Cause and Effect in Uncertainty

Cause and Effect

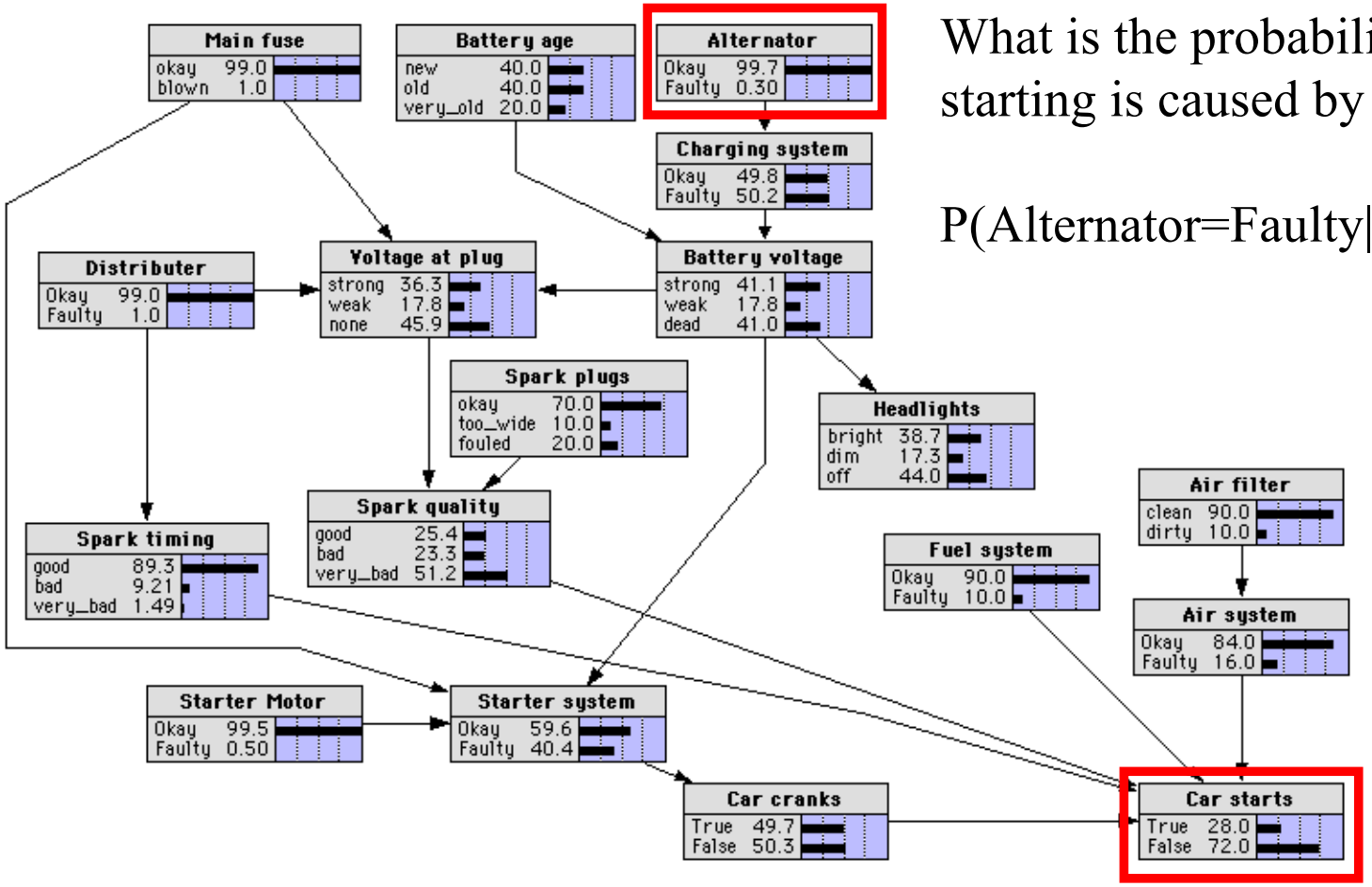
What is the probability of a cause given some evidence?

