# Alternatives to the Accuracy Metric

# Exploring Other Metrics

| | | Prediction outcome: positive | Prediction outcome: negative | | |
|---|---|---|---|---|---|
| Actual value | positive | $TP$ | $FN$ | $TP + FN$ | Total Actual positive |
| | negative | $FP$ | $TN$ | $FP + TN$ | Total Actual negative |

# True Positive Rate

| | | Prediction outcome: positive | Prediction outcome: negative | | |
|---|---|---|---|---|---|
| Actual value | positive | $TP$ | $FN$ | $TP + FN$ | Total Actual positive |
| | negative | $FP$ | $TN$ | $FP + TN$ | Total Actual negative |

Ratio of actual positive predictions over total actual positives

# True Positive Rate

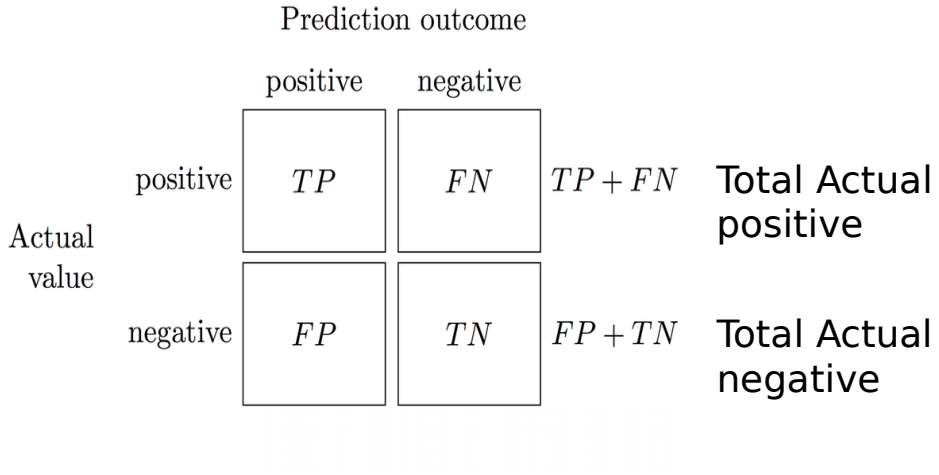
$$TPR = \frac{TP}{TP + FN}$$

| Actual value | Prediction outcome: positive | Prediction outcome: negative | | |
|---|---|---|---|---|
| positive | $TP$ | $FN$ | $TP + FN$ | Total Actual positive |
| negative | $FP$ | $TN$ | $FP + TN$ | Total Actual negative |

