

# Application of Bayesian Networks in Energetics

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## **Real world prediction and diagnostic analysis suffer from many challenges**

- Incomplete input data
- Uncertain data sources
- Complex non-linear relationship between variables



## ① Introduction to Bayesian networks

- Definition
- Construction
- Analysis
- Pros and Cons

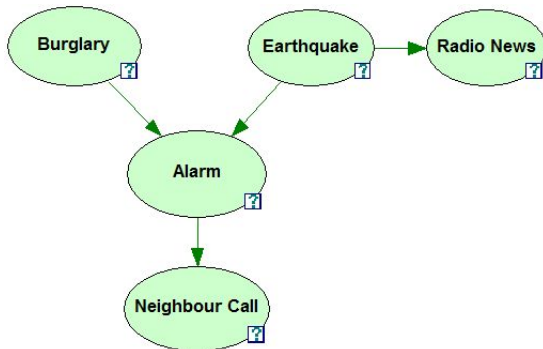
## ② Bayesian networks in energetics

- Demo

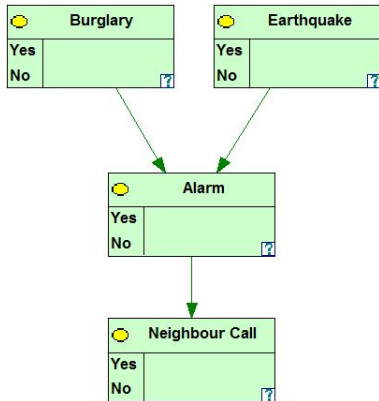


## Informal definition

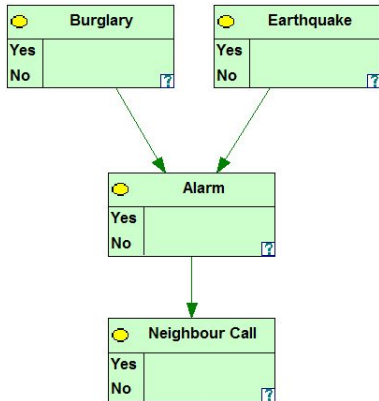
- Framework for graphically representing the logical relationships between variables and capturing the uncertainty in the dependency between these variables using conditional probabilities



# Probability tables



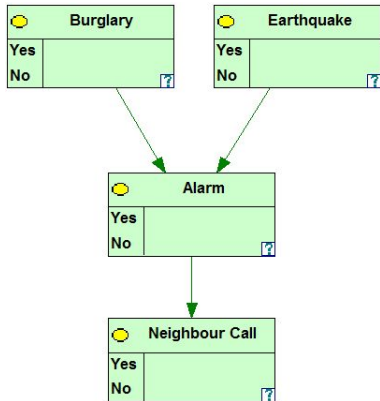
# Probability tables



Yes	0.2
No	0.8

Yes	0.1
No	0.9

# Probability tables



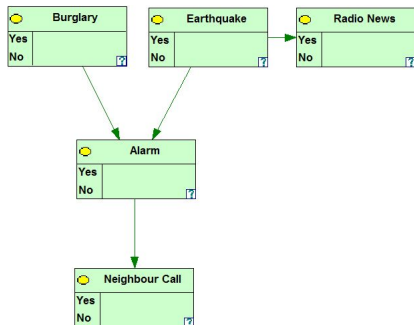
Yes	0.2
No	0.8

Yes	0.1
No	0.9

Earthquake	Burglary = Yes		Burglary = No	
	Yes	No	Yes	No
Yes	0.95	0.8	0.85	0.05
No	0.05	0.2	0.15	0.95

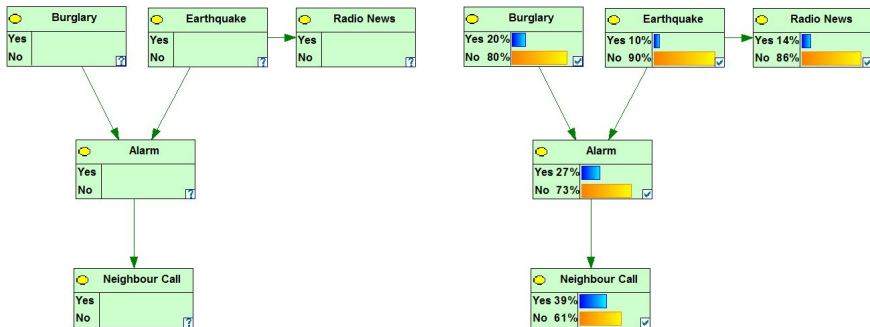
Neighbour Call	Alarm = Yes		Alarm = No	
	Yes	No	Yes	No
Yes	0.9	0.2		
No	0.1	0.8		