What is the probability of an effect given some evidence?

What is the cause of the car not starting?

What is the probability that the car not starting is caused by a faulty alternator?

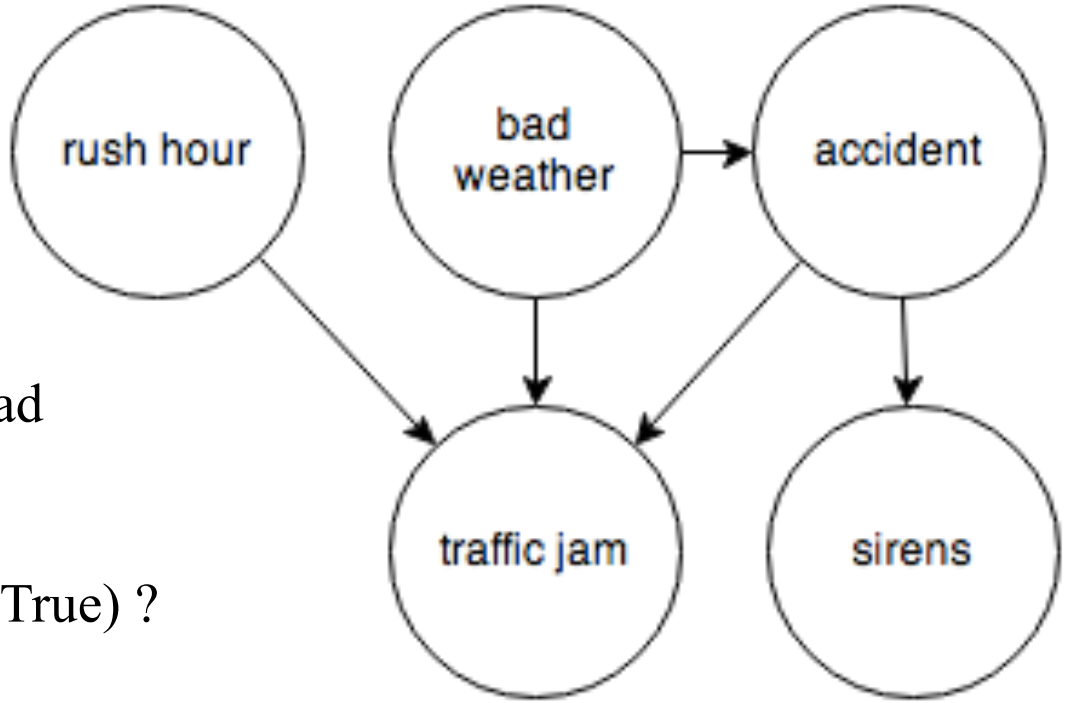
P(Alternator=Faulty|CarStarts=False) ?



