Gui.py

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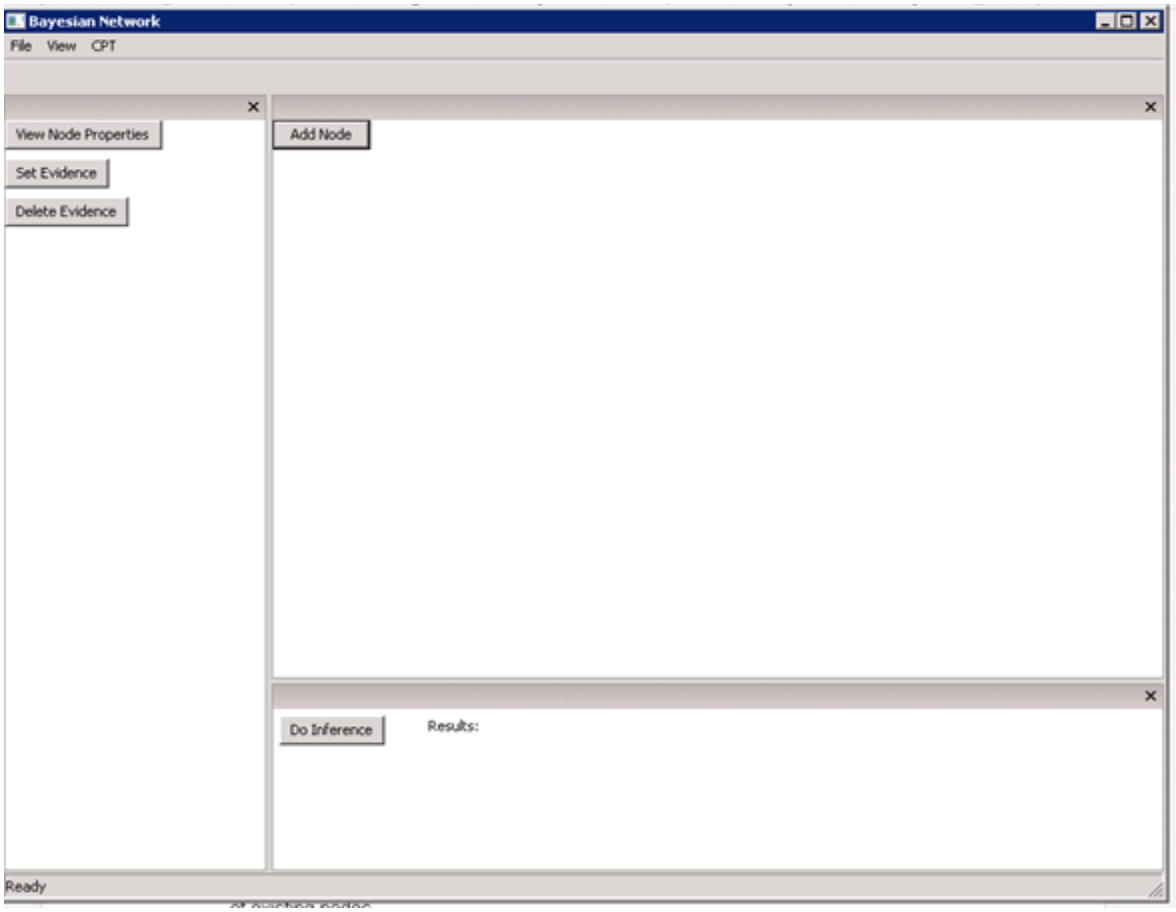
Description:

Gui.py is a module for implementing a simple GUI for BayesianNetwork.py. It has the ability to add, delete, input nodes in a bayesian network as well as to do inference on various nodes. **Note: This application was built with the Phoenix edition of wxPython and is optimized to run on Python 3.3 or later. There could be compatibility issues using older versions of wx or Python.**

The Layout of the GUI is divided into four areas:

