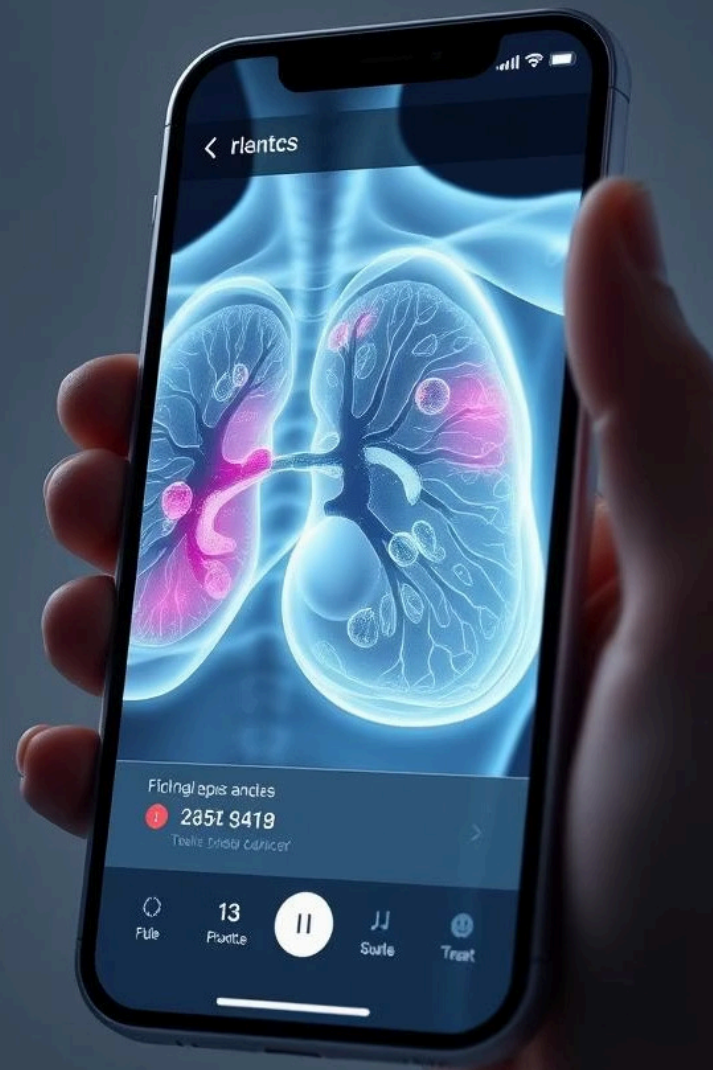
# Breast Cancer Classification Application

This presentation introduces a desktop application developed with Python and PyQt5 for classifying breast cancer tumors as benign or malignant. Using the UCI Breast Cancer Wisconsin dataset, the app integrates data preprocessing, fuzzy feature engineering, decision tree classification, and evaluation visualizations. The user-friendly GUI supports data exploration, model training, and performance assessment to aid healthcare professionals in diagnostic decisions.

A by Abdelrhman Islam



# Project Objectives

## GUI Development

Create an intuitive desktop application for breast cancer classification.

## Data Preprocessing

Implement scaling and fuzzy feature engineering techniques.

## Model Training

Use Decision Tree Classifier with hyperparameter tuning for optimal performance.

## Visualization

Provide interactive visualizations for data exploration and evaluation.

