

# A3 – Emil Collén

## Exercise 1

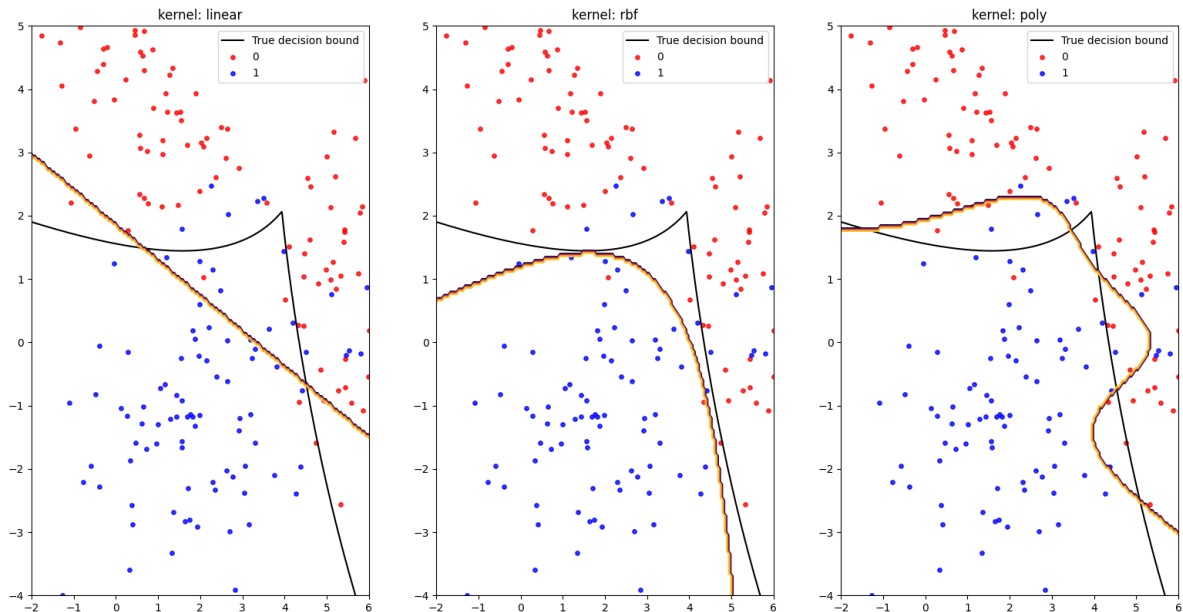


Figure 1 - Plot with decision boundaries and best models for each kernel

```
Best overall:  
Best hyperparameters: {'C': 0.1, 'gamma': 0.1, 'kernel': 'rbf'}  
Training score: 0.9279999999999999  
Validation score: 0.90125  
-----  
linear:  
Best hyperparameters: {'C': 0.01, 'kernel': 'linear'}  
Training score: 0.8880000000000001  
Validation score: 0.8756  
rbf:  
Best hyperparameters: {'C': 0.1, 'gamma': 0.1, 'kernel': 'rbf'}  
Training score: 0.9279999999999999  
Validation score: 0.90125  
poly:  
Best hyperparameters: {'C': 25, 'degree': 5, 'gamma': 0.1, 'kernel': 'poly'}  
Training score: 0.9  
Validation score: 0.90605
```

Figure 2 – Best hyperparameters in the defined search grid and score for each kernel

### Exercise 3

```
Optimal hyperparameters: {'C': 3, 'gamma': 0.023, 'kernel': 'rbf'}
Test accuracy: 0.9856
Accuracy for the one-vs-one: 0.9854
Confusion Matrix for ovo:
[[ 974   0   1   0   0   2   0   1   2   0]
 [   0 1129   2   1   0   1   0   1   1   0]
 [   5   1 1014   0   1   0   1   7   3   0]
 [   0   0   3  997   0   2   0   4   3   1]
 [   0   0   2   0  968   0   4   0   1   7]
 [   2   0   0   6   1  875   3   1   2   2]
 [   3   2   0   0   2   2  948   0   1   0]
 [   0   3   6   1   0   0   0 1009   1   8]
 [   3   0   2   2   1   3   1   2  955   5]
 [   1   2   0   4   8   4   1   3   1  985]]
Accuracy for the one-vs-all: 0.9761
Confusion Matrix for ova:
[[ 978   0   0   0   0   0   0   1   1   0]
 [   8 1126   1   0   0   0   0   0   0   0]
 [  20   0 1005   0   1   0   0   3   3   0]
 [  15   0   2  987   0   2   0   1   2   1]
 [  12   0   2   0  962   0   2   0   0   4]
 [  17   0   0   3   0  868   2   1   1   0]
 [  15   2   0   0   4   2  935   0   0   0]
 [  28   0   5   0   0   0   0  994   0   1]
 [  28   0   1   1   0   1   0   2  940   1]
 [  33   2   0   0   5   0   0   3   0  966]]
```

