



# IS THERE A RISK?

## UNCOVERING YOUR DIABETES DANGER ZONE

# OUR TEAM

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# INTRODUCTION

This project aims to predict diabetes risk using a combination of a neural network and a fuzzy logic system, leveraging the Pima Indians Diabetes dataset.

# THE MAIN STEPS WE FOLLOWED:

- DATA PREPROCESSING
- NEURAL NETWORK MODEL DEVELOPMENT
- FUZZY LOGIC SYSTEM DESIGN
- MODEL INTEGRATION AND ENSEMBLE
- PREDICTION SYSTEM & GUI

# DATA PREPROCESSING

# DATA PREPROCESSING STEPS

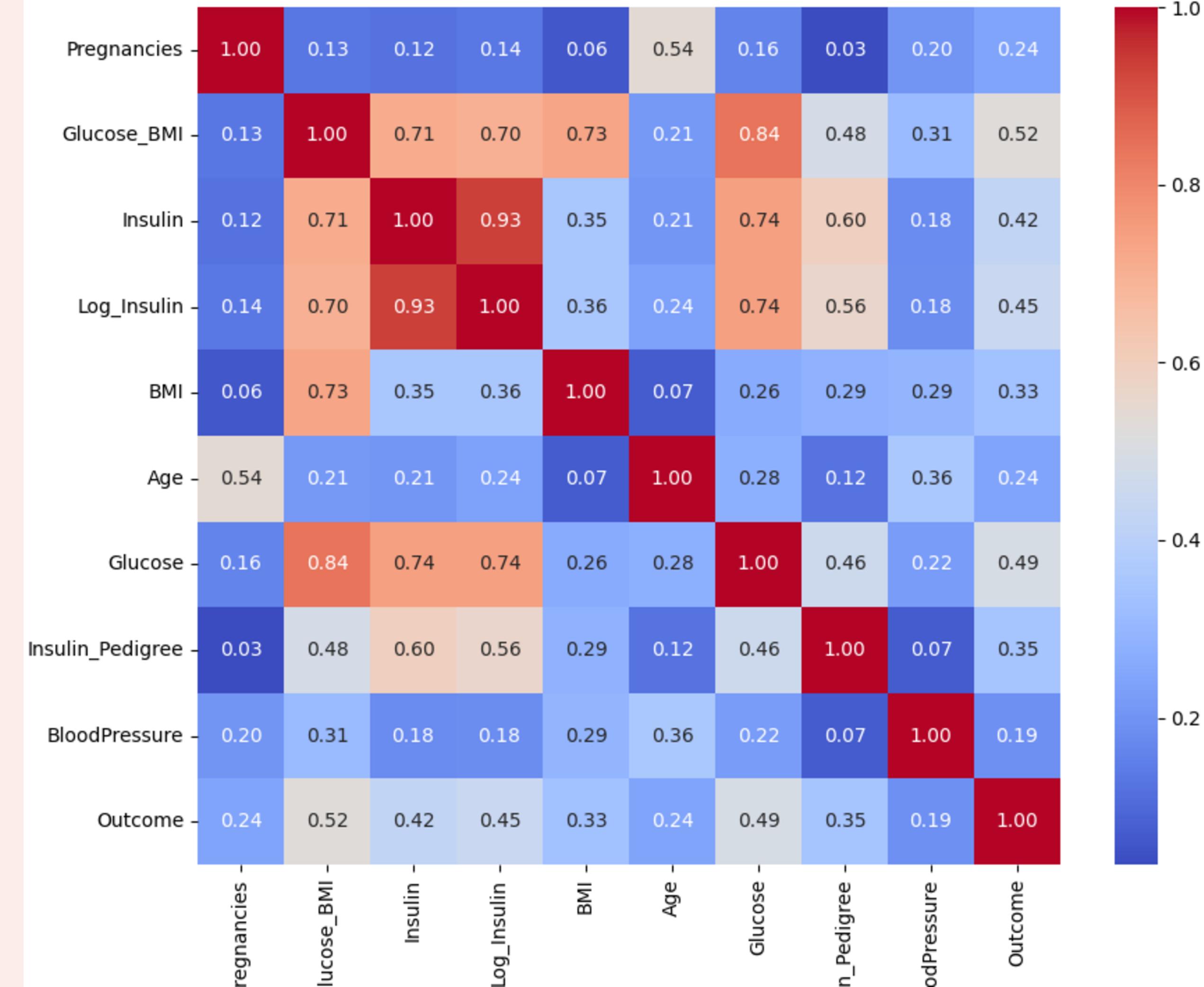
- 1- Loaded the Pima Indians Diabetes dataset (768 samples, 8 features like Glucose, BMI, Blood Pressure, Age).
- 2- Preprocessed the data by handling missing values, detecting and removing outliers, feature selection, and applying SMOTE to balance the dataset .
- 3- Split the data into training and testing sets.