# Dataset and Preprocessing

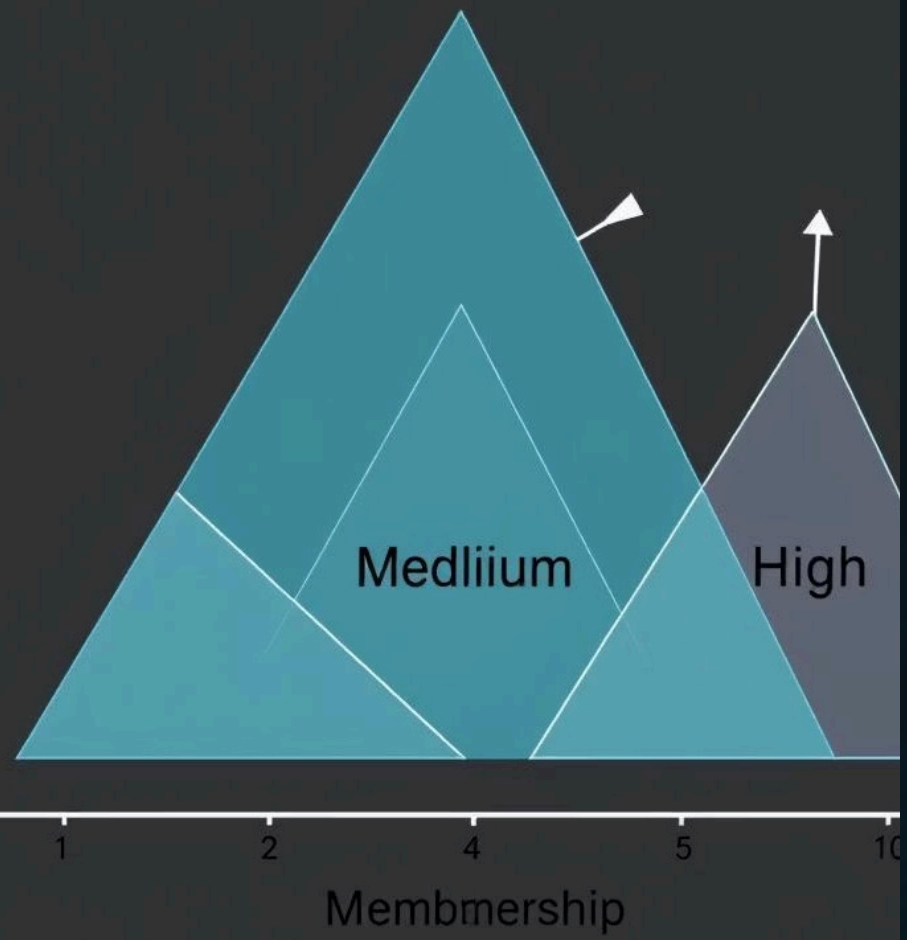
## Dataset Details

Uses UCI Breast Cancer Wisconsin dataset with 569 instances and 30 numerical features.

Labels indicate malignant (M) or benign (B) tumors.

## Preprocessing Steps

- Loading and label encoding
- Data splitting into training and testing sets
- Scaling features using Min-Max normalization




# Fuzzy Feature Engineering

Fuzzy logic is applied to selected features: radius1, area1, and texture1. For each, three membership functions—low, medium, and high—are computed using triangular functions. This enhances feature representation by capturing uncertainty and gradual transitions in data values, improving classification accuracy.

# Model Training Approach

1

## Decision Tree Classifier

Selected for its interpretability and effectiveness in classification tasks.

