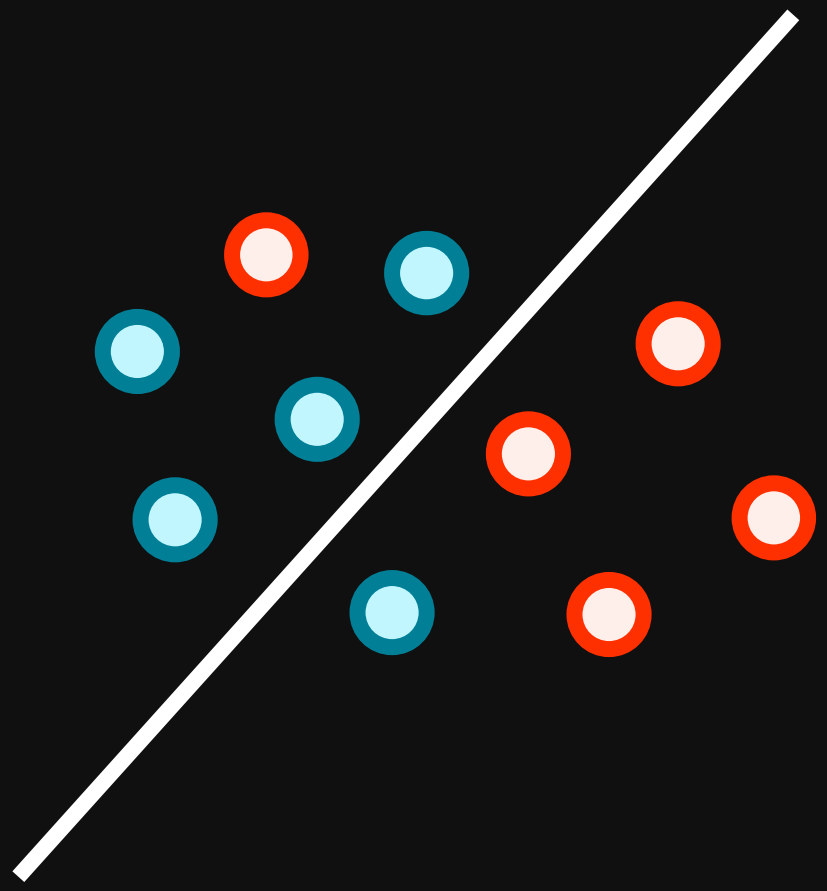
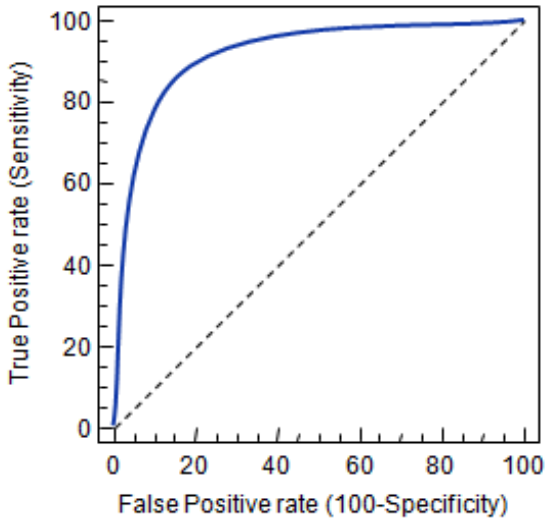
Basics of Machine Learning

Dmitry Ryabokon, github.com/dryabokon



Lesson 17
Benchmarking



Benchmarking

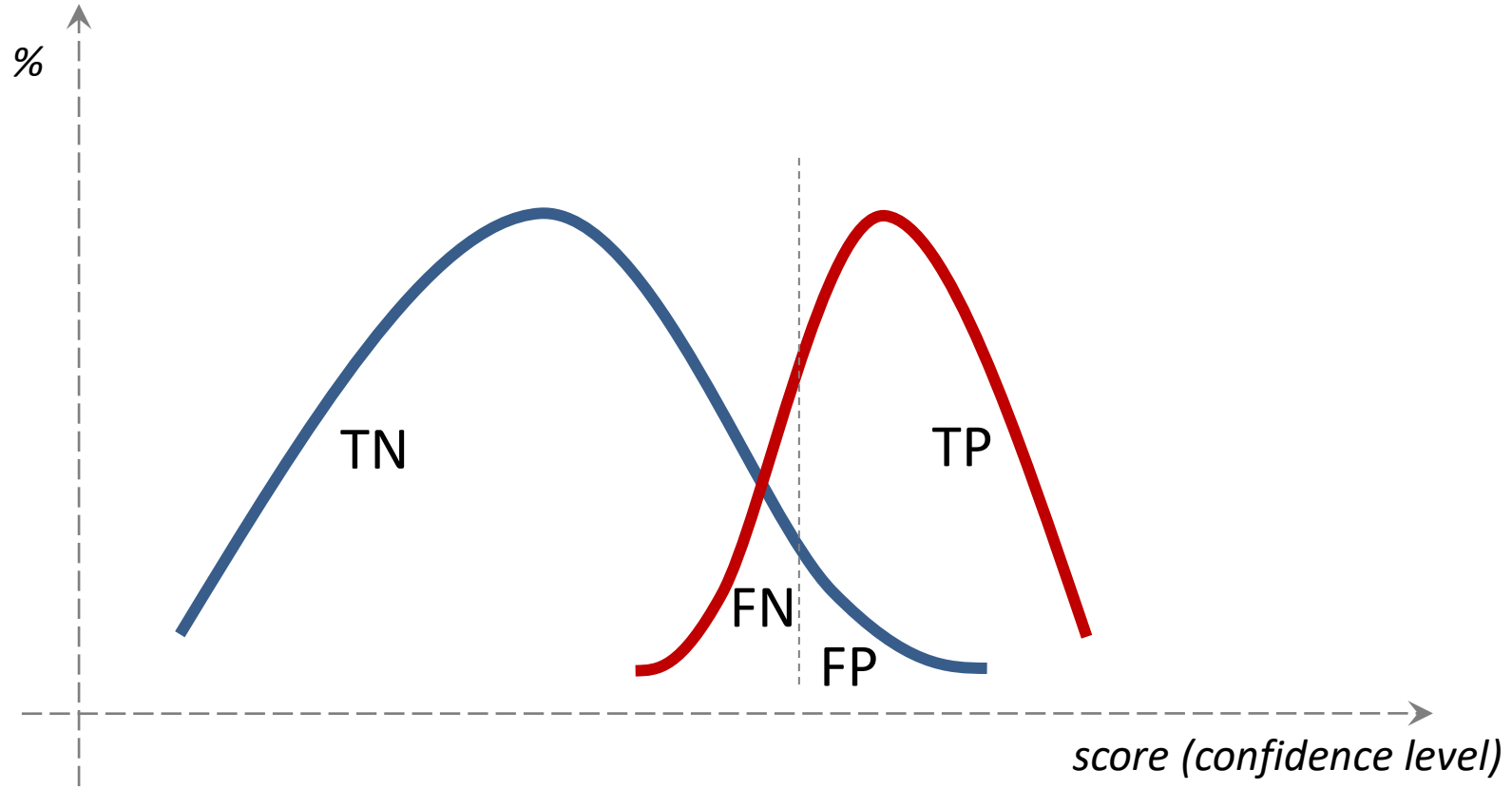
Summary

- ROC Curve
- PR-Curve
- Benchmarking the classifiers

ROC curve

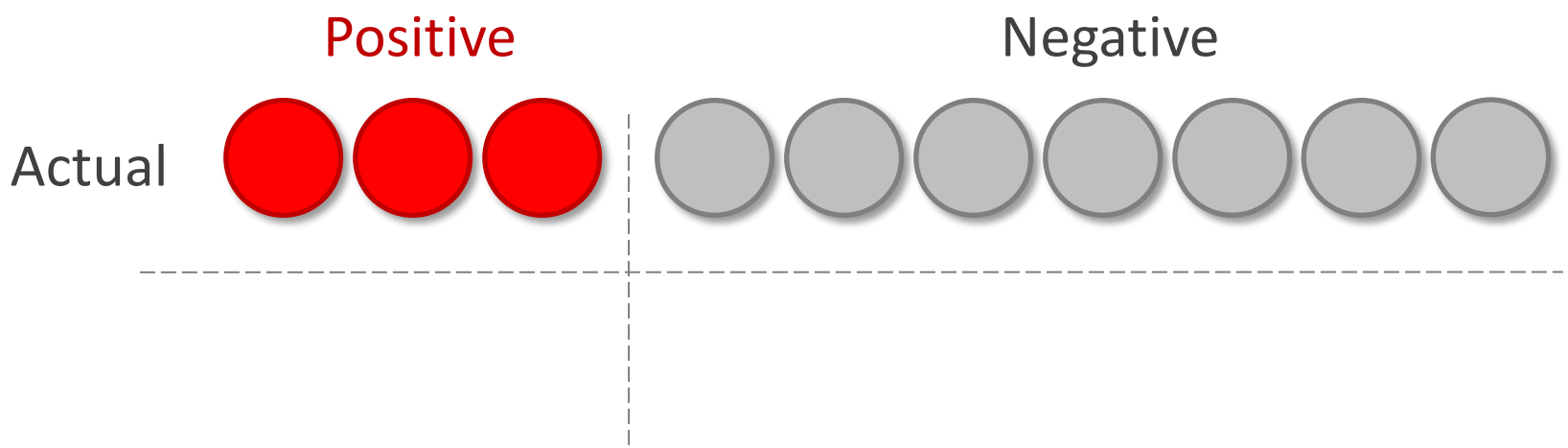
https://github.com/dryabokon/ML/blob/master/ex_03_01_ROC.py

