UNIT 7 ASSIGNMENT

Deep Learning and Computer Vision

## Instructions

The questions below will prepare you for future interviews as they relate to concepts discussed throughout the week. You’ve practiced these concepts in the coding activities, exercises and coding portion of the assignment. Now, let’s formulate your programming into well-thought responses.

Except as indicated, use this document to record all your assignment work and responses to any questions. At a minimum, you will need to turn in a digital copy of this document to your facilitator as part of your assignment completion. You may also have additional supporting documents that you will need to submit. Your facilitator will provide feedback to help you work through your findings.

**Note:** Though your work will only be seen by those grading the course and will not be used or shared outside the course, you should take care to obscure any information you feel might be of a sensitive or confidential nature.

*Begin your assignment by completing the questions below. Directions to submit your work can be found on the assignment page. Information about the grading rubric is available on any of the course assignment pages online. Do not hesitate to contact your facilitator if you have any questions about the assignment.*

Unit 7 Written Portion

# Implementing Neural Networks

Answer the questions below about deep learning and computer vision.

## Questions:

1. What is deep learning? List some real-word applications of deep learning.

| Deep learning is a subset of machine learning and artificial intelligence that uses neural networks with many hidden layers to solve complex problems. These include natural language processing problems such as text analysis and voice recognition, and computer vision problems such as image classification. |
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1. Compare and contrast a neural network to a linear model such as logistic regression. What are the advantages of using a neural network instead of a linear model?

| Neural networks are similar to linear models such as a logistic regression. They have a series of inputs (features) and weights associated with these inputs. The sum of those weights multiplied by the feature values derives a label. Linear models learn one weighted function (or one line) that can be used as a model to make predictions. Neural networks, on the other hand, use many linear functions pieced together by nonlinear activation functions, so that the combination of all the linear functions is nonlinear. This method is more flexible because it allows data to be modeled with more complex weighted functions, thus giving a neural network the ability to solve very complex problems dealing with nonlinear relationships. |
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1. Describe the architecture of a traditional neural network and its core components.

| A neural network is comprised of linear and nonlinear components, namely a linear function and a nonlinear activation function. It consists of layers: an input layer, hidden layers, and an output layer. Each layer has nodes. The input layer has a given number of nodes determined by the input features. The output layer has one node per output. The hidden layers have nodes that contain activation functions. Each node in a hidden layer applies an activation function to the output coming from the previous layer's nodes. The activation function is what introduces nonlinearity to a neural network. It is what pieces together the linear functions. Without an activation function, a neural network would behave like any linear model, such as a logistic regression. |
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1. Summarize the training process of a traditional neural network.

| The training process of a neural network is similar to the training of linear models such as logistic regression. It uses a gradient descent optimization algorithm to update model parameters to minimize a loss function and regularization to prevent overfitting. A neural network is trained through the process of using forward propagation to obtain an output and compute loss and then back propagation using stochastic gradient descent to update model parameters to minimize the loss function. |
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1. Describe a few advantages and disadvantages of using a neural network.

| NNs can represent complex non-linear behavior and therefore can solve complex problems. They have been able to solve complex problems in a number of areas, including image processing, image classification, speech recognition, handwriting recognition, etc. They can also handle very large data sets with a large number of input features. However, they can be prone to over-fitting. They may require a lot of effort for tuning. There's a large number of parameters to learn and they can require a large amount of computational power. |
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1. Why is a specific neural network architecture needed for image data?

| Images are very high-dimensional when they are vectorized and it would take a traditional neural network a very long time to train.   Not only are images high dimensional, but neighboring pixels in an image are also highly correlated. More concretely, an image pixel does not really contain a lot of information, but a block of image pixels is often much more meaningful. If we vectorize an image before inputting it into a traditional NN we would lose much of the spatial relation between neighboring pixels. Therefore, a different NN architecture is needed for image data. |
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1. Compare and contrast a traditional neural network with a convolutional neural network.

| As opposed to traditional NNs, CNNs try to learn small filters that can detect small regional patterns at the first few layers. The vector output of these layers might have higher values if a particular pattern is present, and lower otherwise. In later layers, these outputs are passed into a feedforward for classification. |
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*To submit this assignment, please refer to the instructions in the course*.