

UNIVERSITY *of* WASHINGTON

Data Science UW

Methods for Data Analysis

Conditional Probability
Lecture 4
Steve Elston

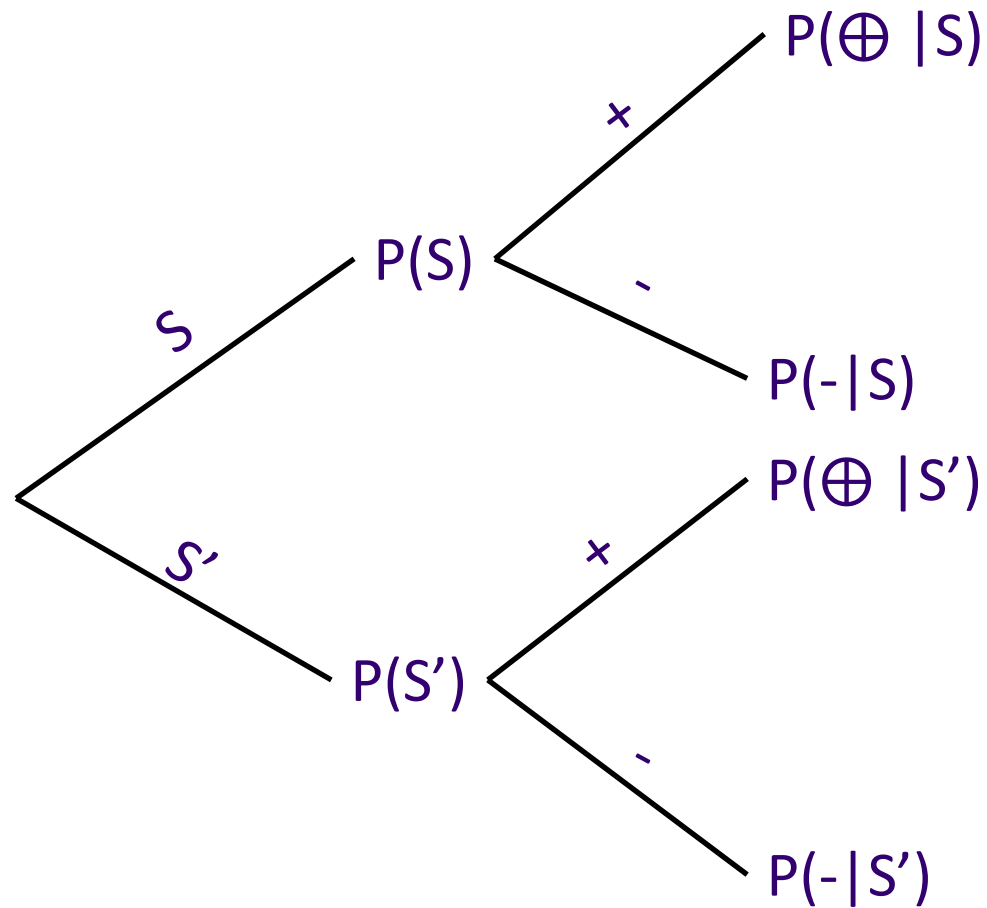


Conditional Probability Trees

- > Let's consider a test for a Sickle Cell Anemia.
- > Events:
 - S = patient has Sickle Cell Anemia
 - S' = patient does not have Sickle Cell Anemia
 - \oplus = patient tests positive
 - $-$ = patient tests negative
- > Rate in US = $1/3200$. $P(S) = 1/3200 = 0.0003125$.
- > Medical company tells us that a test is 99% accurate.
 - $P(\oplus | S) = 0.99$
 - $P(- | S') = 0.99$

