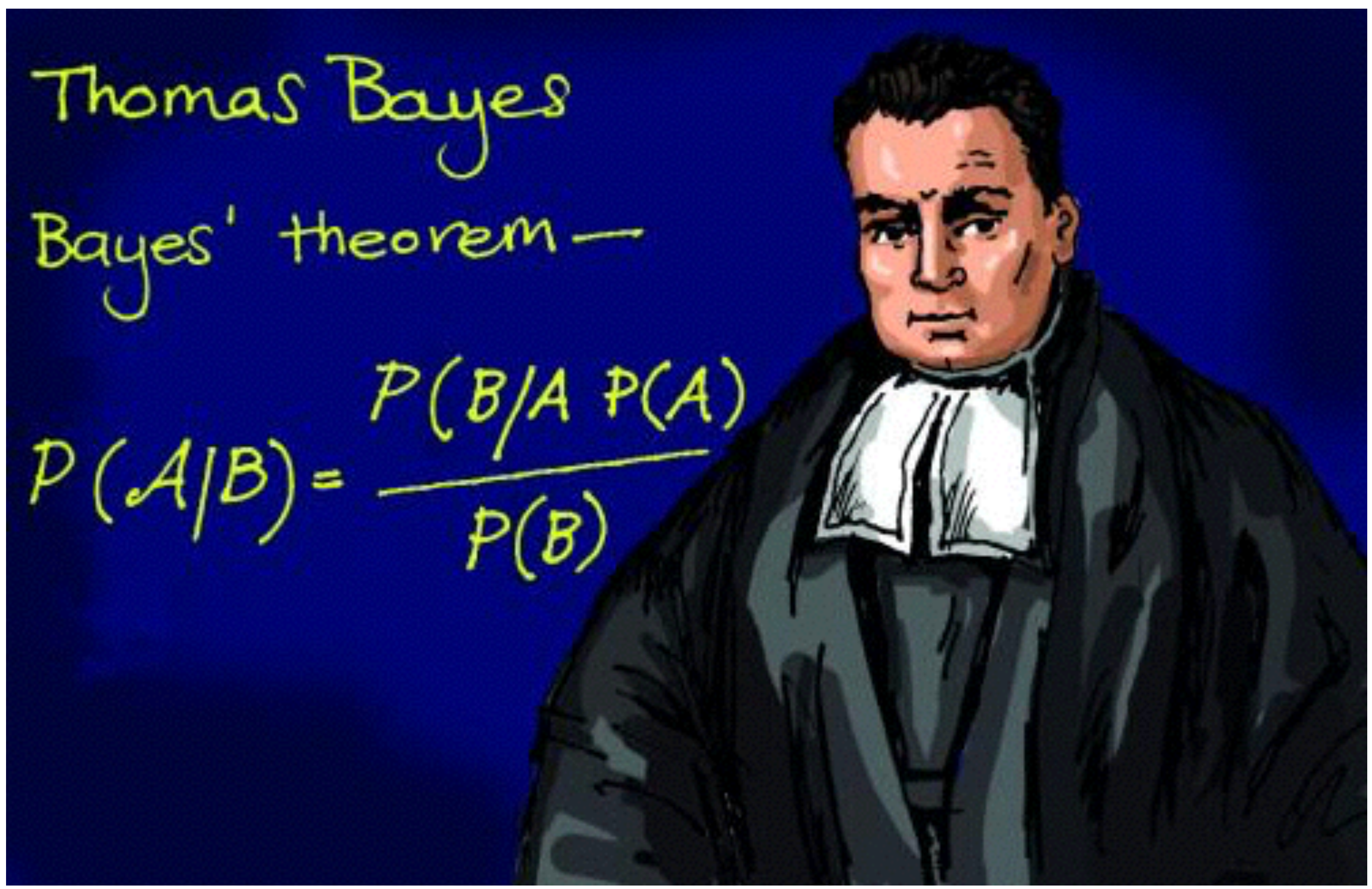
A Brief Overview of Bayesian Inference



http://www.pharmaceutical-journal.com/opinion/blogs/bayess-theorem-falls-foul-of-the-law/11089087.blog

