```
_____
Layer (type)                 Output Shape              Param #
=============================================================
conv2d_1 (Conv2D)            (None, 62, 62, 32)         896
_____
max_pooling2d_1 (MaxPooling2 (None, 31, 31, 32)         0
_____
flatten_1 (Flatten)          (None, 30752)              0
_____
dense_1 (Dense)              (None, 128)                3936384
_____
dense_2 (Dense)              (None, 1)                  129
=============================================================
Total params: 3,937,409
Trainable params: 3,937,409
Non-trainable params: 0
_____
Epoch 1/20
517/516 [==============================] - 89s 172ms/step - loss: 0.6559 - acc: 0.6333 -
val_loss: 0.5904 - val_acc: 0.6929
Epoch 2/20
517/516 [==============================] - 81s 156ms/step - loss: 0.5705 - acc: 0.7125 -
val_loss: 0.5218 - val_acc: 0.7337
Epoch 3/20
517/516 [==============================] - 84s 162ms/step - loss: 0.4660 - acc: 0.7966 -
val_loss: 0.3895 - val_acc: 0.8619
Epoch 4/20
517/516 [==============================] - 83s 161ms/step - loss: 0.3506 - acc: 0.8596 -
val_loss: 0.3126 - val_acc: 0.8639
Epoch 5/20
517/516 [==============================] - 81s 156ms/step - loss: 0.2867 - acc: 0.8905 -
val_loss: 0.2843 - val_acc: 0.8966
Epoch 6/20
517/516 [==============================] - 83s 160ms/step - loss: 0.2519 - acc: 0.9071 -
val_loss: 0.2422 - val_acc: 0.9080
Epoch 7/20
517/516 [==============================] - 83s 161ms/step - loss: 0.2335 - acc: 0.9150 -
val_loss: 0.2395 - val_acc: 0.9133
Epoch 8/20
517/516 [==============================] - 81s 156ms/step - loss: 0.2230 - acc: 0.9188 -
val_loss: 0.2226 - val_acc: 0.9214
Epoch 9/20
517/516 [==============================] - 81s 157ms/step - loss: 0.2141 - acc: 0.9242 -
val_loss: 0.2128 - val_acc: 0.9260
Epoch 10/20
517/516 [==============================] - 83s 161ms/step - loss: 0.2003 - acc: 0.9295 -
val_loss: 0.2148 - val_acc: 0.9343
Epoch 11/20
517/516 [==============================] - 81s 156ms/step - loss: 0.1912 - acc: 0.9362 -
val_loss: 0.2205 - val_acc: 0.9349
Epoch 12/20
517/516 [==============================] - 81s 157ms/step - loss: 0.1885 - acc: 0.9367 -
val_loss: 0.2332 - val_acc: 0.9178
Epoch 13/20
517/516 [==============================] - 83s 160ms/step - loss: 0.1899 - acc: 0.9351 -
val_loss: 0.1874 - val_acc: 0.9325
Epoch 14/20
