In [31]:

```
cpd_a = TabularCPD(
    variable="A",
    variable_card=2,
    values=[[0.95, 0.98, 0.29, 0.001],[0.05, 0.06, 0.71, 0.999]],
    evidence=["R", "S"],
    evidence_card=[2, 2],
)

posterior_p1 = infer.query(['R'], evidence={'J': 1, 'M': 1})
print(posterior_p1)

posterior_p2 = infer.query(['R'], evidence={'J': 0, 'M': 0})
print(posterior_p2)

posterior_p3 = infer.query(['R'], evidence={'J': 1, 'M': 0})
print(posterior_p3)

posterior_p4 = infer.query(['R'], evidence={'J': 1, 'M': 0})
print(posterior_p4)
```

```
+------+----------+
| R    |   phi(R) |
+======+==========+
| R(0) |   0.0056 |
+------+----------+
| R(1) |   0.9944 |
+------+----------+
+------+----------+
| R    |   phi(R) |
+======+==========+
| R(0) |   0.0008 |
+------+----------+
| R(1) |   0.9992 |
+------+----------+
+------+----------+
| R    |   phi(R) |
+======+==========+
| R(0) |   0.0901 |
+------+----------+
| R(1) |   0.9099 |
+------+----------+
+------+----------+
| R    |   phi(R) |
+======+==========+
| R(0) |   0.0901 |
+------+----------+
| R(1) |   0.9099 |
+------+----------+
```

In [30]:

```
posterior_p3 = infer.query(['R'], evidence={'J': 1, 'M': 1})
print(posterior_p3)
```

```
+------+----------+
| R    |   phi(R) |
+======+==========+
| R(0) |   0.0056 |
+------+----------+
| R(1) |   0.9944 |
+------+----------+
```

In [27]:
```
posterior_p3 = infer.query(['R'], evidence={'J': 0, 'M': 0})
print(posterior_p3)
```

```
+------+----------+
| R    |   phi(R) |
+======+==========+
| R(0) |   0.0008 |
+------+----------+
| R(1) |   0.9992 |
+------+----------+
```

In [28]:
```
posterior_p2 = infer.query(['R'], evidence={'J': 1, 'M': 0})
#posterior_probability = infer.query(['R'], evidence={'J': 0, 'M': 0})
print(posterior_p2)
```

```
+------+----------+
| R    |   phi(R) |
+======+==========+
| R(0) |   0.0901 |
+------+----------+
| R(1) |   0.9099 |
+------+----------+
```

In [ ]:
```

```

In [29]:
```
posterior_p1 = infer.query(['R'], evidence={'J': 0, 'M': 1})
#posterior_probability = infer.query(['R'], evidence={'J': 1, 'M': 0})
#posterior_probability = infer.query(['R'], evidence={'J': 0, 'M': 0})
print(posterior_p1)
```

```
+------+----------+
| R    |   phi(R) |
+======+==========+
| R(0) |   0.0001 |
+------+----------+
| R(1) |   0.9999 |
+------+----------+
```

In [21]:
```
infer = VariableElimination(alarm_model)
```

In [20]:
```
from pgmpy.inference import VariableElimination
```

In [22]:
```
from pgmpy.inference import VariableElimination

infer = VariableElimination(alarm_model)
```

In [23]:
```
#posterior_p = infer.query(['R'], evidence={'J': 1, 'M': 1})
#print(posterior_p)
posterior_p = infer.query(["R"], evidence={"J": 1, "M": 0})
print(posterior_p)
#posterior_probability = infer.query(['R'], evidence={'J': 0, 'M': 1})
#posterior_probability = infer.query(['R'], evidence={'J': 1, 'M': 0})
#posterior_probability = infer.query(['R'], evidence={'J': 0, 'M': 0})
```

```
+------+----------+
| R    |   phi(R) |
+======+==========+
| R(0) |   0.0901 |
+------+----------+
| R(1) |   0.9099 |
+------+----------+
```

