Dr. Denton Bobeldyk

CIS 365 Artificial Intelligence

Error Reporting

Week in Review

Blackboard Check-in

Delivery Methods

Lecture

Videos

Lab Time

Small Groups

Methods of Error Reporting

- Accuracy
- Precision, Recall
- ROC Curve
- AUC
- Precision-Recall Curve
- Mean Absolute Error and Mean Squared Error
- Cross Entropy Loss
- Top-k Accuracy
- Confusion Matrix

Accuracy

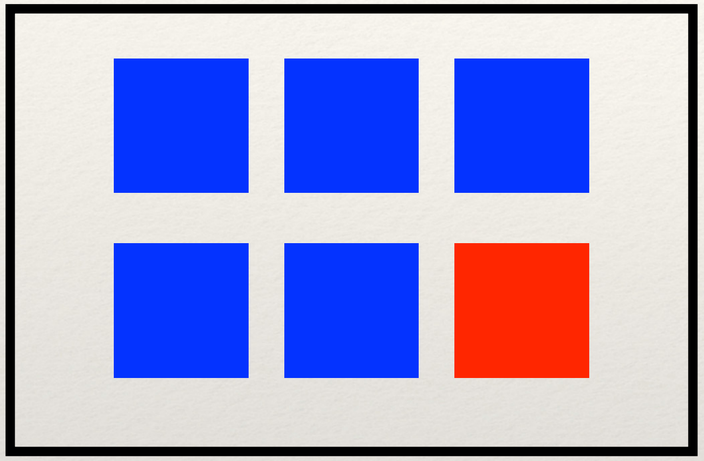
Calculate the ratio of correct predictions to the total number of predictions.