ROC curve



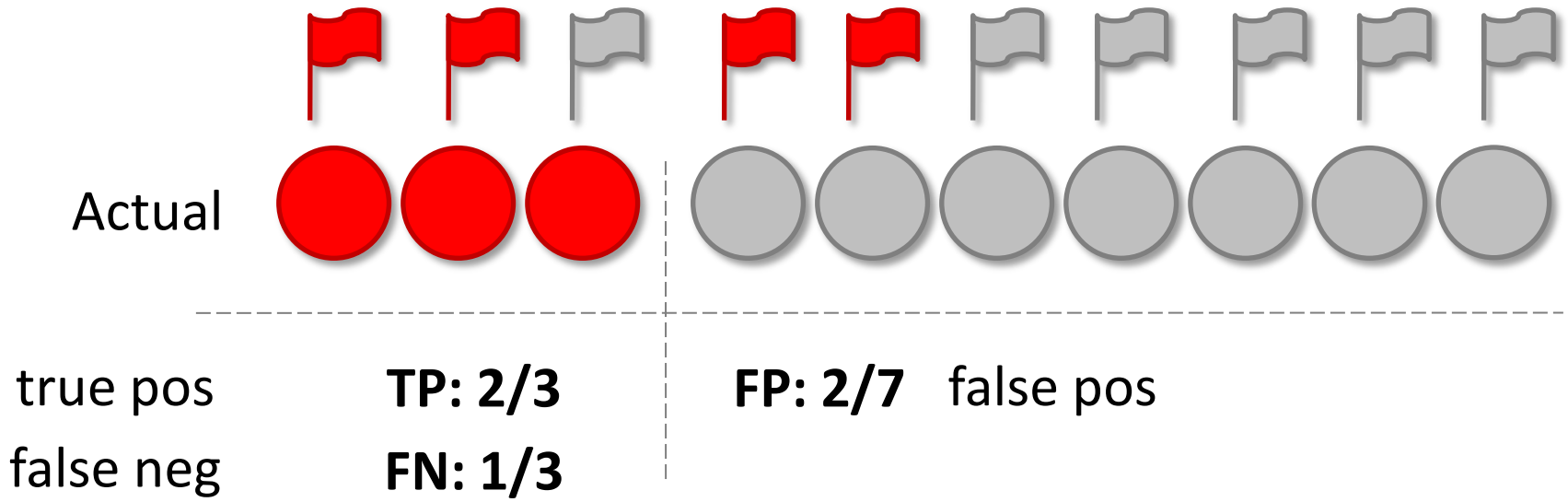
ROC curve

Error types

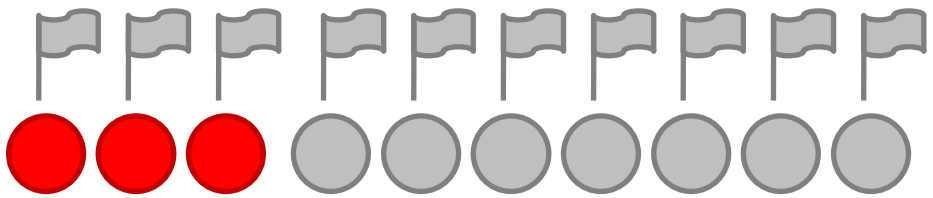


ROC curve

Error types

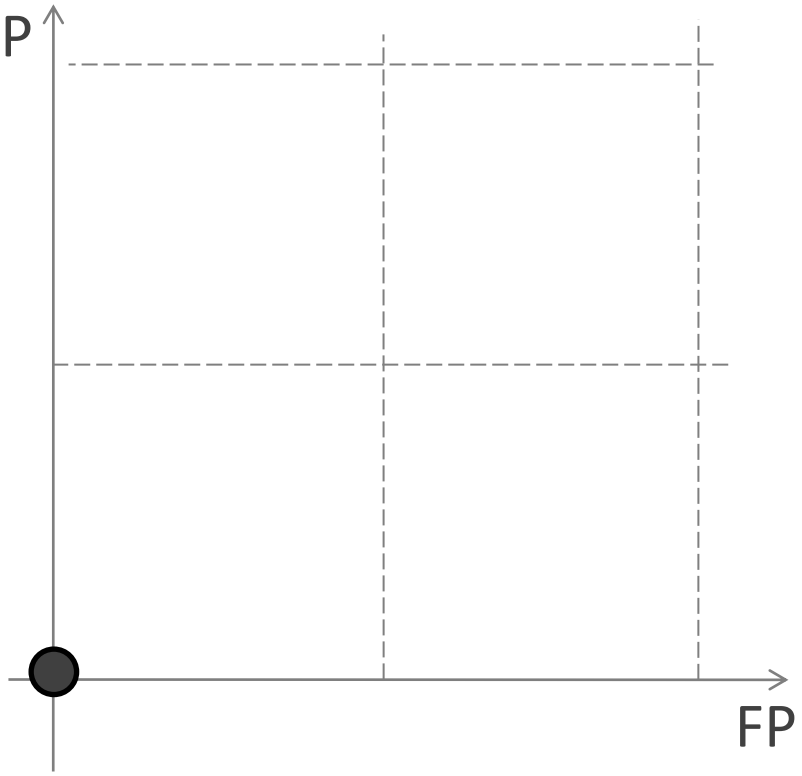


ROC curve

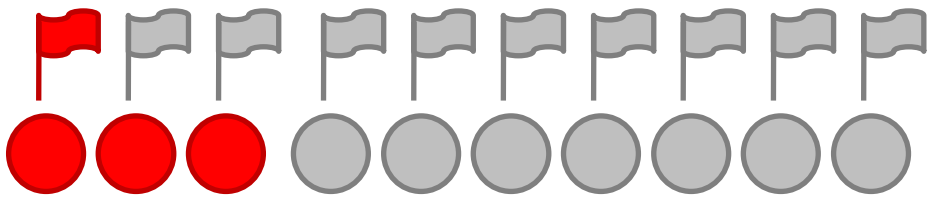


TP: 0/3 FP: 0/7

FN: 3/3

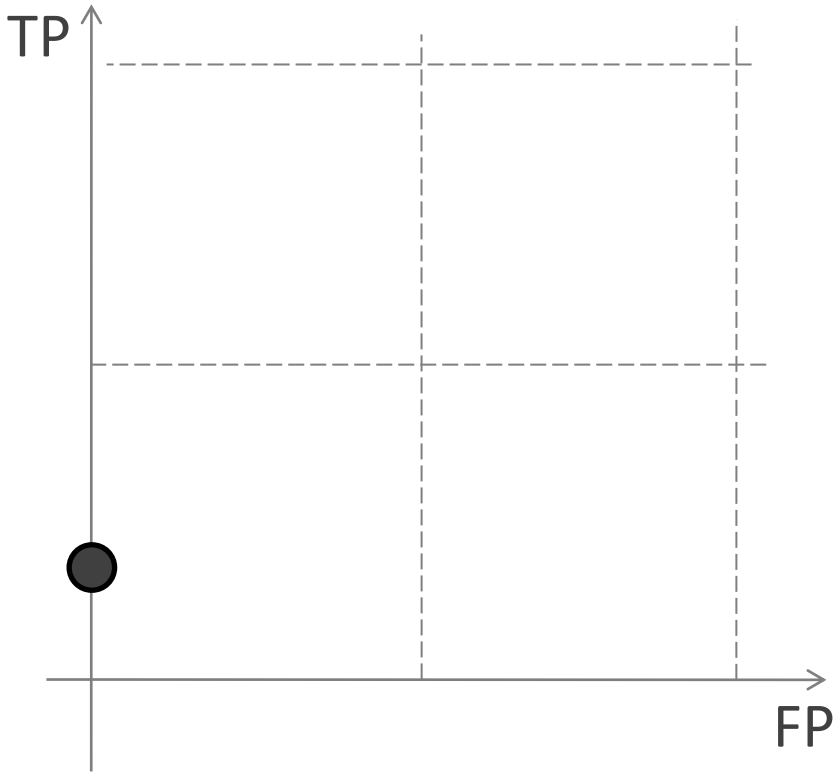


ROC curve

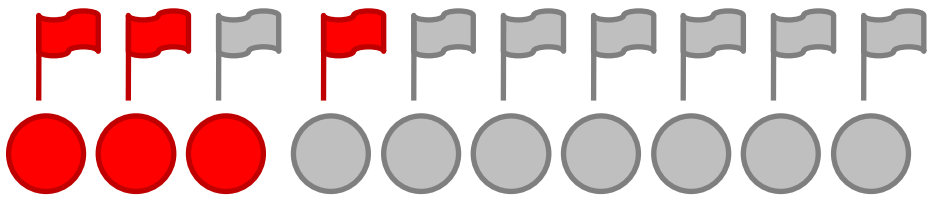


TP: 1/3 **FP: 0/7**

FN: 2/3

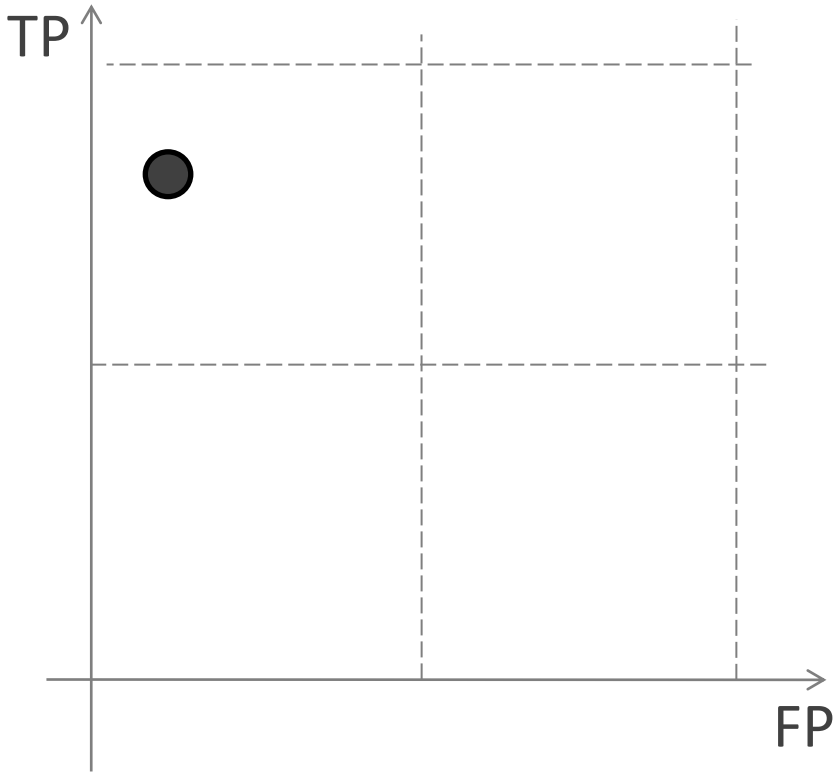


ROC curve

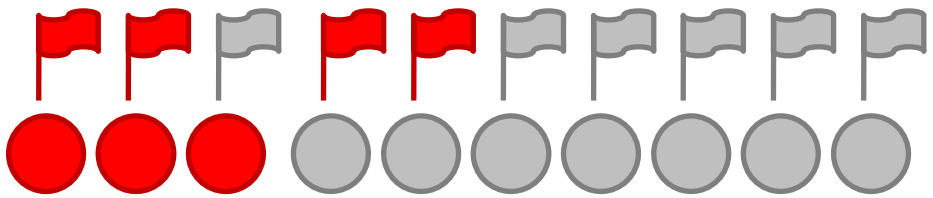


TP: 2/3 FP: 1/7

FN: 1/3

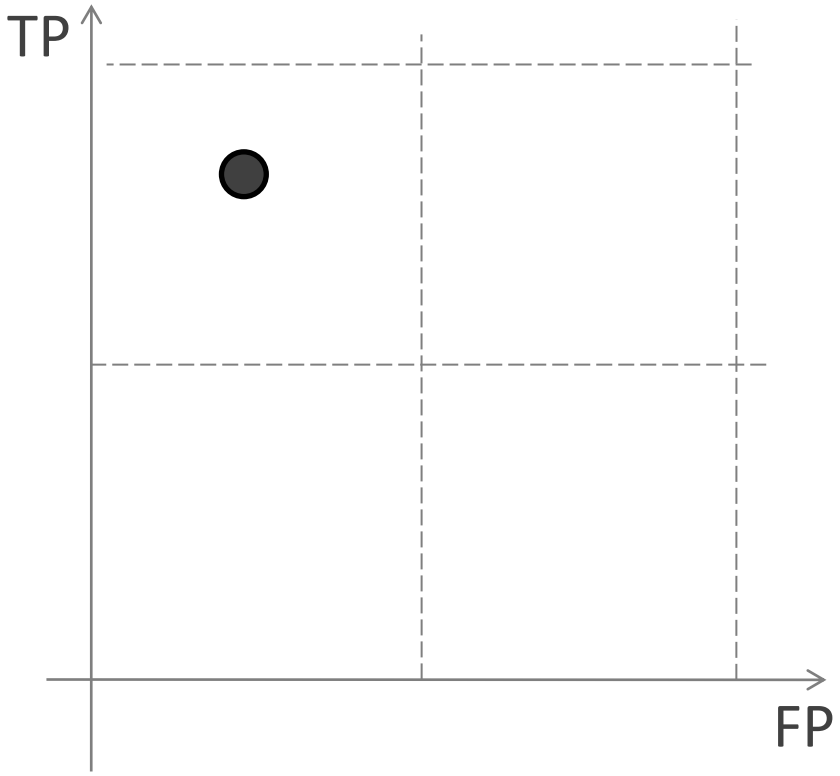


ROC curve

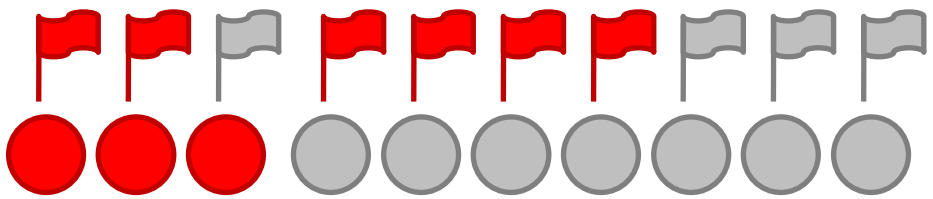


TP: 2/3 **FP: 2/7**

FN: 1/3

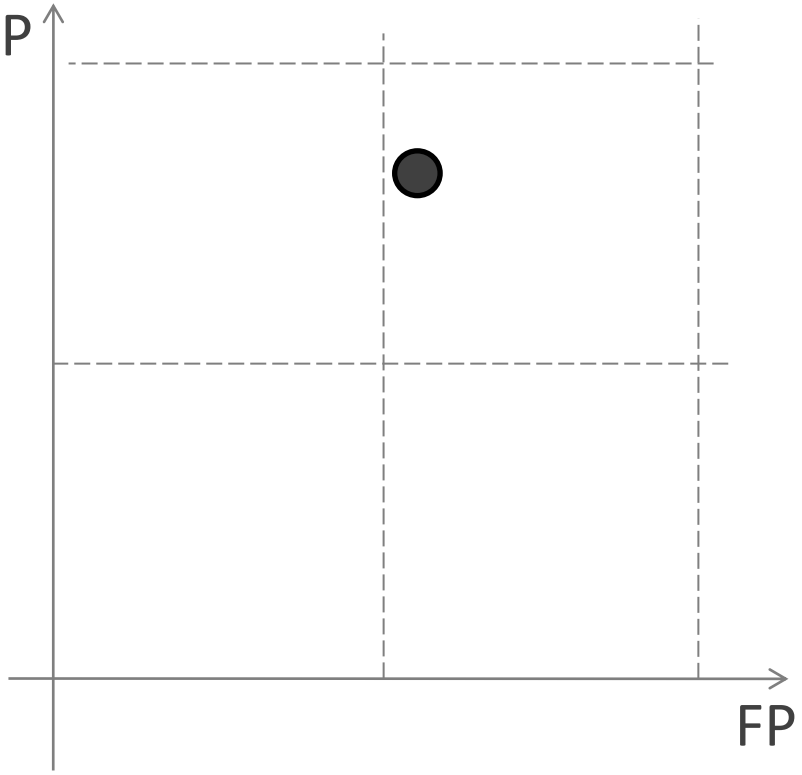


ROC curve

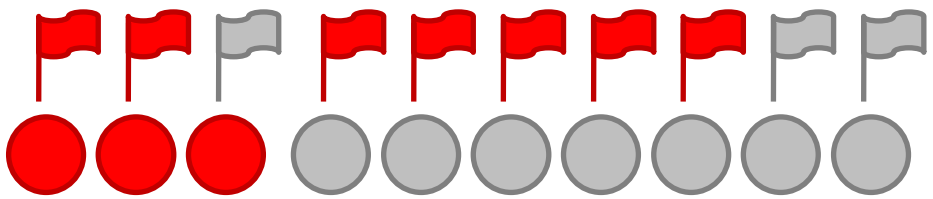


TP: 2/3 FP: 4/7

FN: 1/3

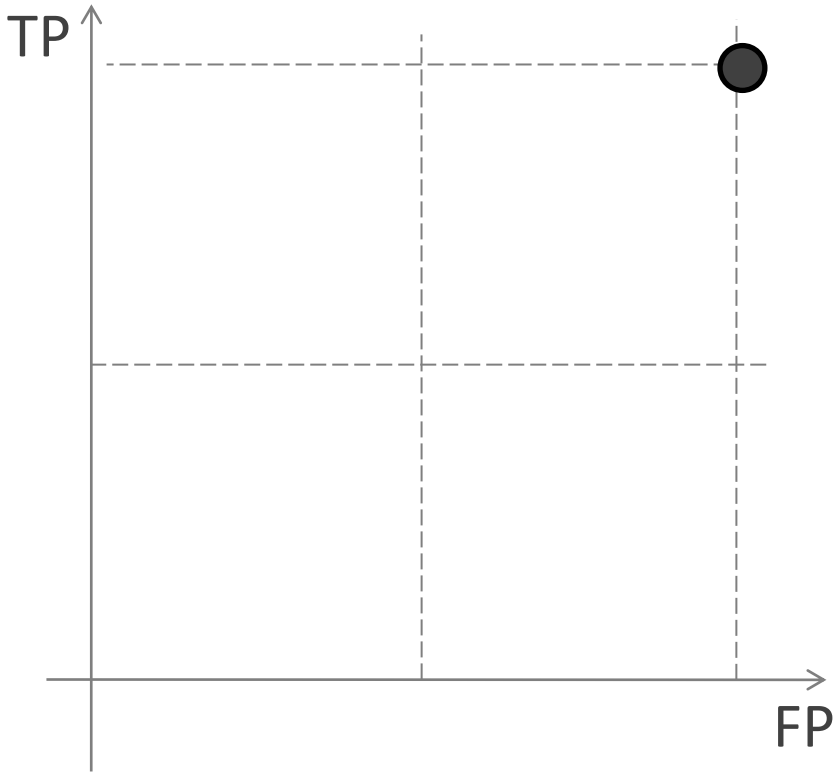


ROC curve



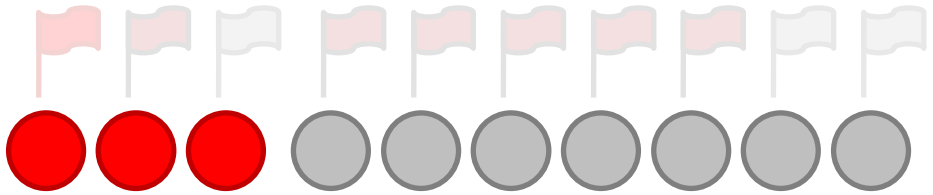
TP: 3/3 FP: 7/7

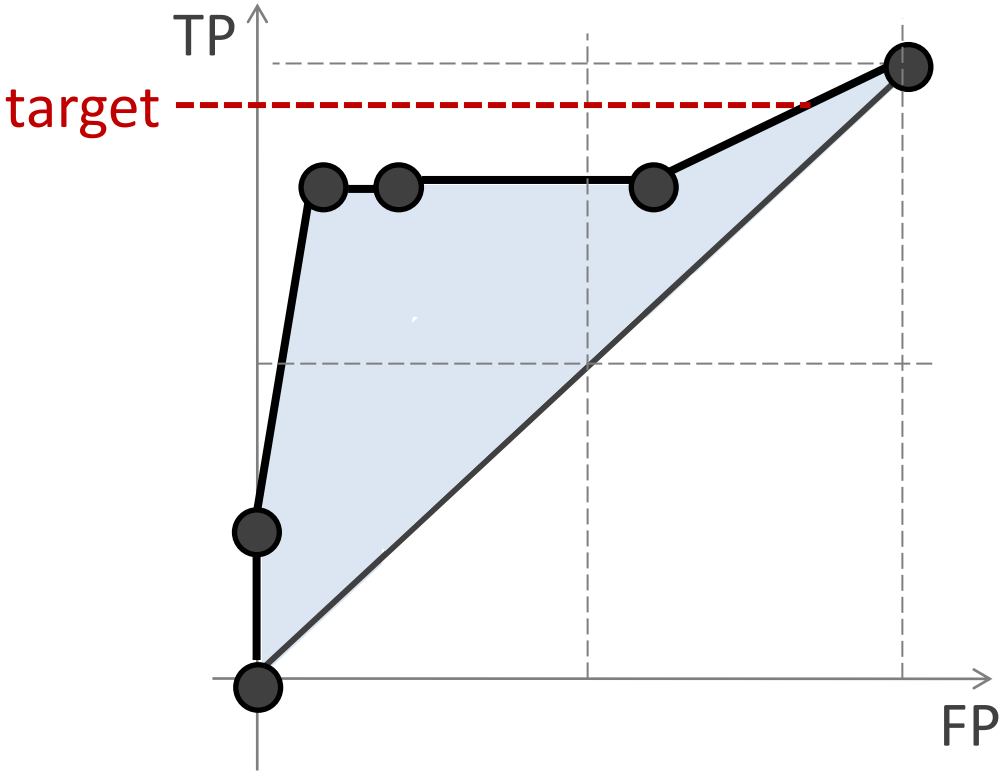
FN: 0/3



ROC curve

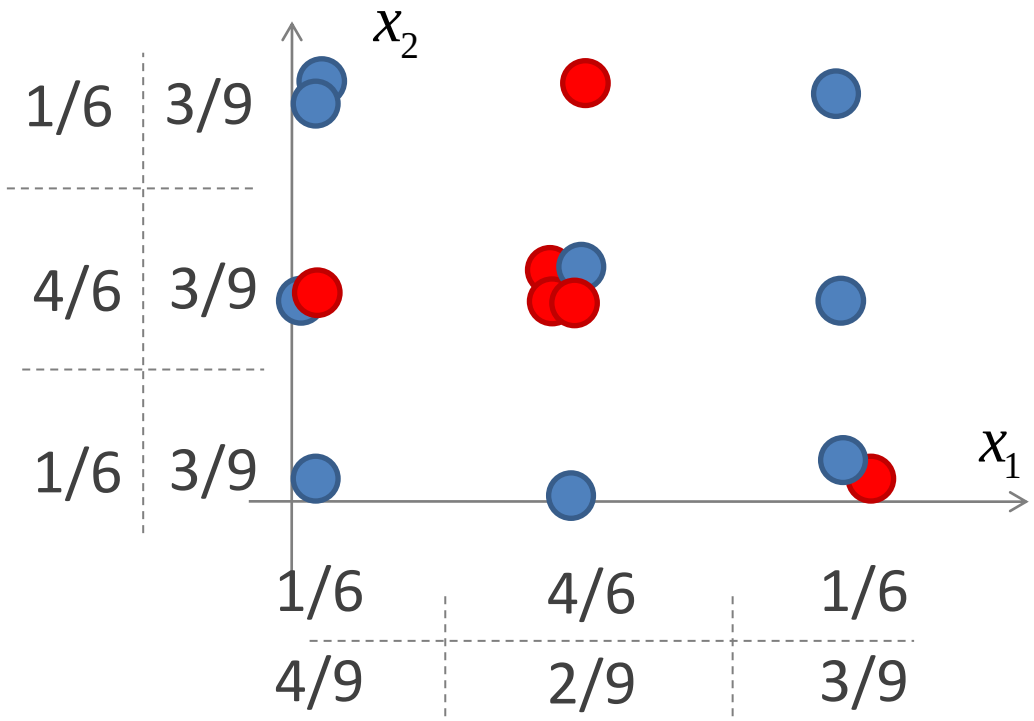
AUC: area under ROC curve





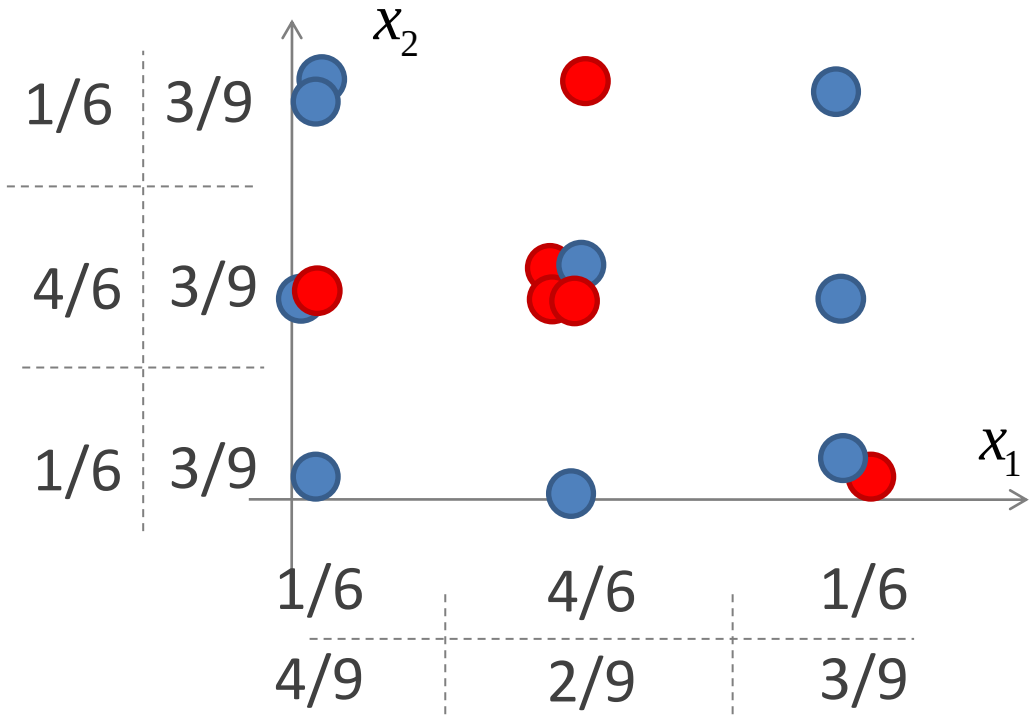
ROC curve

Example: Naive Bayesian classifier



ROC curve

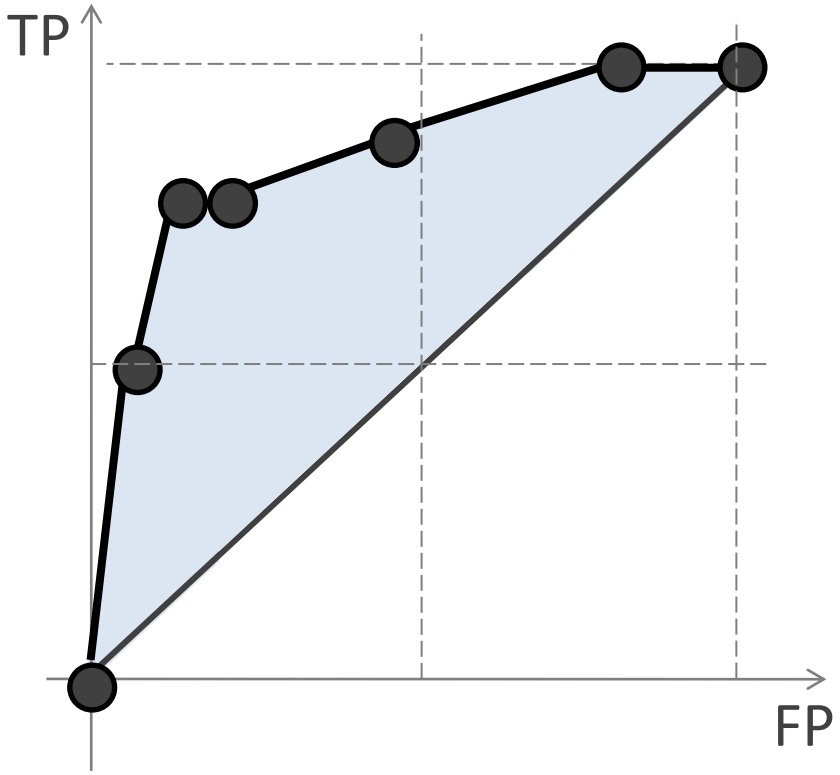
Example: Naive Bayesian classifier



x	(0,0)	(1,0)	(2,0)	(2,0)	(0,1)	(0,1)	(1,1)	(1,1)	(1,1)	(1,1)	(2,1),	(0,2)	(0,2)	(1,2)	(2,2)
k	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
$\frac{p(1\|x)}{p(2\|x)}$	0.19	1.50	0.25	0.25	0.75	0.75	6.00	6.00	6.00	6.00	1.00	0.19	0.19	1.50	0.25

