COS 470 Image Processing and Computer Vision
2024 Fall
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Assignment 4, by hand and code it

Task 1: Calculate output feature map of convolutional layer.
Input feature map = (5*5*4), two kernels (3*3*4), stride = 1, zero padding = 1

A1:

```
Output Feature Map:
[[[ 4.9725  6.9513  6.1706  5.7381  3.4951]
  [ 6.8526 10.5711 10.2292  9.7639  5.5365]
  [ 5.5251 10.2092  8.9023  8.5254  5.5636]
  [ 5.7728  9.6222  9.3598  9.8063  5.1873]
  [ 4.5553  5.2176  5.8535  6.0835  3.4729]]

 [[ 5.4377  7.9858  7.8342  6.861   4.5219]
  [ 7.3113 11.0963 10.3422  9.8995  5.9103]
  [ 6.3227  8.7658  9.6644  9.7349  5.6939]
  [ 6.8362  9.3026  9.4238 10.1539  5.4661]
  [ 4.3696  5.396   4.1176  4.084   3.3017]]]
```

Task 2: Calculate output feature map of pooling layers for average and max pooling.
Input feature map = 9*9*1, filter size = 3, stride = 3

A2:

```
Max Pooling:
[[0.86 0.99 0.99]
 [0.97 0.88 0.98]
 [0.89 0.78 1.  ]]

Average Pooling:
[[0.508 0.511 0.589]
 [0.417 0.404 0.628]
 [0.564 0.412 0.679]]
```

Task 3: Calculate output vector of fully connected layers. Do not consider activation function.

A3:

```
Intermediate Vector:
[3.1, 4.2, 5.8, 0.1]

Output Vector:
[5.68, 2.32]
```

Task 4: Calculate output dimensions and number of parameters
Q4.1: convolutional layer, input 64*64*10, 100 kernels, kernel size 7*7, stride = 1, zero padding = 1. Find size of output feature map and calculate the number of parameters in the layer.

A4.1:

input map: W1, H1, D1
output map: W2, H2, D2
number of kernels, K
kernel size, F*F
stride, S
amount of zero padding, P
W2 = ((W1 - F + 2P) / S) + 1, H2 = ((H1 - F + 2P) / S) + 1, D2 = K
W2 = ((64 - 7 + 1*1) / 1) + 1, H2 = ((64 - 7 + 1*1) / 1) + 1, D2 = 100
output map size: (59, 59, 100)
(F*F*D1 + 1) * K
(7*7*10 + 1) * 100
49,100 total parameters

Q4.2: fully connected layer, input 1*1024, 512 neurons. Find size of output vector and calculate the number of parameters in the layer.

A4.2:

output vector = 1 * # neurons
output vector: (1*512)
number of parameters = inputs * neurons + bias
bias = total # neurons
number of parameters: 1024 * 512 + 512 = 524,800 parameters