CS440 : Introduction to Artificial Intelligence **Spring 2014**

In class assignment 2

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1. **What's the probability of a burglary?**

$$P(B) = 0.001$$

2. **Are burglaries or earthquakes more likely?**

$$P(B) = 0.001 < P(E) = 0.002$$

Earthquakes are more likely.

3. **What's the probability of the alarm sounding when there is an earthquake but no burglary?**

$$P(A|\neg b) = 0.29$$

4. **What's the probability of the alarm sounding given that John had called?**

$p(A|J = true) = \ ?$

$P(\neg a) = 1 - P(a) \rightarrow P(a)$ determines the full distribution.

Baye's Theorem:

$$P(A|J) = \frac{P(J|A)P(A)}{P(J)}$$

Marginalize over B and E:

$$\begin{aligned}
P(A) &= P(A|B, E) = \alpha P(A, B, E) \\
&= \Sigma_{b\in B}\Sigma_{e\in E}P(b)P(e)P(A|b, e) \\
&= \Sigma_{b\in B}P(b)\Sigma_{e\in E}P(e)P(A|b, e) \\
&= P(b)[P(e)P(A|b, e) + P(\neg e)P(A|b, \neg e)] + P(\neg b)[P(e)P(A|\neg b, e) + P(\neg e)P(A|\neg b, \neg e)] \\
&= (0.001)[(0.002)(0.95) + (0.998)(0.95)] + (0.999)[(0.002)(0.29) + (0.998)(0.001)] \\
P(A) &\approx 0.002526422
\end{aligned}$$

Marginalize over A:

$$
\begin{aligned}
P(J) &= P(J|A) = \alpha P(J, A) \\
&= \Sigma_{a \in A} P(a) P(J|a) \\
&= P(a)P(J|a) + P(\neg a)P(J|\neg a) \\
&= (0.002526422)(0.9) + (0.997473578)(0.05) \\
P(J) &\approx 0.0521474587
\end{aligned}
$$