$$\frac{predictedCorrectly}{totalPredictions}$$

$$\frac{truePositive + trueNegative}{totalPredictions}$$

Accuracy Example

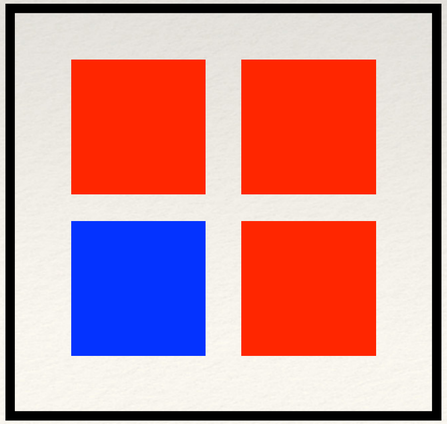
Predicted Blue



5 predicted correctly

1 predicted incorrectly

Predicted Red

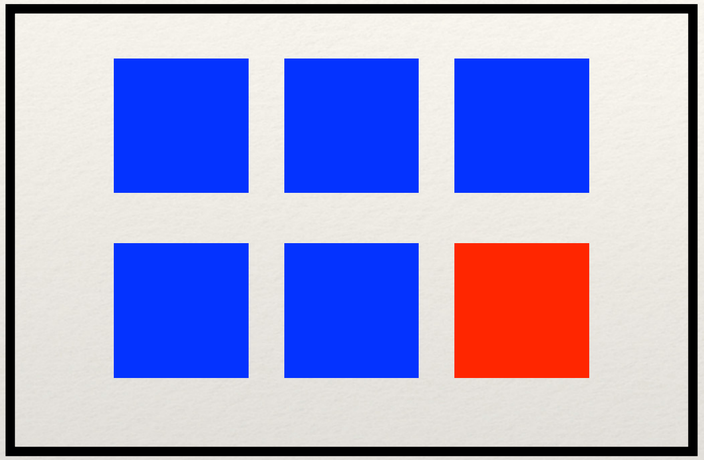


3 predicted correctly

1 predicted incorrectly

Accuracy Example

Predicted Blue

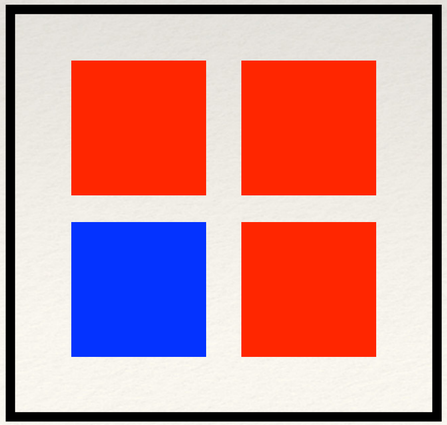


5 predicted correctly

1 predicted incorrectly

$$\frac{5+3}{10} = \frac{8}{10} = .8$$

Predicted Red



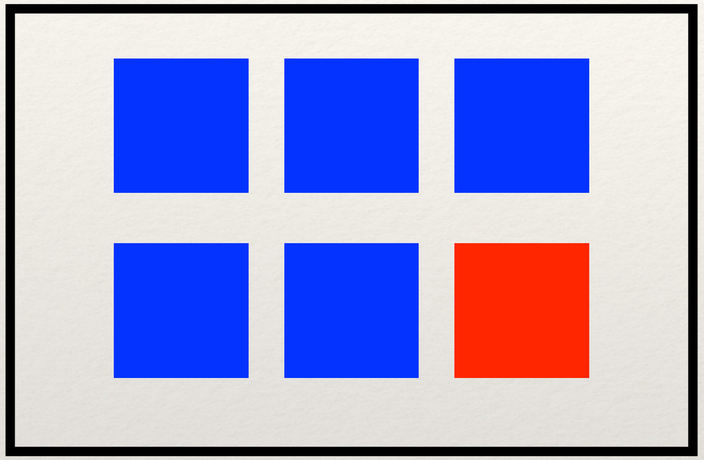
3 predicted correctly

1 predicted incorrectly

80% prediction accuracy

Accuracy Example - Alternative

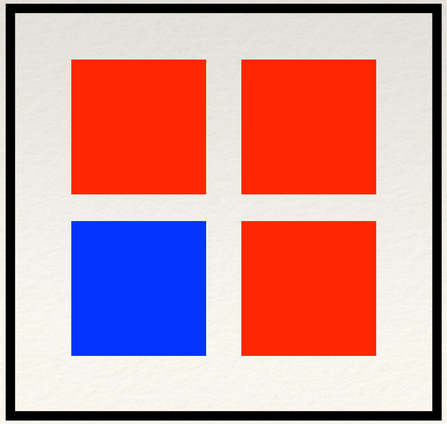
Predicted Blue



5 true positives

1 false positive

Predicted Not Blue



3 true negatives

1 false negative

Can frame the problem as:

Is this square blue?

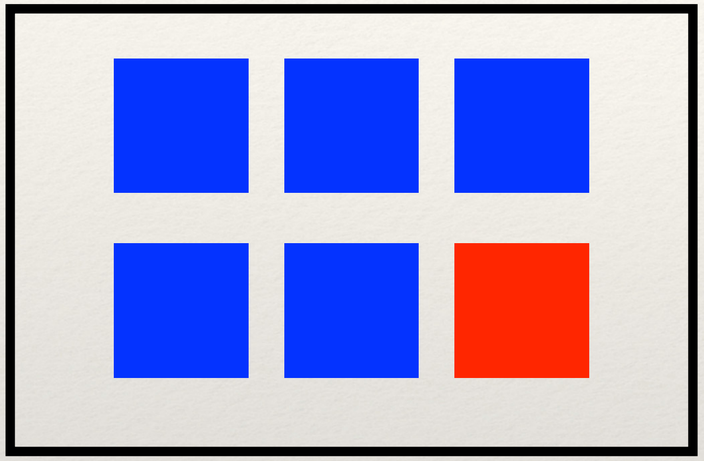
If we frame it this way, we can have true positives and true negatives

