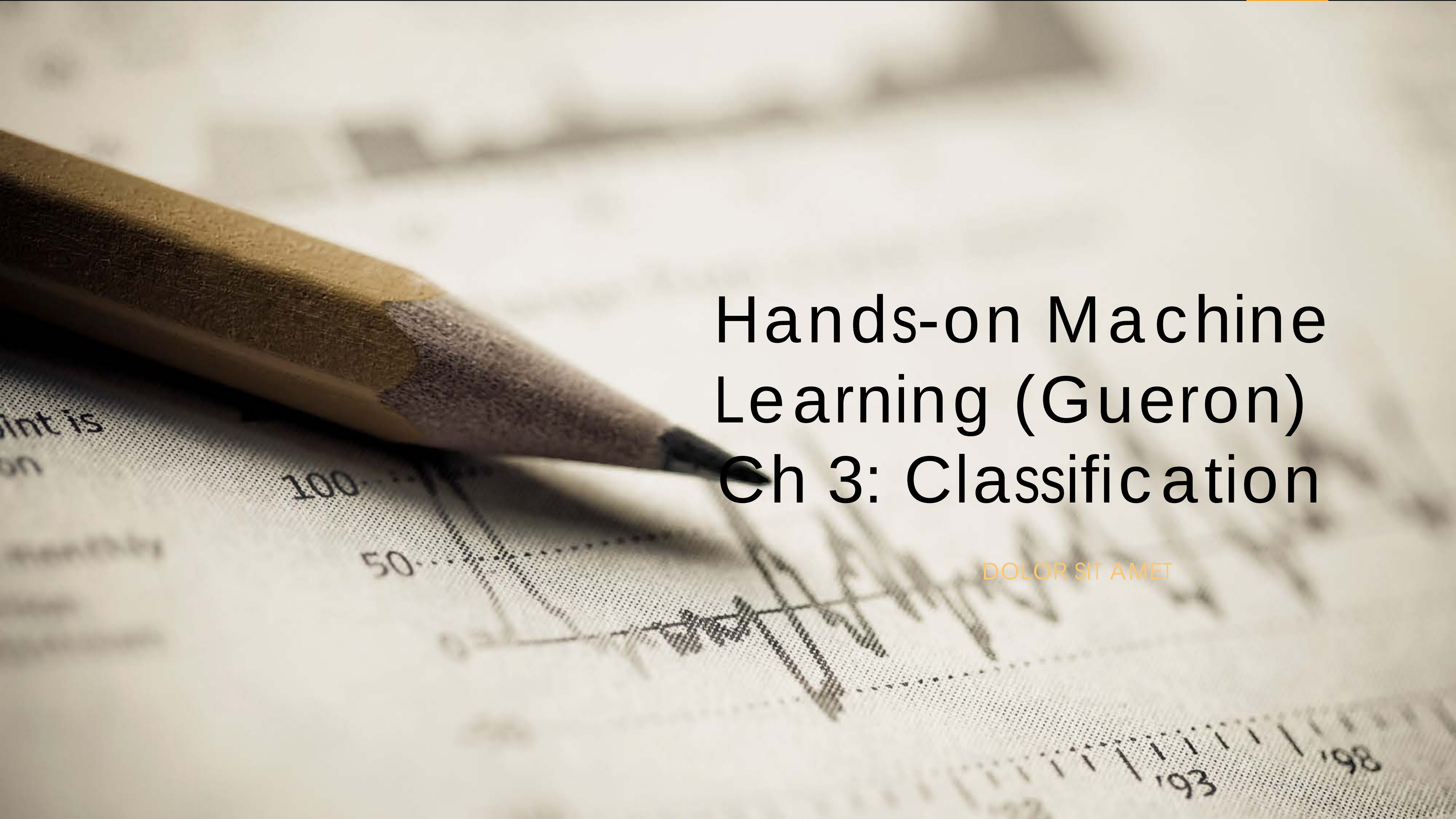


Hands-on Machine Learning (Gueron) Ch 3: Classification

DOLOR SIT AMET

MNIST Dataset

- A dataset compromised of 70,000 hand-written, 28 x 28 (784 features) pixeled images of digits 0-9 written by high school students and US Census Bureau
- Classify the handwritten digits from 0 – 9
- Gueron simplifies the analysis by limiting to classification to the digit 5 using a binary classifier

