```python
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
from tensorflow import keras
from tensorflow.keras import layers
from tensorflow.keras.datasets import imdb
import tensorflow as tf
import random

# 1. Set seed for reproducibility
def set_seed(seed=42):
    """
    Sets random seed for NumPy, TensorFlow, and Python random library.
    """
    np.random.seed(seed)
    tf.random.set_seed(seed)
    random.seed(seed)

# Set the seed for reproducibility
set_seed(42)

# 2. Load and preprocess the IMDB dataset
print("Loading IMDB dataset-")
(train_x, train_y), (test_x, test_y) = imdb.load_data(num_words=10000)

# Function to vectorize sequences into binary multi-hot encoding
def vectorize_sequences(sequences, dimension=10000):
    """
    Converts list of sequences into 2D numpy array with binary indicators.
    """
    results = np.zeros((len(sequences), dimension))
    for i, sequence in enumerate(sequences):
        results[i, sequence] = 1.0
    return results

# Vectorize the training and test data
x_train = vectorize_sequences(train_x)
x_test = vectorize_sequences(test_x)

y_train = np.asarray(train_y).astype("float32")
y_test = np.asarray(test_y).astype("float32")

# Split the training data into a training set and a validation set
x_val = x_train[:10000]
x_train = x_train[10000:]

y_val = y_train[:10000]
y_train = y_train[10000:]

# 3. Define a function to build the model
def build_model(layers_count=2, units=16, activation='relu', dropout=0.0, loss_fn='binary_crossentropy'):
    """
    Builds and compiles Sequential neural network model based on specified hyperparameters.
    """
    model = keras.Sequential()

    # Input layer
    model.add(layers.Dense(units, activation=activation, input_shape=(10000,)))

    # Additional hidden layers
    for _ in range(layers_count - 1):
        model.add(layers.Dense(units, activation=activation))
        if dropout > 0.0:
            model.add(layers.Dropout(dropout))

    # Output layer
    model.add(layers.Dense(1, activation='sigmoid'))

    # Compile the model
    model.compile(optimizer='rmsprop',
                  loss=loss_fn,
                  metrics=['accuracy', 'precision', 'recall', 'auc'])
    return model

# Dictionary to store results
results = {
```

```
        'Layers': {},
        'Units': {},
        'Loss': {},
        'Activation': {},
        'Dropout': {}
}

# Function to plot training and validation metrics
def plot_metrics(history_dict, title, metric):
    """
    Plots training and validation metrics for different hyperparameter settings.
    """
    plt.figure(figsize=(10, 6))
    for label, history in history_dict.items():
        epochs = range(1, len(history.history['accuracy']) + 1)
        plt.plot(epochs, history.history['accuracy'], label=f'Train {metric}')
        plt.plot(epochs, history.history['val_accuracy'], label=f'Validation {metric}')
    plt.title(title)
    plt.xlabel('Epochs')
    plt.ylabel(metric)
    plt.legend()
    plt.show()

# Experiment 1: Varying Number of Hidden Layers
print("\n--- Experiment 1: Hidden Layers ---")
hist_layers = {}
layers_options = [1, 2, 3, 4, 5]

for layers_count in layers_options:
    print(f"\nTraining model with {layers_count} hidden layers...")
    model = build_model(layers_count=layers_count, units=16)
    history = model.fit(x_train, y_train, epochs=20, batch_size=512, validation_data=(x_val, y_val), verbose=1)
    hist_layers[layers_count] = history
    results['Layers'][layers_count] = {'Validation Accuracy': history.history['val_accuracy'][-1], 'Test Accuracy': model.evaluate(x_test, y_

plot_metrics(hist_layers, 'Experiment 1: Hidden Layers - Accuracy', 'Accuracy')
plot_metrics(hist_layers, 'Experiment 1: Hidden Layers - Accuracy - Loss', 'Loss')

# Experiment 2: Adjusting Number of Hidden Units
print("\n--- Experiment 2: Hidden Units ---")
hist_units = {}
units_options = [32, 64, 128, 256]

for units in units_options:
    print(f"\nTraining model with {units} hidden units...")
    model = build_model(layers_count=2, units=units)
    history = model.fit(x_train, y_train, epochs=20, batch_size=512, validation_data=(x_val, y_val), verbose=1)
    hist_units[units] = history
    results['Units'][units] = {'Validation Accuracy': history.history['val_accuracy'][-1], 'Test Accuracy': model.evaluate(x_test, y_test, ve

plot_metrics(hist_units, 'Experiment 2: Hidden Units - Accuracy', 'Accuracy')
plot_metrics(hist_units, 'Experiment 2: Hidden Units - Loss', 'Loss')

# Experiment 3: Different Loss Functions
print("\n--- Experiment 3: Loss Functions ---")
hist_loss = {}
loss_options = ['binary_crossentropy', 'mse']

for loss_fn in loss_options:
    print(f"\nTraining model with {loss_fn} loss...")
    model = build_model(layers_count=2, units=16, loss_fn=loss_fn)
    history = model.fit(x_train, y_train, epochs=20, batch_size=512, validation_data=(x_val, y_val), verbose=1)
    hist_loss[loss_fn] = history
    val_acc = history.history['val_accuracy'][-1]
    test_acc = model.evaluate(x_test, y_test, verbose=0)[1]
    results['Loss'][loss_fn] = {'Validation Accuracy': val_acc, 'Test Accuracy': test_acc}

plot_metrics(hist_loss, 'Experiment 3: Loss Functions - Accuracy', 'Accuracy')
plot_metrics(hist_loss, 'Experiment 3: Loss Functions - Loss', 'Loss')

# Experiment 4: Different Activation Functions
print("\n--- Experiment 4: Activation Functions ---")
hist_activation = {}
activation_options = ['relu', 'tanh']

for activation in activation_options:
    print(f"\nTraining model with {activation} activation...")
    model = build_model(layers_count=2, units=16, activation=activation)
```

```
model = build_model(layers_count=2, units=16, activation=activation)
    history = model.fit(x_train, y_train, epochs=20, batch_size=512, validation_data=(x_val, y_val), verbose=1)
    hist_activation[activation] = history
    val_acc = history.history['val_accuracy'][-1]
    test_acc = model.evaluate(x_test, y_test, verbose=0)[1]
    results['Activation'][activation] = {'Validation Accuracy': val_acc, 'Test Accuracy': test_acc}

plot_metrics(hist_activation, 'Experiment 4: Activation Functions - Accuracy', 'Accuracy')
plot_metrics(hist_activation, 'Experiment 4: Activation Functions - Loss', 'Loss')


# Experiment 5: Dropout Regularization
print("\n--- Experiment 5: Dropout Regularization ---")
hist_dropout = {}
dropout_rates = [0.3, 0.5, 0.7]

for dropout in dropout_rates:
    print(f"\nTraining model with dropout rate {dropout}...")
    model_dropout = build_model(layers_count=2, units=16, dropout=dropout)
    history = model_dropout.fit(x_train, y_train, epochs=20, batch_size=512, validation_data=(x_val, y_val), verbose=1)
    hist_dropout[dropout] = history
    val_acc = history.history['val_accuracy'][-1]
    test_acc = model_dropout.evaluate(x_test, y_test, verbose=0)[1]
    results['Dropout'][dropout] = {'Validation Accuracy': val_acc, 'Test Accuracy': test_acc}

plot_metrics(hist_dropout, 'Experiment 5: Dropout - Accuracy', 'Accuracy')
plot_metrics(hist_dropout, 'Experiment 5: Dropout - Loss', 'Loss')
```

Loading IMDB dataset-

--- Experiment 1: Hidden Layers ---

Training model with 1 hidden layers...
Epoch 1/20
30/30 ———————————— **4s** 94ms/step - accuracy: 0.7302 - auc: 0.8075 - loss: 0.5782 - precision: 0.7289 - recall: 0.7306 - val_ac
Epoch 2/20
30/30 ———————————— **2s** 63ms/step - accuracy: 0.8906 - auc: 0.9549 - loss: 0.3561 - precision: 0.8893 - recall: 0.8909 - val_ac
Epoch 3/20
30/30 ———————————— **2s** 38ms/step - accuracy: 0.9144 - auc: 0.9700 - loss: 0.2788 - precision: 0.9117 - recall: 0.9167 - val_ac
Epoch 4/20
30/30 ———————————— **1s** 38ms/step - accuracy: 0.9279 - auc: 0.9778 - loss: 0.2327 - precision: 0.9270 - recall: 0.9281 - val_ac
Epoch 5/20
30/30 ———————————— **4s** 148ms/step - accuracy: 0.9376 - auc: 0.9827 - loss: 0.2016 - precision: 0.9376 - recall: 0.9368 - val_a
Epoch 6/20
30/30 ———————————— **3s** 97ms/step - accuracy: 0.9453 - auc: 0.9861 - loss: 0.1786 - precision: 0.9459 - recall: 0.9440 - val_ac
Epoch 7/20
30/30 ———————————— **3s** 35ms/step - accuracy: 0.9516 - auc: 0.9888 - loss: 0.1603 - precision: 0.9528 - recall: 0.9497 - val_ac
Epoch 8/20
30/30 ———————————— **1s** 36ms/step - accuracy: 0.9572 - auc: 0.9910 - loss: 0.1449 - precision: 0.9583 - recall: 0.9556 - val_ac
Epoch 9/20
30/30 ———————————— **1s** 38ms/step - accuracy: 0.9621 - auc: 0.9927 - loss: 0.1316 - precision: 0.9631 - recall: 0.9605 - val_ac
Epoch 10/20
30/30 ———————————— **1s** 35ms/step - accuracy: 0.9663 - auc: 0.9942 - loss: 0.1199 - precision: 0.9674 - recall: 0.9647 - val_ac
Epoch 11/20
30/30 ———————————— **1s** 38ms/step - accuracy: 0.9707 - auc: 0.9953 - loss: 0.1093 - precision: 0.9721 - recall: 0.9688 - val_ac
Epoch 12/20
30/30 ———————————— **1s** 37ms/step - accuracy: 0.9738 - auc: 0.9963 - loss: 0.1000 - precision: 0.9750 - recall: 0.9722 - val_ac
Epoch 13/20
30/30 ———————————— **1s** 39ms/step - accuracy: 0.9767 - auc: 0.9970 - loss: 0.0916 - precision: 0.9770 - recall: 0.9760 - val_ac
Epoch 14/20
30/30 ———————————— **1s** 36ms/step - accuracy: 0.9796 - auc: 0.9976 - loss: 0.0839 - precision: 0.9807 - recall: 0.9782 - val_ac
Epoch 15/20
30/30 ———————————— **2s** 62ms/step - accuracy: 0.9824 - auc: 0.9981 - loss: 0.0771 - precision: 0.9834 - recall: 0.9811 - val_ac
Epoch 16/20
30/30 ———————————— **2s** 39ms/step - accuracy: 0.9840 - auc: 0.9985 - loss: 0.0708 - precision: 0.9849 - recall: 0.9829 - val_ac
Epoch 17/20
30/30 ———————————— **1s** 37ms/step - accuracy: 0.9868 - auc: 0.9988 - loss: 0.0659 - precision: 0.9869 - recall: 0.9866 - val_ac
Epoch 18/20
30/30 ———————————— **1s** 36ms/step - accuracy: 0.9885 - auc: 0.9991 - loss: 0.0607 - precision: 0.9882 - recall: 0.9888 - val_ac
Epoch 19/20
30/30 ———————————— **1s** 36ms/step - accuracy: 0.9904 - auc: 0.9993 - loss: 0.0553 - precision: 0.9901 - recall: 0.9907 - val_ac
Epoch 20/20
30/30 ———————————— **1s** 36ms/step - accuracy: 0.9918 - auc: 0.9994 - loss: 0.0511 - precision: 0.9914 - recall: 0.9922 - val_ac