$$\frac{5+3}{10} = \frac{8}{10} = .8$$

80% prediction accuracy

Accuracy Binary Example

Predicted Blue

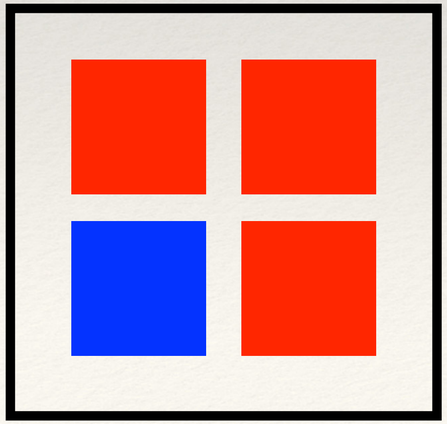


5 predicted correctly

1 predicted incorrectly

$$\frac{5+3}{10} = \frac{8}{10} = .8$$

Predicted Not Blue



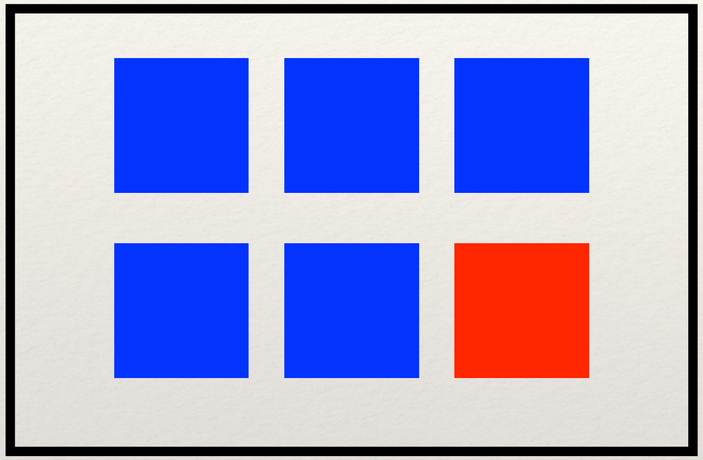
3 predicted correctly

1 predicted incorrectly

80% prediction accuracy

Accuracy Multi-class Example

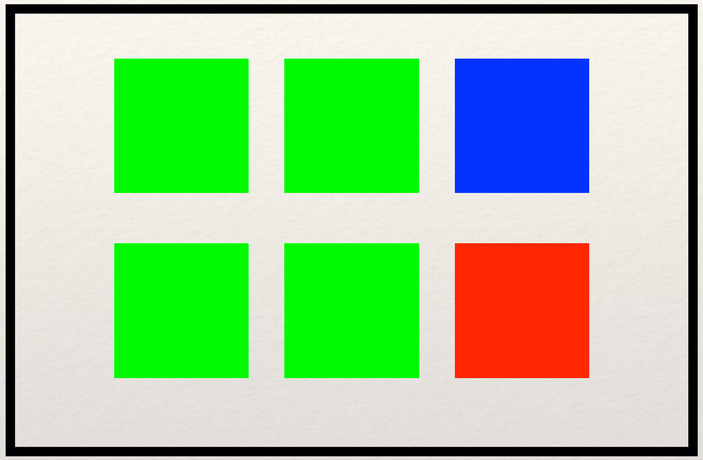
Predicted Blue



5 predicted correctly