Ratio of actual positive predictions over total actual positives

# False Negative Rate

$$TPR = \frac{TP}{TP + FN}$$

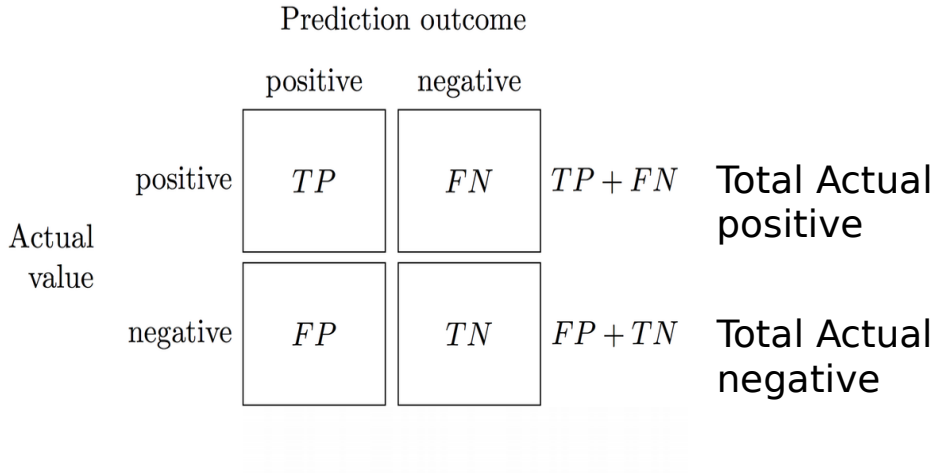



Ratio of actual positive, predicted as negative; over total actual positive

# False Negative Rate

$$TPR = \frac{TP}{TP + FN}$$

$$FNR = \frac{FN}{TP + FN}$$

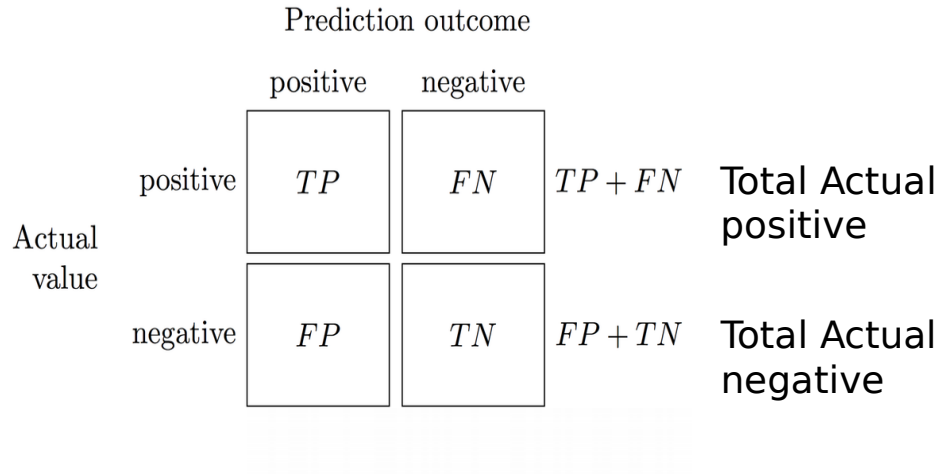



Ratio of actual positive, predicted as negative; over total actual positive

# True Negative Rate

$$TPR = \frac{TP}{TP + FN}$$

$$FNR = \frac{FN}{TP + FN}$$




Ratio of actual negative prediction over total actual negative

# True Negative Rate

$$TPR = \frac{TP}{TP + FN}$$

$$FNR = \frac{FN}{TP + FN}$$

$$TNR = \frac{TN}{FP + TN}$$

| Actual value \ Prediction outcome | positive | negative | |
|---|---|---|---|
| positive | $TP$ | $FN$ | $TP + FN$ Total Actual positive |
| negative | $FP$ | $TN$ | $FP + TN$ Total Actual negative |

Ratio of actual negative prediction over total actual negative

# False Positive Rate

$$TPR = \frac{TP}{TP + FN}$$

$$FNR = \frac{FN}{TP + FN}$$

$$TNR = \frac{TN}{FP + TN}$$

| Actual value \ Prediction outcome | positive | negative | |
|---|---|---|---|
| positive | $TP$ | $FN$ | $TP + FN$ Total Actual positive |
| negative | $FP$ | $TN$ | $FP + TN$ Total Actual negative |

