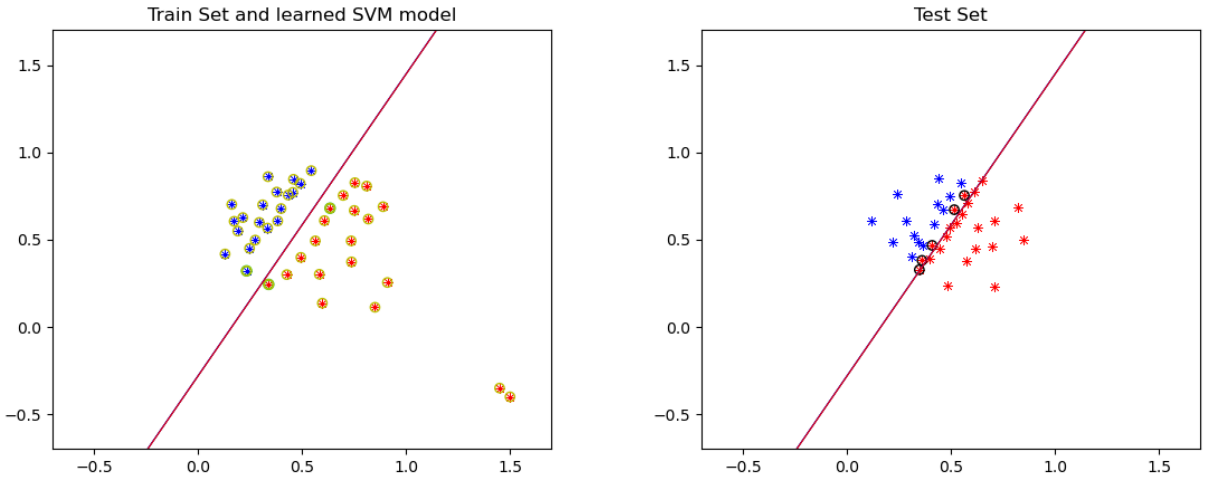
Til Mohr
Simon Michau
Marc Ludevid Wulf

Question 1

(a)

Number of SV: 3
Accuracy on train data with C = 1000: 1.0
Accuracy on test data with C = 1000: 0.8648648648648649



Adjustments to `apply_a.py`

`python apply_a.py` threw a lot of errors, which were mainly due to not enforcing a datatype (i.e. matrix vs nparray) and not taking the dimensions requested in `simlin.py` into account.

For this reason, we have modified `apply_a.py`.

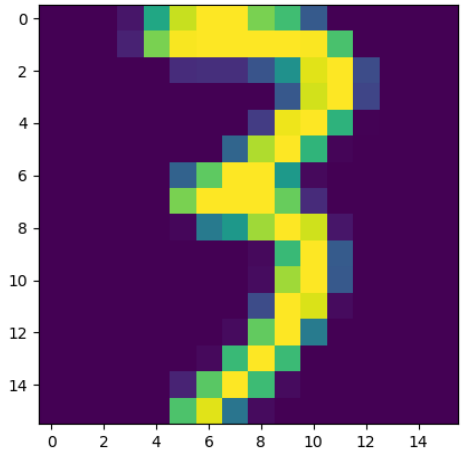
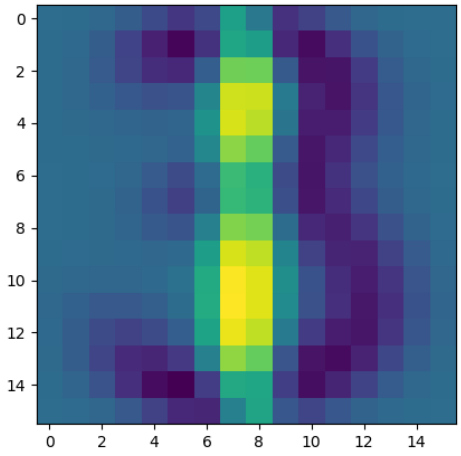
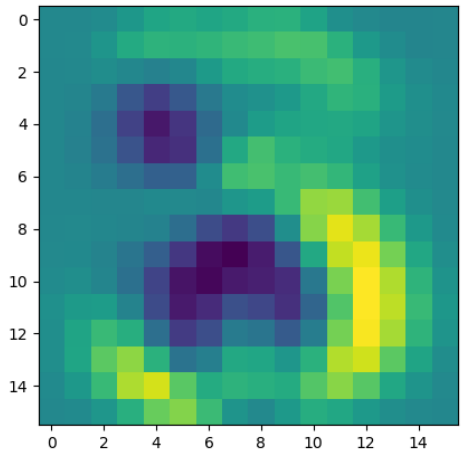
(b+c)