Training model with 2 hidden layers...
Epoch 1/20
30/30 ———————————— **5s** 92ms/step - accuracy: 0.7028 - auc: 0.7760 - loss: 0.5959 - precision: 0.7472 - recall: 0.5908 - val_ac
Epoch 2/20
30/30 ———————————— **4s** 54ms/step - accuracy: 0.8849 - auc: 0.9508 - loss: 0.3399 - precision: 0.8839 - recall: 0.8848 - val_ac
Epoch 3/20
30/30 ———————————— **2s** 41ms/step - accuracy: 0.9181 - auc: 0.9726 - loss: 0.2485 - precision: 0.9153 - recall: 0.9205 - val_ac
Epoch 4/20
30/30 ———————————— **1s** 38ms/step - accuracy: 0.9374 - auc: 0.9823 - loss: 0.1960 - precision: 0.9370 - recall: 0.9372 - val_ac
Epoch 5/20
30/30 ———————————— **1s** 38ms/step - accuracy: 0.9449 - auc: 0.9865 - loss: 0.1666 - precision: 0.9445 - recall: 0.9446 - val_ac
Epoch 6/20
30/30 ———————————— **1s** 38ms/step - accuracy: 0.9524 - auc: 0.9902 - loss: 0.1418 - precision: 0.9519 - recall: 0.9524 - val_ac
Epoch 7/20
30/30 ———————————— **2s** 50ms/step - accuracy: 0.9665 - auc: 0.9940 - loss: 0.1154 - precision: 0.9668 - recall: 0.9658 - val_ac
Epoch 8/20
30/30 ———————————— **1s** 37ms/step - accuracy: 0.9738 - auc: 0.9960 - loss: 0.0972 - precision: 0.9752 - recall: 0.9720 - val_ac
Epoch 9/20
30/30 ———————————— **1s** 38ms/step - accuracy: 0.9772 - auc: 0.9970 - loss: 0.0844 - precision: 0.9774 - recall: 0.9768 - val_ac
Epoch 10/20
30/30 ———————————— **1s** 38ms/step - accuracy: 0.9816 - auc: 0.9981 - loss: 0.0714 - precision: 0.9820 - recall: 0.9810 - val_ac
Epoch 11/20
30/30 ———————————— **2s** 59ms/step - accuracy: 0.9833 - auc: 0.9985 - loss: 0.0643 - precision: 0.9845 - recall: 0.9819 - val_ac
Epoch 12/20
30/30 ———————————— **2s** 39ms/step - accuracy: 0.9873 - auc: 0.9990 - loss: 0.0547 - precision: 0.9869 - recall: 0.9875 - val_ac
Epoch 13/20
30/30 ———————————— **1s** 39ms/step - accuracy: 0.9895 - auc: 0.9993 - loss: 0.0467 - precision: 0.9900 - recall: 0.9888 - val_ac
Epoch 14/20
30/30 ———————————— **1s** 38ms/step - accuracy: 0.9933 - auc: 0.9997 - loss: 0.0362 - precision: 0.9937 - recall: 0.9930 - val_ac
Epoch 15/20
30/30 ———————————— **1s** 49ms/step - accuracy: 0.9952 - auc: 0.9998 - loss: 0.0300 - precision: 0.9945 - recall: 0.9960 - val_ac
Epoch 16/20
30/30 ———————————— **2s** 39ms/step - accuracy: 0.9969 - auc: 0.9999 - loss: 0.0260 - precision: 0.9971 - recall: 0.9967 - val_ac
Epoch 17/20
30/30 ———————————— **1s** 39ms/step - accuracy: 0.9968 - auc: 0.9999 - loss: 0.0233 - precision: 0.9964 - recall: 0.9970 - val_ac
Epoch 18/20
30/30 ———————————— **2s** 50ms/step - accuracy: 0.9978 - auc: 1.0000 - loss: 0.0204 - precision: 0.9971 - recall: 0.9985 - val_ac
Epoch 19/20

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30/30 ──────────────────── 2s 58ms/step - accuracy: 0.9952 - auc: 0.9999 - loss: 0.0210 - precision: 0.9965 - recall: 0.9938 - val_ac
Epoch 20/20
30/30 ──────────────────── 2s 38ms/step - accuracy: 0.9986 - auc: 1.0000 - loss: 0.0143 - precision: 0.9988 - recall: 0.9984 - val_ac

Training model with 3 hidden layers...
Epoch 1/20
30/30 ──────────────────── 7s 118ms/step - accuracy: 0.6970 - auc: 0.7623 - loss: 0.5997 - precision: 0.6848 - recall: 0.7291 - val_a
Epoch 2/20
30/30 ──────────────────── 3s 39ms/step - accuracy: 0.8907 - auc: 0.9518 - loss: 0.3301 - precision: 0.8869 - recall: 0.8942 - val_ac
Epoch 3/20
30/30 ──────────────────── 1s 38ms/step - accuracy: 0.9247 - auc: 0.9746 - loss: 0.2300 - precision: 0.9235 - recall: 0.9253 - val_ac
Epoch 4/20
30/30 ──────────────────── 1s 36ms/step - accuracy: 0.9422 - auc: 0.9846 - loss: 0.1769 - precision: 0.9418 - recall: 0.9420 - val_ac
Epoch 5/20
30/30 ──────────────────── 1s 36ms/step - accuracy: 0.9478 - auc: 0.9869 - loss: 0.1556 - precision: 0.9474 - recall: 0.9476 - val_ac
Epoch 6/20
30/30 ──────────────────── 1s 38ms/step - accuracy: 0.9583 - auc: 0.9903 - loss: 0.1296 - precision: 0.9598 - recall: 0.9561 - val_ac
Epoch 7/20
30/30 ──────────────────── 2s 53ms/step - accuracy: 0.9722 - auc: 0.9950 - loss: 0.0976 - precision: 0.9737 - recall: 0.9703 - val_ac
Epoch 8/20
30/30 ──────────────────── 2s 36ms/step - accuracy: 0.9779 - auc: 0.9964 - loss: 0.0822 - precision: 0.9769 - recall: 0.9787 - val_ac
Epoch 9/20
30/30 ──────────────────── 1s 37ms/step - accuracy: 0.9841 - auc: 0.9976 - loss: 0.0669 - precision: 0.9839 - recall: 0.9841 - val_ac
Epoch 10/20
30/30 ──────────────────── 1s 36ms/step - accuracy: 0.9822 - auc: 0.9978 - loss: 0.0629 - precision: 0.9823 - recall: 0.9818 - val_ac
Epoch 11/20
30/30 ──────────────────── 1s 37ms/step - accuracy: 0.9864 - auc: 0.9987 - loss: 0.0509 - precision: 0.9863 - recall: 0.9865 - val_ac
Epoch 12/20
30/30 ──────────────────── 1s 36ms/step - accuracy: 0.9928 - auc: 0.9993 - loss: 0.0358 - precision: 0.9926 - recall: 0.9929 - val_ac
Epoch 13/20
30/30 ──────────────────── 1s 36ms/step - accuracy: 0.9964 - auc: 0.9998 - loss: 0.0259 - precision: 0.9970 - recall: 0.9957 - val_ac
Epoch 14/20
30/30 ──────────────────── 1s 37ms/step - accuracy: 0.9892 - auc: 0.9992 - loss: 0.0368 - precision: 0.9899 - recall: 0.9883 - val_ac
Epoch 15/20
30/30 ──────────────────── 1s 35ms/step - accuracy: 0.9921 - auc: 0.9992 - loss: 0.0299 - precision: 0.9913 - recall: 0.9928 - val_ac
Epoch 16/20
30/30 ──────────────────── 2s 44ms/step - accuracy: 0.9942 - auc: 0.9996 - loss: 0.0222 - precision: 0.9938 - recall: 0.9946 - val_ac
Epoch 17/20
30/30 ──────────────────── 2s 37ms/step - accuracy: 0.9981 - auc: 0.9999 - loss: 0.0132 - precision: 0.9984 - recall: 0.9978 - val_ac
Epoch 18/20
30/30 ──────────────────── 1s 37ms/step - accuracy: 0.9973 - auc: 0.9997 - loss: 0.0150 - precision: 0.9973 - recall: 0.9972 - val_ac
Epoch 19/20
30/30 ──────────────────── 1s 38ms/step - accuracy: 0.9999 - auc: 1.0000 - loss: 0.0064 - precision: 0.9998 - recall: 1.0000 - val_ac
Epoch 20/20
30/30 ──────────────────── 1s 38ms/step - accuracy: 0.9983 - auc: 0.9998 - loss: 0.0097 - precision: 0.9981 - recall: 0.9985 - val_ac

Training model with 4 hidden layers...
Epoch 1/20
30/30 ──────────────────── 5s 80ms/step - accuracy: 0.6467 - auc: 0.7149 - loss: 0.6542 - precision: 0.6244 - recall: 0.7568 - val_ac
Epoch 2/20
30/30 ──────────────────── 2s 49ms/step - accuracy: 0.8740 - auc: 0.9389 - loss: 0.4015 - precision: 0.8661 - recall: 0.8833 - val_ac
Epoch 3/20
30/30 ──────────────────── 2s 39ms/step - accuracy: 0.9143 - auc: 0.9681 - loss: 0.2634 - precision: 0.9111 - recall: 0.9171 - val_ac
Epoch 4/20
30/30 ──────────────────── 1s 38ms/step - accuracy: 0.9320 - auc: 0.9784 - loss: 0.2030 - precision: 0.9308 - recall: 0.9326 - val_ac
Epoch 5/20
30/30 ──────────────────── 1s 38ms/step - accuracy: 0.9415 - auc: 0.9850 - loss: 0.1652 - precision: 0.9411 - recall: 0.9413 - val_ac
Epoch 6/20
30/30 ──────────────────── 2s 56ms/step - accuracy: 0.9597 - auc: 0.9904 - loss: 0.1311 - precision: 0.9595 - recall: 0.9595 - val_ac
Epoch 7/20
30/30 ──────────────────── 2s 50ms/step - accuracy: 0.9655 - auc: 0.9930 - loss: 0.1107 - precision: 0.9669 - recall: 0.9636 - val_ac
Epoch 8/20
30/30 ──────────────────── 1s 37ms/step - accuracy: 0.9732 - auc: 0.9949 - loss: 0.0917 - precision: 0.9720 - recall: 0.9741 - val_ac
Epoch 9/20
30/30 ──────────────────── 1s 36ms/step - accuracy: 0.9795 - auc: 0.9964 - loss: 0.0746 - precision: 0.9811 - recall: 0.9775 - val_ac
Epoch 10/20
30/30 ──────────────────── 1s 48ms/step - accuracy: 0.9825 - auc: 0.9972 - loss: 0.0637 - precision: 0.9817 - recall: 0.9832 - val_ac
Epoch 11/20
30/30 ──────────────────── 2s 38ms/step - accuracy: 0.9866 - auc: 0.9982 - loss: 0.0511 - precision: 0.9866 - recall: 0.9865 - val_ac
Epoch 12/20
30/30 ──────────────────── 2s 50ms/step - accuracy: 0.9902 - auc: 0.9985 - loss: 0.0448 - precision: 0.9906 - recall: 0.9898 - val_ac
Epoch 13/20
30/30 ──────────────────── 3s 56ms/step - accuracy: 0.9944 - auc: 0.9990 - loss: 0.0321 - precision: 0.9950 - recall: 0.9938 - val_ac
Epoch 14/20
30/30 ──────────────────── 2s 37ms/step - accuracy: 0.9966 - auc: 0.9992 - loss: 0.0244 - precision: 0.9965 - recall: 0.9966 - val_ac
Epoch 15/20
30/30 ──────────────────── 1s 38ms/step - accuracy: 0.9984 - auc: 0.9993 - loss: 0.0185 - precision: 0.9987 - recall: 0.9981 - val_ac
Epoch 16/20
30/30 ──────────────────── 1s 39ms/step - accuracy: 0.9841 - auc: 0.9967 - loss: 0.0531 - precision: 0.9832 - recall: 0.9849 - val_ac
Epoch 17/20
30/30 ──────────────────── 1s 38ms/step - accuracy: 0.9879 - auc: 0.9980 - loss: 0.0404 - precision: 0.9882 - recall: 0.9876 - val_ac
Epoch 18/20
30/30 ──────────────────── 1s 37ms/step - accuracy: 0.9960 - auc: 0.9995 - loss: 0.0165 - precision: 0.9961 - recall: 0.9959 - val_ac
Epoch 19/20
30/30 ──────────────────── 1s 38ms/step - accuracy: 0.9997 - auc: 1.0000 - loss: 0.0067 - precision: 0.9998 - recall: 0.9995 - val_ac
```
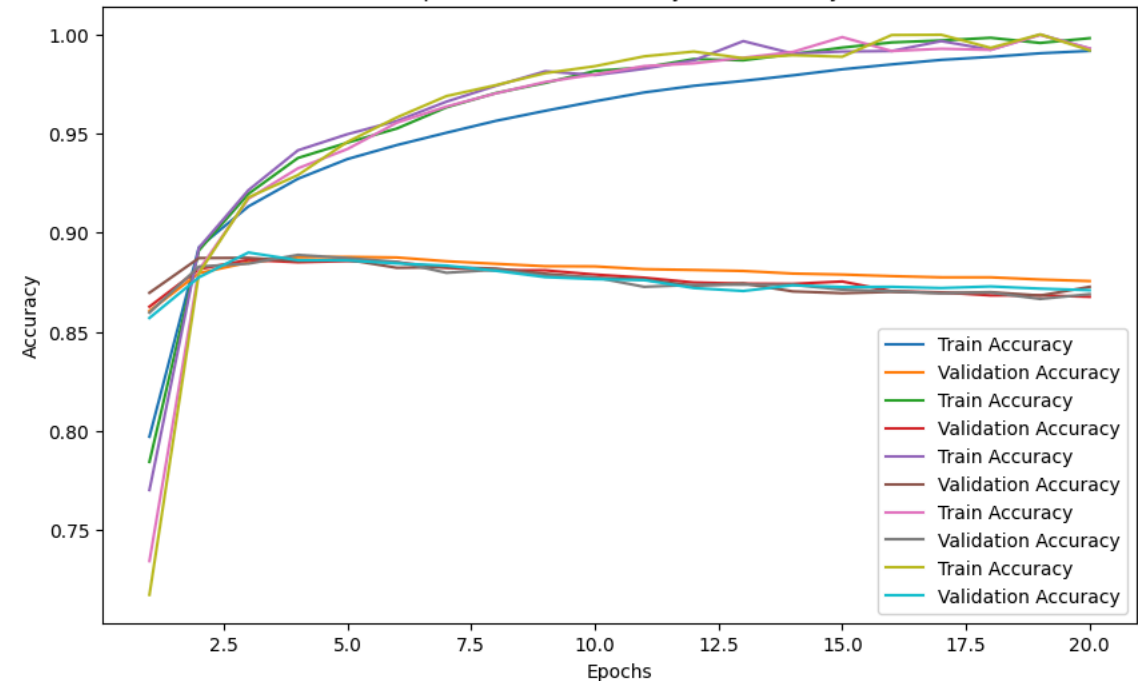
```
Epoch 20/20
30/30 ─────────────────── 1s 39ms/step - accuracy: 0.9967 - auc: 0.9996 - loss: 0.0133 - precision: 0.9967 - recall: 0.9967 - val_ac