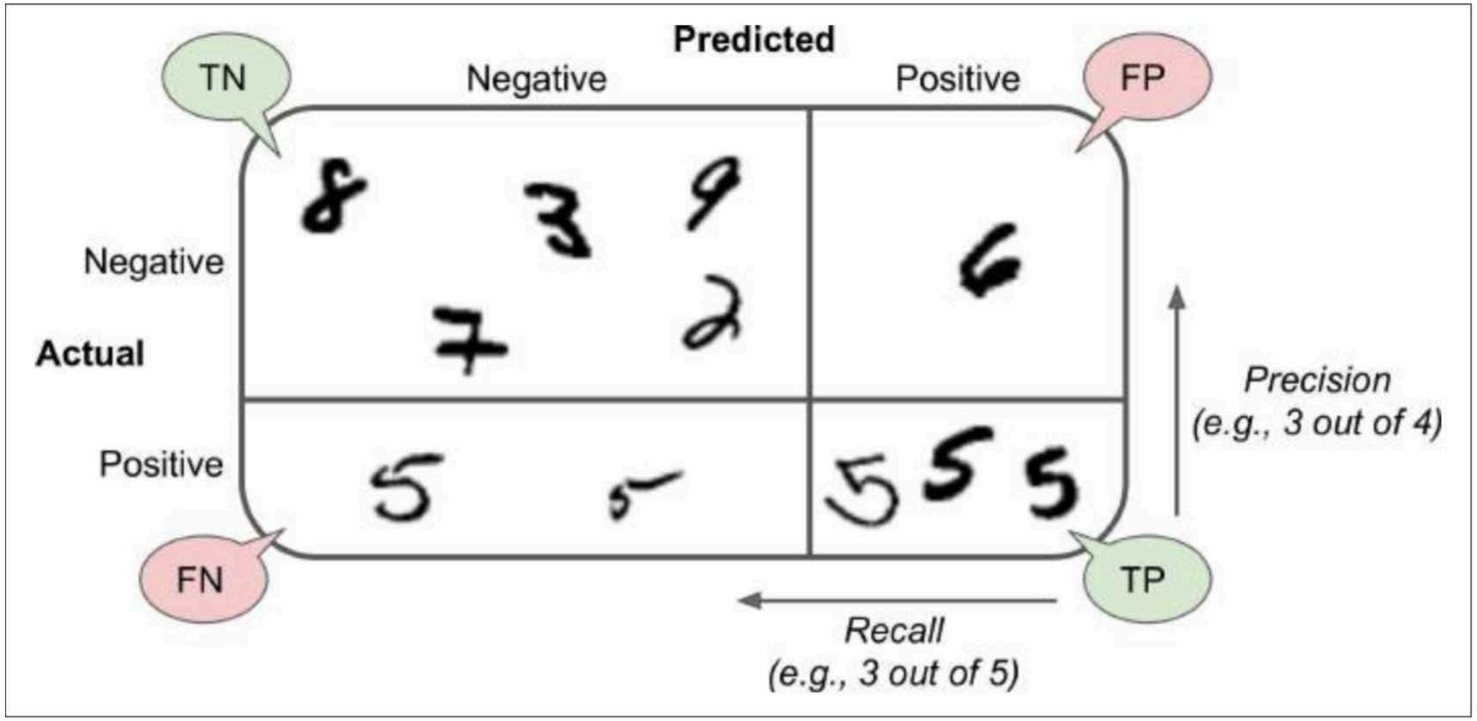
Training a Binary Classifier

1. Split into training and test datasets and explores training dataset
    1. Heterogeneity – different portion of digits per category
    2. Homogeneity – same/similar portion of digits per category
    3. Shuffle data prior to minimize heterogeneity
2. Fits SGD Classifier
3. Predicts class
4. Evaluate classifier

