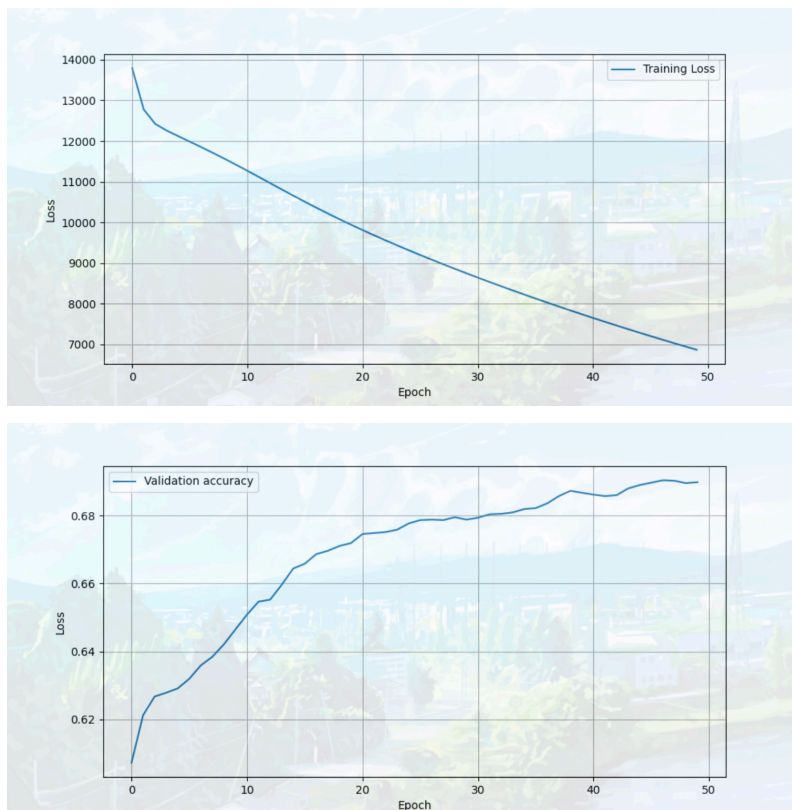


Question 3

We choose Option 2

- (a)
- ALS breaks down large matrices into lower-dimensional matrices, while neural networks model non-linear relationships through layers.
 - ALS is less flexible than neural networks because it is designed for matrix factorization, whereas neural networks can model non-linear relationships.
 - ALS is more computationally efficient than neural networks for sparse datasets because neural networks require significant computational resources.
- (b) The implementation is in `neural_network.py`.
- (c) The optimization hyperparameters we chose are:
 $k = 50$, $lr = 0.01$, $num_epoch = 50$
 The Validation Accuracy we obtained is 0.68981.
- (d) The plot with $k = 50$, $lr = 0.01$, $num_epoch = 50$ is shown below:



The Final Test Accuracy is 0.68558.

- (e) The best regularization penalty we found is $\lambda = 0.01$. With this value of λ , we obtained:

Final Validation Accuracy: 0.67824

Final Test Accuracy: 0.68078

The model performed about the same with the regularization penalty. This may be because our model is already well-regularized and does not overfit, or only has negligible overfitting issues.