1 predicted incorrectly

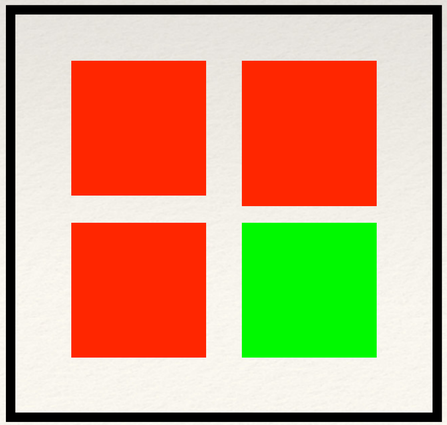
Predicted Green



4 predicted correctly

2 predicted incorrectly

Predicted Red



3 predicted correctly

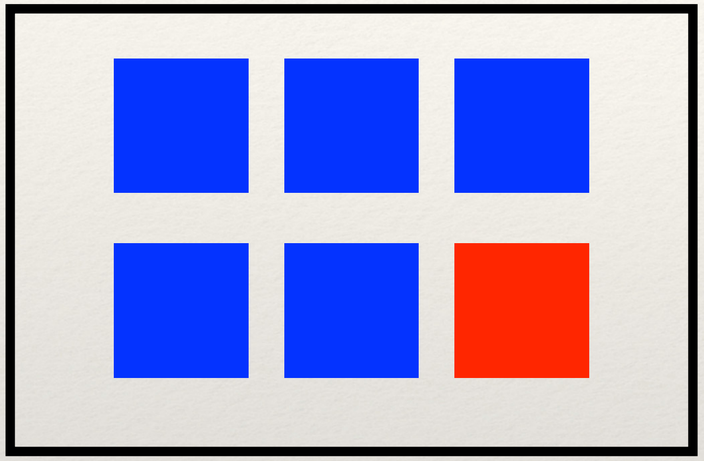
1 predicted incorrectly

$$\frac{5+3+4}{16} = \frac{12}{16} = .75$$

75% prediction accuracy

Confusion Matrix

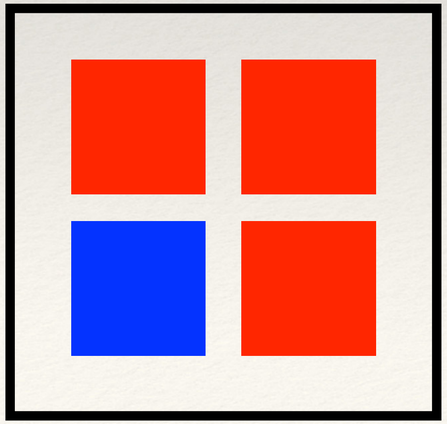
Predicted Blue



5 predicted correctly

1 predicted incorrectly

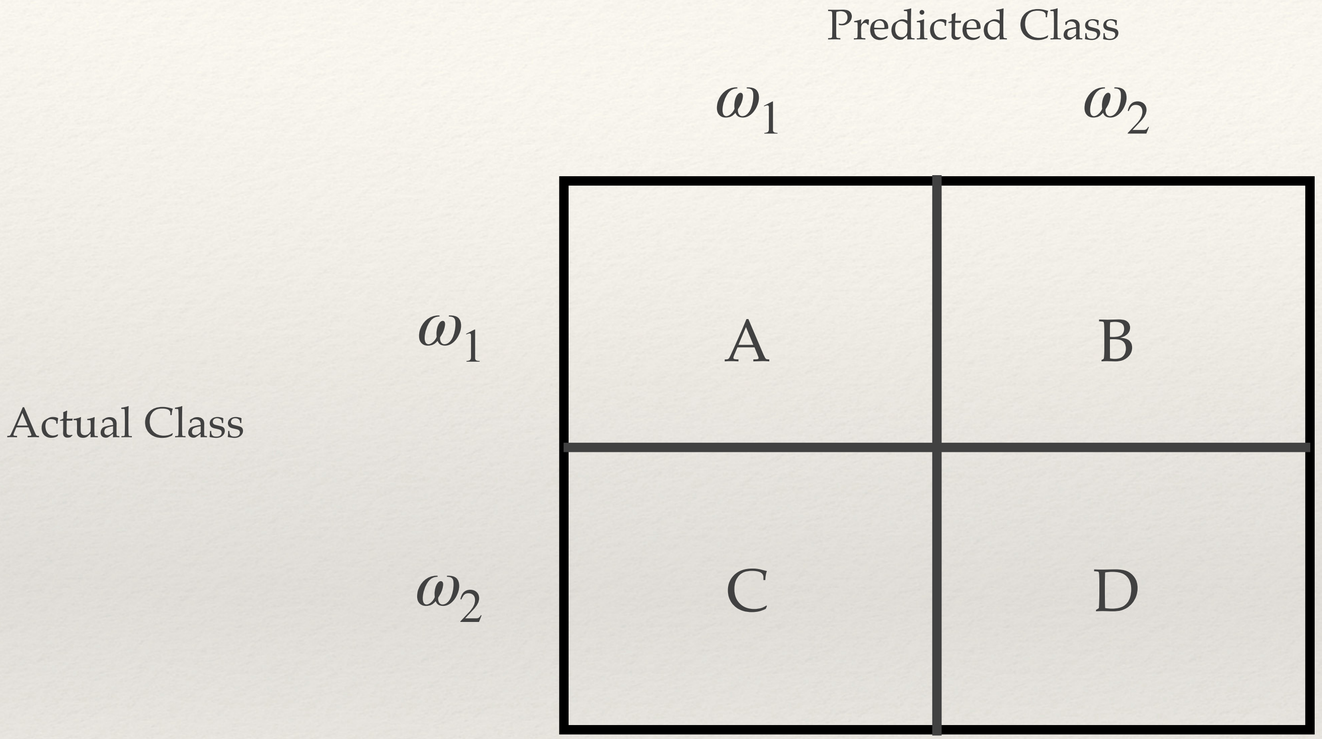