# CORRELATION MATRIX



Correlation Matrix of Selected Features



# NEURAL NETWORK MODEL DEVELOPMENT

# NEURAL NETWORK STEPS

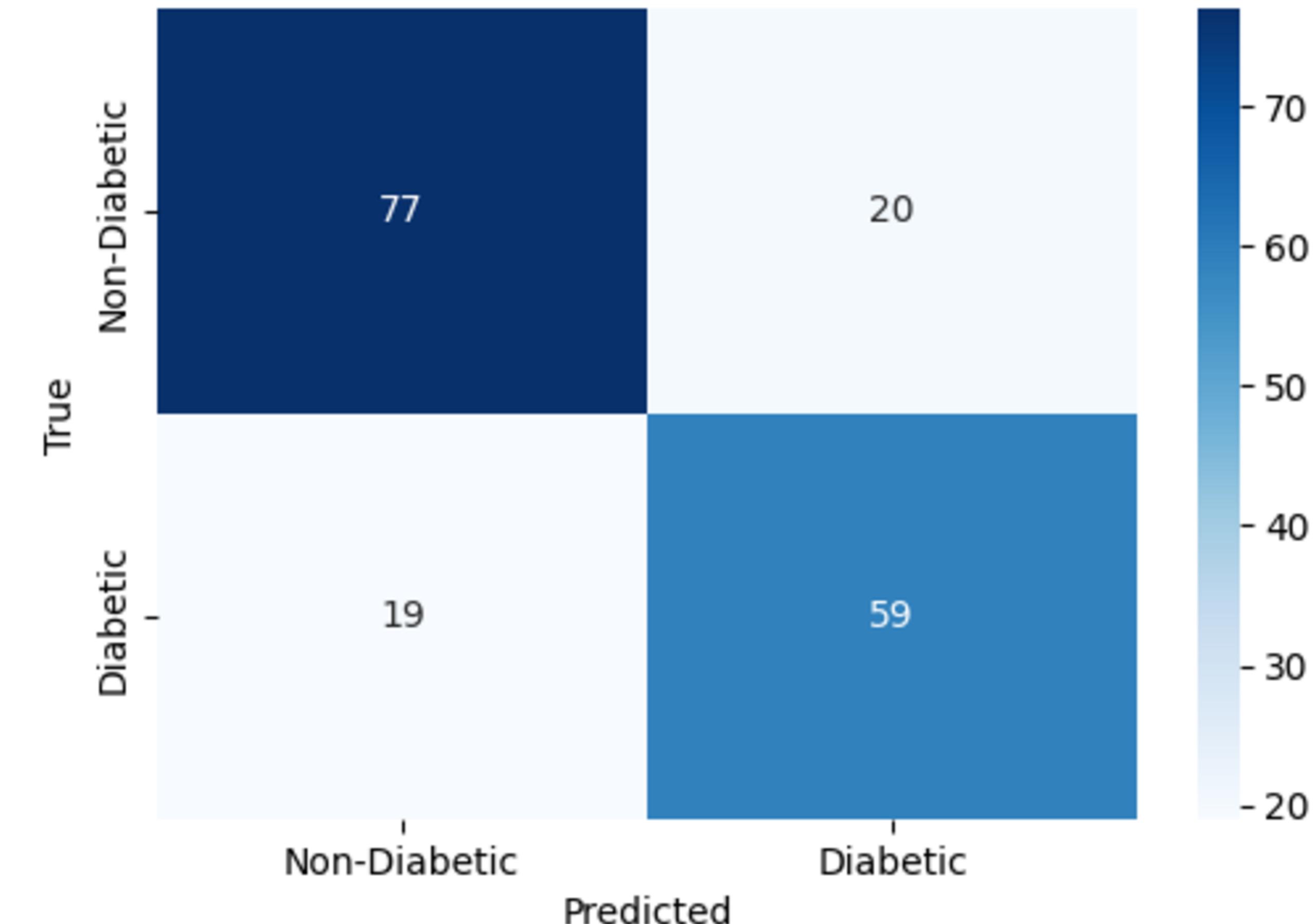
- 1- Built a Feedforward Neural Network (Multilayer Perceptron) with 3 hidden layers (128, 64, 32 neurons), using ReLU activation, Dropout, and Batch Normalization.
- 2- Trained the model with class weights to prioritize diabetic cases and used early stopping to prevent overfitting.
- 3- Performed 5-fold cross-validation to ensure robustness.



