AI – Lab 11

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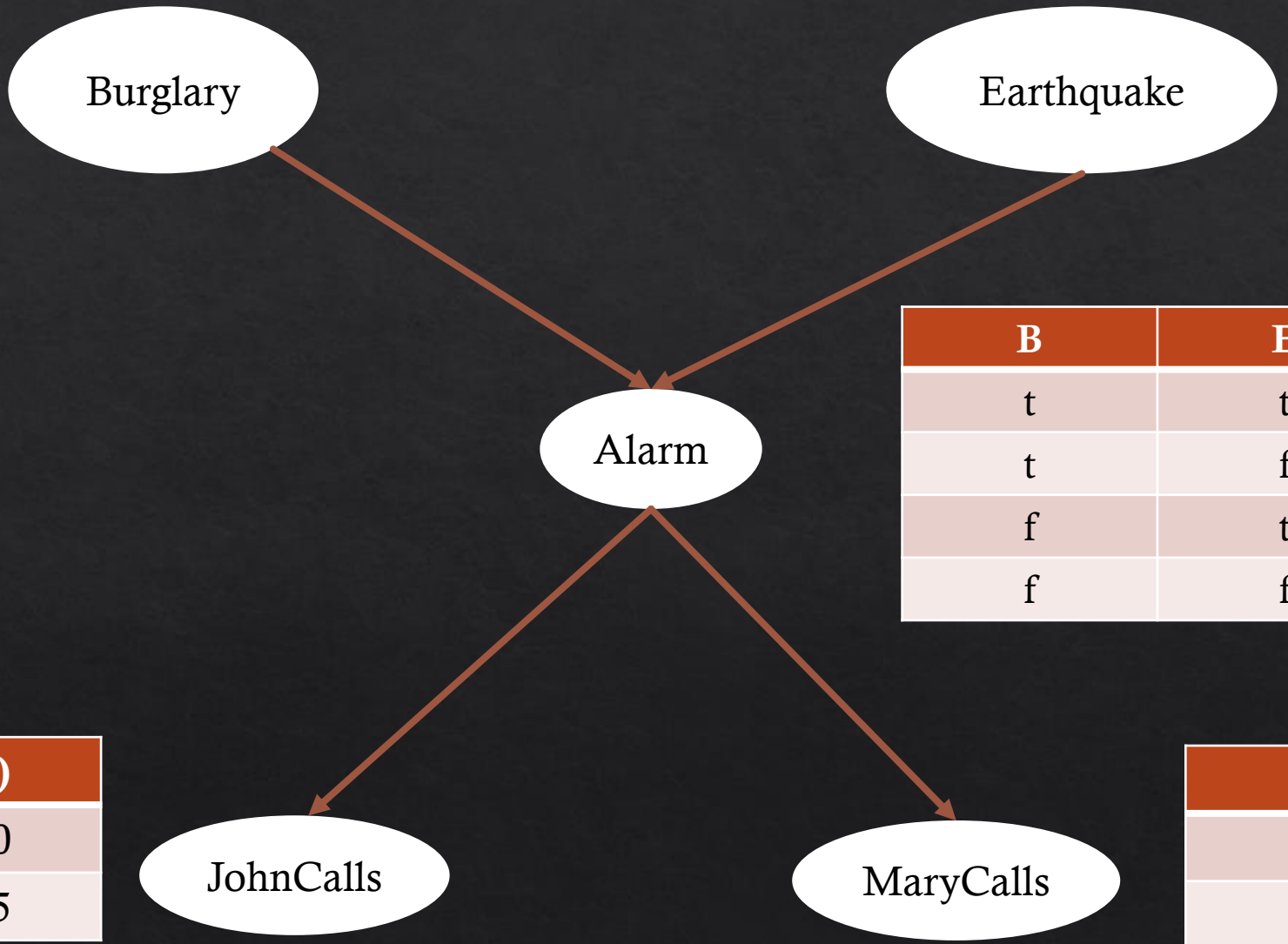
Bayesian networks