1-vs-3

Number of SV: 26
Width of margin: 0.000527852066940575
Train Error 1-vs-3: 7
Test Error 1-vs-3: 0.013953488372093023

3-vs-8

Number of SV: 89
Width of margin: 0.00010191438464165348
Train Error 3-vs-8: 66
Test Error 3-vs-8: 0.09939759036144578

Adjustments to `apply_bc.py`

As `python apply_a.py`, `python apply_bc.py` threw a lot of errors, which were mainly due to not enforcing a datatype (i.e. matrix vs nparray) and not taking the dimensions requested in `simlin.py` into account.

For this reason, we have modified `apply_bc.py`.

(d)

Accuracy of kernel SVM with C=1000 and norm=5: 0.40540540540540543

This shows, that the accuracy of the kernel SVM is much lower than the accuracy of the linear SVM.

Adjustments to `apply_d.py` and `svmkern.py`

There was a mismatch between the number of variables unpacked from the function `svmkern` in `apply_d.py` and the number of variables to be returned by this function, defined by its description. We have extended the function to return the same values as `svmlin`.
As with the previous adjustments that had to be made, we again had to enforce datatypes and dimensions.

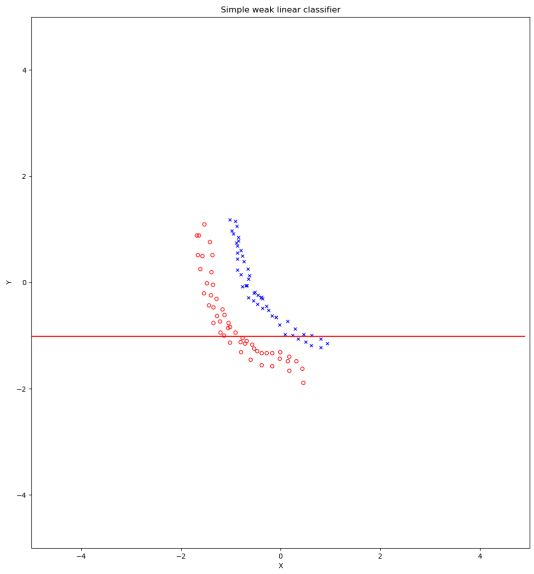
Question 3

(a)

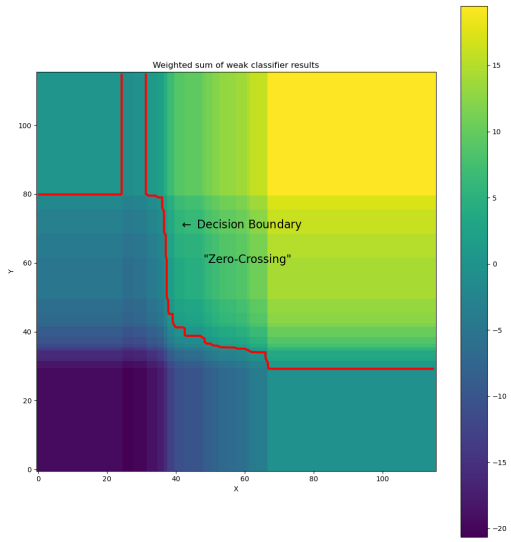
The resulting decision boundary is a linear combination of the decision boundaries of the weak learners.

