PROJECT REPORT: C S 487/519 Applied Machine Learning I

Project 7: Convolutional Neural Networks

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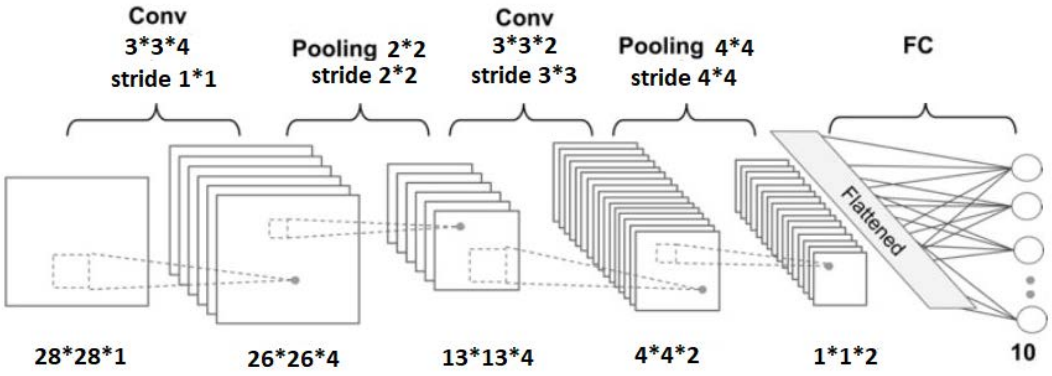
Question 1: CNN Architecture



Question 2:

The dimensions of the tensors in each layer are as follows:

- Input: [100 × 28 × 28 × 1]
- Conv_1: [100 × 26 × 26 × 4]
- Pooling_1: [100 × 13 × 13 × 4]
- Conv_2: [100 × 4 × 4 × 2]
- Pooling_2: [100 × 1 × 1 × 2]
- FC_1: [100 ×10]

Analysis:

Accuracy (%)	
Default	22.07
Changed kernel size of both conv layers to 2*2	15.83
Changed the pooling size of both max pooling layers to 2*2	21.35
Used average pooling instead of max pooling	19.24

Since we are only changing the kernel and pooling sizes without changing the output channel size and strides, we are always getting worse accuracy.

Outputs:

Default options:

```
Epoch 01: Training Avg. Loss: 1167.036 Validation Acc:   0.110
Epoch 02: Training Avg. Loss: 1152.080 Validation Acc:   0.100
Epoch 03: Training Avg. Loss: 1148.860 Validation Acc:   0.070
Epoch 04: Training Avg. Loss: 1147.251 Validation Acc:   0.100
Epoch 05: Training Avg. Loss: 1145.887 Validation Acc:   0.110
Epoch 06: Training Avg. Loss: 1144.137 Validation Acc:   0.090
Epoch 07: Training Avg. Loss: 1141.767 Validation Acc:   0.140
Epoch 08: Training Avg. Loss: 1139.107 Validation Acc:   0.110
Epoch 09: Training Avg. Loss: 1136.457 Validation Acc:   0.140
Epoch 10: Training Avg. Loss: 1133.938 Validation Acc:   0.180
Epoch 11: Training Avg. Loss: 1131.244 Validation Acc:   0.110
Epoch 12: Training Avg. Loss: 1127.391 Validation Acc:   0.130
Epoch 13: Training Avg. Loss: 1119.400 Validation Acc:   0.180
Epoch 14: Training Avg. Loss: 1109.927 Validation Acc:   0.130
Epoch 15: Training Avg. Loss: 1100.909 Validation Acc:   0.210
Epoch 16: Training Avg. Loss: 1091.076 Validation Acc:   0.220
Epoch 17: Training Avg. Loss: 1082.063 Validation Acc:   0.180
Epoch 18: Training Avg. Loss: 1074.683 Validation Acc:   0.180
Epoch 19: Training Avg. Loss: 1068.533 Validation Acc:   0.220
Epoch 20: Training Avg. Loss: 1063.202 Validation Acc:   0.260
```