Training model with 5 hidden layers...
Epoch 1/20
30/30 ─────────────────── 5s 83ms/step - accuracy: 0.6414 - auc: 0.6932 - loss: 0.6552 - precision: 0.6493 - recall: 0.6156 - val_ac
Epoch 2/20
30/30 ─────────────────── 2s 51ms/step - accuracy: 0.8729 - auc: 0.9373 - loss: 0.3936 - precision: 0.8761 - recall: 0.8669 - val_ac
Epoch 3/20
30/30 ─────────────────── 2s 41ms/step - accuracy: 0.9156 - auc: 0.9692 - loss: 0.2542 - precision: 0.9187 - recall: 0.9109 - val_ac
Epoch 4/20
30/30 ─────────────────── 2s 37ms/step - accuracy: 0.9276 - auc: 0.9778 - loss: 0.1988 - precision: 0.9261 - recall: 0.9285 - val_ac
Epoch 5/20
30/30 ─────────────────── 1s 39ms/step - accuracy: 0.9515 - auc: 0.9872 - loss: 0.1503 - precision: 0.9541 - recall: 0.9480 - val_ac
Epoch 6/20
30/30 ─────────────────── 1s 39ms/step - accuracy: 0.9606 - auc: 0.9919 - loss: 0.1185 - precision: 0.9607 - recall: 0.9601 - val_ac
Epoch 7/20
30/30 ─────────────────── 1s 38ms/step - accuracy: 0.9716 - auc: 0.9945 - loss: 0.0951 - precision: 0.9705 - recall: 0.9725 - val_ac
Epoch 8/20
30/30 ─────────────────── 1s 39ms/step - accuracy: 0.9762 - auc: 0.9955 - loss: 0.0820 - precision: 0.9756 - recall: 0.9765 - val_ac
Epoch 9/20
30/30 ─────────────────── 1s 37ms/step - accuracy: 0.9780 - auc: 0.9964 - loss: 0.0719 - precision: 0.9762 - recall: 0.9797 - val_ac
Epoch 10/20
30/30 ─────────────────── 2s 54ms/step - accuracy: 0.9821 - auc: 0.9970 - loss: 0.0622 - precision: 0.9815 - recall: 0.9826 - val_ac
Epoch 11/20
30/30 ─────────────────── 2s 39ms/step - accuracy: 0.9853 - auc: 0.9981 - loss: 0.0498 - precision: 0.9860 - recall: 0.9844 - val_ac
Epoch 12/20
30/30 ─────────────────── 1s 39ms/step - accuracy: 0.9911 - auc: 0.9989 - loss: 0.0349 - precision: 0.9910 - recall: 0.9911 - val_ac
Epoch 13/20
30/30 ─────────────────── 1s 38ms/step - accuracy: 0.9896 - auc: 0.9977 - loss: 0.0406 - precision: 0.9892 - recall: 0.9899 - val_ac
Epoch 14/20
30/30 ─────────────────── 1s 38ms/step - accuracy: 0.9961 - auc: 0.9994 - loss: 0.0178 - precision: 0.9965 - recall: 0.9958 - val_ac
Epoch 15/20
30/30 ─────────────────── 1s 38ms/step - accuracy: 0.9968 - auc: 0.9996 - loss: 0.0147 - precision: 0.9965 - recall: 0.9972 - val_ac
Epoch 16/20
30/30 ─────────────────── 1s 39ms/step - accuracy: 0.9997 - auc: 1.0000 - loss: 0.0069 - precision: 0.9998 - recall: 0.9995 - val_ac
Epoch 17/20
30/30 ─────────────────── 1s 39ms/step - accuracy: 0.9997 - auc: 1.0000 - loss: 0.0049 - precision: 0.9998 - recall: 0.9997 - val_ac
Epoch 18/20
30/30 ─────────────────── 1s 38ms/step - accuracy: 0.9897 - auc: 0.9979 - loss: 0.0368 - precision: 0.9944 - recall: 0.9848 - val_ac
Epoch 19/20
30/30 ─────────────────── 2s 58ms/step - accuracy: 0.9999 - auc: 1.0000 - loss: 0.0020 - precision: 0.9998 - recall: 1.0000 - val_ac
Epoch 20/20
30/30 ─────────────────── 2s 41ms/step - accuracy: 0.9967 - auc: 0.9988 - loss: 0.0160 - precision: 0.9946 - recall: 0.9988 - val_ac
```
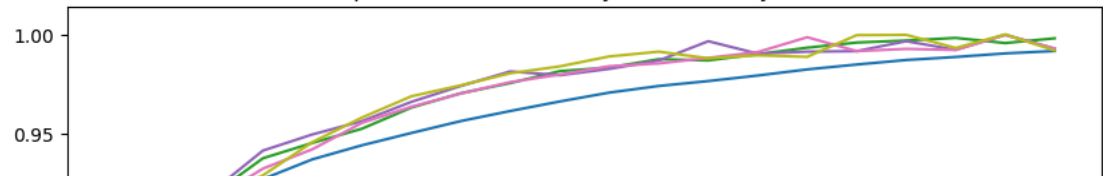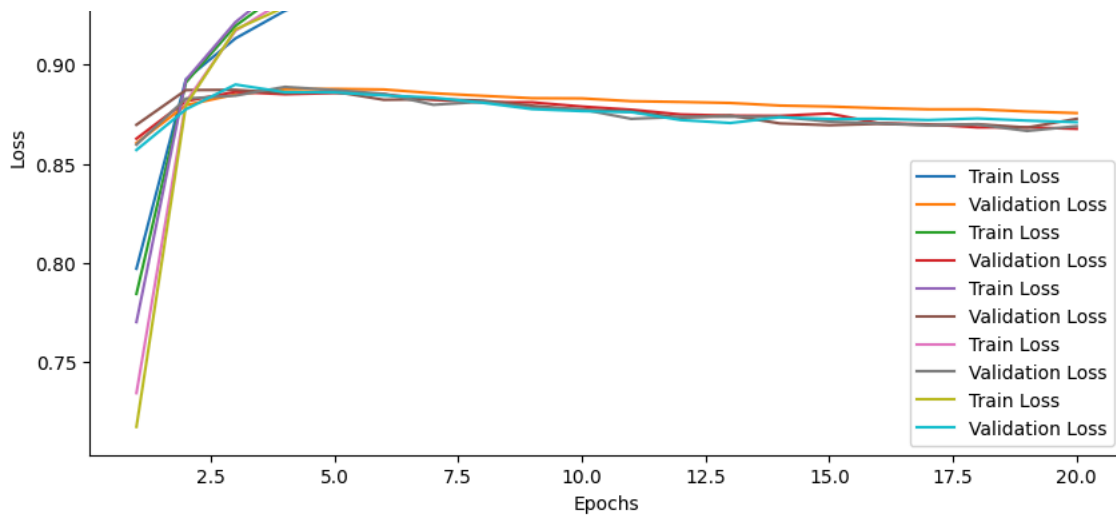

Experiment 1: Hidden Layers - Accuracy

Experiment 1: Hidden Layers - Accuracy - Loss

```
--- Experiment 2: Hidden Units ---

Training model with 32 hidden units...
Epoch 1/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 5s 107ms/step - accuracy: 0.7030 - auc: 0.7676 - loss: 0.5940 - precision: 0.6935 - recall: 0.7451 - val_a
Epoch 2/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 2s 71ms/step - accuracy: 0.8883 - auc: 0.9511 - loss: 0.3281 - precision: 0.8796 - recall: 0.8985 - val_ac
Epoch 3/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 2s 54ms/step - accuracy: 0.9176 - auc: 0.9727 - loss: 0.2376 - precision: 0.9158 - recall: 0.9188 - val_ac
Epoch 4/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 1s 44ms/step - accuracy: 0.9308 - auc: 0.9808 - loss: 0.1921 - precision: 0.9289 - recall: 0.9323 - val_ac
Epoch 5/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 3s 55ms/step - accuracy: 0.9500 - auc: 0.9877 - loss: 0.1554 - precision: 0.9516 - recall: 0.9477 - val_ac
Epoch 6/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 2s 55ms/step - accuracy: 0.9578 - auc: 0.9914 - loss: 0.1301 - precision: 0.9578 - recall: 0.9574 - val_ac
Epoch 7/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 2s 56ms/step - accuracy: 0.9595 - auc: 0.9928 - loss: 0.1174 - precision: 0.9628 - recall: 0.9555 - val_ac
Epoch 8/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 3s 66ms/step - accuracy: 0.9686 - auc: 0.9957 - loss: 0.0959 - precision: 0.9684 - recall: 0.9684 - val_ac
Epoch 9/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 2s 53ms/step - accuracy: 0.9744 - auc: 0.9967 - loss: 0.0837 - precision: 0.9751 - recall: 0.9734 - val_ac
Epoch 10/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 2s 43ms/step - accuracy: 0.9815 - auc: 0.9982 - loss: 0.0656 - precision: 0.9812 - recall: 0.9816 - val_ac
Epoch 11/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 3s 43ms/step - accuracy: 0.9854 - auc: 0.9987 - loss: 0.0559 - precision: 0.9849 - recall: 0.9858 - val_ac
Epoch 12/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 3s 60ms/step - accuracy: 0.9897 - auc: 0.9992 - loss: 0.0463 - precision: 0.9896 - recall: 0.9897 - val_ac
Epoch 13/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 2s 67ms/step - accuracy: 0.9921 - auc: 0.9996 - loss: 0.0379 - precision: 0.9916 - recall: 0.9926 - val_ac
Epoch 14/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 2s 44ms/step - accuracy: 0.9851 - auc: 0.9981 - loss: 0.0496 - precision: 0.9833 - recall: 0.9869 - val_ac
Epoch 15/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 3s 44ms/step - accuracy: 0.9839 - auc: 0.9975 - loss: 0.0517 - precision: 0.9813 - recall: 0.9865 - val_ac
Epoch 16/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 1s 45ms/step - accuracy: 0.9953 - auc: 0.9996 - loss: 0.0241 - precision: 0.9938 - recall: 0.9967 - val_ac
Epoch 17/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 1s 43ms/step - accuracy: 0.9974 - auc: 0.9999 - loss: 0.0162 - precision: 0.9973 - recall: 0.9974 - val_ac
Epoch 18/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 1s 44ms/step - accuracy: 0.9973 - auc: 0.9996 - loss: 0.0170 - precision: 0.9979 - recall: 0.9966 - val_ac
Epoch 19/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 3s 72ms/step - accuracy: 0.9998 - auc: 1.0000 - loss: 0.0085 - precision: 0.9998 - recall: 0.9998 - val_ac
Epoch 20/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 2s 67ms/step - accuracy: 0.9983 - auc: 0.9997 - loss: 0.0114 - precision: 0.9987 - recall: 0.9978 - val_ac