ROC curve

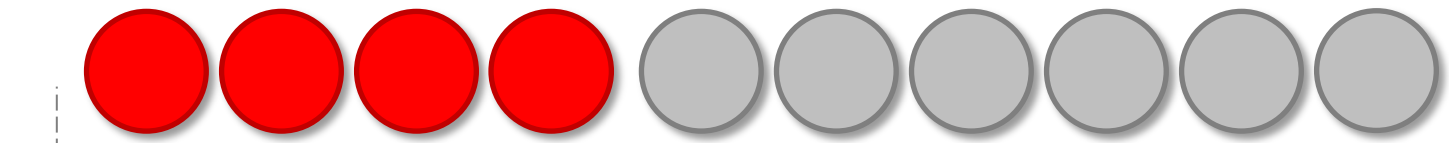
Example: Naive Bayesian classifier



k															
$\frac{p(1\|x)}{p(2\|x)}$	6.00	6.00	6.00	6.00	1.50	1.50	1.00	0.75	0.75	0.25	0.25	0.25	0.19	0.19	0.19

ROC curve

The task: compare accuracy of two strategies



Strategy 1:	63	81	23	54	10	17	29	5	34	21
Strategy 2:	86	98	18	42	21	23	37	18	74	27

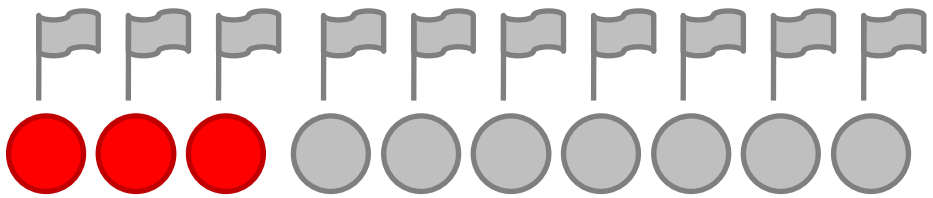
Precision-Recall

Precision - Recall

Precision: TP / (TP+FP)
Recall: TP / (TP+FN)

Accuracy: (TP+TN) /Total
F1-score: 2 x Precision x Recall / (Precision+ Recall)

