MTL782: Data Mining
Assignment 2

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Question 1: MNIST Handwritten Digits

Packages Used: sklearn, keras, pandas, numpy, matplotlib, seaborn

Decision Tree

Accuracy: 0.8730714285714286
Precision: 0.8728356387299575
Recall: 0.8730714285714286
F1 Score: 0.8728940837963073

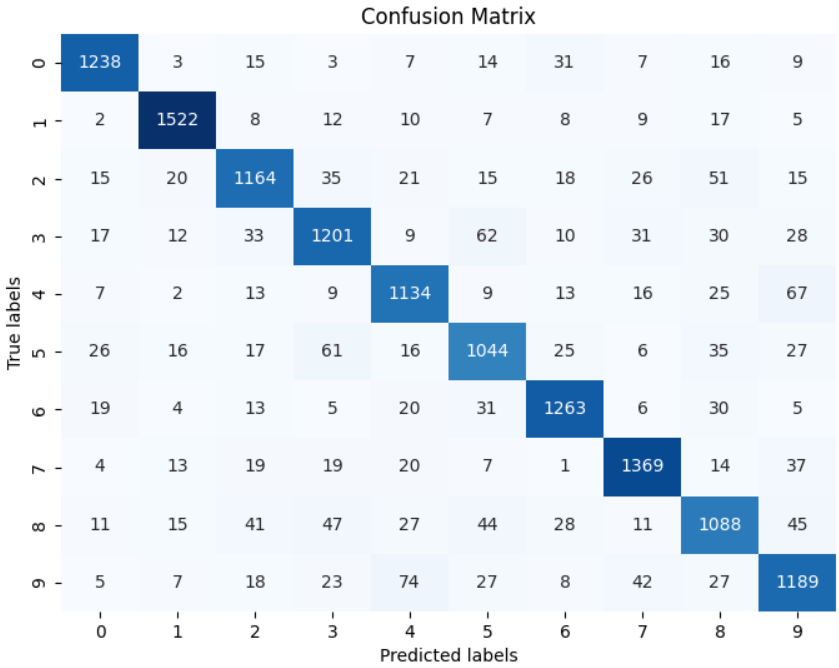

Figure 1: Confusion Matrix : Decision Tree

Best Performance by GridSearch:
Best parameters: {'max_depth': 20,'min_samples_leaf': 4, 'min_samples_split': 5}
Accuracy: 0.876

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Random Forest

Accuracy: 0.9676428571428571
Precision: 0.9676483805024302
Recall: 0.9676428571428571
F1 Score: 0.9676255671575715

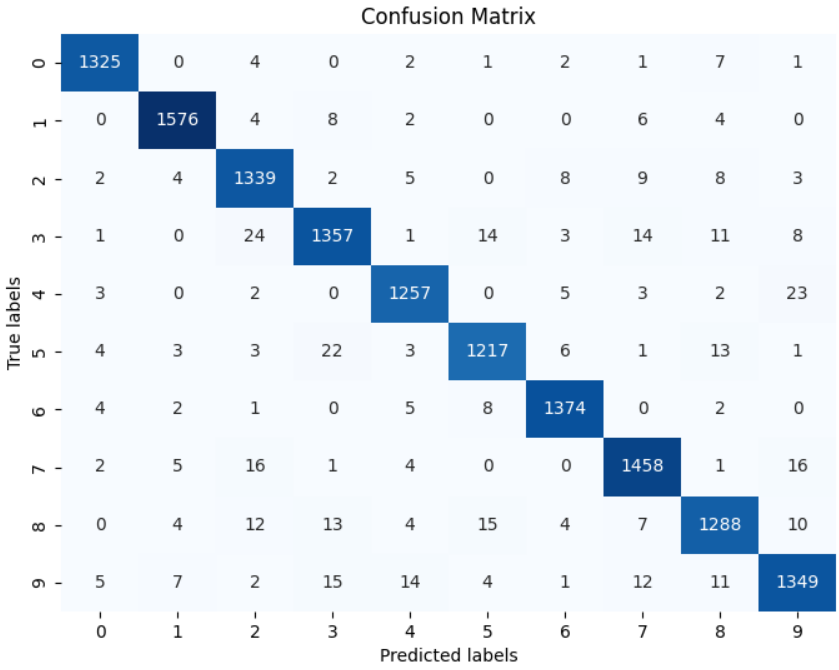

Figure 2: Confusion Matrix : Random Forest

Best Performance by GridSearch:
Best parameters: {'max_depth': None, 'n_estimators': 300}
Accuracy: 0.9676428571428571