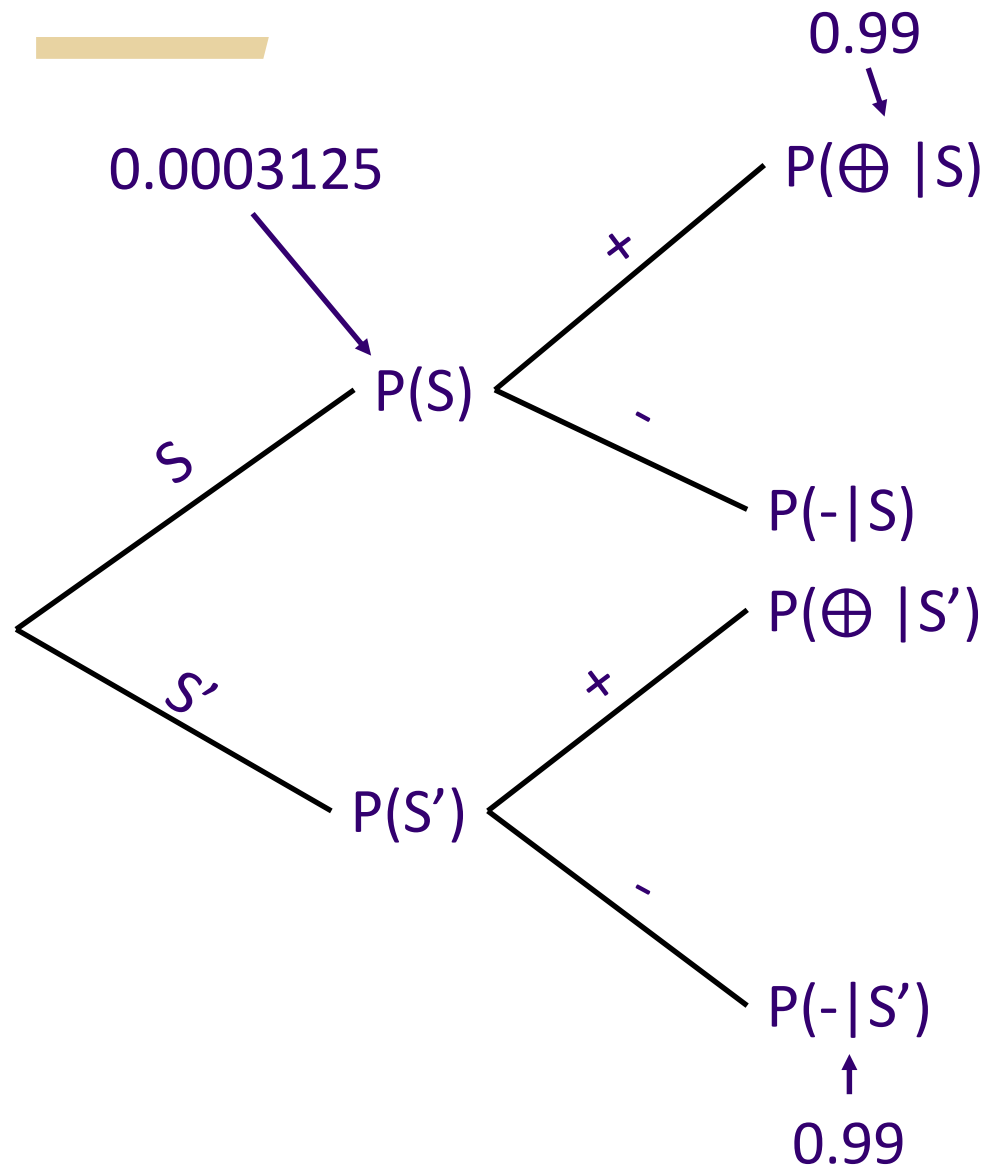


Conditional Probability Trees



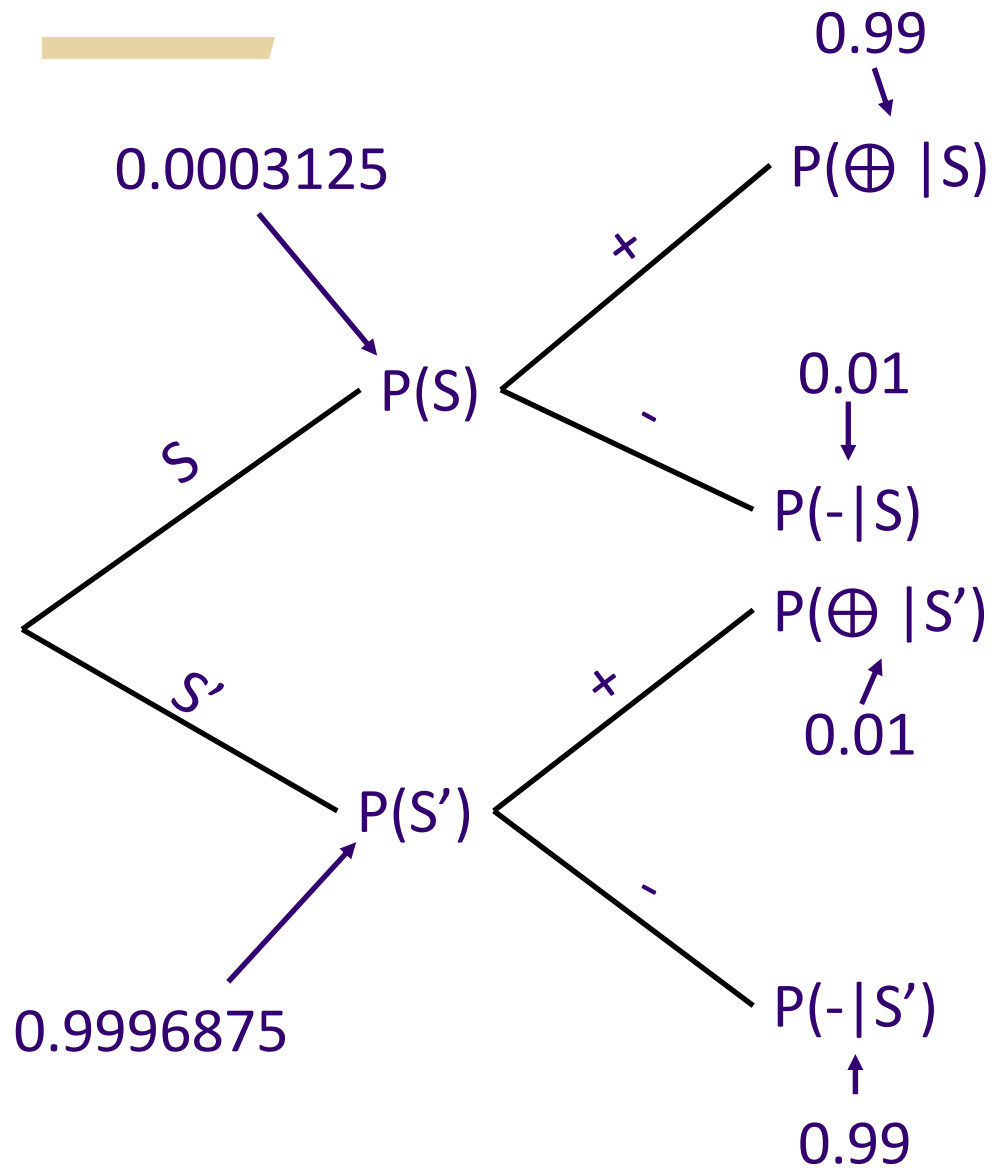
W

Conditional Probability Trees



W

Conditional Probability Trees



W

Conditional Probability Trees

- > What we really want to know is:
 - What is the $P(S|\oplus)$?
 - Also important to know: $P(S| -)$?
- > From conditional probability definition:

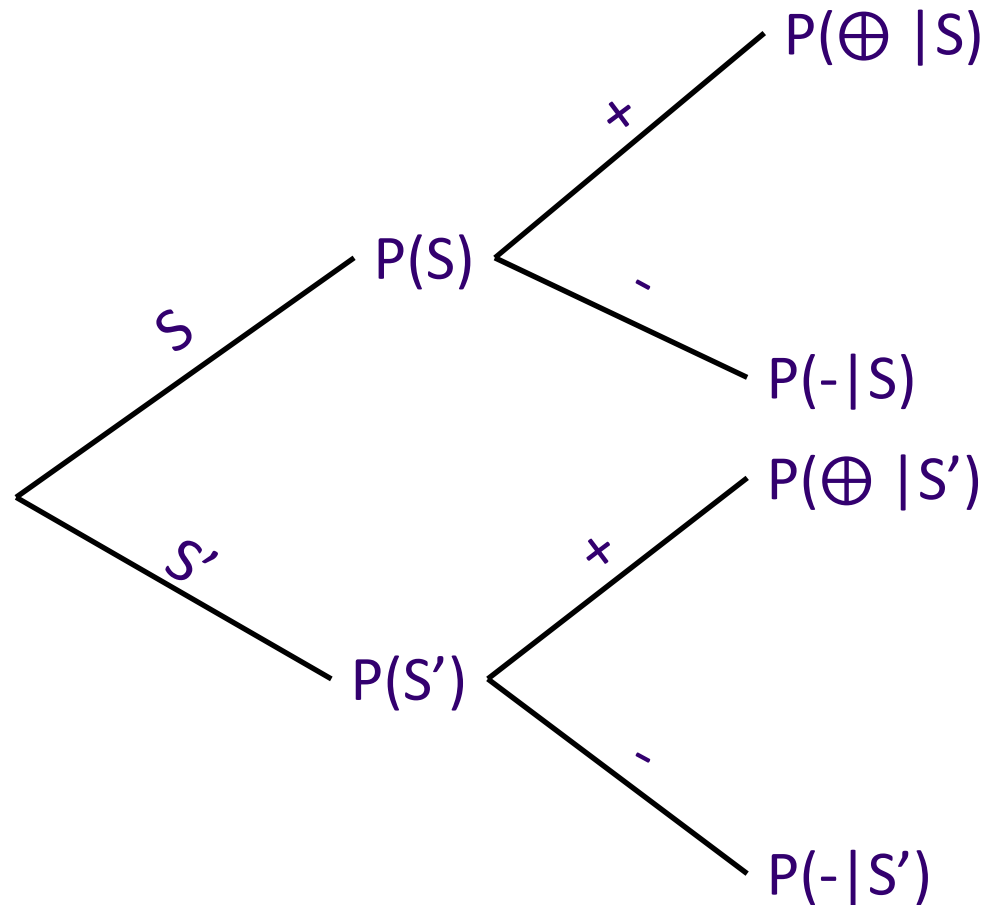
$$P(S|\oplus) = \frac{P(S \cap \oplus)}{P(\oplus)}$$