Accuracy – 10% Digits 5

Classifier	Accuracy
Stochastic Gradient Descent	0.95
Never5/Guessing	0.90

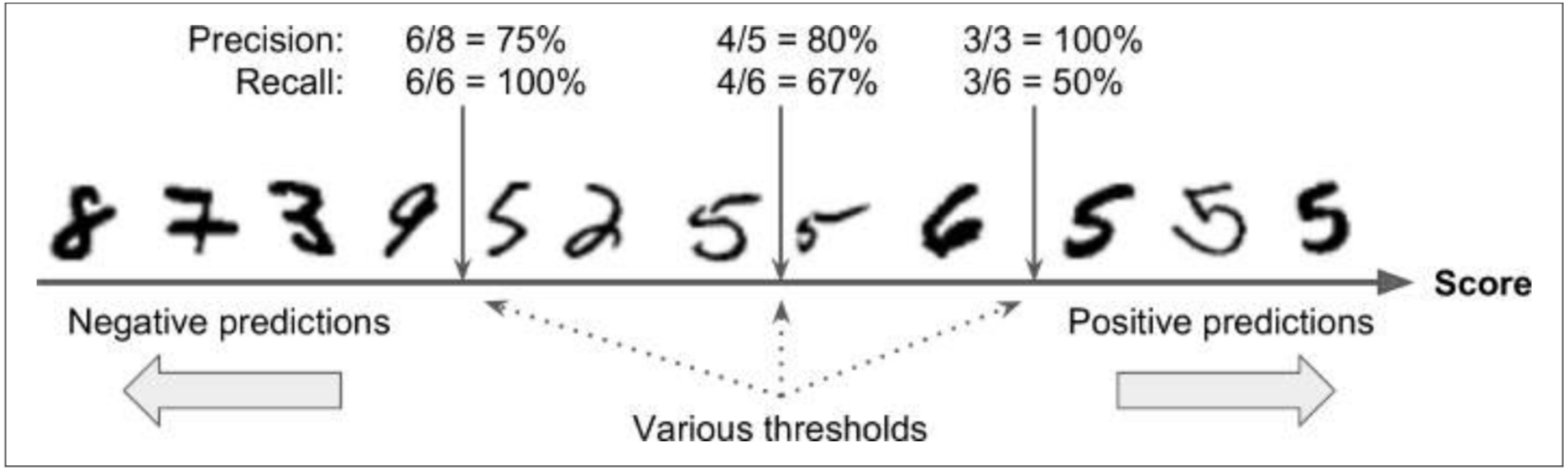
Confusion Matrix



Confusion Matrix Terms

Cell Terms	True positive	Predict +, Actual +
	True negatives	Predict -, Actual -
	False positives	Predict +, Actual -
	False negatives	Predict -, Actual +
Marginal Terms	Precision	TP : (TP +FP)
	Recall	TP : (TP +FN)
	Accuracy	(TP + TP) : N
Composite	F1-score	Harmonic mean of precision and recall

