Bayesian Belief Network

A Bayesian Belief Network is a visual model that illustrates how random variables in a specific group are related through probability. It's a type of classifier that doesn't consider connections between attributes, meaning it assumes they are unrelated. In Bayesian Belief Networks, probabilities are calculated by considering the likelihood of an attribute being true given the state of its parent attribute, denoted as P(attribute/parent).

Considering an example

1) There's an alarm system ('A') installed in the house of an individual.' This alarm can be triggered by two events: burglary ('B') and Earthquake ('E'), both of which are considered as parent nodes of the alarm. The alarm system, in turn, influences two person nodes: John(‘J’) and Mary(‘M’) who are responsible for making calls in response to the alarm.

2) In the event of a burglary or Earthquake, John(‘J’) and Mary(‘M’) are supposed to call individual.' However, there are certain limitations in this setup. John might occasionally forget to make the call even after hearing the alarm, possibly due to a tendency to forget things quickly. Similarly, Mary may fail to make the call at times, especially if he is too far away from the alarm to hear it.

The output we require from this example if the conditional probability whether Burglary will happen or not considering different cases.For example P(B=true| J=True,M=true), P(B=true| J=True,M=false),P(B=true| J=false,M=true) etc

Algorithm:

- **Enumeration-Ask Algorithm**

1. Initialized an empty distribution for the query variable X.

2. For each possible value of X, we did the following:

    i. Calculated the probability distribution using the Enumerate-All Algorithm procedure.

    ii. Updated the distribution for X.

3. Normalized the final distribution.

4. Returned the normalized distribution as the answer to the query.

- **Enumerate-All Algorithm**

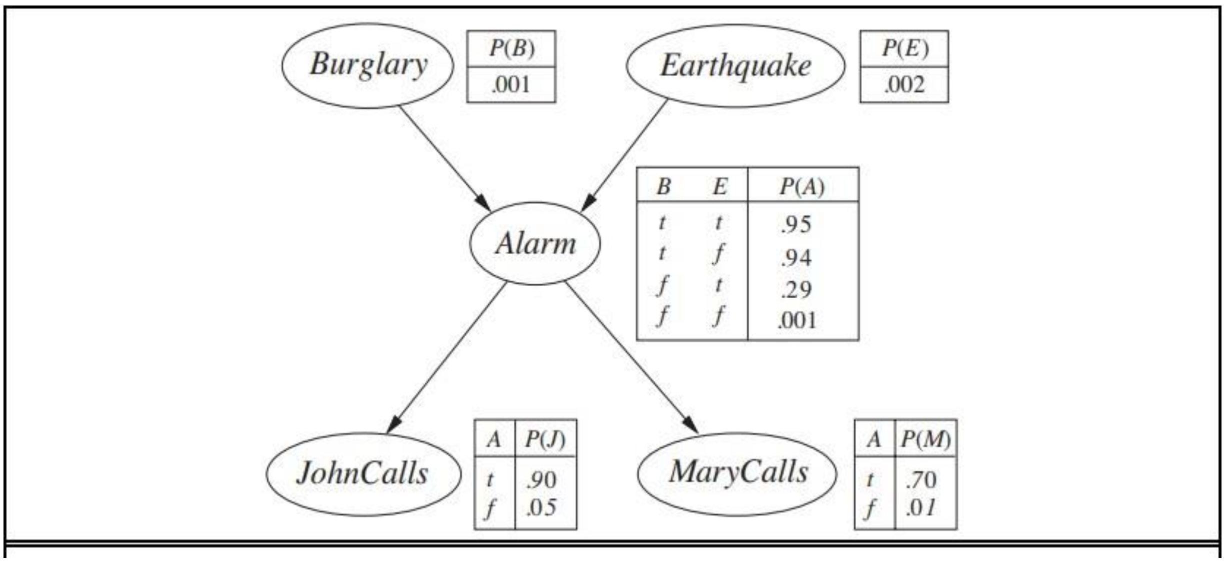
1. If there are no variables left to consider, return 1.0.

2. Selected the first variable Y from the set of variables.

3. If Y has a known value in the evidence (e), we calculated the probability of that value given its parents and continued with the remaining variables.

4. If Y does not have a known value, we considered all possible values for Y given its parents and calculated their probabilities, then we continued with the remaining variables.

INPUT IN OUR CODE:



OUTPUT:

```
P(B = true | (J = true, M = true)) - 0.22931
P(B = true | (J = false, M = true)) - 0.00349957
P(B = true | (J = true, M = false)) - 0.00261232
P(B = true | (J = false, M = false)) - 7.51585e-05
P(B = false, E = false, A = true, J = true, M = true) - 0.000628111
```