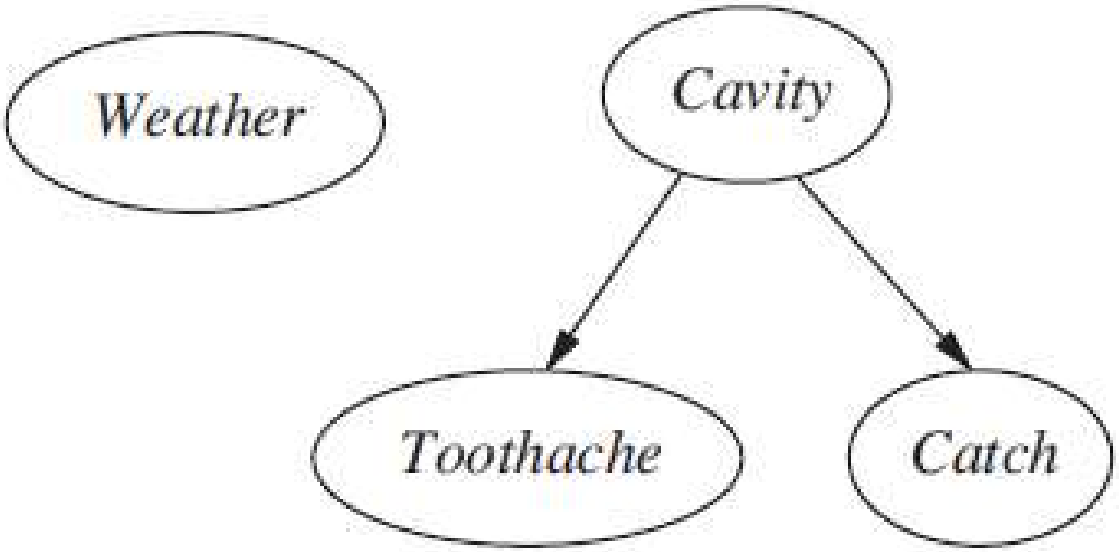
LU31-Representing Knowledge in an uncertain domain

LU Objectives	
To explain how to build network models to reason under uncertainity using probability theory	
LU Outcomes	CO : 3
Design Bayesian network for representing knowledge	