Precision/Recall Tradeoff

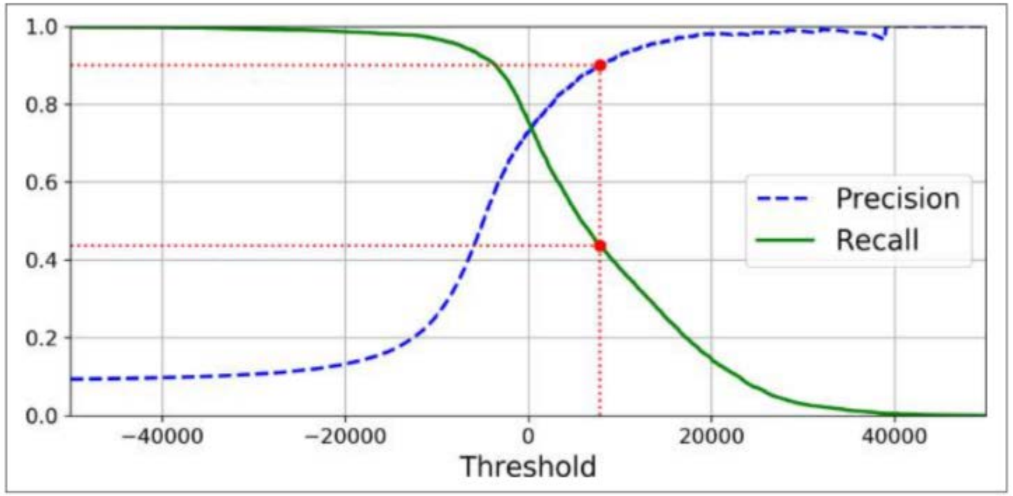


Effect Precision-Recall on F1

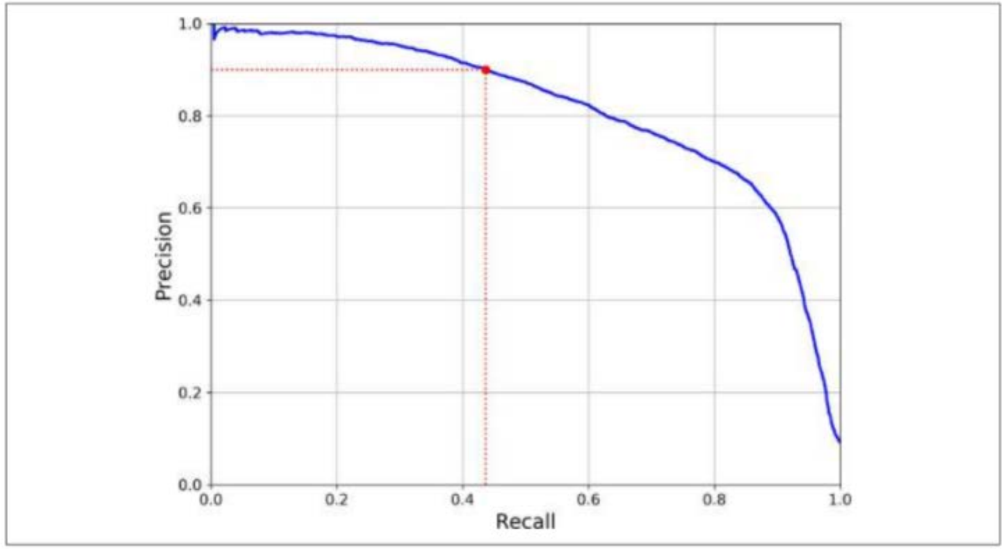
Precision	Recall	F1
0.75	1.00	0.857
0.80	0.67	0.729
1.00	0.50	0.667

