MODEL1：

model.add(Conv2D(32, kernel\_size=(3, 3),  
 activation=**'relu'**,  
 input\_shape=(img\_rows, img\_cols, 1)))

model.add(BatchNormalization())  
model.add(Conv2D(32, 3, 3))  
model.add(MaxPooling2D(pool\_size=(2, 2)))  
model.add(Dropout(0.5))

model.add(Flatten())  
model.add(Dense(128, activation=**'relu'**))  
model.add(Dropout(0.5))  
model.add(Dense(nb\_classes))  
model.add(Activation(**'softmax'**))

Layer (type) Output Shape Param #

=================================================================

conv2d\_1 (Conv2D) (None, 198, 198, 32) 320

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

batch\_normalization\_1 (Batch (None, 198, 198, 32) 128

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

conv2d\_2 (Conv2D) (None, 196, 196, 32) 9248

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

max\_pooling2d\_1 (MaxPooling2 (None, 98, 98, 32) 0

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

dropout\_1 (Dropout) (None, 98, 98, 32) 0

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

flatten\_1 (Flatten) (None, 307328) 0

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

dense\_1 (Dense) (None, 128) 39338112

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

dropout\_2 (Dropout) (None, 128) 0

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

dense\_2 (Dense) (None, 8) 1032

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

activation\_1 (Activation) (None, 8) 0

=================================================================

Total params: 39,348,840

Trainable params: 39,348,776

Non-trainable params: 64

806

(806, 40000)

(806,)

('X\_train shape:', (644, 200, 200, 1))

(644, 'train samples')

(162, 'test samples')

