Bayes' theorem

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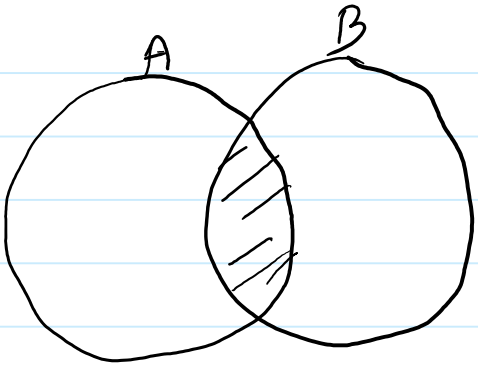

TP

$P(A) = 1/2 \Rightarrow P(A \cap B) = \frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$

$P(B) = 1/2$

$P(A) = 0.1$

$P(B) = 0.1$ $\Rightarrow P(A \cap B) = \frac{1}{0.01}$

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

$Cor(A, B) = 0$

Bayes' theorem

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

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

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

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

posterior

likelihood

evidence

prior

Bayes' theorem

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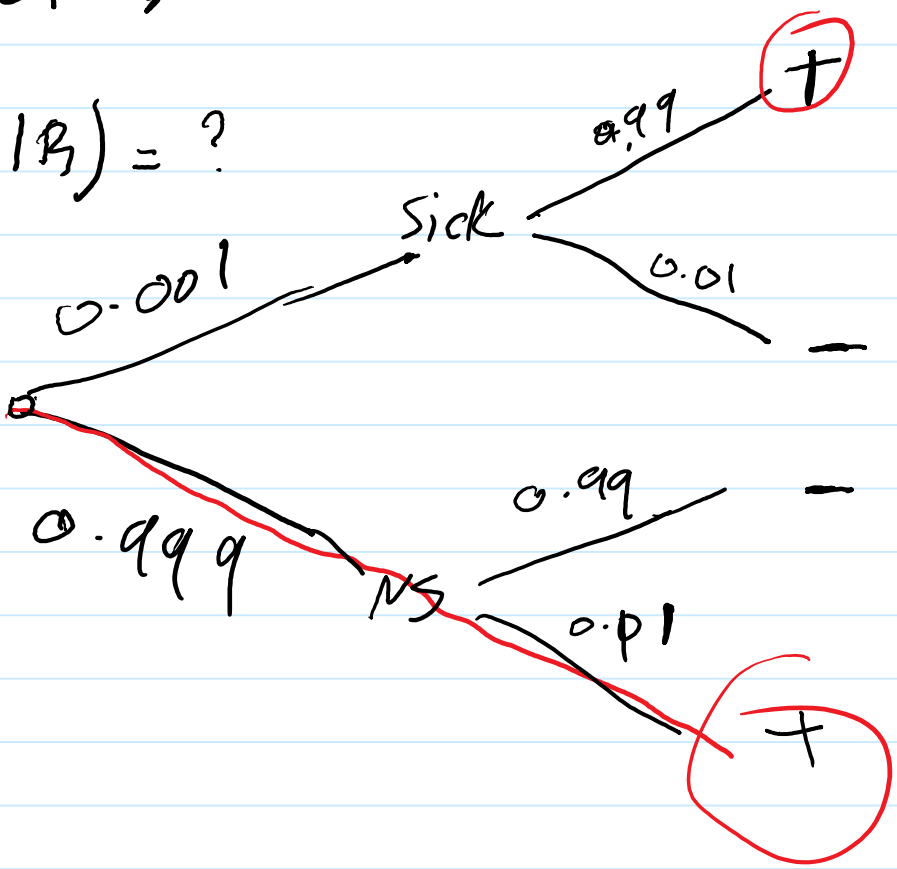
$P(A) = 0.1\%$

