# Assessment 8: Bayesian Network

**Step-by-Step Instructions with Comments in Python Code**

# Import required libraries

from pgmpy.models import BayesianNetwork

from pgmpy.inference import VariableElimination

from pgmpy.factors.discrete import TabularCPD

# Step 1: Define the structure of the Bayesian network

# Nodes: Fever, Cough, Fatigue, Disease

model = BayesianNetwork([('Disease', 'Fever'),

('Disease', 'Cough'),

('Disease', 'Fatigue')])

# Step 2: Define the Conditional Probability Distributions (CPDs)

# CPD for Disease (prior probabilities)

cpd\_disease = TabularCPD(variable='Disease', variable\_card=3,

values=[[0.1], [0.3], [0.6]], # Probabilities for Flu, COVID-19, None

state\_names={'Disease': ['Flu', 'COVID-19', 'None']})

# CPDs for symptoms given Disease

cpd\_fever = TabularCPD(variable='Fever', variable\_card=2,

values=[[0.8, 0.9, 0.1], # P(Fever | Flu), P(Fever | COVID-19), P(Fever | None)

[0.2, 0.1, 0.9]], # P(~Fever | Flu), P(~Fever | COVID-19), P(~Fever | None)

evidence=['Disease'],

evidence\_card=[3])

cpd\_cough = TabularCPD(variable='Cough', variable\_card=2,

values=[[0.7, 0.8, 0.2], # P(Cough | Flu), P(Cough | COVID-19), P(Cough | None)

[0.3, 0.2, 0.8]],

evidence=['Disease'],

evidence\_card=[3])

cpd\_fatigue = TabularCPD(variable='Fatigue', variable\_card=2,

values=[[0.6, 0.85, 0.1], # P(Fatigue | Flu), P(Fatigue | COVID-19), P(Fatigue | None)

[0.4, 0.15, 0.9]],

evidence=['Disease'],

evidence\_card=[3])

# Step 3: Add the CPDs to the model

model.add\_cpds(cpd\_disease, cpd\_fever, cpd\_cough, cpd\_fatigue)

# Step 4: Verify the model

assert model.check\_model(), "Model validation failed!"

# Step 5: Perform inference using the model

inference = VariableElimination(model)

# Example: Calculate the probability of diseases given Fever=True and Cough=True

result = inference.query(variables=['Disease'], evidence={'Fever': 1, 'Cough': 1})

print(result)

# Example output: Probabilities of each disease given observed symptoms