```
pip install git+https://github.com/pgmpy/pgmpy.git
```

```
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Downloading nvidia_curand_cu12-10.3.5.147-py3-none-manylinux2014_x86_64.whl (56.3 MB)
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Downloading nvidia_cusolver_cu12-11.6.1.9-py3-none-manylinux2014_x86_64.whl (127.9 MB)
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Downloading nvidia_cusparse_cu12-12.3.1.170-py3-none-manylinux2014_x86_64.whl (207.5 MB)
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Downloading nvidia_nvjitlink_cu12-12.4.127-py3-none-manylinux2014_x86_64.whl (21.1 MB)
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Downloading pyro_api-0.1.2-py3-none-any.whl (11 kB)
Building wheels for collected packages: pgmpy
  Building wheel for pgmpy (pyproject.toml) ... done
  Created wheel for pgmpy: filename=pgmpy-1.0.0-py3-none-any.whl size=2049499 sha256=8591fab7d57290c5708a4301dc567ef627a2954eec8b2de3
  Stored in directory: /tmp/pip-ephem-wheel-cache-22pilknz/wheels/d9/9f/45/a2e53089feda9327b2633091eed8fd63db751b9c8b9b1c94f7
Successfully built pgmpy
Installing collected packages: pyro-api, nvidia-nvjitlink-cu12, nvidia-curand-cu12, nvidia-cufft-cu12, nvidia-cuda-runtime-cu12, nvid
  Attempting uninstall: nvidia-nvjitlink-cu12
    Found existing installation: nvidia-nvjitlink-cu12 12.5.82
    Uninstalling nvidia-nvjitlink-cu12-12.5.82:
      Successfully uninstalled nvidia-nvjitlink-cu12-12.5.82
  Attempting uninstall: nvidia-curand-cu12
    Found existing installation: nvidia-curand-cu12 10.3.6.82
    Uninstalling nvidia-curand-cu12-10.3.6.82:
      Successfully uninstalled nvidia-curand-cu12-10.3.6.82
  Attempting uninstall: nvidia-cufft-cu12
    Found existing installation: nvidia-cufft-cu12 11.2.3.61
    Uninstalling nvidia-cufft-cu12-11.2.3.61:
      Successfully uninstalled nvidia-cufft-cu12-11.2.3.61
  Attempting uninstall: nvidia-cuda-runtime-cu12
    Found existing installation: nvidia-cuda-runtime-cu12 12.5.82
    Uninstalling nvidia-cuda-runtime-cu12-12.5.82:
      Successfully uninstalled nvidia-cuda-runtime-cu12-12.5.82
  Attempting uninstall: nvidia-cuda-nvrtc-cu12
    Found existing installation: nvidia-cuda-nvrtc-cu12 12.5.82
    Uninstalling nvidia-cuda-nvrtc-cu12-12.5.82:
      Successfully uninstalled nvidia-cuda-nvrtc-cu12-12.5.82
  Attempting uninstall: nvidia-cuda-cupti-cu12
    Found existing installation: nvidia-cuda-cupti-cu12 12.5.82
    Uninstalling nvidia-cuda-cupti-cu12-12.5.82:
      Successfully uninstalled nvidia-cuda-cupti-cu12-12.5.82
  Attempting uninstall: nvidia-cublas-cu12
    Found existing installation: nvidia-cublas-cu12 12.5.3.2
    Uninstalling nvidia-cublas-cu12-12.5.3.2:
      Successfully uninstalled nvidia-cublas-cu12-12.5.3.2
  Attempting uninstall: nvidia-cusparse-cu12
    Found existing installation: nvidia-cusparse-cu12 12.5.1.3
    Uninstalling nvidia-cusparse-cu12-12.5.1.3:
      Successfully uninstalled nvidia-cusparse-cu12-12.5.1.3
  Attempting uninstall: nvidia-cudnn-cu12
    Found existing installation: nvidia-cudnn-cu12 9.3.0.75
    Uninstalling nvidia-cudnn-cu12-9.3.0.75:
      Successfully uninstalled nvidia-cudnn-cu12-9.3.0.75
  Attempting uninstall: nvidia-cusolver-cu12
    Found existing installation: nvidia-cusolver-cu12 11.6.3.83
    Uninstalling nvidia-cusolver-cu12-11.6.3.83:
      Successfully uninstalled nvidia-cusolver-cu12-11.6.3.83
Successfully installed nvidia-cublas-cu12-12.4.5.8 nvidia-cuda-cupti-cu12-12.4.127 nvidia-cuda-nvrtc-cu12-12.4.127 nvidia-cuda-runtim
```

```
import pandas as pd
import numpy as np
from sklearn.preprocessing import MinMaxScaler
from pgmpy.models import DiscreteBayesianNetwork
from pgmpy.estimators import MaximumLikelihoodEstimator
from pgmpy.inference import VariableElimination
import networkx as nx
import matplotlib.pyplot as plt


df = pd.read_csv('/content/drive/MyDrive/heart_disease.csv')


df = df.dropna().drop_duplicates().reset_index(drop=True)


scaler = MinMaxScaler()
num_cols = df.select_dtypes(include=np.number).columns.tolist()
df[num_cols] = scaler.fit_transform(df[num_cols])
```

```
df.to_csv("cleaned_data.csv", index=False)


df['age'] = pd.cut(df['age'], bins=3, labels=["low", "medium", "high"])
df['chol'] = pd.cut(df['chol'], bins=3, labels=["low", "medium", "high"])
df['thalach'] = pd.cut(df['thalach'], bins=3, labels=["low", "medium", "high"])


model = DiscreteBayesianNetwork([
    ("age", "fbs"),
    ("fbs", "target"),
    ("target", "chol"),
    ("target", "thalach")
])


model.fit(df, estimator=MaximumLikelihoodEstimator)
```

```
<pgmpy.models.DiscreteBayesianNetwork.DiscreteBayesianNetwork at 0x7bebe90de0d0>
```

```
infer = VariableElimination(model)
print("🔍 P(target | age = medium):")
print(infer.query(variables=["target"], evidence={"age": "medium"}))
```

```
🔍 P(target | age = medium):
+-------------+---------------+
| target      |   phi(target) |
+=============+===============+
| target(0.0) |        0.4578 |
+-------------+---------------+
| target(1.0) |        0.5422 |
+-------------+---------------+
```

```
print("\n P(target | age = 0.5):")
print(infer.query(variables=["target"], evidence={"age": "medium"}))
```

```
 P(target | age = 0.5):
+-------------+---------------+
| target      |   phi(target) |
+=============+===============+
| target(0.0) |        0.4578 |
+-------------+---------------+
| target(1.0) |        0.5422 |
+-------------+---------------+
```

```
print("\n P(chol | target = 1):")
print(infer.query(variables=["chol"], evidence={"target": 1}))
```

```
 P(chol | target = 1):
+--------------+-------------+
| chol         |   phi(chol) |
+==============+=============+
| chol(high)   |      0.0061 |
+--------------+-------------+
| chol(low)    |      0.7927 |
+--------------+-------------+
| chol(medium) |      0.2012 |
+--------------+-------------+
```

```
print("\n P(thalach | target = 1):")
print(infer.query(variables=["thalach"], evidence={"target": 1}))
```

```
 P(thalach | target = 1):
+-----------------+----------------+
| thalach         |   phi(thalach) |
+=================+================+
| thalach(high)   |         0.5610 |
+-----------------+----------------+
| thalach(low)    |         0.0244 |
+-----------------+----------------+