Training model with 64 hidden units...
Epoch 1/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 6s 130ms/step - accuracy: 0.7005 - auc: 0.7644 - loss: 0.5875 - precision: 0.7002 - recall: 0.7040 - val_a
Epoch 2/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 3s 62ms/step - accuracy: 0.8883 - auc: 0.9495 - loss: 0.3122 - precision: 0.8833 - recall: 0.8935 - val_ac
Epoch 3/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 2s 63ms/step - accuracy: 0.9135 - auc: 0.9700 - loss: 0.2320 - precision: 0.9094 - recall: 0.9174 - val_ac
Epoch 4/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 3s 66ms/step - accuracy: 0.9389 - auc: 0.9833 - loss: 0.1757 - precision: 0.9384 - recall: 0.9388 - val_ac
Epoch 5/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 3s 70ms/step - accuracy: 0.9375 - auc: 0.9850 - loss: 0.1608 - precision: 0.9360 - recall: 0.9386 - val_ac
Epoch 6/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 3s 102ms/step - accuracy: 0.9589 - auc: 0.9919 - loss: 0.1215 - precision: 0.9592 - recall: 0.9580 - val_a
Epoch 7/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 2s 70ms/step - accuracy: 0.9665 - auc: 0.9948 - loss: 0.0984 - precision: 0.9665 - recall: 0.9662 - val_ac
Epoch 8/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 2s 69ms/step - accuracy: 0.9757 - auc: 0.9961 - loss: 0.0817 - precision: 0.9752 - recall: 0.9760 - val_ac
Epoch 9/20
```

```
Epoch 9/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 2s 64ms/step - accuracy: 0.9773 - auc: 0.9971 - loss: 0.0718 - precision: 0.9796 - recall: 0.9747 - val_ac
Epoch 10/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 3s 67ms/step - accuracy: 0.9859 - auc: 0.9986 - loss: 0.0521 - precision: 0.9854 - recall: 0.9862 - val_ac
Epoch 11/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 3s 105ms/step - accuracy: 0.9884 - auc: 0.9994 - loss: 0.0431 - precision: 0.9875 - recall: 0.9892 - val_a
Epoch 12/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 2s 72ms/step - accuracy: 0.9947 - auc: 0.9998 - loss: 0.0271 - precision: 0.9948 - recall: 0.9945 - val_ac
Epoch 13/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 2s 64ms/step - accuracy: 0.9828 - auc: 0.9981 - loss: 0.0515 - precision: 0.9845 - recall: 0.9809 - val_ac
Epoch 14/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 3s 72ms/step - accuracy: 0.9948 - auc: 0.9996 - loss: 0.0231 - precision: 0.9952 - recall: 0.9942 - val_ac
Epoch 15/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 2s 66ms/step - accuracy: 0.9998 - auc: 1.0000 - loss: 0.0076 - precision: 0.9997 - recall: 0.9998 - val_ac
Epoch 16/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 3s 109ms/step - accuracy: 0.9924 - auc: 0.9988 - loss: 0.0266 - precision: 0.9918 - recall: 0.9930 - val_a
Epoch 17/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 4s 69ms/step - accuracy: 0.9999 - auc: 1.0000 - loss: 0.0044 - precision: 0.9998 - recall: 1.0000 - val_ac
Epoch 18/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 2s 73ms/step - accuracy: 0.9978 - auc: 0.9995 - loss: 0.0106 - precision: 0.9974 - recall: 0.9982 - val_ac
Epoch 19/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 2s 71ms/step - accuracy: 1.0000 - auc: 1.0000 - loss: 0.0036 - precision: 1.0000 - recall: 1.0000 - val_ac
Epoch 20/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 3s 103ms/step - accuracy: 0.9994 - auc: 0.9999 - loss: 0.0042 - precision: 0.9989 - recall: 0.9998 - val_a

Training model with 128 hidden units...
Epoch 1/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 7s 176ms/step - accuracy: 0.6496 - auc: 0.7200 - loss: 0.6054 - precision: 0.6437 - recall: 0.5851 - val_a
Epoch 2/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 4s 120ms/step - accuracy: 0.8783 - auc: 0.9412 - loss: 0.3207 - precision: 0.8710 - recall: 0.8865 - val_a
Epoch 3/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 4s 120ms/step - accuracy: 0.9084 - auc: 0.9648 - loss: 0.2432 - precision: 0.9004 - recall: 0.9171 - val_a
Epoch 4/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 6s 161ms/step - accuracy: 0.9372 - auc: 0.9819 - loss: 0.1769 - precision: 0.9334 - recall: 0.9407 - val_a
Epoch 5/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 4s 119ms/step - accuracy: 0.9494 - auc: 0.9879 - loss: 0.1442 - precision: 0.9464 - recall: 0.9522 - val_a
Epoch 6/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 4s 120ms/step - accuracy: 0.9598 - auc: 0.9923 - loss: 0.1174 - precision: 0.9581 - recall: 0.9611 - val_a
Epoch 7/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 6s 146ms/step - accuracy: 0.9674 - auc: 0.9946 - loss: 0.0967 - precision: 0.9649 - recall: 0.9698 - val_a
Epoch 8/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 4s 117ms/step - accuracy: 0.9806 - auc: 0.9977 - loss: 0.0659 - precision: 0.9797 - recall: 0.9814 - val_a
Epoch 9/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 5s 123ms/step - accuracy: 0.9855 - auc: 0.9970 - loss: 0.0562 - precision: 0.9840 - recall: 0.9868 - val_a
Epoch 10/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 5s 121ms/step - accuracy: 0.9932 - auc: 0.9988 - loss: 0.0338 - precision: 0.9918 - recall: 0.9946 - val_a
Epoch 11/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 5s 119ms/step - accuracy: 0.9970 - auc: 0.9999 - loss: 0.0190 - precision: 0.9967 - recall: 0.9974 - val_a
Epoch 12/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 5s 113ms/step - accuracy: 0.9972 - auc: 0.9995 - loss: 0.0187 - precision: 0.9974 - recall: 0.9970 - val_a
Epoch 13/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 4s 120ms/step - accuracy: 0.9997 - auc: 1.0000 - loss: 0.0125 - precision: 0.9998 - recall: 0.9995 - val_a
Epoch 14/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 4s 120ms/step - accuracy: 0.9997 - auc: 1.0000 - loss: 0.0059 - precision: 0.9998 - recall: 0.9995 - val_a
Epoch 15/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 5s 155ms/step - accuracy: 0.9846 - auc: 0.9951 - loss: 0.0598 - precision: 0.9820 - recall: 0.9872 - val_a
Epoch 16/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 3s 99ms/step - accuracy: 1.0000 - auc: 1.0000 - loss: 0.0032 - precision: 1.0000 - recall: 1.0000 - val_ac
Epoch 17/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 4s 120ms/step - accuracy: 0.9904 - auc: 0.9983 - loss: 0.0307 - precision: 0.9888 - recall: 0.9920 - val_a
Epoch 18/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 3s 107ms/step - accuracy: 1.0000 - auc: 1.0000 - loss: 0.0026 - precision: 1.0000 - recall: 1.0000 - val_a
Epoch 19/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 5s 118ms/step - accuracy: 1.0000 - auc: 1.0000 - loss: 0.0015 - precision: 1.0000 - recall: 1.0000 - val_a
Epoch 20/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 5s 117ms/step - accuracy: 0.9926 - auc: 0.9975 - loss: 0.0323 - precision: 0.9919 - recall: 0.9932 - val_a