In [19]:
```
alarm_model.get_independencies()
```

Out[19]:
```
(M ⊥ J, S, R | A)
(M ⊥ S, R | A, J)
(M ⊥ J, R | A, S)
(M ⊥ J, S | A, R)
(M ⊥ R | A, S, J)
(M ⊥ S | R, A, J)
(M ⊥ J | A, S, R)
(J ⊥ S, M, R | A)
(J ⊥ M, R | A, S)
(J ⊥ S, R | A, M)
(J ⊥ S, M | A, R)
(J ⊥ R | A, S, M)
(J ⊥ M | A, S, R)
(J ⊥ S | A, M, R)
(S ⊥ R)
(S ⊥ J, M | A)
(S ⊥ M | A, J)
(S ⊥ J | A, M)
(S ⊥ J, M | A, R)
(S ⊥ M | R, A, J)
(S ⊥ J | A, M, R)
(R ⊥ S)
(R ⊥ J, M | A)
(R ⊥ M | J, A)
(R ⊥ J, M | A, S)
(R ⊥ J | A, M)
(R ⊥ M | J, S, A)
(R ⊥ J | A, S, M)
```

In [18]:
```
# Checking if the cpds are valid for the model
alarm_model.check_model()
```

Out[18]:
```
True
```

In [17]:
```
# Associating the parameters with the model structure
alarm_model.add_cpds(
    cpd_r, cpd_s, cpd_a, cpd_j, cpd_m
)
```

In [16]:
```
cpd_j = TabularCPD(
    variable="J",
    variable_card=2,
    values=[[0.1, 0.95], [0.9, 0.05]],
    evidence=["A"],
    evidence_card=[2],
)
```

```
cpd_m = TabularCPD(
    variable="M",
    variable_card=2,
    values=[[0.7, 0.1], [0.3, 0.9]],
    evidence=["A"],
    evidence_card=[2],
)
```

In [15]:

```
# Defining network structure

alarm_model = BayesianNetwork(
    [
        ("R", "A"),
        ("S", "A"),
        ("A", "J"),
        ("A", "M"),
    ]
)

# Defining the parameters using CPT
from pgmpy.factors.discrete import TabularCPD

cpd_r = TabularCPD(
    variable="R", variable_card=2, values=[[0.001], [0.999]]
)
cpd_s = TabularCPD(
    variable="S", variable_card=2, values=[[0.002], [0.998]]
)
cpd_a = TabularCPD(
    variable="A",
    variable_card=2,
    values=[[0.95, 0.94, 0.29, 0.001],[0.05, 0.06, 0.71, 0.999]],
    evidence=["R", "S"],
    evidence_card=[2, 2],
)
```

In [3]:

```
# Importing Library
from pgmpy.models import BayesianNetwork
from pgmpy.inference import VariableElimination
```

In [30]:

```
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
<ipython-input-30-e5815641b030> in <module>
----> 1 cpd_m = TabularCPD(
      2     variable="M",
      3     variable_card=2,
      4     values=[
      5         [0.70, 0.01],

~\anaconda3\lib\site-packages\pgmpy\factors\discrete\CPD.py in __init__(self, variable,
variable_card, values, evidence, evidence_card, state_names)
    118             variables.extend(evidence)
    119             if not len(evidence_card) == len(evidence):
--> 120                 raise ValueError(
    121                     "Length of evidence_card doesn't match length of evidence"
```

```
    122                 )

ValueError: Length of evidence_card doesn't match length of evidence
```

In [14]:
```
cpd_j = TabularCPD(
    variable="J",
    variable_card=2,
    values=[
        [0.90, 0.05],
        [0.10, 0.95],
    ],
    evidence=["R", "S"],
    evidence_card=[2,2],
)
```

```
---------------------------------------------------------------------------
ValueError                                Traceback (most recent call last)
<ipython-input-14-2cb80bc8b3e8> in <module>
----> 1 cpd_j = TabularCPD(
      2     variable="J",
      3     variable_card=2,
      4     values=[
      5         [0.90, 0.05],

~\anaconda3\lib\site-packages\pgmpy\factors\discrete\CPD.py in __init__(self, variable,
variable_card, values, evidence, evidence_card, state_names)
    131             expected_cpd_shape = (variable_card, np.product(evidence_card))
    132         if values.shape != expected_cpd_shape:
--> 133             raise ValueError(
    134                 f"values must be of shape {expected_cpd_shape}. Got shape: {valu
es.shape}"
    135             )

ValueError: values must be of shape (2, 4). Got shape: (2, 2)
```