517/516 [==============================] - 81s 156ms/step - loss: 0.1798 - acc: 0.9392 -
val_loss: 0.1876 - val_acc: 0.9419
Epoch 15/20
517/516 [==============================] - 81s 156ms/step - loss: 0.1817 - acc: 0.9386 -
val_loss: 0.1926 - val_acc: 0.9383
Epoch 16/20
517/516 [==============================] - 83s 160ms/step - loss: 0.1823 - acc: 0.9390 -
val_loss: 0.1689 - val_acc: 0.9468
Epoch 17/20
517/516 [==============================] - 81s 157ms/step - loss: 0.1771 - acc: 0.9418 -
val_loss: 0.1614 - val_acc: 0.9507
Epoch 18/20
```
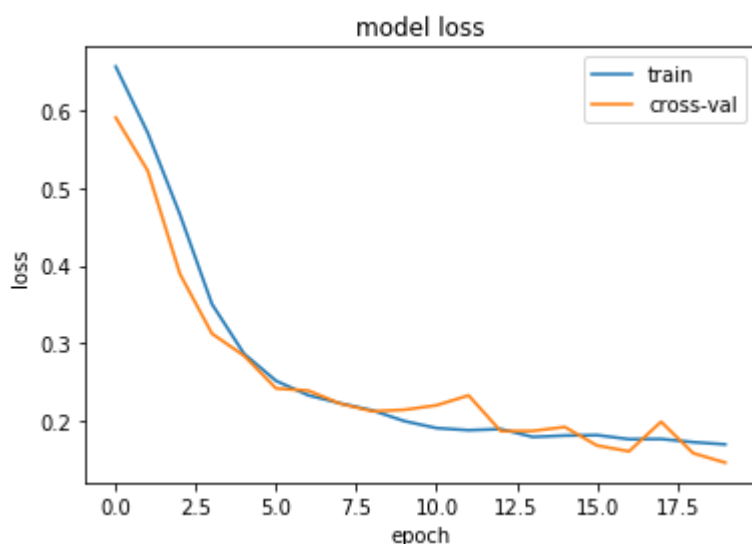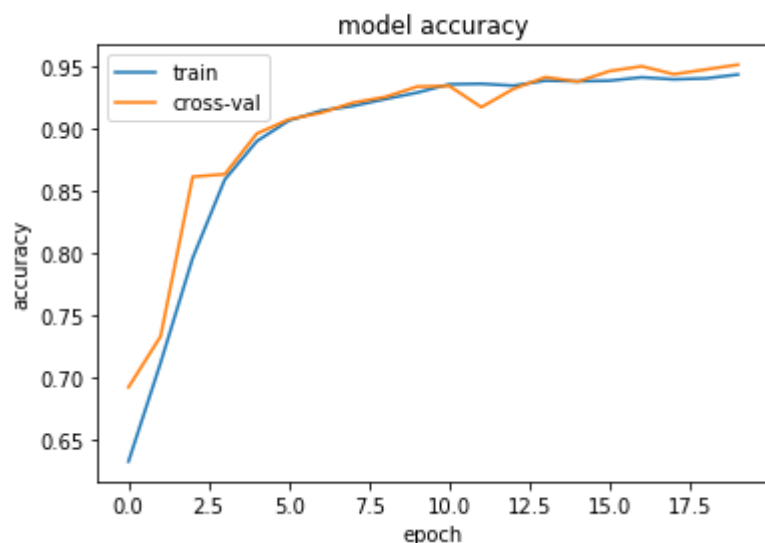
```
517/516 [==============================] - 81s 156ms/step - loss: 0.1773 - acc: 0.9402 -
val_loss: 0.1994 - val_acc: 0.9443
Epoch 19/20
517/516 [==============================] - 83s 160ms/step - loss: 0.1731 - acc: 0.9410 -
val_loss: 0.1590 - val_acc: 0.9481
Epoch 20/20
517/516 [==============================] - 83s 161ms/step - loss: 0.1703 - acc: 0.9441 -
val_loss: 0.1468 - val_acc: 0.9519
```



```
_____
Layer (type)                 Output Shape              Param #
=================================================================
conv2d_2 (Conv2D)            (None, 62, 62, 32)        896
_____
max_pooling2d_2 (MaxPooling2 (None, 31, 31, 32)        0
_____
conv2d_3 (Conv2D)            (None, 29, 29, 32)        9248
_____
max_pooling2d_3 (MaxPooling2 (None, 14, 14, 32)        0
_____
flatten_2 (Flatten)          (None, 6272)              0
_____
dense_3 (Dense)              (None, 128)               802944
_____
dense_4 (Dense)              (None, 1)                 129
=================================================================
Total params: 813,217
Trainable params: 813,217
Non-trainable params: 0
_____
Epoch 1/20
```
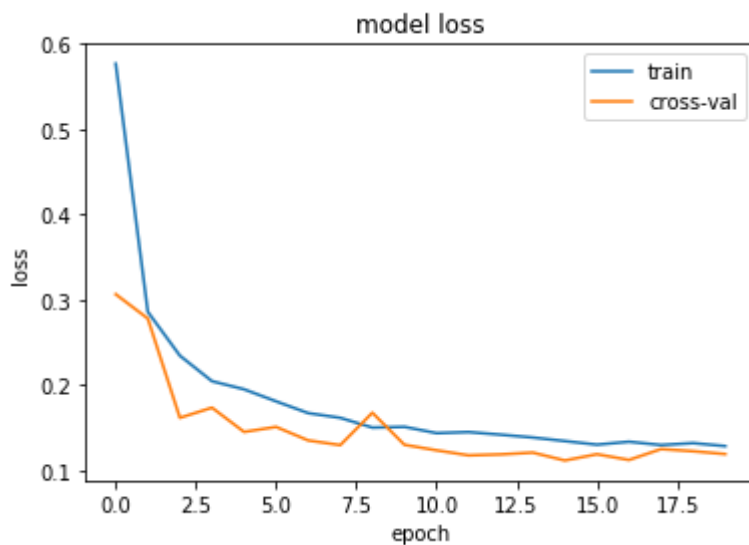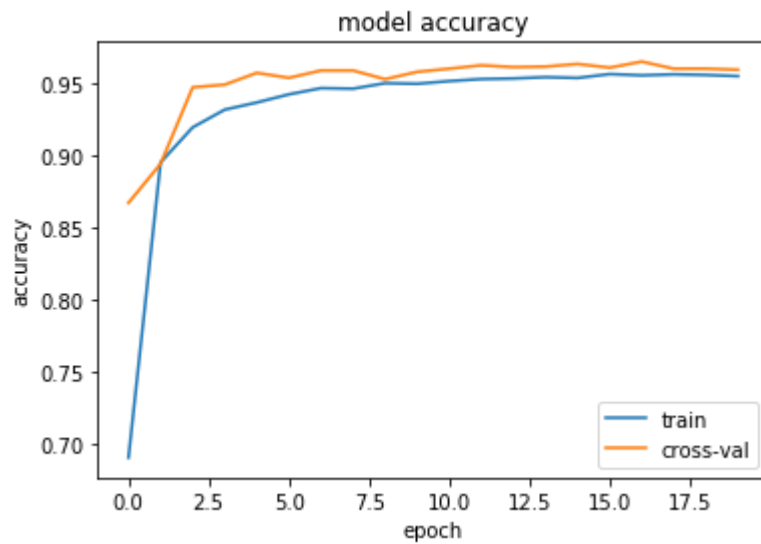
```
517/516 [==============================] - 86s 166ms/step - loss: 0.5763 - acc: 0.6905 -
val_loss: 0.3064 - val_acc: 0.8668
Epoch 2/20
517/516 [==============================] - 86s 166ms/step - loss: 0.2859 - acc: 0.8948 -
val_loss: 0.2780 - val_acc: 0.8939
Epoch 3/20
517/516 [==============================] - 87s 168ms/step - loss: 0.2345 - acc: 0.9191 -
val_loss: 0.1616 - val_acc: 0.9468
Epoch 4/20
517/516 [==============================] - 86s 166ms/step - loss: 0.2045 - acc: 0.9314 -
val_loss: 0.1736 - val_acc: 0.9487
Epoch 5/20
