

Methodology, Results, and Comparison

Methodology

We compared two machine learning models for binary classification on the Breast Cancer Wisconsin dataset:

1. A simple feedforward neural network with a single layer and sigmoid activation.
2. A manually implemented ID3 decision tree algorithm with a controlled maximum depth.

The dataset was preprocessed using StandardScaler, and split into 80% training and 20% testing. The neural network was trained using gradient descent to minimize cross-entropy loss. The decision tree used entropy and information gain for splits, and a maximum depth of 8 to avoid overfitting.

Results

After training:

- Neural Network Accuracy:
 - Train: ~99.0%
 - Test: ~97.0%
- Decision Tree Accuracy:
 - Train: 98.24%
 - Test: 96.49%

The neural network slightly outperformed the decision tree on both training and test data, showing better generalization while being slightly more sensitive to optimization dynamics (e.g., learning rate, number of epochs).

Comparison

- Neural Network:
 - Pros: Higher accuracy, adaptable via hyperparameter tuning.
 - Cons: Requires more training time and sensitive to scaling and parameter choice.
- Decision Tree:
 - Pros: Very interpretable, quick to train, non-parametric.
 - Cons: Slightly lower accuracy, can overfit without pruning or depth control.

Plot and Visualization

