Confusion about confusion matrices

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1 Example from lecture

Confusion Matrix

		Predicted J	Predicted $\neg J$	Total
Actual	J	a TP	b FN	$a+b$
	$\neg J$	c FP	d TN	$c+d$
	Total	$a+c$	$b+d$	N

Accuracy : $\frac{\text{number correctly classified}}{\text{total number of cases}} = \frac{a+d}{a+b+c+d}$

Precision : $\frac{\text{number of TP}}{\text{number of TP+number of FP}} = \frac{a}{a+c}$.
Fraction of the documents predicted to be J, that were in fact J.

Recall : $\frac{\text{number of TP}}{\text{number of TP + number of FN}} = \frac{a}{a+b}$.
Fraction of the documents that were in fact J, that method predicted were J.

F : $2\frac{\text{precision}\cdot\text{recall}}{\text{precision+recall}}$. Harmonic mean of precision and recall.

() March 1, 2018

Recall the above slide from Lecture 5. Note that:

- Actual classes generally go on the left, predicted classes go on the top

- In this example, the order of the rows (columns) is $\{Class, \neg Class\}$

In general form,

Table 1: General confusion matrix

	Predicted ¬Class	Predicted Class
Actual ¬Class	TN (Actual ¬Class predicted as ¬Class)	FP (Actual ¬Class predicted as Class)
Actual Class	FN (Actual Class predicted as ¬Class)	TP (Actual Class predicted as Class)

2 Common issues on the HW

2.1 Reversing the axes

Table 2: Reversed axes

	Actual 0	Actual 1
Predicted 0	TN	FN
Predicted 1	FP	TP

- Putting actual classes on the top and predicted classes on the left, as in Table 2, is not incorrect, but it tended to cause people to mix up the location of FP, FN when they used a matrix with different axes as reference.

Table 3: Conventional axes

	Predicted 0	Predicted 1
Actual 0	TN	FP
Actual 1	FN	TP

- Table 3 presents the conventional setup of a two-class confusion matrix. Note that the TN and TP are in the same places compared to Table 2, but the FN and FP are switched.

2.2 Reversing the order of rows

Most confusion matrices actually have rows in the reverse order of the example from lecture, i.e. $\{\neg Class, Class\}$. Doing it one way versus the other is not incorrect, but again, people tend to get mixed up when they set up their matrix one way but refer to a matrix with reversed row order/axes for the location of FP, FN.

2.3 Which class is "Class"?

In the case of the HW, the classes were $\{0, 1\}$ corresponding to $\{negative, positive\}$—i.e. $\{\neg positive, positive\}$. Unless your answer stated otherwise, the assumption is that $\neg Class = negative$ and $Class = positive$, according to the logical interpretation that True Positive is a positive review that was correctly predicted to be positive, and True Negative is a negative review that was correctly predicted to be negative.

Thus, the location of TN, TP, FN, FP in the confusion matrix corresponds to Table 3.

2.3.1 Note

The classes $\{negative, positive\}$ could be designated as $\{negative, \neg negative\}$, i.e. $\neg Class = positive$ and $Class = negative$. If your answer stated that $\{Class, \neg Class\}$ corresponded with the labels in this manner (e.g. "True Positive is a negative review that is correctly predicted to be negative"), answers based on the following confusion matrix would have been acceptable:

Table 4: Reversing the definition of the classes

	Predicted 0	Predicted 1
Actual 0	TP	FN
Actual 1	FP	TN

It was also acceptable if you presented confusion matrices for both cases, the standard $Class = Positive, \neg Class = Negative$ as well as the alternative $Class = Negative, \neg Class = Positive$.