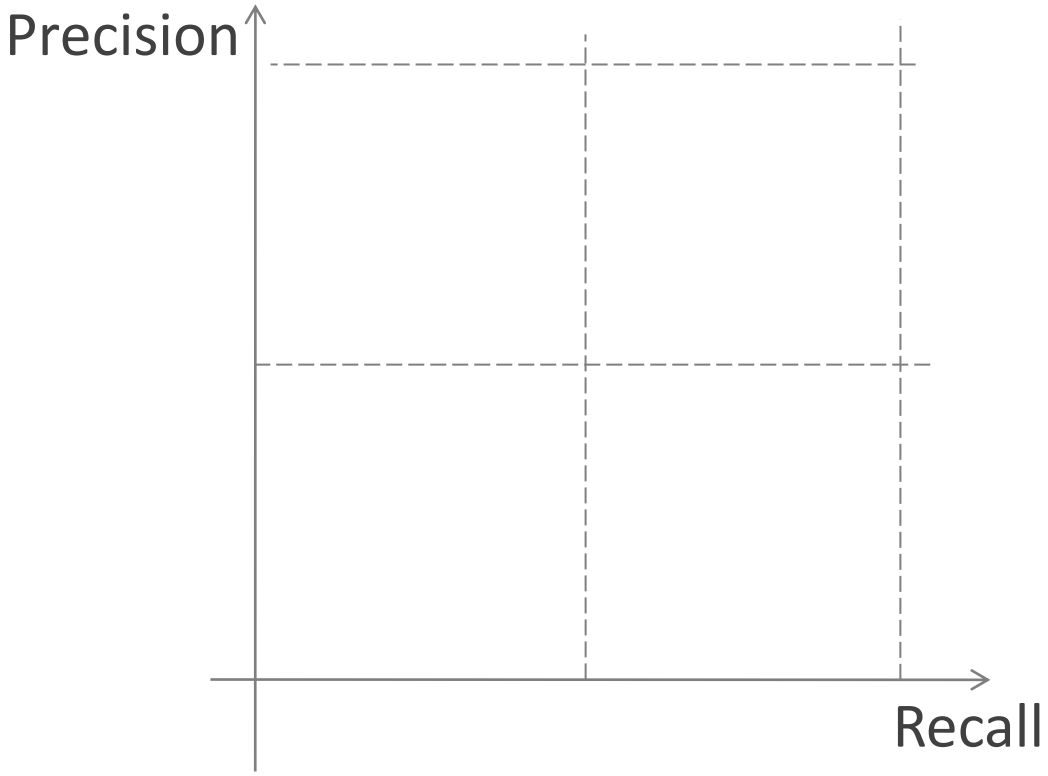
Precision - Recall



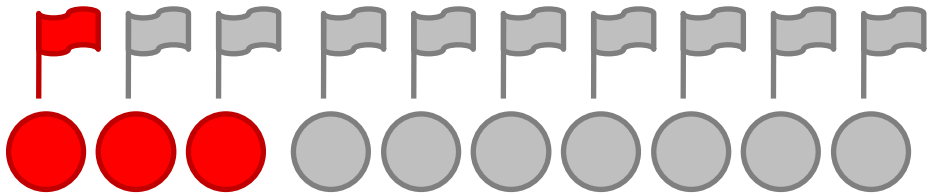
TP: 0	FP: 0
FN: 3	

Precision: 0/0

Recall: 0/3



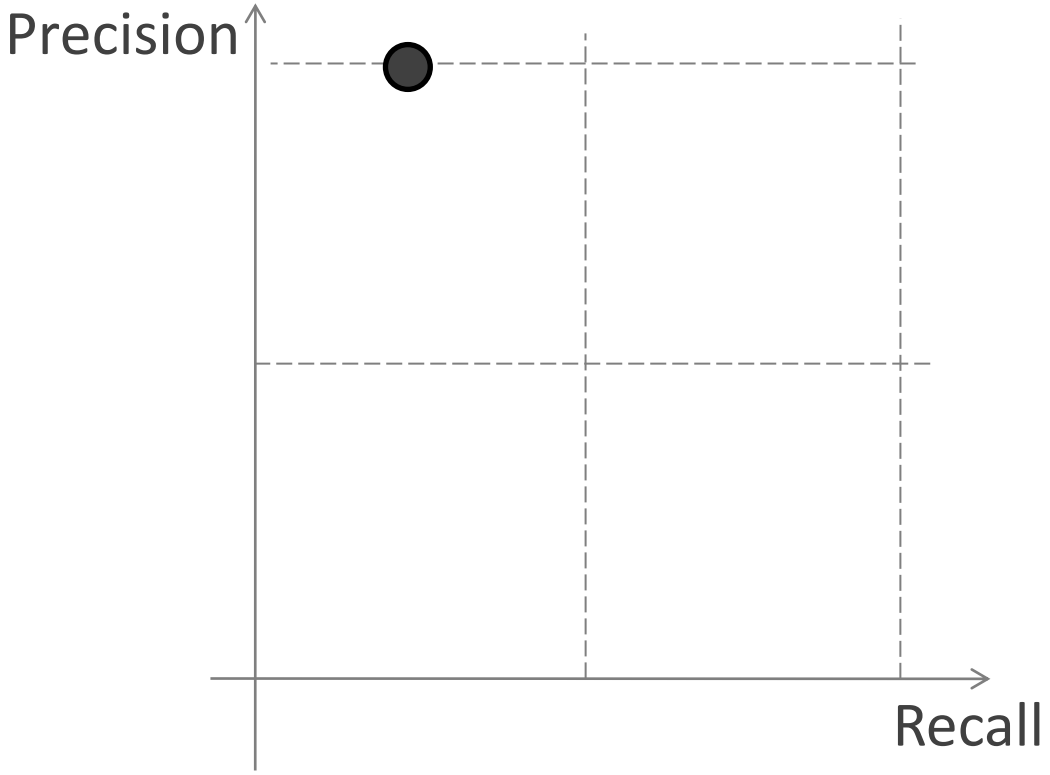
Precision - Recall



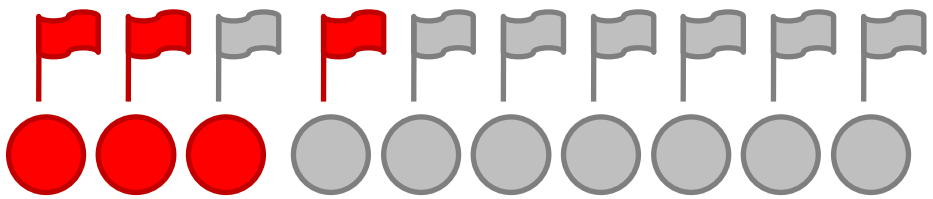
TP: 1	**FP: 0**
FN: 2	

Precision: 1

Recall: 1/3



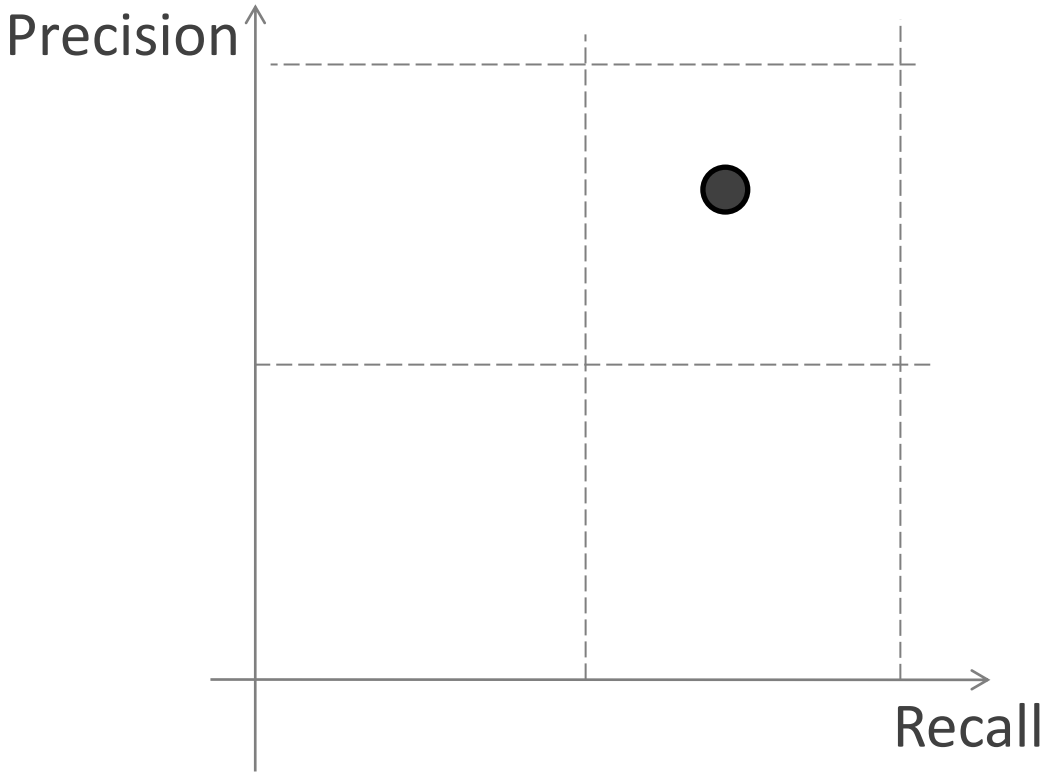
Precision - Recall



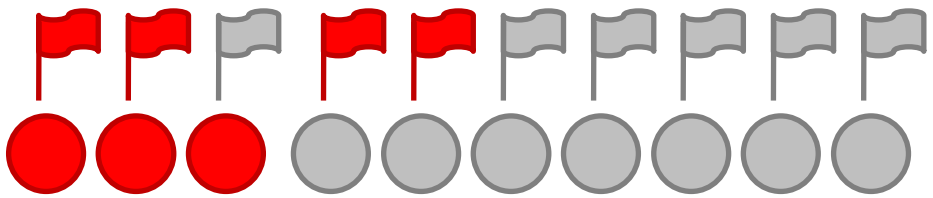
TP: 2	FP: 1
FN: 1	

Precision: 2/3

Recall: 2/3



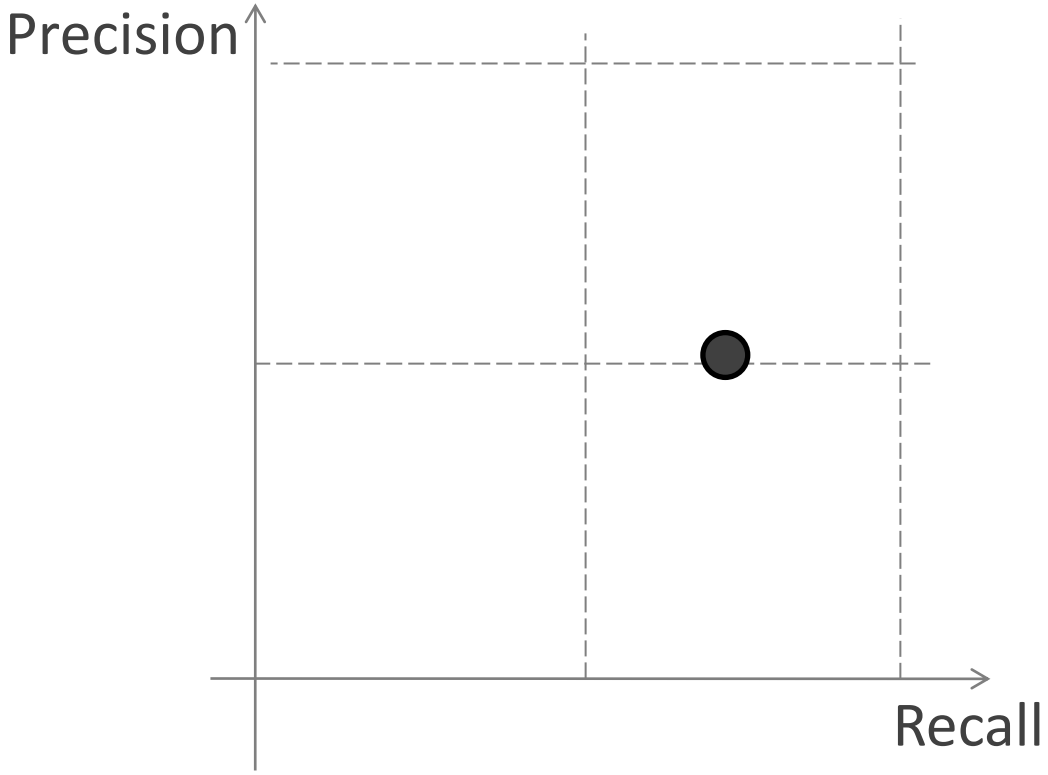
Precision - Recall



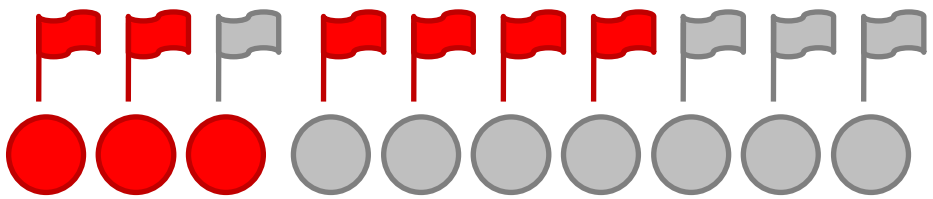
TP: 2	FP: 2
FN: 1	

Precision: 1/2

Recall: 2/3



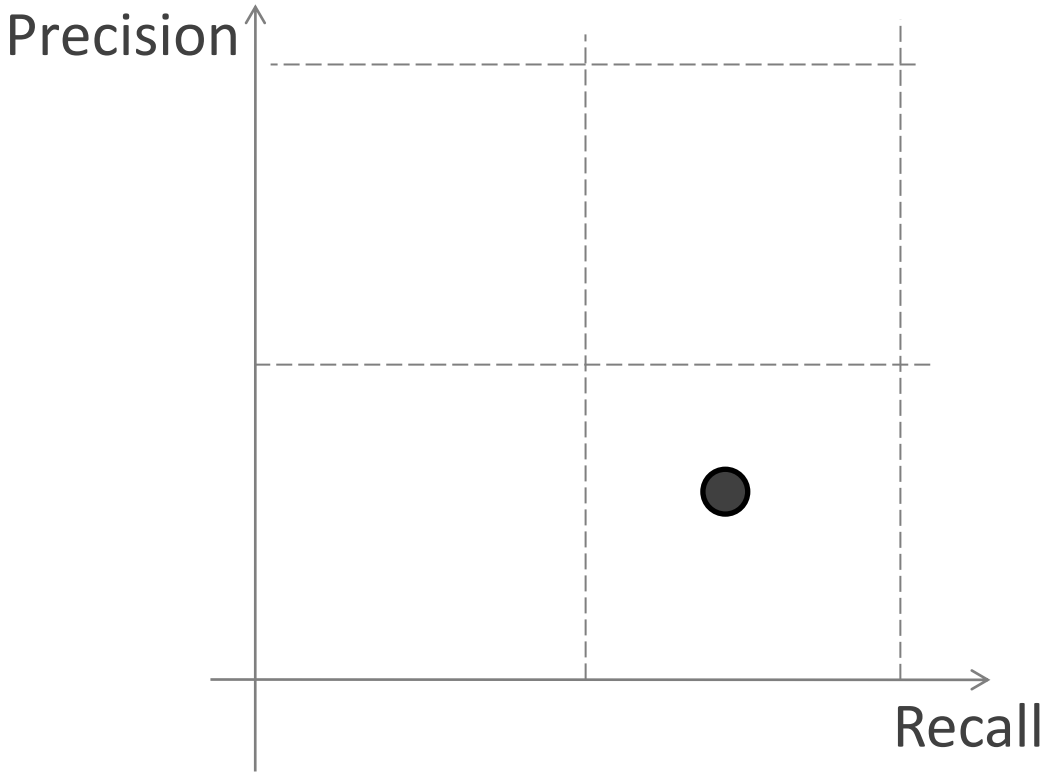
Precision - Recall



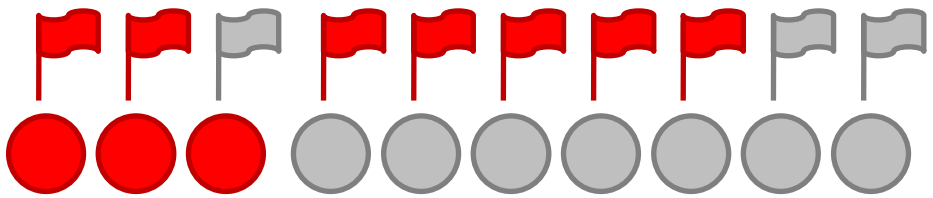
TP: 2	**FP: 4**
FN: 1	

Precision: 2/6

Recall: 2/3



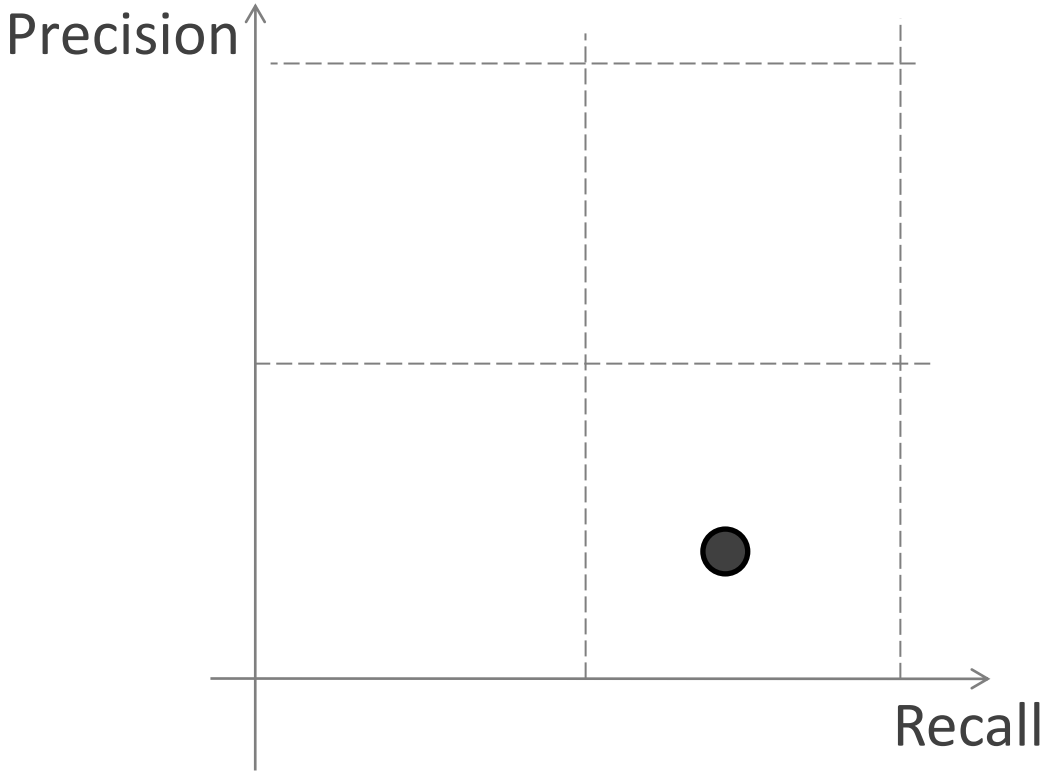
Precision - Recall



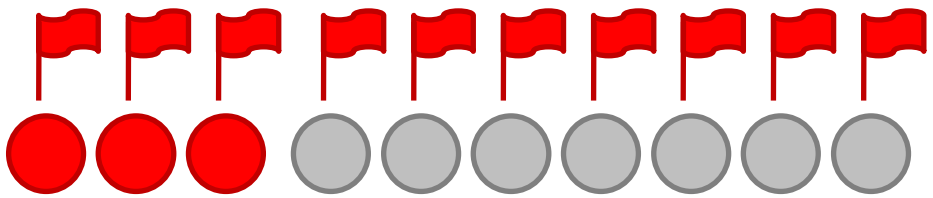
TP: 2	**FP: 5**
FN: 1	

Precision: 2/7

Recall: 2/3