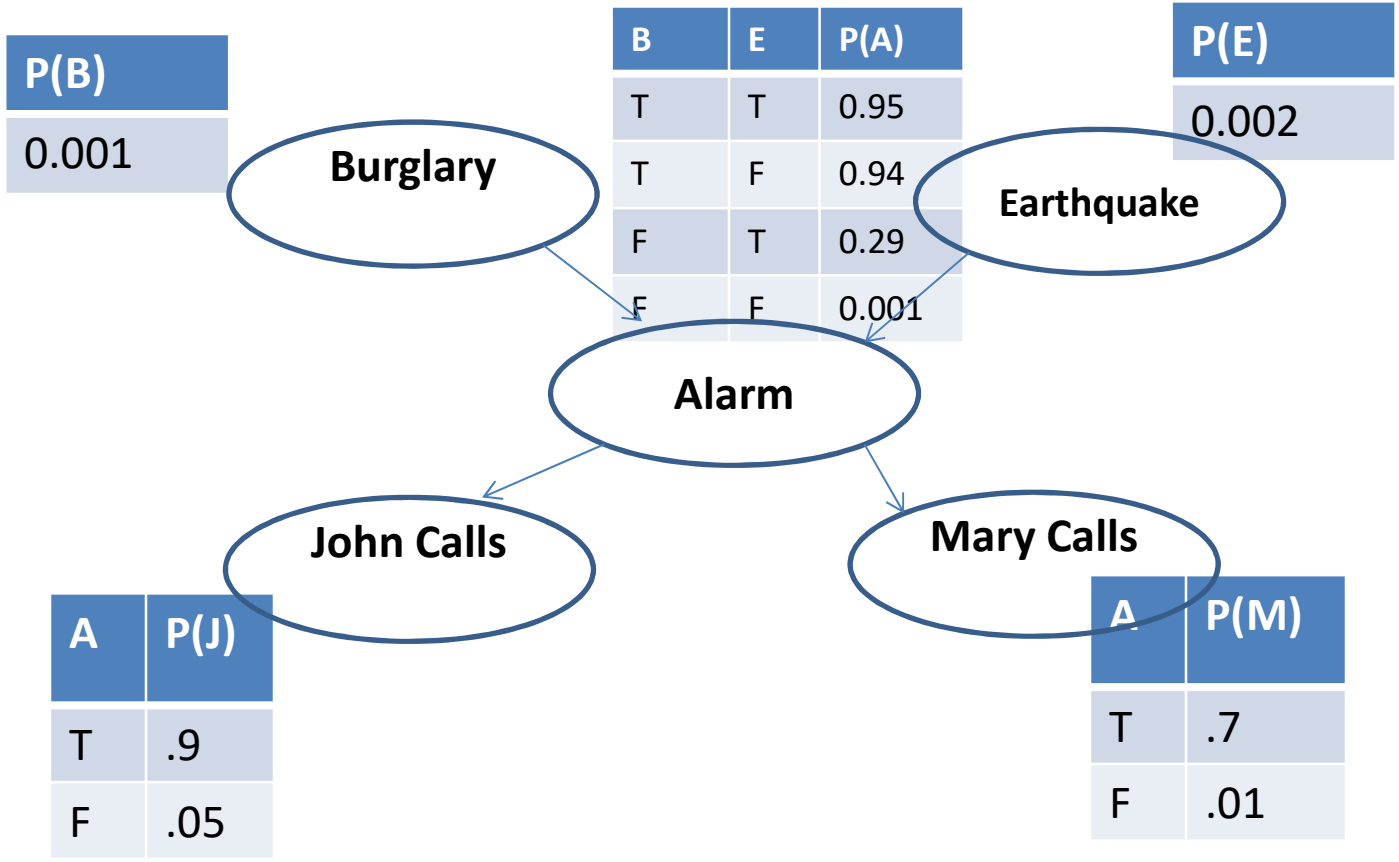
Bayesian Network

1. **Bayesian Network is used to represent the dependence between variables and to give a concise specification of the joint probability distribution**
2. **It is a directed graph in which each node is annotated with quantitative probability information. The full specification is as follows:**
   - A set of random variables makes up the nodes of the network.
   - A set of directed links or arrows connects pairs of nodes. The intuitive meaning of an arrow from node *X* to node *Y* is that *X* has a *direct influence* on *Y.*
   - Each node has a conditional probability table that quantifies the effects that the parents have on the node. The parents of a node are all those nodes that have arrows pointing to it.
   - The graph has no directed cycles (hence is a directed, acyclic graph, or DAG).

Simple Bayesian Network



Bayesian Network



Conditional Probability Table

- The conditional distributions are shown as a conditional probability table, or CPT.
- Each row in a CPT contains the conditional probability of each node value for a **conditioning case.**
- A conditioning case is just a possible combination of values for the parent nodes—a miniature possible world.
- Each row must sum to 1, because the entries represent an exhaustive set of cases for the variable.
- A table for a Boolean variable with k Boolean parents contains 2^k independently specifiable probabilities.
- A node with no parents has only one row, representing the prior probabilities of each possible value of the variable

Conditional Probability Table

- Notice that the network does not have nodes corresponding to Mary's currently listening to loud music or to the telephone ringing and confusing John.
- This shows both laziness and ignorance in operation. However we have no reasonable way to obtain the relevant information anyway.
- The probabilities actually summarize a *potentially infinite set of circumstances in which the alarm might fail to go off (high humidity, power* failure, dead battery, cut wires, a dead mouse stuck inside the bell, etc.) or John or Mary might fail to call and report it (out to lunch, on vacation, temporarily deaf, passing helicopter, etc.).
- In this way, a small agent can cope with a very large world, at least approximately.
- The degree of approximation can be improved if we introduce additional relevant information.

Assessment Questions

Define Bayesian Networks.	2	R
Enumerate the Burglary alarm problem.	4	U
What is conditional Probability table?	4	U
What are the properties of Bayesian Networks?	4	R
Draw the simple Bayesian Network consists of Toothache, Cavity, Catch & Weather?	8	A
What is chain rule?	2	R
Describe compactness and node ordering.	4	U
What is a belief network? Explain.	4	R
Give the full specification of a Bayesian network.	2	R