2

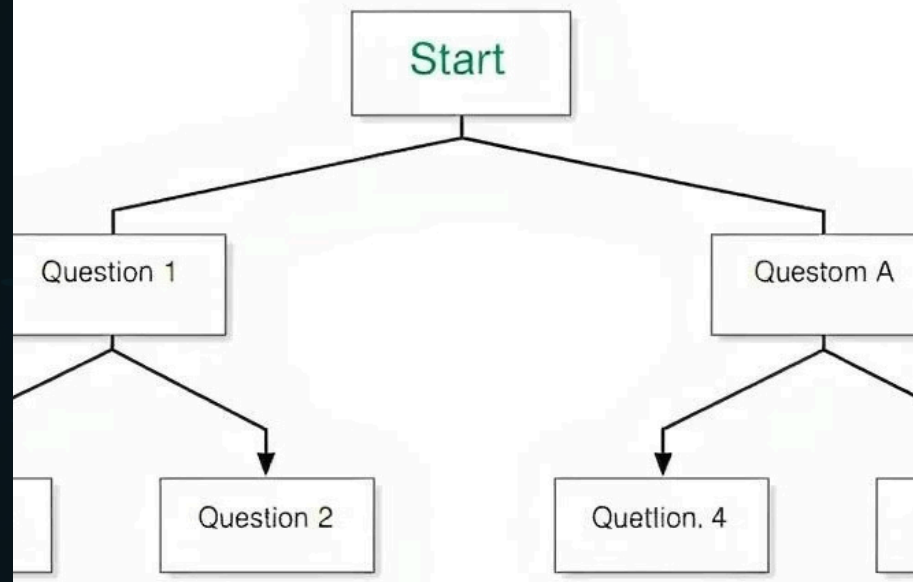
## Hyperparameter Tuning

Hill Climbing and Grid Search methods used to optimize tree depth.

3

## Optimal Model

Chosen based on performance metrics to balance accuracy and complexity.



# Evaluation Metrics

## Accuracy

Measures overall correctness of the model.

## Precision and Recall

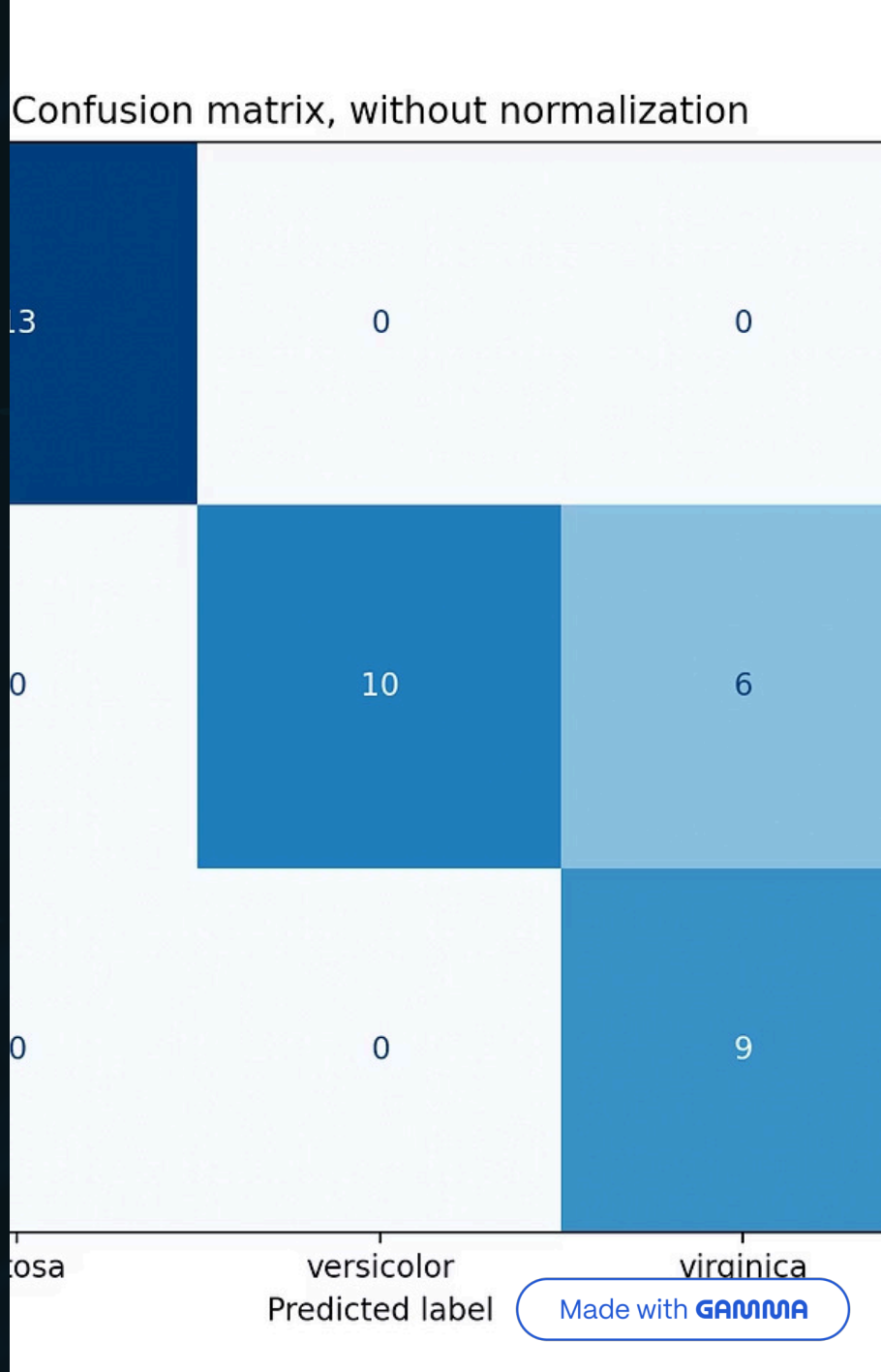
Assess the model's ability to correctly identify malignant and benign cases.