P(B)
0.001

P(E)
0.002

B	E	P(A)
t	t	0.95
t	f	0.94
f	t	0.29
f	f	0.001

A	P(J)
t	0.90
f	0.05

A	P(M)
t	0.70
f	0.01

Simple interogations

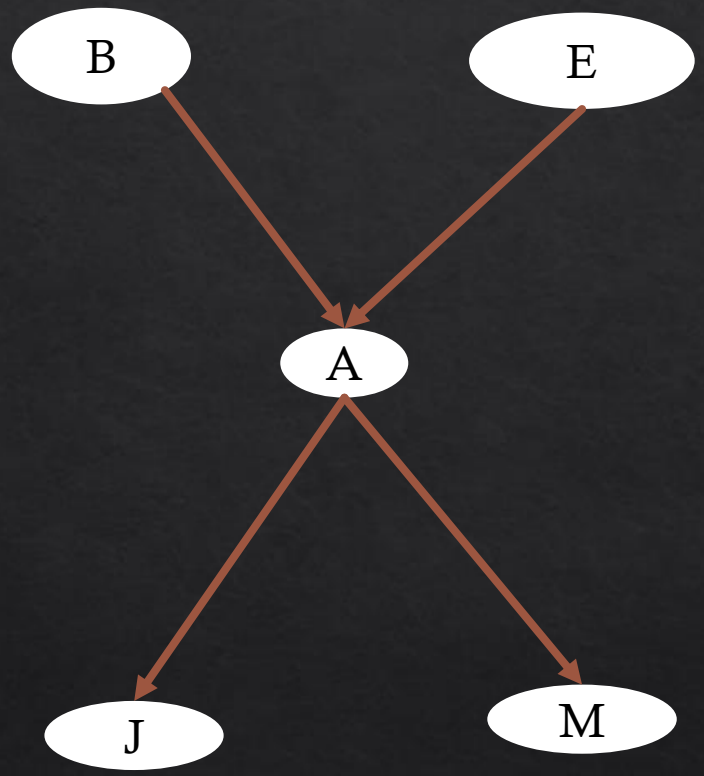
They have the form $P(X_1 = x_1 \wedge X_2 = x_2 \wedge \cdots \wedge X_n = x_n) = ?$

For example: $P(j,\ m, \neg a, b, \neg e,) = ?$

Calculate it using this formula:

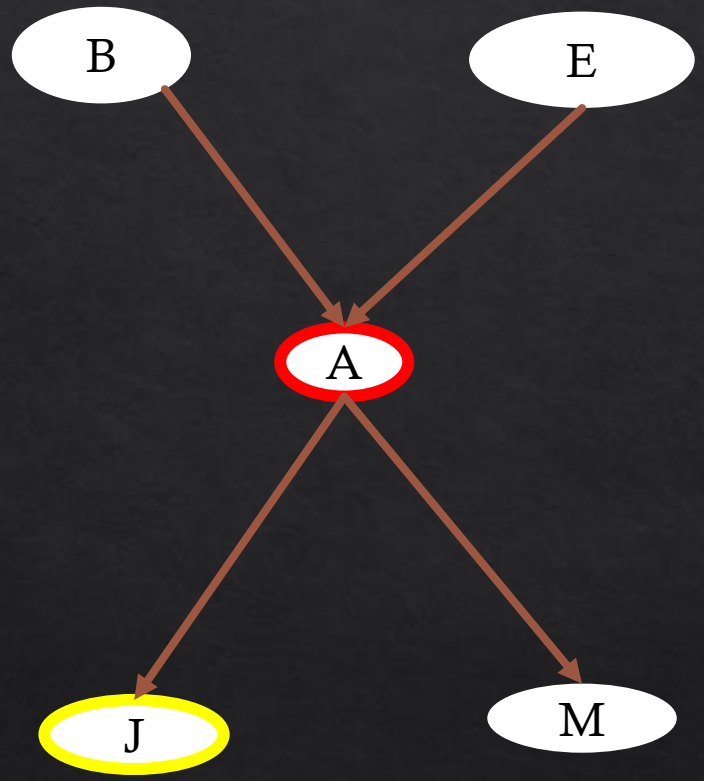
$$P(x_1, x_2, \ldots, x_n) = \prod_{i=1}^{n} P(x_i | parents(X_i))$$