(b)

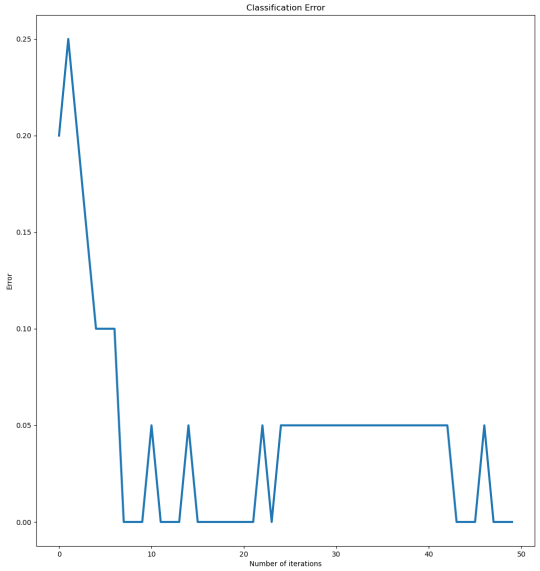
p is also a very important parameter of this classifier. We had to extend everything (also in the following subtasks) to include p.

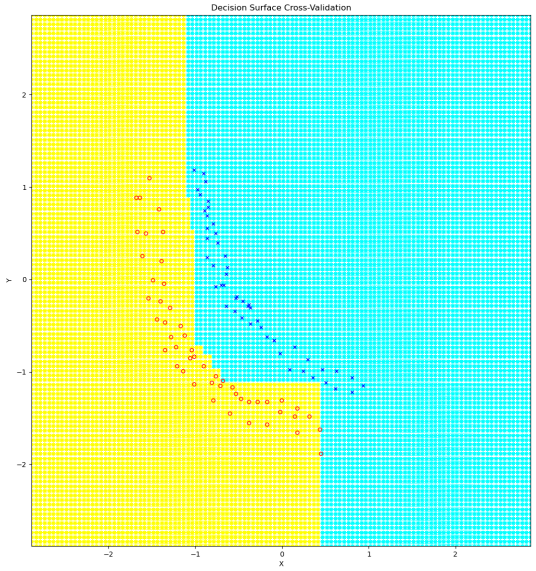


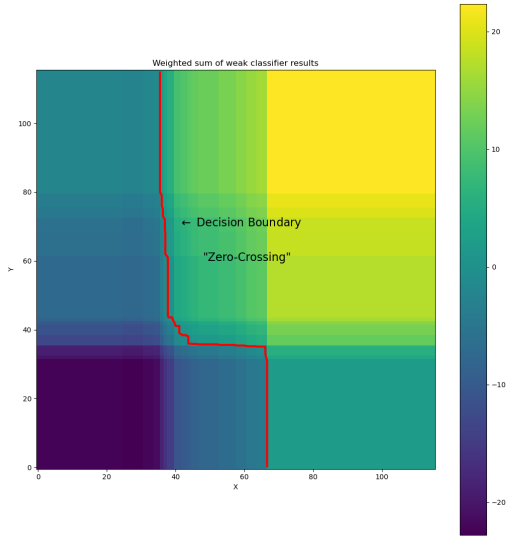
(c)



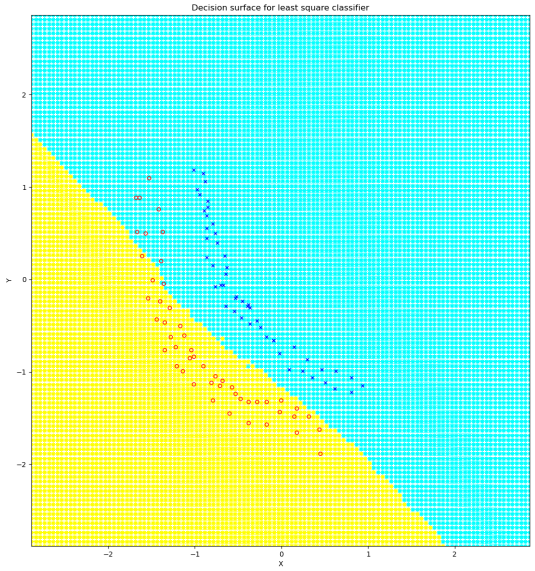
(d)

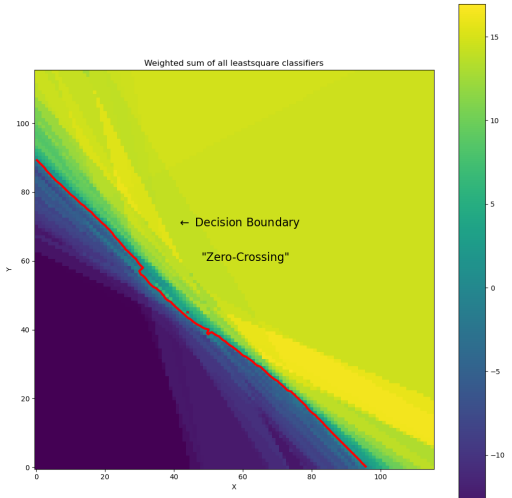

Classification Error
Error
Number of iterations
0.25
0.20
0.15
0.10
0.05
0.00
0
10
20
30
40
50