# CONFUSION MATRIX

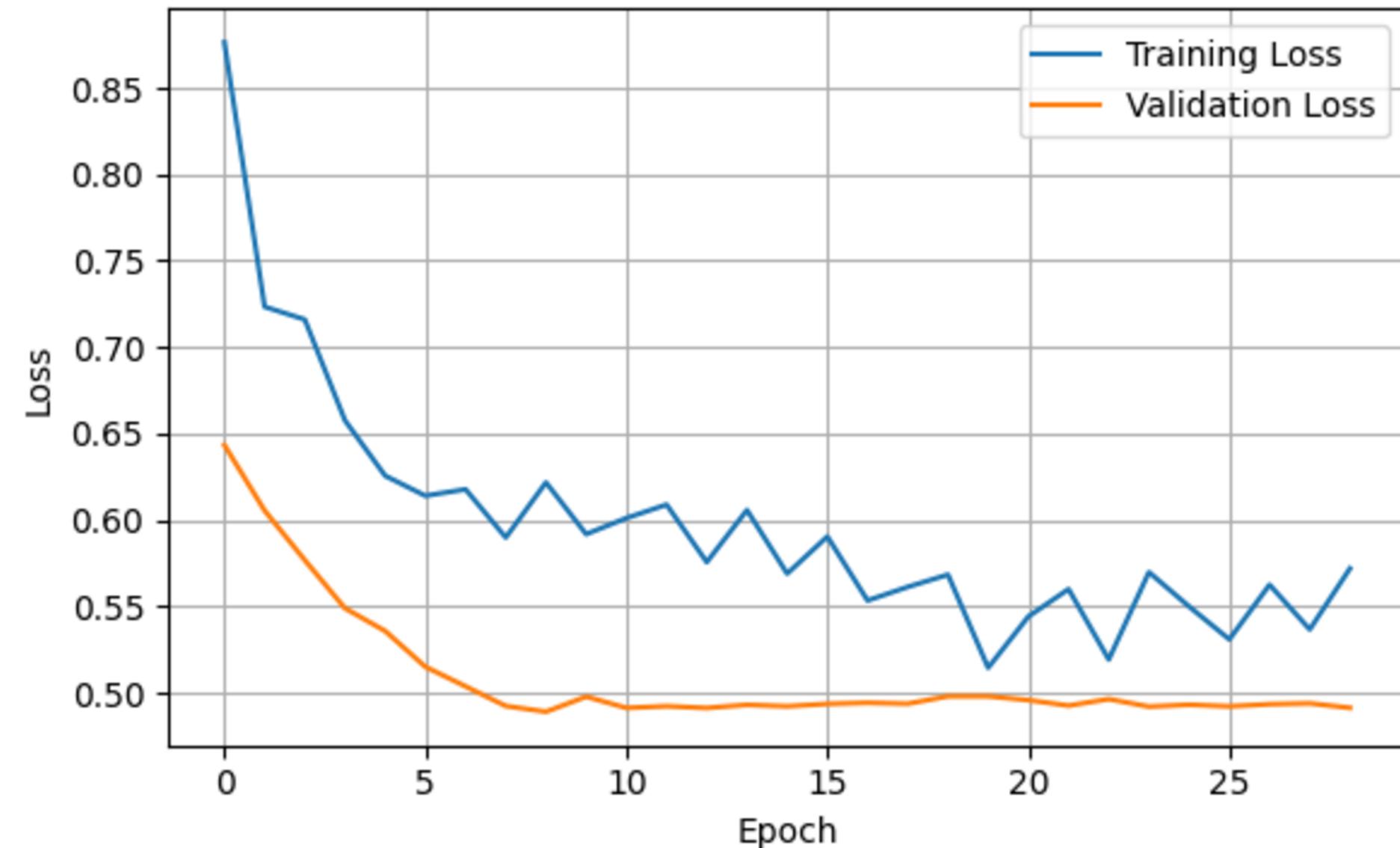


## Neural Network Confusion Matrix

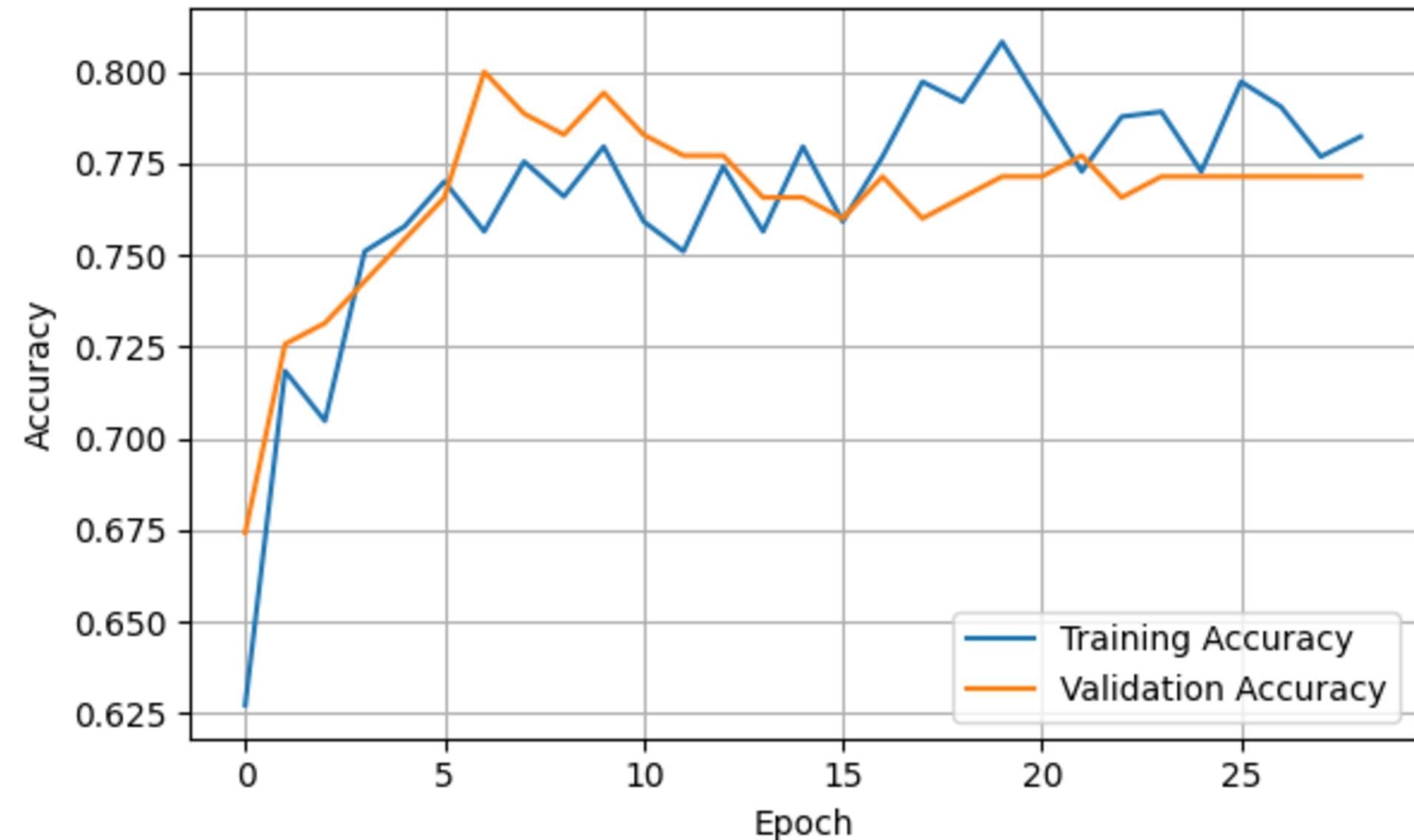


# TRAINING HISTORY

Model Loss



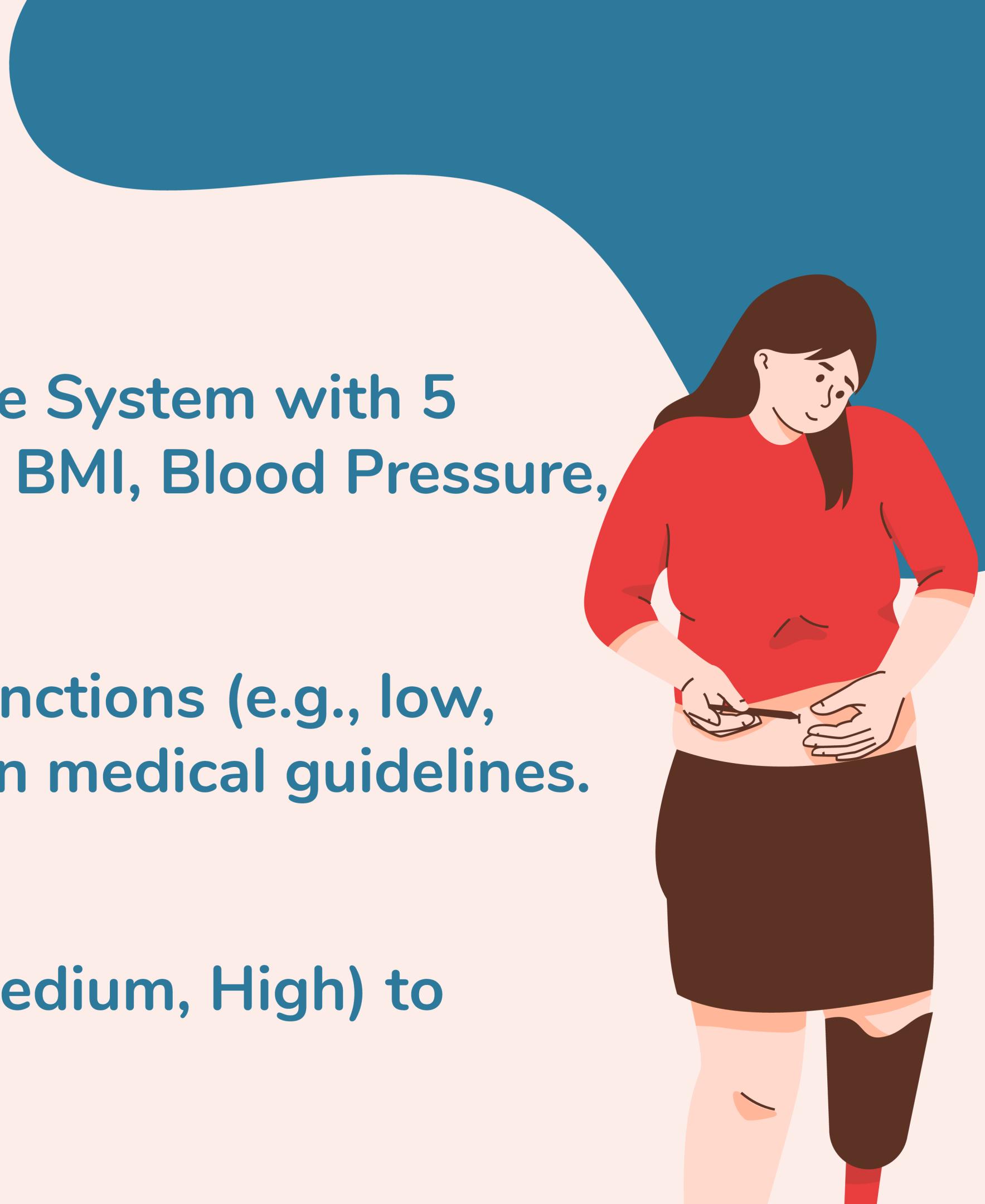
Model Accuracy