Some Facts About Probability

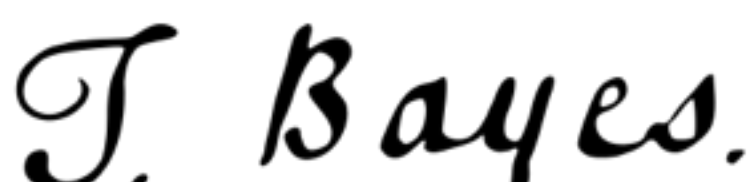
$$P(A \cap B) = P(A|B)P(B) = P(B|A)P(A)$$

$$P(A|B)P(B) = P(B|A)P(A)$$

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)}$$

Bayes Theorem

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)}$$



https://en.wikipedia.org/wiki/Thomas_Bayes

Bayes Theorem

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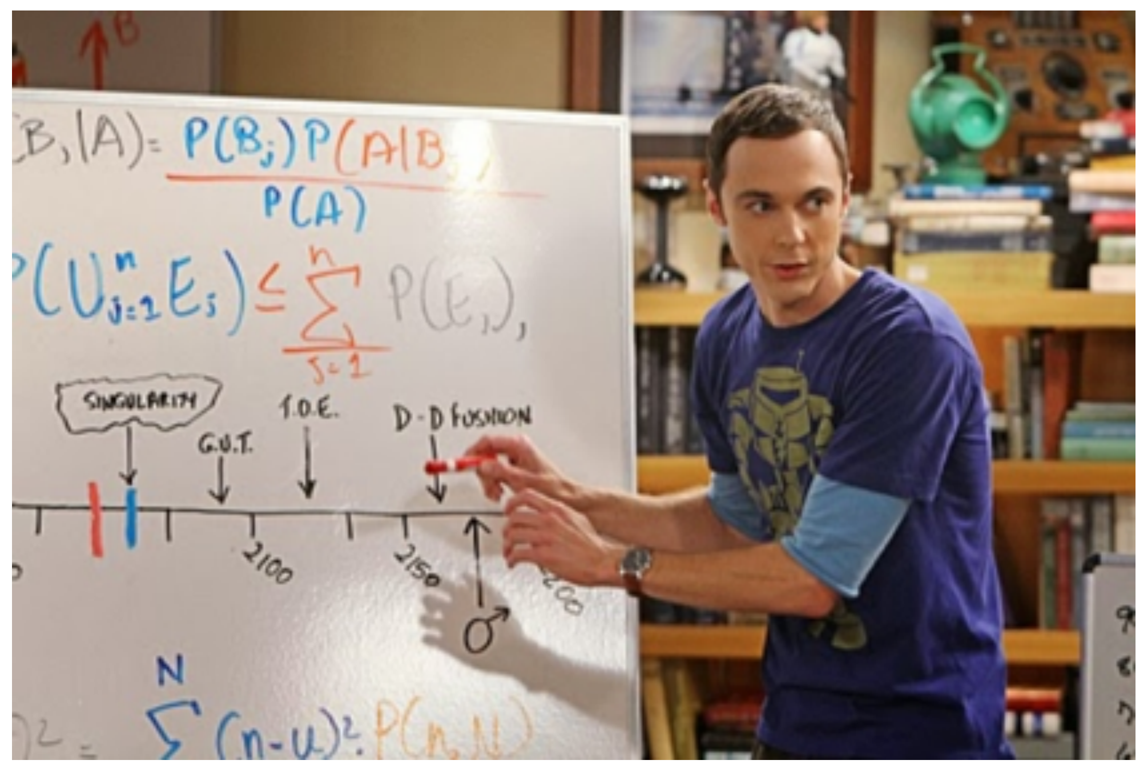
T. Bayes.



