FUNDAMENTALS OF MACHINE LEARNING

SCIKIT-LEARN ADDITIONAL LECTURE

CSCI3320

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Introduction to Machine Learning
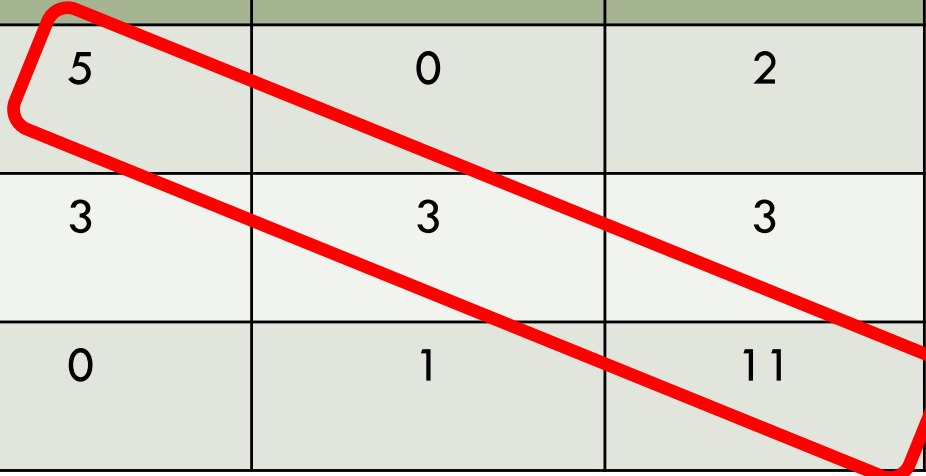
Metrics

☐ How to evaluate how good or effective is your model?

☐ Various performance metrics:

- Confusion matrix
- Accuracy vs. precision vs. recall
- F1 score

Example: Confusion matrix

□ It is a multi-class classification problem *Example of 3 classes of professors*

□ An example of a red **confusion matrix** C where $C_{ij} =$
# of observatons of category j but the true category is i

Predict / Actual	Human	Octopus	Penguin
Human	5	0	2
Octopus	3	3	3
Penguin	0	1	11

□ Good for penguin, not so good in predicting octopus

Accuracy vs precision vs recall

□ Consider the following example of detecting cancer

Predict / Actual	Positive	Negative
Positive	1	2
Negative	0	997

□ **Accuracy**: correct prediction / all observations

□ In this case, the accuracy is (1+997)/(1+2+0+997)=.998

□ *But two thirds of the people who actually have the disease will be judged free of it by this model !!!!*

Accuracy vs precision vs recall

- Consider the following example of detecting cancer

Predict / Actual		Positive	Negative
Positive		1	2
Negative		0	997

Positive	C_{00}	C_{01}
Negative	C_{10}	C_{11}

- **Precision (of positive) = true positive /(true positive + false positive)**

  What is the precision of "negative"?

- **For the above case, it is 1, best we can have** ☺

- $\text{Precision}_i = \dfrac{C_{ii}}{\sum_j C_{ji}}$ for any class i

Accuracy vs precision vs recall

- Consider the following example of detecting cancer

Predict / Actual	Positive	Negative
Positive	1	2
Negative	0	997

Positive	C_{00}	C_{01}
Negative	C_{10}	C_{11}

- Our problem is not in precision, but in the *recall*
- **Recall (of positive) = true positive /(true positive + false negative) = 1/(1+2) = 1/3**
- **For the above case, our recall on positive is only 1/3 accurate !!!**

- Recall$_i = \dfrac{C_{ii}}{\sum_j C_{ij}}$ for any class i

Accuracy vs precision vs recall

☐ Consider the following example of detecting cancer

Predict / Actual	Positive	Negative
Positive	1	2
Negative	0	997

☐ **F1 score: combine precision and recall to produce a single score**

Why F1 score is intuitive ?

☐ $F1 = 2 * \dfrac{precision * recall}{precision + recall}$ for each category

☐ **F1 average = average F1 scores for all categories**