

Errors in Heuristics

Bayes' Theorem

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

A = Event A

B = Event B

P(A) = probability of event A

P(B) = probability of event B

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

↑
"given"



B = snowing

A = going outside

P(A|B)

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

$$P(A \cap B) = \frac{50}{365} = \frac{1}{8}$$

$$P(B) = \frac{100}{365} = \frac{1}{4}$$

$$P(A|B) = \frac{\frac{1}{8}}{\frac{1}{4}} = \frac{1}{2}$$

\cap = and

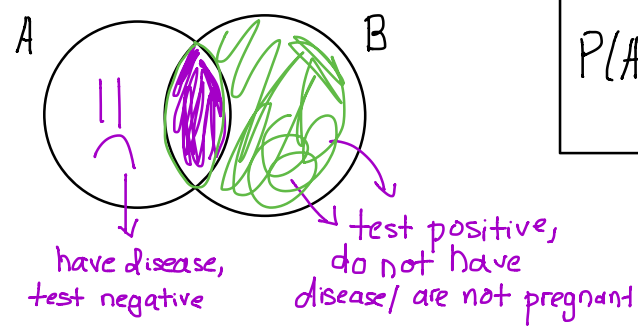
\cup = or

| = given

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

\downarrow = "bar"
 \downarrow = opposite of

A = have disease
 B = test positive
 $P(\bar{A}) = 1 - P(A) = 0.9 = 90\%$



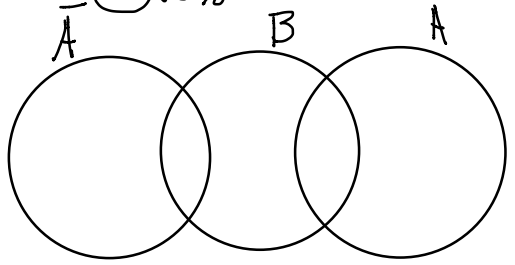
$$P(A|B) = \frac{0.98(0.1)}{0.98(0.1) + (0.25)(0.9)}$$

$$= \frac{0.98 \times 0.1}{0.98 \times 0.1 + 0.25 \times 0.9}$$

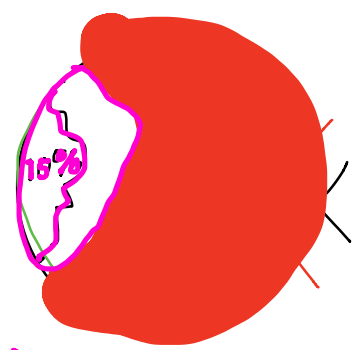
$$= 0.303$$

$$= \boxed{30.3\%}$$

$P(A) = 10\% = 0.1$
 $P(B|A) = 98\% = 0.98$ (↑ 100%)
 $P(B|\bar{A}) = 25\% = 0.25$ (↓ 0%)



$P(A|B) = ?$
 $P(\text{have disease} | \text{test positive}) = ?$



$P(A) = 75\% = 0.75$

$$P(A|B) = \frac{0.98(0.75)}{0.98(0.75) + (0.25)(0.25)}$$

$$= 0.922$$

$$= \boxed{92.2\%}$$

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

$$\hookrightarrow P(\bar{A}) = 1 - P(A)$$

B = ask for video game

A = do homework

$$P(A) = 50\% = 0.5$$

$$P(B|A) = 0.75$$

$$P(B|\bar{A}) = 0.5$$

$$P(A|B) = 0.6 = 60\%$$