## Confusion Matrix

Visualizes true vs. predicted classifications for detailed analysis.

## Classification Report

Summarizes precision, recall, and F1-score for each class.



# Application Features Overview

## Data Exploration

- Load dataset
- View data information and tables

## Visualizations

- Select features
- Display various plots

## Model Training

- Set max tree depth
- Train and view results

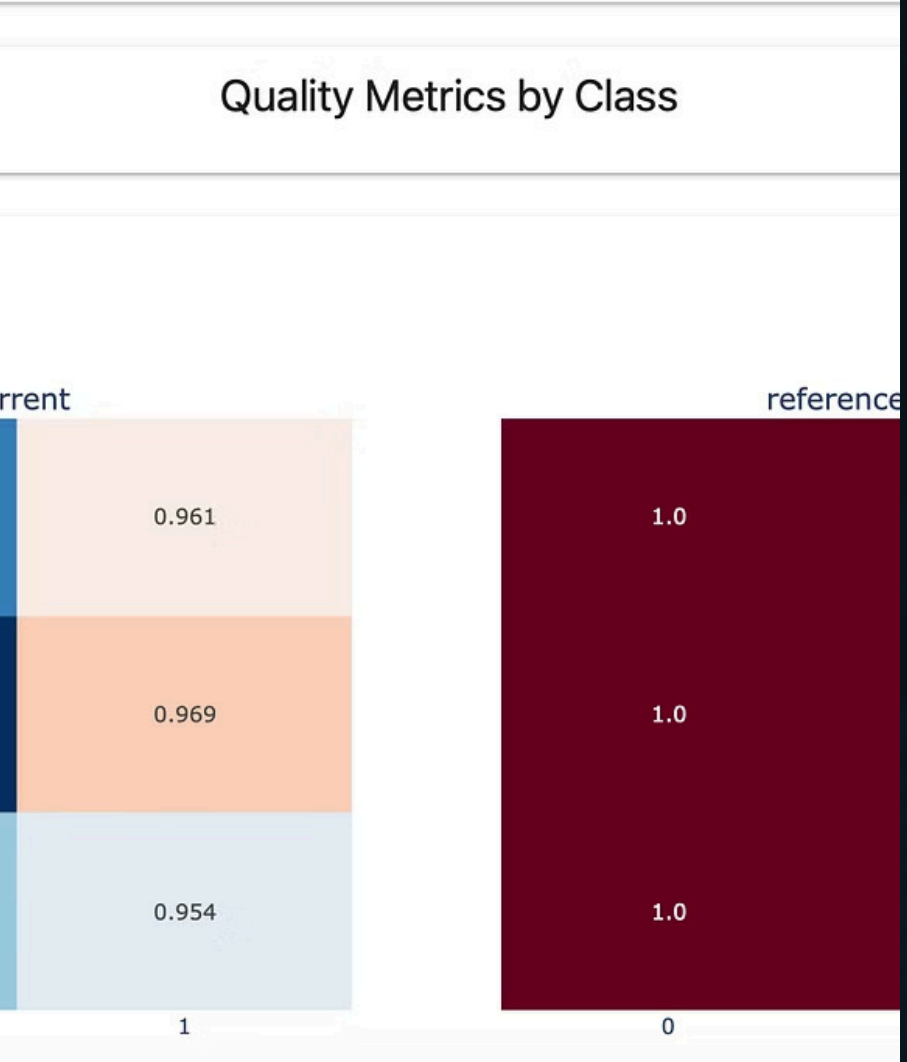
## Evaluation

- Choose evaluation metrics
- Plot and analyze results

```
ort = Report(metrics=[
s_threshold=0.7),


ort.run(current_data=bcancer_cur, reference_data=bcancer_

ort
```