In [13]:
```
cpd_a = TabularCPD(
    variable="A",
    variable_card=2,
    values=[
        [0.95, 0.94, 0.29, 0.001],
        [0.5, 0.06, 0.71, 0.999],
    ],
    evidence=["R", "S"],
    evidence_card=[2, 2],
)
```

In [12]:
```
cpd_r = TabularCPD(variable="R", variable_card=2, values=[[0.01], [0.99]])
cpd_s = TabularCPD(variable="S", variable_card=2, values=[[0.02], [0.98]])
```

In [11]:
```
from pgmpy.models import BayesianNetwork
from pgmpy.factors.discrete import TabularCPD
modelo = BayesianNetwork([("R", "A"), ("S", "A"), ("A", "J"), ("A", "M")])
```

In [54]:
```
posterior_p = infer.query(["C"], evidence={"U": 2, "A": 0})
print(posterior_p)
```

```
+------+----------+
| C    |   phi(C) |
+======+==========+
| C(0) |   0.0000 |
+------+----------+
| C(1) |   0.6667 |
+------+----------+
| C(2) |   0.3333 |
+------+----------+
```

In [53]:
```
posterior_p = infer.query(["C"], evidence={"U": 0, "A": 1})
print(posterior_p)
```

```
+------+----------+
| C    |   phi(C) |
+======+==========+
| C(0) |   0.3333 |
+------+----------+
| C(1) |   0.0000 |
+------+----------+
| C(2) |   0.6667 |
+------+----------+
```

In [52]:
```
posterior_p = infer.query(["C"], evidence={"U": 0, "A": 2})
print(posterior_p)
```

```
+------+----------+
| C    |   phi(C) |
+======+==========+
| C(0) |   0.3333 |
+------+----------+
| C(1) |   0.6667 |
+------+----------+
| C(2) |   0.0000 |
+------+----------+
```

In [ ]:
```

```

In [51]:
```
from pgmpy.inference import VariableElimination

infer = VariableElimination(modelo)
```

In [50]:
```
modelo.check_model()
```

Out[50]: True

In [ ]:
```
cpd_r = TabularCPD(variable="C", variable_card=2, values=[[0.1], [0.9]])
cpd_s = TabularCPD(variable="C", variable_card=2, values=[[0.33], [0.33]])
cpd_j = TabularCPD(variable="C", variable_card=2, values=[[0.33], [0.33]])
cpd_m = TabularCPD(variable="C", variable_card=2, values=[[0.33], [0.33]])
```

In [49]:
```
modelo.add_cpds(cpd_c, cpd_u, cpd_a)
```

In [ ]:

In [46]:
```
cpd_a = TabularCPD(
    variable="A",
    variable_card=3,
    values=[
        [0, 0, 0, 0, 0.5, 1, 0, 1, 0.5],
        [0.5, 0, 1, 0, 0, 0, 1, 0, 0.5],
        [0.5, 1, 0, 1, 0.5, 0, 0, 0, 0],
    ],
    evidence=["C", "U"],
    evidence_card=[3, 3],
)
```

In [45]:
```
cpd_c = TabularCPD(variable="C", variable_card=3, values=[[0.33], [0.33], [0.33]])
cpd_u = TabularCPD(variable="U", variable_card=3, values=[[0.33], [0.33], [0.33]])
```

In [3]:
```
from pgmpy.models import BayesianNetwork
from pgmpy.factors.discrete import TabularCPD
modelo = BayesianNetwork([("C", "A"), ("U", "A")])
```