Training model with 256 hidden units...
Epoch 1/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 9s 243ms/step - accuracy: 0.6450 - auc: 0.7088 - loss: 0.6159 - precision: 0.6518 - recall: 0.6126 - val_a
Epoch 2/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 5s 168ms/step - accuracy: 0.8693 - auc: 0.9391 - loss: 0.3220 - precision: 0.8698 - recall: 0.8673 - val_a
Epoch 3/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 7s 221ms/step - accuracy: 0.8955 - auc: 0.9593 - loss: 0.2595 - precision: 0.8911 - recall: 0.9000 - val_a
Epoch 4/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 5s 169ms/step - accuracy: 0.9379 - auc: 0.9833 - loss: 0.1681 - precision: 0.9370 - recall: 0.9382 - val_a
Epoch 5/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 6s 212ms/step - accuracy: 0.9490 - auc: 0.9893 - loss: 0.1370 - precision: 0.9517 - recall: 0.9455 - val_a
Epoch 6/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 5s 162ms/step - accuracy: 0.9611 - auc: 0.9943 - loss: 0.1049 - precision: 0.9546 - recall: 0.9687 - val_a
Epoch 7/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 5s 168ms/step - accuracy: 0.9725 - auc: 0.9951 - loss: 0.0838 - precision: 0.9739 - recall: 0.9706 - val_a
Epoch 8/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 6s 209ms/step - accuracy: 0.9828 - auc: 0.9969 - loss: 0.0605 - precision: 0.9818 - recall: 0.9837 - val_a
Epoch 9/20
```

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30/30 ─────────────── 10s 202ms/step - accuracy: 0.9908 - auc: 0.9989 - loss: 0.0338 - precision: 0.9891 - recall: 0.9924 - val_
Epoch 10/20
30/30 ─────────────── 5s 164ms/step - accuracy: 0.9918 - auc: 0.9987 - loss: 0.0302 - precision: 0.9921 - recall: 0.9913 - val_a
Epoch 11/20
30/30 ─────────────── 5s 162ms/step - accuracy: 0.9995 - auc: 1.0000 - loss: 0.0083 - precision: 0.9998 - recall: 0.9993 - val_a
Epoch 12/20
30/30 ─────────────── 6s 210ms/step - accuracy: 0.9958 - auc: 0.9980 - loss: 0.0247 - precision: 0.9972 - recall: 0.9944 - val_a
Epoch 13/20
30/30 ─────────────── 11s 224ms/step - accuracy: 1.0000 - auc: 1.0000 - loss: 0.0059 - precision: 1.0000 - recall: 1.0000 - val_
Epoch 14/20
30/30 ─────────────── 5s 167ms/step - accuracy: 1.0000 - auc: 1.0000 - loss: 0.0026 - precision: 1.0000 - recall: 1.0000 - val_a
Epoch 15/20
30/30 ─────────────── 5s 178ms/step - accuracy: 0.9986 - auc: 0.9994 - loss: 0.0083 - precision: 0.9992 - recall: 0.9980 - val_a
Epoch 16/20
30/30 ─────────────── 10s 164ms/step - accuracy: 0.9987 - auc: 1.0000 - loss: 0.0067 - precision: 0.9975 - recall: 1.0000 - val_
Epoch 17/20
30/30 ─────────────── 6s 211ms/step - accuracy: 1.0000 - auc: 1.0000 - loss: 0.0014 - precision: 1.0000 - recall: 1.0000 - val_a
Epoch 18/20
30/30 ─────────────── 5s 168ms/step - accuracy: 1.0000 - auc: 1.0000 - loss: 8.5040e-04 - precision: 1.0000 - recall: 1.0000 - v
Epoch 19/20
30/30 ─────────────── 6s 201ms/step - accuracy: 1.0000 - auc: 1.0000 - loss: 7.1691e-04 - precision: 1.0000 - recall: 1.0000 - v
Epoch 20/20
30/30 ─────────────── 9s 168ms/step - accuracy: 0.9831 - auc: 0.9935 - loss: 0.0757 - precision: 0.9834 - recall: 0.9826 - val_a
```
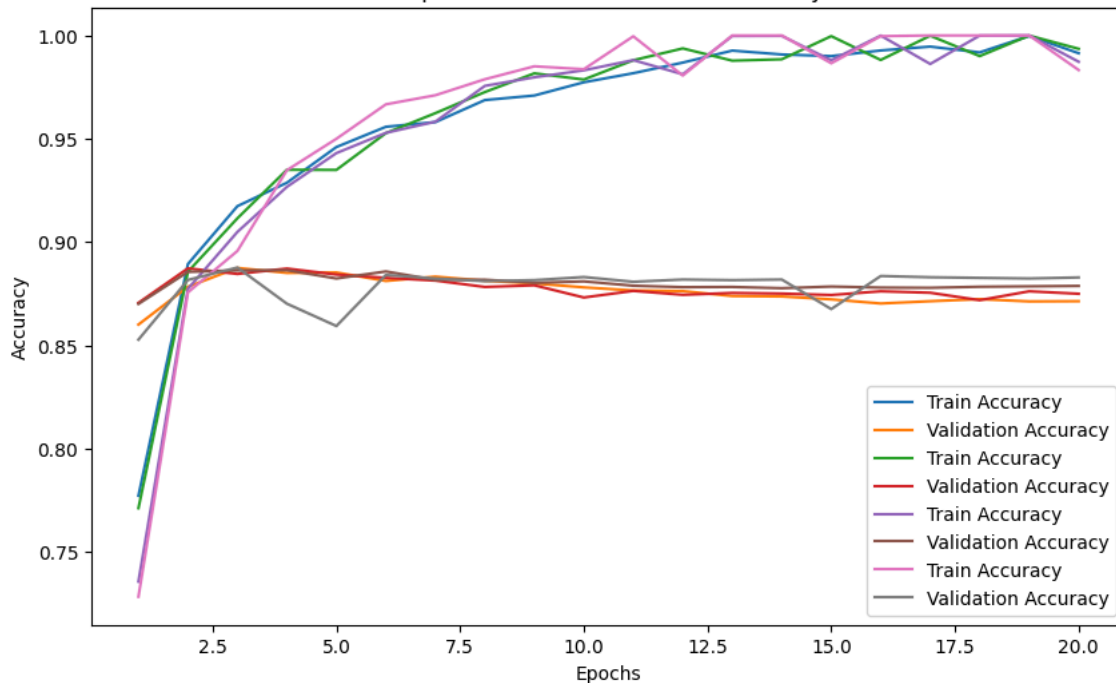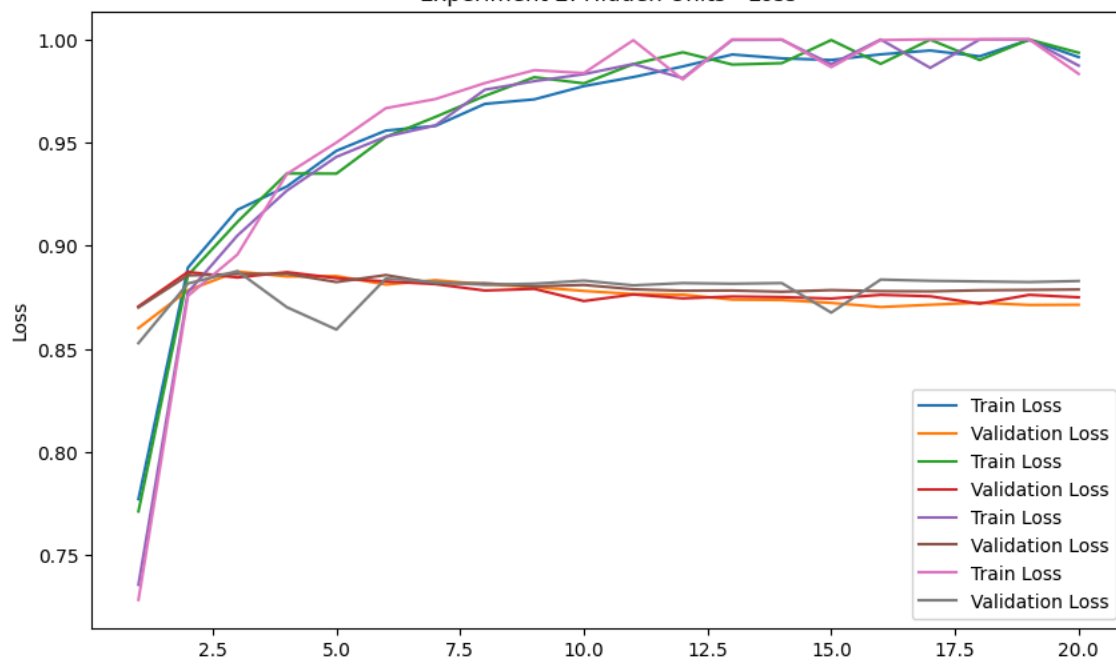

Experiment 2: Hidden Units - Accuracy

Experiment 2: Hidden Units - Loss

Epochs

--- Experiment 3: Loss Functions ---

Training model with binary_crossentropy loss...
Epoch 1/20
30/30 ──────────────── **5s** 100ms/step - accuracy: 0.6837 - auc: 0.7678 - loss: 0.6238 - precision: 0.7639 - recall: 0.5192 - val_a
Epoch 2/20
30/30 ──────────────── **3s** 40ms/step - accuracy: 0.8855 - auc: 0.9484 - loss: 0.3737 - precision: 0.8912 - recall: 0.8768 - val_ac
Epoch 3/20
30/30 ──────────────── **1s** 39ms/step - accuracy: 0.9145 - auc: 0.9700 - loss: 0.2669 - precision: 0.9126 - recall: 0.9156 - val_ac
Epoch 4/20
30/30 ──────────────── **1s** 39ms/step - accuracy: 0.9299 - auc: 0.9787 - loss: 0.2150 - precision: 0.9298 - recall: 0.9292 - val_ac
Epoch 5/20
30/30 ──────────────── **1s** 37ms/step - accuracy: 0.9417 - auc: 0.9850 - loss: 0.1783 - precision: 0.9426 - recall: 0.9399 - val_ac
Epoch 6/20
30/30 ──────────────── **1s** 39ms/step - accuracy: 0.9555 - auc: 0.9900 - loss: 0.1475 - precision: 0.9553 - recall: 0.9552 - val_ac
Epoch 7/20
30/30 ──────────────── **1s** 39ms/step - accuracy: 0.9633 - auc: 0.9930 - loss: 0.1251 - precision: 0.9638 - recall: 0.9624 - val_ac
Epoch 8/20
30/30 ──────────────── **2s** 50ms/step - accuracy: 0.9719 - auc: 0.9950 - loss: 0.1068 - precision: 0.9719 - recall: 0.9715 - val_ac
Epoch 9/20
30/30 ──────────────── **2s** 65ms/step - accuracy: 0.9761 - auc: 0.9965 - loss: 0.0914 - precision: 0.9776 - recall: 0.9742 - val_ac
Epoch 10/20
30/30 ──────────────── **2s** 38ms/step - accuracy: 0.9794 - auc: 0.9973 - loss: 0.0802 - precision: 0.9798 - recall: 0.9787 - val_ac
Epoch 11/20
30/30 ──────────────── **1s** 36ms/step - accuracy: 0.9825 - auc: 0.9981 - loss: 0.0693 - precision: 0.9825 - recall: 0.9823 - val_ac
Epoch 12/20
30/30 ──────────────── **1s** 40ms/step - accuracy: 0.9892 - auc: 0.9989 - loss: 0.0570 - precision: 0.9889 - recall: 0.9893 - val_ac
Epoch 13/20
30/30 ──────────────── **1s** 38ms/step - accuracy: 0.9883 - auc: 0.9990 - loss: 0.0533 - precision: 0.9887 - recall: 0.9878 - val_ac
Epoch 14/20
30/30 ──────────────── **1s** 37ms/step - accuracy: 0.9897 - auc: 0.9993 - loss: 0.0461 - precision: 0.9899 - recall: 0.9894 - val_ac
Epoch 15/20
30/30 ──────────────── **1s** 38ms/step - accuracy: 0.9936 - auc: 0.9996 - loss: 0.0364 - precision: 0.9944 - recall: 0.9928 - val_ac
Epoch 16/20
30/30 ──────────────── **1s** 36ms/step - accuracy: 0.9944 - auc: 0.9997 - loss: 0.0328 - precision: 0.9954 - recall: 0.9933 - val_ac
Epoch 17/20
30/30 ──────────────── **1s** 43ms/step - accuracy: 0.9965 - auc: 0.9998 - loss: 0.0275 - precision: 0.9961 - recall: 0.9967 - val_ac
Epoch 18/20
30/30 ──────────────── **2s** 54ms/step - accuracy: 0.9974 - auc: 0.9999 - loss: 0.0225 - precision: 0.9967 - recall: 0.9981 - val_ac
Epoch 19/20
30/30 ──────────────── **2s** 50ms/step - accuracy: 0.9965 - auc: 0.9999 - loss: 0.0237 - precision: 0.9960 - recall: 0.9969 - val_ac
Epoch 20/20
30/30 ──────────────── **2s** 39ms/step - accuracy: 0.9951 - auc: 0.9999 - loss: 0.0224 - precision: 0.9953 - recall: 0.9949 - val_ac