517/516 [==============================] - 98s 189ms/step - loss: 0.1951 - acc: 0.9363 -
val_loss: 0.1452 - val_acc: 0.9568
Epoch 6/20
517/516 [==============================] - 93s 180ms/step - loss: 0.1810 - acc: 0.9419 -
val_loss: 0.1510 - val_acc: 0.9534
Epoch 7/20
517/516 [==============================] - 94s 181ms/step - loss: 0.1671 - acc: 0.9463 -
val_loss: 0.1352 - val_acc: 0.9585
Epoch 8/20
517/516 [==============================] - 92s 177ms/step - loss: 0.1617 - acc: 0.9458 -
val_loss: 0.1297 - val_acc: 0.9585
Epoch 9/20
517/516 [==============================] - 93s 181ms/step - loss: 0.1502 - acc: 0.9497 -
val_loss: 0.1676 - val_acc: 0.9525
Epoch 10/20
517/516 [==============================] - 92s 178ms/step - loss: 0.1510 - acc: 0.9493 -
val_loss: 0.1300 - val_acc: 0.9575
Epoch 11/20
517/516 [==============================] - 87s 169ms/step - loss: 0.1437 - acc: 0.9512 -
val_loss: 0.1236 - val_acc: 0.9597
Epoch 12/20
517/516 [==============================] - 86s 167ms/step - loss: 0.1450 - acc: 0.9525 -
val_loss: 0.1177 - val_acc: 0.9621
Epoch 13/20
517/516 [==============================] - 91s 176ms/step - loss: 0.1421 - acc: 0.9529 -
val_loss: 0.1188 - val_acc: 0.9608
Epoch 14/20
517/516 [==============================] - 91s 175ms/step - loss: 0.1385 - acc: 0.9539 -
val_loss: 0.1209 - val_acc: 0.9612
Epoch 15/20
517/516 [==============================] - 87s 169ms/step - loss: 0.1343 - acc: 0.9533 -
val_loss: 0.1117 - val_acc: 0.9630
Epoch 16/20
517/516 [==============================] - 87s 168ms/step - loss: 0.1303 - acc: 0.9559 -
val_loss: 0.1190 - val_acc: 0.9604
Epoch 17/20
517/516 [==============================] - 89s 173ms/step - loss: 0.1336 - acc: 0.9551 -
val_loss: 0.1123 - val_acc: 0.9646
Epoch 18/20
517/516 [==============================] - 87s 169ms/step - loss: 0.1298 - acc: 0.9558 -
val_loss: 0.1250 - val_acc: 0.9597
Epoch 19/20
517/516 [==============================] - 84s 163ms/step - loss: 0.1324 - acc: 0.9553 -
val_loss: 0.1225 - val_acc: 0.9597
Epoch 20/20
517/516 [==============================] - 88s 169ms/step - loss: 0.1285 - acc: 0.9546 -
val_loss: 0.1192 - val_acc: 0.9590
```

model accuracy

model loss

```
_____
Layer (type)                 Output Shape              Param #
=================================================================
conv2d_4 (Conv2D)            (None, 62, 62, 32)        896
