BAYES THEOREM

Disease → 10% popⁿ

Covid → Home ← RTPCR

Positive → Affected

Positive → Not affected

Negative → Not affected

Negative → Affected

Diseases → +ve 80%

Diseases → −ve 20%

No Disease → +ve

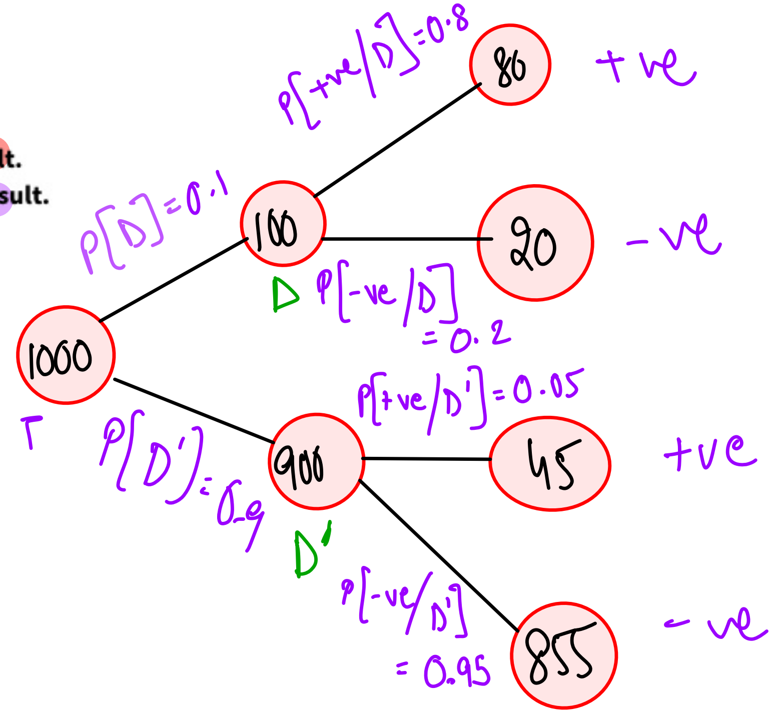
No Disease → −ve

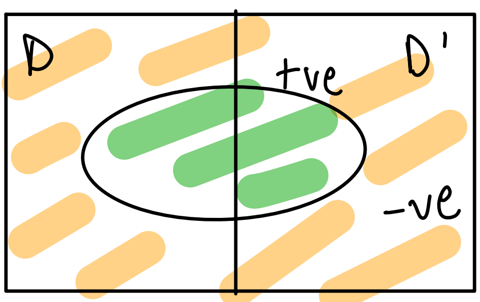
Quiz Ended!

1. A disease affects 10% of the population.
Among those who have the disease, 80% get “positive” test result.
Among those who don’t have the disease, 5% get “positive” test result.
What is P(+ve | Disease)

11 users have participated

A	0.05	64%
B	0.1	0%
C ✓	0.8	36%
D	0.9	0%





Quiz time!

Quiz Ended!

2. A disease affects 10% of the population.
Among those who have the disease, 80% get "positive" test result
Among those who don't have the disease, 5% get "positive" test result.
Overall, what percentage of people tested "positive"?

46 users have participated

A	90	2%
B	80	11%
C	64	4%
D	12.5	83%

$\left.\begin{matrix} \\ \\ \\ \end{matrix}\right\} 17$ ✓

$$P[+ve] = \frac{80+45}{1000} = \frac{125}{1000}$$

$$= 12.5$$

Quiz time!

Quiz Ended!

3. A disease affects 10% of the population.
Among those who have the disease, 80% get "positive" test result.
Among those who don't have the disease, 5% get "positive" test result.
What is P(+ve ∩ Disease)?

49 users have participated

A	0.8	22%	✗
B	0.64	18%	✗
C	0.1	12%	✗
D	0.08	47%	✓

$$P[+ve \cap D] = P[+ve/D] \cdot P[D]$$
$$= 0.1 \times 0.8$$
$$= \underline{0.08}$$

$$P[+ve \cap D'] = P[+ve/D'] \cdot P[D']$$
$$= 0.05 \times 0.9$$
$$= 0.045$$

Suspose you are tested positive.

