Know if the weather is play

sunny + hot $\overset{?}{\Longrightarrow}$ Yes / No

Day	Outlook	Temperature	PlayTennis
Day1	Sunny	Hot	No
Day2	Sunny	Hot	No
Day3	Overcast	Hot	Yes
Day4	Rain	Mild	Yes
Day5	Rain	Cool	Yes
Day6	Rain	Cool	No
Day7	Overcast	Cool	Yes
Day8	Sunny	Mild	No
Day9	Sunny	Cool	Yes
Day10	Rain	Mild	Yes
Day11	Sunny	Mild	Yes
Day12	Overcast	Mild	Yes
Day13	Overcast	Hot	Yes
Day14	Rain	Mild	No

P(Yes | sunny and hot) = ?

P(No | sunny and hot) = ?

outlook

	Yes	No	
sunny	2	3	5
overcast	4	0	4
raining	3	2	5
	9	5	14

Temp

	Yes	No	
Hot	2	2	4
Mild	4	2	6
Cool	3	1	4
	9	5	14

$$P(\text{Yes} \mid \text{hot}, \text{sunny}) = \frac{P(\text{sunny} \mid \text{Yes})\, P(\text{hot} \mid \text{Yes}) \cdot P(\text{Yes})}{P(\text{hot}, \text{sunny})}$$

$$= \frac{2/9 * 2/9 \cdot 9/14}{}$$

$$P(\text{hot}, \text{sunny}) = \text{today}$$

$$P(\text{No} \mid \text{hot}, \text{sunny}) = \frac{P(\text{sunny} \mid \text{No}) \cdot P(\text{hot} \mid \text{No}) \cdot P(\text{No})}{P(\text{hot}, \text{sunny})}$$

$$= \frac{3/5 * 2/5 \quad 5/14}{\text{today}}$$

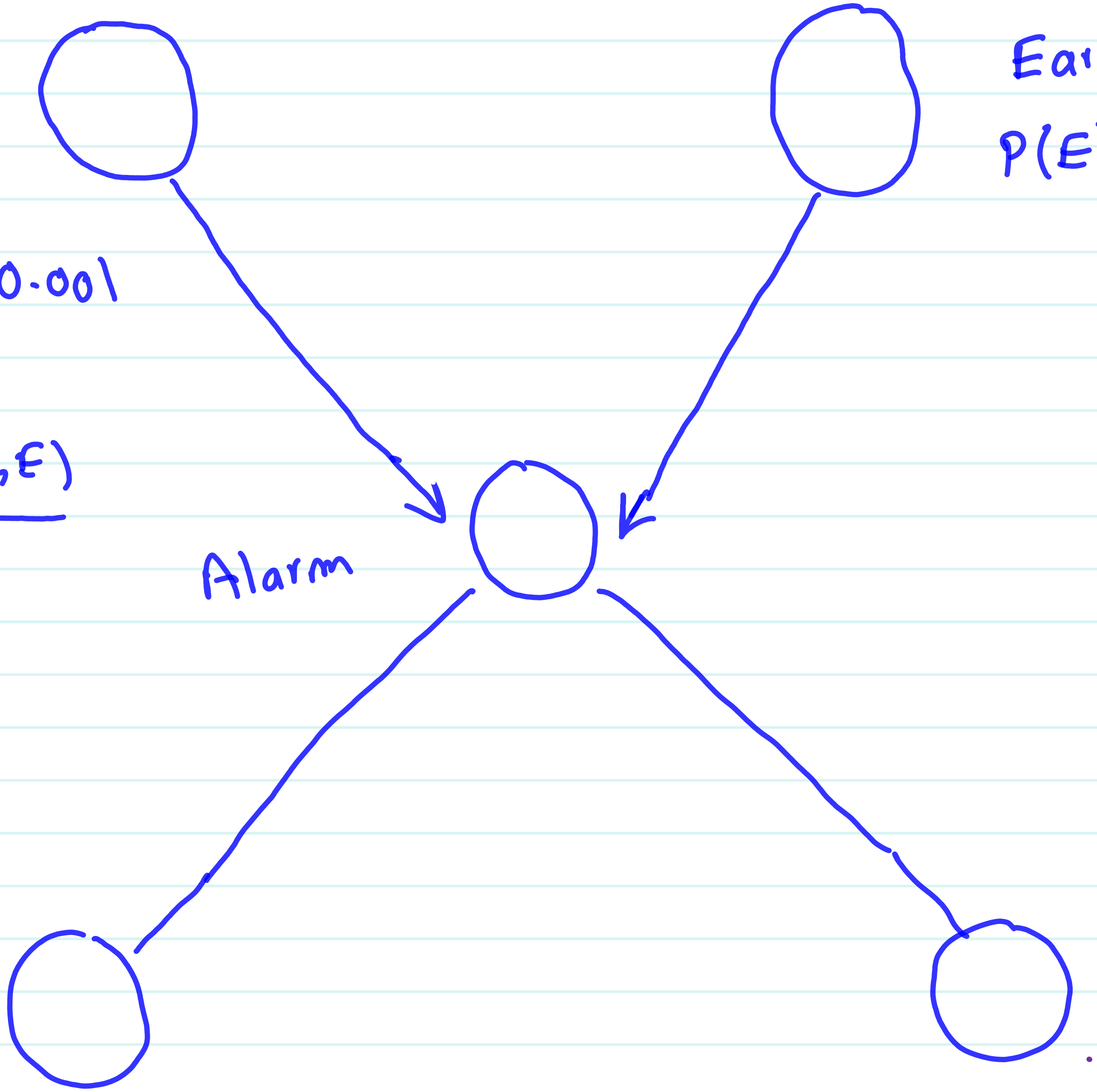
$$P(\text{Yes} \mid \text{today}) = \frac{0.031}{0.031 + 0.8571} = 26\%$$