## Unconditional (a priori) node probabilities



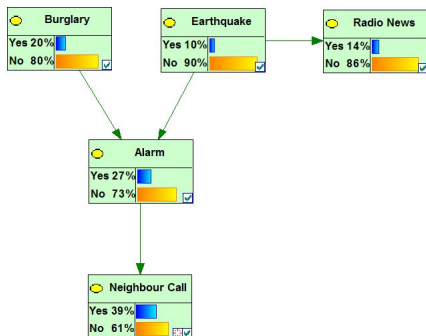


## Unconditional (a priori) node probabilities



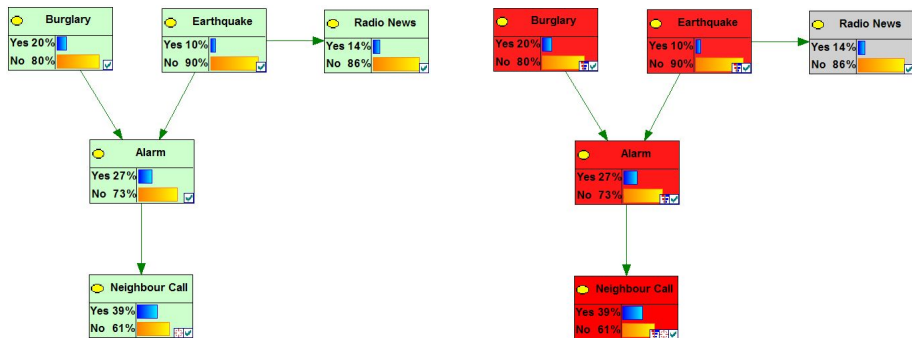
## Sensitivity analysis

- Identification of nodes with the highest impact on the target node

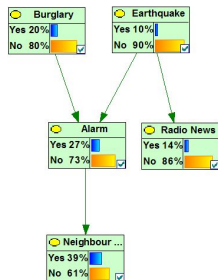


## Sensitivity analysis

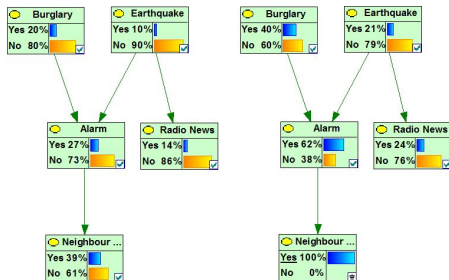
- Identification of nodes with the highest impact on the target node



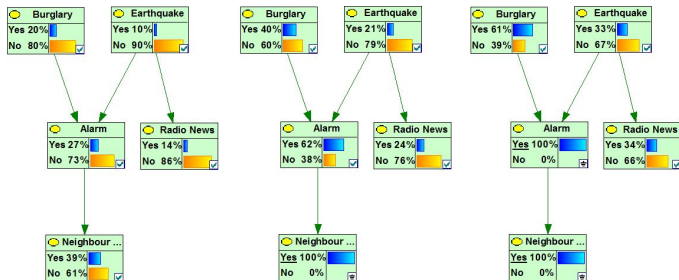
## Inference and propagation of evidence



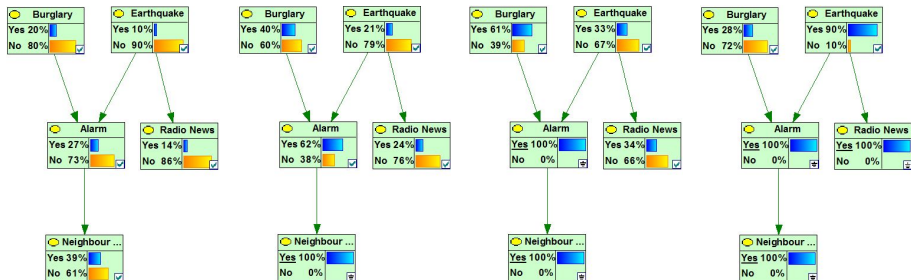
## Inference and propagation of evidence



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## Inference and propagation of evidence



## Domains of BN application

- Medical diagnostics
- Language understanding
- Weather forecasting
- Legal arguments
- Software reliability analysis
- ...

## Modifications and extensions of BN

- Dynamic BN
- OOBN
- Influence diagrams





## Advantages of Bayesian networks

- Uncertainty handling
- Complex relationships between variables
- Robust model
- Intuitive parameters
- Variety of analysis options

## Disadvantages of Bayesian networks

- Support for continuous variables
- Construction of topology



DEMO