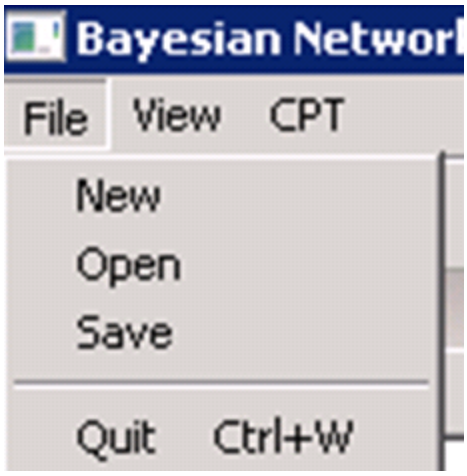
- Menus
- Draw Panel
- Evidence Panel
- Inference Panel



Menus

File:

- **Open:** Open allows the user to open a JSON file and load an existing network into the module.
- **Save:** Save allows the user to save the current network into a JSON file.
- **Quit:** Quit the application.

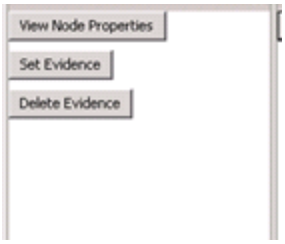


Draw Panel

- Draw Panel draws the nodes in the form of circles and connects the nodes with lines.

Evidence Panel

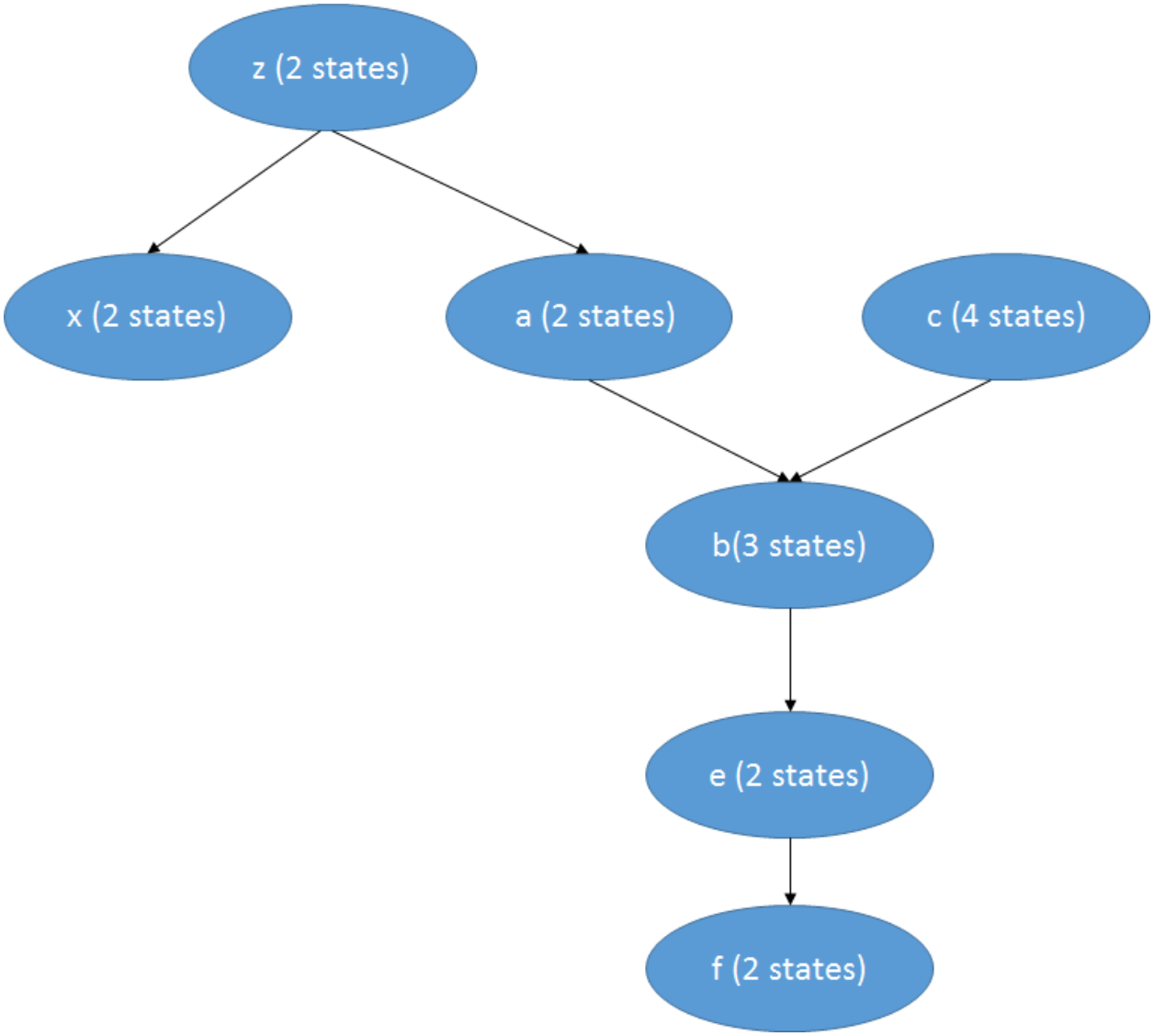
- Evidence Panel allows the user to input evidence in the network and also view properties of existing nodes