Predicted Red



3 predicted correctly

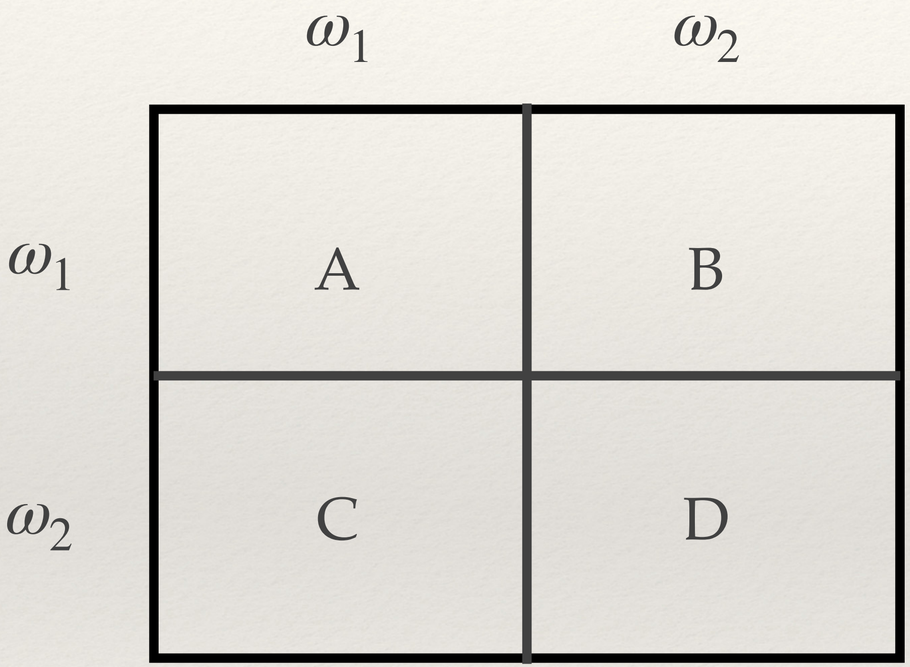
1 predicted incorrectly

Confusion Matrix



ω Is a notation that's used to refer to a class

Confusion Matrix



A = number of data points from class ω_1 that were correctly classified as ω_1

B = number of data points from class ω_1 that were incorrectly classified as ω_2

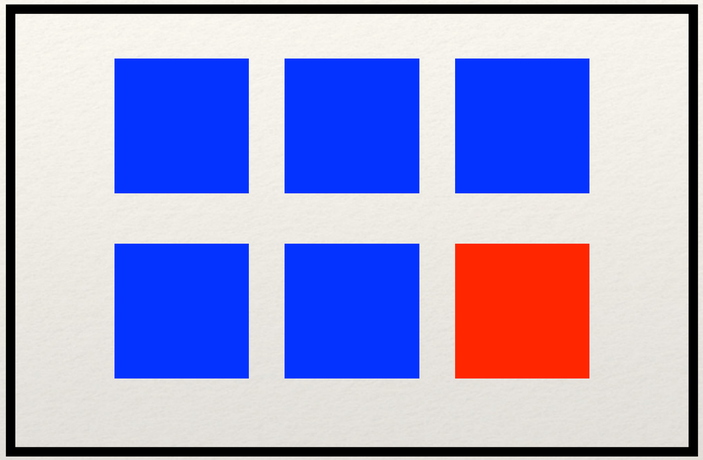
C = number of data points from class ω_2 that were incorrectly classified as ω_1