$P(B|A) = 0.99$

$P(A|B) = ?$



$$\frac{0.001 \times 0.99}{0.001 \times 0.99 + 0.999 \times 0.01} = 0.09$$

Bayes' theorem

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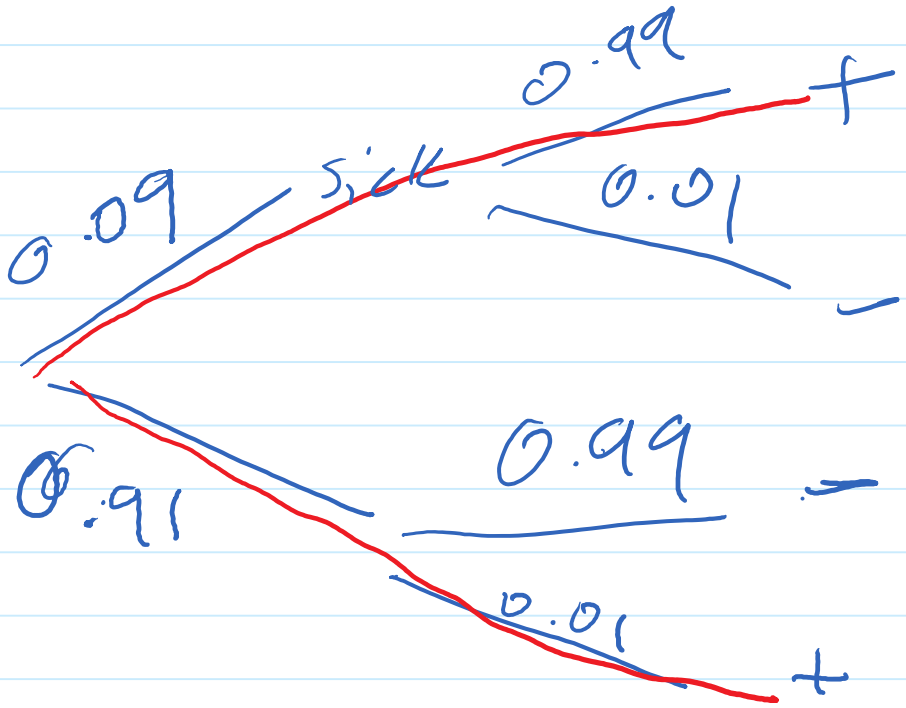
$$P(A|B) = \frac{P(B|A) \cdot P(A)}{P(B)}$$

(0.99 → $P(B|A)$, 0.1 → $P(A)$)

$$P(B) = P(B|A) \cdot P(A) + P(B|-A) \cdot P(-A)$$



$$\frac{0.09 \times 0.99}{0.09 \times 0.99 + 0.91 \times 0.01} = 91\%$$

Bayes' theorem

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

$P(B|A)$ → 0.99, $P(A)$ → 0.91

$$P(B) = P(B|A) \times P(A) + P(B|-A) \times P(-A)$$

$$\frac{0.99 \times 0.91}{0.99 \times 0.91 + (1-0.99) \times (1-0.91)}$$

$$= 99.9$$

Markov chain Monte Carlo

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$$p(R_t) = 0.5$$

$$p(S_t) = 0.5$$

$$p(S_{t+1} \mid R_t) = 0.5$$

$$p(R_{t+1} \mid R_t) = 0.5$$

$$p(S_{t+1} \mid S_t) = 0.9$$

$$p(R_{t+1} \mid S_t) = 0.1$$

MCMC

MCMC

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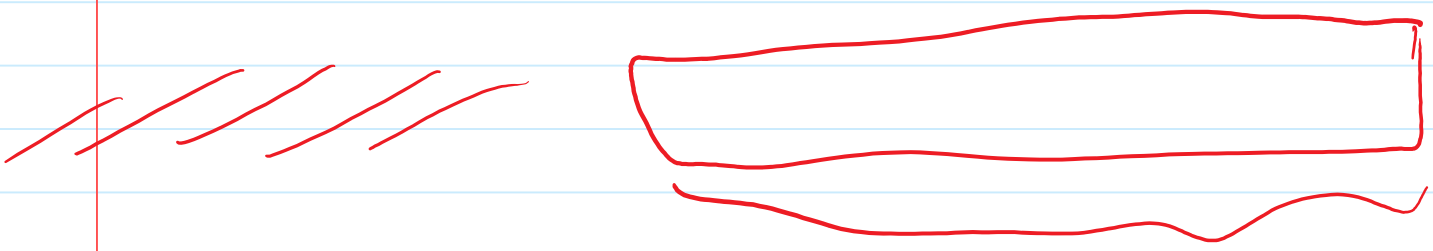
1000 →