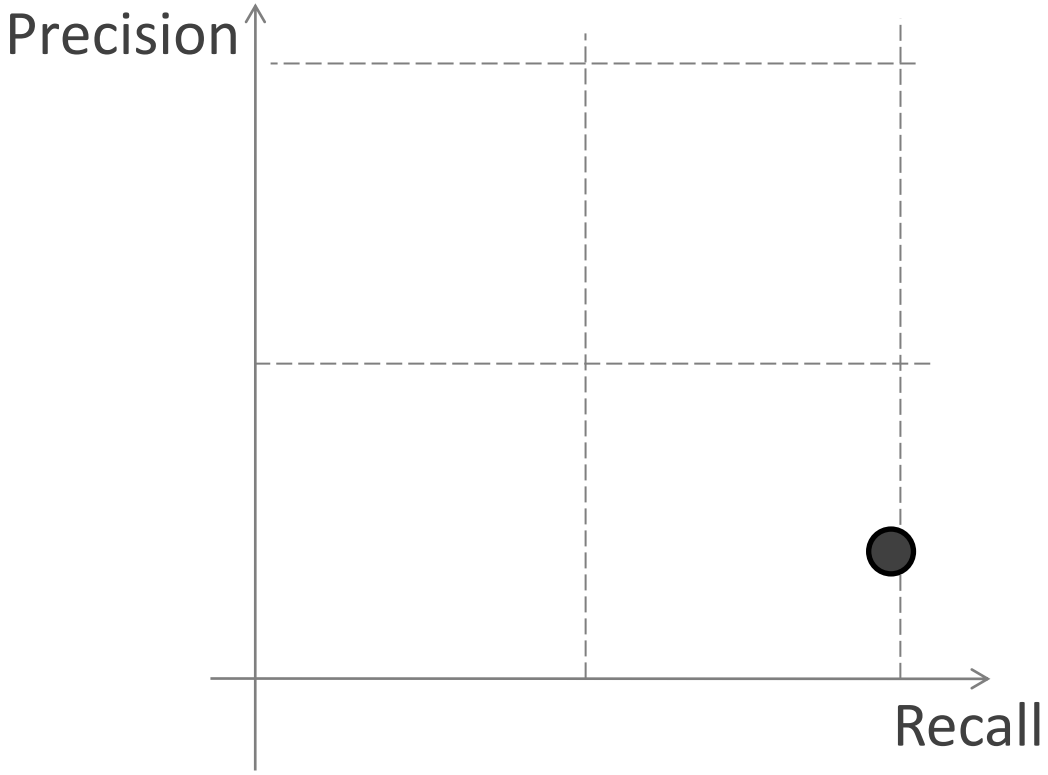
Precision - Recall



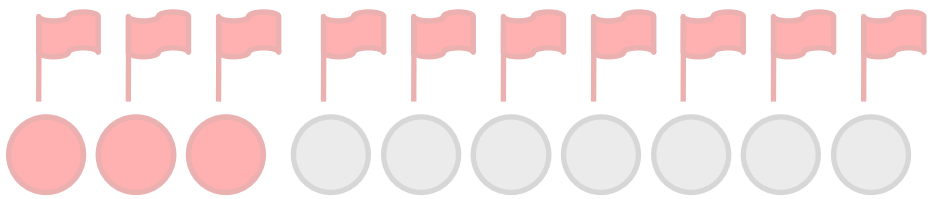
TP: 3	**FP: 7**
FN: 0	

Precision: 3/7

Recall: 1

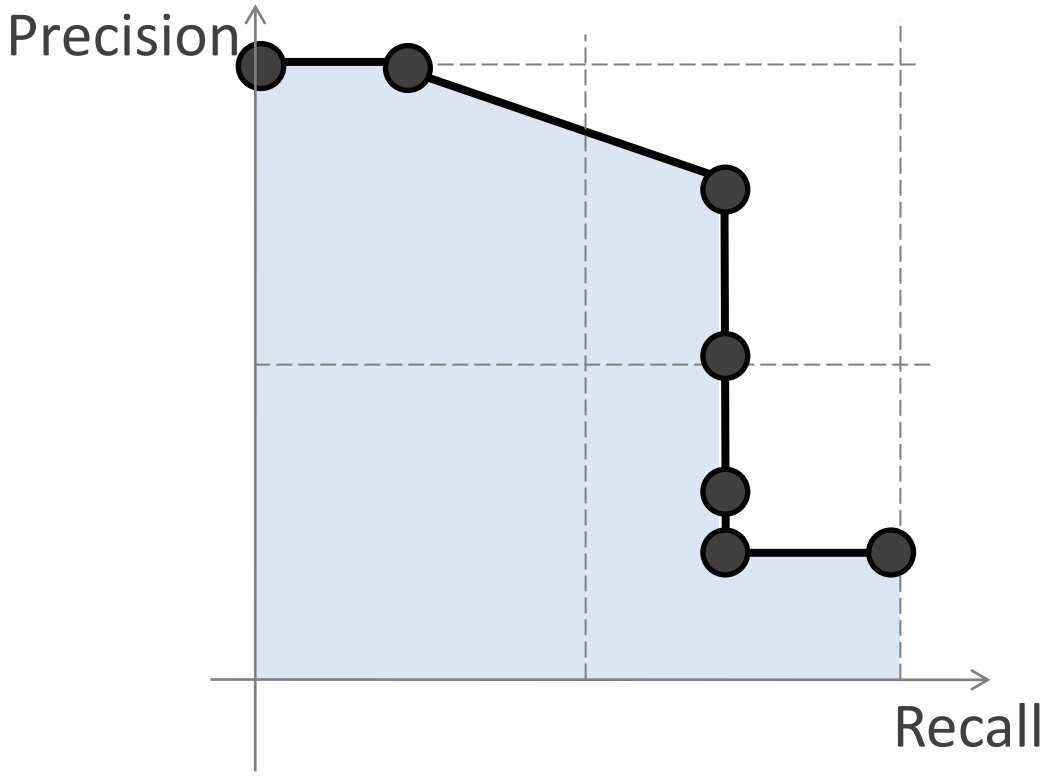


Precision - Recall



TP: 3	FP: 7
FN: 0	

Recall: 1

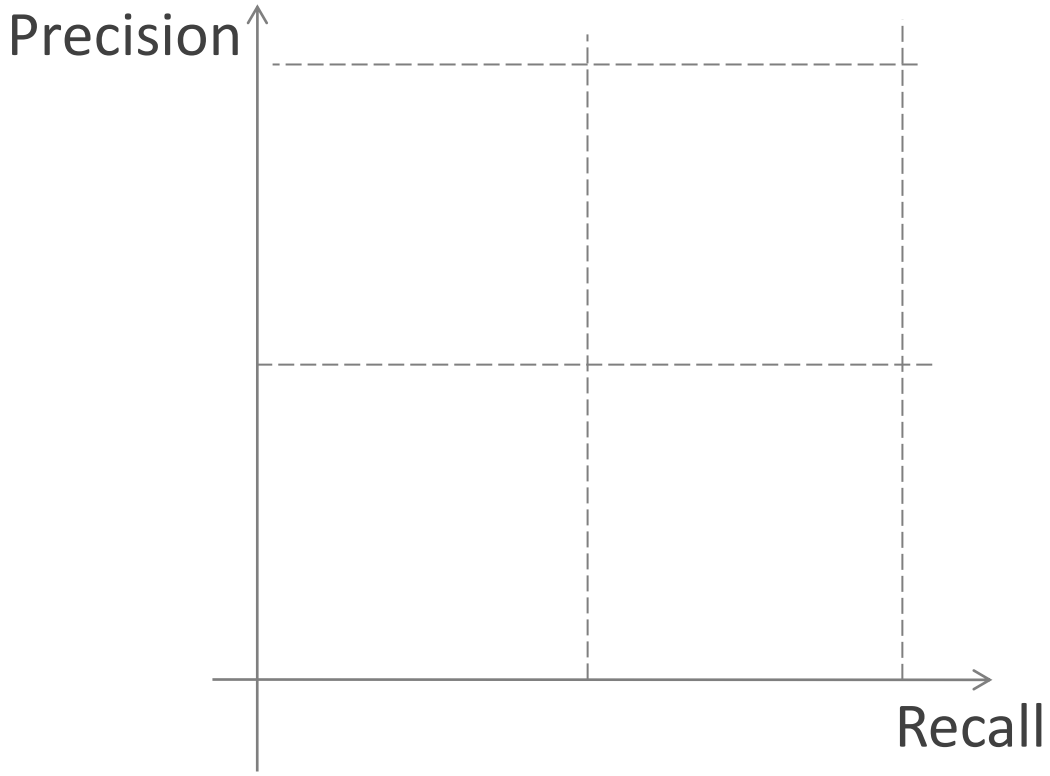


Precision - Recall

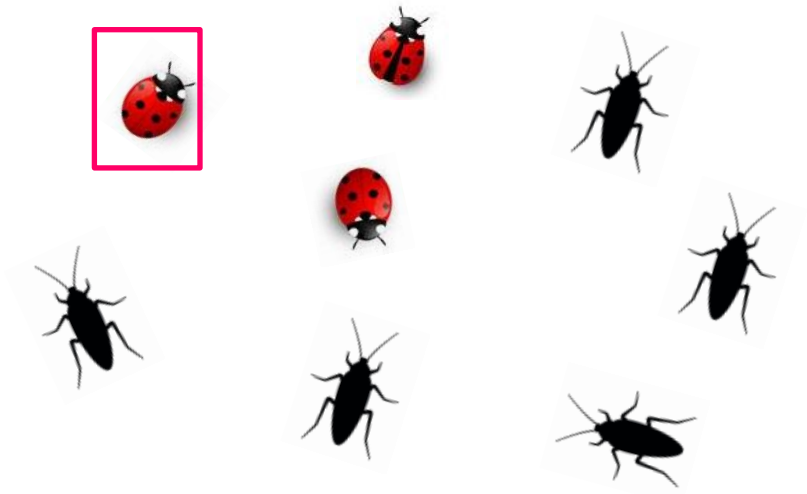
TP: 0	**FP: 0**
FN: 3	

Precision: 0

Recall: 0



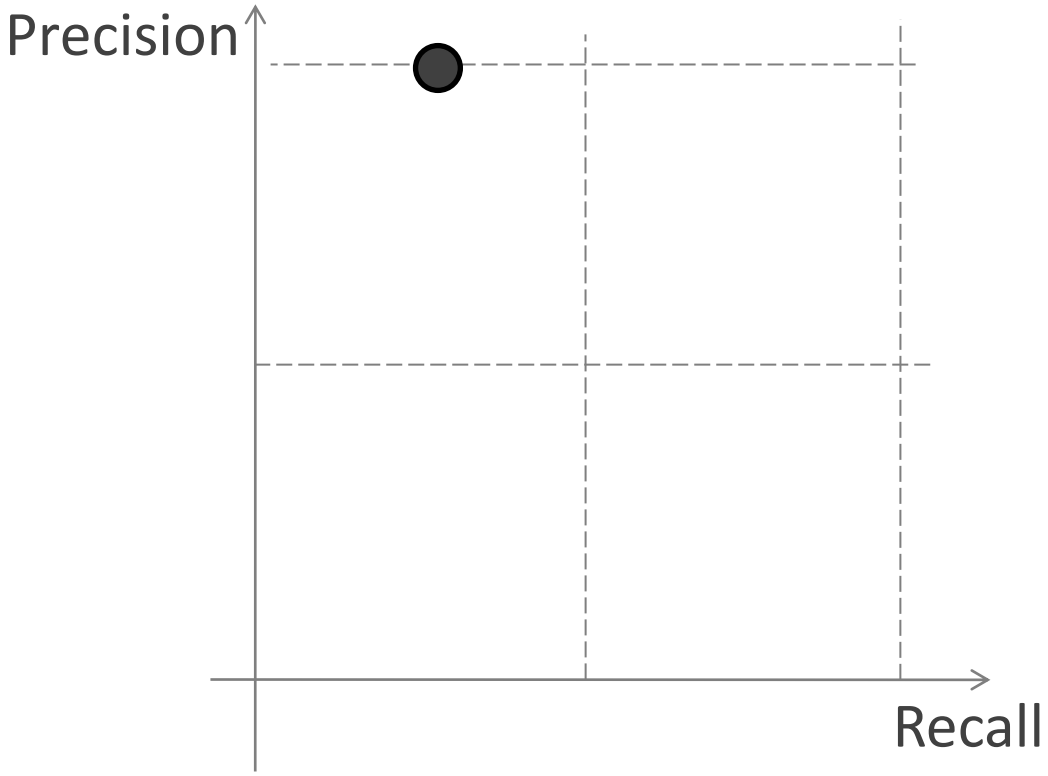
Precision - Recall



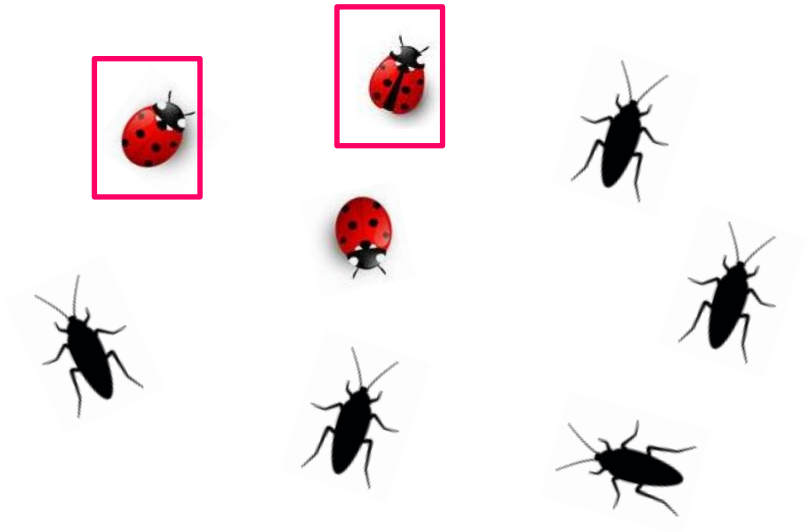
TP: 1	FP: 0
FN: 2	

Precision: 1

Recall: 1/3



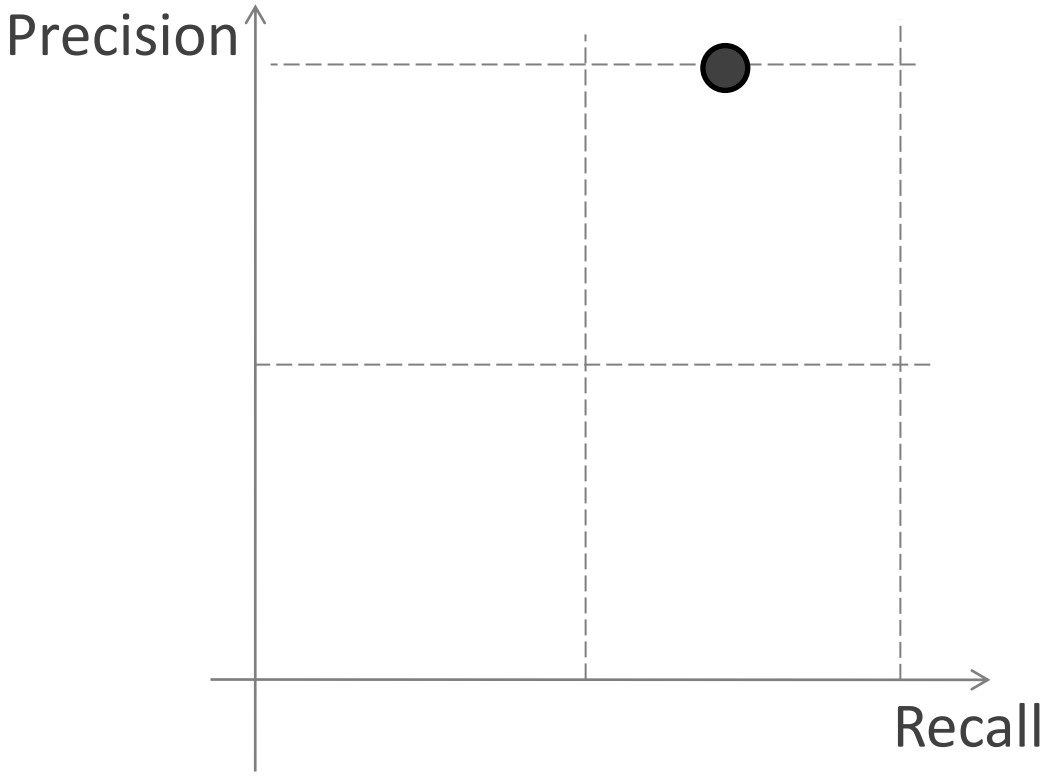
Precision - Recall



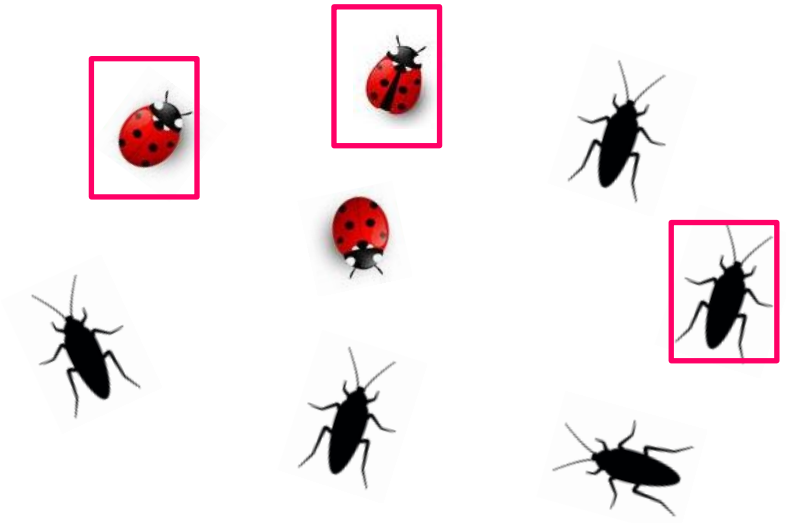
TP: 2	**FP: 0**
FN: 1	

Precision: 1

Recall: 2/3



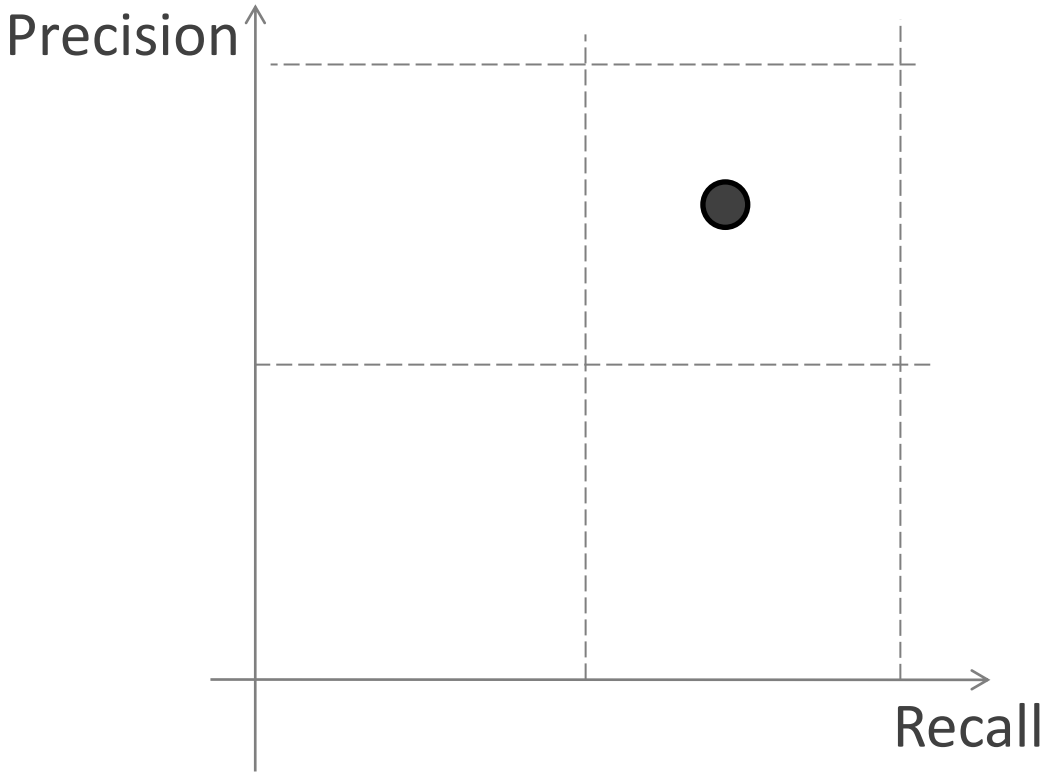
Precision - Recall



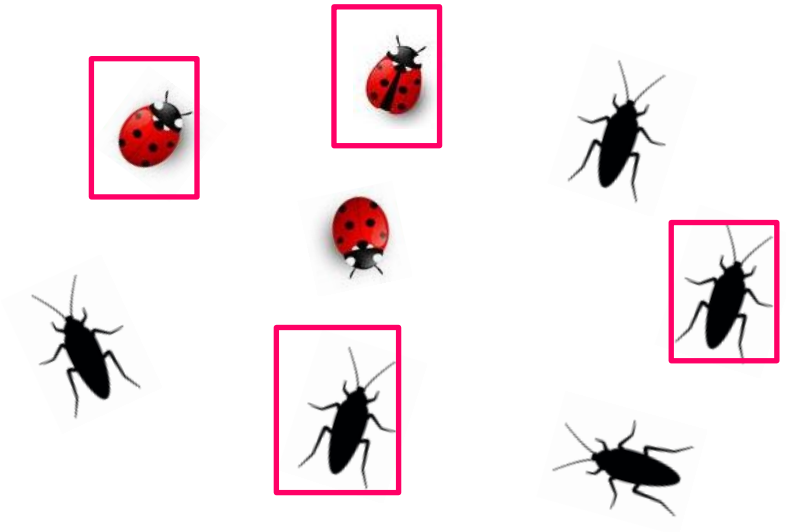
TP: 2	**FP: 1**
FN: 1	

Precision: 2/3

Recall: 2/3



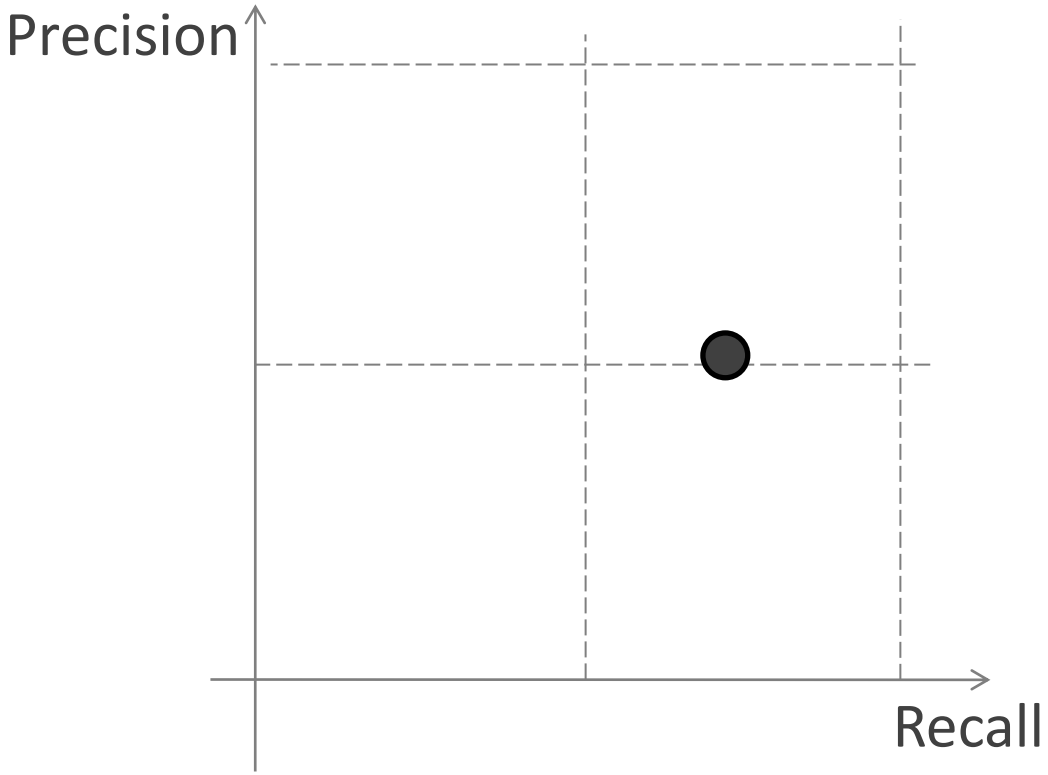
Precision - Recall