- > We also know that

$$P(\oplus) = P(\oplus \cap S) + P(\oplus \cap S')$$



Conditional Probability Trees



$$P(\oplus \cap S) = P(S)P(\oplus | S)$$

$$0.0003125 * 0.99 = 0.000309375$$

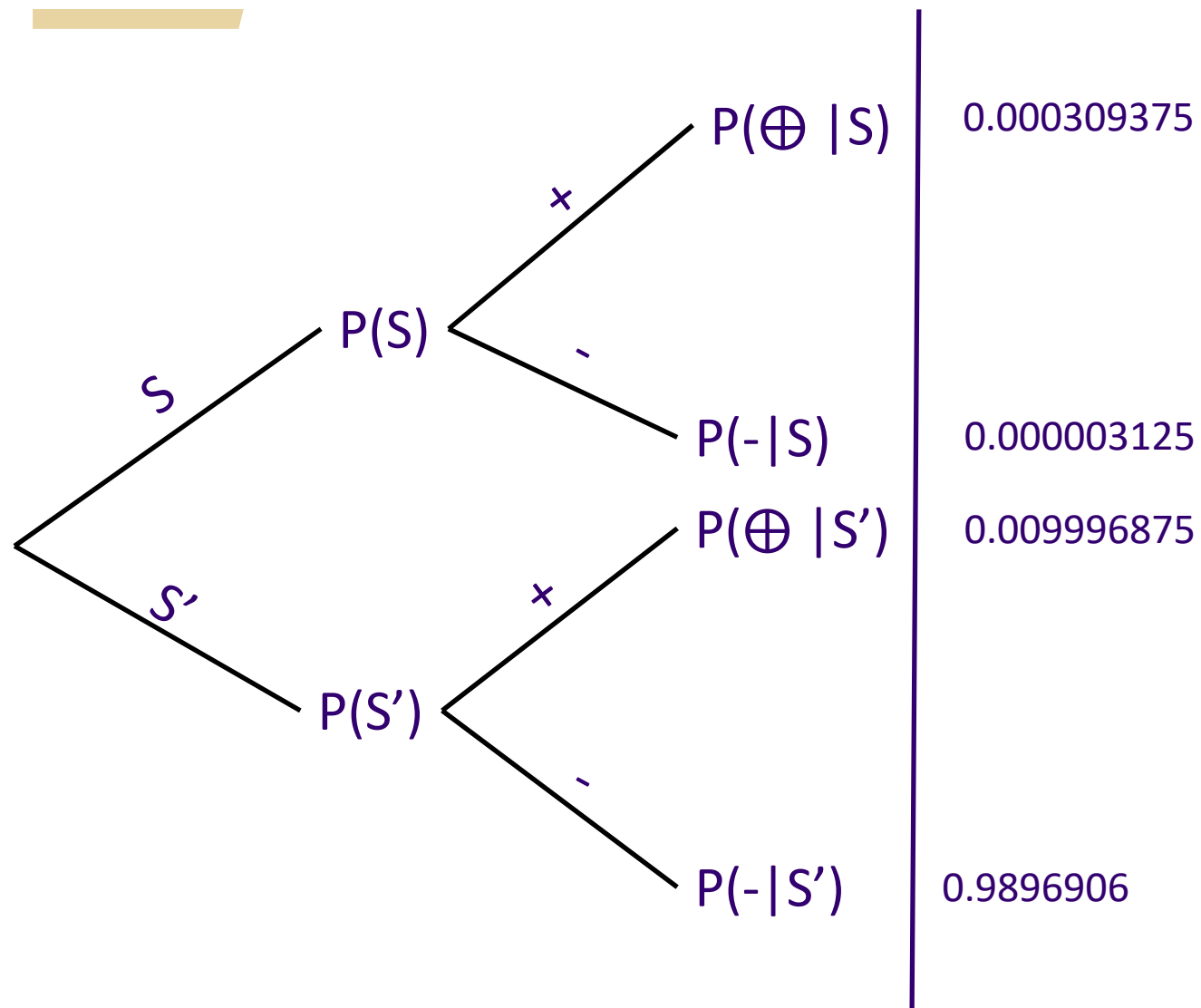
$$P(- \cap S) = P(S)P(- | S)$$

$$P(\oplus \cap S') = P(S')P(\oplus | S')$$

$$P(- \cap S') = P(S')P(- | S')$$

W

Conditional Probability Trees



W

Conditional Probability Trees

$$P(\oplus) = P(\oplus \cap S) + P(\oplus \cap S')$$

$$P(\oplus) = 0.01030625$$

$$P(S|\oplus) = \frac{P(S \cap \oplus)}{P(\oplus)}$$

$$P(S|\oplus) = \frac{0.000309375}{0.01030625}$$

$$P(S|\oplus) = 0.03001819$$

Similarly,

$$P(S|-) = 0.000003157543$$

$$0.000309375 = P(\oplus \cap S)$$

$$0.000003125 = P(- \cap S)$$

$$0.009996875 = P(\oplus \cap S')$$

$$0.9896906 = P(- \cap S')$$

W

*Now see the probability interview question