0.8 0.3 0.7 0.5 0.91

R R S S S R



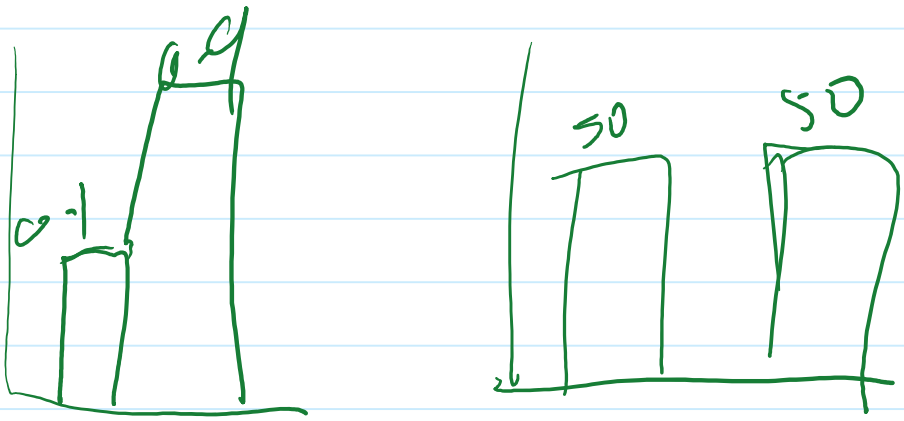
P(R)

0 — 1

P(S)

0.1 0.7 0.93 0.53 0.3

S S S R R S̄



S S_{+1} R R_{+1}

MCMC

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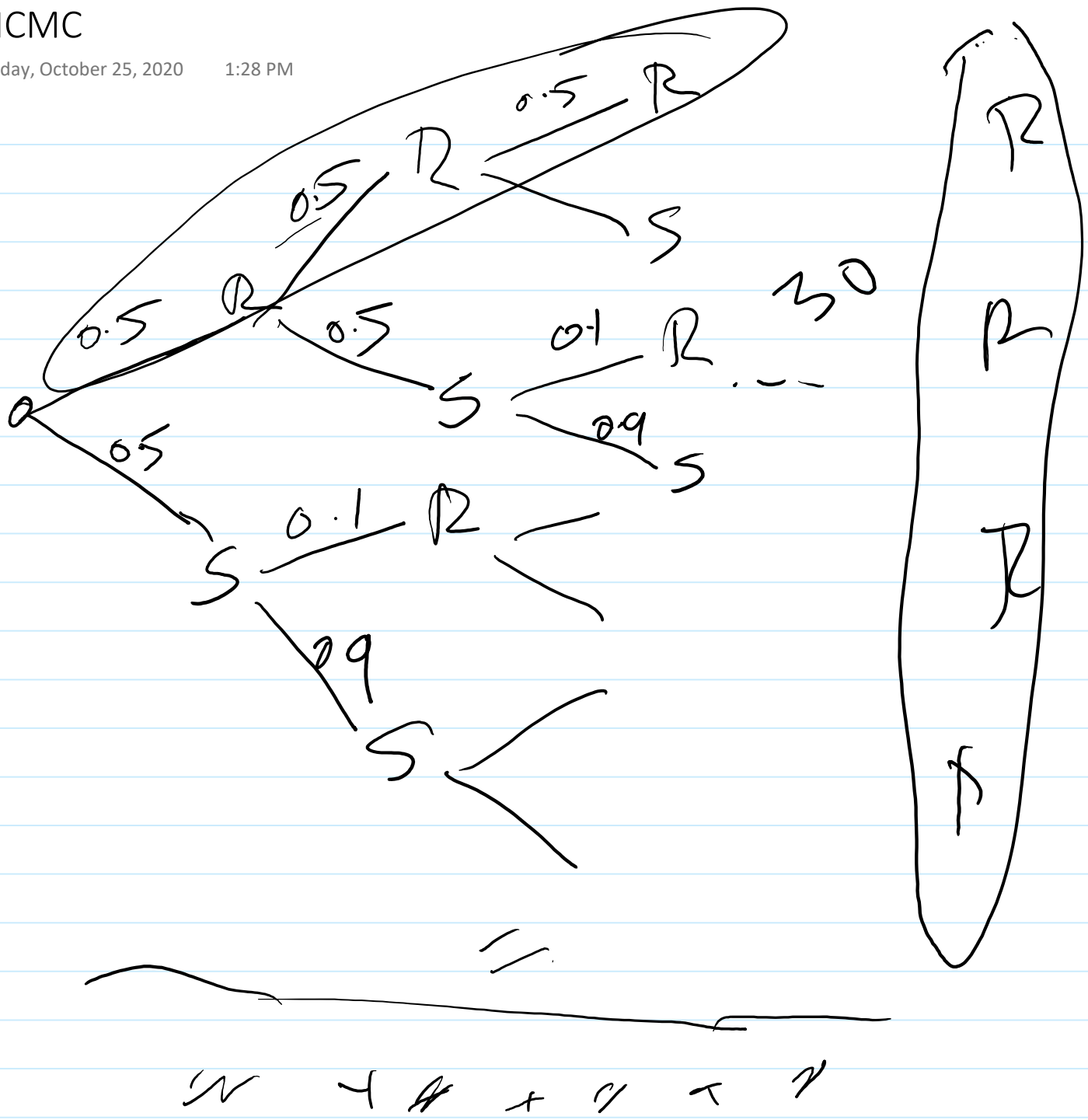