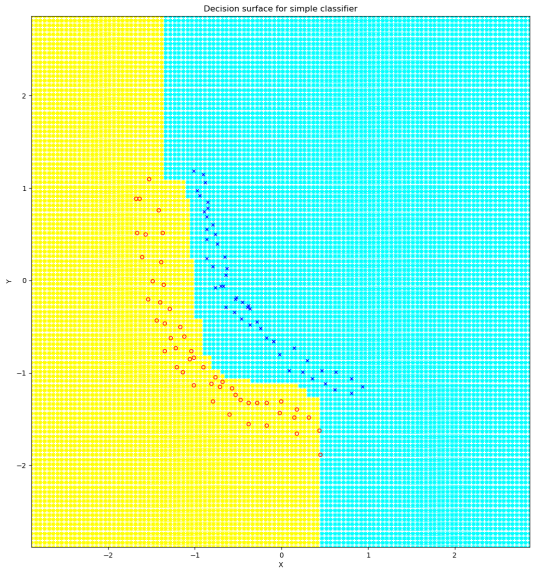

Decision Surface Cross-Validation
X
Y
2
1
0
−1
−2

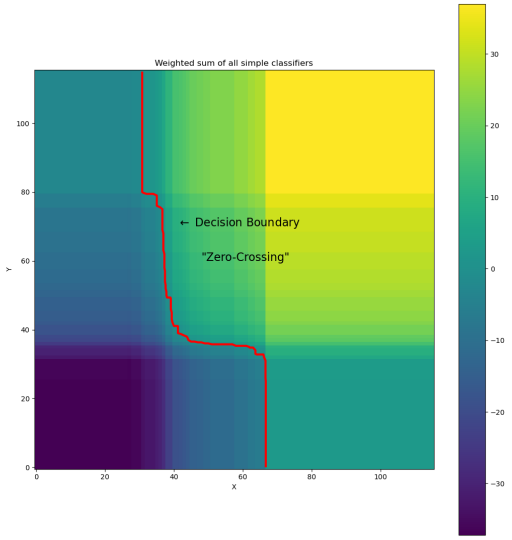

Weighted sum of weak classifier results
← Decision Boundary
"Zero-Crossing"
X
Y
100
80
60
40
20
0
20
40
60
80
100
20
10
0
−10
−20

(e)

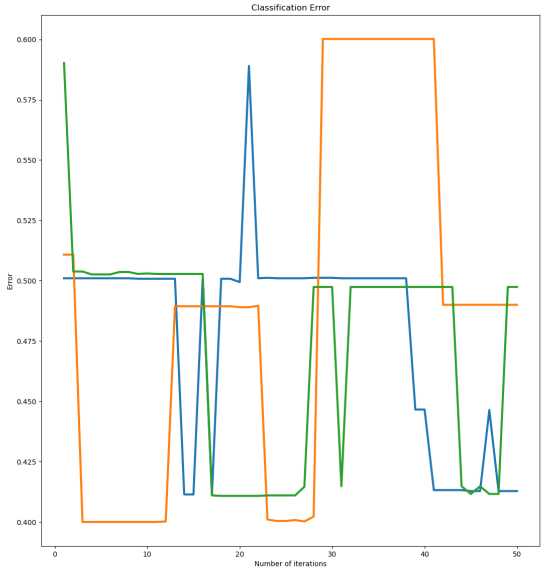

Decision surface for least square classifier
X
Y


Weighted sum of all leastsquare classifiers
← Decision Boundary
"Zero-Crossing"
X
Y


Decision surface for simple classifier
X
Y


Weighted sum of all simple classifiers
← Decision Boundary
"Zero-Crossing"
X
Y

(f)


Classification Error
Error
Number of iterations
0.600
0.575
0.550
0.525
0.500
0.475
0.450
0.425
0.400
0
10
20
30
40
50