Train on 644 samples, validate on 162 samples

1. 81s 125ms/step - loss: 3.8215 - acc: 0.1227 - val\_loss: 2.1070 - val\_acc: 0.1235
2. 77s 119ms/step - loss: 2.0838 - acc: 0.1506 - val\_loss: 2.0843 - val\_acc: 0.1543
3. 74s 114ms/step - loss: 2.0602 - acc: 0.1957 - val\_loss: 2.1294 - val\_acc: 0.2099
4. 74s 114ms/step - loss: 2.0535 - acc: 0.1832 - val\_loss: 2.1410 - val\_acc: 0.1543
5. 73s 113ms/step - loss: 1.9809 - acc: 0.2283 - val\_loss: 2.1918 - val\_acc: 0.1914
6. 71s 110ms/step - loss: 1.9434 - acc: 0.2748 - val\_loss: 2.2569 - val\_acc: 0.0988
7. 71s 111ms/step - loss: 1.8136 - acc: 0.3385 - val\_loss: 2.2861 - val\_acc: 0.1914
8. 71s 110ms/step - loss: 1.7090 - acc: 0.4053 - val\_loss: 2.2431 - val\_acc: 0.1111
9. 77s 120ms/step - loss: 1.5137 - acc: 0.4627 - val\_loss: 2.4372 - val\_acc: 0.1543
10. 74s 114ms/step - loss: 1.3061 - acc: 0.5466 - val\_loss: 2.9246 - val\_acc: 0.2037
11. 73s 113ms/step - loss: 1.2926 - acc: 0.5745 - val\_loss: 3.2231 - val\_acc: 0.1790
12. 74s 115ms/step - loss: 0.9078 - acc: 0.7189 - val\_loss: 3.7410 - val\_acc: 0.2037
13. 74s 115ms/step - loss: 0.8454 - acc: 0.7360 - val\_loss: 3.2786 - val\_acc: 0.1667
14. 73s 114ms/step - loss: 0.5185 - acc: 0.8742 - val\_loss: 3.0377 - val\_acc: 0.1296
15. 72s 112ms/step - loss: 0.3836 - acc: 0.8975 - val\_loss: 2.9963 - val\_acc: 0.1358
16. 73s 114ms/step - loss: 0.2956 - acc: 0.9394 - val\_loss: 3.5479 - val\_acc: 0.1173
17. 74s 115ms/step - loss: 0.2626 - acc: 0.9332 - val\_loss: 3.4757 - val\_acc: 0.0988
18. 73s 114ms/step - loss: 0.1702 - acc: 0.9550 - val\_loss: 3.4981 - val\_acc: 0.1852
19. 73s 113ms/step - loss: 0.1574 - acc: 0.9612 - val\_loss: 3.3616 - val\_acc: 0.1173
20. 73s 113ms/step - loss: 0.1646 - acc: 0.9689 - val\_loss: 3.3494 - val\_acc: 0.0926
21. 72s 111ms/step - loss: 3.0745 - acc: 0.1320 - val\_loss: 2.0930 - val\_acc: 0.1111
22. 75s 116ms/step - loss: 2.0947 - acc: 0.1801 - val\_loss: 2.0789 - val\_acc: 0.2037
23. 78s 121ms/step - loss: 2.0768 - acc: 0.2034 - val\_loss: 2.0956 - val\_acc: 0.1358
24. 69s 106ms/step - loss: 2.0690 - acc: 0.2158 - val\_loss: 2.0811 - val\_acc: 0.1481
25. 72s 112ms/step - loss: 2.0799 - acc: 0.1848 - val\_loss: 2.1567 - val\_acc: 0.1358
26. 69s 108ms/step - loss: 2.0613 - acc: 0.1972 - val\_loss: 2.0753 - val\_acc: 0.1975
27. 73s 113ms/step - loss: 2.0432 - acc: 0.2158 - val\_loss: 2.1099 - val\_acc: 0.1852
28. 72s 112ms/step - loss: 2.0099 - acc: 0.1925 - val\_loss: 2.0967 - val\_acc: 0.2099
29. 72s 112ms/step - loss: 1.9357 - acc: 0.2516 - val\_loss: 2.1147 - val\_acc: 0.1605
30. 74s 114ms/step - loss: 1.8391 - acc: 0.3043 - val\_loss: 2.1740 - val\_acc: 0.1975
31. 70s 109ms/step - loss: 1.7969 - acc: 0.3602 - val\_loss: 2.3966 - val\_acc: 0.0494
32. 70s 109ms/step - loss: 1.6085 - acc: 0.4068 - val\_loss: 2.5280 - val\_acc: 0.1235
33. 71s 110ms/step - loss: 1.2356 - acc: 0.5575 - val\_loss: 2.4312 - val\_acc: 0.1481
34. 71s 110ms/step - loss: 1.0582 - acc: 0.6615 - val\_loss: 2.5721 - val\_acc: 0.1173
35. 72s 113ms/step - loss: 0.7851 - acc: 0.7640 - val\_loss: 3.0208 - val\_acc: 0.1481
36. 71s 110ms/step - loss: 0.5693 - acc: 0.8354 - val\_loss: 2.8057 - val\_acc: 0.1605
37. 72s 111ms/step - loss: 0.3831 - acc: 0.8991 - val\_loss: 3.2680 - val\_acc: 0.1543
38. 70s 109ms/step - loss: 0.2829 - acc: 0.9317 - val\_loss: 3.4204 - val\_acc: 0.1728
39. 71s 110ms/step - loss: 0.2797 - acc: 0.9286 - val\_loss: 3.5963 - val\_acc: 0.1049
40. 71s 110ms/step - loss: 0.2134 - acc: 0.9550 - val\_loss: 3.5321 - val\_acc: 0.1605
41. ('Test score:', 3.532064891155855)
42. ('Test accuracy:', 0.16049382716049382)
43. 108s 167ms/step - loss: 0.1231 - acc: 0.1429 - val\_loss: 0.1093 - val\_acc: 0.0988
44. 102s 158ms/step - loss: 0.1117 - acc: 0.1770 - val\_loss: 0.1092 - val\_acc: 0.2222
45. 97s 150ms/step - loss: 0.1097 - acc: 0.1863 - val\_loss: 0.1093 - val\_acc: 0.1975
46. 107s 166ms/step - loss: 0.1081 - acc: 0.1941 - val\_loss: 0.1093 - val\_acc: 0.1852