D = number of data points from class ω_2 that were correctly classified as ω_2

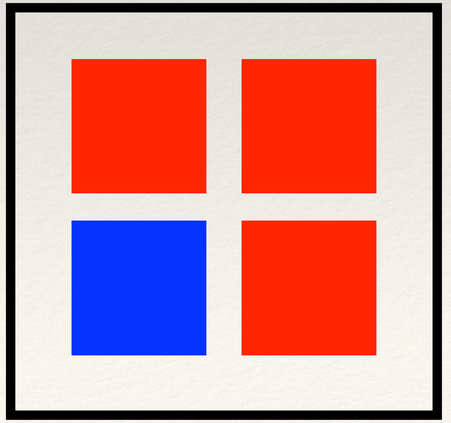
Confusion Matrix Example

	ω_1	ω_2
ω_1	5	1
ω_2	1	3

Predicted Blue



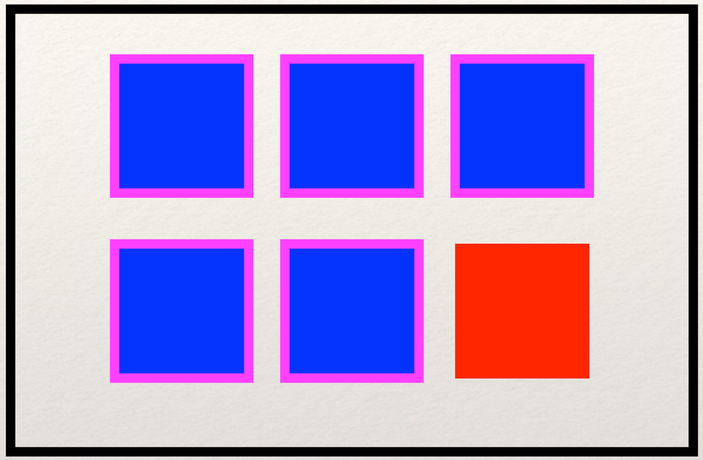
Predicted Red



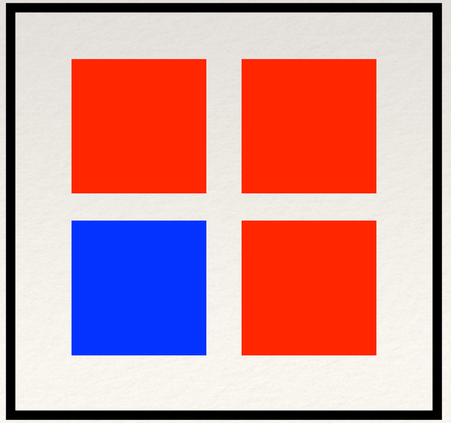
Confusion Matrix Example

	ω_1	ω_2
ω_1	5	1
ω_2	1	3

Predicted Blue



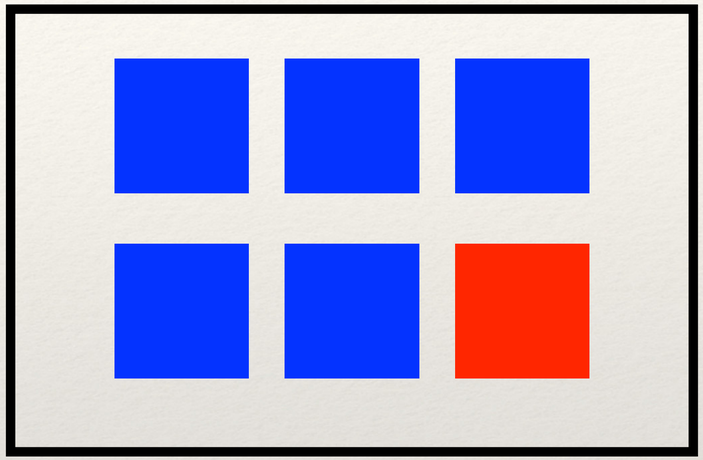
Predicted Red



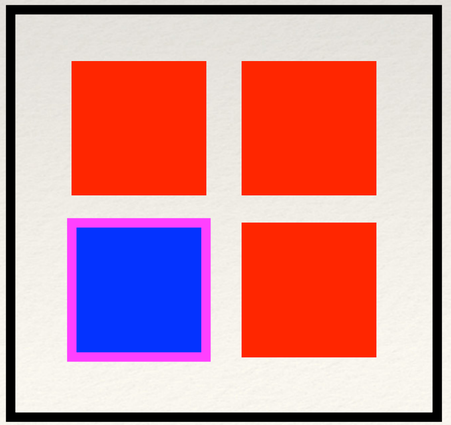
Confusion Matrix Example

	ω_1	ω_2
ω_1	5	1
ω_2	1	3

Predicted Blue



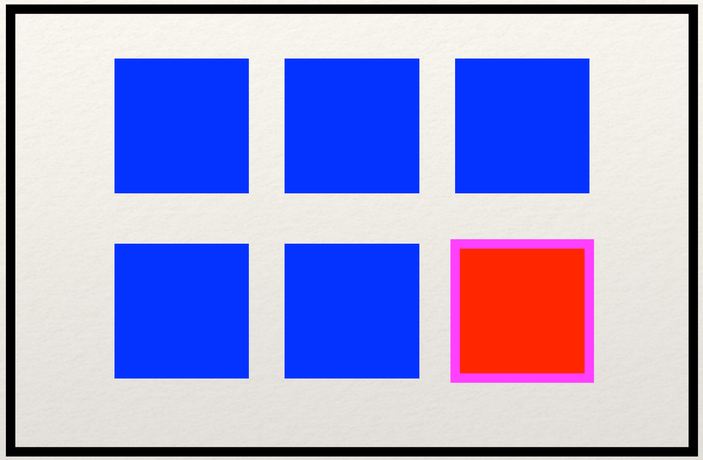
Predicted Red



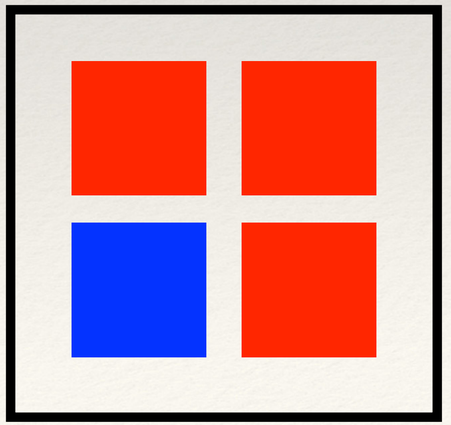
