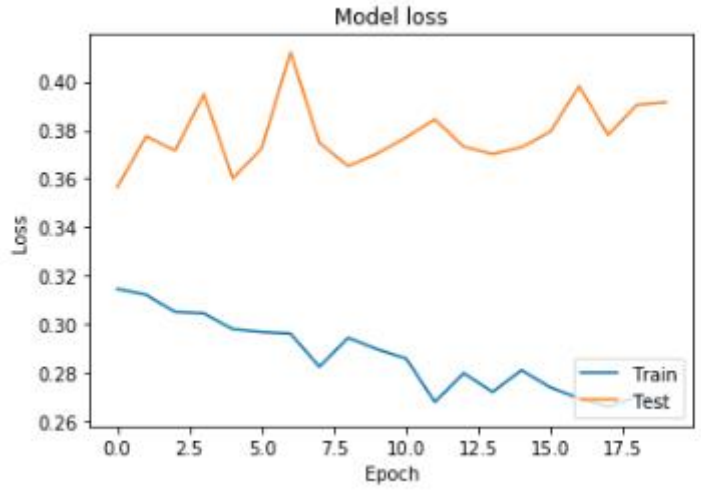





```
sgd = keras.optimizers.SGD(lr=0.001, decay=1e-6, momentum=0.9, nesterov=True)
model.compile(loss='binary_crossentropy', optimizer=sgd, metrics=['accuracy'])
```

```
val_loss: 0.35650308181217405
val_acc: 0.858
```





VGG16冻结一些layer进行训练看结果

```
for layer in base_model.layers[:-8]:
 layer.trainable = False
```

```
<tensorflow.python.keras.engine.input_layer.InputLayer object at 0x7efb662405c0> False
<tensorflow.python.keras.layers.convolutional.Conv2D object at 0x7efb662403c8> False
<tensorflow.python.keras.layers.convolutional.Conv2D object at 0x7efb6a852fd0> False
<tensorflow.python.keras.layers.pooling.MaxPooling2D object at 0x7efb69ce1400> False
<tensorflow.python.keras.layers.convolutional.Conv2D object at 0x7efb69ce17f0> False
<tensorflow.python.keras.layers.convolutional.Conv2D object at 0x7efb69b7f7f0> False
<tensorflow.python.keras.layers.pooling.MaxPooling2D object at 0x7efb69b269b0> False
<tensorflow.python.keras.layers.convolutional.Conv2D object at 0x7efb69b87780> False
<tensorflow.python.keras.layers.convolutional.Conv2D object at 0x7efb69b357f0> False
<tensorflow.python.keras.layers.convolutional.Conv2D object at 0x7efb69b51320> False
<tensorflow.python.keras.layers.pooling.MaxPooling2D object at 0x7efb69aec2e8> False
<tensorflow.python.keras.layers.convolutional.Conv2D object at 0x7efb69b5de48> True
<tensorflow.python.keras.layers.convolutional.Conv2D object at 0x7efb69afa9e8> True
<tensorflow.python.keras.layers.convolutional.Conv2D object at 0x7efb69b144e0> True
<tensorflow.python.keras.layers.pooling.MaxPooling2D object at 0x7efb69ab3588> True
<tensorflow.python.keras.layers.convolutional.Conv2D object at 0x7efb69ab3550> True
<tensorflow.python.keras.layers.convolutional.Conv2D object at 0x7efb69ad1550> True
<tensorflow.python.keras.layers.convolutional.Conv2D object at 0x7efb69adefd0> True
<tensorflow.python.keras.layers.pooling.MaxPooling2D object at 0x7efb69a89e80> True
```

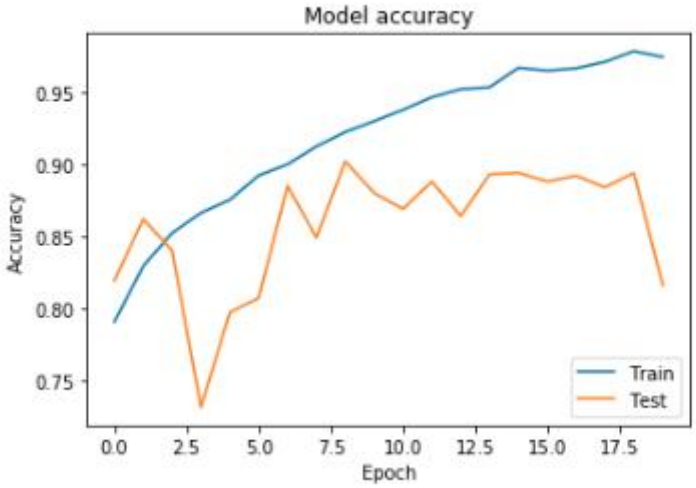
```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
vgg16 (Model)                (None, 3, 3, 512)         14714688
_________________________________________________________________
flatten (Flatten)            (None, 4608)              0
_________________________________________________________________
dense (Dense)                (None, 256)               1179648
_________________________________________________________________
batch_normalization_v1 (Batc (None, 256)               1024
_________________________________________________________________
activation (Activation)      (None, 256)               0
_________________________________________________________________
dropout (Dropout)            (None, 256)               0
_________________________________________________________________
dense_1 (Dense)              (None, 2)                 514
=================================================================
Total params: 15,895,874
Trainable params: 14,159,874
Non-trainable params: 1,736,000
_________________________________________________________________
```