Monte Carlo

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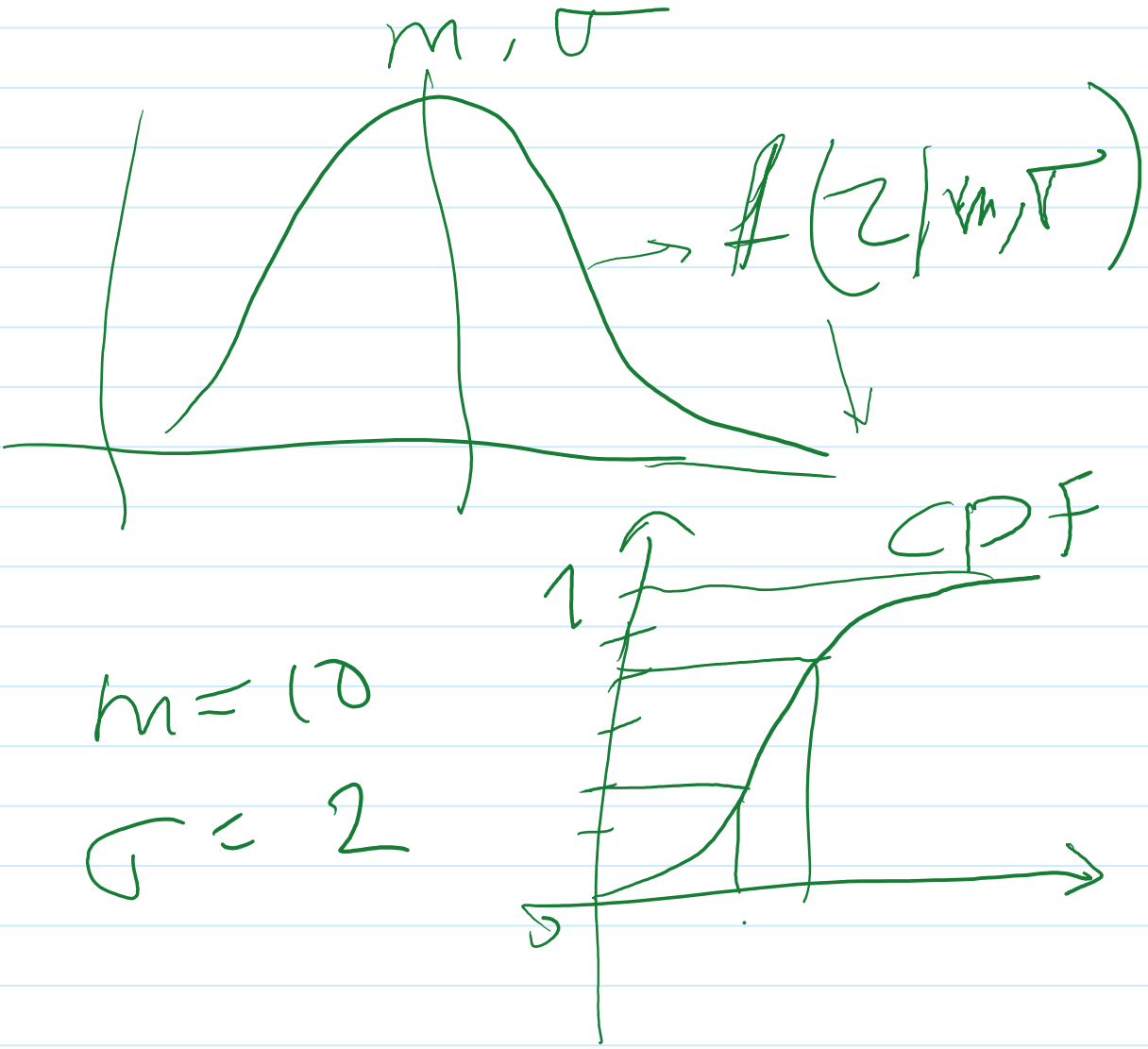