Changed kernel size of both conv layers to 2*2:

```
Epoch 01: Training Avg. Loss: 1173.096 Validation Acc:   0.080
Epoch 02: Training Avg. Loss: 1157.969 Validation Acc:   0.080
Epoch 03: Training Avg. Loss: 1153.586 Validation Acc:   0.130
Epoch 04: Training Avg. Loss: 1151.539 Validation Acc:   0.070
Epoch 05: Training Avg. Loss: 1150.496 Validation Acc:   0.150
Epoch 06: Training Avg. Loss: 1149.985 Validation Acc:   0.120
Epoch 07: Training Avg. Loss: 1149.526 Validation Acc:   0.140
Epoch 08: Training Avg. Loss: 1149.130 Validation Acc:   0.110
Epoch 09: Training Avg. Loss: 1148.692 Validation Acc:   0.070
Epoch 10: Training Avg. Loss: 1148.212 Validation Acc:   0.130
Epoch 11: Training Avg. Loss: 1147.633 Validation Acc:   0.100
Epoch 12: Training Avg. Loss: 1146.940 Validation Acc:   0.090
Epoch 13: Training Avg. Loss: 1146.007 Validation Acc:   0.080
Epoch 14: Training Avg. Loss: 1144.823 Validation Acc:   0.080
Epoch 15: Training Avg. Loss: 1143.624 Validation Acc:   0.070
Epoch 16: Training Avg. Loss: 1142.477 Validation Acc:   0.140
Epoch 17: Training Avg. Loss: 1141.404 Validation Acc:   0.120
Epoch 18: Training Avg. Loss: 1140.394 Validation Acc:   0.140
Epoch 19: Training Avg. Loss: 1139.261 Validation Acc:   0.150
Epoch 20: Training Avg. Loss: 1138.055 Validation Acc:   0.140
```

Changed the pooling size of both max pooling layers to 2*2:

```
Epoch 01: Training Avg. Loss: 1158.554 Validation Acc:   0.120
Epoch 02: Training Avg. Loss: 1146.845 Validation Acc:   0.140
Epoch 03: Training Avg. Loss: 1136.275 Validation Acc:   0.120
Epoch 04: Training Avg. Loss: 1124.303 Validation Acc:   0.120
Epoch 05: Training Avg. Loss: 1112.786 Validation Acc:   0.120
Epoch 06: Training Avg. Loss: 1103.734 Validation Acc:   0.140
Epoch 07: Training Avg. Loss: 1097.422 Validation Acc:   0.200
Epoch 08: Training Avg. Loss: 1093.073 Validation Acc:   0.160
Epoch 09: Training Avg. Loss: 1089.934 Validation Acc:   0.150
Epoch 10: Training Avg. Loss: 1087.475 Validation Acc:   0.170
Epoch 11: Training Avg. Loss: 1085.176 Validation Acc:   0.250
Epoch 12: Training Avg. Loss: 1083.002 Validation Acc:   0.190
Epoch 13: Training Avg. Loss: 1081.207 Validation Acc:   0.210
Epoch 14: Training Avg. Loss: 1079.560 Validation Acc:   0.250
Epoch 15: Training Avg. Loss: 1078.047 Validation Acc:   0.160
Epoch 16: Training Avg. Loss: 1076.638 Validation Acc:   0.180
Epoch 17: Training Avg. Loss: 1075.309 Validation Acc:   0.270
Epoch 18: Training Avg. Loss: 1074.050 Validation Acc:   0.150
Epoch 19: Training Avg. Loss: 1072.846 Validation Acc:   0.270
Epoch 20: Training Avg. Loss: 1071.708 Validation Acc:   0.180
```

Used average pooling instead of max pooling:

```
Epoch 01: Training Avg. Loss: 1152.425 Validation Acc:   0.130
Epoch 02: Training Avg. Loss: 1151.077 Validation Acc:   0.080
Epoch 03: Training Avg. Loss: 1150.208 Validation Acc:   0.070
Epoch 04: Training Avg. Loss: 1149.221 Validation Acc:   0.080
Epoch 05: Training Avg. Loss: 1147.985 Validation Acc:   0.100
Epoch 06: Training Avg. Loss: 1146.437 Validation Acc:   0.080
Epoch 07: Training Avg. Loss: 1144.715 Validation Acc:   0.120
Epoch 08: Training Avg. Loss: 1142.840 Validation Acc:   0.080
Epoch 09: Training Avg. Loss: 1140.565 Validation Acc:   0.110
Epoch 10: Training Avg. Loss: 1137.426 Validation Acc:   0.140
Epoch 11: Training Avg. Loss: 1133.769 Validation Acc:   0.100
Epoch 12: Training Avg. Loss: 1130.054 Validation Acc:   0.120
Epoch 13: Training Avg. Loss: 1126.554 Validation Acc:   0.160
Epoch 14: Training Avg. Loss: 1123.227 Validation Acc:   0.120
Epoch 15: Training Avg. Loss: 1119.979 Validation Acc:   0.130
Epoch 16: Training Avg. Loss: 1116.815 Validation Acc:   0.090
Epoch 17: Training Avg. Loss: 1113.731 Validation Acc:   0.220
Epoch 18: Training Avg. Loss: 1110.724 Validation Acc:   0.130
Epoch 19: Training Avg. Loss: 1107.799 Validation Acc:   0.190
Epoch 20: Training Avg. Loss: 1104.921 Validation Acc:   0.230
```