Naive Bayes

We tested three cases, and selected Bernoulli for cross-validation since it had the best performance.

GaussianNB

0.5566 accuracy with a standard deviation of 0.0063

MultinomialNB

0.8256 accuracy with a standard deviation of 0.0104

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BernoulliNB

Accuracy: 0.8348571428571429
Precision: 0.8367482492867026
Recall: 0.8348571428571429
F1 Score: 0.8346397011541737

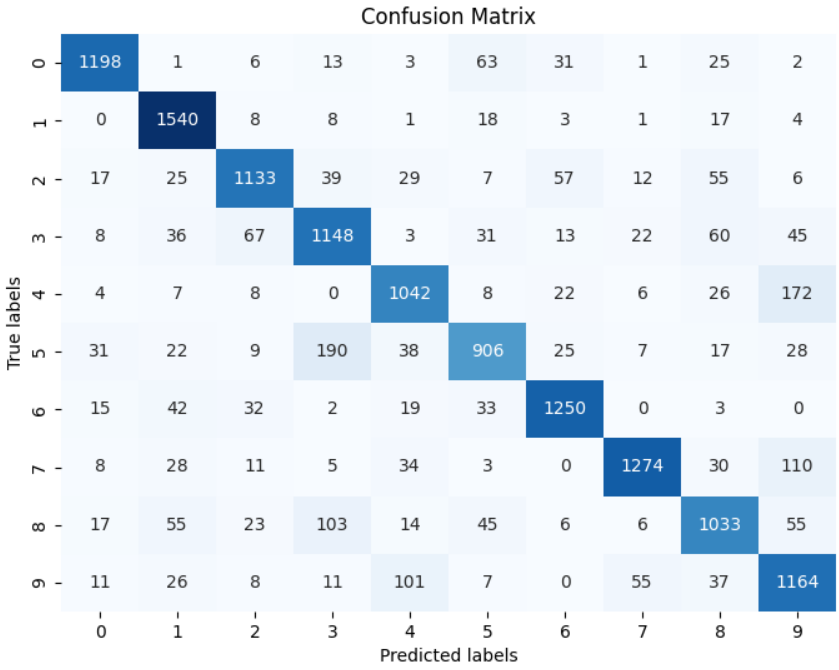

Figure 3: Confusion Matrix : Naive Bayes - Bernoulli

Best Performance by GridSearch:
Best parameters: {'alpha': 0.1, 'binarize': 0.0}
Accuracy: 0.8352857142857143

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KNN

Accuracy: 0.9700714285714286
Precision: 0.9702368001894589
Recall: 0.9700714285714286
F1 Score: 0.9700163750952855