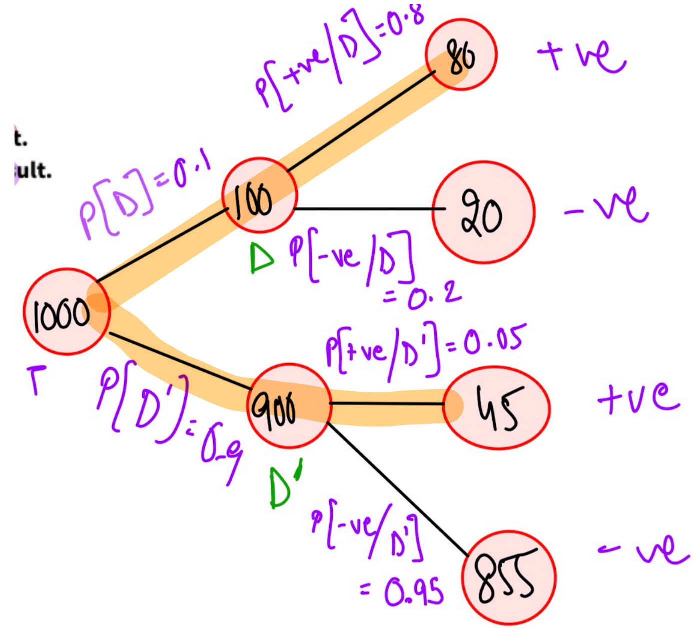
What is the prob that you have the disease?

A) $P[D]$

B) $P[+ve \mid D]$

C) $P[D \mid +ve]$ ✓

D) $P[D \cap +ve]$



$$P[D / +ve]$$

If you are tested positive ,then you belong to (80 + 45) people.
Among these people . How many do actually have the disease?

$$P[D / +ve] = \frac{80}{80+45} = \frac{80}{125} = 0.64$$

$$P[B/A] = \frac{P[A/B] \cdot P[B]}{P[A]}$$

$$P[D/+ve] = \frac{P[+ve/D] \cdot P[D]}{P[+ve]}$$

$$P[+ve] = P[+ve \cap D] + P[+ve \cap D']$$

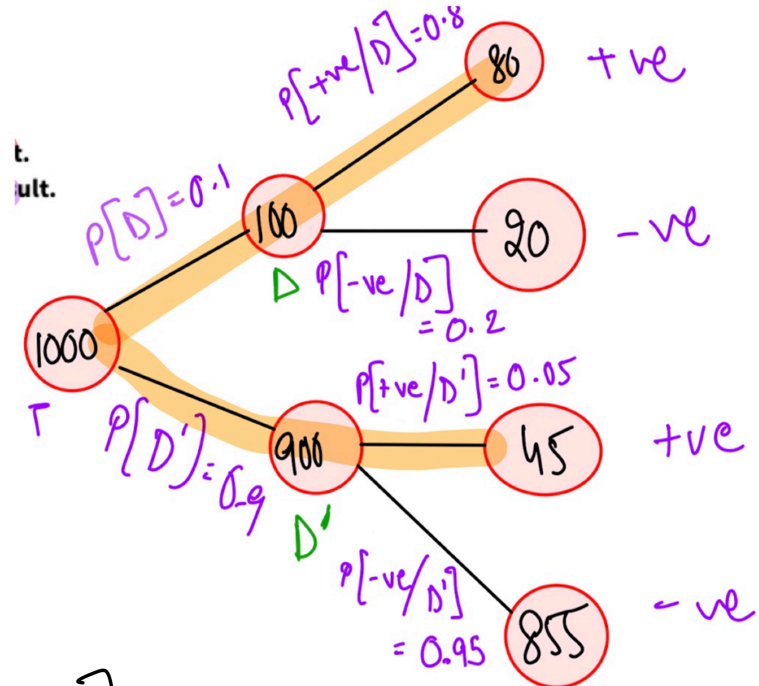
$$= P[+ve/D] \cdot P[D] + P[+ve/D'] \cdot P[D']$$