In [6]:
```
conda install pytorch torchvision torchaudio cpuonly -c pytorch
```

```
Collecting package metadata (current_repodata.json): ...working... done
Solving environment: ...working... done

## Package Plan ##

  environment location: C:\Users\Usuario\anaconda3

  added / updated specs:
    - cpuonly
    - pytorch
    - torchaudio
    - torchvision


The following packages will be downloaded:

    package                    |            build
    ---------------------------|-----------------
    cpuonly-2.0                |                0           2 KB  pytorch
    libuv-1.40.0               |       he774522_0         255 KB
    pytorch-1.13.1             |      py3.8_cpu_0       135.8 MB  pytorch
    pytorch-mutex-1.0          |              cpu           3 KB  pytorch
    torchaudio-0.13.1          |         py38_cpu         4.5 MB  pytorch
    torchvision-0.14.1         |         py38_cpu         6.3 MB  pytorch
    ------------------------------------------------------------
                                           Total:       146.8 MB

The following NEW packages will be INSTALLED:

  cpuonly            pytorch/noarch::cpuonly-2.0-0
  libuv              pkgs/main/win-64::libuv-1.40.0-he774522_0
  pytorch            pytorch/win-64::pytorch-1.13.1-py3.8_cpu_0
  pytorch-mutex      pytorch/noarch::pytorch-mutex-1.0-cpu
```

```
  torchaudio          pytorch/win-64::torchaudio-0.13.1-py38_cpu
  torchvision         pytorch/win-64::torchvision-0.14.1-py38_cpu


Downloading and Extracting Packages

torchaudio-0.13.1    | 4.5 MB    |            |   0%
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Preparing transaction: ...working... done
Verifying transaction: ...working... done
Executing transaction: ...working... done

Note: you may need to restart the kernel to use updated packages.


==> WARNING: A newer version of conda exists. <==
  current version: 4.10.3
  latest version: 23.1.0

Please update conda by running

    $ conda update -n base -c defaults conda
```