47. 99s 154ms/step - loss: 0.1077 - acc: 0.2220 - val\_loss: 0.1092 - val\_acc: 0.1543
48. 99s 153ms/step - loss: 0.1075 - acc: 0.2019 - val\_loss: 0.1093 - val\_acc: 0.1605
49. 99s 153ms/step - loss: 0.1066 - acc: 0.2220 - val\_loss: 0.1092 - val\_acc: 0.1852
50. 97s 150ms/step - loss: 0.1073 - acc: 0.2174 - val\_loss: 0.1094 - val\_acc: 0.1481
51. 96s 149ms/step - loss: 0.1069 - acc: 0.2314 - val\_loss: 0.1093 - val\_acc: 0.1420
52. 101s 157ms/step - loss: 0.1049 - acc: 0.2593 - val\_loss: 0.1093 - val\_acc: 0.1358
53. 101s 156ms/step - loss: 0.1053 - acc: 0.2360 - val\_loss: 0.1092 - val\_acc: 0.1235
54. 100s 156ms/step - loss: 0.1047 - acc: 0.2547 - val\_loss: 0.1091 - val\_acc: 0.1728
55. 100s 155ms/step - loss: 0.1038 - acc: 0.2655 - val\_loss: 0.1089 - val\_acc: 0.1852
56. 100s 155ms/step - loss: 0.1038 - acc: 0.2655 - val\_loss: 0.1089 - val\_acc: 0.1852
57. 102s 159ms/step - loss: 0.1025 - acc: 0.2780 - val\_loss: 0.1091 - val\_acc: 0.1605
58. 99s 154ms/step - loss: 0.1035 - acc: 0.2640 - val\_loss: 0.1091 - val\_acc: 0.2037
59. 97s 151ms/step - loss: 0.1006 - acc: 0.2981 - val\_loss: 0.1094 - val\_acc: 0.1605
60. 106s 164ms/step - loss: 0.1000 - acc: 0.3152 - val\_loss: 0.1093 - val\_acc: 0.2037
61. 104s 162ms/step - loss: 0.0996 - acc: 0.3043 - val\_loss: 0.1098 - val\_acc: 0.1543
62. 100s 155ms/step - loss: 0.0992 - acc: 0.3183 - val\_loss: 0.1099 - val\_acc: 0.1605
63. 100s 155ms/step - loss: 0.0975 - acc: 0.3432 - val\_loss: 0.1117 - val\_acc: 0.2160
64. 98s 153ms/step - loss: 0.0982 - acc: 0.3463 - val\_loss: 0.1097 - val\_acc: 0.1728
65. 99s 154ms/step - loss: 0.0943 - acc: 0.3634 - val\_loss: 0.1125 - val\_acc: 0.1296
66. 99s 154ms/step - loss: 0.0955 - acc: 0.3696 - val\_loss: 0.1140 - val\_acc: 0.2160
67. 98s 152ms/step - loss: 0.0938 - acc: 0.3649 - val\_loss: 0.1121 - val\_acc: 0.2160
68. 101s 157ms/step - loss: 0.0902 - acc: 0.4068 - val\_loss: 0.1127 - val\_acc: 0.1543
69. 101s 157ms/step - loss: 0.0902 - acc: 0.4317 - val\_loss: 0.1128 - val\_acc: 0.1296
70. 100s 156ms/step - loss: 0.0917 - acc: 0.4006 - val\_loss: 0.1139 - val\_acc: 0.0926
71. 99s 154ms/step - loss: 0.0870 - acc: 0.4627 - val\_loss: 0.1138 - val\_acc: 0.1235
72. 100s 155ms/step - loss: 0.0878 - acc: 0.4130 - val\_loss: 0.1154 - val\_acc: 0.1728
73. 100s 156ms/step - loss: 0.0845 - acc: 0.4705 - val\_loss: 0.1160 - val\_acc: 0.1728
74. 100s 155ms/step - loss: 0.0811 - acc: 0.4922 - val\_loss: 0.1189 - val\_acc: 0.2099
75. 100s 156ms/step - loss: 0.0807 - acc: 0.5124 - val\_loss: 0.1176 - val\_acc: 0.1420
76. 99s 154ms/step - loss: 0.0771 - acc: 0.5342 - val\_loss: 0.1172 - val\_acc: 0.1914
77. 99s 154ms/step - loss: 0.0767 - acc: 0.5280 - val\_loss: 0.1156 - val\_acc: 0.1420
78. 101s 157ms/step - loss: 0.0752 - acc: 0.5404 - val\_loss: 0.1200 - val\_acc: 0.1420
79. 100s 155ms/step - loss: 0.0742 - acc: 0.5342 - val\_loss: 0.1194 - val\_acc: 0.1296
80. 100s 155ms/step - loss: 0.0709 - acc: 0.5621 - val\_loss: 0.1201 - val\_acc: 0.1420
81. 99s 154ms/step - loss: 0.0687 - acc: 0.6009 - val\_loss: 0.1236 - val\_acc: 0.1543
82. 99s 154ms/step - loss: 0.0693 - acc: 0.5792 - val\_loss: 0.1222 - val\_acc: 0.0988
83. 100s 155ms/step - loss: 0.0688 - acc: 0.5730 - val\_loss: 0.1249 - val\_acc: 0.1235
84. 103s 160ms/step - loss: 0.0647 - acc: 0.6351 - val\_loss: 0.1222 - val\_acc: 0.1667
85. 100s 155ms/step - loss: 0.0620 - acc: 0.6537 - val\_loss: 0.1220 - val\_acc: 0.1667
86. 96s 149ms/step - loss: 0.0610 - acc: 0.6615 - val\_loss: 0.1268 - val\_acc: 0.2099
87. 104s 162ms/step - loss: 0.0586 - acc: 0.6568 - val\_loss: 0.1195 - val\_acc: 0.1173
88. 98s 153ms/step - loss: 0.0554 - acc: 0.7081 - val\_loss: 0.1227 - val\_acc: 0.1667
89. 98s 153ms/step - loss: 0.0556 - acc: 0.6957 - val\_loss: 0.1227 - val\_acc: 0.0988
90. 100s 155ms/step - loss: 0.0557 - acc: 0.6910 - val\_loss: 0.1270 - val\_acc: 0.1049
91. 99s 153ms/step - loss: 0.0526 - acc: 0.7003 - val\_loss: 0.1213 - val\_acc: 0.1605
92. 99s 153ms/step - loss: 0.0478 - acc: 0.7438 - val\_loss: 0.1305 - val\_acc: 0.1049