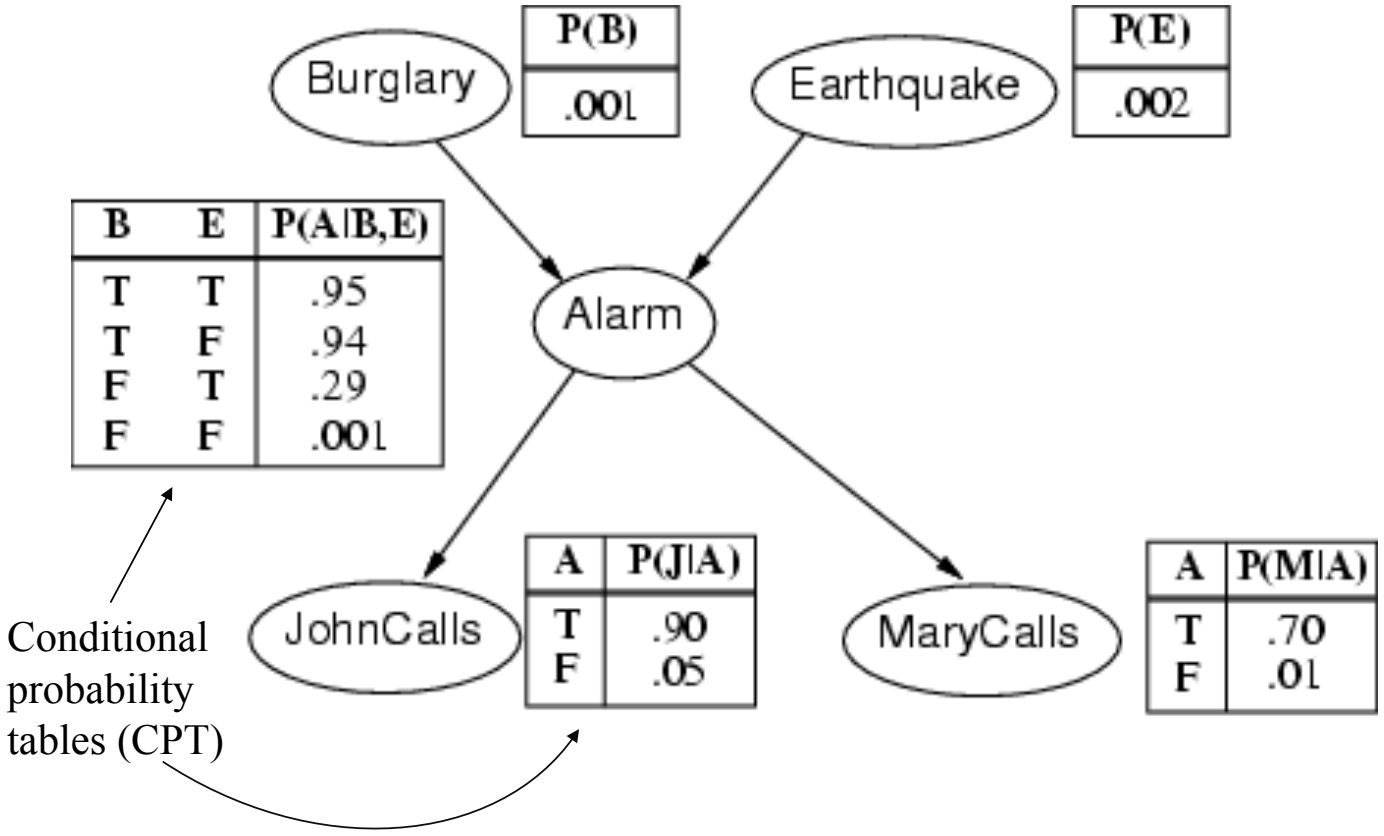
Will there be a traffic jam?

What is the probability that the bad weather will cause a traffic jam?

P(TrafficJam=True|BadWeather=True) ?



Burglary network

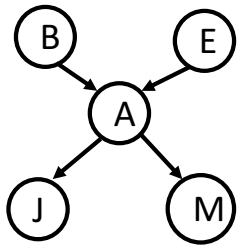


Simplification:
We will only be handling variables with Boolean values

Inference by Enumeration

- Bayes Nets represent a joint probability

Simple query on the burglary network:



$$\mathrm{P}(b|j,m)$$

$$= \mathrm{P}(b,j,m) \,/\, \mathrm{P}(j,m)$$

$$= \alpha\, \mathrm{P}(b,j,m)$$

$$= \alpha\, \mathrm{P}(b,E,A,j,m)$$

$$= \alpha \sum_e \sum_a P(b,e,a,j,m)$$

What is the probability of there being a burglary if John and Mary called?

Need to include the variables that are related but value is not known

Capital letters to indicate unknown values

Normalization constant

Sum over the possible values for the variables where the values are not known

Inference by Enumeration

$$\mathrm{P}(b|j,m) = \alpha \sum_e \sum_a P(b,e,a,j,m)$$

This is ugly.
And we don't know it.

$$= \alpha\, P(b) \sum_e P(e) \sum_a P(a|b,e) P(j|a) P(m|a)$$

We do know all of these terms

Now we can lookup each term in the CPT in the Bayes Net

Evaluation Tree