Ratio of actual negative, predicted as positive; over total actual negative

# False Positive Rate

$$TPR = \frac{TP}{TP + FN}$$

$$FNR = \frac{FN}{TP + FN}$$

$$TNR = \frac{TN}{FP + TN}$$

$$FPR = \frac{FP}{FP + TN}$$

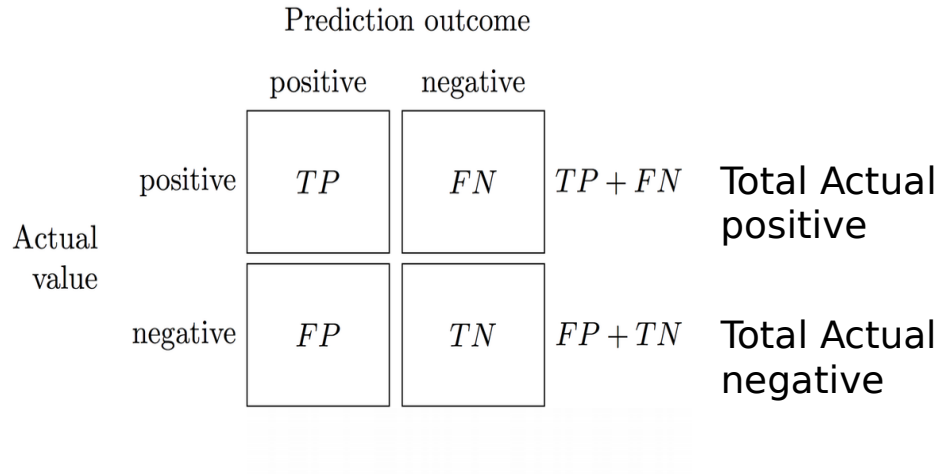
| | | Prediction outcome: positive | Prediction outcome: negative | | |
|---|---|---|---|---|---|
| Actual value | positive | $TP$ | $FN$ | $TP + FN$ | Total Actual positive |
| | negative | $FP$ | $TN$ | $FP + TN$ | Total Actual negative |

Ratio of actual negative, predicted as positive; over total actual negative

# False Positive Rate

$$TPR = \frac{TP}{TP + FN}$$

$$FNR = \frac{FN}{TP + FN}$$



# False Positive Rate

| | | Prediction outcome: positive | Prediction outcome: negative | | |
|---|---|---|---|---|---|
| Actual value | positive | $TP$ | $FN$ | $TP + FN$ | Total Actual positive |
| | negative | $FP$ | $TN$ | $FP + TN$ | Total Actual negative |

$$TNR = \frac{TN}{FP + TN}$$

$$FPR = \frac{FP}{FP + TN}$$

# Dumb Model

We train a “dumb” model to detect cancer

Negative report for every patient

Or

No patient has cancer

98.8% Accuracy for dumb model!

500 Patients with Cancer symptoms

494 Negative Results  6 Positive Results

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# Dumb Model

$$TPR = \frac{TP}{TP + FN}$$

$$FNR = \frac{FN}{TP + FN}$$

$$TNR = \frac{TN}{FP + TN}$$

$$FPR = \frac{FP}{FP + TN}$$

| | | Prediction outcome: positive | Prediction outcome: negative |
|---|---|---|---|
| Actual value | positive | 0 | 6 |
| | negative | 0 | 494 |

98.8% Accuracy for dumb model!