('Test score:', 0.1304728173547321)

('Test accuracy:', 0.10493827160493827)

Y prediction

[[ 0.07434587 0.06770271 0.27028343 ..., 0.09965665 0.05106599

0.07326832]

[ 0.01501654 0.06852302 0.24074718 ..., 0.38293791 0.01901244

0.05069768]

[ 0.06502783 0.04878724 0.0732377 ..., 0.03950659 0.03084735

0.26403013]

...,

[ 0.04521906 0.19830893 0.10494161 ..., 0.15319099 0.07780758

0.18505977]

[ 0.02984506 0.00867953 0.09305932 ..., 0.06422432 0.08059774

0.11228412]

[ 0.02285448 0.12648661 0.24824829 ..., 0.14799753 0.06039876

0.08449367]]

y prediction

[3 5 3 5 2 2 3 3 7 3 5 7 2 5 7 3 2 3 2 2 5 2 2 2 2 2 5 7 7 7 2 3 7 2 2 3 3

2 2 2 2 1 3 3 2 2 3 5 2 5 2 2 7 7 5 3 3 2 2 2 7 3 2 7 2 2 2 3 3 7 3 3 3 2

3 2 3 3 5 1 2 5 7 7 2 3 3 2 2 2 2 5 3 2 2 3 2 2 2 5 3 2 2 3 7 7 3 2 2 3 7

2 7 2 3 7 2 2 3 3 5 3 2 3 2 2 2 2 7 7 3 2 2 3 2 3 2 3 3 6 2 2 2 5 2 7 3 7

2 3 5 3 2 5 2 5 7 2 7 1 3 2]

Classification Report:

precision recall f1-score support

class 0(Amusement) 0.00 0.00 0.00 28

class 1(Anger) 0.00 0.00 0.00 15

class 2(Awe) 0.09 0.29 0.13 21

class3(Contentment) 0.09 0.29 0.13 14

class4(Disgust) 0.00 0.00 0.00 11

class5(Excitement) 0.06 0.05 0.05 19

class6(Fear) 1.00 0.05 0.10 20

class7(sad) 0.20 0.15 0.17 34

avg / total 0.19 0.10 0.08 162

Confusion matrix:

[[ 0 0 13 5 0 3 0 7]

[ 0 0 6 4 0 2 0 3]

[ 0 0 6 10 0 2 0 3]

[ 0 0 7 4 0 1 0 2]

[ 0 2 4 2 0 2 0 1]

[ 0 0 9 7 0 1 0 2]

[ 0 0 12 4 0 1 1 2]

[ 0 1 12 10 0 6 0 5]]

1. 129s 201ms/step - loss: 9.4452 - acc: 0.1537 - val\_loss: 2.0785 - val\_acc: 0.1420
2. 115s 178ms/step - loss: 2.0897 - acc: 0.1693 - val\_loss: 2.0760 - val\_acc: 0.2099
3. 116s 179ms/step - loss: 2.0979 - acc: 0.2019 - val\_loss: 2.0762 - val\_acc: 0.2037
4. 112s 174ms/step - loss: 2.0755 - acc: 0.1770 - val\_loss: 2.0736 - val\_acc: 0.2099
5. 106s 165ms/step - loss: 2.0182 - acc: 0.2081 - val\_loss: 2.0733 - val\_acc: 0.1914
6. 114s 177ms/step - loss: 1.9924 - acc: 0.2453 - val\_loss: 2.0747 - val\_acc: 0.1667
7. 107s 166ms/step - loss: 1.9414 - acc: 0.2624 - val\_loss: 2.0730 - val\_acc: 0.2160
8. 112s 174ms/step - loss: 1.8518 - acc: 0.2593 - val\_loss: 2.0648 - val\_acc: 0.2346
9. 111s 173ms/step - loss: 1.7663 - acc: 0.3183 - val\_loss: 2.0707 - val\_acc: 0.2037
10. 112s 173ms/step - loss: 1.6679 - acc: 0.3509 - val\_loss: 2.0710 - val\_acc: 0.1914

Model2

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Layer (type) Output Shape Param #