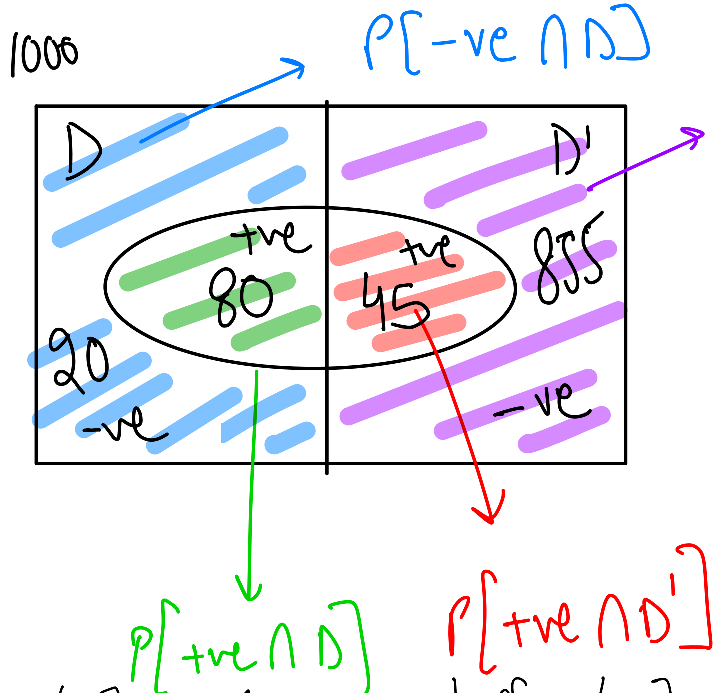
$$P[D/+ve] = \frac{P[+ve/D] \cdot P[D]}{P[+ve/D] \cdot P[D] + P[+ve/D'] \cdot P[D']}$$

