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.

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| Deep learning is a subset of machine learning that uses neural networks. Most of the time, we use deep learning for image recognition and computer vision like FaceId or thumbprints to unlock technological devices, converting handwriting to type, and object recognition for self-driving cars. |

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?

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| A linear model is better used when the data has a linear relationship; otherwise, for more complex and nonlinear data, we can use a neural network. For a linear model such as logistic regression, we would learn one weighted function that can be used to make predictions. A neural network extends logistic regression in that many linear functions, coupled with nonlinear transformations and activation functions, create a final nonlinear combination to make predictions. In addition, a neural network might have hundreds more model parameters than a linear model. However, both the linear model and a neural network are used for supervised learning problems.  The advantages of using a neural network instead of a linear model are that a neural network can identify nonlinear relationships amongst features and labels (which is impossible to do with a linear model). |

1. Describe the architecture of a traditional neural network and its core components.

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| Called feed forward NN and in general neural networks mimic the structure of brain neurons and how they fire and produce information. In that, we first start with the input layer, which is a function the reads our features and transforms them. Next are hidden layers whose input are the output from previous layers and their job is to transform them. Between layers, we use activation function, which outputs either 0 or 1, and decides whether the current layer output should be used in the next layer. Lastly, we have the output layer. Throughout the process of training, we also use backpropagation to minimize the loss function and we use forward propagation to input data, make transformations, and make predictions. |

1. Summarize the training process of a traditional neural network.

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| The training process of a traditional neural network relies on forward and backward propagation in this order. Forward propagation helps us obtain outputs from the neural network and backpropagation is used to update weights to minimize the loss function. We can also optimize training with stochastic gradient descent (SGD). To prevent overfitting, we also use the dropout technique and weight decay to introduce redundancy and to change the loss function respectively. The loss function used will depend on the type of ML problem. |

1. Describe a few advantages and disadvantages of using a neural network.

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| A few advantages of using a neural network are that they are versatile, can be used to solve large and complex problems with nonlinear relationships, can use the difference between the prediction and actual outcome to minimize error, and can be applied to a classification or regression supervised learning problem like image recognition. A few disadvantages are that the best-performing neural networks are that it can be overfit, computationally expensive, can have many model parameter that must be fit, and one cannot always reproduce results with neural networks. |

1. Why is a specific neural network architecture needed for image data?

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| Image data should not use traditional feedforward neural networks because it can not handle the vast amount of data (would take a long time to train) and would not generalize well, so we need to use convolutional neural networks (CNNs). Image data is very high dimensional and CNNs are translation invariant. CNNs can use filters to detect small patterns in the image and use pooling to extract key features that will ultimately lead to the classification and recognition of an image. |

1. Compare and contrast a traditional neural network with a convolutional neural network.

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| A traditional neural network is not translation invariant like a CNN and does not pool layers. However, the traditional neural network needs much less layers and model parameters that a CNN does to generalize correctly. Though a CNN is very similar to multi-layer perceptrons in that we still use linear transformations and the same propagation techniques, except that a CNN has fewer parameters and applies a convolutional filter over the image. |



*To submit this assignment, please refer to the instructions in the course*.