Example of simple interogation



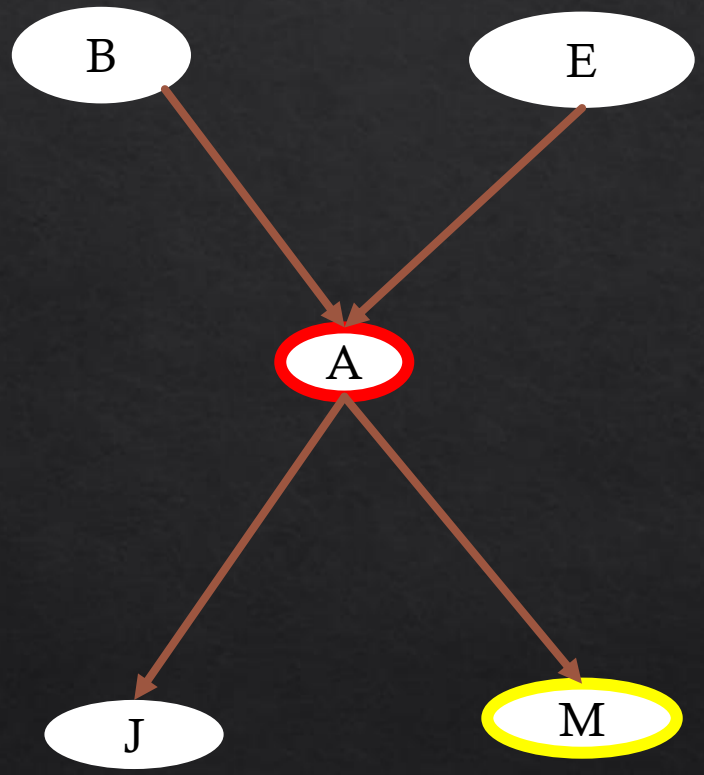
$P(j, m, \neg a, b, \neg e,) = \cdots$

Example of simple interogation



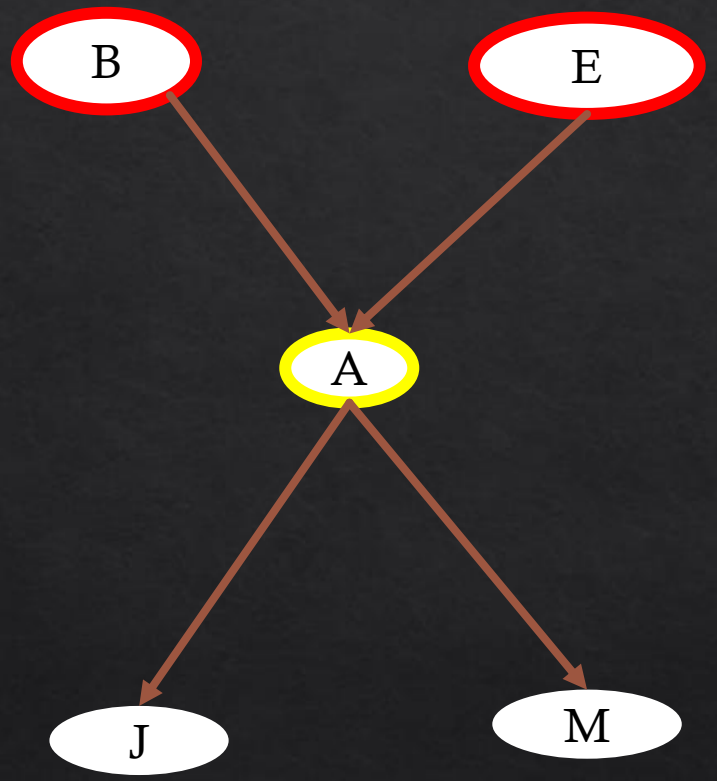
$P(j, m, \neg a, b, \neg e,) = P(j|\neg a)$ ...

