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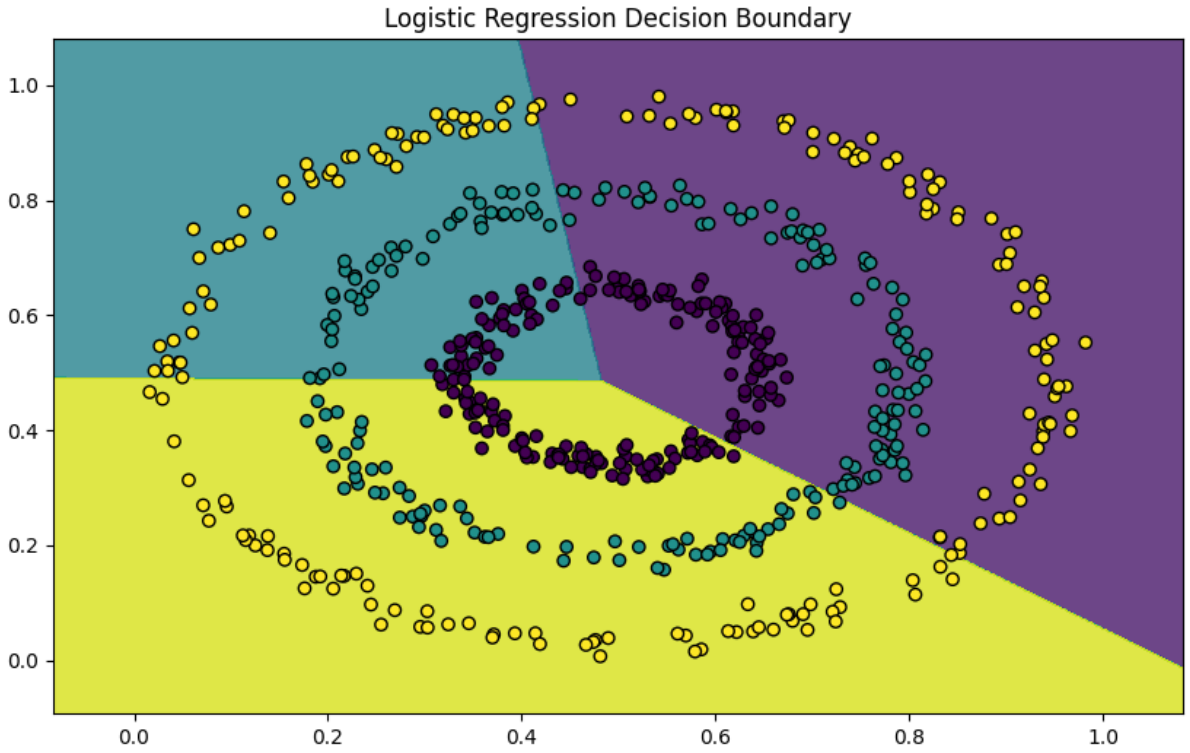
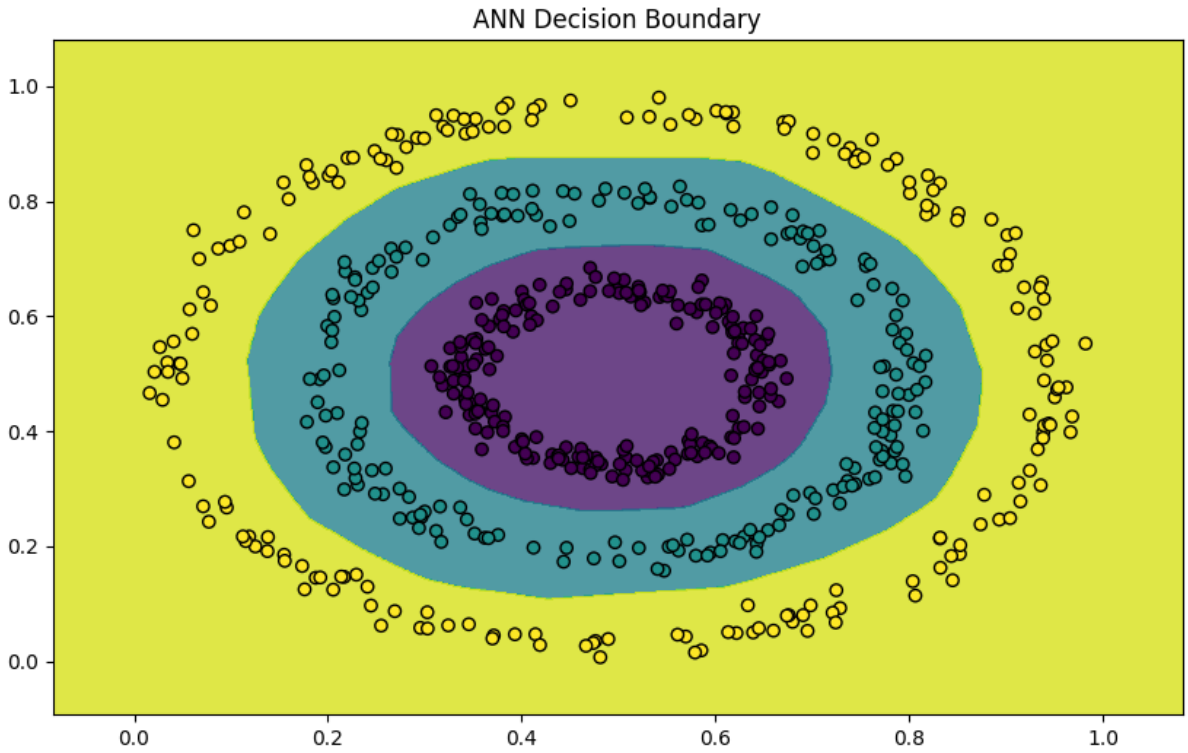
Assignment no.: 03

Output:

Logistic Regression Accuracy: 0.3133
ANN Accuracy: 1.0000



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Performance Comparison:
Metric     Logistic Regression  ANN
Accuracy   0.3133               1.0000
Precision  0.3131               1.0000
Recall     0.3133               1.0000
F1 Score   0.3094               1.0000
```

Why Logistic Regression Fails

1. Linear Decision Boundaries

Logistic regression creates **linear decision boundaries** through the feature space. For the circular dataset:

- Can only draw straight lines/hyperplanes
- Unable to capture radial patterns
- Visualized boundaries show intersecting lines that misclassify outer rings

2. Limited Model Capacity

- No hidden layers to learn hierarchical features
- Direct mapping from input to output using linear transformations
- Can't represent complex relationships between x1 and x2

Why ANN Succeeds

1. Non-Linear Transformations

- Hidden layer with ReLU activation enables **non-linear feature learning**
- Can approximate any continuous function (Universal Approximation Theorem)
- Learns combinations like:
  ReLU(w1x1+w2x2+b)ReLU($w1x1+w2x2+b$)
  Which can represent radial patterns

2. Hierarchical Feature Learning

1. **Hidden Layer** detects circular patterns through:
   ReLU(WhiddenX+bhidden)ReLU($WhiddenX+bhidden$)
2. **Output Layer** combines these detected patterns:
   softmax(WoutputH+boutput)softmax($WoutputH+boutput$)

3. Architecture Advantages

- 64 hidden neurons provide sufficient capacity
- Mini-batch training (batch_size=32) stabilizes learning
- He initialization prevents vanishing gradients
- 5000 epochs allow complete convergence