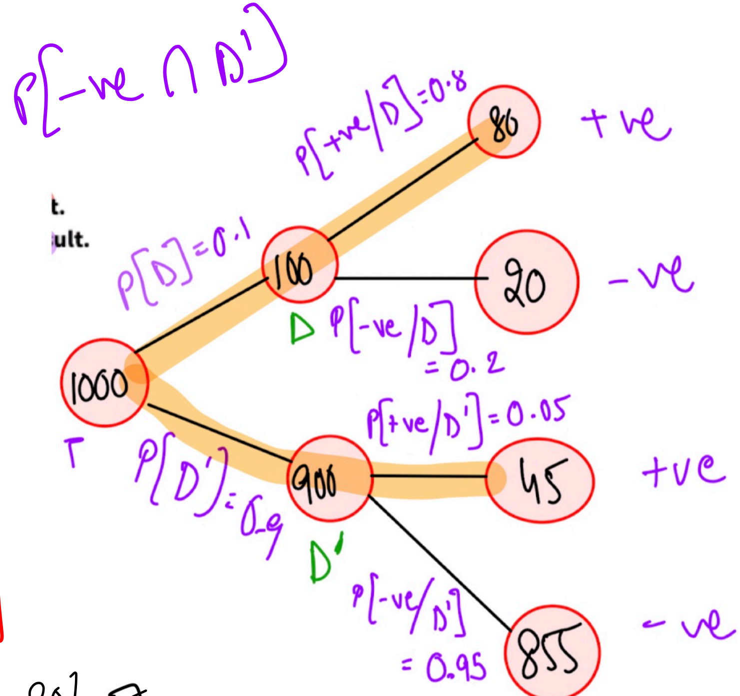
$$P[D' \mid +ve] = \frac{45}{80 + 45}$$

$$= \frac{P[+ve/D'] \cdot P[D']}{P[+ve/D] \cdot P[D] + P[+ve/D'] \cdot P[D']}$$

$$P[D'/+ve] = \frac{P[+ve \cap D']}{P[+ve \cap D] + P[+ve \cap D']}$$







$P[+ve/D] = 80/100 = 0.8$

$P[+ve/D'] = 45/900 = 0.05$

$P[-ve/D] = 20/100$

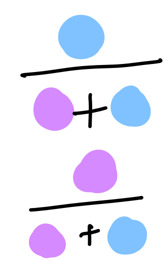
$P[-ve/D'] = 855/900$

$P[D/+ve] = 80/125$

$P[D'/+ve] = 45/125$

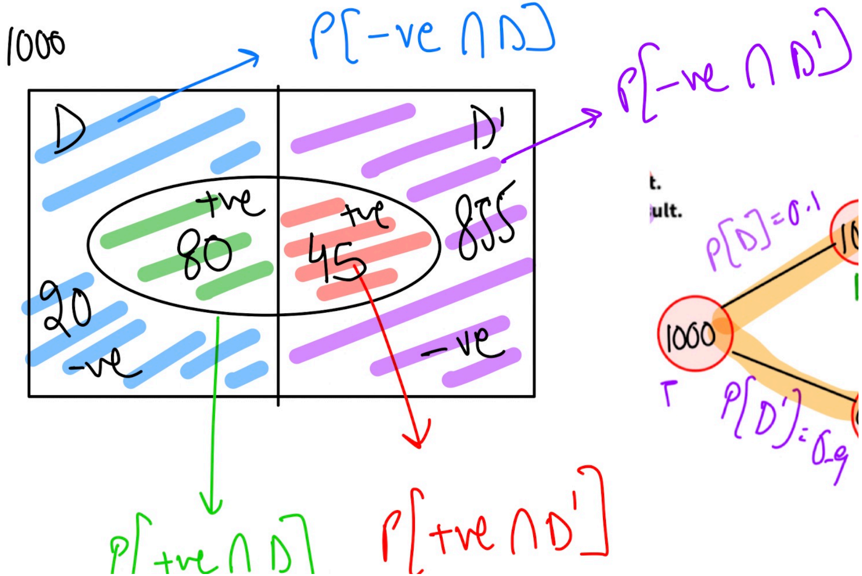
$P[D/-ve] = 20/875$

$P[D'/-ve] = 855/875$



$= \frac{20}{855+20}$

$\frac{855}{855+20}$



$$P[+ve] = \quad + $$

$$= P[+ve \cap D] + P[+ve \cap D']$$

$$= P[+ve / D] \cdot P[D] + P[+ve/D'] \cdot P[D']$$

$$P[D/+ve] = \frac{P[D \cap +ve]}{P[+ve]}$$

$$\Rightarrow P[A/B] = \frac{P[A \cap B]}{P[B]}$$ Conditional probability

$$P[A \cap B] = P[A/B] \cdot P[B] =$$ Multiplication Rule

$$P[B \cap A] = P[B/A] \cdot P[A]$$

$$P[A/B] \cdot P[B] = P[B/A] \cdot P[A]$$

$$P[B/A] = \frac{P[A/B] \cdot P[B]}{P[A]}$$ Bayes Theorem

Law of Total probability $P[A \cap C'] + P[A \cap C]$

Cohort Starting DSML

$x\%$ SQL $\longrightarrow$ $y\%$ Excel

$z\%$ SQL' $\longrightarrow$ $a\%$ Excel

5. For a new cohort in DSML, we have the following information:

30% of the people know SQL.

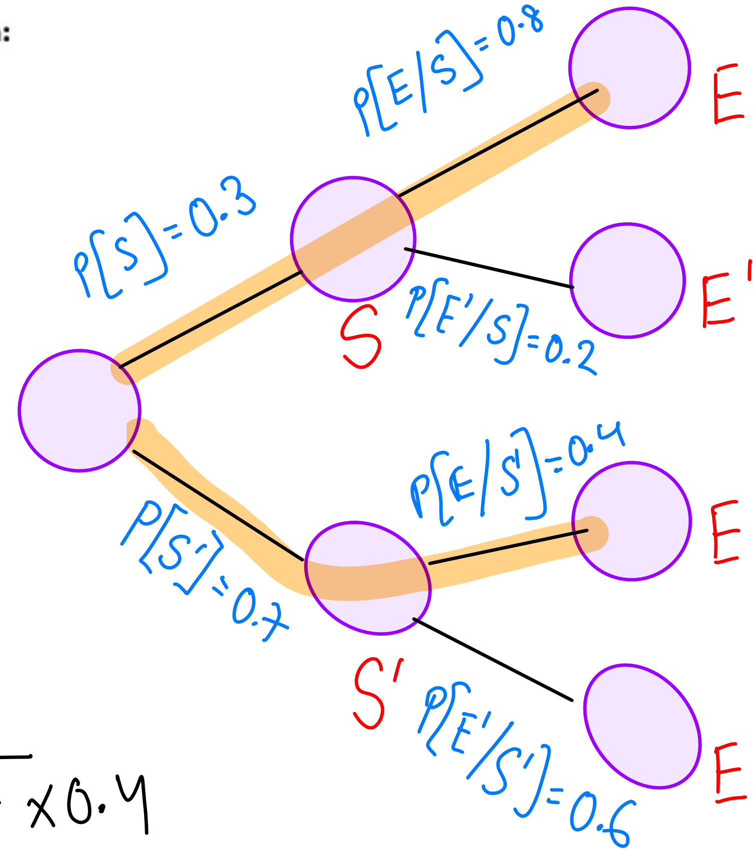
80% of the people who know SQL also know Excel.