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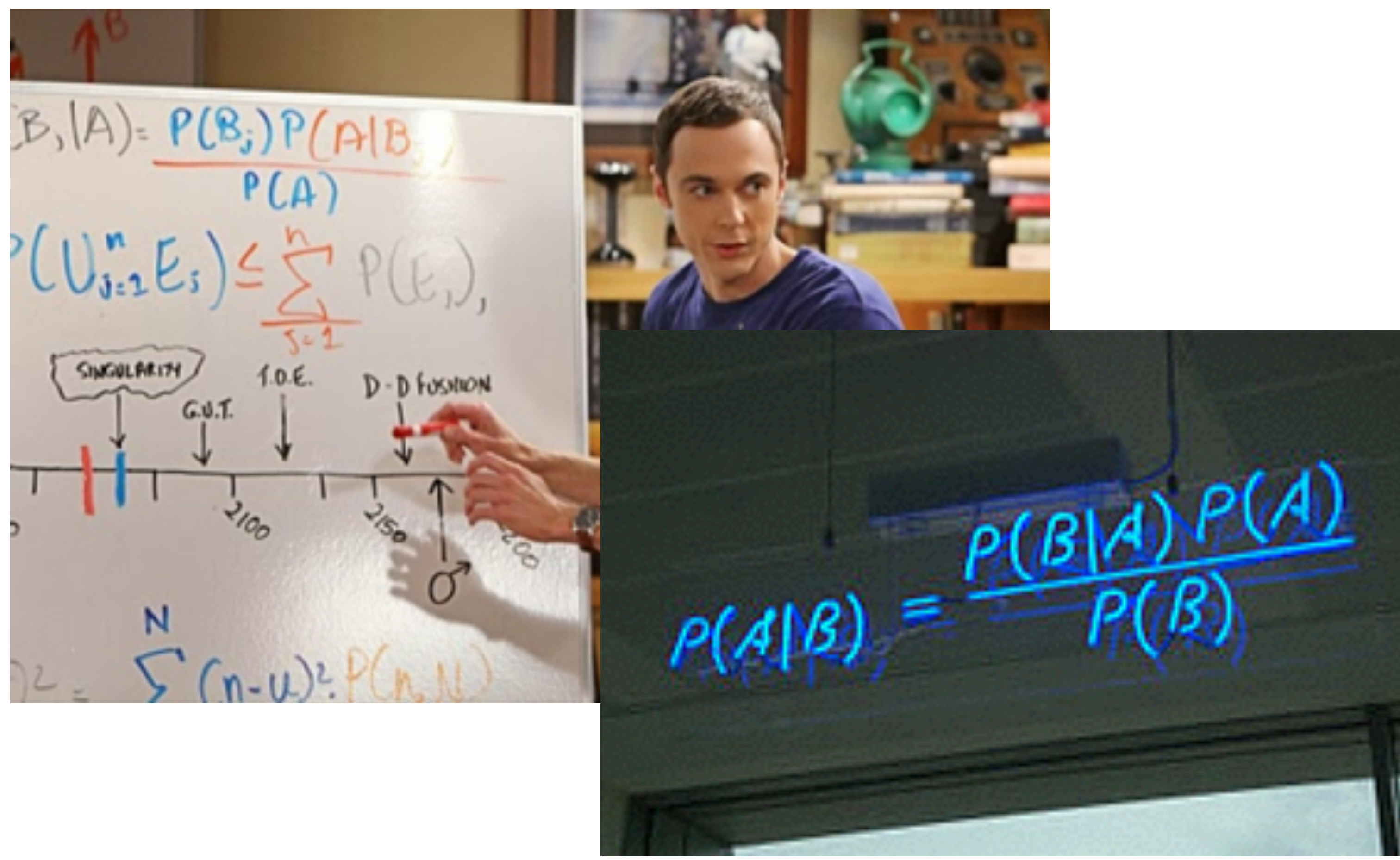