Precision vs Recall

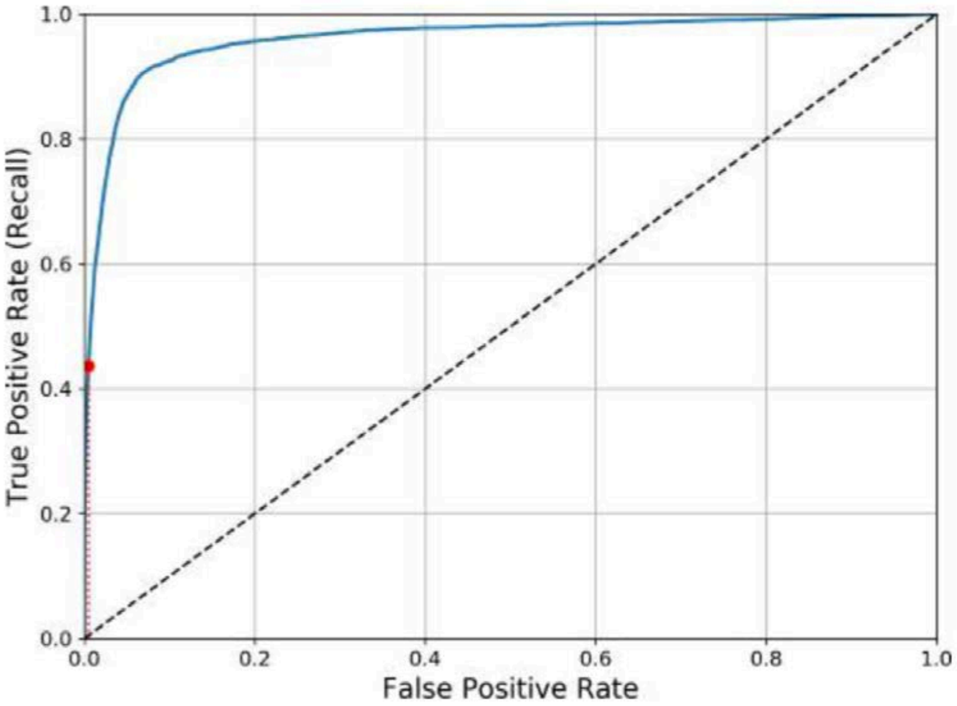
Precision-Recall vs Threshold



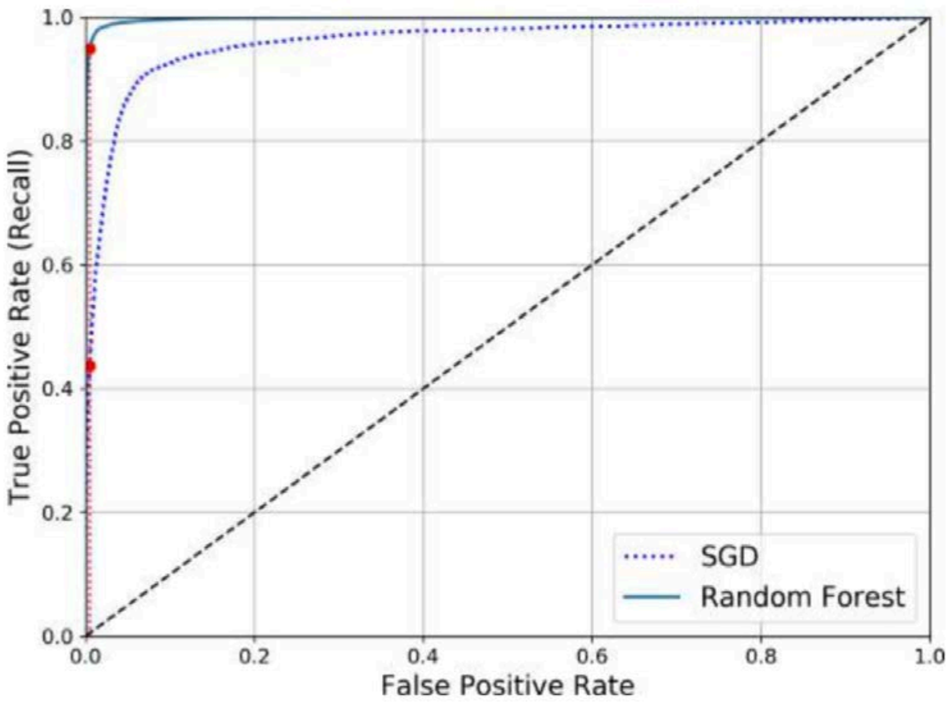
Precision vs Recall



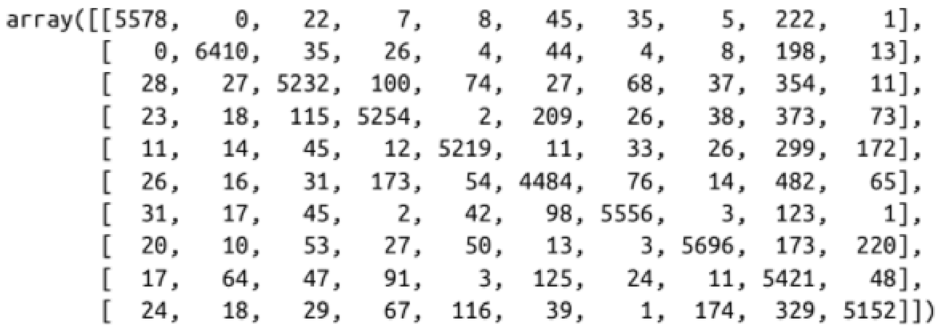
ROC Curve: SGD Classifier



ROC Curve: SGD vs Random Forest



Error Analysis: Raw Counts



```
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       [  26,   16,   31,  173,   54, 4484,   76,   14,  482,   65],