Inference Panel

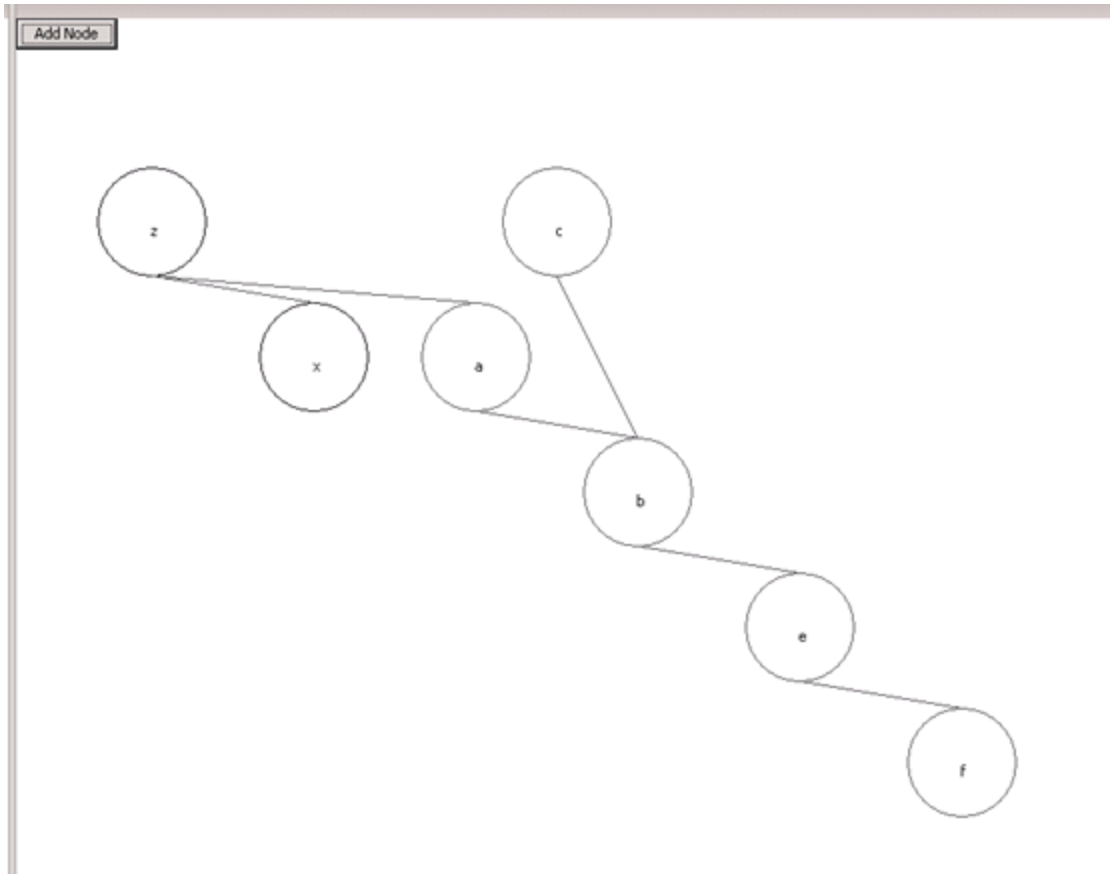
- Inference Panel allows the user to click on the ‘Do Inference’ button and the inference panel displays the marginal probability distributions of the nodes after setting up the evidence in the evidence panel.