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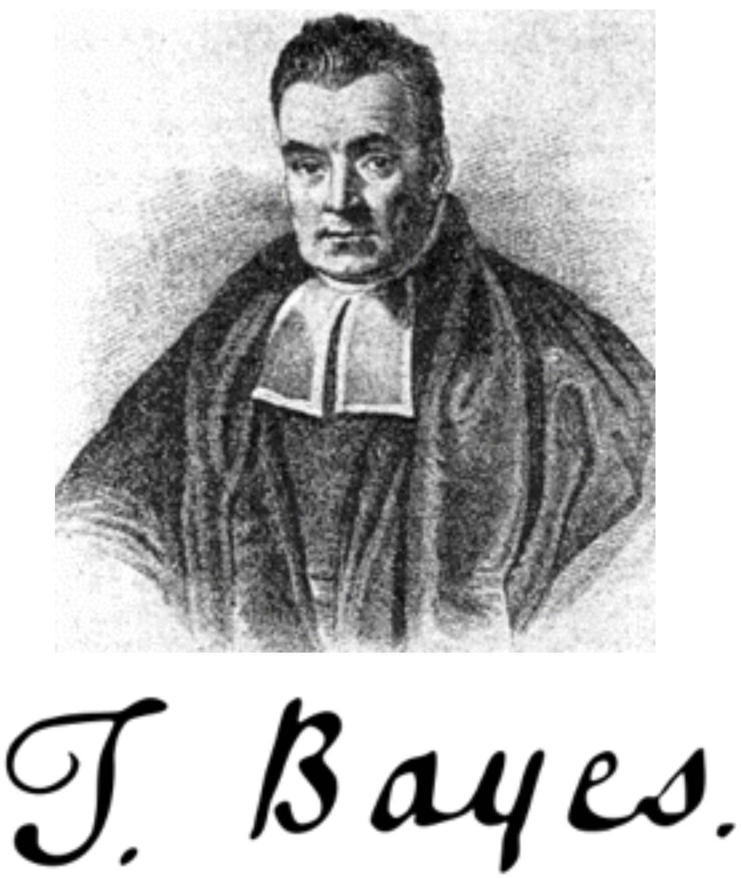