Training model with mse loss...
Epoch 1/20
30/30 ──────────────── **6s** 147ms/step - accuracy: 0.6952 - auc: 0.7699 - loss: 0.2112 - precision: 0.7333 - recall: 0.5915 - val_a
Epoch 2/20
30/30 ──────────────── **2s** 51ms/step - accuracy: 0.8803 - auc: 0.9456 - loss: 0.1157 - precision: 0.8770 - recall: 0.8831 - val_ac
Epoch 3/20
30/30 ──────────────── **2s** 51ms/step - accuracy: 0.9084 - auc: 0.9648 - loss: 0.0843 - precision: 0.9059 - recall: 0.9104 - val_ac
Epoch 4/20
30/30 ──────────────── **2s** 44ms/step - accuracy: 0.9225 - auc: 0.9745 - loss: 0.0679 - precision: 0.9200 - recall: 0.9246 - val_ac
Epoch 5/20
30/30 ──────────────── **1s** 39ms/step - accuracy: 0.9382 - auc: 0.9806 - loss: 0.0563 - precision: 0.9370 - recall: 0.9388 - val_ac
Epoch 6/20
30/30 ──────────────── **4s** 150ms/step - accuracy: 0.9482 - auc: 0.9838 - loss: 0.0489 - precision: 0.9497 - recall: 0.9460 - val_a
Epoch 7/20
30/30 ──────────────── **3s** 84ms/step - accuracy: 0.9547 - auc: 0.9861 - loss: 0.0433 - precision: 0.9544 - recall: 0.9545 - val_ac
Epoch 8/20
30/30 ──────────────── **1s** 39ms/step - accuracy: 0.9583 - auc: 0.9878 - loss: 0.0393 - precision: 0.9584 - recall: 0.9577 - val_ac
Epoch 9/20
30/30 ──────────────── **1s** 39ms/step - accuracy: 0.9679 - auc: 0.9895 - loss: 0.0337 - precision: 0.9683 - recall: 0.9672 - val_ac
Epoch 10/20
30/30 ──────────────── **1s** 39ms/step - accuracy: 0.9718 - auc: 0.9903 - loss: 0.0305 - precision: 0.9724 - recall: 0.9709 - val_ac
Epoch 11/20
30/30 ──────────────── **1s** 40ms/step - accuracy: 0.9742 - auc: 0.9911 - loss: 0.0277 - precision: 0.9731 - recall: 0.9750 - val_ac
Epoch 12/20
30/30 ──────────────── **1s** 37ms/step - accuracy: 0.9788 - auc: 0.9915 - loss: 0.0250 - precision: 0.9798 - recall: 0.9775 - val_ac
Epoch 13/20
30/30 ──────────────── **1s** 40ms/step - accuracy: 0.9794 - auc: 0.9917 - loss: 0.0238 - precision: 0.9803 - recall: 0.9781 - val_ac
Epoch 14/20
30/30 ──────────────── **1s** 38ms/step - accuracy: 0.9834 - auc: 0.9923 - loss: 0.0205 - precision: 0.9828 - recall: 0.9839 - val_ac
Epoch 15/20
30/30 ──────────────── **2s** 52ms/step - accuracy: 0.9859 - auc: 0.9926 - loss: 0.0181 - precision: 0.9865 - recall: 0.9851 - val_ac
Epoch 16/20
30/30 ──────────────── **2s** 56ms/step - accuracy: 0.9884 - auc: 0.9929 - loss: 0.0162 - precision: 0.9877 - recall: 0.9891 - val_ac
Epoch 17/20
30/30 ──────────────── **2s** 39ms/step - accuracy: 0.9886 - auc: 0.9930 - loss: 0.0154 - precision: 0.9886 - recall: 0.9886 - val_ac
Epoch 18/20
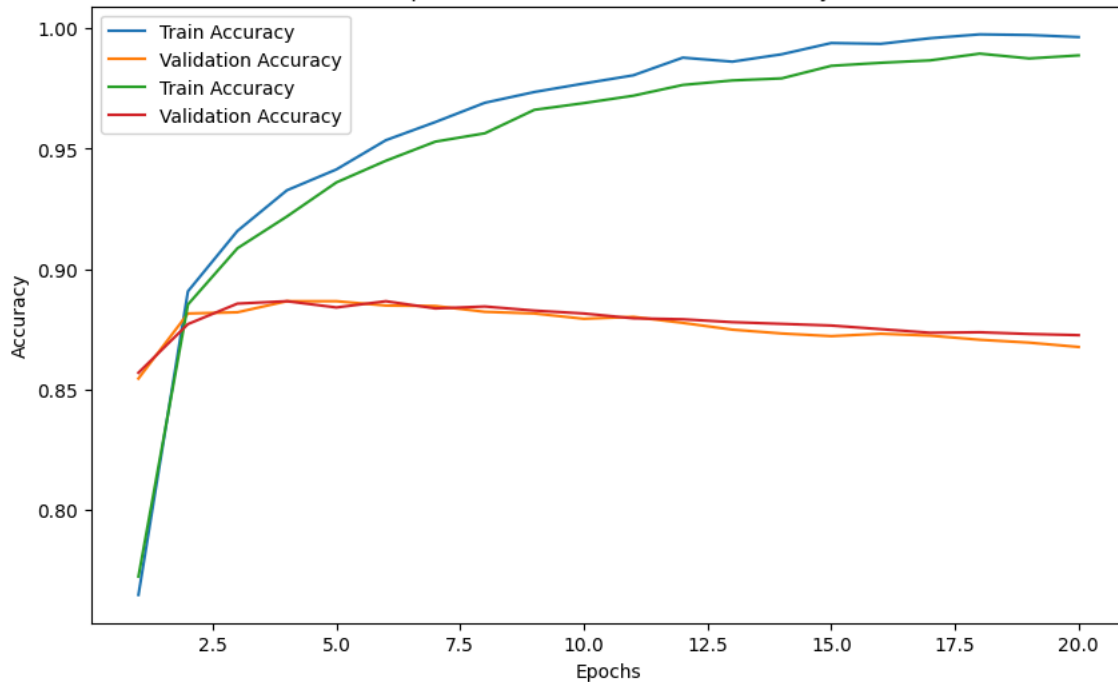30/30 ──────────────── **1s** 41ms/step - accuracy: 0.9904 - auc: 0.9932 - loss: 0.0140 - precision: 0.9902 - recall: 0.9904 - val_ac
Epoch 19/20
30/30 ──────────────── **2s** 38ms/step - accuracy: 0.9903 - auc: 0.9933 - loss: 0.0131 - precision: 0.9901 - recall: 0.9904 - val_ac

```
Epoch 20/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 1s 39ms/step - accuracy: 0.9916 - auc: 0.9936 - loss: 0.0115 - precision: 0.9917 - recall: 0.9915 - val_a
```
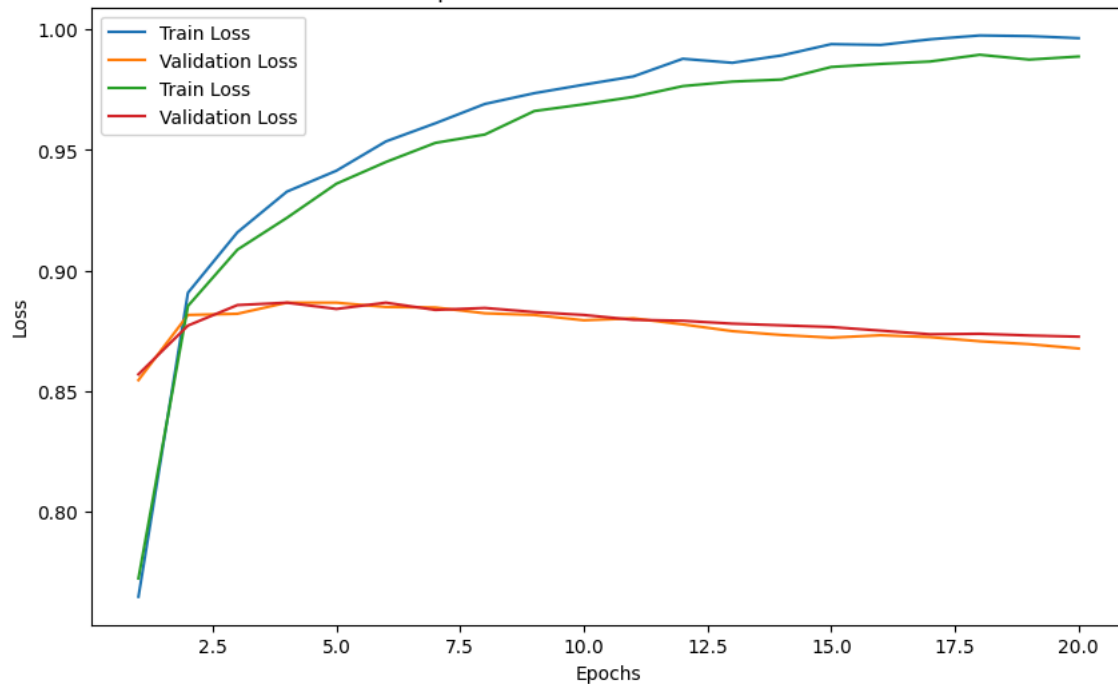
Experiment 3: Loss Functions - Accuracy