40% of the people who do not know SQL, also know Excel.

Among those who know Excel, what percentage know SQL?

22 users have participated

✓	A	0.46	59%
	B	0.28	23%
	C	0.24	18%
	D	0.4	0%

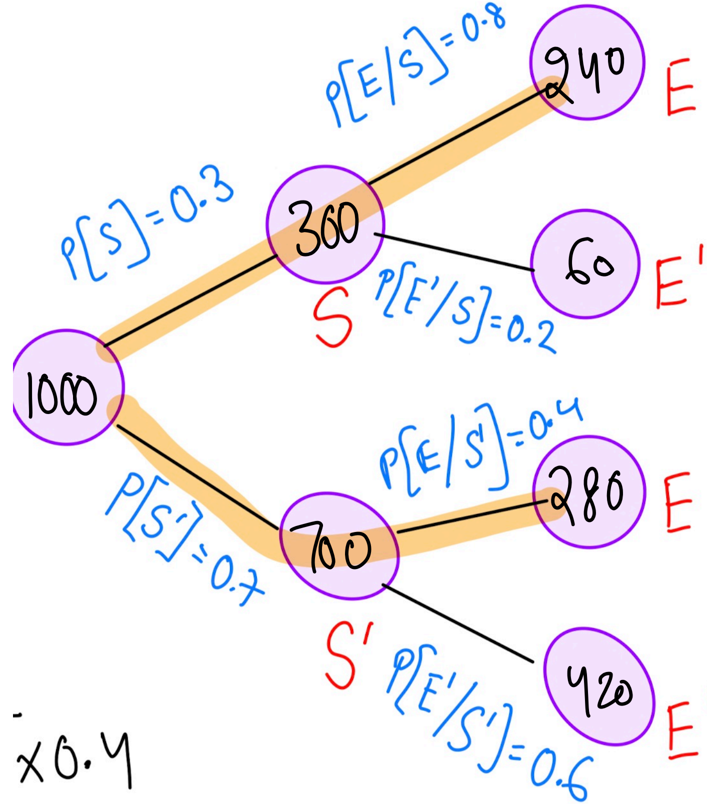


$$P[S/E] = \frac{0.3 \times 0.8}{0.3 \times 0.8 + 0.7 \times 0.4}$$

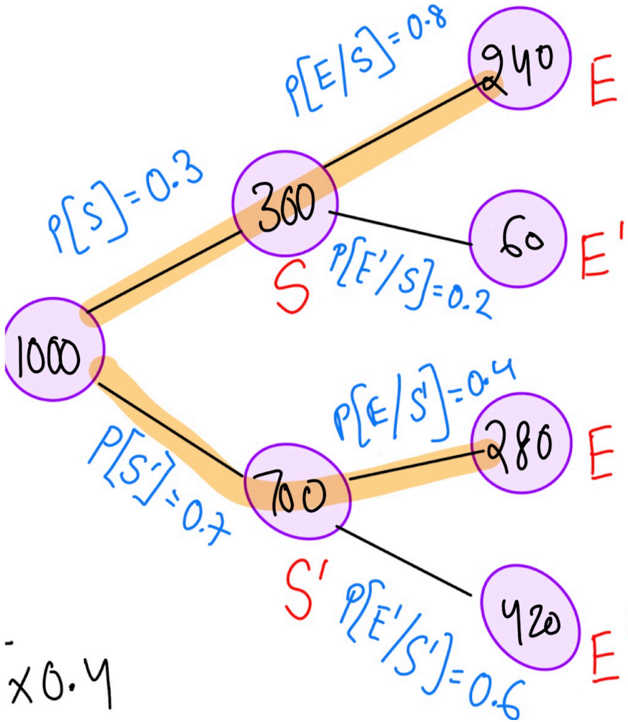
$$= \frac{0.24}{0.24 + 0.28} = \frac{0.24}{0.52} = 46\%$$