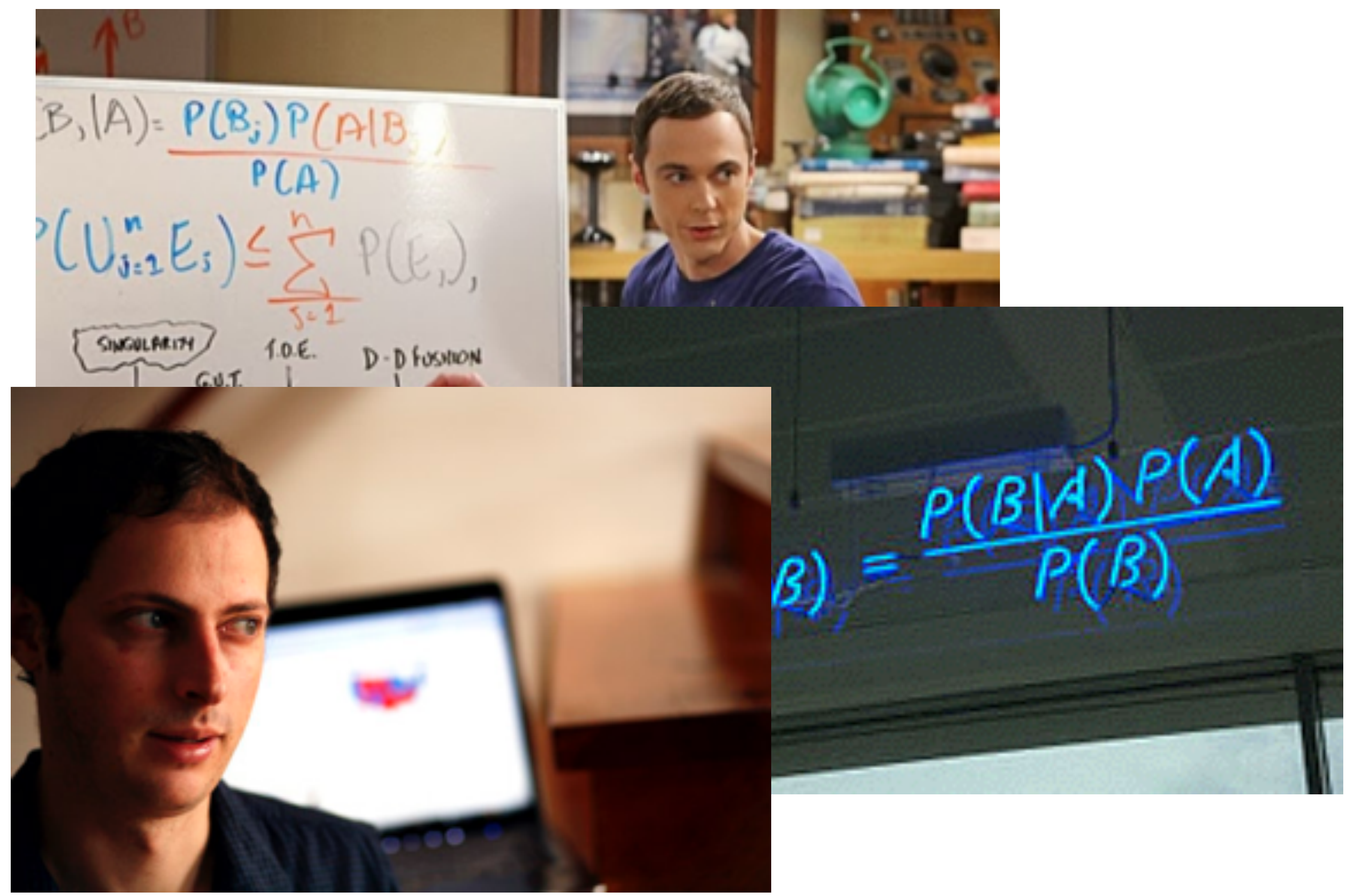

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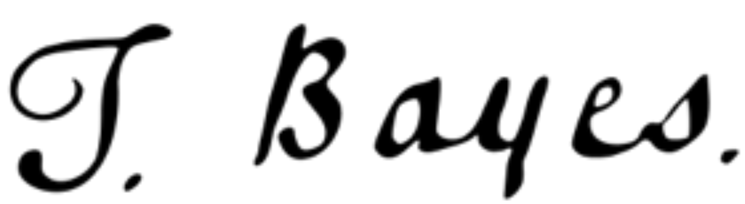