In [31]:

```
from pgmpy.factors.discrete import TabularCPD
```

In [30]:

```
from pgmpy.models import BayesianNetwork
```

In [3]:
```
!pip install scipy
!pip install scikit-learn
!pip install pandas
!pip install pyparsing
!pip install statsmodels
!pip install tqdm
!pip install joblib
```

```
Requirement already satisfied: scipy in c:\users\usuario\anaconda3\lib\site-packages (1.
6.2)
Requirement already satisfied: numpy<1.23.0,>=1.16.5 in c:\users\usuario\anaconda3\lib\s
ite-packages (from scipy) (1.20.1)
Requirement already satisfied: scikit-learn in c:\users\usuario\anaconda3\lib\site-packa
ges (0.24.1)
Requirement already satisfied: scipy>=0.19.1 in c:\users\usuario\anaconda3\lib\site-pack
ages (from scikit-learn) (1.6.2)
Requirement already satisfied: joblib>=0.11 in c:\users\usuario\anaconda3\lib\site-packa
ges (from scikit-learn) (1.0.1)
Requirement already satisfied: numpy>=1.13.3 in c:\users\usuario\anaconda3\lib\site-pack
ages (from scikit-learn) (1.20.1)
Requirement already satisfied: threadpoolctl>=2.0.0 in c:\users\usuario\anaconda3\lib\si
te-packages (from scikit-learn) (2.1.0)
Requirement already satisfied: pandas in c:\users\usuario\anaconda3\lib\site-packages
(1.2.4)
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ages (from pandas) (1.20.1)
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ges (from pandas) (2021.1)
Requirement already satisfied: python-dateutil>=2.7.3 in c:\users\usuario\anaconda3\lib
\site-packages (from pandas) (2.8.1)
Requirement already satisfied: six>=1.5 in c:\users\usuario\anaconda3\lib\site-packages
(from python-dateutil>=2.7.3->pandas) (1.15.0)
Requirement already satisfied: pyparsing in c:\users\usuario\anaconda3\lib\site-packages
(2.4.7)
Collecting pytorch
```

```
  ERROR: Command errored out with exit status 1:
   command: 'C:\Users\Usuario\anaconda3\python.exe' -u -c 'import sys, setuptools, token
ize; sys.argv[0] = '"'"'C:\\Users\\Usuario\\AppData\\Local\\Temp\\pip-install-0sx7up_c
\\pytorch_7c765d92d1ca4b0baad84b1db8df222a\\setup.py'"'"'; __file__='"'"'C:\\Users\\Usua
rio\\AppData\\Local\\Temp\\pip-install-0sx7up_c\\pytorch_7c765d92d1ca4b0baad84b1db8df222
a\\setup.py'"'"';f=getattr(tokenize, '"'"'open'"'"', open)(__file__);code=f.read().repla
ce('"'"'\r\n'"'"', '"'"'\n'"'"');f.close();exec(compile(code, __file__, '"'"'exe
c'"'"'))' bdist_wheel -d 'C:\Users\Usuario\AppData\Local\Temp\pip-wheel-jufn7qo0'
       cwd: C:\Users\Usuario\AppData\Local\Temp\pip-install-0sx7up_c\pytorch_7c765d92d1c
a4b0baad84b1db8df222a\
  Complete output (5 lines):
  Traceback (most recent call last):
    File "<string>", line 1, in <module>
    File "C:\Users\Usuario\AppData\Local\Temp\pip-install-0sx7up_c\pytorch_7c765d92d1ca4
b0baad84b1db8df222a\setup.py", line 15, in <module>
      raise Exception(message)
  Exception: You tried to install "pytorch". The package named for PyTorch is "torch"
  ----------------------------------------
  ERROR: Failed building wheel for pytorch
    ERROR: Command errored out with exit status 1:
     command: 'C:\Users\Usuario\anaconda3\python.exe' -u -c 'import sys, setuptools, tok
enize; sys.argv[0] = '"'"'C:\\Users\\Usuario\\AppData\\Local\\Temp\\pip-install-0sx7up_c
\\pytorch_7c765d92d1ca4b0baad84b1db8df222a\\setup.py'"'"'; __file__='"'"'C:\\Users\\Usua
rio\\AppData\\Local\\Temp\\pip-install-0sx7up_c\\pytorch_7c765d92d1ca4b0baad84b1db8df222
a\\setup.py'"'"';f=getattr(tokenize, '"'"'open'"'"', open)(__file__);code=f.read().repla
ce('"'"'\r\n'"'"', '"'"'\n'"'"');f.close();exec(compile(code, __file__, '"'"'exe
c'"'"'))' install --record 'C:\Users\Usuario\AppData\Local\Temp\pip-record-binqw168\inst
```

```
all-record.txt' --single-version-externally-managed --compile --install-headers 'C:\User
s\Usuario\anaconda3\Include\pytorch'
         cwd: C:\Users\Usuario\AppData\Local\Temp\pip-install-0sx7up_c\pytorch_7c765d92d
1ca4b0baad84b1db8df222a\
    Complete output (5 lines):
    Traceback (most recent call last):
      File "<string>", line 1, in <module>
      File "C:\Users\Usuario\AppData\Local\Temp\pip-install-0sx7up_c\pytorch_7c765d92d1c
a4b0baad84b1db8df222a\setup.py", line 11, in <module>
        raise Exception(message)
    Exception: You tried to install "pytorch". The package named for PyTorch is "torch"
    ----------------------------------------
ERROR: Command errored out with exit status 1: 'C:\Users\Usuario\anaconda3\python.exe' -
u -c 'import sys, setuptools, tokenize; sys.argv[0] = '"'"'C:\\Users\\Usuario\\AppData
\\Local\\Temp\\pip-install-0sx7up_c\\pytorch_7c765d92d1ca4b0baad84b1db8df222a\\setup.p
y'"'"'; __file__='"'"'C:\\Users\\Usuario\\AppData\\Local\\Temp\\pip-install-0sx7up_c\\py
torch_7c765d92d1ca4b0baad84b1db8df222a\\setup.py'"'"';f=getattr(tokenize, '"'"'ope
n'"'"', open)(__file__);code=f.read().replace('"'"'\r\n'"'"', '"'"'\n'"'"');f.close();ex
ec(compile(code, __file__, '"'"'exec'"'"'))' install --record 'C:\Users\Usuario\AppData
\Local\Temp\pip-record-binqw168\install-record.txt' --single-version-externally-managed
--compile --install-headers 'C:\Users\Usuario\anaconda3\Include\pytorch' Check the logs
for full command output.
  Downloading pytorch-1.0.2.tar.gz (689 bytes)
Building wheels for collected packages: pytorch
  Building wheel for pytorch (setup.py): started
  Building wheel for pytorch (setup.py): finished with status 'error'
  Running setup.py clean for pytorch
Failed to build pytorch
Installing collected packages: pytorch
    Running setup.py install for pytorch: started
    Running setup.py install for pytorch: finished with status 'error'
Requirement already satisfied: statsmodels in c:\users\usuario\anaconda3\lib\site-packag
es (0.12.2)
Requirement already satisfied: numpy>=1.15 in c:\users\usuario\anaconda3\lib\site-packag
es (from statsmodels) (1.20.1)
Requirement already satisfied: scipy>=1.1 in c:\users\usuario\anaconda3\lib\site-package
s (from statsmodels) (1.6.2)
Requirement already satisfied: pandas>=0.21 in c:\users\usuario\anaconda3\lib\site-packa
ges (from statsmodels) (1.2.4)
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s (from statsmodels) (0.5.1)
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\site-packages (from pandas>=0.21->statsmodels) (2.8.1)
Requirement already satisfied: six in c:\users\usuario\anaconda3\lib\site-packages (from
patsy>=0.5->statsmodels) (1.15.0)
Requirement already satisfied: tqdm in c:\users\usuario\anaconda3\lib\site-packages (4.5
9.0)
Requirement already satisfied: joblib in c:\users\usuario\anaconda3\lib\site-packages
(1.0.1)
```

