University of Dayton, Dept. of ECE

ECE 595-Quiz 2

Date: Thursday, July 20, 2023

Question 1

1. What is the Wiener filter's objective function for image restoration?

   (a) To minimize the mean squared error between the original and the restored image.

   (b) To maximize the signal-to-noise ratio of the degraded image.

   (c) To minimize the total variation of the restored image.

   (d) To maximize the peak signal-to-noise ratio (PSNR) of the restored image.

2. Let X be a continuous random variable with cumulative distribution function $F_X(x)$ and Y be another random variable given by $Y = F_X(X)$. Then the distribution of Y will be

   (a) dependant on the distribution of X.

   (b) uniform in [0, 1].

   (c) standard normal distribution.

   (d) normal distribution with mean and standard deviation equal to that of X.

3. A common activation function is the sigmoid function $\sigma(x) = \frac{1}{1+e^{-x}}$. If $\sigma^{'}(x)$ is the derivative of $\sigma(x)$, The value of $\sigma(0)$ and $\sigma^{'}(0)$ will be

   (a) $0.5, 1$

   (b) $0.5, 0.25$

   (c) $0.5, 0.5$

   (d) $0.25, 0.5$

4. Which of the following has range of values from [-1,1]

   (a) Relu

   (b) Leaky Relu

   (c) Sigmoid

   (d) None of the above

5. If X is a random variable with mean = μ and standard deviation = σ, Which of the following random variable will have mean = 0 and standard deviation = 1?

   (a) $\frac{X-\mu}{\sigma^2}$

   (b) $\frac{X-\mu}{\sigma}$

   (c) $\frac{X-\mu}{2\sigma}$

   (d) $X - \mu$

Question 2

Let's consider a simple convolutional neural network designed to perform image classification on the CIFAR-10 dataset (a well-known dataset containing 32×32 color images in 10 different classes). The architecture of our proposed network is shown in Figure 1.

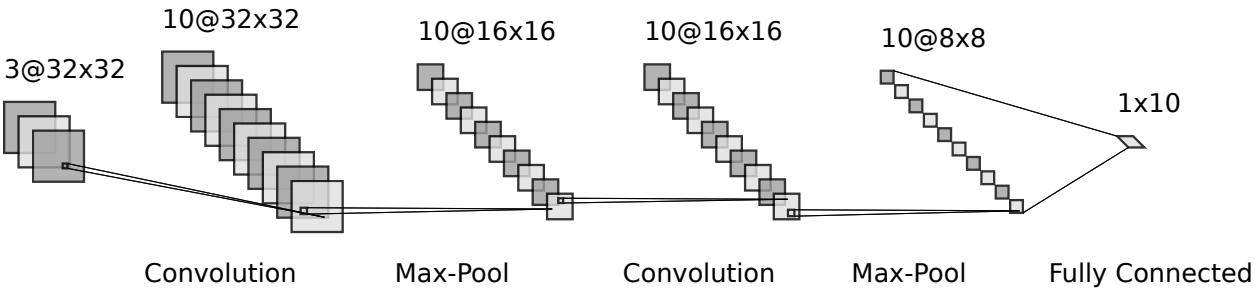

Figure 1: *A simple convolutional neural network for image classification. Note that $Z@X \times Y$ refers to the dimensions at a particular layer, where X represents width, Y represents height, and Z represents depth.*

This convolutional neural network takes as input a 32×32 RGB image, and outputs a vector of length 10. It does so by interleaving a series of convolution operations and max-pooling operations, followed by a single fully connected layer.

1. What is the kernel size used for the convolution operations in Figure 1 (assuming that we used a stride of 1 and padding 2)? What about the kernel size used for the max-pooling operations (assuming that we used a stride of 2 and padding 0)?

2. What are the number of learnable parameters (weights and biases) in this network? Make sure to explain how you reached your answer.

3. Suppose a softmax layer is connected to the output layer and and for a given input image, all the 10 input values to the softmax layer is 25, what is the output of this layer?