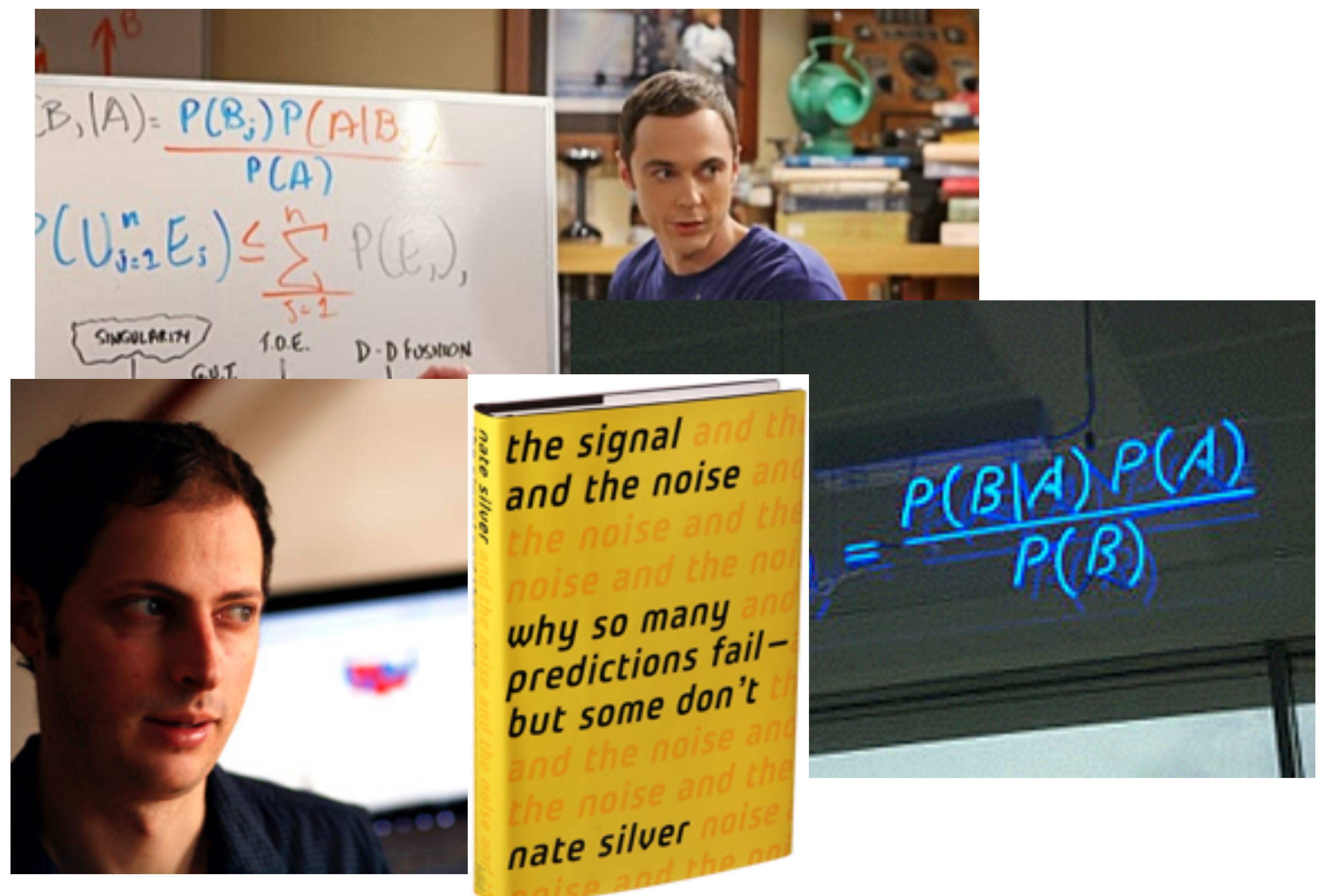

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Bayes Theorem

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Rev. Thomas Bayes
1701-1761

“An Essay towards solving a Problem in the Doctrine of Chances” published in 1763 (Richard Price)

Binomial with a uniform prior on *p*

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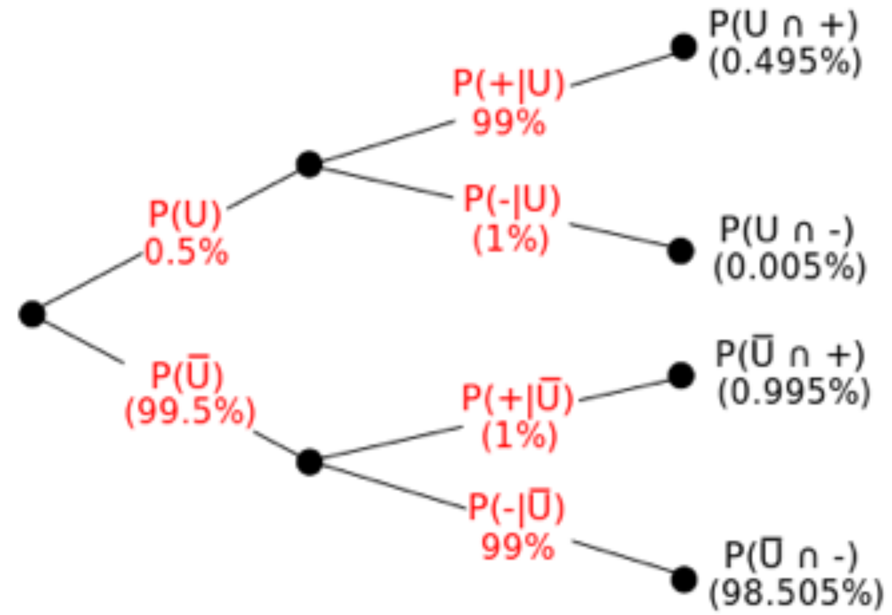
Bayes Theorem

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)}$$

Also used with frequentist probabilities!

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)}$$

Suppose a drug test is 99% sensitive and 99% specific. That is, the test will produce 99% true positive results for drug users and 99% true negative results for non-drug users. Suppose that 0.5% of people are users of the drug. If a randomly selected individual tests positive, what is the probability that he is a user?



$$P(\text{User} \mid +) = \frac{P(+ \mid \text{User})P(\text{User})}{P(+ \mid \text{User})P(\text{User}) + P(+ \mid \text{Non-user})P(\text{Non-user})}$$

$$= \frac{0.99 \times 0.005}{0.99 \times 0.005 + 0.01 \times 0.995}$$

$$\approx 33.2\%$$

https://en.wikipedia.org/wiki/Bayes'_theorem

Bayes Theorem

Likelihood

Posterior

Prior

$$P(H|D) = \frac{P(D|H)\,P(H)}{P(D)}$$

Normalizing Constant
(Marginal Likelihood)