Figure 3 – One-vs-one and one-vs-all confusion matrices on whole dataset

### Exercise 4



Figure 4 - Decision boundaries for all models, including the ensemble model in the bottom right corner (green)

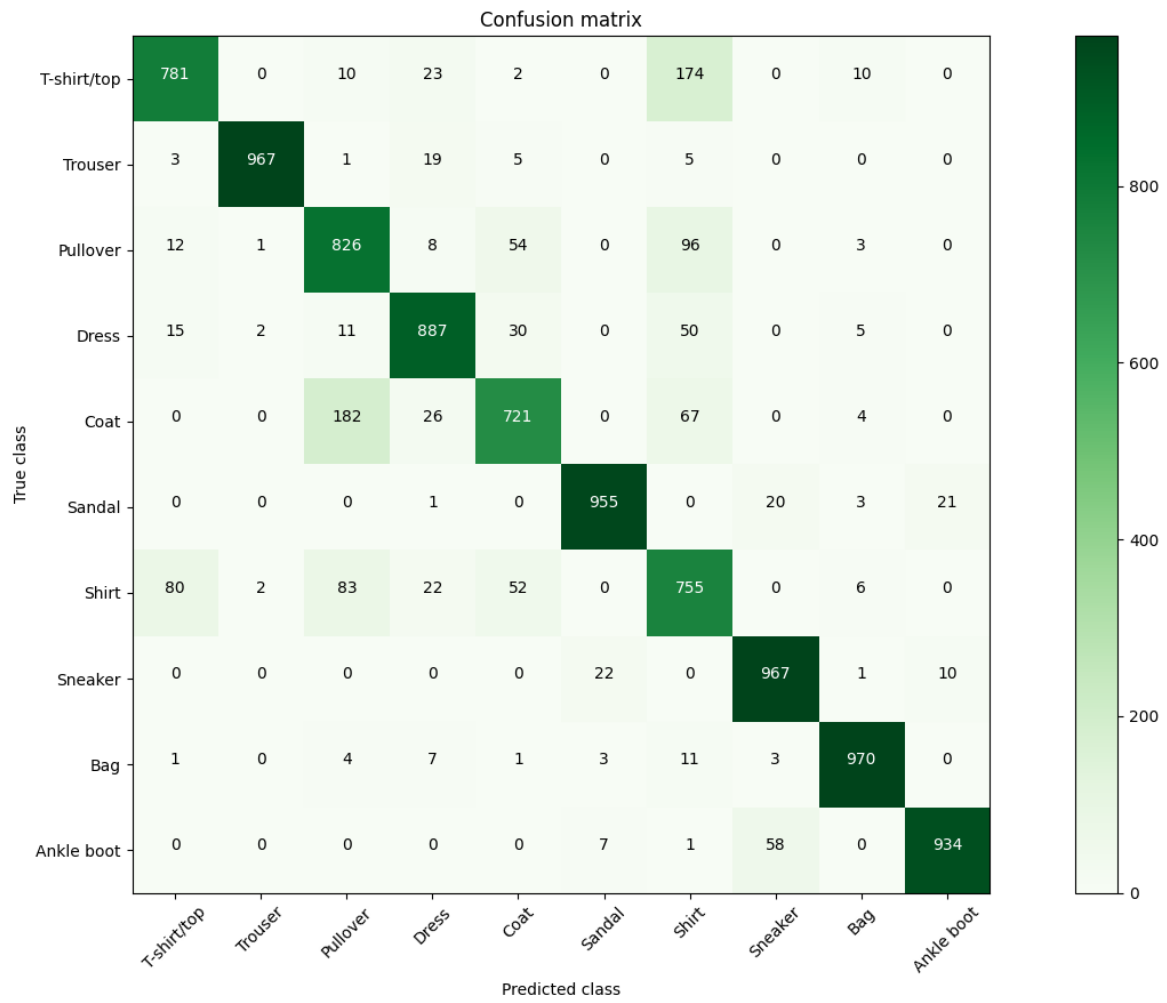
## Exercise 5



Figur 5 - 16 random samples plotted

```
Best parameters: {'activation_function': 'tanh', 'hidden_layer_size': 64, 'learning_rate': 0.001, 'num_hidden_layers': 4, 'regularization': 1e-06}  
Best accuracy: 0.8865166666666667  
PS C:\Users\colle\Desktop\A3_ML\MachineLearning_A3\ec222sz_A3> █
```

Figur 6 - Best parameters and best accuracy of the grid search



Figur 7 - Confusion matrix