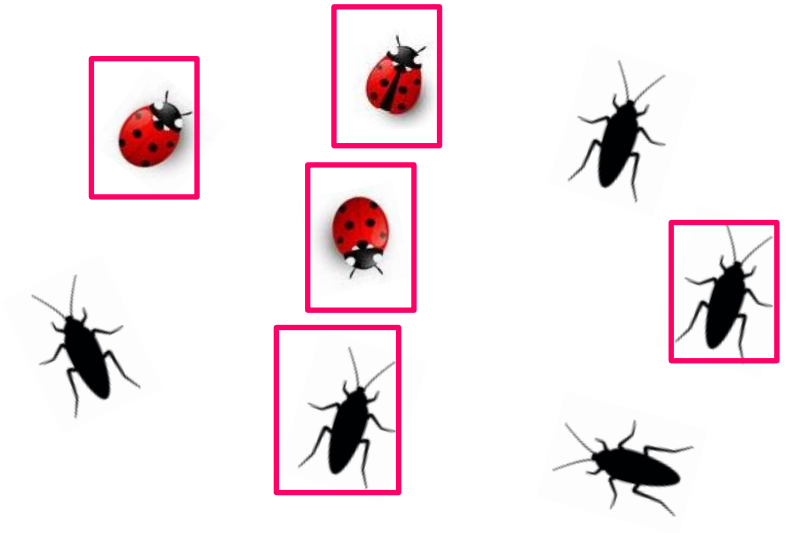
TP: 2	**FP: 2**
FN: 1	

Precision: 2/4

Recall: 2/3



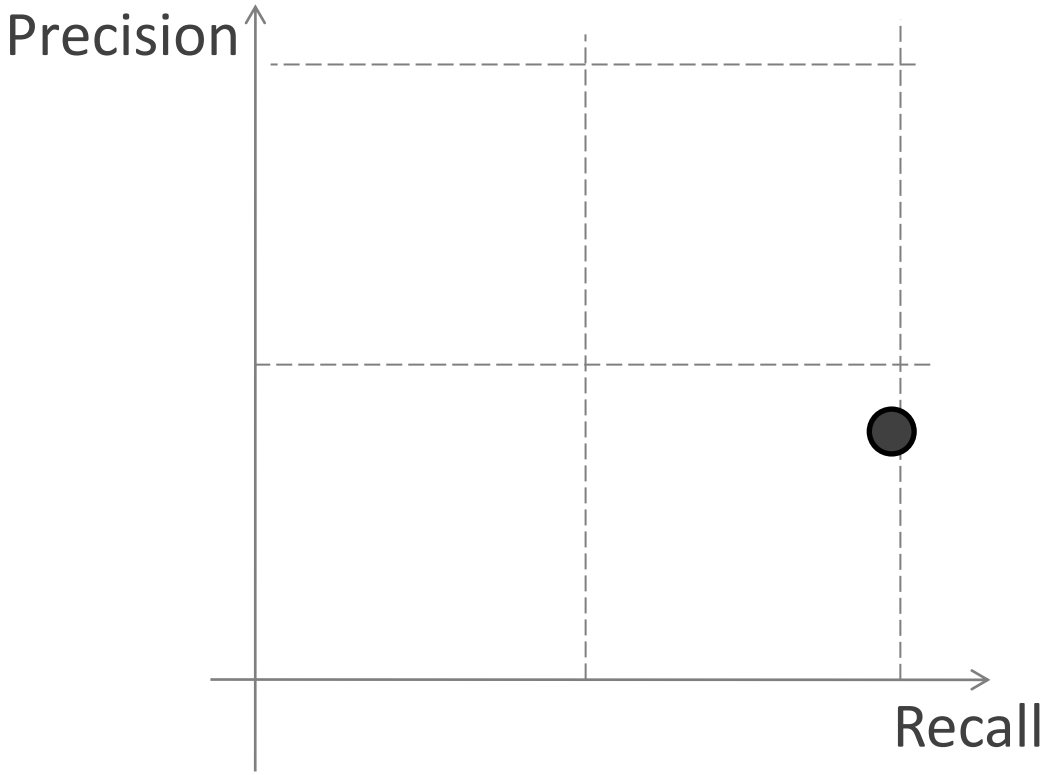
Precision - Recall



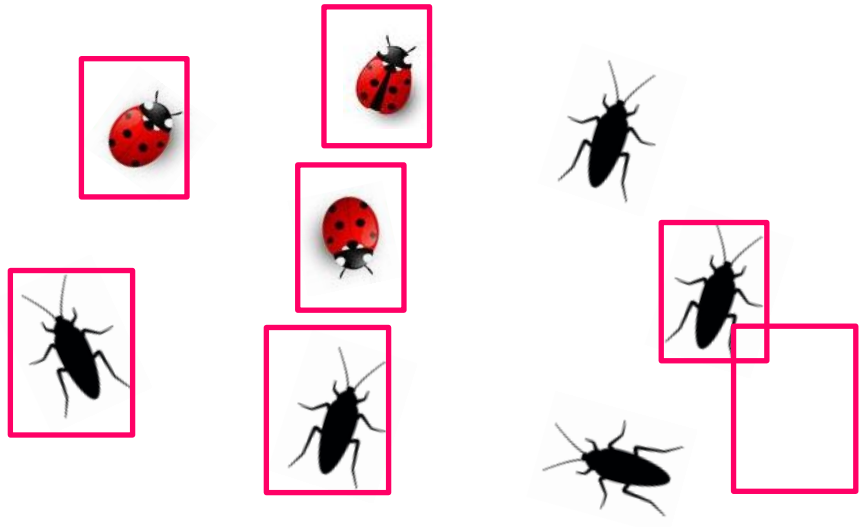
TP: 3	FP: 2
FN: 0	

Precision: 2/5

Recall: 1



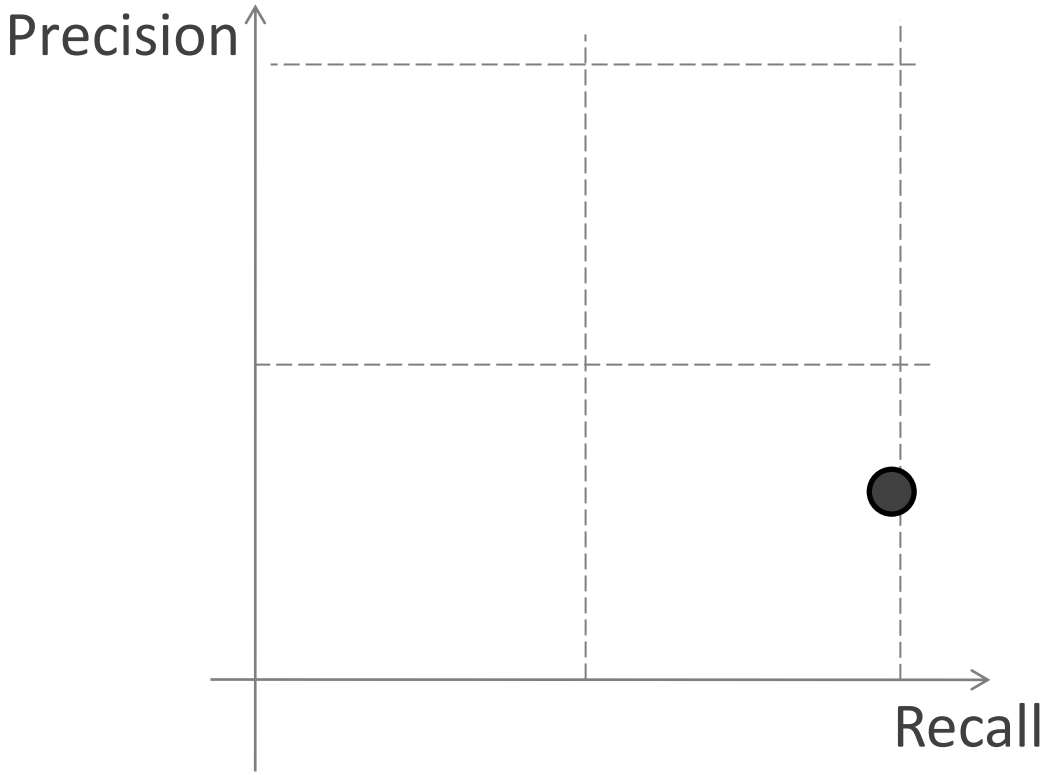
Precision - Recall



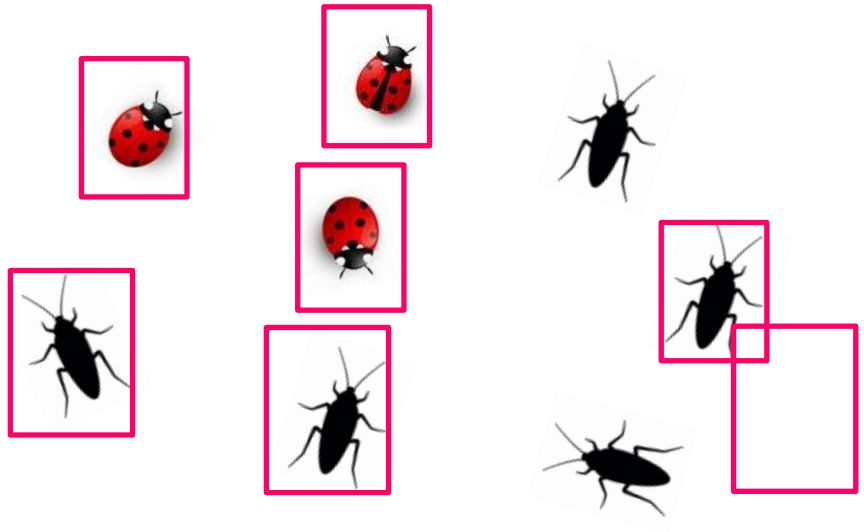
TP: 3	FP: 4
FN: 0	

Precision: 3/7

Recall: 1



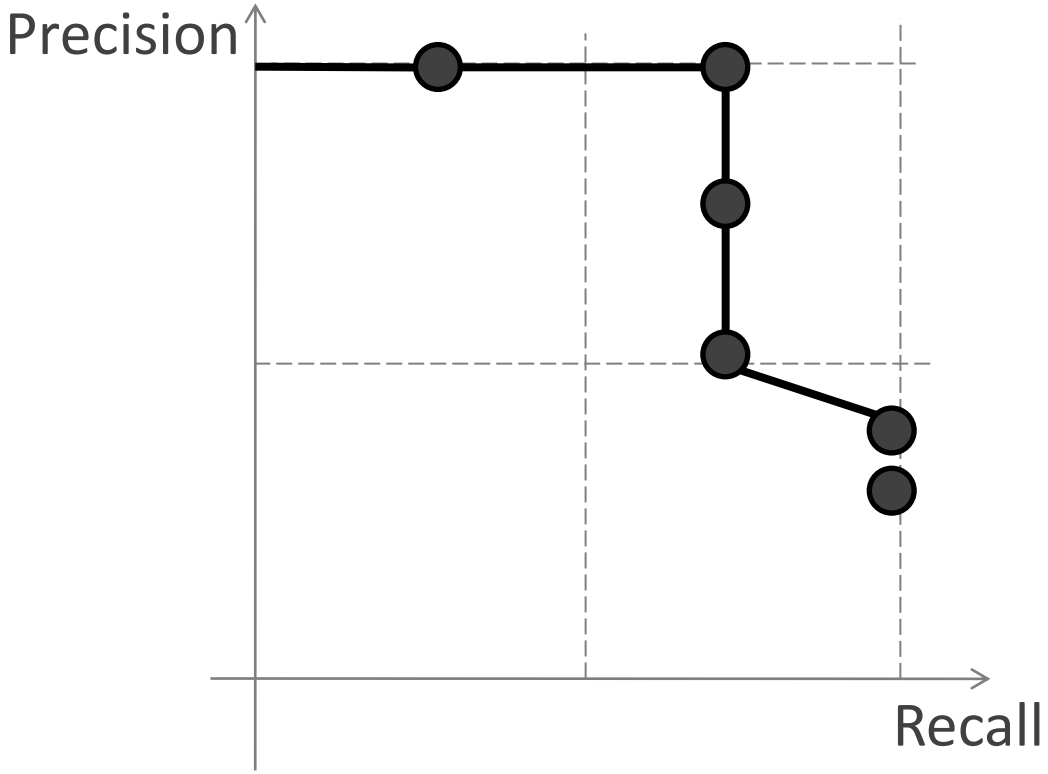
Precision - Recall



TP: 3	FP: 4
FN: 0	

Precision: 3/7

Recall: 1



Benchmarking the classifiers

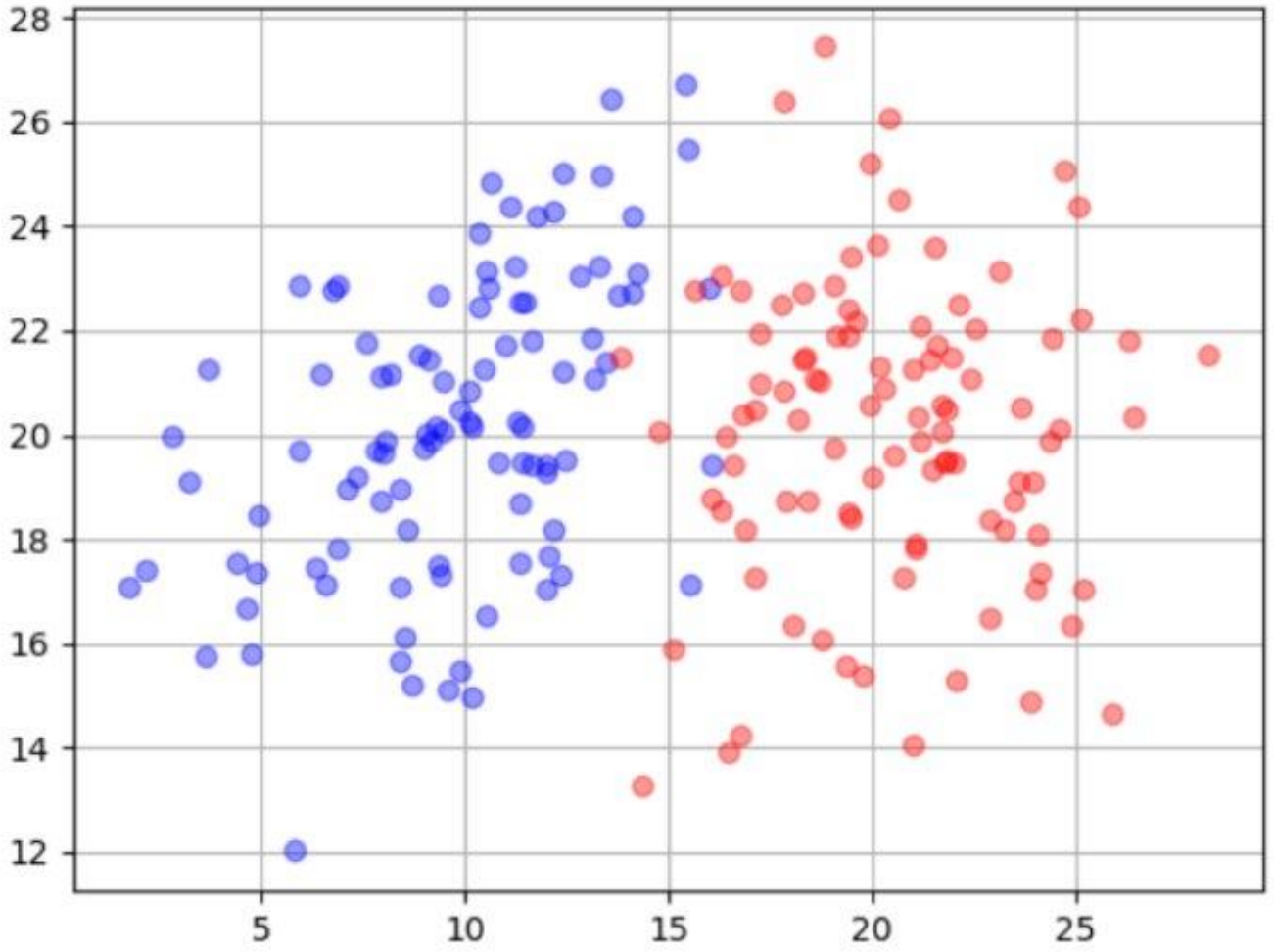
github.com/dryabokon/ML/blob/master/ex_03_03_benchmark_classifiers_k2.py
github.com/dryabokon/ML/blob/master/ex_03_03_benchmark_classifiers_multi_class.py

Benchmarking the Classifiers

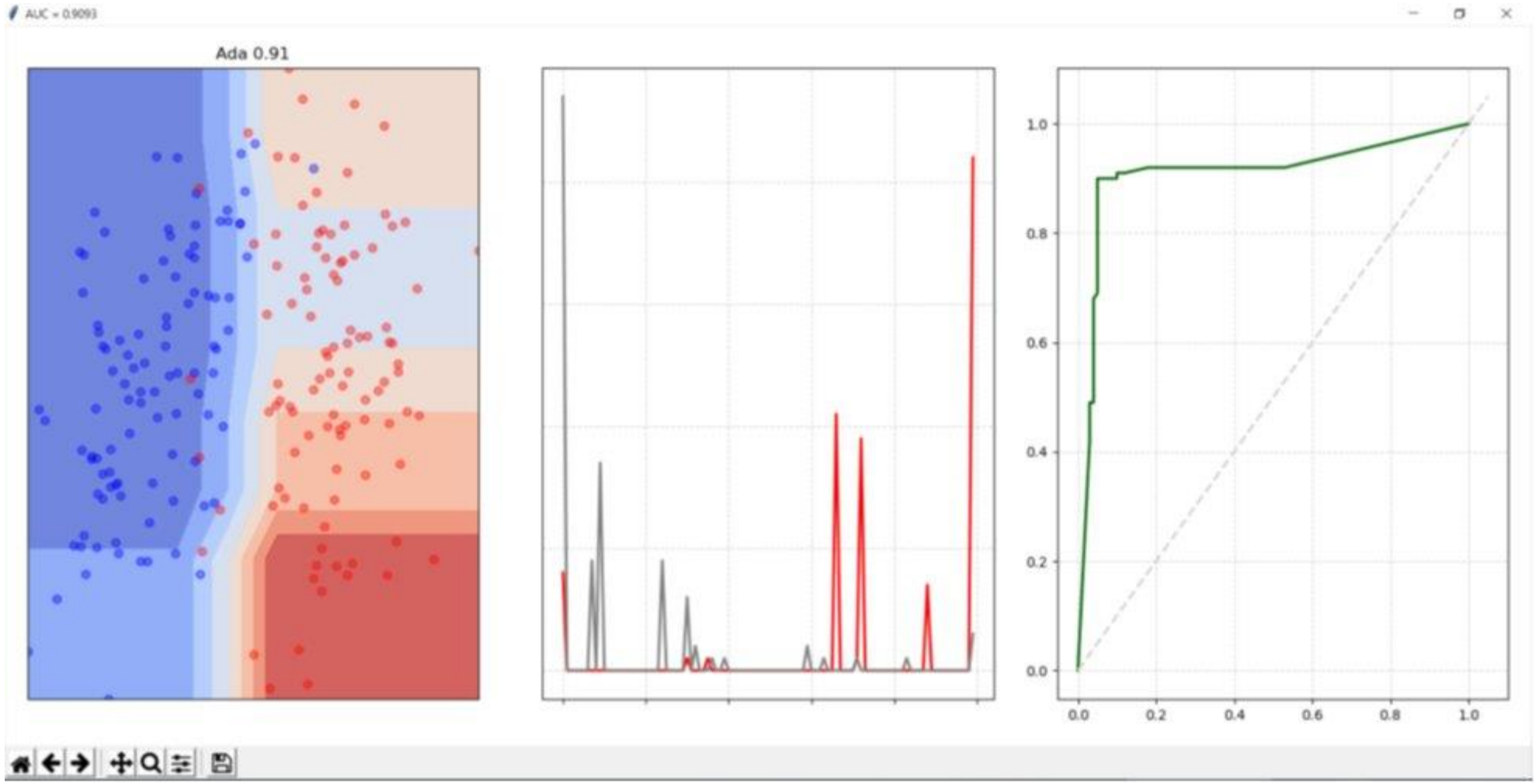
- Regression
- Naive Bayes
- Gaussian
- SVM
- Nearest Neighbors
- Decision Tree
- Random Forest
- AdaBoost
- xgboost
- Neural Net