Bayes' theorem

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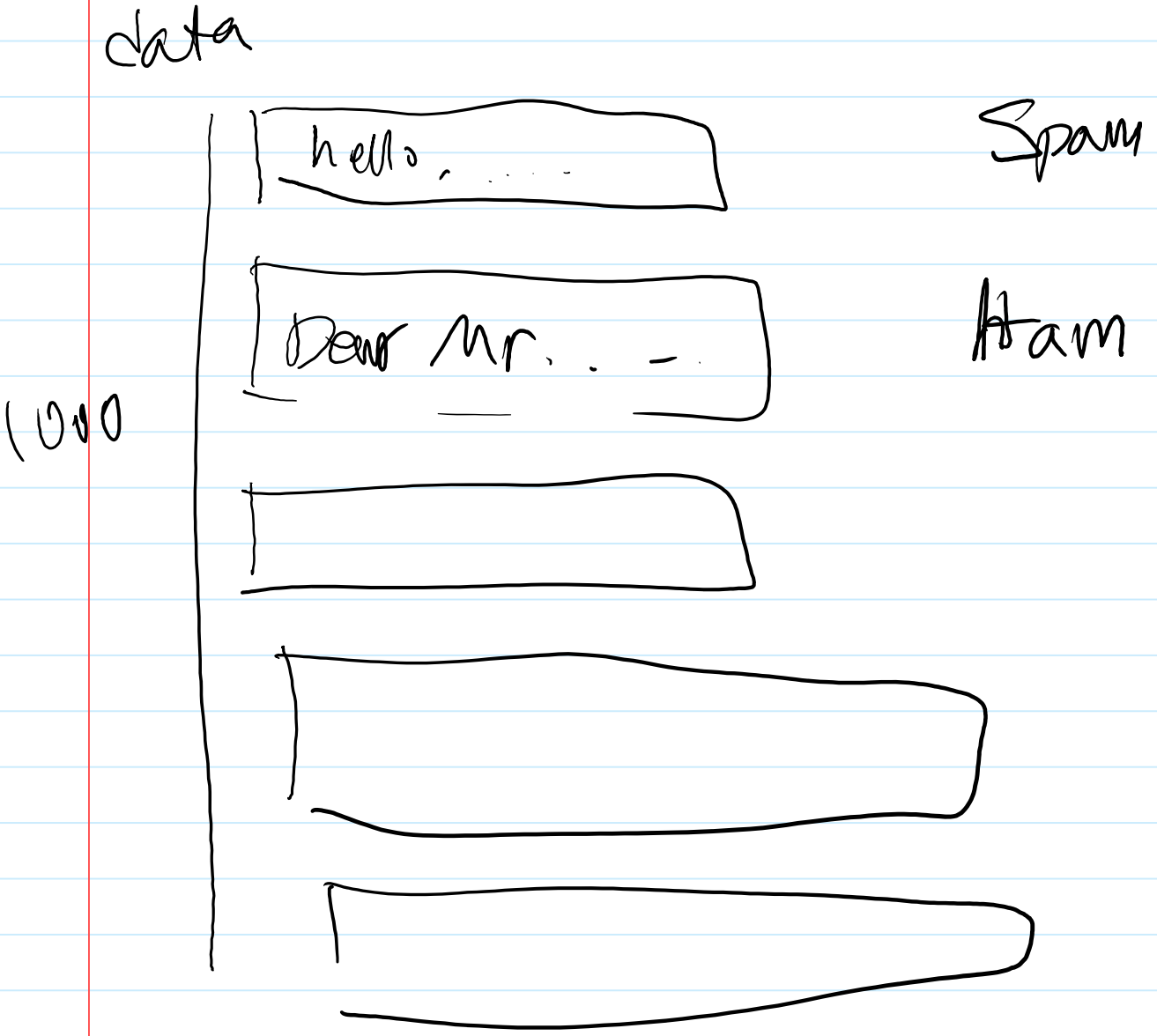