Confusion Matrix Example

	ω_1	ω_2
ω_1	5	1
ω_2	1	3

Predicted Blue



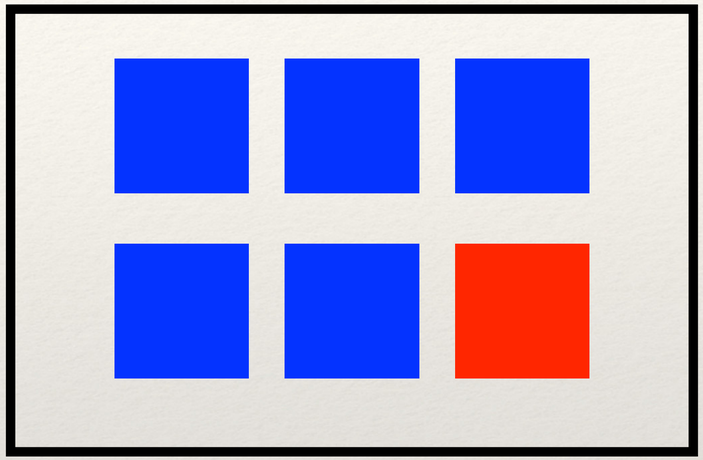
Predicted Red



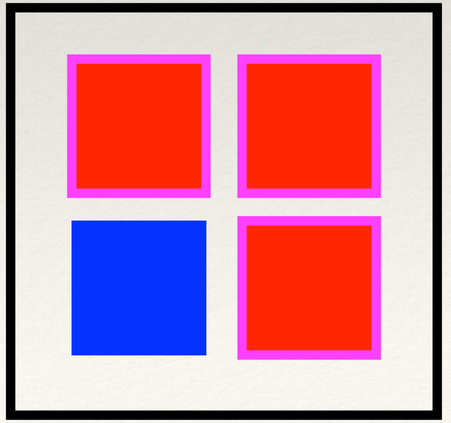
Confusion Matrix Example

	ω_1	ω_2
ω_1	5	1
ω_2	1	3

Predicted Blue



Predicted Red



Confusion Matrix Example

	ω_1	ω_2
ω_1	5	1
ω_2	1	3

The numbers on the diagonal are the correct predictions and for a system that is performing well, we expect those numbers to be the highest

Confusion Matrix

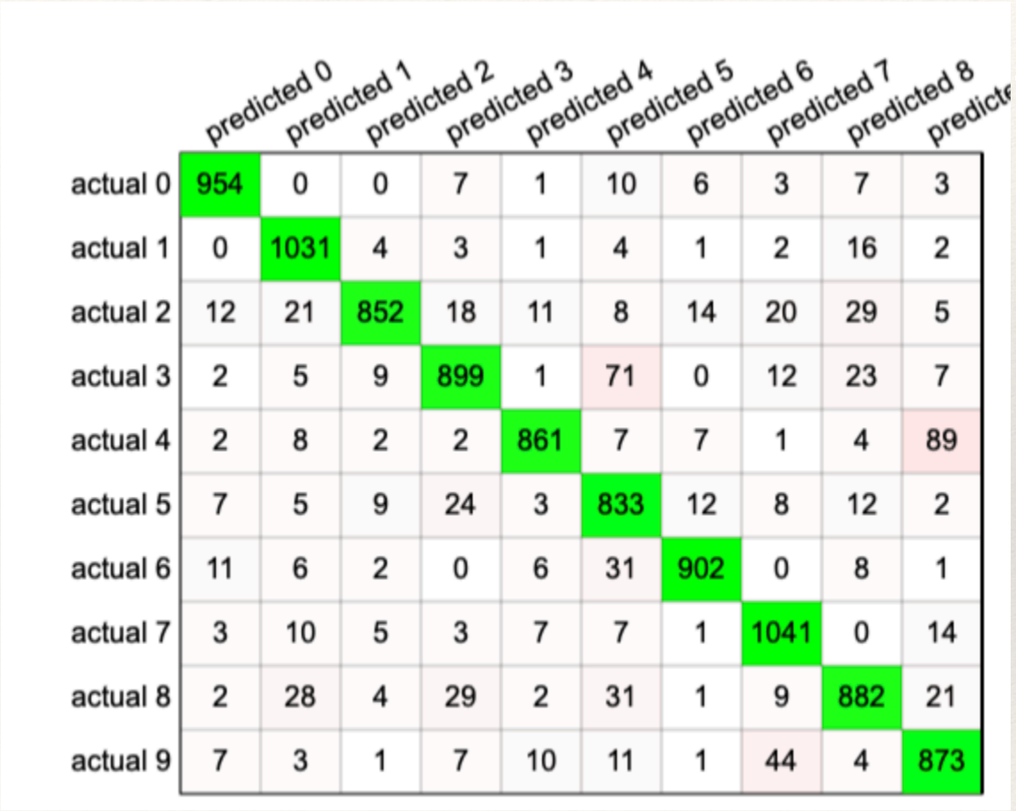
	ω_1	$\tilde{\omega}_1$
ω_1	True Positive	False Negative
$\tilde{\omega}_1$	False Positive	True Negative

