Experiment-No.8

Objective: Write a program to demonstrate the working of Bayesian network for the following graph:

Calculate the probability of a burglary if John and Mary calls (0: True, 1: False)

Calculate the probability of alarm starting if there is a burglary and an earthquake (0: True, 1: False)

Calculate the probability of alarm starting if there is a burglary and an earthquake (0: True, 1: False)

Scheduled Date:	Compiled Date:	Submitted Date:
27 Sep 2023	28 Sep 2023	30- Sep 2023

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Python code:

```
pip install pgmpy
import pgmpy. inference
import pgmpy. models
import networkx as nx
import pylab as plt
model = pgmpy. models . BayesianNetwork ([( ' Burglary ' , 'Alarm ') , ( ' Ea
rthquake ' , 'Alarm ') ,
                                          ( 'Alarm ' , ' JohnCalls ') , ( 'Al
arm ' , 'MaryCalls ' ) ] )
# Define conditional probability distributions (CPD)
# Probability of burglary (True , False )
```

```
cpd burglary = pgmpy. factors . discrete .TabularCPD(" Burglary " , 2 , [[0.0
01] , [0.999]])

# Probability of earthquake (True , False )

cpd earthquake = pgmpy. factors . discrete .TabularCPD("Earthquake" , 2 , [[0
.002] , [0.998]])

# Probability of alarm going of (True , False ) given a burglary and/or earth
quake

cpd alarm = pgmpy. factors . discrete .TabularCPD( 'Alarm ' , 2 , [[0.95 , 0.
94 , 0.29 , 0.001] , [0.05 , 0.06 , 0.71 , 0.999]] ,

                                                    evidence =['Burglary ' , 'E
arthquake '] , evidence card =[2, 2])

# Probability that John calls (True , False ) given that the alarm has sounde
d

cpd john = pgmpy. factors . discrete .TabularCPD( ' JohnCalls ' , 2 , [[0.90
, 0.05] , [0.10 , 0.95]] , evidence =['Alarm '] , evidence card =[2])

# Probability that Mary calls (True , False ) given that the alarm has sounde
d

cpd mary = pgmpy. factors . discrete .TabularCPD( ' MaryCalls ' , 2 , [[0.70
, 0.01] , [0.30 , 0.99]] , evidence =['Alarm '] , evidence card =[2])

# Add CPDs to the network structure

model . add cpds ( cpd burglary , cpd earthquake , cpd alarm , cpd john , cpd
 mary)

# Check i f the model is valid , throw an exception otherwise

model . check model ()

# Print probability distributions

print ( ' Probability distribution , P( Burglary ) ')

print ( cpd burglary )

print ()

print ( ' Probability distribution , P(Earthquake ) ')

print ( cpd earthquake )
```

```
print ()
print ( ' Joint probability distribution , P(Alarm | Burglary , Earthquake )
')
print ( cpd alarm )
print ()
print ( ' Joint probability distribution , P( JohnCalls | Alarm) ')
print ( cpd john )
print ()
print ( ' Joint probability distribution , P(MaryCalls | Alarm) ')
print (cpd mary) print () # Plot the model
nx. draw(model , with labels=True) plt . savefig ( ' alarm1 .png ') plt . clo
se ()
# Perform variable elimination for inference
# Variable elimination (VE) is a an exact inference algorithm in bayesian net
works
infer = pgmpy. inference . VariableElimination (model)
# Calculate the probability of a burglary i f John and Mary calls (0: True ,
1: False )
posterior probability = infer . query ([ ' Burglary '] , evidence={'JohnCalls
 ' : 0 , 'MaryCalls ' : 0})
# Print posterior probability
print ( ' Posterior probability of Burglary i f JohnCalls (True) and MaryCall
s(True ) ')
print ( posterior probability )
print ()
# Calculate the probability of alarm starting i f there is a burglary and an
earthquake (0: True , 1: False )
posterior probability = infer . query ([ ' Alarm '] , evidence= {' Burglary '
 : 0 , 'Earthquake ' : 0})
```

```
# Print posterior probability

print ( ' Posterior probability of Alarm sounding i f Burglary (True) and Ear
thquake(True ) ')

print ( posterior probability )

print ()
```

Output:

Probability distribution, P(Burglary)

Burglary(0)	0.001
Burglary(1)	0.999

Probability distribution, P(Earthquake)

Earthquake(0)	0.002
Earthquake(1)	0.998

Joint probability distribution, P(Alarm | Burglary, Earthquake)

Burglary	Burglary(0)	Burglary(0)	Burglary(1)	Burglary(1)
Earthquake	Earthquake(0)	Earthquake(1)	Earthquake(0)	Earthquake(1)
Alarm(0)	0.95	0.94	0.29	0.001
Alarm(1)	0.05	0.06	0.71	0.999

Joint probability distribution, P(JohnCalls | Alarm)

Alarm	Alarm(0)	Alarm(1)
JohnCalls(0)	0.9	0.05
JohnCalls(1)	0.1	0.95

Joint probability distribution, P(MaryCalls | Alarm)

Alarm	Alarm(0)	Alarm(1)
MaryCalls(0)	0.7	0.01
MaryCalls(1)	0.3	0.99

Posterior probability of Burglary if JohnCalls(True) and MaryCalls(True)

Burglary	phi(Burglary)
Burglary(0)	0.2842
Burglary(1)	0.7158

Finding Elimination Order: : 0/0 [00:00<?, ?it/s]

0/0 [00:00<?, ?it/s]

Posterior probability of Alarm sounding if Burglary(True) and Earthquake(True)

Alarm	phi(Alarm)
Alarm(0)	0.9500
Alarm(1)	0.0500