Prob 3-C-(2)

Performances using different configurations

todo: past your performance v.s different network configurations in a table.

epoch = 30	conv layer	kernel size	stride	dilation	dropout	performance on cifar_test_loader
LeNet-5	2	5x5	1x1	1x1	0%	64.39%
model_1	2	3x3	1x1	1x1	30%	73.56%
model_2	9	3x3	1x1	1x1	30%	80.13%
model_3	2	5x5	1x1	1x1	0%	70.77%
model_4	5	3x3	1x1	1x1	0%	79.37%
model_5	5	3x3	1x1	1x1	30%	80.39%

LeNet-5 and model_3 has different architecture,

1. LeNet-5 has three fully connected layers and uses Sigmoid activation function
2. model_3 has two fully connected layers and uses ReLU activation function

Prob 3-(b) Dicussion

Discussion

(1) Which framework can achieve higher accuracy, MLP or CNN? Briefly explain the reason.

(2) Based on your experiments in Problem3, which parameter can potentially affect your performance most?

1. CNNs generally achieve higher accuracy than MLPs in image recognition tasks because they can learn spatial features through convolutional layers and pooling operations. MLPs, on the other hand, treat input data as a flat vector and do not exploit the inherent spatial structure of images.
2. the number of convolution layers affects the most

Prob 4-1.

$$\frac{\partial E_{total}}{\partial out_{o1}} = -(target_{o1} - out_{o1}) \qquad \frac{\partial E_{total}}{\partial out_{o2}} = -(target_{o2} - out_{o2})$$

$$\frac{\partial E_{total}}{\partial w_5} = \frac{\partial E_{total}}{\partial out_{o1}} \times \frac{\partial out_{o1}}{\partial net_{o1}} \times \frac{\partial net_{o1}}{\partial w_5} = -(target_{o1} - out_{o1}) \times [out_{o1} \times (1 - out_{o1})] \times out_{h1}$$

$$\doteqdot 0.08217$$

$$\frac{\partial E_{total}}{\partial w_7} = \frac{\partial E_{total}}{\partial out_{o2}} \times \frac{\partial out_{o2}}{\partial net_{o2}} \times \frac{\partial net_{o2}}{\partial w_7} = -(target_{o2} - out_{o2}) \times \overset{0.1868}{[out_{o2} \times (1 - out_{o2})]} \times \overset{0.5933}{out_{h1}}$$

$$\doteqdot -0.0226$$

$$w_5^+ = w_5 - \eta \times \frac{\partial E_{total}}{\partial w_5} = 0.4 - 0.5 \times 0.08217 \doteqdot 0.3589$$

$$w_7^+ = w_7 - \eta \times \frac{\partial E_{total}}{\partial w_7} = 0.5 - 0.5 \times -0.0226 \doteqdot 0.613$$

$$\frac{\partial E_{total}}{\partial out_{h1}} = \sum_{k=1}^{2} \frac{\partial E_{\text{總}}}{\partial O_k} \times \frac{\partial O_k}{\partial out_{h1}} = \frac{\partial E_{\text{總}}}{\partial O_1} \times \frac{\partial O_1}{\partial out_{h1}} + \frac{\partial E_{\text{總}}}{\partial O_2} \times \frac{\partial O_2}{\partial out_{h2}}$$

$$= \frac{\partial E_{\text{總}}}{\partial out_{o1}} \times \frac{\partial out_{o1}}{\partial net_{o1}} \times \frac{\partial net_{o1}}{\partial out_{h1}} + \frac{\partial E_{\text{總}}}{\partial out_{o2}} \times \frac{\partial out_{o2}}{\partial net_{o2}} \times \frac{\partial net_{o2}}{\partial out_{h1}}$$

$$= -(target_{o1} - out_{o1}) \times [out_{o1} \times (1 - out_{o1})] \times w_5 + [-(target_{o2} - out_{o2}) \times [out_{o2} \times (1 - out_{o2})]] \times w_7$$

$$= 0.7414 \times 0.1868 \times 0.4 + (-0.21707) \times 0.1755 \times 0.5$$

$$\doteqdot 0.037$$

Since $out_{h1} = \frac{1}{1 + e^{-net_{h1}}}$ and $net_{h1} = w_1 \times i_1 + w_2 \times i_2 + b_1 \times 1$

$$\Rightarrow \frac{\partial E_{total}}{\partial w_2} = \frac{\partial E_{total}}{\partial out_{h1}} \times \frac{\partial out_{h1}}{\partial net_{h1}} \times \frac{\partial net_{h1}}{\partial w_2} = 0.037 \times [out_{h1} \times (1 - out_{h1})] \times out\ i_2 \doteqdot 0.00089$$

$$w_2^+ = w_2 - \eta \times \frac{\partial E_{total}}{\partial w_2} = 0.2 - 0.5 \times 0.00089 \doteqdot 0.199555$$

Prob4-2

layer	# filters	filter size	Weight	Tensor size	Bias	Parameters
Conv1	128	1x1	1x1x192x128	28x28x128	128	24704
Conv2	32	1x1	1x1x128x32	28x28x32	32	4128
Max pool	X					
Conv3	64	1x1	1x1x32x64	28x28x64	64	2112
Conv4	128	3x3	3x3x64x128	28x28x128	128	73856
Conv5	32	5x5	5x5x128x32	28x28x32	32	102432
Conv6	32	1x1	1x1x32x32	28x28x32	32	1056

Parameters = 24704 + 4128 + 2112 + 73856 + 102432 + 1056 = 208288 ※

Line 1: $(1\times1\times192\times64)\times256 = 3145728$

Line 2: $(1\times1\times192\times128)+(3\times3\times128\times128) = 172032$

Line 3: $(1\times1\times192\times32)+(5\times5\times32\times32) = 31744$

Line 4: $1\times1\times192\times32 = 6144$

Connections = 3145728 + 172032 + 31744 + 6144 = 3355648 ※