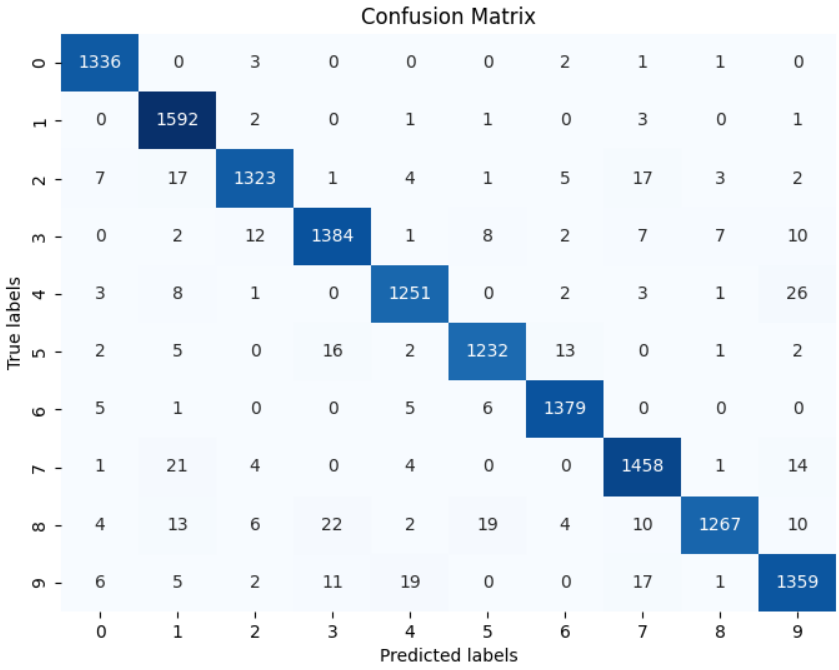

Figure 4: Confusion Matrix : KNN

Best Performance by GridSearch:
Best parameters: {'n_neighbors': 3, 'p': 2, 'weights': 'distance'}
Accuracy: 0.9728571428571429

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Neural Networks

Accuracy: 0.9625714285714285
Precision: 0.9628620900925863
Recall: 0.9625714285714285
F1 Score: 0.9625253215986614

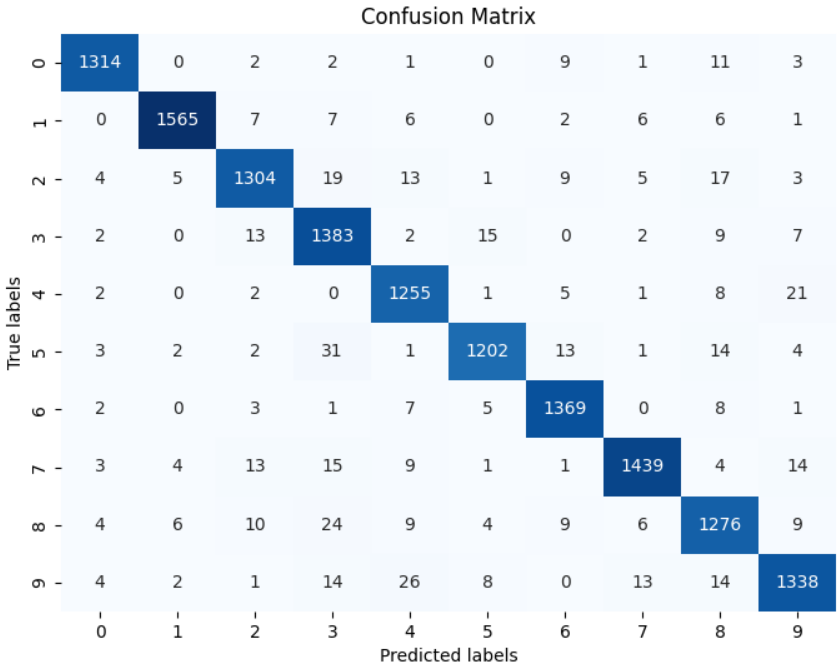

Figure 5: Confusion Matrix : Neural Networks

Best Performance by GridSearch:
Best parameters: {'activation': 'relu', 'alpha': 0.001, 'hidden_layer_sizes': (500,)}
Accuracy: 0.9741428571428571

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Grid Search Cross Validation

Model	Accuracy
Decision Tree	0.876
Random Forest	0.9676
Bernoulli NB	0.8353
KNN	0.9728
Neural Network	0.9741

Table 1: Model Comparison

Glossary

$$\text{Accuracy} = \frac{TP + TN}{TP + FP + TN + FN}$$

$$\text{Precision} = \frac{TP}{TP + FP}$$

$$\text{Recall} = \frac{TP}{TP + FN}$$

$$\text{F1 Score} = \frac{Precision \times Recall}{Precision + Recall}$$