# FUZZY LOGIC SYSTEM DESIGN

# FUZZY LOGIC SYSTEM DESIGN STEPS

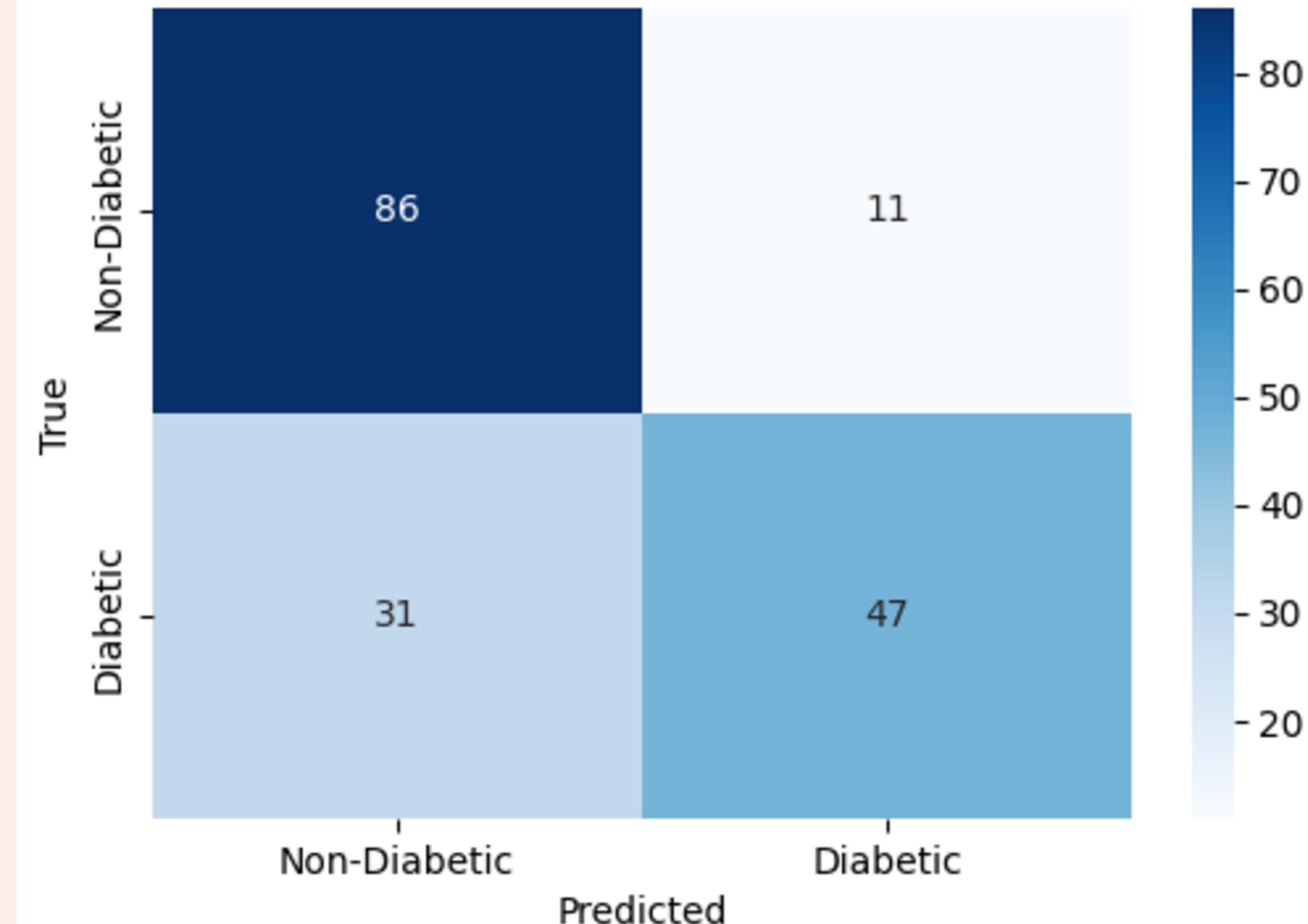
- 1- Designed a Mamdani Fuzzy Inference System with 5 input variables (NN risk score, Glucose, BMI, Blood Pressure, Age) and 48 rules.
- 2- Defined Trapezoidal membership functions (e.g., low, normal, high) for each variable based on medical guidelines.
- 3- Generated fuzzy risk scores (Low, Medium, High) to complement neural network predic