# Dumb Model

$$TPR = \frac{TP}{TP + FN} = 0$$

$$FNR = \frac{FN}{TP + FN} = 1$$

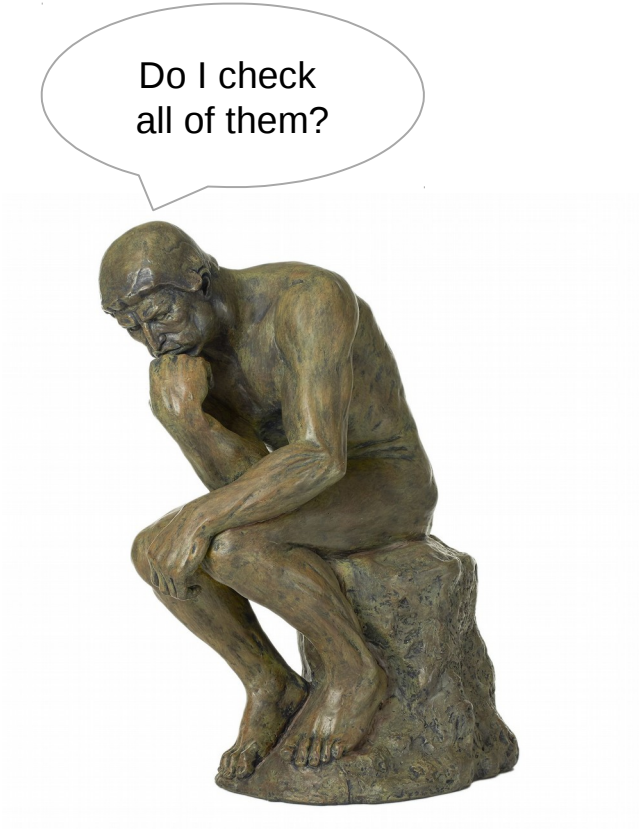
$$TNR = \frac{TN}{FP + TN} = 1$$

$$FPR = \frac{FP}{FP + TN} = 0$$

| | | Prediction outcome: positive | Prediction outcome: negative |
|---|---|---|---|
| Actual value | positive | 0 | 6 |
| | negative | 0 | 494 |

98.8% Accuracy for dumb model!

# How to select a metric

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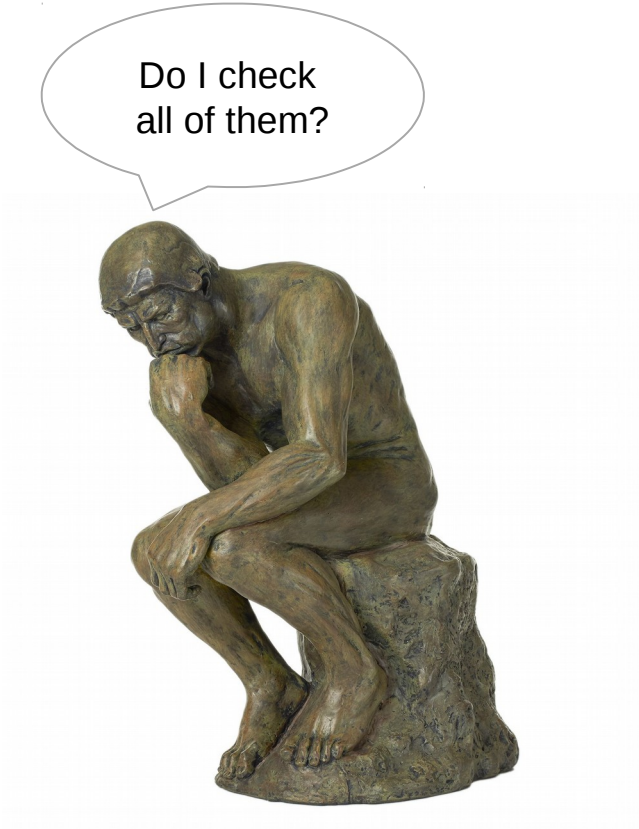
# How to select a metric

- Not necessarily

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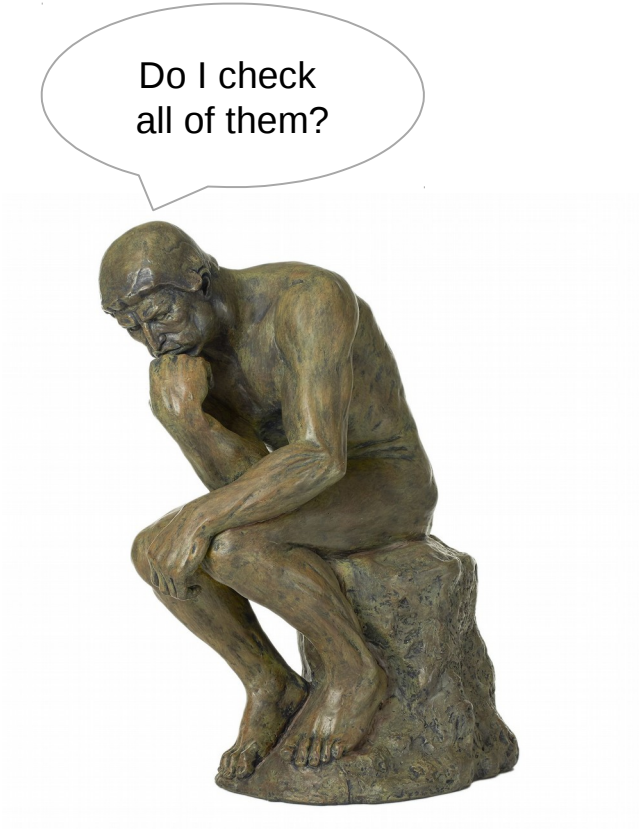
# How to select a metric

