

## CSCI 467 – Project 4

### Q1.5

- 1) The neural network is trying to classify the data in its layers. It first uses the training data to learn which features lead to which labels and then uses this information to predict the labels of the test data to classify. The neural network works like a human brain. Layers are connected so the first layer receives the input, creates an output and passes this output as the input of the second layer. Then the second layer creates an output and passes it to the third layer as an input. And it goes like this through the layers until it reaches the output layer and makes the guess. During training, the network uses backward pass to signal wrong answers which helps to update the weights that models use. After enough training, the network learns enough to classify the test data with the updated weights that will give the most accurate answers possible.

t-SNE plots visualize high-dimensional data by giving each sample a point on a 2D map. It helps us to see how the layers classify the test. It uses colors for different labels, and it groups the data that belongs to the same label together to show the classification. So, if the same colored points clustered together, it means that the network did a good job on classifying. In “t-SNE raw MNIST.png” we see the raw input and points that belong to different labels are spread out. After linear layer 1, the points start to come together as the network processes them. After linear layer 2, we can see that same colored points are well clustered as they are processed by the layers and the network completes classifying them.

- 2) Momentum boosts up the convergence of training. When we have momentum, training converges faster because it helps accelerate gradient vectors in the right directions. It optimizes gradient descent to minimize the error function to prevent getting stuck in a local minima so that the algorithm can reach a global minima.
- 3) It would have been a good time to stop when validation accuracy is stabilized. When we no longer get performance improvement on the validation set, we can stop training and evaluate our model on the test set. If we continue training after validation accuracy stabilized, validation accuracy will start to decrease and this will cause overfitting. Stabilized validation accuracy means that we reached the optimal performance.