The following example is used throughout this documentation:


z (2 states)
x (2 states)
a (2 states)
c (4 states)
b(3 states)
e (2 states)
f (2 states)

Output from gui.py:

Note: The child node is always below the parent node and the line is drawn from the parent to the child node.



The marginal and conditional for the network shown above:
P(z):

z1	z2
0.45	0.55

P(x):

	z1	z2
x1	0.52	0.85
x2	0.48	0.15

P(a):

	z1	z2
a1	0.32	0.25
a2	0.68	0.75

P(c):

c1	c2	c3	c4
0.1	0.2	0.3	0.4

P(b):

	a1c1	a1c2	a1c3	a1c4	a2c1	a2c2	a2c3	a2c4
b1	0.2	0.1	0.01	0.2	0.33	0.3	0.2	0.9
b2	0.4	0.5	0.01	0.1	0.33	0.1	0.7	0.05
b3	0.4	0.4	0.98	0.7	0.34	0.6	0.1	0.05

P(e)

	b1	b2	b3
e1	0.1	0.3	0.6
e2	0.9	0.7	0.4

P(f):

	e1	e2
f1	0.2	0.55
f2	0.8	0.45

Program Inputs and Outputs:

JSON Formatting:

Two methods are available for building and initializing a network:

1. Creating a network from scratch using the ‘Add Node’ button
2. Calling the ‘Open’ function from the ‘File’ dropdown which allows for loading in an existing network in the specified JSON format

the program

For the first method,one JSON file is needed:

- Format:
  [{"Name": "Node_Name","Parents":[List of Parent Nodes],"States":[State_Names],"cpt": [Marginal or Conditional Probabilities]}]

- Example:
  For parent Node “z”:
  {"Name": "z","Parents":[],"States":["z1","z2"],"cpt": [0.45, 0.55]}
  For child Node “x”:
  {"Name": "x","Parents":["z"],"States":["x1","x2"],"cpt": [[0.52, 0.48],[0.85,0.15]]}

  Above two examples (dictionaries) will be stored in a list, resulting in a list of dictionaries (each dictionary represents one node

Notes:

- **Conditional probabilities for child node must respect order that parent nodes were input.**
- **Parent nodes must be entered in the JSON file before their children**
- Example: For the child node ‘b’ with parents ‘a’ and ‘c’

Test Case:

If the user would like to load pre-existing ‘nodes’ and ‘network’ JSON files, set evidence, do inference,and save a network, the following lines of instructions can be followed:
--click on the ‘Open’ under the file to load the network.
--click on the ‘Set Evidence’ and choose the node from the drop-down combobox.
--select the state for evidence
--click on the ‘Do Inference’ on the bottom panel

Example:

We have the option of starting out with a partially built network (input.JSON) and add/delete nodes to it or start out from scratch. In this example we start out with a partial network of 3 nodes (z,a,x)
corresponding to the figure shown above:

z->a and z->x

The input json that contains this partial network will look like this:
[{"Name": "z","Parents":[],"States":["z1","z2"],"cpt": [0.45, 0.55]},{"Name": "x","Parents":["z"],"States":["x1","x2"],"cpt": [[0.52, 0.48],[0.85,0.15]]},

{"Name": "a","Parents":["z"],"States":["a1","a2"],"cpt":[[0.32, 0.68],[0.25,0.75]]}]

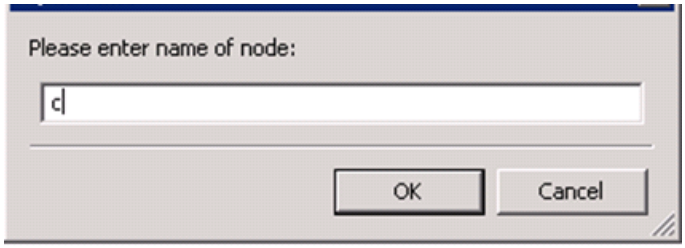
Note: To build the JSON file please enter information for the parent nodes prior to information for the child nodes.