_____
max_pooling2d_4 (MaxPooling2 (None, 31, 31, 32)        0
_____
conv2d_5 (Conv2D)            (None, 29, 29, 32)        9248
_____
max_pooling2d_5 (MaxPooling2 (None, 14, 14, 32)        0
_____
conv2d_6 (Conv2D)            (None, 12, 12, 32)        9248
_____
max_pooling2d_6 (MaxPooling2 (None, 6, 6, 32)          0
_____
flatten_3 (Flatten)          (None, 1152)              0
_____
dense_5 (Dense)              (None, 128)               147584
_____
dense_6 (Dense)              (None, 1)                 129
=================================================================
Total params: 167,105
Trainable params: 167,105
Non-trainable params: 0
_____
Epoch 1/20
517/516 [==============================] - 88s 171ms/step - loss: 0.4944 - acc: 0.7383 -
val_loss: 0.1756 - val_acc: 0.9468
Epoch 2/20
517/516 [==============================] - 87s 167ms/step - loss: 0.1989 - acc: 0.9350 -
val_loss: 0.1545 - val_acc: 0.9505
```
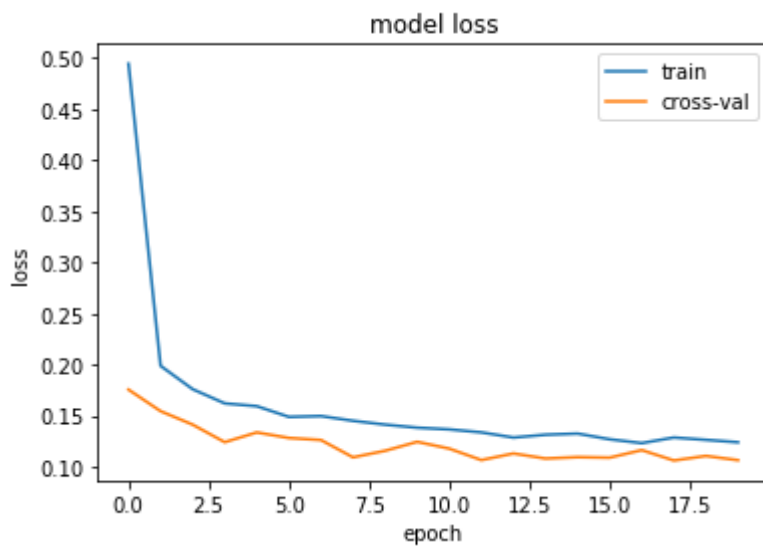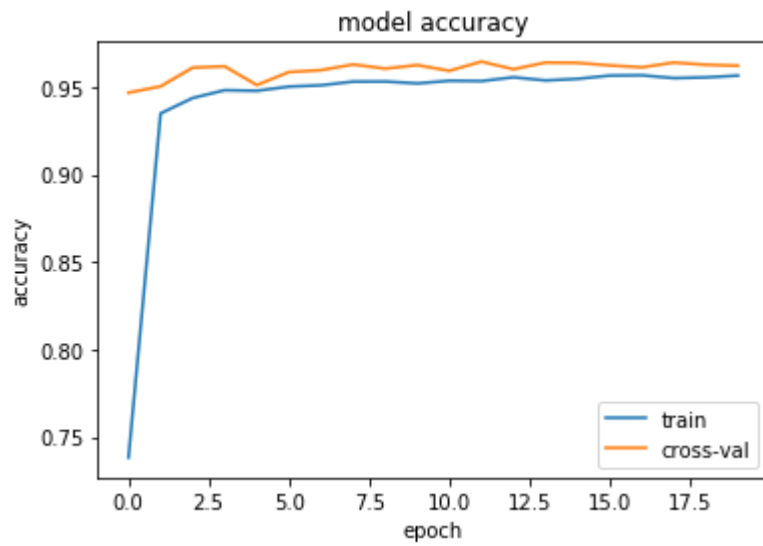
```
Epoch 3/20
517/516 [==============================] - 84s 163ms/step - loss: 0.1759 - acc: 0.9438 -
val_loss: 0.1413 - val_acc: 0.9612
Epoch 4/20
517/516 [==============================] - 87s 168ms/step - loss: 0.1621 - acc: 0.9483 -
val_loss: 0.1241 - val_acc: 0.9619
Epoch 5/20
517/516 [==============================] - 89s 171ms/step - loss: 0.1593 - acc: 0.9479 -
val_loss: 0.1337 - val_acc: 0.9512
Epoch 6/20
517/516 [==============================] - 91s 176ms/step - loss: 0.1488 - acc: 0.9504 -
val_loss: 0.1282 - val_acc: 0.9586
Epoch 7/20
517/516 [==============================] - 87s 169ms/step - loss: 0.1496 - acc: 0.9511 -
val_loss: 0.1262 - val_acc: 0.9597
Epoch 8/20
517/516 [==============================] - 90s 175ms/step - loss: 0.1452 - acc: 0.9532 -
val_loss: 0.1093 - val_acc: 0.9630
Epoch 9/20
517/516 [==============================] - 89s 172ms/step - loss: 0.1413 - acc: 0.9532 -
val_loss: 0.1157 - val_acc: 0.9606
Epoch 10/20
517/516 [==============================] - 87s 169ms/step - loss: 0.1383 - acc: 0.9522 -
val_loss: 0.1245 - val_acc: 0.9626
Epoch 11/20
517/516 [==============================] - 88s 170ms/step - loss: 0.1367 - acc: 0.9537 -
val_loss: 0.1178 - val_acc: 0.9594
Epoch 12/20
517/516 [==============================] - 94s 181ms/step - loss: 0.1336 - acc: 0.9535 -
val_loss: 0.1066 - val_acc: 0.9646
Epoch 13/20
