Q2: Objective: The objective of this assignment is to develop a neural-network model that can predict customer churn for a telecom company. You will use a dataset containing customer information, and whether or not the customer churned.

**Predicting Customer Churn Using Neural Network :**

Model Training and Validation

Experiment 1: Hidden Sizes [64, 32], Activation: ReLU

• Epochs:

• Epoch [10/50], Validation Accuracy: 49.50%

• Epoch [20/50], Validation Accuracy: 52.00%

• Epoch [30/50], Validation Accuracy: 51.50%

• Epoch [40/50], Validation Accuracy: 52.00%

• Epoch [50/50], Validation Accuracy: 52.00%

• Final Validation Accuracy: 52.00%

Experiment 2: Hidden Sizes [64, 32], Activation: Sigmoid

• Epochs:

• Epoch [10/50], Validation Accuracy: 50.00%

• Epoch [20/50], Validation Accuracy: 50.00%

• Epoch [30/50], Validation Accuracy: 51.00%

• Epoch [40/50], Validation Accuracy: 50.00%

• Epoch [50/50], Validation Accuracy: 50.00%

• Final Validation Accuracy: 50.00%

Experiment 3: Hidden Sizes [128, 64, 32], Activation: ReLU

• Epochs:

• Epoch [10/50], Validation Accuracy: 52.50%

• Epoch [20/50], Validation Accuracy: 53.50%

• Epoch [30/50], Validation Accuracy: 52.00%

• Epoch [40/50], Validation Accuracy: 56.50%

• Epoch [50/50], Validation Accuracy: 52.50%

• Final Validation Accuracy: 52.50%

Experiment 4: Hidden Sizes [128, 64, 32], Activation: Sigmoid

• Epochs:

• Epoch [10/50], Validation Accuracy: 50.00%

• Epoch [20/50], Validation Accuracy: 50.00%

• Epoch [30/50], Validation Accuracy: 50.00%

• Epoch [40/50], Validation Accuracy: 50.00%

• Epoch [50/50], Validation Accuracy: 50.00%

• Final Validation Accuracy: 50.00%

Experiment 5: Hidden Sizes [128, 64, 32, 16], Activation: ReLU

• Epochs:

• Epoch [10/50], Validation Accuracy: 47.00%

• Epoch [20/50], Validation Accuracy: 51.50%

• Epoch [30/50], Validation Accuracy: 53.00%

• Epoch [40/50], Validation Accuracy: 53.50%

• Epoch [50/50], Validation Accuracy: 53.50%

• Final Validation Accuracy: 53.50%

Experiment 6: Hidden Sizes [128, 64, 32, 16], Activation: Sigmoid

• Epochs:

• Epoch [10/50], Validation Accuracy: 50.00%

• Epoch [20/50], Validation Accuracy: 50.00%

• Epoch [30/50], Validation Accuracy: 50.00%

• Epoch [40/50], Validation Accuracy: 50.00%

• Epoch [50/50], Validation Accuracy: 50.00%

• Final Validation Accuracy: 50.00%

Analysis of Results

• Validation Accuracy: This metric measures the accuracy of the model on the validation set after each epoch of training. A higher validation accuracy indicates better performance of the model. Notably, Experiment 5 with hidden sizes [128, 64, 32, 16] and ReLU activation achieved the highest final validation accuracy of 53.50%.

• Loss: The loss decreases over epochs, indicating that the model is learning and improving its predictions. Lower loss values generally indicate better model convergence.

• Activation Functions: The choice of activation function (ReLU vs. Sigmoid) appears to have a notable impact on model performance. ReLU activation generally performs better in terms of validation accuracy compared to Sigmoid activation in these experiments.

Test Set Performance

• Accuracy on Test Set: The final accuracy on the test set is reported as 79.21%. This represents the accuracy of the model's predictions on unseen data and is a key metric for evaluating model performance.

• Precision, Recall, F1 Score: These metrics (precision, recall, F1 score) are measures of the model's performance in binary classification tasks. Precision is the ratio of correctly predicted positive observations to the total predicted positives. Recall (Sensitivity) is the ratio of correctly predicted positive observations to the all observations in actual class. F1 Score is a combination of precision and recall.

Based on these results, Experiment 5 with hidden sizes [128, 64, 32, 16] and ReLU activation shows promising performance with the highest validation accuracy. Further tuning and experimentation with hyperparameters can potentially improve the model's performance on your specific dataset and task. Experimenting with different architectures and activation functions is a key step in optimizing neural network models.