=================================================================

conv2d\_1 (Conv2D) (None, 198, 198, 32) 320

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

conv2d\_2 (Conv2D) (None, 196, 196, 32) 9248

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

max\_pooling2d\_1 (MaxPooling2 (None, 98, 98, 32) 0

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

dropout\_1 (Dropout) (None, 98, 98, 32) 0

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

flatten\_1 (Flatten) (None, 307328) 0

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

dense\_1 (Dense) (None, 128) 39338112

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

dropout\_2 (Dropout) (None, 128) 0

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

dense\_2 (Dense) (None, 8) 1032

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

activation\_1 (Activation) (None, 8) 0

=================================================================

Total params: 39,348,712

Trainable params: 39,348,712

Non-trainable params: 0

1. 68s 105ms/step - loss: 0.1096 - acc: 0.1398 - val\_loss: 0.1088 - val\_acc: 0.2037
2. 65s 100ms/step - loss: 0.1087 - acc: 0.1988 - val\_loss: 0.1086 - val\_acc: 0.1975
3. 67s 105ms/step - loss: 0.1089 - acc: 0.1848 - val\_loss: 0.1085 - val\_acc: 0.1975
4. 77s 119ms/step - loss: 0.1090 - acc: 0.1832 - val\_loss: 0.1085 - val\_acc: 0.1975
5. 69s 106ms/step - loss: 0.1087 - acc: 0.1786 - val\_loss: 0.1085 - val\_acc: 0.2099
6. 65s 101ms/step - loss: 0.1084 - acc: 0.1894 - val\_loss: 0.1084 - val\_acc: 0.2099
7. 67s 103ms/step - loss: 0.1085 - acc: 0.1957 - val\_loss: 0.1085 - val\_acc: 0.2099
8. 65s 100ms/step - loss: 0.1085 - acc: 0.2019 - val\_loss: 0.1085 - val\_acc: 0.2099
9. 62s 97ms/step - loss: 0.1084 - acc: 0.2096 - val\_loss: 0.1084 - val\_acc: 0.2099
10. 63s 97ms/step - loss: 0.1082 - acc: 0.2003 - val\_loss: 0.1085 - val\_acc: 0.2099
11. 62s 97ms/step - loss: 0.1087 - acc: 0.1894 - val\_loss: 0.1086 - val\_acc: 0.2037
12. 72s 112ms/step - loss: 0.1081 - acc: 0.1988 - val\_loss: 0.1086 - val\_acc: 0.2037
13. 66s 102ms/step - loss: 0.1082 - acc: 0.2034 - val\_loss: 0.1086 - val\_acc: 0.2099
14. 65s 101ms/step - loss: 0.1081 - acc: 0.2065 - val\_loss: 0.1085 - val\_acc: 0.2099
15. 72s 112ms/step - loss: 0.1083 - acc: 0.1925 - val\_loss: 0.1085 - val\_acc: 0.2037
16. 66s 103ms/step - loss: 0.1083 - acc: 0.1755 - val\_loss: 0.1085 - val\_acc: 0.2037
17. 75s 116ms/step - loss: 0.1083 - acc: 0.1925 - val\_loss: 0.1086 - val\_acc: 0.2037
18. 71s 110ms/step - loss: 0.1079 - acc: 0.1941 - val\_loss: 0.1086 - val\_acc: 0.2037
19. 65s 101ms/step - loss: 0.1080 - acc: 0.2003 - val\_loss: 0.1086 - val\_acc: 0.2037
20. 67s 104ms/step - loss: 0.1080 - acc: 0.1879 - val\_loss: 0.1086 - val\_acc: 0.2099

Model3

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Layer (type) Output Shape Param #

=================================================================

conv2d\_1 (Conv2D) (None, 196, 196, 16) 416

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

batch\_normalization\_1 (Batch (None, 196, 196, 16) 64

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

conv2d\_2 (Conv2D) (None, 192, 192, 16) 6416

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

batch\_normalization\_2 (Batch (None, 192, 192, 16) 64

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

average\_pooling2d\_1 (Average (None, 96, 96, 16) 0

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

dropout\_1 (Dropout) (None, 96, 96, 16) 0

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

conv2d\_3 (Conv2D) (None, 94, 94, 32) 4640

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

batch\_normalization\_3 (Batch (None, 94, 94, 32) 128

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

conv2d\_4 (Conv2D) (None, 92, 92, 32) 9248

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

batch\_normalization\_4 (Batch (None, 92, 92, 32) 128

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

average\_pooling2d\_2 (Average (None, 46, 46, 32) 0

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

dropout\_2 (Dropout) (None, 46, 46, 32) 0

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

conv2d\_5 (Conv2D) (None, 44, 44, 64) 18496

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

batch\_normalization\_5 (Batch (None, 44, 44, 64) 256

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

conv2d\_6 (Conv2D) (None, 42, 42, 64) 36928

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

batch\_normalization\_6 (Batch (None, 42, 42, 64) 256

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

max\_pooling2d\_1 (MaxPooling2 (None, 21, 21, 64) 0

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

dropout\_3 (Dropout) (None, 21, 21, 64) 0

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

flatten\_1 (Flatten) (None, 28224) 0

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

dense\_1 (Dense) (None, 128) 3612800

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

dropout\_4 (Dropout) (None, 128) 0

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

dense\_2 (Dense) (None, 8) 1032

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

activation\_1 (Activation) (None, 8) 0

=================================================================

Total params: 3,690,872

Trainable params: 3,690,424

Non-trainable params: 448

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Train on 644 samples, validate on 162 samples

