Error Analysis for Skewed Data

Handling Skewed Data

Advice for Applying Machine Learning:

Cancer classification example

Train logistic regression model $h_\theta(x)$. ($y = 1$ if cancer, $y = 0$ otherwise)

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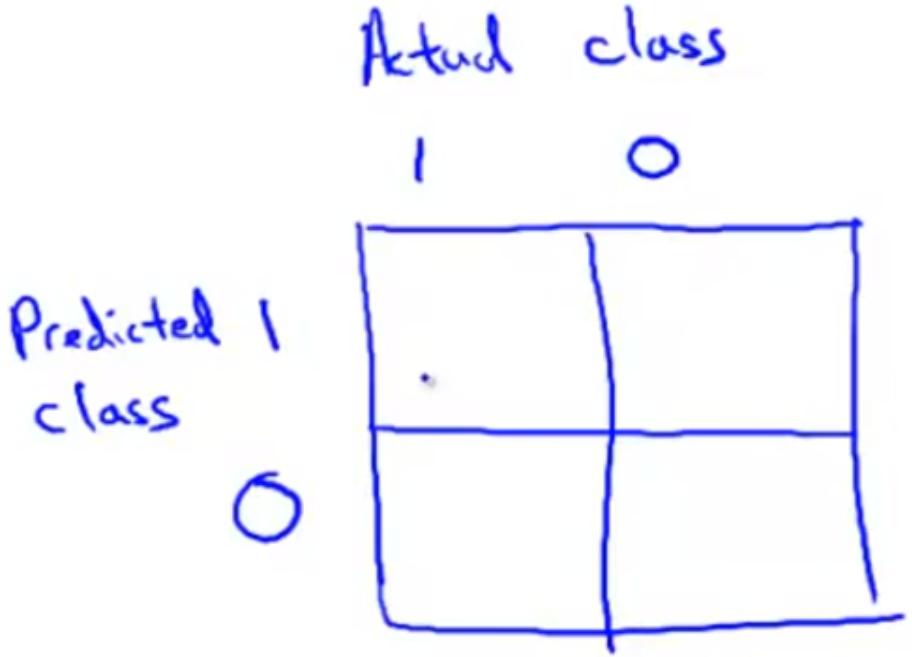
99.2% accuracy (0.8% error)

99.5% accuracy (0.5% error)

Is there an improvement or not?

Precision/Recall

$y = 1$ in presence of rare class that we want to detect



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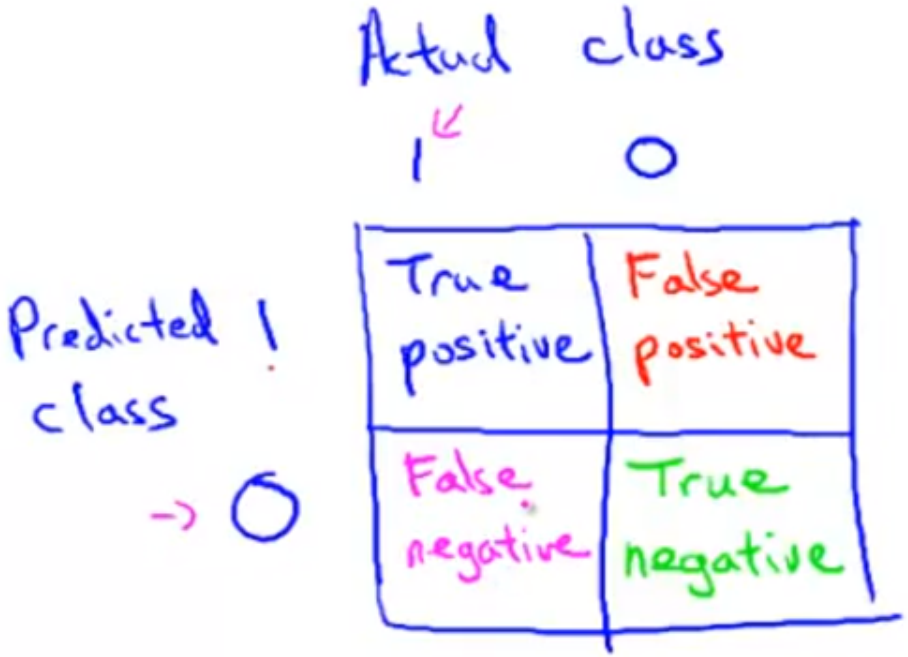