We will now build this network to the complete one shown in the figure above. We will run an inference based on user provided evidence and then build an output json that captures nodes and probabilities for the full network.

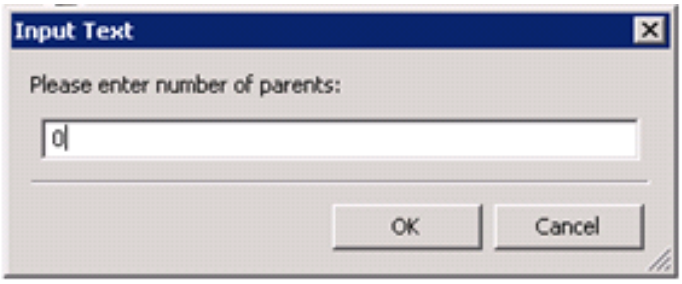
Since we will be adding four additional nodes we will click on 'Add Node' button in the main panel.

Note: We must work our way from the top to the bottom. (user input shown in orange) The conditional probability that is being inputted must respect the order in which the parents were input.

-click on 'Add Node' and it opens up :"Please enter the name of the node': c



-click on 'OK' and it opens up: "Please enter number of parents': 0



-click on 'OK' and it opens up: "Please enter number of states': 4
-click on 'OK' and it opens up: 'Please enter name for state 1': c1
-click on 'OK' and it opens up:'Please enter name for state 2': c2
-click on 'OK' and it opens up:'Please enter name for state 3': c3
-click on 'OK' and it opens up:'Please enter name for state 4': c4
-click on 'OK' and it opens up:'Please enter probability distribution': [0.1, 0.2, 0.3, 0.4]

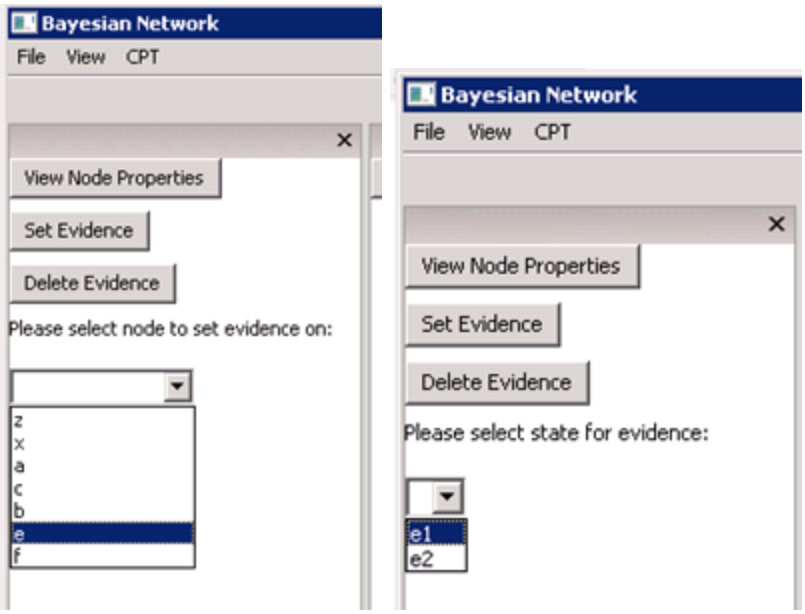
-click on 'Add Node' and it opens up :"Please enter the name of the node': b
-click on 'OK' and it opens up: "Please enter number of parents': 2
-click on 'OK' and it opens up: "Please enter name of parent 1': a