$$P[S|E] = \frac{240}{240+280}$$

$$= \frac{24\cancel{0}}{52\cancel{0}} = \underline{\underline{0.46}}$$



$\times 0.4$



$\times 0.4$

$$P[S|E] = \frac{P[E/S] \cdot P[S]}{P[E]}$$

$$P[S|E] = \frac{P[E/S] \cdot P[S]}{P[E/S] \cdot P[S] + P[E/S'] \cdot P[S']}$$

$$= \frac{0.8 \times 0.3}{0.8 \times 0.3 + 0.4 \times 0.7}$$

$$P[E] = P[E \cap S] + P[E \cap S']$$
$$= P[E/S] \cdot P[S] + P[E/S'] \cdot P[S']$$

In a university, 30% of the faculty members are Female. Of the Female faculty members, 60% have PhD. Of the Male faculty members, 40% have PhD. What is the Probability that

(a) randomly chosen faculty member is Female and has a PhD? $P[F \cap Phd]$
(b) randomly chosen faculty member is Male and has a PhD?
(c) randomly chosen faculty member has a PhD?
(d) randomly chosen PhD holder is Female?

$P[F] = 0.3$ $\quad P[Phd/F] = 0.6$

$P[M] = 0.7$ $\quad P[Phd/M] = 0.4$

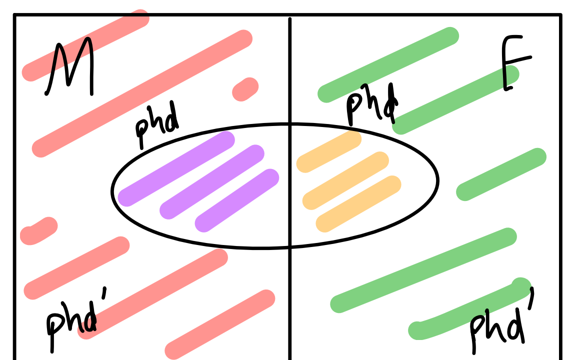
$P[Phd \cap F] = P[Phd/F] . P[F] = 0.6 \times 0.3 = 0.18$

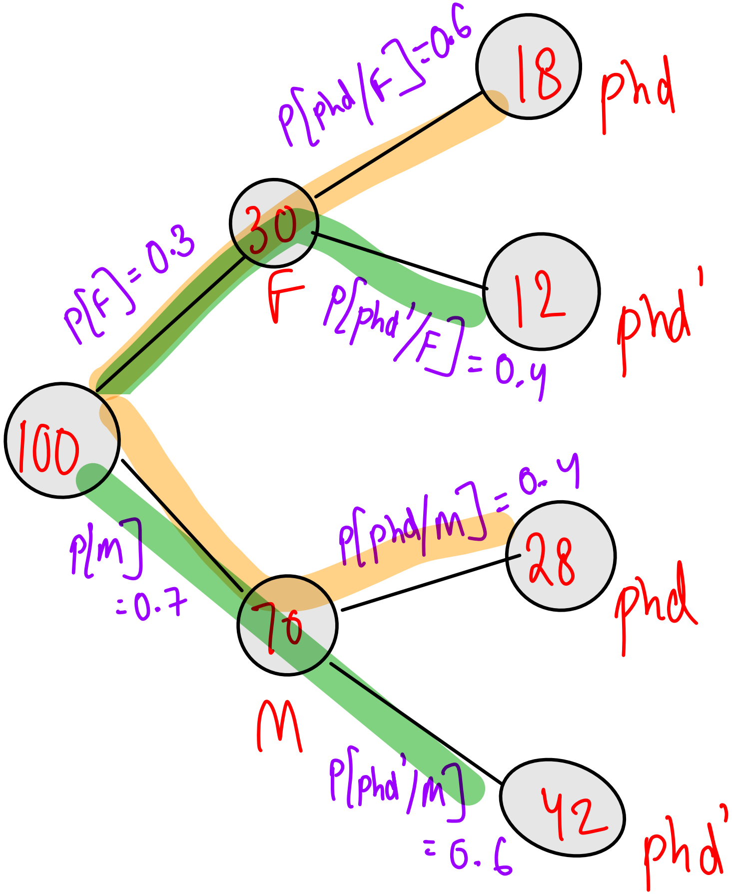
$P[Phd \cap M] = P[Phd/M] . P[M] = 0.4 \times 0.7 = 0.28$