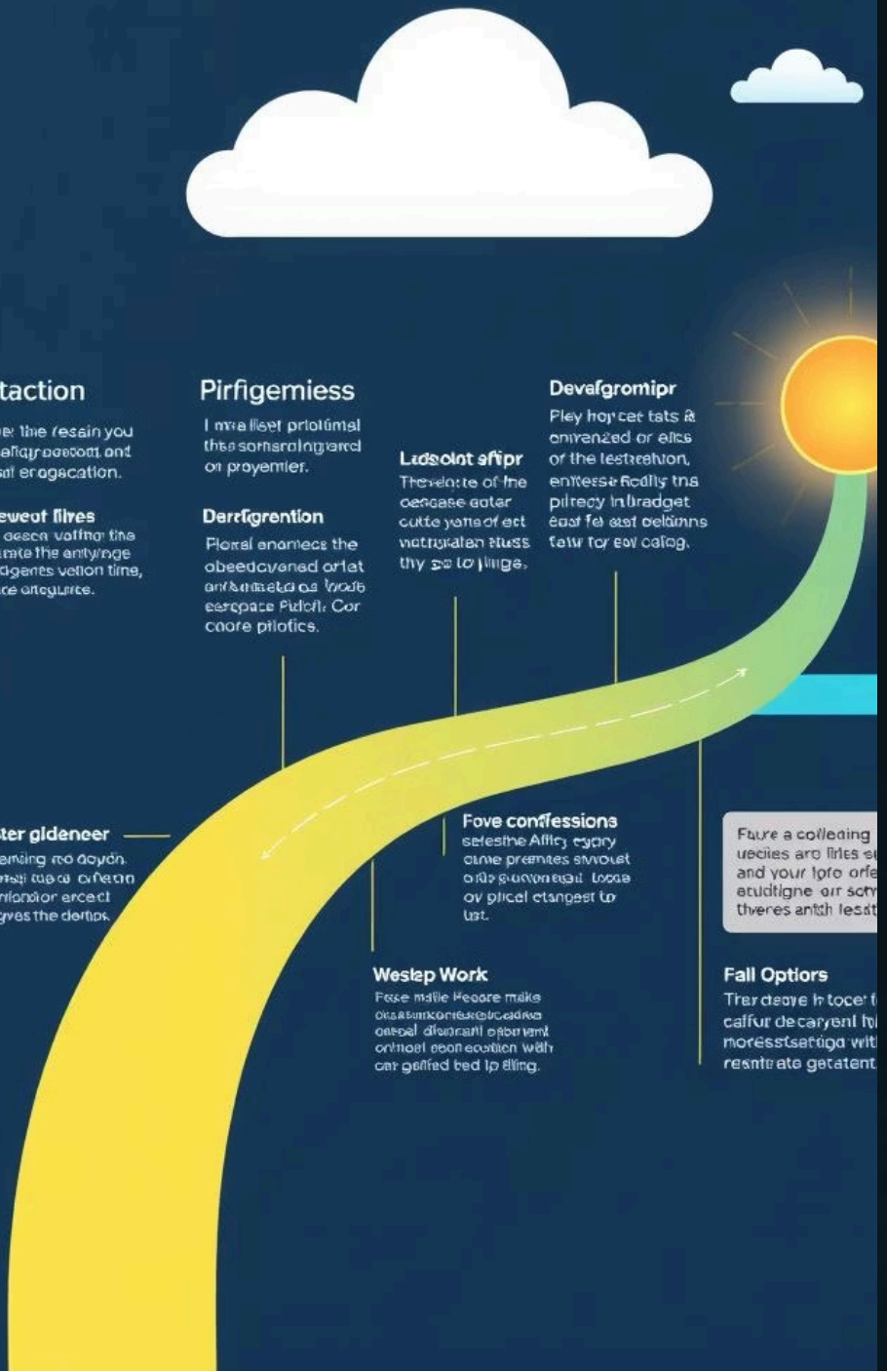



# Results and Performance

The trained model achieved high accuracy on the training set, demonstrating effective learning. Evaluation on the test set showed satisfactory precision and recall, indicating reliable classification of malignant and benign tumors. These results validate the model's potential as a diagnostic support tool.

# Conclusion

The application successfully integrates data preprocessing, fuzzy feature engineering, decision tree training, and evaluation within a user-friendly GUI. It offers healthcare