146s 227ms/step - loss: 0.1709 - acc: 0.1475 - val\_loss: 0.1098 - val\_acc: 0.0864

141s 218ms/step - loss: 0.1639 - acc: 0.1366 - val\_loss: 0.1132 - val\_acc: 0.0864

171s 265ms/step - loss: 0.1561 - acc: 0.1444 - val\_loss: 0.1151 - val\_acc: 0.0864

142s 220ms/step - loss: 0.1487 - acc: 0.1584 - val\_loss: 0.1153 - val\_acc: 0.1481

141s 219ms/step - loss: 0.1378 - acc: 0.1429 - val\_loss: 0.1173 - val\_acc: 0.1481

140s 217ms/step - loss: 0.1314 - acc: 0.1382 - val\_loss: 0.1223 - val\_acc: 0.0926

138s 214ms/step - loss: 0.1257 - acc: 0.1289 - val\_loss: 0.1241 - val\_acc: 0.0926

162s 252ms/step - loss: 0.1210 - acc: 0.1242 - val\_loss: 0.1280 - val\_acc: 0.1111

Model4

model = Sequential()  
model.add(Conv2D(32, kernel\_size=(5, 5),activation=**'relu'**,input\_shape=(200, 200, 1)))  
model.add(BatchNormalization())  
model.add(Conv2D(32, kernel\_size=(5, 5),activation=**'relu'**))  
model.add(BatchNormalization())  
model.add(AveragePooling2D(pool\_size=(2, 2)))  
model.add(Dropout(0.5))  
  
  
model.add(Conv2D(64, (3, 3),activation=**'relu'**))  
model.add(BatchNormalization())  
model.add(Conv2D(64, (3, 3),activation=**'relu'**))  
model.add(BatchNormalization())  
model.add(MaxPooling2D(pool\_size=(2, 2)))  
model.add(Dropout(0.5))  
  
model.add(Flatten())  
model.add(Dense(128, activation=**'relu'**))  
model.add(Dropout(0.5))  
model.add(Dense(nb\_classes))  
model.add(Activation(**'softmax'**))

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Layer (type) Output Shape Param #

=================================================================

conv2d\_1 (Conv2D) (None, 196, 196, 32) 832

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

batch\_normalization\_1 (Batch (None, 196, 196, 32) 128

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

conv2d\_2 (Conv2D) (None, 192, 192, 32) 25632

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

batch\_normalization\_2 (Batch (None, 192, 192, 32) 128

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

average\_pooling2d\_1 (Average (None, 96, 96, 32) 0

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

dropout\_1 (Dropout) (None, 96, 96, 32) 0

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

conv2d\_3 (Conv2D) (None, 94, 94, 64) 18496

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

batch\_normalization\_3 (Batch (None, 94, 94, 64) 256

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

conv2d\_4 (Conv2D) (None, 92, 92, 64) 36928

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

batch\_normalization\_4 (Batch (None, 92, 92, 64) 256

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

max\_pooling2d\_1 (MaxPooling2 (None, 46, 46, 64) 0

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

dropout\_2 (Dropout) (None, 46, 46, 64) 0

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

flatten\_1 (Flatten) (None, 135424) 0

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

dense\_1 (Dense) (None, 128) 17334400

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

dropout\_3 (Dropout) (None, 128) 0

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

dense\_2 (Dense) (None, 8) 1032

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

activation\_1 (Activation) (None, 8) 0

=================================================================

Total params: 17,418,088

Trainable params: 17,417,704

Non-trainable params: 384

318s 494ms/step - loss: 0.1697 - acc: 0.1398 - val\_loss: 0.1109 - val\_acc: 0.0864

288s 447ms/step - loss: 0.1576 - acc: 0.1351 - val\_loss: 0.1207 - val\_acc: 0.0864

290s 450ms/step - loss: 0.1253 - acc: 0.1413 - val\_loss: 0.1369 - val\_acc: 0.0864

312s 484ms/step - loss: 0.1134 - acc: 0.1646 - val\_loss: 0.1472 - val\_acc: 0.0864

297s 462ms/step - loss: 0.1106 - acc: 0.1630 - val\_loss: 0.1602 - val\_acc: 0.0864

\_Model5

model = Sequential()  
model.add(Conv2D(32, kernel\_size=(5, 5),activation=**'relu'**,input\_shape=(200, 200, 1)))  
model.add(BatchNormalization())  
model.add(Conv2D(32, kernel\_size=(5, 5),activation=**'relu'**))  
model.add(BatchNormalization())  
model.add(AveragePooling2D(pool\_size=(2, 2)))  
model.add(Dropout(0.5))  
model.add(Flatten())  
model.add(Dense(128, activation=**'relu'**))  
model.add(Dropout(0.5))  
model.add(Dense(nb\_classes))  
model.add(Activation(**'softmax'**))