Experiment 3: Loss Functions - Loss


```
--- Experiment 4: Activation Functions ---

Training model with relu activation...
Epoch 1/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 4s 83ms/step - accuracy: 0.6693 - auc: 0.7691 - loss: 0.6081 - precision: 0.7639 - recall: 0.4569 - val_ac
Epoch 2/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 1s 41ms/step - accuracy: 0.8914 - auc: 0.9529 - loss: 0.3500 - precision: 0.8945 - recall: 0.8861 - val_ac
Epoch 3/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 3s 66ms/step - accuracy: 0.9161 - auc: 0.9707 - loss: 0.2536 - precision: 0.9142 - recall: 0.9174 - val_ac
Epoch 4/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 2s 38ms/step - accuracy: 0.9323 - auc: 0.9811 - loss: 0.1988 - precision: 0.9300 - recall: 0.9341 - val_ac
Epoch 5/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 1s 39ms/step - accuracy: 0.9520 - auc: 0.9883 - loss: 0.1591 - precision: 0.9521 - recall: 0.9513 - val_ac
Epoch 6/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 1s 38ms/step - accuracy: 0.9591 - auc: 0.9916 - loss: 0.1335 - precision: 0.9573 - recall: 0.9605 - val_ac
Epoch 7/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 1s 39ms/step - accuracy: 0.9662 - auc: 0.9939 - loss: 0.1145 - precision: 0.9659 - recall: 0.9660 - val_ac
Epoch 8/20
30/30 ━━━━━━━━━━━━━━━━━━━━ 1s 38ms/step - accuracy: 0.9722 - auc: 0.9962 - loss: 0.0959 - precision: 0.9715 - recall: 0.9727 - val_ac
```
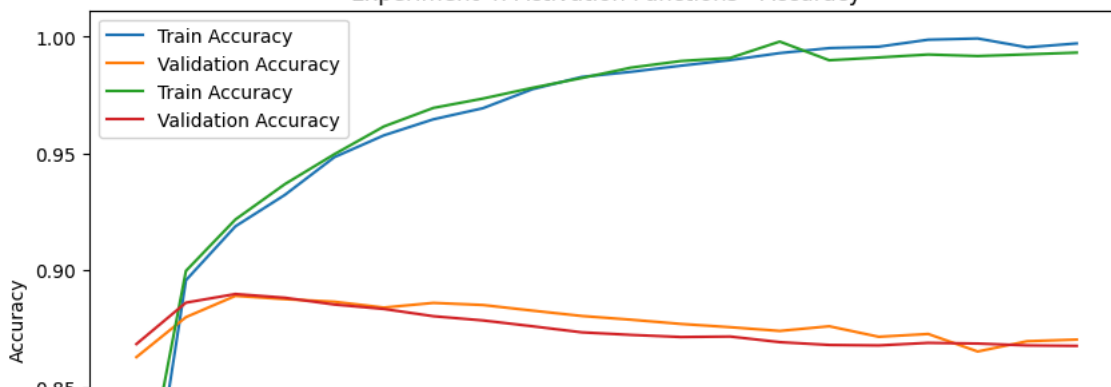
```
                          1s 38ms/step - accuracy: 0.9722 - auc: 0.9982 - loss: 0.0950 - precision: 0.9715 - recall: 0.9727 - val_ac
Epoch 9/20
30/30 ─────────────────── 1s 39ms/step - accuracy: 0.9787 - auc: 0.9975 - loss: 0.0777 - precision: 0.9784 - recall: 0.9787 - val_ac
Epoch 10/20
30/30 ─────────────────── 1s 38ms/step - accuracy: 0.9842 - auc: 0.9983 - loss: 0.0658 - precision: 0.9834 - recall: 0.9849 - val_ac
Epoch 11/20
30/30 ─────────────────── 2s 50ms/step - accuracy: 0.9873 - auc: 0.9990 - loss: 0.0552 - precision: 0.9868 - recall: 0.9877 - val_ac
Epoch 12/20
30/30 ─────────────────── 2s 59ms/step - accuracy: 0.9900 - auc: 0.9993 - loss: 0.0480 - precision: 0.9899 - recall: 0.9900 - val_ac
Epoch 13/20
30/30 ─────────────────── 2s 39ms/step - accuracy: 0.9929 - auc: 0.9996 - loss: 0.0380 - precision: 0.9919 - recall: 0.9939 - val_ac
Epoch 14/20
30/30 ─────────────────── 1s 38ms/step - accuracy: 0.9953 - auc: 0.9998 - loss: 0.0291 - precision: 0.9949 - recall: 0.9957 - val_ac
Epoch 15/20
30/30 ─────────────────── 1s 38ms/step - accuracy: 0.9968 - auc: 0.9999 - loss: 0.0244 - precision: 0.9965 - recall: 0.9970 - val_ac
Epoch 16/20
30/30 ─────────────────── 1s 39ms/step - accuracy: 0.9976 - auc: 1.0000 - loss: 0.0201 - precision: 0.9971 - recall: 0.9982 - val_ac
Epoch 17/20
30/30 ─────────────────── 1s 38ms/step - accuracy: 0.9991 - auc: 1.0000 - loss: 0.0157 - precision: 0.9989 - recall: 0.9993 - val_ac
Epoch 18/20
30/30 ─────────────────── 1s 38ms/step - accuracy: 0.9993 - auc: 1.0000 - loss: 0.0134 - precision: 0.9987 - recall: 0.9998 - val_ac
Epoch 19/20
30/30 ─────────────────── 1s 37ms/step - accuracy: 0.9887 - auc: 0.9991 - loss: 0.0329 - precision: 0.9884 - recall: 0.9891 - val_ac
Epoch 20/20
30/30 ─────────────────── 1s 42ms/step - accuracy: 0.9954 - auc: 0.9995 - loss: 0.0215 - precision: 0.9966 - recall: 0.9941 - val_ac

Training model with tanh activation...
Epoch 1/20
30/30 ─────────────────── 4s 82ms/step - accuracy: 0.7049 - auc: 0.7782 - loss: 0.5811 - precision: 0.7121 - recall: 0.6878 - val_ac
Epoch 2/20
30/30 ─────────────────── 2s 52ms/step - accuracy: 0.8988 - auc: 0.9590 - loss: 0.3247 - precision: 0.8955 - recall: 0.9016 - val_ac
Epoch 3/20
30/30 ─────────────────── 1s 43ms/step - accuracy: 0.9236 - auc: 0.9754 - loss: 0.2318 - precision: 0.9218 - recall: 0.9248 - val_ac
Epoch 4/20
30/30 ─────────────────── 3s 56ms/step - accuracy: 0.9387 - auc: 0.9829 - loss: 0.1805 - precision: 0.9377 - recall: 0.9391 - val_ac
Epoch 5/20
30/30 ─────────────────── 1s 44ms/step - accuracy: 0.9544 - auc: 0.9885 - loss: 0.1412 - precision: 0.9549 - recall: 0.9534 - val_ac
Epoch 6/20
30/30 ─────────────────── 2s 41ms/step - accuracy: 0.9645 - auc: 0.9918 - loss: 0.1138 - precision: 0.9647 - recall: 0.9639 - val_ac
Epoch 7/20
30/30 ─────────────────── 3s 40ms/step - accuracy: 0.9720 - auc: 0.9938 - loss: 0.0948 - precision: 0.9720 - recall: 0.9717 - val_ac
Epoch 8/20
30/30 ─────────────────── 1s 41ms/step - accuracy: 0.9774 - auc: 0.9954 - loss: 0.0781 - precision: 0.9775 - recall: 0.9771 - val_ac
Epoch 9/20
30/30 ─────────────────── 2s 52ms/step - accuracy: 0.9780 - auc: 0.9961 - loss: 0.0705 - precision: 0.9790 - recall: 0.9766 - val_ac
Epoch 10/20
30/30 ─────────────────── 2s 73ms/step - accuracy: 0.9887 - auc: 0.9974 - loss: 0.0491 - precision: 0.9885 - recall: 0.9888 - val_ac
Epoch 11/20
30/30 ─────────────────── 2s 40ms/step - accuracy: 0.9930 - auc: 0.9982 - loss: 0.0364 - precision: 0.9937 - recall: 0.9923 - val_ac
Epoch 12/20
30/30 ─────────────────── 1s 41ms/step - accuracy: 0.9940 - auc: 0.9985 - loss: 0.0310 - precision: 0.9944 - recall: 0.9935 - val_ac
Epoch 13/20
30/30 ─────────────────── 1s 41ms/step - accuracy: 0.9962 - auc: 0.9987 - loss: 0.0253 - precision: 0.9966 - recall: 0.9957 - val_ac
Epoch 14/20
30/30 ─────────────────── 1s 39ms/step - accuracy: 0.9982 - auc: 0.9990 - loss: 0.0193 - precision: 0.9980 - recall: 0.9984 - val_ac
Epoch 15/20
30/30 ─────────────────── 1s 40ms/step - accuracy: 0.9836 - auc: 0.9960 - loss: 0.0567 - precision: 0.9815 - recall: 0.9855 - val_ac
Epoch 16/20
30/30 ─────────────────── 1s 40ms/step - accuracy: 0.9871 - auc: 0.9980 - loss: 0.0431 - precision: 0.9863 - recall: 0.9876 - val_ac
Epoch 17/20
30/30 ─────────────────── 1s 40ms/step - accuracy: 0.9918 - auc: 0.9985 - loss: 0.0289 - precision: 0.9931 - recall: 0.9904 - val_ac
Epoch 18/20
30/30 ─────────────────── 2s 54ms/step - accuracy: 0.9935 - auc: 0.9987 - loss: 0.0250 - precision: 0.9932 - recall: 0.9937 - val_ac
Epoch 19/20
30/30 ─────────────────── 2s 46ms/step - accuracy: 0.9953 - auc: 0.9987 - loss: 0.0210 - precision: 0.9943 - recall: 0.9963 - val_ac
Epoch 20/20
30/30 ─────────────────── 1s 42ms/step - accuracy: 0.9969 - auc: 0.9995 - loss: 0.0135 - precision: 0.9971 - recall: 0.9966 - val_ac
```
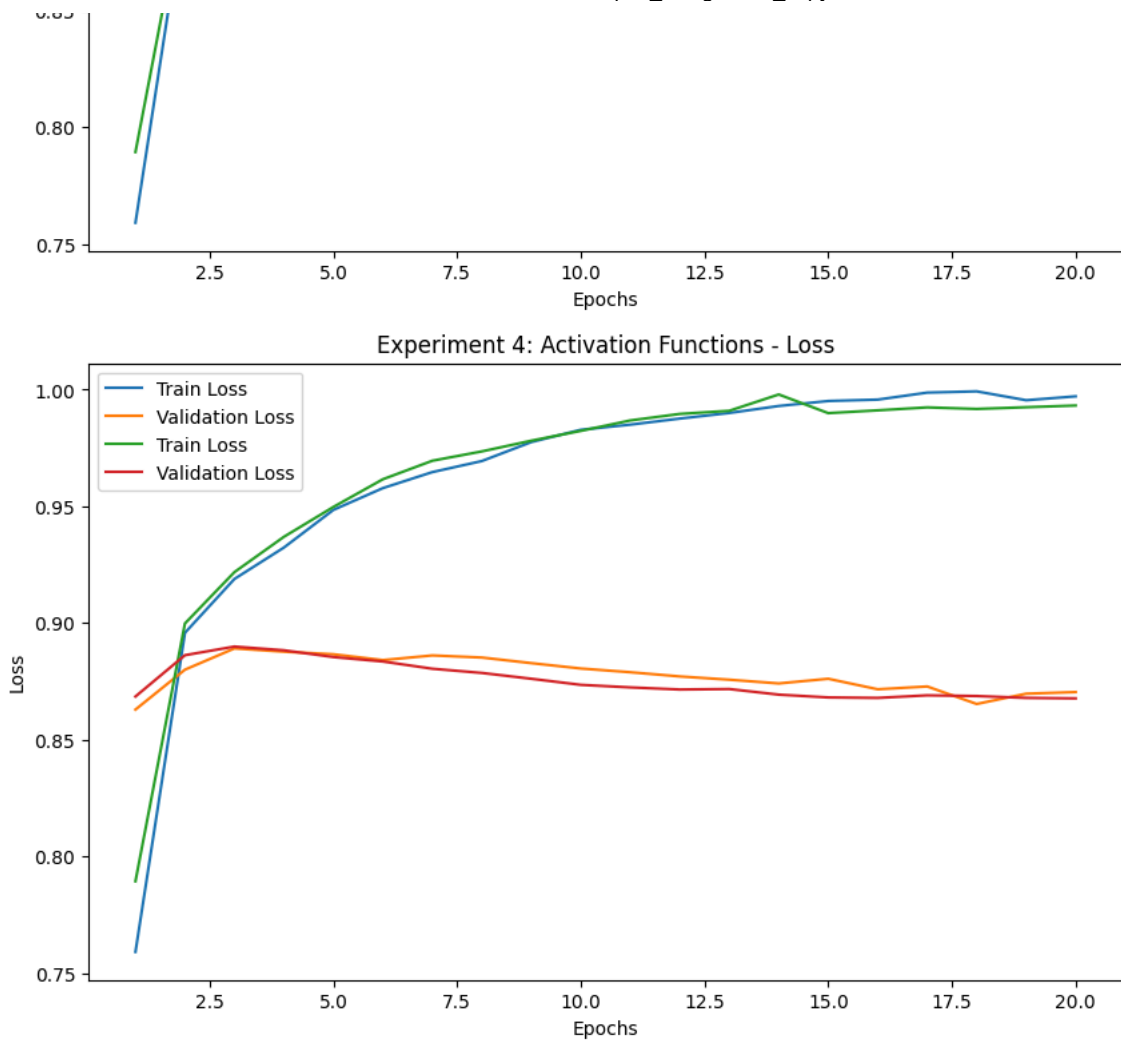