professionals a practical tool to assist in breast cancer tumor classification, supporting early detection and diagnostic accuracy.




# Future Work and Enhancements

## Additional Algorithms

Incorporate more classification methods to improve accuracy.

## Cross-Validation

Implement to ensure model robustness and generalization.

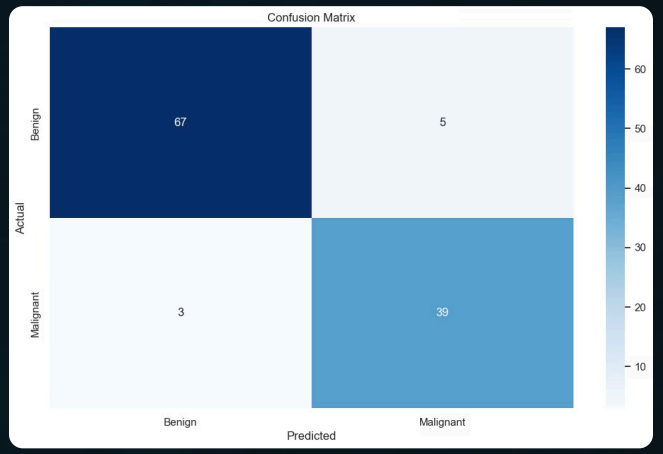
## GUI Enhancements

Improve user experience and interface design.

## Web Deployment

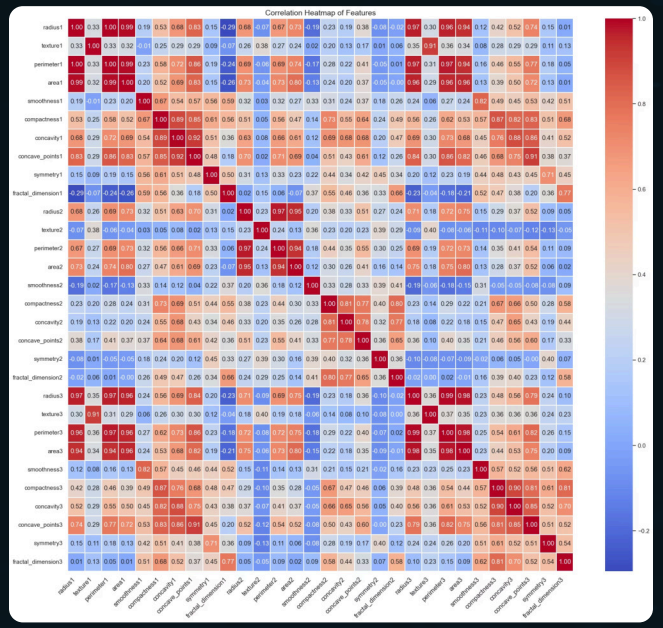
Make the application accessible online for wider use.