# CONFUSION MATRIX



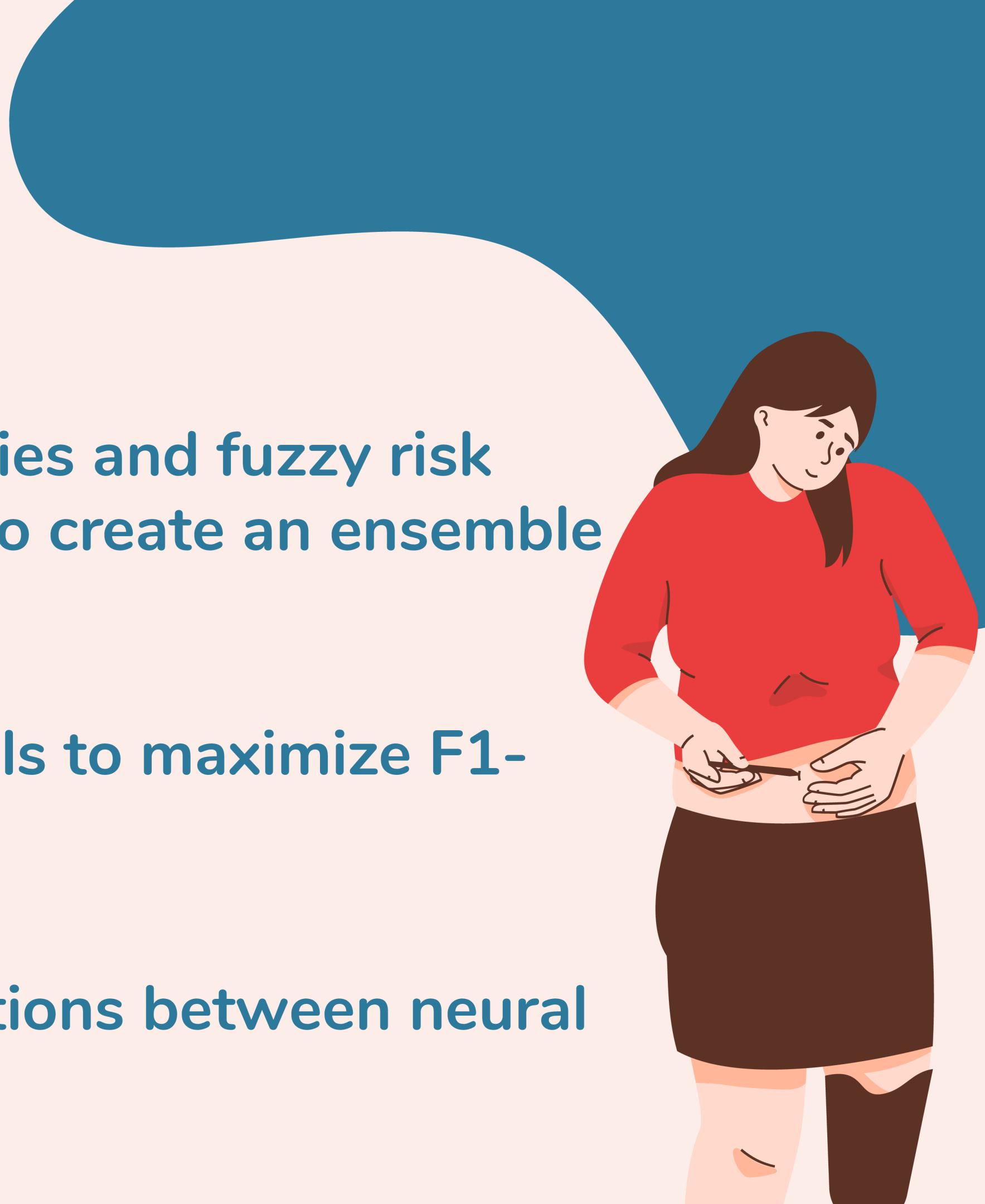
## Fuzzy System Confusion Matrix



# MODEL INTEGRATION AND ENSEMBLE

# MODEL INTEGRATION AND ENSEMBLE STEPS

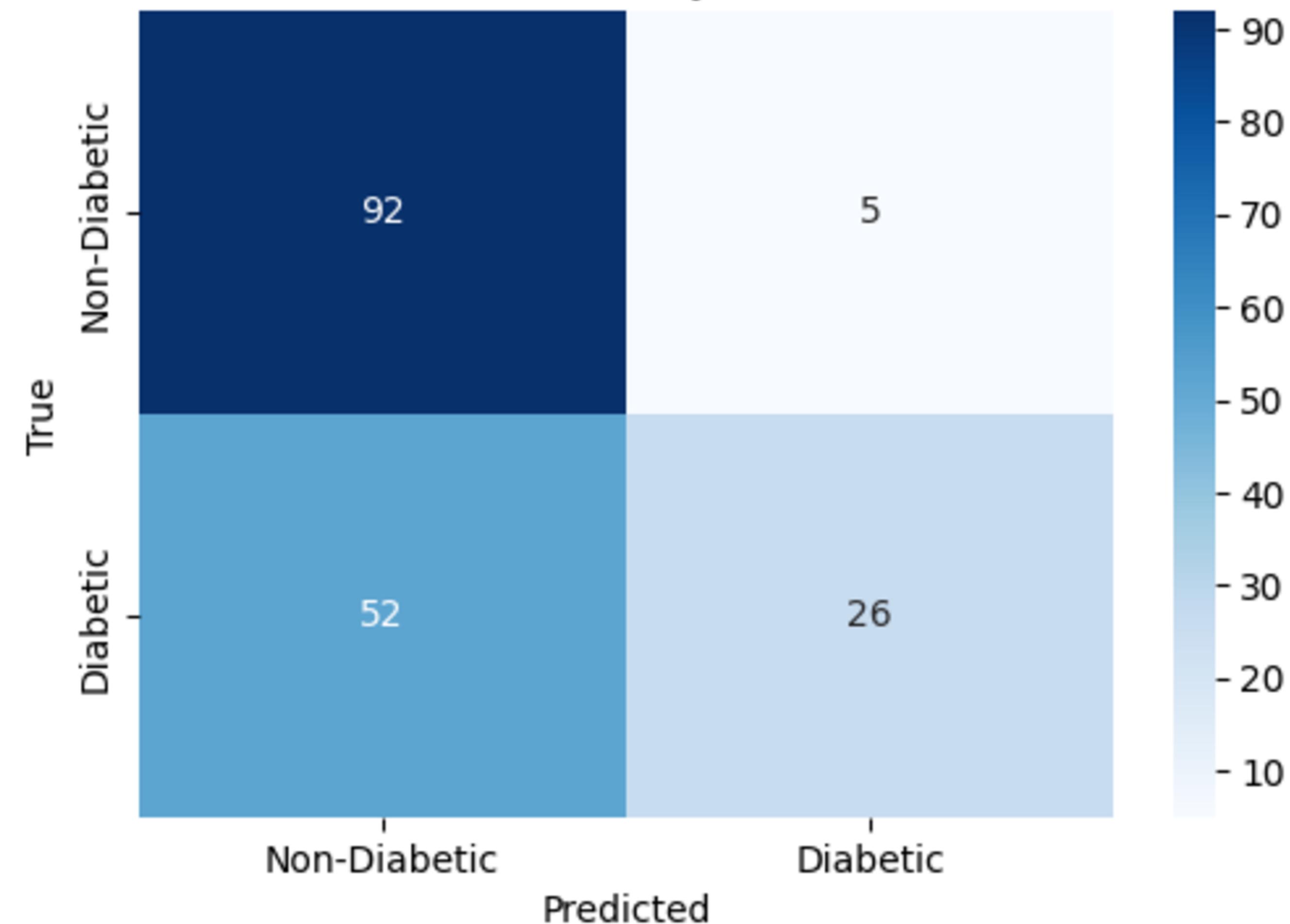
- 1- Combined neural network probabilities and fuzzy risk scores using equal weights (0.5 each) to create an ensemble prediction.
- 2- Optimized thresholds for both models to maximize F1-score.
- 3- Saved results and visualized correlations between neural and fuzzy outputs.



