Experiment No. 7

Title: Bayesian Network Problem Solving

KJSCE/IT/SY/SEM IV/HO-IAI/2021-22

Batch: B4 Roll No.:16010420133
Experiment No.: 7

Aim: Study of Netica Software (free version) and use of it to build a small Bayesian Network

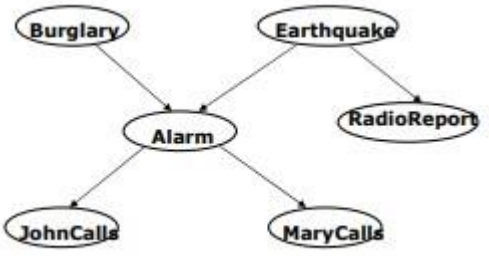
Resources needed: Netica Software, Internet

Theory

Bayesian networks are directed acyclic graphs whose nodes represent variables, and whose missing edges encode conditional independencies between the variables. Nodes represent random variables – they may be observable quantities, latent variables, unknown parameters or hypotheses. Each node is associated with a probability function that takes as input a particular set of values for the node's parent variables and gives the probability of the variable represented by the node. If the parents are m Boolean variables then the probability function could be represented by a table of 2m entries, one entry for each possible combination of its parents being true or false.

Procedure:

1. Consider the Bayesian Network Diagram given below containing six random variables:
   "Burglary", "Earthquake", "Alarm", "JohnCalls", " MaryCalls" and "Radio Announcement"



In this, "Burglary" and "Earthquake" are independent, and "Burglary" and "Radio Announcement" are independent given "Earthquake." This is to say that there is no event that affects both burglaries and earthquakes.

As well, "Burglary" and "Radio Announcements" are independent given "Earthquake" - meaning that while a radio announcement might result from an earthquake, it will not result as a repercussion from a burglary.

2. Create a Bayesian Network using Netica (free version) and explore the functions of Netica on the created network.

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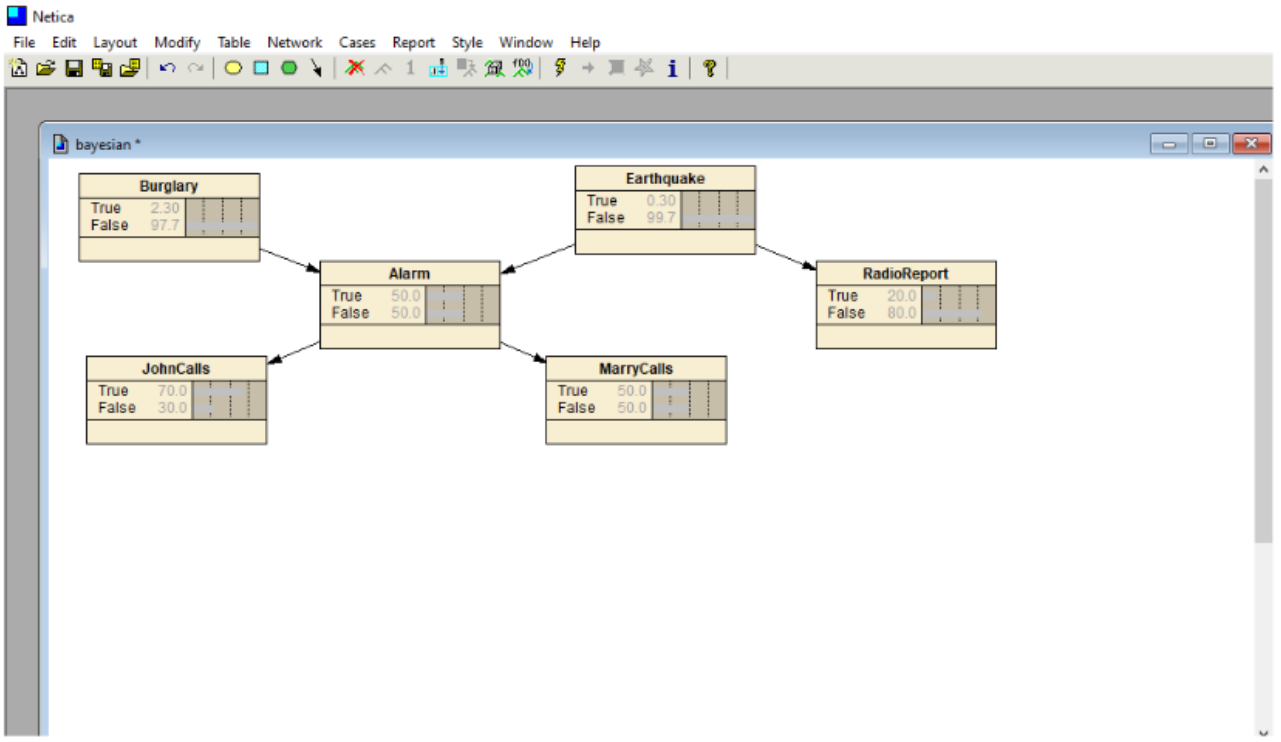

