Assignment 1: Summary Report

# Q1. You used two hidden layers. Try using one or three hidden layers, and see how doing so affects validation and test accuracy.

The original code used two hidden layers, here is the outcome of training accuracy and loss & validation accuracy and loss:

A graph showing the loss of a training

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Then, I tried using one hidden layer:

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Here is the training and validation loss & accuracy:

A graph of training and validation

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Then I tuned to epoch to 7 according to the result and compared with the two hidden layer model:

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Comparison:

The validation accuracy of the model with two hidden layers was somewhat higher (87.07%) than that of the model with one hidden layer (86.41%).  
On the test set, both models demonstrated great accuracy; however, the one-hidden-layer model outperformed the two-hidden-layers model by a little margin. In comparison to the two-hidden-layers model, the one-hidden-layer model had a somewhat lower test loss (0.2869 vs. 0.2983) and a marginally higher test accuracy (88.51% vs. 87.99%). Both models demonstrated successful learning from the training data by increasing accuracy and decreasing loss over the epochs.  
In contrast to the two-hidden-layers model, which trained over four epochs, the one-hidden-layer model trained over seven. Nonetheless, both models obtained great accuracy on the test set, and the performance difference between them is negligible.

# Q2. Try using layers with more hidden units or fewer hidden units: 32 units, 64 units, and so on.

As we know, model with 16 Units:

Training Accuracy: Achieved an accuracy of approximately 93.27%. Test Accuracy: Achieved an accuracy of approximately 87.99%.

Model with 32 hidden units:

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Training Accuracy: Achieved an accuracy of approximately 93.30%. Test Accuracy: Achieved an accuracy of approximately 87.85%.

Model with 64 hidden units:

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Based on the observed trend, I tried training for 11 epochs

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Training Accuracy: Achieved an accuracy of approximately 98.91%. Test Accuracy: Achieved an accuracy of approximately 86.79%.

Comparison:

Out of the three models, the one with 64 hidden units had the highest training accuracy, suggesting a superior fit to the training set. Its test accuracy was marginally worse than that of the models with less hidden units, though. Overfitting is more likely when model capacity is increased.  
  
Similar test accuracies were shown by the models with 16 and 32 hidden units, with the 16-unit model marginally beating the 32-unit model.

The better training accuracy in the 64-unit model suggests that increasing the number of hidden units enhances the model's capacity to match the training data. The drop in test accuracy as compared to models with fewer hidden units, however, indicates that overfitting resulted from this increase in complexity.  
  
However, as demonstrated by the marginally improved test accuracy of the model with 16 units in comparison to the others, fewer hidden units lead to simpler models that generalize better to unseen data.

# Q3. Try using the mse loss function instead of binary\_crossentropy.

Validation performance:

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AI-generated content may be incorrect.A graph of a training and validation accuracy

AI-generated content may be incorrect.A graph of training and validation loss

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Then I tuned the epochs to 7:

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The model appears to be overfitting to some degree based on the performance. While the training accuracy keeps getting better, the validation accuracy appears to peak and then significantly decline after a specific number of epochs. This implies that the model is not generalizing effectively to new data and is beginning to overfit the training set. MSE loss may not be the ideal option for classification issues such as binary sentiment analysis, but it is appropriate for regression tasks.

# A screen shot of a computer program AI-generated content may be incorrect.Q4. Try using the tanh activation (an activation that was popular in the early days of neural networks) instead of relu.

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AI-generated content may be incorrect.A graph of training and validation loss

AI-generated content may be incorrect.A graph of a training and validation accuracy

AI-generated content may be incorrect.Training and validation performance:

Then based on the observation i adjust the epochs number to 3

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There are signs of overfitting as seen in the increasing gap between training and validation performance, especially towards the later epochs.

Comparing these two models:

Both models achieved similar validation accuracy. The model with ReLU activation converged faster, reaching a higher training accuracy after fewer epochs. The model with Tanh activation required fewer epochs but achieved a slightly lower training accuracy compared to the ReLU model. The choice of activation function seems to have influenced the convergence rate and the final training accuracy.

# Q5. Use any technique we studied in class, and these include regularization, dropout, etc., to get your model to perform better on validation.

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AI-generated content may be incorrect.To improve the performance of the model on the validation set, I modify the model to include dropout in it:

Here is the validation performance:

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Examining the results prior to and following the implementation of dropout regularization: Prior to regularization of dropouts: The training accuracy varies between 97-98%.  
The validation accuracy varies from 87-89%.  
Following regularization of dropouts: Training Accuracy: Variables between 94 and 95 percent, lower than previously.  
Validation Accuracy: Varying between 88 and 89%, slightly better than before dropout.  
As demonstrated by the gain in validation accuracy and the decrease in training accuracy, dropout regularization has assisted in reducing overfitting of the original model. Better generalization performance is the outcome of the updated model's decreased reliance on particular features during training. Additionally, dropout has enhanced performance on unseen data (validation set) by preventing the model from memorizing the training data.

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Following the implementation of dropout regularization and training on the testing dataset, the model's accuracy was 88.61% and its performance was 0.3381.  
It appears that the model has maintained a comparable level of performance on unseen data when compared to the validation set results following the application of dropout regularization. This further suggests that the dropout regularization technique has successfully prevented overfitting, enabling the model to generalize well to new data.