517/516 [==============================] - 91s 175ms/step - loss: 0.1287 - acc: 0.9556 -
val_loss: 0.1130 - val_acc: 0.9603
Epoch 14/20
517/516 [==============================] - 89s 171ms/step - loss: 0.1314 - acc: 0.9538 -
val_loss: 0.1081 - val_acc: 0.9641
Epoch 15/20
517/516 [==============================] - 87s 168ms/step - loss: 0.1324 - acc: 0.9548 -
val_loss: 0.1095 - val_acc: 0.9639
Epoch 16/20
517/516 [==============================] - 89s 172ms/step - loss: 0.1269 - acc: 0.9567 -
val_loss: 0.1090 - val_acc: 0.9624
Epoch 17/20
517/516 [==============================] - 90s 174ms/step - loss: 0.1231 - acc: 0.9568 -
val_loss: 0.1163 - val_acc: 0.9614
Epoch 18/20
517/516 [==============================] - 88s 171ms/step - loss: 0.1287 - acc: 0.9551 -
val_loss: 0.1062 - val_acc: 0.9641
Epoch 19/20
517/516 [==============================] - 85s 164ms/step - loss: 0.1263 - acc: 0.9556 -
val_loss: 0.1106 - val_acc: 0.9628
Epoch 20/20
517/516 [==============================] - 86s 167ms/step - loss: 0.1240 - acc: 0.9566 -
val_loss: 0.1065 - val_acc: 0.9623
```

model accuracy

model loss


```
Layer (type)                 Output Shape              Param #
=================================================================
conv2d_7 (Conv2D)            (None, 62, 62, 32)        896

max_pooling2d_7 (MaxPooling2 (None, 31, 31, 32)        0

conv2d_8 (Conv2D)            (None, 29, 29, 32)        9248

max_pooling2d_8 (MaxPooling2 (None, 14, 14, 32)        0

conv2d_9 (Conv2D)            (None, 12, 12, 32)        9248

max_pooling2d_9 (MaxPooling2 (None, 6, 6, 32)          0

conv2d_10 (Conv2D)           (None, 4, 4, 32)          9248

max_pooling2d_10 (MaxPooling (None, 2, 2, 32)          0

flatten_4 (Flatten)          (None, 128)               0

dense_7 (Dense)              (None, 128)               16512

dense_8 (Dense)              (None, 1)                 129
=================================================================
Total params: 45,281
Trainable params: 45,281
Non-trainable params: 0
```

Epoch 1/20

```
517/516 [==============================] - 88s 170ms/step - loss: 0.3764 - acc: 0.8228 -
val_loss: 0.1531 - val_acc: 0.9525
Epoch 2/20
517/516 [==============================] - 85s 164ms/step - loss: 0.1881 - acc: 0.9400 -
val_loss: 0.1406 - val_acc: 0.9550
Epoch 3/20
517/516 [==============================] - 86s 165ms/step - loss: 0.1656 - acc: 0.9457 -