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Layer (type) Output Shape Param #

=================================================================

conv2d\_1 (Conv2D) (None, 196, 196, 32) 832

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

batch\_normalization\_1 (Batch (None, 196, 196, 32) 128

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

conv2d\_2 (Conv2D) (None, 192, 192, 32) 25632

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

batch\_normalization\_2 (Batch (None, 192, 192, 32) 128

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

average\_pooling2d\_1 (Average (None, 96, 96, 32) 0

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

dropout\_1 (Dropout) (None, 96, 96, 32) 0

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

flatten\_1 (Flatten) (None, 294912) 0

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

dense\_1 (Dense) (None, 128) 37748864

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

dropout\_2 (Dropout) (None, 128) 0

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

dense\_2 (Dense) (None, 8) 1032

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

activation\_1 (Activation) (None, 8) 0

=================================================================

Total params: 37,776,616

Trainable params: 37,776,488

Non-trainable params: 128

1. 238s 369ms/step - loss: 0.1543 - acc: 0.1335 - val\_loss: 0.1095 - val\_acc: 0.2222
2. 218s 339ms/step - loss: 0.1483 - acc: 0.1770 - val\_loss: 0.1095 - val\_acc: 0.1111
3. 215s 333ms/step - loss: 0.1429 - acc: 0.2127 - val\_loss: 0.1090 - val\_acc: 0.1975
4. 220s 342ms/step - loss: 0.1383 - acc: 0.2469 - val\_loss: 0.1102 - val\_acc: 0.1296
5. 217s 336ms/step - loss: 0.1218 - acc: 0.3168 - val\_loss: 0.1107 - val\_acc: 0.1790
6. 212s 329ms/step - loss: 0.1183 - acc: 0.3385 - val\_loss: 0.1107 - val\_acc: 0.1852
7. 220s 342ms/step - loss: 0.1094 - acc: 0.3944 - val\_loss: 0.1103 - val\_acc: 0.1728
8. 221s 343ms/step - loss: 0.1007 - acc: 0.4301 - val\_loss: 0.1097 - val\_acc: 0.1605
9. 218s 338ms/step - loss: 0.0914 - acc: 0.4736 - val\_loss: 0.1115 - val\_acc: 0.1049
10. 216s 336ms/step - loss: 0.0837 - acc: 0.5357 - val\_loss: 0.1107 - val\_acc: 0.0988

model = Sequential()  
model.add(Conv2D(32, kernel\_size=(5, 5),activation=**'relu'**,input\_shape=(200, 200, 1)))  
model.add(Conv2D(32, kernel\_size=(5, 5),activation=**'relu'**))  
model.add(BatchNormalization())  
model.add(MaxPooling2D(pool\_size=(2, 2)))  
model.add(Dropout(0.5))  
model.add(Flatten())  
model.add(Dense(128, activation=**'relu'**))  
model.add(Dropout(0.5))  
model.add(Dense(nb\_classes))  
model.add(Activation(**'softmax'**))

model 6

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Layer (type) Output Shape Param #