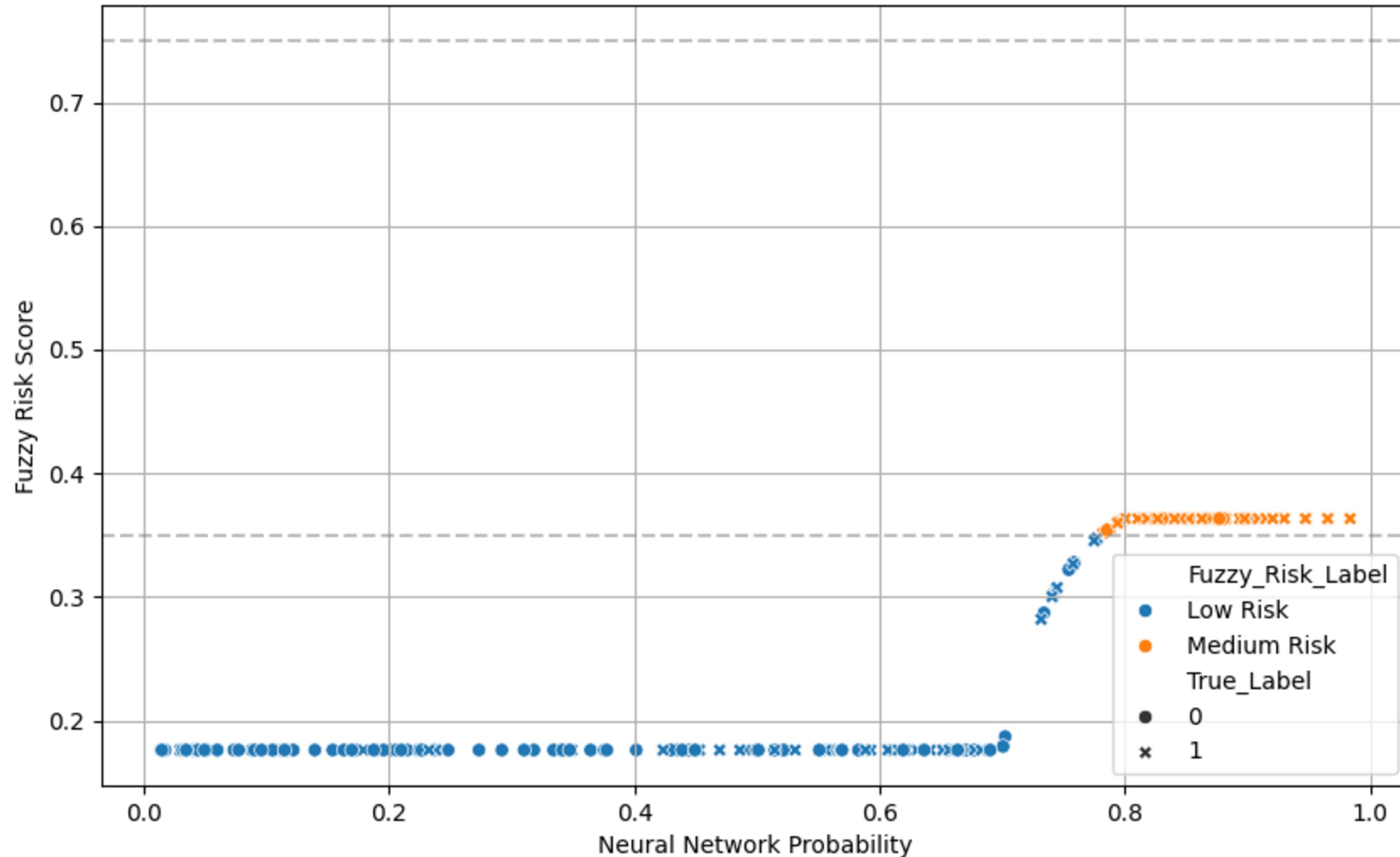
# CONFUSION MATRIX



Ensemble (Neural + Fuzzy) Confusion Matrix



# Neural Network Probability vs Fuzzy Risk Score



# PREDICTION SYSTEM & GUI

# GUI EXAMINATION

Diabetes Risk Predictor

Enter patient data to predict diabetes risk

Patient Data

Glucose (mg/dL, 0-400)	148
BMI (0-80)	33.6
Blood Pressure (mmHg, 50-150)	72
Age (years, 20-100)	50

**Predict**   **Clear**

Prediction Results

Neural Network Probability:	0.3346
Fuzzy Risk Score:	0.1841
Fuzzy Risk Label:	Low Risk
Ensemble Prediction:	Non-Diabetic

Diabetes Risk Predictor

Enter patient data to predict diabetes risk

Patient Data

Glucose (mg/dL, 0-400)	200
BMI (0-80)	25
Blood Pressure (mmHg, 50-150)	80
Age (years, 20-100)	30

**Predict**   **Clear**

Prediction Results

Neural Network Probability:	0.3392
Fuzzy Risk Score:	0.5500
Fuzzy Risk Label:	Medium Risk
Ensemble Prediction:	Non-Diabetic

Diabetes Risk Predictor

Enter patient data to predict diabetes risk

Patient Data

Glucose (mg/dL, 0-400)	220
BMI (0-80)	40
Blood Pressure (mmHg, 50-150)	90
Age (years, 20-100)	40

**Predict**   **Clear**

Prediction Results

Neural Network Probability:	0.7465
Fuzzy Risk Score:	0.8398
Fuzzy Risk Label:	High Risk
Ensemble Prediction:	Diabetic



**THANK YOU!**