# Image Descriptions



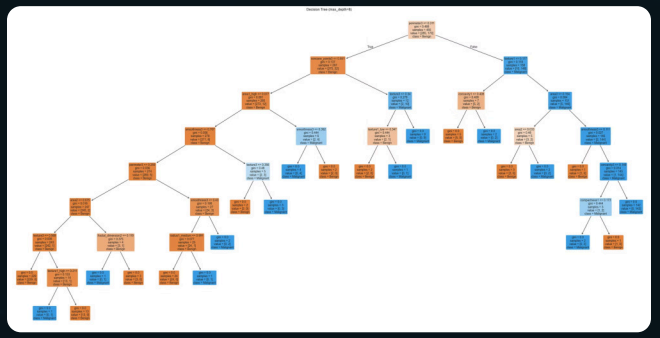

## First Image

This image illustrates an important aspect of the application, such as displaying data or analysis results.



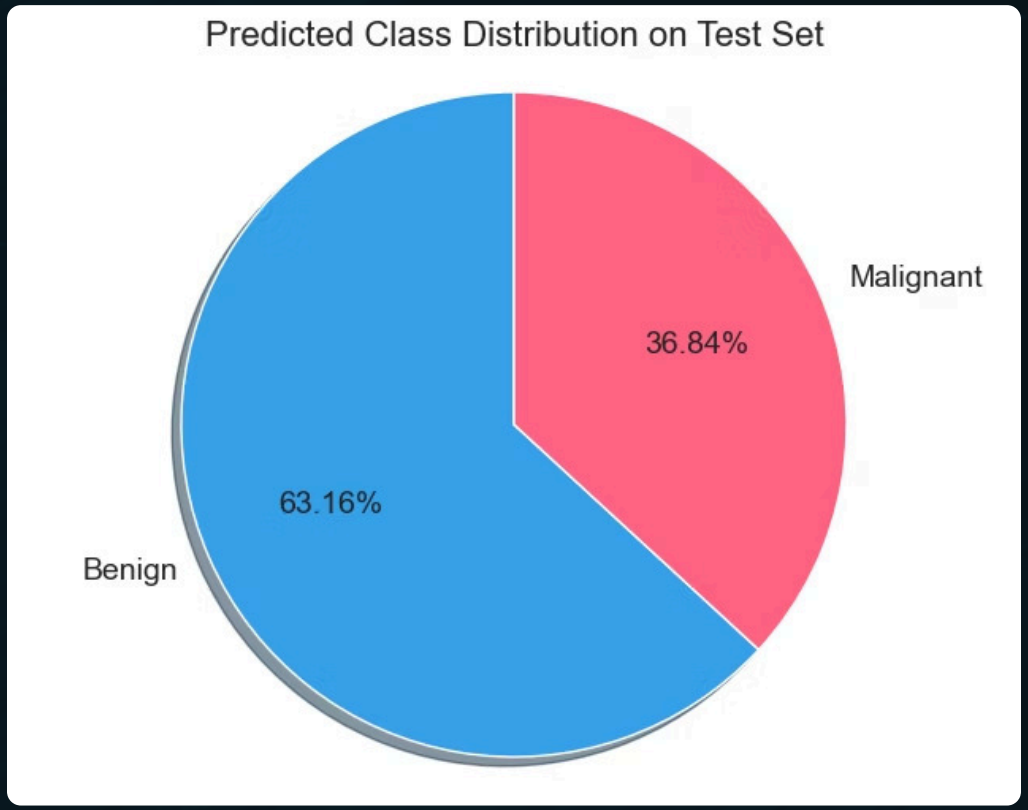

## Second Image

This image shows a sample of the user interface where different features can be selected for analysis.



## Third Image

This image displays the graphs or results obtained from the classification model.




# Application Features Overview

This application offers comprehensive tools for breast cancer classification, including data exploration, interactive visualizations, model training controls, and detailed evaluation metrics. Users can seamlessly load datasets, analyze key features through various plots, adjust model parameters, and review performance to support informed decision-making in diagnosis.