-click on ‘OK’ and it opens up: “Please enter name of parent 2’: c
-click on ‘OK’ and it opens up: “Please enter number of states’: 3
-click on ‘OK’ and it opens up: ‘Please enter name for state 1’: b1
-click on ‘OK’ and it opens up:’Please enter name for state 2’: b2
-click on ‘OK’ and it opens up:’Please enter name for state 3’: b3
-click on ‘OK’ and it opens up:’Please enter probability distribution (order of parents must be respected)’:
[[[0.2 , 0.4 , 0.4],[0.33, 0.33, 0.34]],[[0.1 , 0.5 , 0.4],[0.3 , 0.1 , 0.6]],[[0.01, 0.01, 0.98],[0.2 , 0.7 , 0.1]],[[0.2 , 0.1 , 0.7],[0.9 , 0.05, 0.05]]]

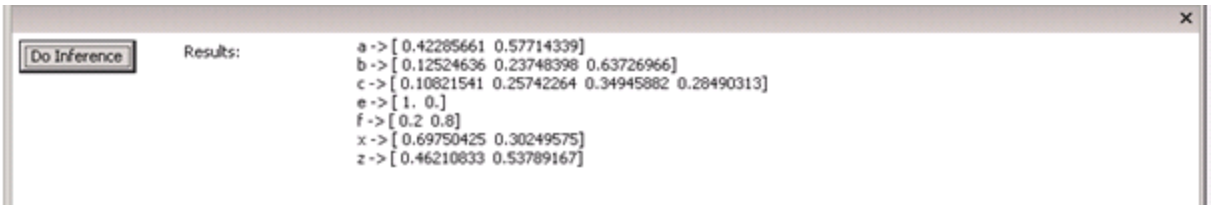
-click on ‘Add Node’ and it opens up :”Please enter the name of the node’: e
-click on ‘OK’ and it opens up: “Please enter number of parents’: 1
-click on ‘OK’ and it opens up: “Please enter name of parent 1’: b
-click on ‘OK’ and it opens up: “Please enter number of states’: 2
-click on ‘OK’ and it opens up: ‘Please enter name for state 1’: e1
-click on ‘OK’ and it opens up:’Please enter name for state 2’: e2
-click on ‘OK’ and it opens up:’Please enter probability distribution’:
[[.1, .9],[.3,.7],[.6,.4]]

-click on ‘Add Node’ and it opens up :”Please enter the name of the node’: f
-click on ‘OK’ and it opens up: ‘Please enter number of parents’: 1
-click on ‘OK’ and it opens up: ‘Please enter name of parent 1’: e
-click on ‘OK’ and it opens up: ‘Please enter number of states’: 2
-click on ‘OK’ and it opens up: ‘Please enter name for state 1’: f1
-click on ‘OK’ and it opens up:’Please enter name for state 2’: f2
-click on ‘OK’ and it opens up:’Please enter probability distribution’:
[[.2, .8],[.55,.45]]

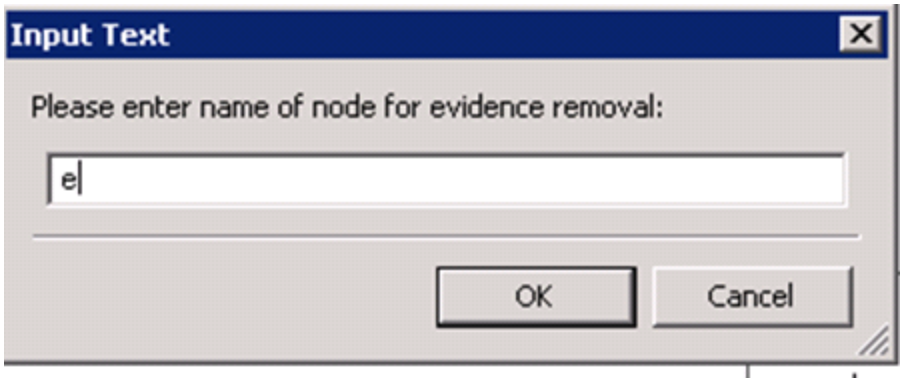
Now that we have built the network lets run an inference on it.
-click on ‘Set Evidence’ and it opens up: ‘Please select node to set evidence on’: e
-’Please select state for evidence’: e1