Example of simple interogation



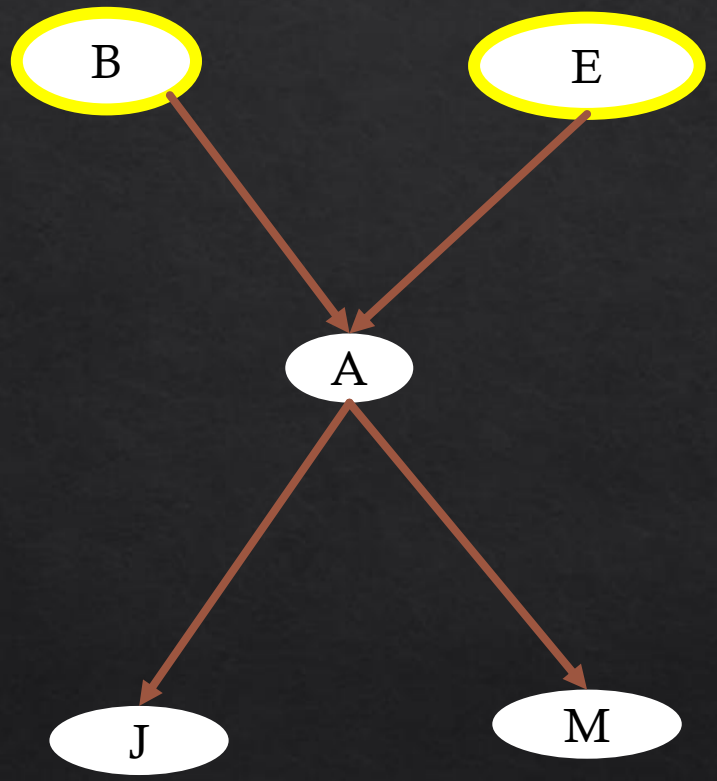
$P(j, m, \neg a, b, \neg e,) = P(j|\neg a)P(m|\neg a)$ ...

Example of simple interogation



$$P(j, m, \neg a, b, \neg e,) = P(j|\neg a)P(m|\neg a)P(, \neg a|b, \neg e) \ldots$$

Example of simple interogation



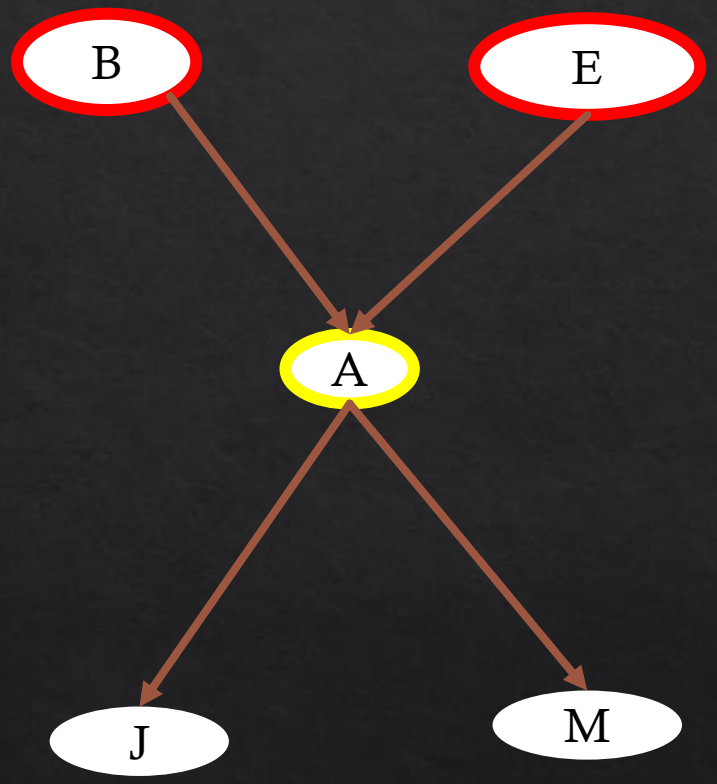
$$P(j, m, \neg a, b, \neg e) = P(j|\neg a)P(m|\neg a)P(, \neg a|b, \neg e)P(b)P(\neg e)$$