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```
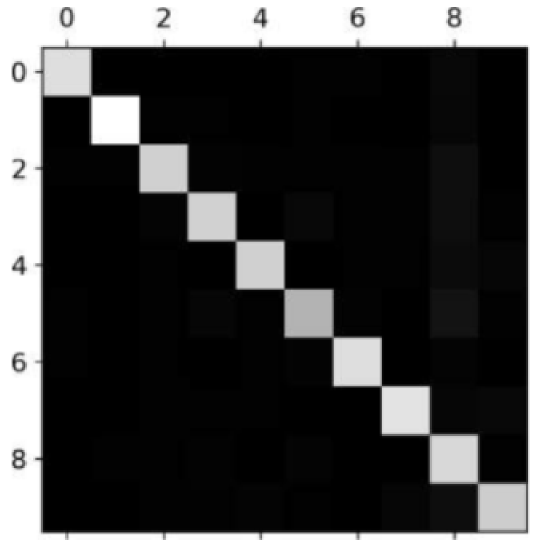
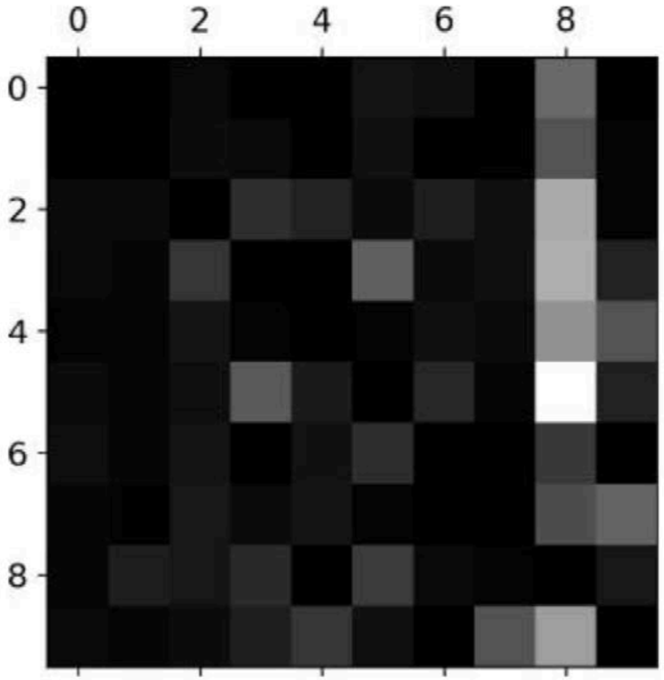



Error Analysis: Error Rates



Multi-s Target Variable Differences

	Num Class Categories	Num Targets/Y's
Multiclass	2 or more	1
Multilabel	2	2 or more
Multioutput	2 or more	2 or more