| thalach(medium) |         0.4146 |
+-----------------+----------------+
```

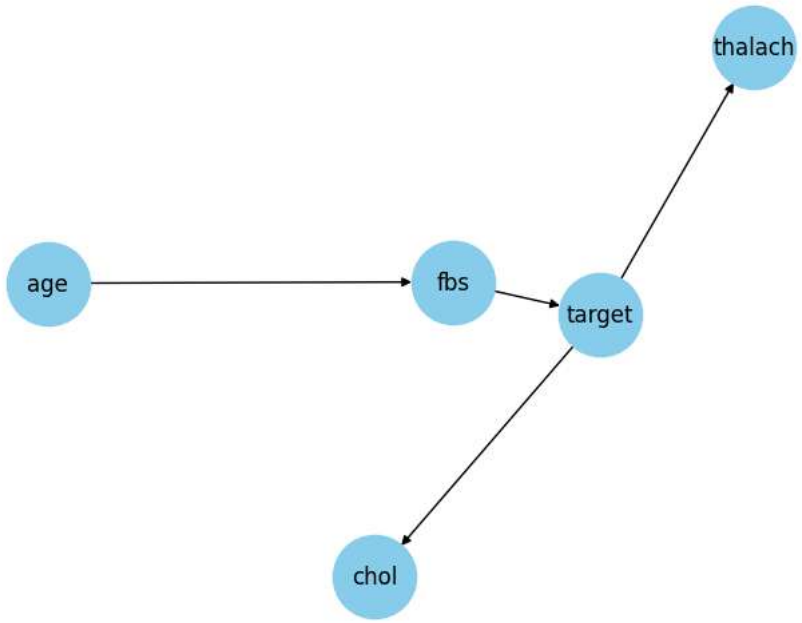
```
print("\n P(target | fbs = 1):")
print(infer.query(variables=["target"], evidence={"fbs": 1}))
```

```
 P(target | fbs = 1):
+-------------+---------------+
| target      |   phi(target) |
+=============+===============+
| target(0.0) |        0.4889 |
+-------------+---------------+
| target(1.0) |        0.5111 |
+-------------+---------------+
```

```
plt.figure(figsize=(8, 6))
G = nx.DiGraph()
G.add_edges_from(model.edges)
```

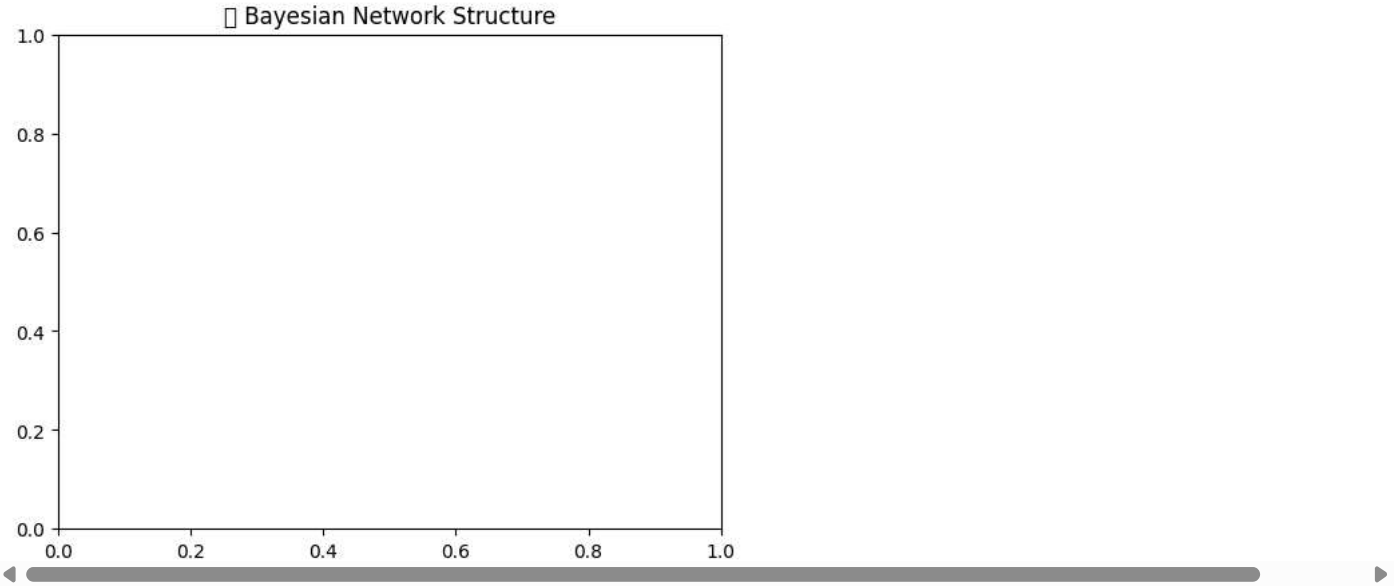
```
<Figure size 800x600 with 0 Axes>
```

```
nx.draw(G, with_labels=True, node_color="skyblue", node_size=2000, font_size=12, arrows=True)
```




```
plt.title("📊 Bayesian Network Structure")
plt.savefig("bayesian_network.png")
```

```
/tmp/ipython-input-17-15972331.py:2: UserWarning: Glyph 128202 (\N{BAR CHART}) missing from font(s) DejaVu Sans.
  plt.savefig("bayesian_network.png")
/usr/local/lib/python3.11/dist-packages/IPython/core/pylabtools.py:151: UserWarning: Glyph 128202 (\N{BAR CHART}) missing from font(s) D
  fig.canvas.print_figure(bytes_io, **kw)
```



```
infer = VariableElimination(model)


age_levels = ['low', 'medium', 'high']
chol_levels = ['low', 'medium', 'high']


print("P(target | age)")
```

```
P(target | age)
```

```
for level in age_levels:
    q = infer.query(variables=['target'], evidence={'age': level})
    print(f"age = {level} →\n{q}")
```

```
age = low →
+-------------+---------------+
| target      |   phi(target) |
+=============+===============+
| target(0.0) |        0.4534 |
+-------------+---------------+
| target(1.0) |        0.5466 |
+-------------+---------------+
age = medium →
+-------------+---------------+
| target      |   phi(target) |
+=============+===============+
| target(0.0) |        0.4578 |
+-------------+---------------+
| target(1.0) |        0.5422 |
+-------------+---------------+
age = high →
+-------------+---------------+
| target      |   phi(target) |
+=============+===============+
| target(0.0) |        0.4577 |
+-------------+---------------+
| target(1.0) |        0.5423 |
+-------------+---------------+
```

```
print("\nP(target | chol)")
```

```

P(target | chol)
```

```
for level in chol_levels:
    q = infer.query(variables=['target'], evidence={'chol': level})
    print(f"chol = {level} →\n{q}")
```

```
chol = low →
+-------------+---------------+
| target      |   phi(target) |
+=============+===============+
| target(0.0) |        0.4118 |
+-------------+---------------+
| target(1.0) |        0.5882 |
+-------------+---------------+
chol = medium →
+-------------+---------------+
| target      |   phi(target) |
+=============+===============+
| target(0.0) |        0.5875 |
+-------------+---------------+
| target(1.0) |        0.4125 |
+-------------+---------------+
chol = high →
+-------------+---------------+
| target      |   phi(target) |
+=============+===============+
| target(0.0) |        0.0000 |
+-------------+---------------+
| target(1.0) |        1.0000 |
+-------------+---------------+
```