Bayes Rule

- A method to calculate the conditional probability of one event based on the conditional probability of another
  - Why? One conditional probability may be easier to calculate than the other
  - We want to obtain the probability of an event given some evidence, some data, some observations, some experiments

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- $P(X|Y) = \frac{P(Y|X) \cdot P(X)}{P(Y)}$
  - $P(X|Y)$ → Posterior probability
  - $P(X)$ → Prior probability
  - $P(Y|X)$ → Likelihood
  - $P(Y)$ → Evidence
- Posterior = Likelihood x Prior / Evidence

Bayes Rule Example

Numeric example:

- C = have covid
- T = test result
- Problem: If a randomly selected patient has the test and it comes back positive, what is the probability that the patient has covid?
  - Test sensitivity (true positives) : P(T=positive | C=true) = 0.85 → 85% probability?

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  - P(C=true | T=positive)?
  - P(C=true) = 0.02%
  - P(T=positive) = 5%

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  - P(C=true | T=positive)?
  - P(C=true) = 0.02%
  - P(T=positive) = 5%
  - P(C=true | T=positive) = P(T=positive | C=true) P(C=true) / P(T=positive)
    = 0.85 x 0.0002 / 0.05 = 0.0034 = 0.34%