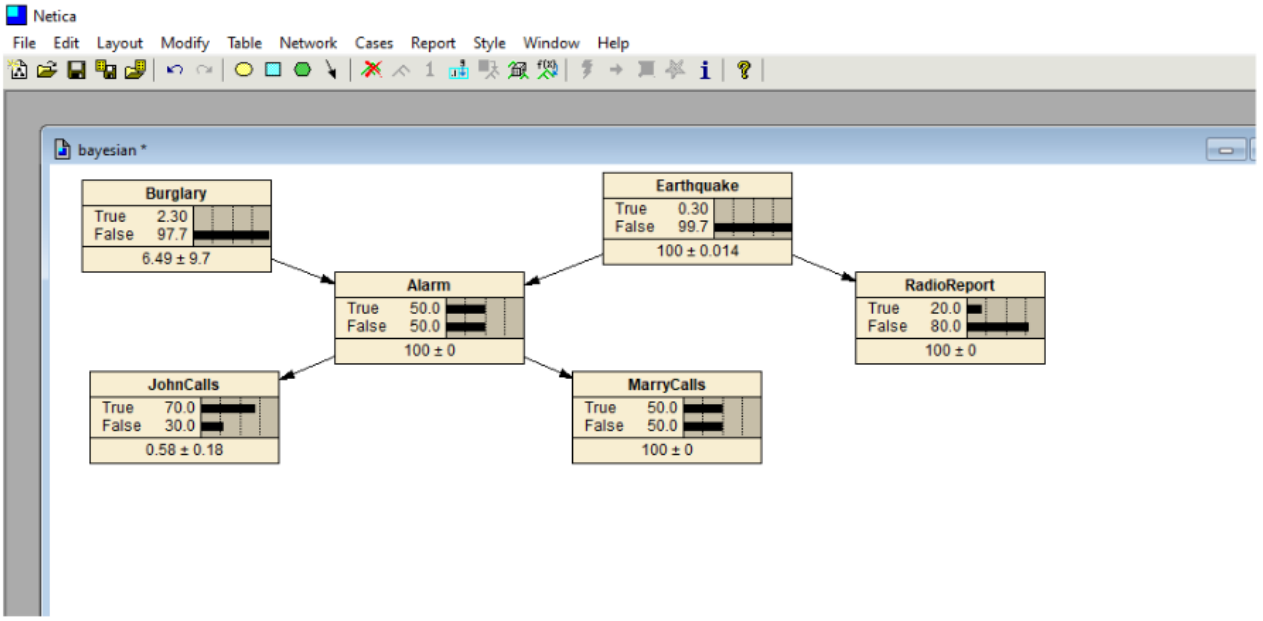

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Questions:

Q1. List the features of Netica

• Compiles Bayes nets into junction trees of cliques for fast probabilistic reasoning.

• Can learn probabilistic relations from data (including EM and gradient descent learning).

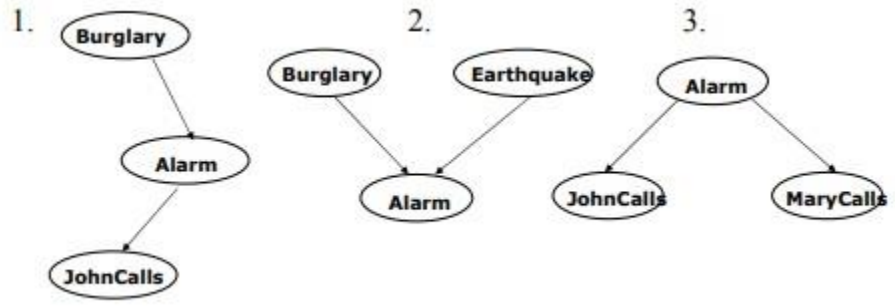
• Generates presentation quality graphics which can be transferred to other documents, including SVG graphics.

• Allows the entry of probabilistic relations by equation, with an extensive built-in library of probabilistic functions and other mathematical functions. The equations can be deterministic or probabilistic, and for discrete or continuous variables.

• Can find optimal decisions for sequential decision problems (i.e. later decisions are dependent on the results of earlier ones).

• Can test the performance of a Bayes net using a file of cases. Netica will print out a confusion matrix, error rate, logarithmic and quadratic (Brier) scoring rule results, calibration table and surprise indexes for each node desired.

Q2. State the following statements with respective to the diagrams are **true or false** and Justify your answer



1. JohnCalls is independent of Burglary, given Alarm

   TRUE
   P(J | A, B) = P(J | A) P(J , B | A) = P(J | A)P(B | A)

1. Burglary is independent of Earthquake (not knowing Alarm) but Burglary and Earthquake become dependent, given Alarm

   TRUE
   P(B, E) = P(B)P(E)

1. MaryCalls is independent of JohnCalls, given Alarm.

   TRUE
   P(J | A, M) = P(J | A)
   P(J , M | A) = P(J | A)P(M | A)

Outcomes: CO4: Comprehend problems with uncertainty, formalize the problem and understand how solutions are found.

Conclusion

I have understood and implemented small Bayesian network of burglar, alarm, etc in netica.

Grade: AA / AB / BB / BC / CC / CD /DD

Signature of faculty in-charge with date

References:

- Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Second Edition, Pearson Publication
- https://www.norsys.com/netica_api.html
- https://www.norsys.com/tutorials/netica/nt_toc_A.htm.