Inference of marginal probabilities

When we want to determine the marginal probability (i.e. the probability that an event will happen, without any condition), we use the formula for total probability.

$$P(A) = \sum_{n} P(A|B_n)P(B_n)$$

Marginal probability example…



$$P(a) =$$
$$P(a\,|b,e)\;P(b)P(e)$$
$$+P(a|\neg b,e)P(\neg b)P(e)$$
$$+P(a|b,\neg e)P(b)P(\neg e)$$
$$+P(a|\neg b,\neg e)P(\neg b)P(\neg e)$$

Inference by enumeration

$$P(X \mid e) = \alpha P(X, e) = \alpha \sum_{y} P(X, e, y)$$

X- the variable we are interested in
e - the observed variables
α- normalization coefficient, i.e. $\frac{1}{P(e)}$
y- the unobserved variables i.e. the ones that are not in e

Example

$$P(b|j,m)$$

Who is e? Who is y? Who is α ?

Example

$P(b|j,m)$

$e = \{j, m\}$

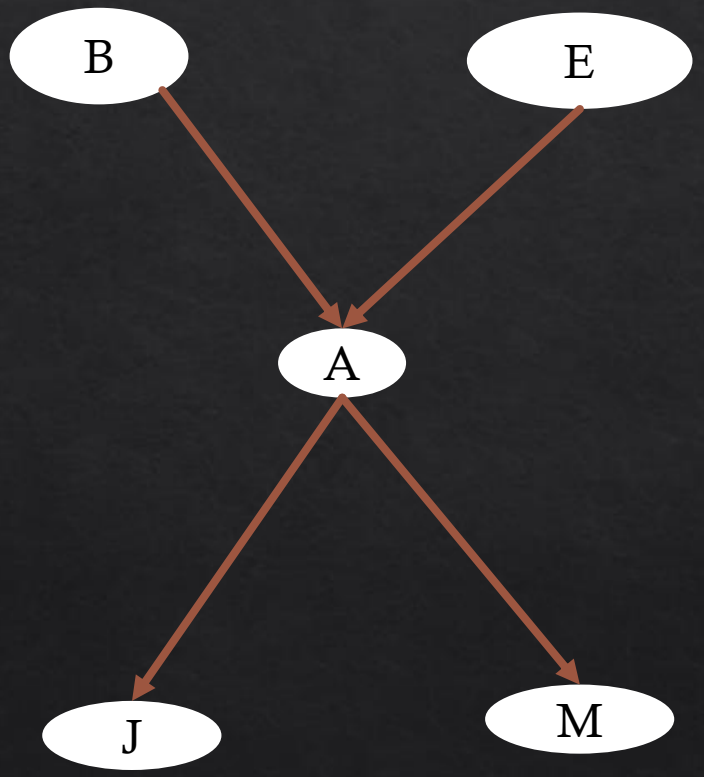
$y = \{e, a\}$

$\alpha = \frac{1}{P(j,m)}.$

Example

$$P(b|j,m) = \alpha \sum_{e \epsilon \{t,f\}} \sum_{a \epsilon \{t,f\}} P(b,j,m,e\ a)$$

Example



$$P(b|j,m)$$
$$= \alpha \sum_{e \epsilon \{t,f\}} \sum_{a \epsilon \{t,f\}} P(b)P(j|a)P(m|a)\ P(e)\ P(a|b,e)$$

Q & A

Bibliography

- The slides were just an extract of this course https://drive.google.com/file/d/1ElrtXRB-VNPdhgBD9pUx14Ebht9zhQ4N/view