$$P[Phd] = P[Phd \cap M] + P[Phd \cap F] = 0.18 + 0.28 = 0.46$$

$$P[F/Phd] = \frac{P[F \cap Phd]}{P[Phd]} = \frac{0.18}{0.46}$$

$$P[M/Phd] = \frac{P[M \cap Phd]}{P(Phd]} = \frac{0.28}{0.46}$$





$$P[F/phd] = \frac{18}{18+28}$$

$$P[M/phd] = \frac{28}{18+28}$$

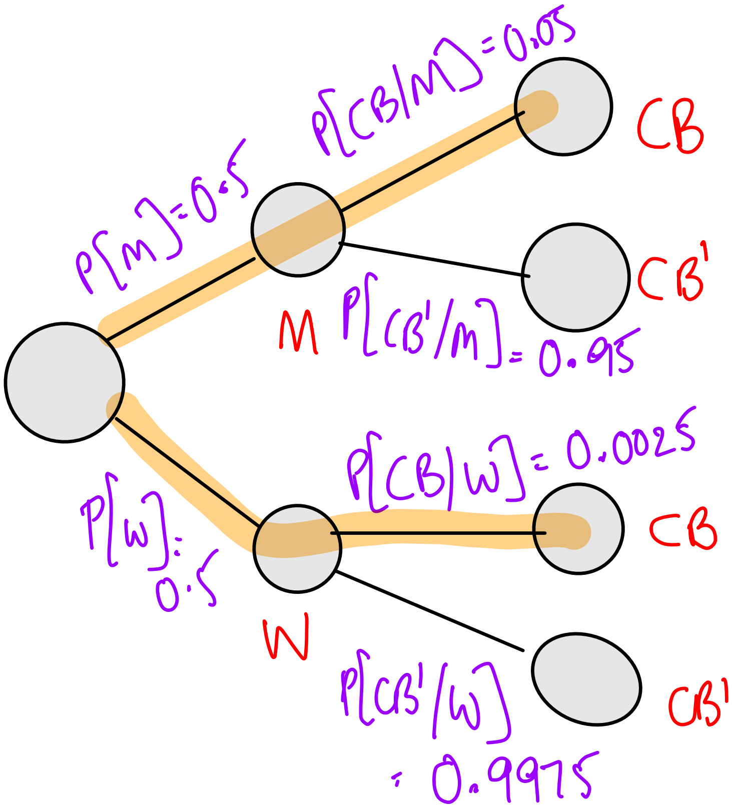
$$P[F/phd'] = \frac{12}{12+42}$$

$$P[M/phd'] = \frac{42}{12+42}$$

$$P[phd] = P[phd/F] \cdot P[F] + P[phd/M] \cdot P[M]$$

$$P[phd'] = P[phd'/F] \cdot P[F] + P[phd'/M] \cdot P[M]$$

Suppose 5 % Men and 0.25% Women are color blind. A randomly colour blind person is chosen. What is the prob that this person is a male? Assume same number of males and females.



$$P[M/CB] = \frac{P[CB|M]\,.\,P[M]}{P[CB|M]\,.\,P[M] + P[W]P[CB|W]}$$

$$= \frac{0.05 \times 0.5}{0.05 \times 0.5 + 0.5 \times 0.0025}$$

$$= \frac{0.05}{0.05 + 0.0025} = \frac{500}{525}$$

$$= \frac{\cancel{0.0}500}{\cancel{0.0}525} = \underline{\underline{95.23}}$$