Homework 2

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Theory

Problem 1.1: Convolutional Neural Netoworks

1. Given an input image of dimension 21×12, what will be output dimension after applying a convolution with 4×5 kernel, stride of 4, and no padding?

   5×2

2. Given an input of dimension $C \times H \times W$ what will be the dimension of the output of a convolutional layer with kernel of size $K \times K$, padding P, stride S, dilation D, and F filters. Assume that H $\geq$ K, W $\geq$ K.

Define Padding along height on top P_{H1}

Define Padding along height on bottom P_{H2}

Define Padding along width on left P_{W1}

Define Padding along width on right P_{W2}

Define Kernel width K_H

Define Kernel height K_W

Define Stride horizontal S_W

Define Stride vertical S_H

Define Batch Count B

Effect of adding padding and applying kernel to dimensions:

$$\begin{aligned} H_P &= P_{H1} + P_{H2} + H \\ W_P &= P_{W1} + P_{W2} + W \\ H_{PK} &= H_1 - [D_H(K_H - 1) + 1] \\ &= P_{H1} + P_{H2} + H - [D_H(K_H - 1) + 1] \\ W_{PK} &= W_1 - [D_W(K_W - 1) + 1] \\ &= P_{W1} + P_{W2} + W - [D_W(K_W - 1) + 1] \end{aligned}$$

Considering stride to dimensions:

$$\begin{aligned} H_{PKS} &= \left\lfloor \frac{H_P - [D_H(K_H - 1) + 1] + S_H}{S_H} \right\rfloor \\ &= \left\lfloor \frac{P_{H1} + P_{H2} + H - [D_H(K_H - 1) + 1]}{S_H} \right\rfloor + 1 \\ W_{PKS} &= \left\lfloor \frac{W_P - [D_W(K_W - 1) + 1] + S_W}{S_W} \right\rfloor \\ &= \left\lfloor \frac{P_{W1} + P_{W2} + W - [D_W(K_W - 1) + 1]}{S_W} \right\rfloor + 1 \end{aligned}$$

We can make simplifcations that I think are implied here:

$$
\begin{aligned}
S &= S_W = S_H \\
D &= D_W = D_H \\
K &= K_W = K_H \\
B &= 1 \\
P &= P_{W1} + P_{W2} = P_{H1} + P_{H2}
\end{aligned}
$$

$$
\begin{aligned}
W &= \frac{2P + W - [D(K-1)+1]}{S} + 1 \\
H &= \frac{2P + H - [D(K-1)+1]}{S} + 1
\end{aligned}
$$

Thus the output dimension is:

$$
F \times \left(\left\lfloor \frac{2P + H - [D(K-1)+1]}{S} \right\rfloor + 1 \right) \times \left(\left\lfloor \frac{2P + W - [D(K-1)+1]}{S} \right\rfloor + 1 \right)
$$

3. Write d
4. Show

Problem 1.2: Recurrent Neural Networks

$\sigma(z) = \frac{1}{1+\exp(-z)}$.

1. If you want
2. Now

Problem 1.3: Debugging Loss Curves

1. Why is softmax actually softargmax?