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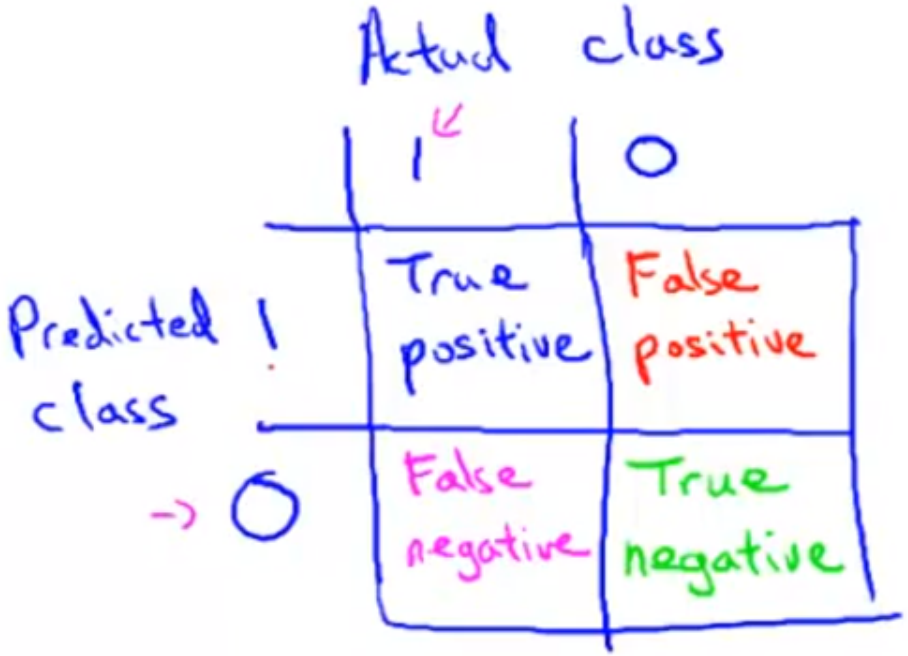

→ **Precision**
(Of all patients where we predicted $y = 1$, what fraction actually has cancer?)

Recall
(Of all patients that actually have cancer, what fraction did we correctly detect as having cancer?)

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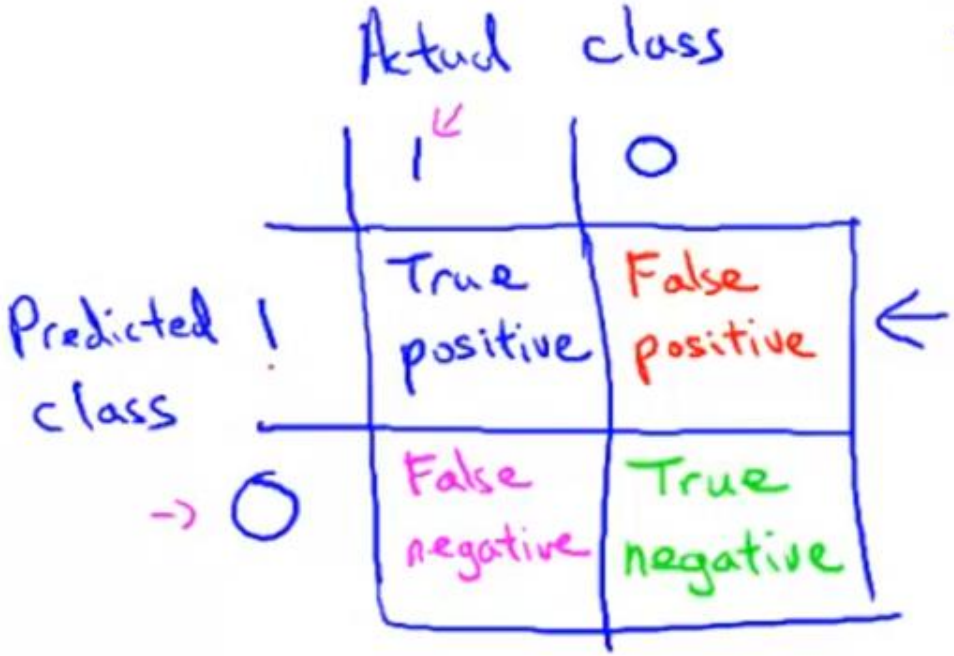

→ **Precision**

(Of all patients where we predicted $y = 1$, what fraction actually has cancer?)

$$\frac{\text{True positives}}{\#\text{predicted positive}} = \frac{\text{True positive}}{\text{True pos} + \text{False pos}}$$

Recall

(Of all patients that actually have cancer, what fraction did we correctly detect as having cancer?)