Experiment 4: Activation Functions - Accuracy

Experiment 4: Activation Functions - Loss

--- Experiment 5: Dropout Regularization ---

Training model with dropout rate 0.3...
Epoch 1/20
30/30 ———————————— **5s** 109ms/step - accuracy: 0.6295 - auc: 0.7065 - loss: 0.6420 - precision: 0.5924 - recall: 0.8383 - val_a
Epoch 2/20
30/30 ———————————— **3s** 43ms/step - accuracy: 0.8335 - auc: 0.9206 - loss: 0.4419 - precision: 0.7919 - recall: 0.9024 - val_ac
Epoch 3/20
30/30 ———————————— **1s** 39ms/step - accuracy: 0.8806 - auc: 0.9461 - loss: 0.3465 - precision: 0.8570 - recall: 0.9120 - val_ac
Epoch 4/20
30/30 ———————————— **1s** 39ms/step - accuracy: 0.9096 - auc: 0.9621 - loss: 0.2889 - precision: 0.8940 - recall: 0.9283 - val_ac
Epoch 5/20
30/30 ———————————— **1s** 37ms/step - accuracy: 0.9247 - auc: 0.9707 - loss: 0.2469 - precision: 0.9163 - recall: 0.9339 - val_ac
Epoch 6/20
30/30 ———————————— **1s** 39ms/step - accuracy: 0.9418 - auc: 0.9792 - loss: 0.2078 - precision: 0.9430 - recall: 0.9398 - val_ac
Epoch 7/20
30/30 ———————————— **1s** 47ms/step - accuracy: 0.9501 - auc: 0.9848 - loss: 0.1752 - precision: 0.9493 - recall: 0.9504 - val_ac
Epoch 8/20
30/30 ———————————— **2s** 61ms/step - accuracy: 0.9544 - auc: 0.9870 - loss: 0.1541 - precision: 0.9571 - recall: 0.9510 - val_ac
Epoch 9/20
30/30 ———————————— **1s** 40ms/step - accuracy: 0.9588 - auc: 0.9899 - loss: 0.1349 - precision: 0.9611 - recall: 0.9558 - val_ac
Epoch 10/20
30/30 ———————————— **1s** 38ms/step - accuracy: 0.9699 - auc: 0.9927 - loss: 0.1138 - precision: 0.9723 - recall: 0.9671 - val_ac
Epoch 11/20
30/30 ———————————— **1s** 38ms/step - accuracy: 0.9721 - auc: 0.9936 - loss: 0.1024 - precision: 0.9756 - recall: 0.9682 - val_ac
Epoch 12/20
30/30 ———————————— **1s** 37ms/step - accuracy: 0.9756 - auc: 0.9945 - loss: 0.0937 - precision: 0.9792 - recall: 0.9715 - val_ac
Epoch 13/20
30/30 ———————————— **1s** 39ms/step - accuracy: 0.9804 - auc: 0.9960 - loss: 0.0792 - precision: 0.9838 - recall: 0.9767 - val_ac
Epoch 14/20
30/30 ———————————— **1s** 40ms/step - accuracy: 0.9824 - auc: 0.9970 - loss: 0.0705 - precision: 0.9855 - recall: 0.9790 - val_ac
Epoch 15/20
30/30 ———————————— **1s** 39ms/step - accuracy: 0.9863 - auc: 0.9976 - loss: 0.0627 - precision: 0.9897 - recall: 0.9827 - val_ac
Epoch 16/20
30/30 ———————————— **1s** 37ms/step - accuracy: 0.9882 - auc: 0.9979 - loss: 0.0553 - precision: 0.9901 - recall: 0.9860 - val_ac
Epoch 17/20
30/30 ———————————— **2s** 48ms/step - accuracy: 0.9894 - auc: 0.9977 - loss: 0.0527 - precision: 0.9928 - recall: 0.9859 - val_ac
Epoch 18/20
30/30 ———————————— **2s** 39ms/step - accuracy: 0.9900 - auc: 0.9986 - loss: 0.0454 - precision: 0.9921 - recall: 0.9877 - val_ac

```
Epoch 19/20
30/30 ──────────────────── 1s 38ms/step - accuracy: 0.9941 - auc: 0.9987 - loss: 0.0399 - precision: 0.9969 - recall: 0.9912 - val_ac
Epoch 20/20
30/30 ──────────────────── 1s 39ms/step - accuracy: 0.9941 - auc: 0.9992 - loss: 0.0333 - precision: 0.9963 - recall: 0.9918 - val_ac

Training model with dropout rate 0.5...
Epoch 1/20
30/30 ──────────────────── 5s 112ms/step - accuracy: 0.6598 - auc: 0.7215 - loss: 0.6255 - precision: 0.6591 - recall: 0.6598 - val_a
Epoch 2/20
30/30 ──────────────────── 3s 40ms/step - accuracy: 0.8290 - auc: 0.9084 - loss: 0.4378 - precision: 0.8152 - recall: 0.8486 - val_ac
Epoch 3/20
30/30 ──────────────────── 1s 41ms/step - accuracy: 0.8746 - auc: 0.9425 - loss: 0.3490 - precision: 0.8705 - recall: 0.8786 - val_ac
Epoch 4/20
30/30 ──────────────────── 1s 40ms/step - accuracy: 0.8939 - auc: 0.9567 - loss: 0.2966 - precision: 0.8977 - recall: 0.8877 - val_ac
Epoch 5/20
30/30 ──────────────────── 1s 38ms/step - accuracy: 0.9080 - auc: 0.9665 - loss: 0.2580 - precision: 0.9175 - recall: 0.8955 - val_ac
Epoch 6/20
30/30 ──────────────────── 1s 39ms/step - accuracy: 0.9205 - auc: 0.9742 - loss: 0.2276 - precision: 0.9281 - recall: 0.9106 - val_ac
Epoch 7/20
30/30 ──────────────────── 2s 60ms/step - accuracy: 0.9342 - auc: 0.9803 - loss: 0.1989 - precision: 0.9438 - recall: 0.9226 - val_ac
Epoch 8/20
30/30 ──────────────────── 2s 62ms/step - accuracy: 0.9399 - auc: 0.9839 - loss: 0.1759 - precision: 0.9486 - recall: 0.9295 - val_ac
Epoch 9/20
30/30 ──────────────────── 2s 40ms/step - accuracy: 0.9433 - auc: 0.9860 - loss: 0.1628 - precision: 0.9538 - recall: 0.9310 - val_ac
Epoch 10/20
30/30 ──────────────────── 1s 38ms/step - accuracy: 0.9524 - auc: 0.9900 - loss: 0.1420 - precision: 0.9641 - recall: 0.9393 - val_ac
Epoch 11/20
30/30 ──────────────────── 1s 38ms/step - accuracy: 0.9565 - auc: 0.9919 - loss: 0.1250 - precision: 0.9689 - recall: 0.9427 - val_ac
Epoch 12/20
30/30 ──────────────────── 1s 40ms/step - accuracy: 0.9596 - auc: 0.9933 - loss: 0.1160 - precision: 0.9730 - recall: 0.9450 - val_ac
Epoch 13/20
30/30 ──────────────────── 1s 41ms/step - accuracy: 0.9644 - auc: 0.9948 - loss: 0.1027 - precision: 0.9781 - recall: 0.9497 - val_ac
Epoch 14/20
30/30 ──────────────────── 1s 38ms/step - accuracy: 0.9650 - auc: 0.9950 - loss: 0.0977 - precision: 0.9777 - recall: 0.9513 - val_ac
Epoch 15/20
30/30 ──────────────────── 1s 38ms/step - accuracy: 0.9671 - auc: 0.9960 - loss: 0.0900 - precision: 0.9820 - recall: 0.9512 - val_ac
Epoch 16/20
30/30 ──────────────────── 2s 54ms/step - accuracy: 0.9703 - auc: 0.9972 - loss: 0.0765 - precision: 0.9862 - recall: 0.9536 - val_ac
Epoch 17/20
30/30 ──────────────────── 2s 40ms/step - accuracy: 0.9709 - auc: 0.9976 - loss: 0.0708 - precision: 0.9876 - recall: 0.9535 - val_ac
Epoch 18/20
30/30 ──────────────────── 1s 39ms/step - accuracy: 0.9738 - auc: 0.9980 - loss: 0.0653 - precision: 0.9881 - recall: 0.9589 - val_ac
Epoch 19/20
30/30 ──────────────────── 1s 40ms/step - accuracy: 0.9754 - auc: 0.9981 - loss: 0.0623 - precision: 0.9905 - recall: 0.9598 - val_ac
Epoch 20/20
30/30 ──────────────────── 1s 39ms/step - accuracy: 0.9746 - auc: 0.9981 - loss: 0.0613 - precision: 0.9893 - recall: 0.9594 - val_ac

Training model with dropout rate 0.7...
Epoch 1/20
30/30 ──────────────────── 5s 93ms/step - accuracy: 0.5881 - auc: 0.6422 - loss: 0.6537 - precision: 0.5973 - recall: 0.5324 - val_ac
Epoch 2/20
30/30 ──────────────────── 1s 43ms/step - accuracy: 0.7662 - auc: 0.8675 - loss: 0.4816 - precision: 0.7913 - recall: 0.7196 - val_ac
Epoch 3/20
30/30 ──────────────────── 2s 42ms/step - accuracy: 0.8152 - auc: 0.9175 - loss: 0.3901 - precision: 0.8401 - recall: 0.7761 - val_ac
Epoch 4/20
30/30 ──────────────────── 3s 41ms/step - accuracy: 0.8388 - auc: 0.9349 - loss: 0.3412 - precision: 0.8418 - recall: 0.8324 - val_ac
Epoch 5/20
30/30 ──────────────────── 1s 46ms/step - accuracy: 0.8608 - auc: 0.9469 - loss: 0.3079 - precision: 0.8498 - recall: 0.8746 - val_ac
Epoch 6/20
30/30 ──────────────────── 2s 68ms/step - accuracy: 0.8888 - auc: 0.9596 - loss: 0.2748 - precision: 0.8809 - recall: 0.8978 - val_ac
Epoch 7/20
30/30 ──────────────────── 2s 42ms/step - accuracy: 0.9004 - auc: 0.9645 - loss: 0.2553 - precision: 0.8887 - recall: 0.9141 - val_ac
Epoch 8/20
30/30 ──────────────────── 2s 40ms/step - accuracy: 0.9156 - auc: 0.9723 - loss: 0.2300 - precision: 0.9055 - recall: 0.9270 - val_ac
Epoch 9/20
30/30 ──────────────────── 1s 39ms/step - accuracy: 0.9228 - auc: 0.9774 - loss: 0.2070 - precision: 0.9119 - recall: 0.9351 - val_ac
Epoch 10/20
30/30 ──────────────────── 1s 40ms/step - accuracy: 0.9320 - auc: 0.9795 - loss: 0.1951 - precision: 0.9182 - recall: 0.9477 - val_ac
Epoch 11/20
30/30 ──────────────────── 1s 41ms/step - accuracy: 0.9384 - auc: 0.9830 - loss: 0.1777 - precision: 0.9218 - recall: 0.9574 - val_ac
Epoch 12/20
30/30 ──────────────────── 1s 38ms/step - accuracy: 0.9424 - auc: 0.9853 - loss: 0.1621 - precision: 0.9254 - recall: 0.9616 - val_ac
Epoch 13/20
30/30 ──────────────────── 2s 56ms/step - accuracy: 0.9465 - auc: 0.9871 - loss: 0.1516 - precision: 0.9259 - recall: 0.9700 - val_ac
Epoch 14/20
30/30 ──────────────────── 2s 54ms/step - accuracy: 0.9505 - auc: 0.9884 - loss: 0.1434 - precision: 0.9291 - recall: 0.9747 - val_ac
Epoch 15/20
30/30 ──────────────────── 2s 50ms/step - accuracy: 0.9532 - auc: 0.9895 - loss: 0.1355 - precision: 0.9339 - recall: 0.9747 - val_ac
Epoch 16/20
30/30 ──────────────────── 2s 44ms/step - accuracy: 0.9521 - auc: 0.9898 - loss: 0.1289 - precision: 0.9278 - recall: 0.9801 - val_ac
Epoch 17/20
30/30 ──────────────────── 1s 40ms/step - accuracy: 0.9549 - auc: 0.9904 - loss: 0.1239 - precision: 0.9306 - recall: 0.9827 - val_ac
Epoch 18/20
30/30 ──────────────────── 1s 41ms/step - accuracy: 0.9583 - auc: 0.9917 - loss: 0.1132 - precision: 0.9346 - recall: 0.9851 - val_ac
Epoch 19/20
```
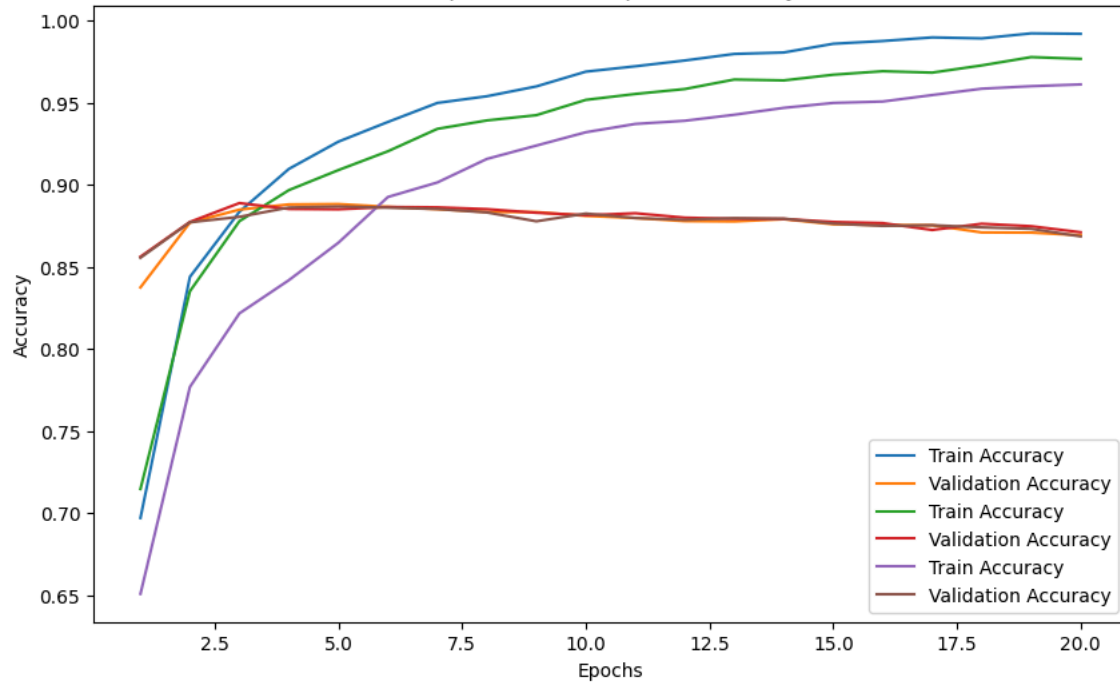
Epoch 19/20
30/30 ━━━━━━━━━━━━━━━━ **1s** 42ms/step - accuracy: 0.9620 - auc: 0.9931 - loss: 0.1046 - precision: 0.9393 - recall: 0.9874 - val_ac
Epoch 20/20
30/30 ━━━━━━━━━━━━━━━━ **1s** 40ms/step - accuracy: 0.9635 - auc: 0.9934 - loss: 0.0997 - precision: 0.9420 - recall: 0.9875 - val_ac

Experiment 5: Dropout - Accuracy

Experiment 5: Dropout - Loss