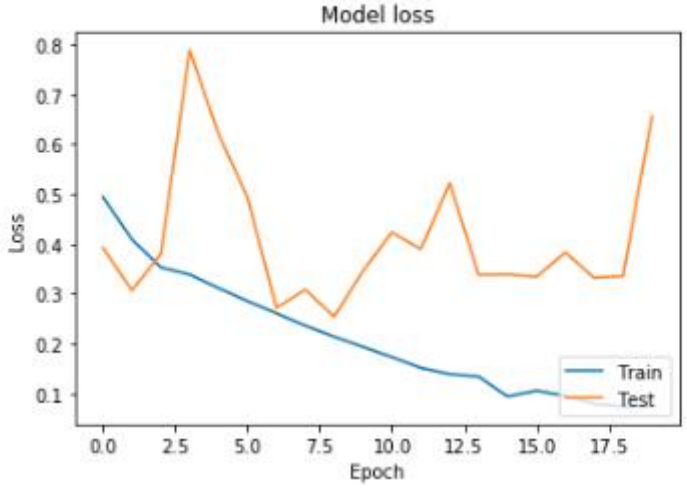
编译器的选择

```
sgd = keras.optimizers.SGD(lr=0.001, decay=1e-6, momentum=0.9, nesterov=True)
model.compile(loss='binary_crossentropy', optimizer=sgd, metrics=['accuracy'])
```

结果

```
val_loss: 0.2540596631398621
val_acc: 0.902
```





VGG解冻

模型结构

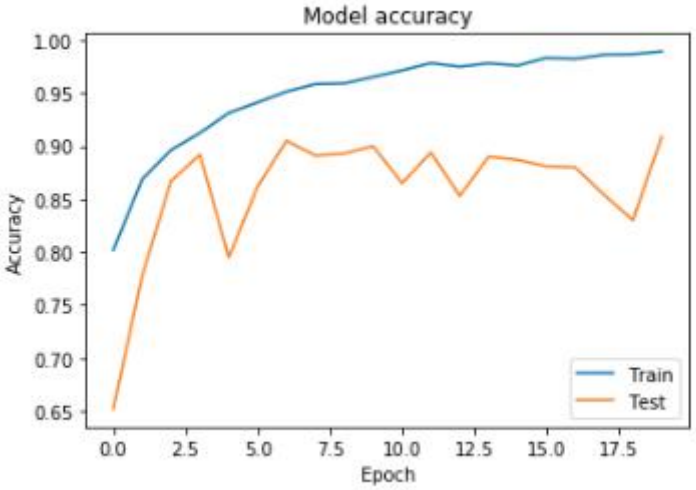
```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
vgg16 (Model)                (None, 3, 3, 512)         14714688
_________________________________________________________________
flatten_1 (Flatten)          (None, 4608)              0
_________________________________________________________________
dense_2 (Dense)              (None, 256)               1179648
_________________________________________________________________
batch_normalization_v1_1 (Ba (None, 256)               1024
_________________________________________________________________
activation_1 (Activation)    (None, 256)               0
_________________________________________________________________
dropout_1 (Dropout)          (None, 256)               0
_________________________________________________________________
dense_3 (Dense)              (None, 2)                 514
=================================================================
Total params: 15,895,874
Trainable params: 15,895,362
Non-trainable params: 512
_________________________________________________________________
```

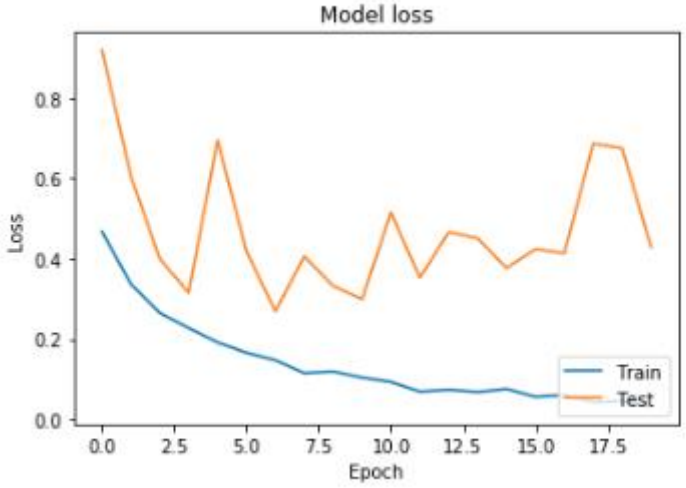
编译器的选择

```
1 sgd = keras.optimizers.SGD(lr=0.001, decay=1e-6, momentum=0.9, nesterov=T
rue)
2 model.compile(loss='binary_crossentropy', optimizer=sgd, metrics=['accura
cy'])
```

结果

```
val_loss: 0.42879582741776356
val_acc: 0.909
```


Model accuracy
Accuracy
Epoch
Train
Test
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5


Model loss
Loss
Epoch
Train
Test
0.8
0.6
0.4
0.2
0.0
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5