$$P(\text{No} \mid \text{today}) = \frac{0.08571}{0.031 + 0.0571} = 73\%$$

Play Yes X

$\boxed{\text{NO}}$

Ex. Baysian Network



$P(B) = 0.001$

$P(E) = 0.002$

B	E	$P(A \mid B,E)$
T	T	0.95
T	F	0.94
F	T	.29
F	F	0.001

$P(B, m)$

A	$P(J \mid A)$
T	0.9
F	0.05

A	$P(M \mid A)$
T	0.7
F	0 01

Suppose Mary has called to tell the alarm is on.

Should you call 911?

$$P(B \mid \text{Mary}) > P(\bar{B} \mid \text{Mary}) \rightarrow$$

$\boxed{\text{Step 1}}$ Find the joint probability $P(B, M)$

$$P(B \mid M) = \frac{P(B, M)}{P(M)} =$$

$$P(B, E, A, M) = P(M \mid A) \cdot P(A \mid B, E) \cdot P(B) \cdot P(E)$$

$$P(\bar{B}, \bar{E}, \bar{A}, \bar{M}) = P(\bar{M} \mid \bar{A}) \cdot P(\bar{A} \mid \bar{B}, \bar{E}) \cdot P(\bar{B}) \cdot P(\bar{E})$$

$$= (1 - .01)(1 - 0.001)(1 - .001)(1 - .002) = .9860$$

$P(B, E, A, E)$	$\bar{M}, \bar{A}$	$\bar{M}, A$	$M, \bar{A}$	M, A
$\bar{B}, \bar{E}$	09860			
$\bar{B}, E$				
$B, \bar{E}$				
B, E				

$P(B,E,A,M)$	$\bar{M}, \bar{A}$	$\bar{M}, A$	$M, \bar{A}$	M, A
$\bar{B}, \bar{E}$	0.9860	2.99×10^{-4}	9.96×10^{-3}	6.9×10^{-4}
$\bar{B}, E$	1.4×10^{-3} #2	1.7×10^{-4}	1.4×10^{-5}	4.06×10^{-4}
$B, \bar{E}$	5.93×10^{-5}	2.81×10^{-4}	5.99×10^{-7}	6.57×10^{-4}
B, E	9.9×10^{-8}	5.7×10^{-7}	10^{-9} #1	1.3×10^{-6}

$\boxed{\text{Step 2}}$: Marginalize (add) to get rid of variables that you don't care

$$P(B,M) = \sum_{e \in \{F,T\}} \sum_{a \in \{F,T\}} P(B, E=e, A=a, M) \quad \#1$$

$P(\bar{B}, \bar{M}) = \# 2$

$P(B,M)$	$\cancel{\bar{M}}$	M
$\bar{B}$	$\cancel{0.987}$	0.011
B	$\cancel{0.00034}$	0.000658

$\boxed{\text{Step 3)}}$ ignore (delete) the unwanted column.

$P(B,M)$	M
$\bar{B}$	$.011$
B	$.000658$

Step 4

$$P(\bar{B}|M) = \frac{P(\bar{B}, M)}{P(M)} = \frac{.011}{0.000658 + .011} = \boxed{94\%}$$

$$P(B|M) = \frac{.000658}{.000658 + .011} = 5\%$$

So should May call police or $\boxed{\text{Not}}$