

- ⑦ Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart disease. If heart patient using standard Heart Disease Data set. You can use java/python ML library classes/API.

```
import numpy as np
import pandas as pd
import csv

from pgmpy. estimators import MaximumLikelihoodEstimator
from pgmpy. models import BayesianModel
from pgmpy. inference import VariableElimination
```

```
heartDisease = pd.read_csv('heart.csv')
heartDisease = heartDisease.replace('?', np.nan)
```

```
print('Sample instances from the dataset are given below')
print(heartDisease.head())
```

```
print('In Attributes and datatypes')
print(heartDisease.dtypes)
model = BayesianModel([('age', 'heartDisease'), ('sex', 'heartDisease'), ('exang', 'heartDisease'), ('cp', 'heartDisease'), ('heartDisease', 'restecg'), ('heartDisease', 'chol')])
```

```
print('In Learning CDP using Maximum Likelihood estimators')
model.fit(heartDisease, estimator=MaximumLikelihoodEstimator)
print('In inferring with Bayesian Network:')
HeartDiseaseTest.infer = VariableElimination(model)
```

Teacher's Signature \_\_\_\_\_

```
print('In 1. Probability of HeartDisease given evidence =  
rest eg: 1')
```

```
q1 = HeartDisease - infer.query(variables = ['heartdisease'],  
                                evidence = {'rest eg': 1})
```

```
print(q1)
```

```
q2 = HeartDisease - infer.query(variables = ['heartdisease'],  
                                evidence = {'cp': 2})
```

```
print(q2)
```

## Output

sample instances from the dataset are given below

sample	age	sex	cp	trestbps	chol	fbs	restecg	thalach	exang	oldpeak
0	63	1	1	145	233	1	2	150	0	2.3
1	67	1	4	160	286	0	2	108	1	1.5
2	67	1	4	120	229	0	2	129	1	2.6
3	37	1	3	130	250	0	0	187	0	3.5
4	41	0	2	130	204	0	2	170	0	1.9

	co	thal	heartdisease.
0	0	6	0
1	3	3	2
2	2	7	1
3	0	3	0
4	0	3	0

## Attributes and datatypes

age	int64
sex	int64
cp	int64
trestbps	int64
chol	int64
fbs	int64
restecg	int64
thalach	int64
exang	int64
oldpeak	float64
slope	int64
co	object
thal	object
heartdisease	int64
dtype: object	



Learning can use maximum likelihood estimators  
Inferencing with Bayesian network:

1. Probability of Heartdisease given evidence = restecg : 1

heartdisease	$\phi(\text{heartdisease})$
heartdisease (0)	0.1012
heartdisease (1)	0.0000
heartdisease (2)	0.2392
heartdisease (3)	0.0015
heartdisease (4)	0.4581

2. Probability of Heart Disease given evidence = cp: 2

heartdisease	$\phi(\text{heartdisease})$
heartdisease (0)	0.3610
heartdisease (1)	0.2159
heartdisease (2)	0.1973
heartdisease (3)	0.1537
heartdisease (4)	0.1321