Benchmarking the Classifiers

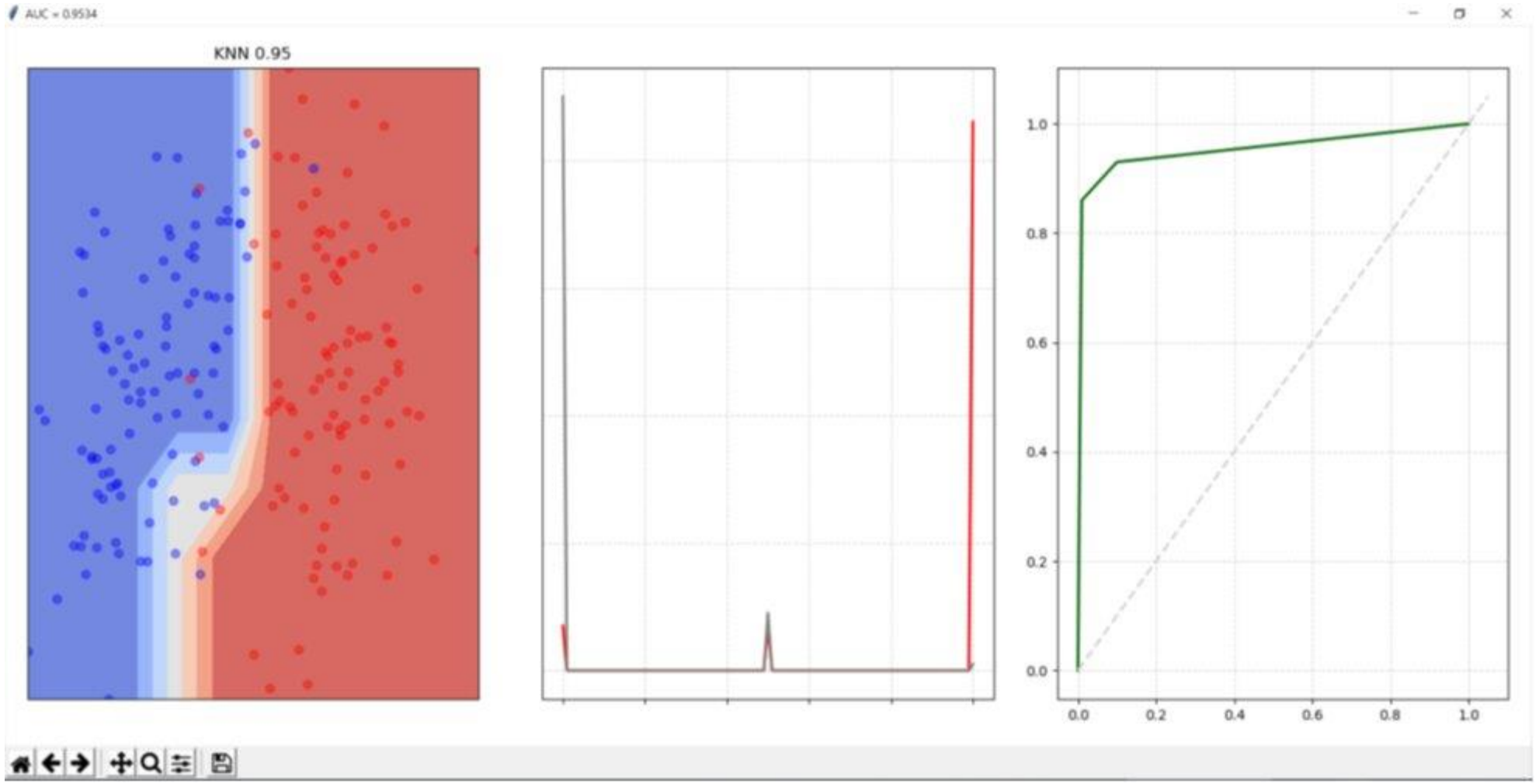
Gaussian distribution



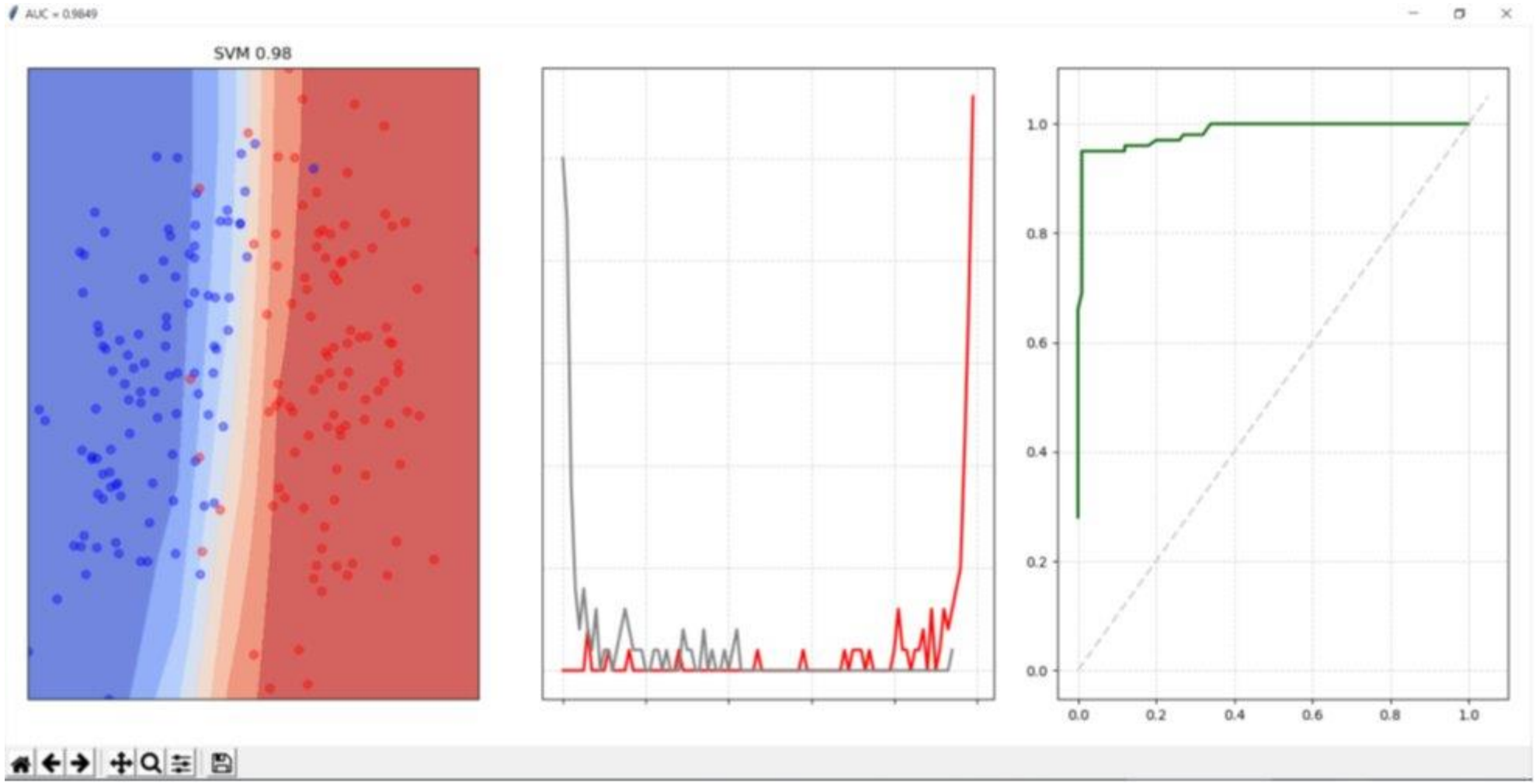
Benchmarking the Classifiers



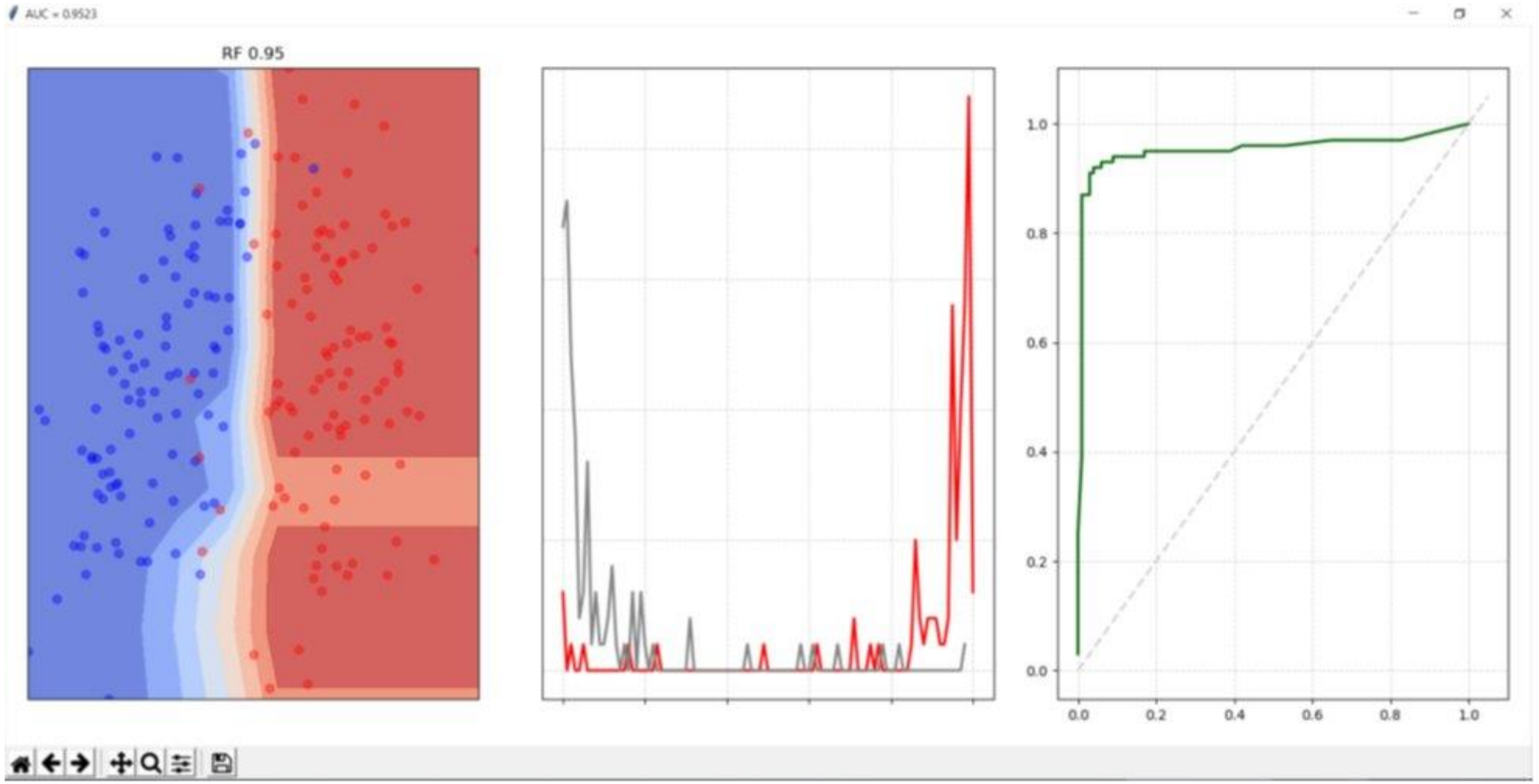
Benchmarking the Classifiers



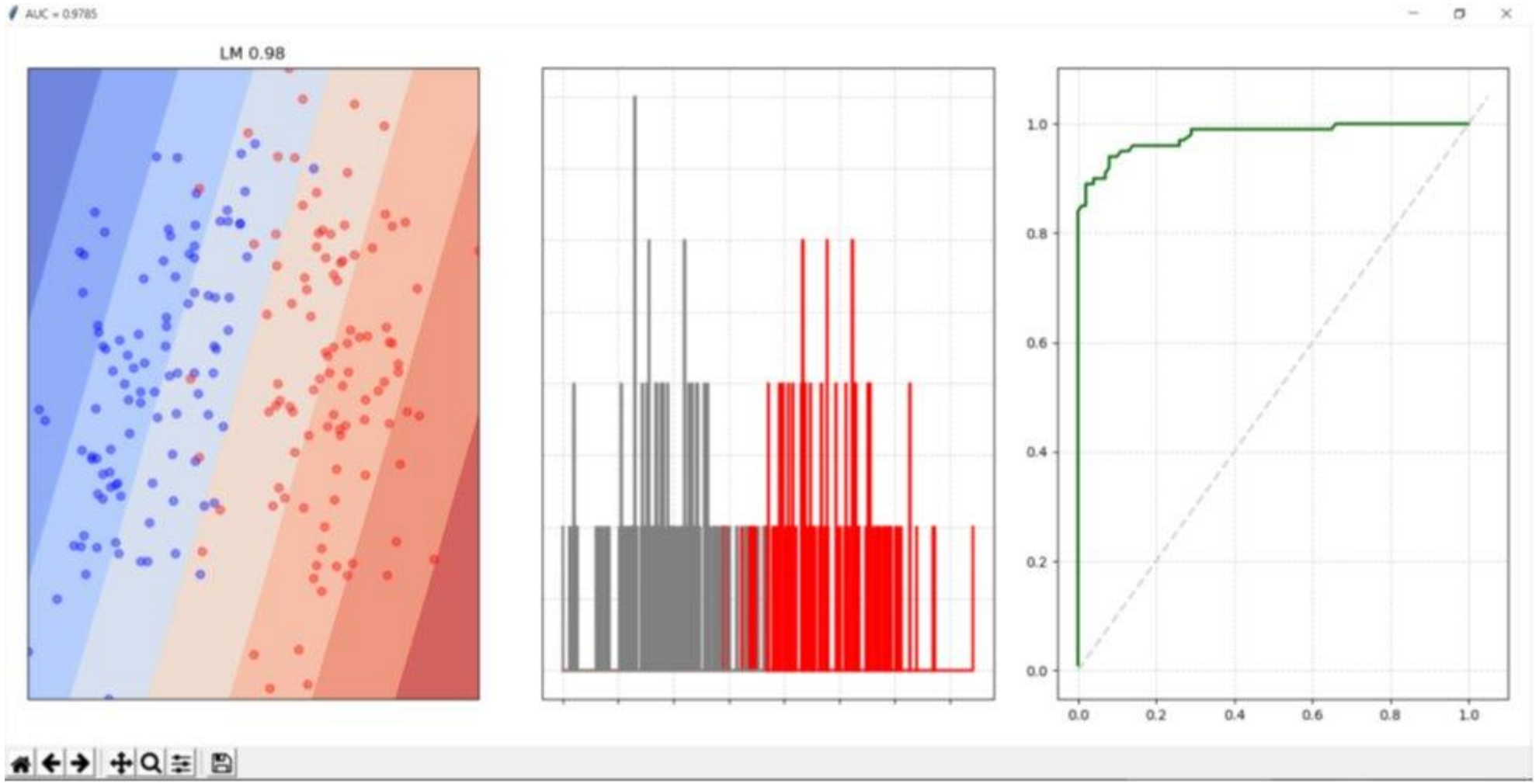
Benchmarking the Classifiers



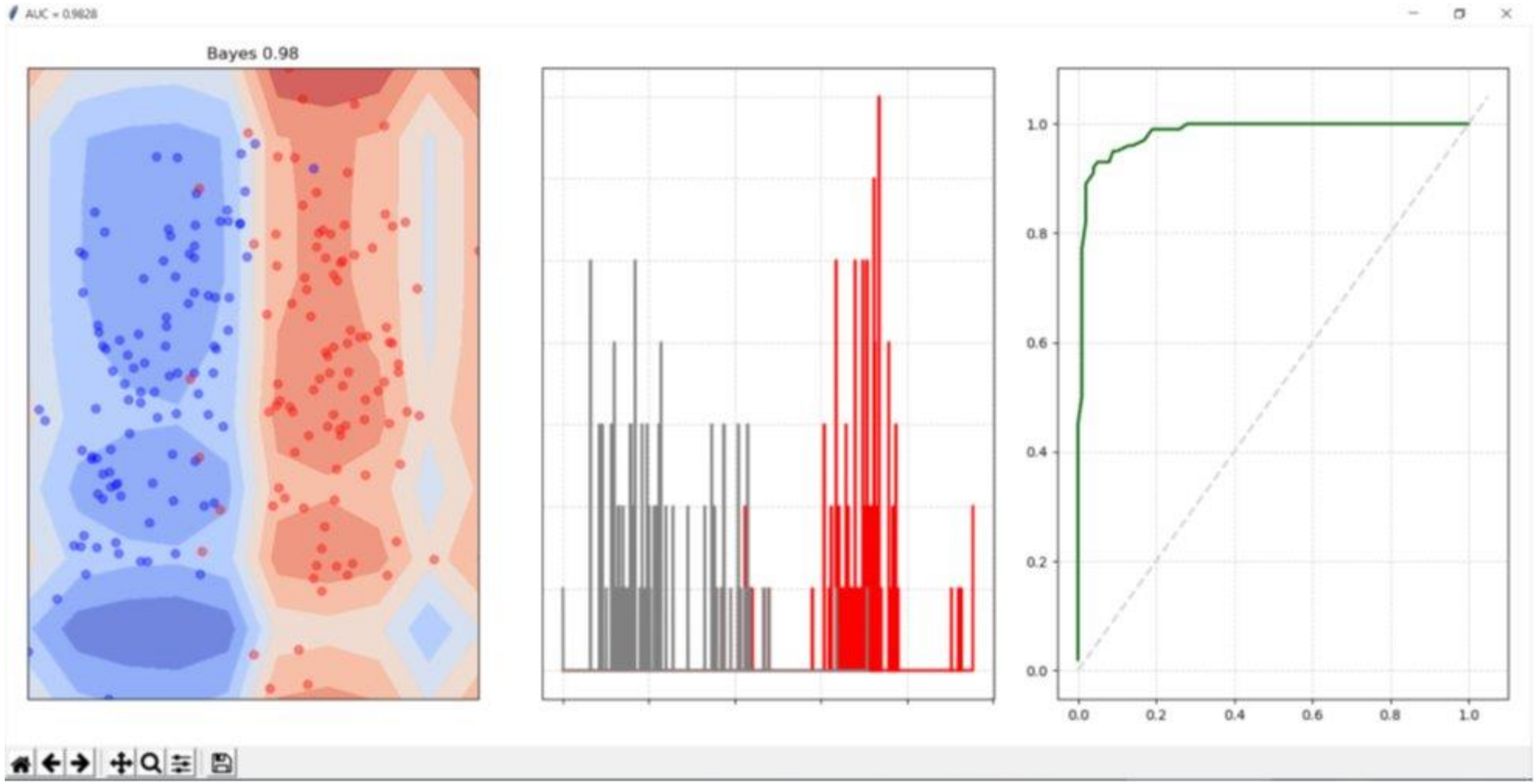
Benchmarking the Classifiers



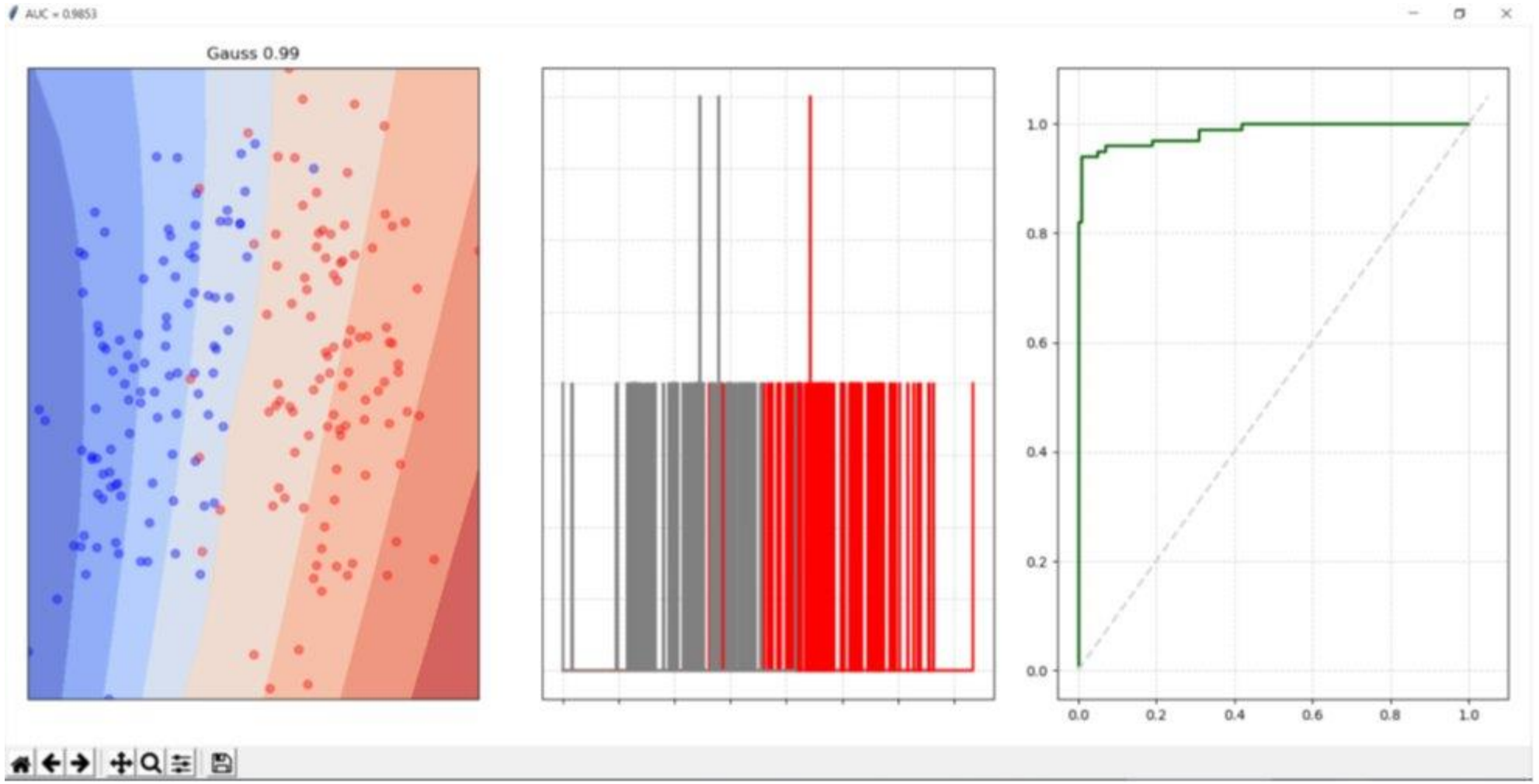
Benchmarking the Classifiers



Benchmarking the Classifiers



Benchmarking the Classifiers



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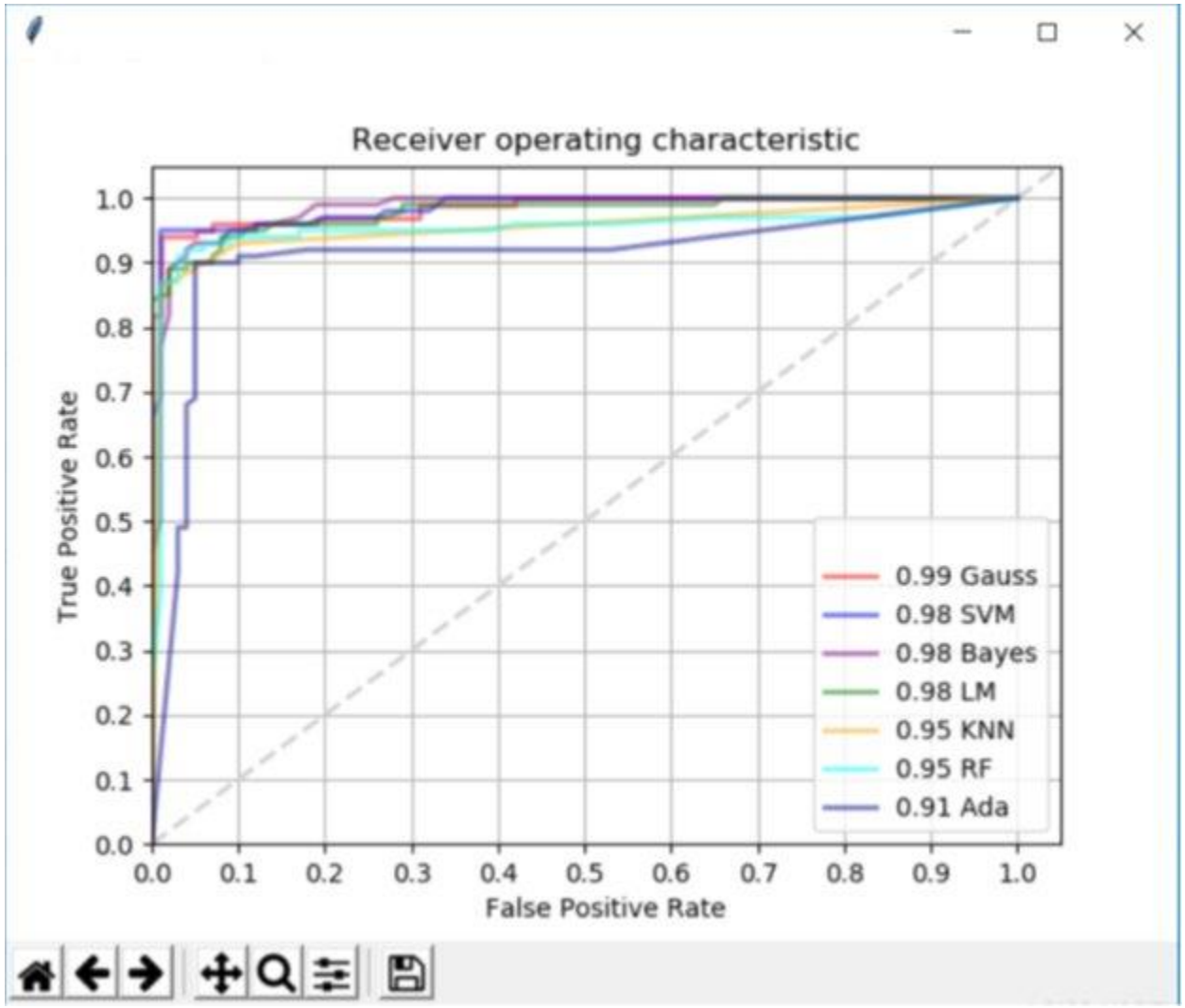