$$\text{Accuracy} = \frac{TP + TN}{TP + TN + FP + FN}$$

$$\text{Precision} = \frac{TP}{TP + FP}$$

$$\text{Recall} = \frac{TP}{TP + FN}$$

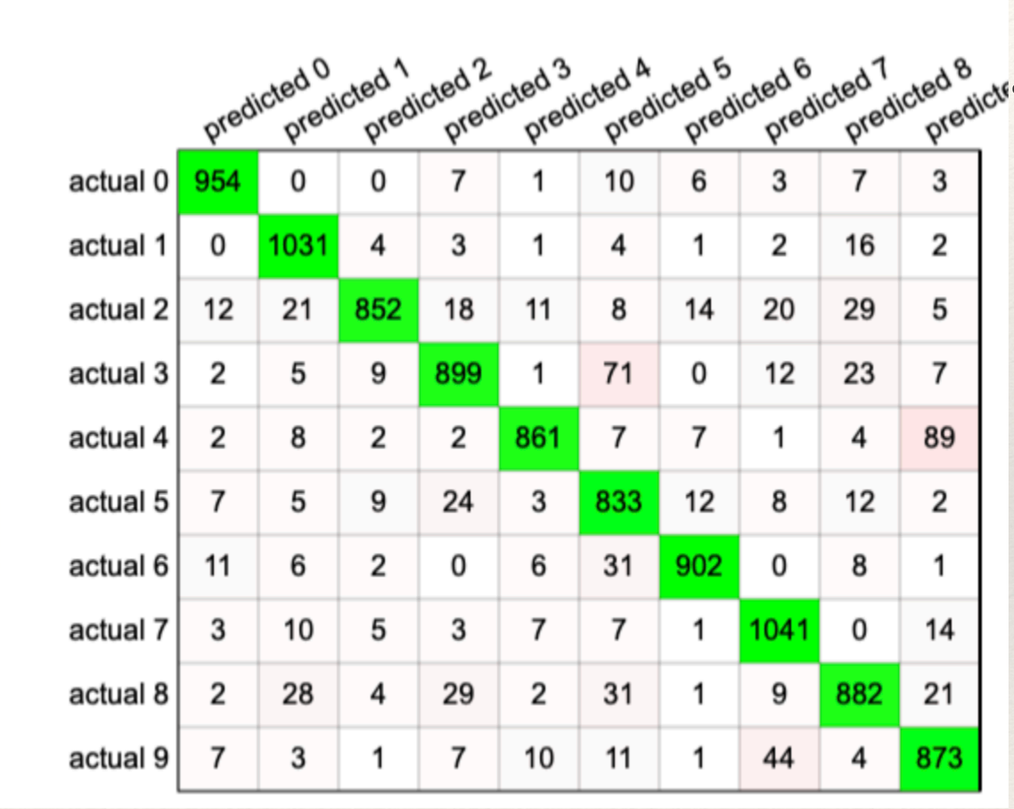
Confusion Matrix Multi-ClassExample



	predicted 0	predicted 1	predicted 2	predicted 3	predicted 4	predicted 5	predicted 6	predicted 7	predicted 8	predicted 9
actual 0	954	0	0	7	1	10	6	3	7	3
actual 1	0	1031	4	3	1	4	1	2	16	2
actual 2	12	21	852	18	11	8	14	20	29	5
actual 3	2	5	9	899	1	71	0	12	23	7
actual 4	2	8	2	2	861	7	7	1	4	89
actual 5	7	5	9	24	3	833	12	8	12	2
actual 6	11	6	2	0	6	31	902	0	8	1
actual 7	3	10	5	3	7	7	1	1041	0	14
actual 8	2	28	4	29	2	31	1	9	882	21
actual 9	7	3	1	7	10	11	1	44	4	873

Retrieved from: https://ml4a.github.io/demos/confusion_mnist/

Confusion Matrix Multi-ClassExample



	predicted 0	predicted 1	predicted 2	predicted 3	predicted 4	predicted 5	predicted 6	predicted 7	predicted 8	predicted 9
actual 0	954	0	0	7	1	10	6	3	7	3
actual 1	0	1031	4	3	1	4	1	2	16	2
actual 2	12	21	852	18	11	8	14	20	29	5
actual 3	2	5	9	899	1	71	0	12	23	7
actual 4	2	8	2	2	861	7	7	1	4	89
actual 5	7	5	9	24	3	833	12	8	12	2
actual 6	11	6	2	0	6	31	902	0	8	1
actual 7	3	10	5	3	7	7	1	1041	0	14
actual 8	2	28	4	29	2	31	1	9	882	21
actual 9	7	3	1	7	10	11	1	44	4	873

What information does this confusion matrix tell us?

Retrieved from: https://ml4a.github.io/demos/confusion_mnist/

In Class Exercise

Confusion Matrix Worksheet

End