$$P(A/B) = P(A) \cdot P(B)$$

Bayes' theorem

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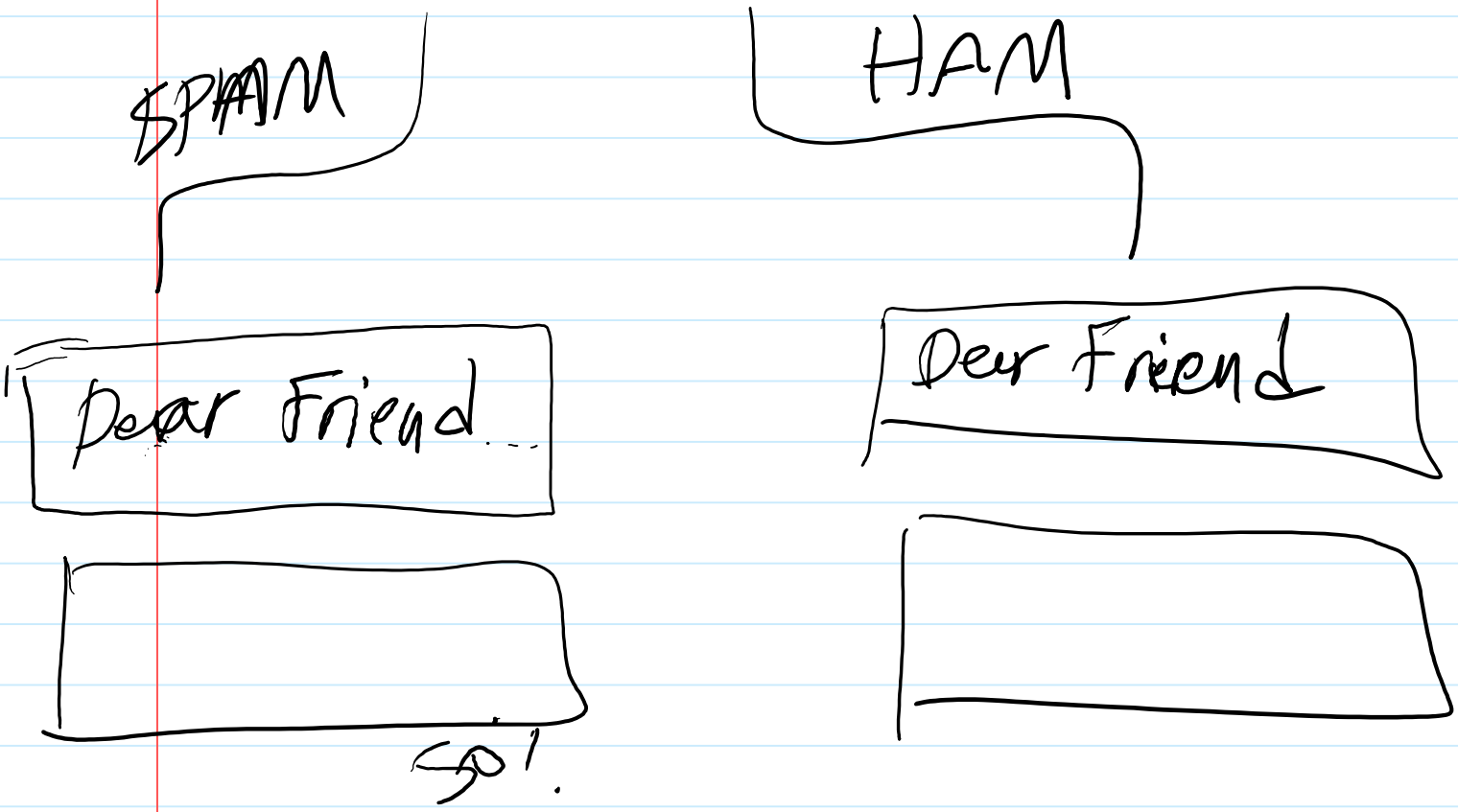

$P(A) = 0.1$

Dear $0.1 \times 0.5 = 0.05$

$P(B|A) = 0.1 \times 0.5 \times 0.7 \times 0.7 \times 0.7 \times$

0.5 $0.9 \times 0.01 \times 0.01 \times 0.01) =$