=================================================================

conv2d\_1 (Conv2D) (None, 196, 196, 32) 832

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

conv2d\_2 (Conv2D) (None, 192, 192, 32) 25632

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

batch\_normalization\_1 (Batch (None, 192, 192, 32) 128

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

max\_pooling2d\_1 (MaxPooling2 (None, 96, 96, 32) 0

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

dropout\_1 (Dropout) (None, 96, 96, 32) 0

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

flatten\_1 (Flatten) (None, 294912) 0

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

dense\_1 (Dense) (None, 128) 37748864

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

dropout\_2 (Dropout) (None, 128) 0

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

dense\_2 (Dense) (None, 8) 1032

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

activation\_1 (Activation) (None, 8) 0

=================================================================

Total params: 37,776,488

Trainable params: 37,776,424

Non-trainable params: 64

1. 203s 315ms/step - loss: 4.2052 - acc: 0.1196 - val\_loss: 2.0782 - val\_acc: 0.0988
2. 209s 325ms/step - loss: 1.8258 - acc: 0.3634 - val\_loss: 2.0658 - val\_acc: 0.2099
3. 188s 292ms/step - loss: 1.2950 - acc: 0.5807 - val\_loss: 2.0634 - val\_acc: 0.2099
4. 187s 291ms/step - loss: 0.7474 - acc: 0.7811 - val\_loss: 2.0652 - val\_acc: 0.1728
5. 188s 292ms/step - loss: 0.4837 - acc: 0.8929 - val\_loss: 2.0850 - val\_acc: 0.1358
6. 188s 292ms/step - loss: 0.3799 - acc: 0.9022 - val\_loss: 2.0922 - val\_acc: 0.1420
7. 187s 290ms/step - loss: 0.3397 - acc: 0.9146 - val\_loss: 2.0826 - val\_acc: 0.1975
8. 183s 284ms/step - loss: 0.1854 - acc: 0.9503 - val\_loss: 2.0817 - val\_acc: 0.1543
9. 180s 280ms/step - loss: 0.2534 - acc: 0.9441 - val\_loss: 2.0847 - val\_acc: 0.1790
10. 180s 280ms/step - loss: 0.2192 - acc: 0.9565 - val\_loss: 2.0942 - val\_acc: 0.1852
11. 181s 281ms/step - loss: 0.1880 - acc: 0.9550 - val\_loss: 2.1020 - val\_acc: 0.2099
12. 178s 276ms/step - loss: 0.1491 - acc: 0.9658 - val\_loss: 2.1039 - val\_acc: 0.1420
13. 192s 298ms/step - loss: 0.1303 - acc: 0.9705 - val\_loss: 2.1535 - val\_acc: 0.1481
14. 188s 292ms/step - loss: 0.1260 - acc: 0.9705 - val\_loss: 2.1232 - val\_acc: 0.1235
15. 202s 313ms/step - loss: 0.1046 - acc: 0.9689 - val\_loss: 2.1450 - val\_acc: 0.1790
16. 190s 295ms/step - loss: 0.1677 - acc: 0.9643 - val\_loss: 2.1444 - val\_acc: 0.1543
17. 191s 296ms/step - loss: 0.1524 - acc: 0.9581 - val\_loss: 2.3141 - val\_acc: 0.1605
18. 190s 295ms/step - loss: 0.1570 - acc: 0.9612 - val\_loss: 2.4252 - val\_acc: 0.1173
19. 188s 292ms/step - loss: 0.1506 - acc: 0.9674 - val\_loss: 2.3265 - val\_acc: 0.1235
20. 185s 287ms/step - loss: 0.1301 - acc: 0.9767 - val\_loss: 2.4124 - val\_acc: 0.1543

('Test score:', 2.4123531947901218)

('Test accuracy:', 0.15432098765432098)

Y prediction

[[ 0.08323497 0.1893782 0.07393295 ..., 0.04917811 0.2087048

0.17834514]

[ 0.0285863 0.01852262 0.07443601 ..., 0.51873422 0.11395542

0.20195743]

[ 0.17526972 0.05723434 0.07528937 ..., 0.07841302 0.08621927

0.21887662]

...,

[ 0.06909663 0.15555167 0.05814102 ..., 0.08051468 0.17325436

0.30007997]

[ 0.12441353 0.12380978 0.08498745 ..., 0.18330389 0.16137204

0.1811828 ]

[ 0.12236235 0.15225707 0.16047679 ..., 0.08574443 0.15089321

0.13368964]]

y prediction

[6 5 7 0 7 6 2 5 7 1 7 6 6 6 1 6 1 2 4 6 6 5 7 1 7 1 5 6 7 7 3 6 5 7 2 5 7

5 2 1 2 7 5 6 3 6 0 1 2 7 6 0 7 1 7 2 7 7 2 6 7 3 7 7 6 6 0 2 3 6 7 5 0 7

1 7 6 7 7 1 1 7 7 1 6 7 6 7 0 5 7 6 2 1 6 7 7 6 2 6 5 1 6 1 1 7 7 0 1 2 7

0 6 6 1 7 7 2 1 6 7 7 2 7 2 7 1 7 7 7 6 5 7 6 0 7 2 6 6 6 2 1 1 5 1 7 1 7

0 6 1 7 1 1 2 1 7 1 7 7 5 2]

Classification Report:

precision recall f1-score support

class 0(Amusement) 0.10 0.04 0.05 28

class 1(Anger) 0.07 0.13 0.09 15

class 2(Awe) 0.11 0.10 0.10 21

class3(Contentment) 0.00 0.00 0.00 14

class4(Disgust) 0.00 0.00 0.00 11

class5(Excitement) 0.14 0.11 0.12 19

class6(Fear) 0.15 0.25 0.19 20

class7(sad) 0.25 0.38 0.31 34

avg / total 0.13 0.15 0.13 162

Confusion matrix:

[[ 1 8 3 1 0 4 3 8]

[ 1 2 2 0 0 1 2 7]

[ 2 2 2 1 0 3 6 5]

[ 1 2 3 0 0 2 3 3]

[ 0 3 2 0 0 2 0 4]

[ 1 3 4 0 0 2 4 5]

[ 2 4 1 1 1 0 5 6]

[ 2 5 2 1 0 0 11 13]]