In [2]:

```
!pip install numpy
```

```
Requirement already satisfied: numpy in c:\users\usuario\anaconda3\lib\site-packages (1.
20.1)
```

In [1]:

```
!pip install pgmpy
```

```
Collecting pgmpy
  Downloading pgmpy-0.1.21-py3-none-any.whl (1.9 MB)
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om pgmpy) (1.6.2)
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rom pgmpy) (1.2.4)
Requirement already satisfied: tqdm in c:\users\usuario\anaconda3\lib\site-packages (fro
m pgmpy) (4.59.0)
Requirement already satisfied: pyparsing in c:\users\usuario\anaconda3\lib\site-packages
(from pgmpy) (2.4.7)
Collecting torch
  Downloading torch-1.13.1-cp38-cp38-win_amd64.whl (162.6 MB)
Requirement already satisfied: joblib in c:\users\usuario\anaconda3\lib\site-packages (f
rom pgmpy) (1.0.1)
Requirement already satisfied: statsmodels in c:\users\usuario\anaconda3\lib\site-packag
es (from pgmpy) (0.12.2)
Collecting opt-einsum
  Downloading opt_einsum-3.3.0-py3-none-any.whl (65 kB)
Requirement already satisfied: networkx in c:\users\usuario\anaconda3\lib\site-packages
(from pgmpy) (2.5)
Requirement already satisfied: scikit-learn in c:\users\usuario\anaconda3\lib\site-packa
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Requirement already satisfied: decorator>=4.3.0 in c:\users\usuario\anaconda3\lib\site-p
ackages (from networkx->pgmpy) (4.4.2)
Requirement already satisfied: python-dateutil>=2.7.3 in c:\users\usuario\anaconda3\lib
\site-packages (from pandas->pgmpy) (2.8.1)
Requirement already satisfied: pytz>=2017.3 in c:\users\usuario\anaconda3\lib\site-packa
ges (from pandas->pgmpy) (2021.1)
Requirement already satisfied: six>=1.5 in c:\users\usuario\anaconda3\lib\site-packages
(from python-dateutil>=2.7.3->pandas->pgmpy) (1.15.0)
Requirement already satisfied: threadpoolctl>=2.0.0 in c:\users\usuario\anaconda3\lib\si
te-packages (from scikit-learn->pgmpy) (2.1.0)
Requirement already satisfied: patsy>=0.5 in c:\users\usuario\anaconda3\lib\site-package
s (from statsmodels->pgmpy) (0.5.1)
Requirement already satisfied: typing-extensions in c:\users\usuario\anaconda3\lib\site-
packages (from torch->pgmpy) (3.7.4.3)
Installing collected packages: torch, opt-einsum, pgmpy
Successfully installed opt-einsum-3.3.0 pgmpy-0.1.21 torch-1.13.1
```