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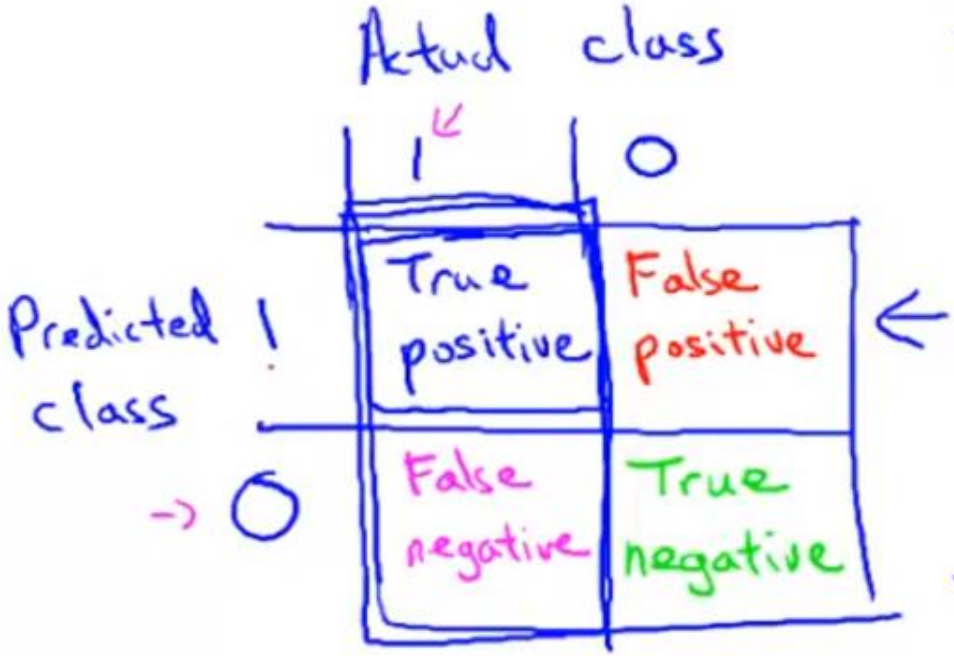

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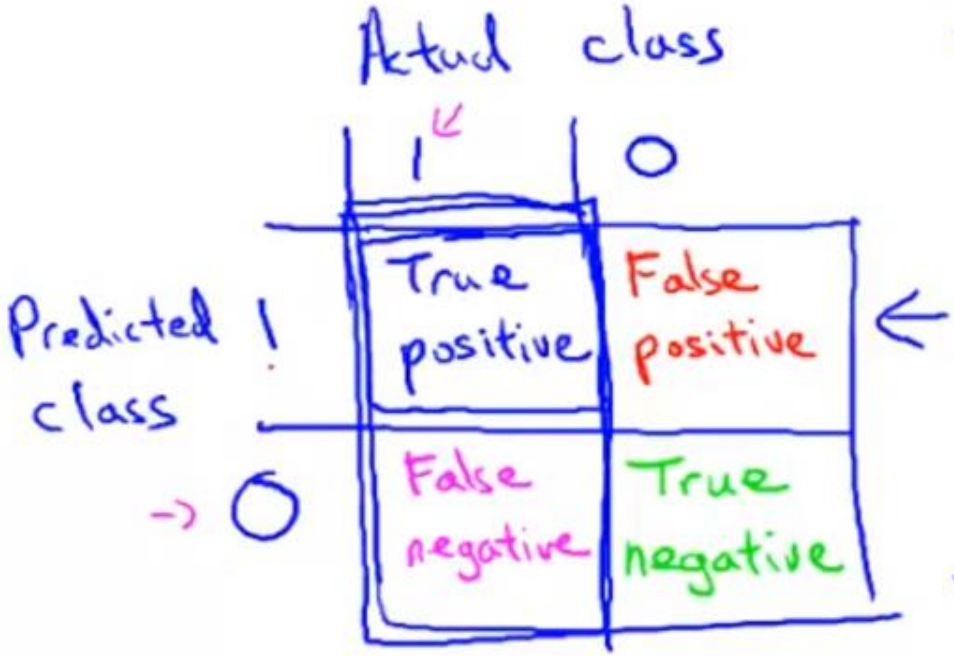

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$y = 0$

recall = 0

Example

- Your algorithm's performance on the test set is given to the right. What is the algorithm's precision and recall?

Predicted class \ Actual class	1	0
1	80	20
0	80	820

Precision/Recall

- Usually we use the convention that y is equal to 1, in the presence of the more rare class.
- So if we are trying to detect rare conditions such as cancer, precision and recall are defined setting y equals 1, rather than y equals 0.
- And by using precision and recall, we find, what happens is that even if we have very skewed classes, it's not possible for an algorithm to you know, "cheat" and predict y equals 1 all the time, or predict y equals 0 all the time, and get high precision and recall.
- And in particular, if a classifier is getting high precision and high recall, then we are actually confident that the algorithm has to be doing well, even if we have very skewed classes.