- Not necessarily
- Use  a combination

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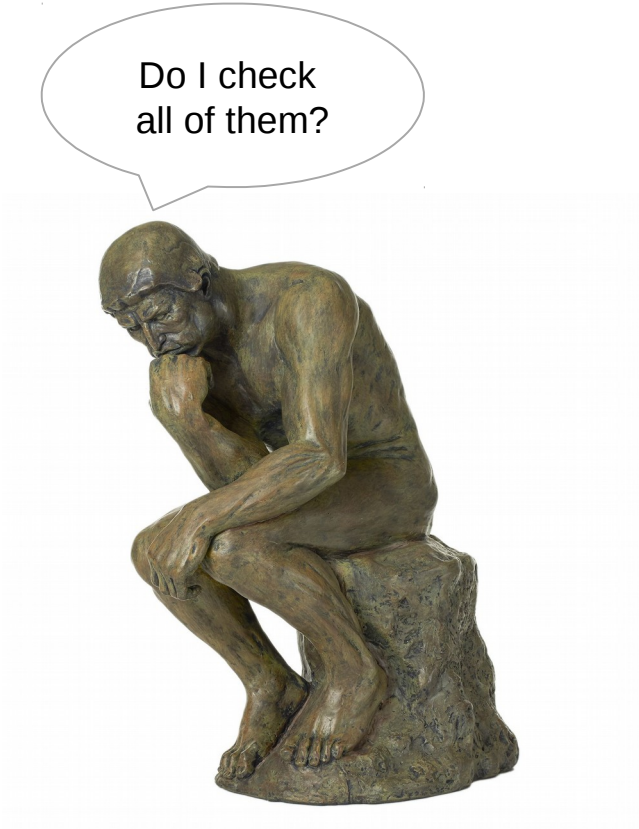
# How to select a metric

- Not necessarily
- Use  a combination
- Validation

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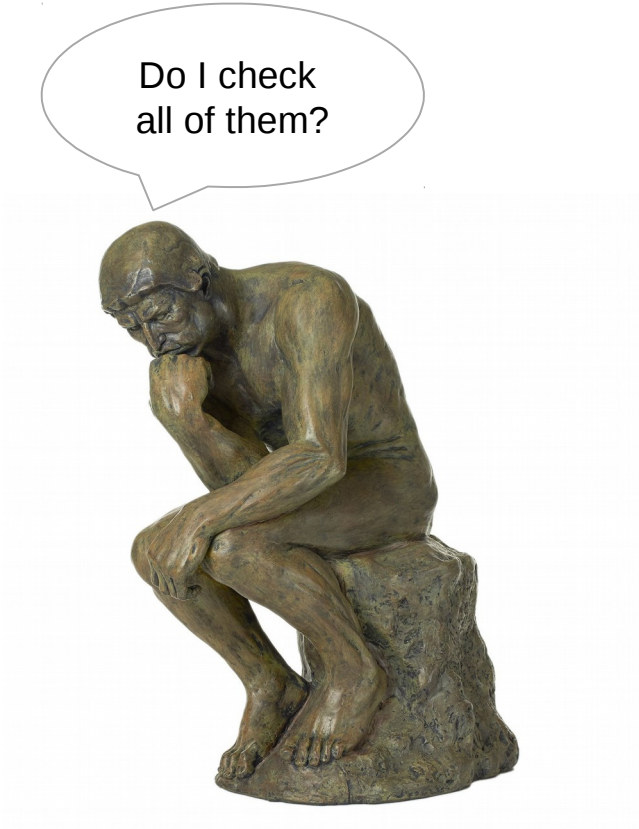
# How to select a metric

- Not necessarily
- Use  a combination
- Validation
- Depends on use case

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