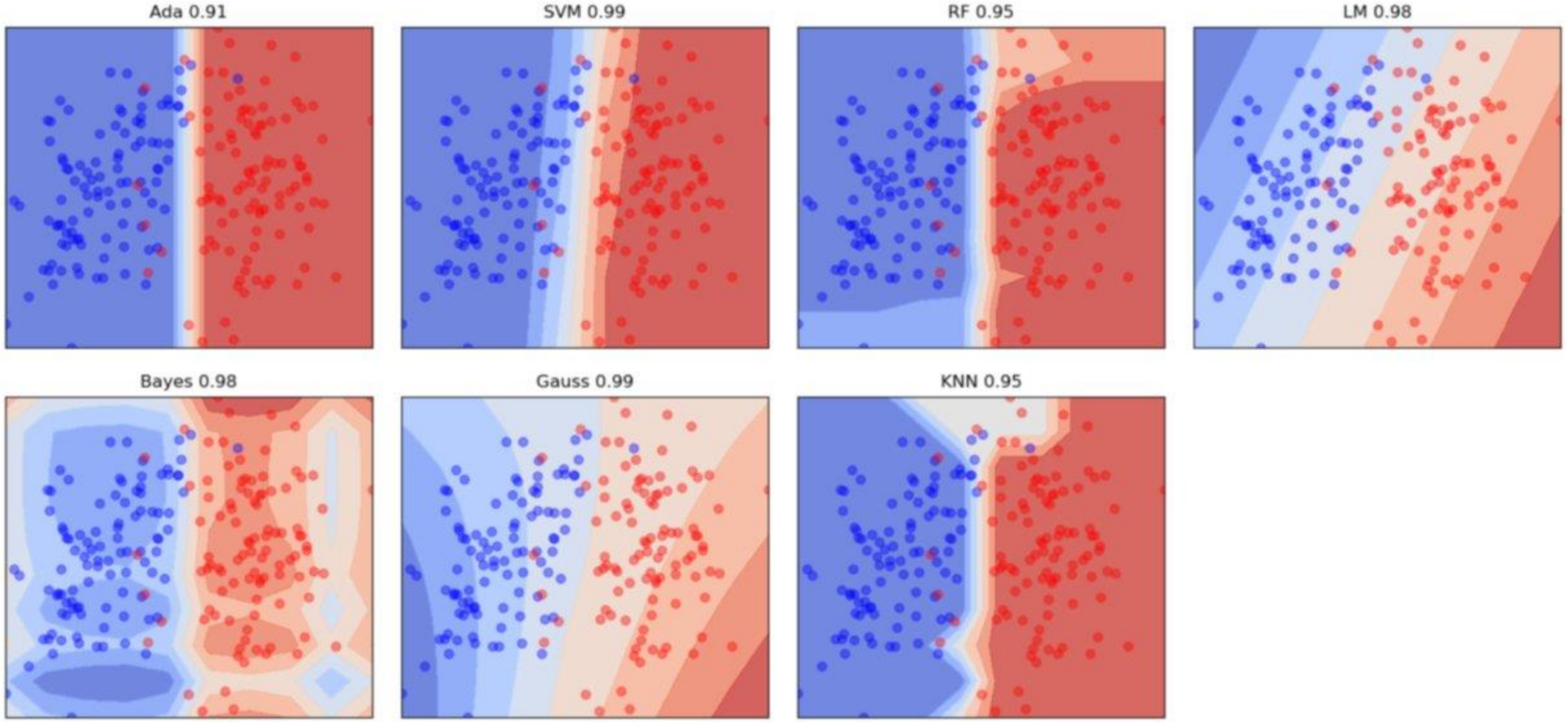
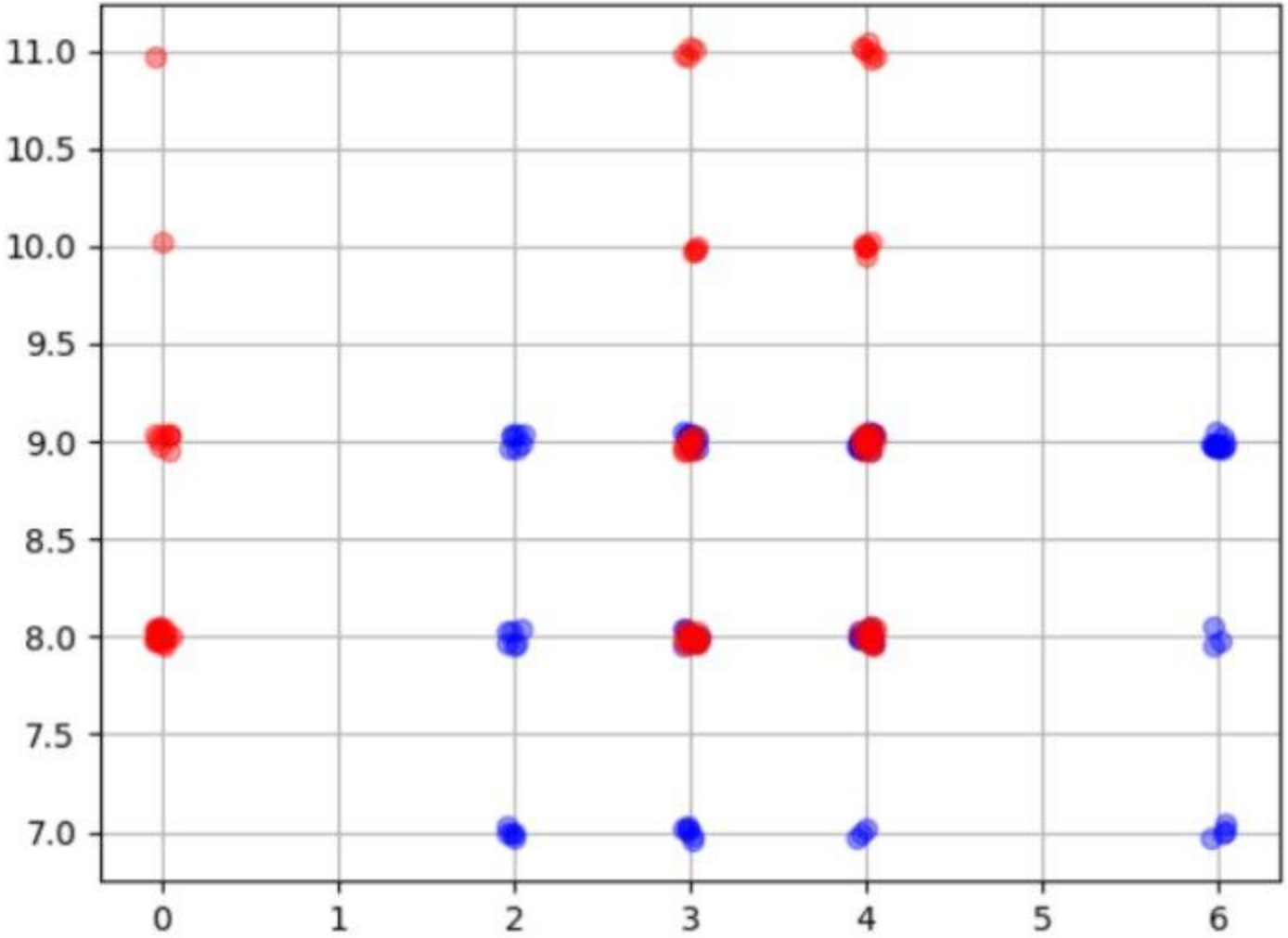


Benchmarking the Classifiers

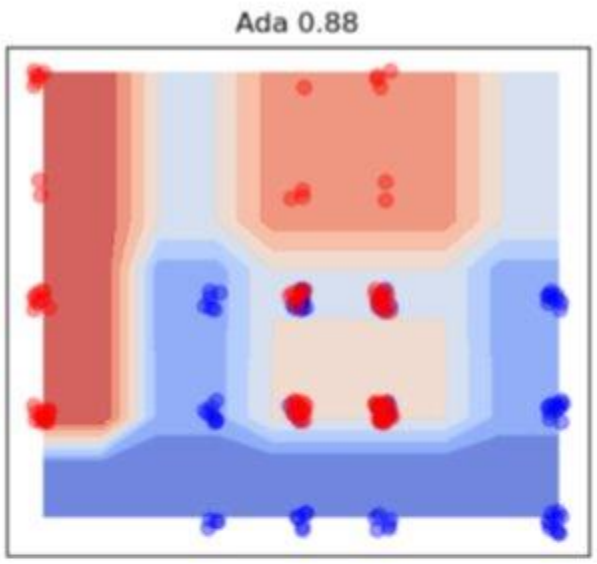


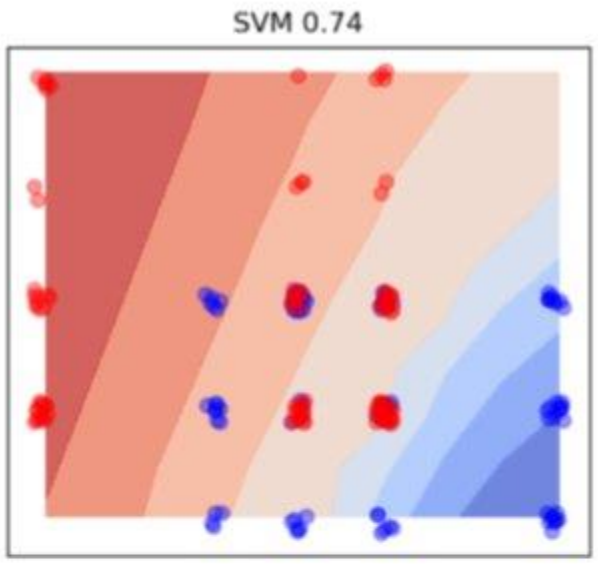
Benchmarking the Classifiers

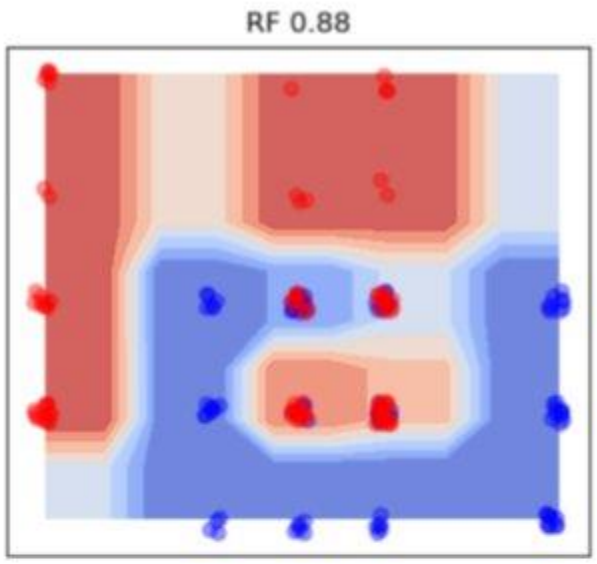
Non-gaussian distribution

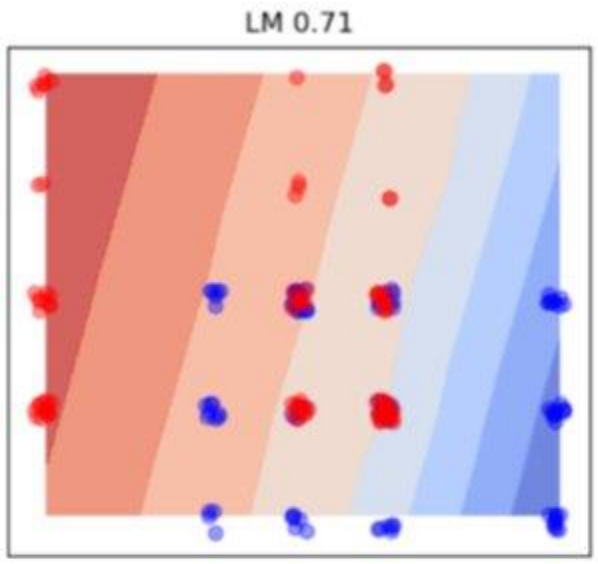


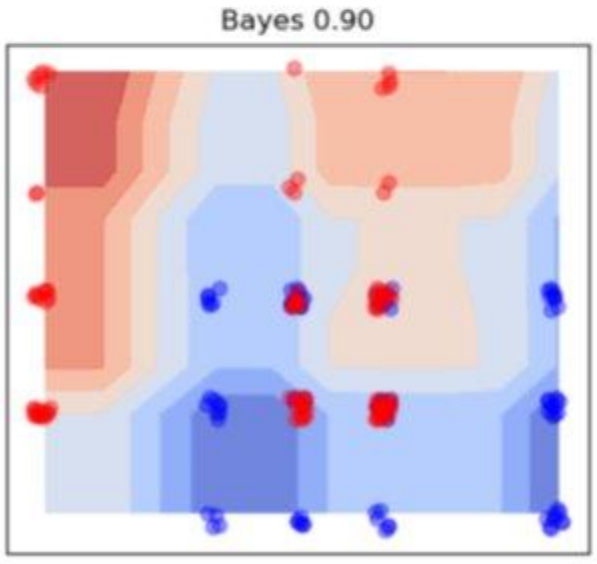
Benchmarking the Classifiers

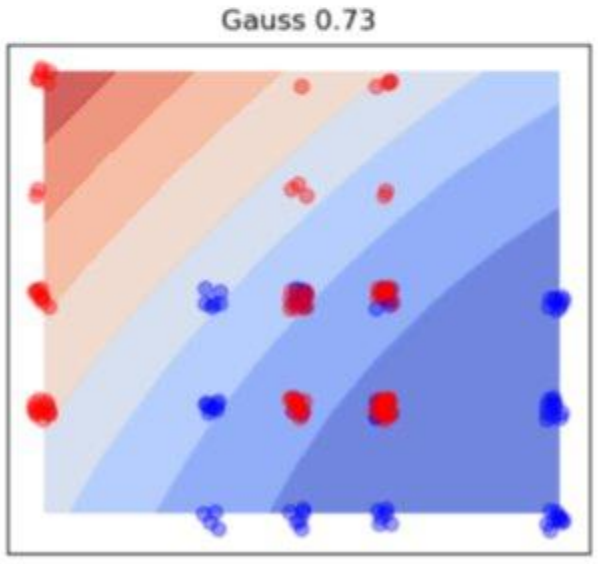


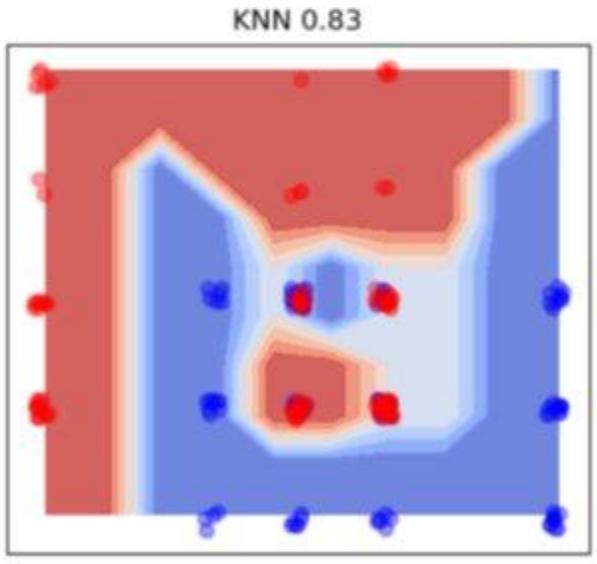












Benchmarking the Classifiers