val_loss: 0.1309 - val_acc: 0.9610
Epoch 4/20
517/516 [==============================] - 87s 168ms/step - loss: 0.1635 - acc: 0.9477 -
val_loss: 0.1241 - val_acc: 0.9630
Epoch 5/20
517/516 [==============================] - 86s 166ms/step - loss: 0.1593 - acc: 0.9488 -
val_loss: 0.1602 - val_acc: 0.9441
Epoch 6/20
517/516 [==============================] - 84s 163ms/step - loss: 0.1543 - acc: 0.9491 -
val_loss: 0.1209 - val_acc: 0.9615
Epoch 7/20
517/516 [==============================] - 87s 168ms/step - loss: 0.1506 - acc: 0.9493 -
val_loss: 0.1299 - val_acc: 0.9579
Epoch 8/20
517/516 [==============================] - 87s 167ms/step - loss: 0.1530 - acc: 0.9481 -
val_loss: 0.1220 - val_acc: 0.9604
Epoch 9/20
517/516 [==============================] - 86s 166ms/step - loss: 0.1489 - acc: 0.9499 -
val_loss: 0.1298 - val_acc: 0.9575
Epoch 10/20
517/516 [==============================] - 86s 166ms/step - loss: 0.1418 - acc: 0.9533 -
val_loss: 0.1196 - val_acc: 0.9623
Epoch 11/20
517/516 [==============================] - 87s 168ms/step - loss: 0.1413 - acc: 0.9510 -
val_loss: 0.1183 - val_acc: 0.9614
Epoch 12/20
517/516 [==============================] - 86s 167ms/step - loss: 0.1426 - acc: 0.9529 -
val_loss: 0.1195 - val_acc: 0.9577
Epoch 13/20
517/516 [==============================] - 84s 163ms/step - loss: 0.1412 - acc: 0.9511 -
val_loss: 0.1166 - val_acc: 0.9619
Epoch 14/20
517/516 [==============================] - 87s 168ms/step - loss: 0.1308 - acc: 0.9549 -
val_loss: 0.1193 - val_acc: 0.9583
Epoch 15/20
517/516 [==============================] - 87s 168ms/step - loss: 0.1355 - acc: 0.9531 -
val_loss: 0.1084 - val_acc: 0.9626
Epoch 16/20
517/516 [==============================] - 85s 164ms/step - loss: 0.1321 - acc: 0.9539 -
val_loss: 0.1095 - val_acc: 0.9635
Epoch 17/20
517/516 [==============================] - 85s 165ms/step - loss: 0.1348 - acc: 0.9537 -
val_loss: 0.1078 - val_acc: 0.9630
Epoch 18/20
517/516 [==============================] - 87s 169ms/step - loss: 0.1281 - acc: 0.9547 -
val_loss: 0.1072 - val_acc: 0.9621
Epoch 19/20
517/516 [==============================] - 86s 166ms/step - loss: 0.1264 - acc: 0.9549 -
val_loss: 0.1050 - val_acc: 0.9623
Epoch 20/20
517/516 [==============================] - 84s 163ms/step - loss: 0.1246 - acc: 0.9574 -
val_loss: 0.1110 - val_acc: 0.9630
```

model accuracy

model loss