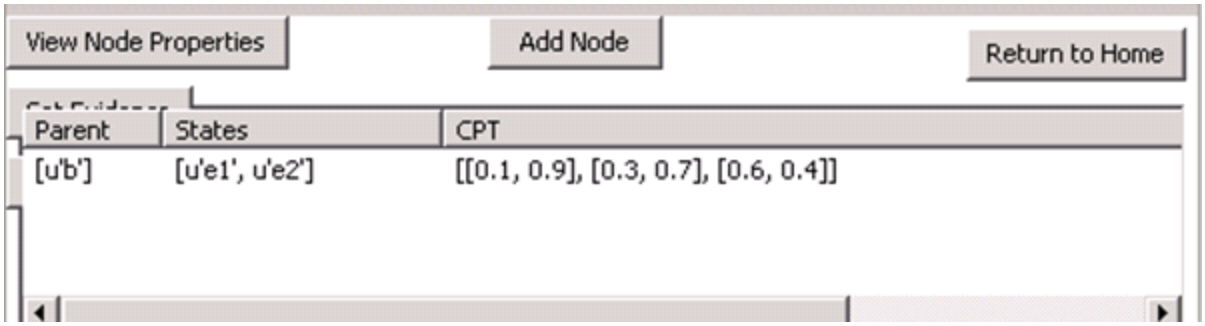
-click on ’Do Inference’



To delete an evidence:
-click on ‘Delete Evidence’ and it pops up: ‘Please enter name of node for evidence removal:e



To view properties of a node:
-click on ‘View Properties’ and select the node to view:e

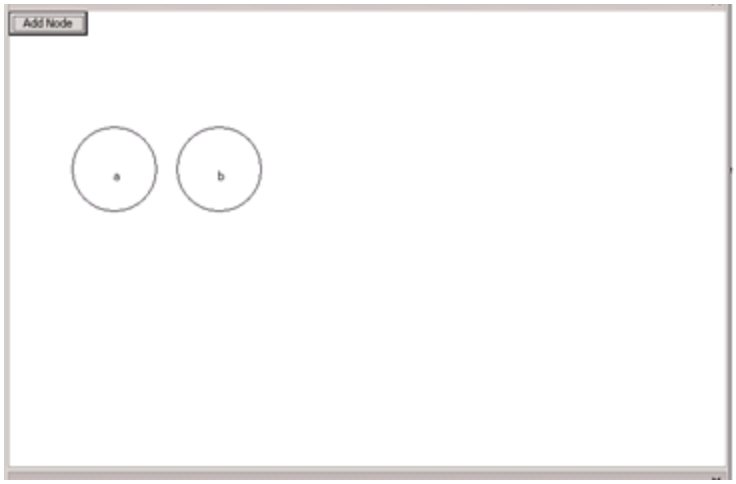


Additonal Example: Test Network

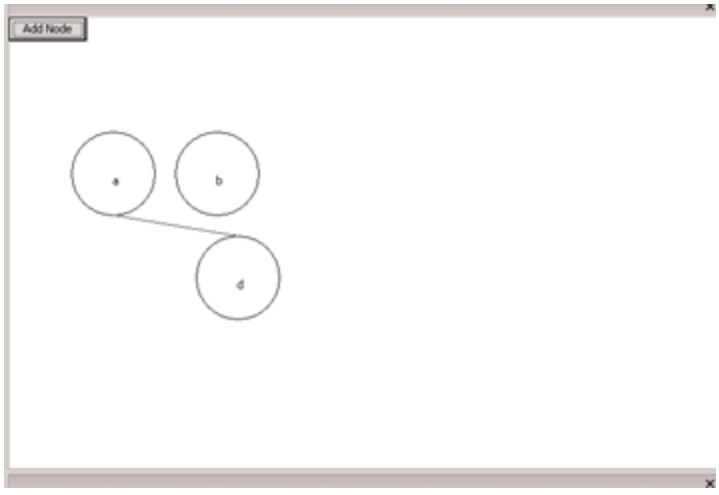
Step 1: Create the network (or load from test_network.JSON file)

-click on ‘Add Node’ and it opens up :”Please enter the name of the node’: a
-click on ‘OK’ and it opens up: “Please enter number of parents’: 0
-click on ‘OK’ and it opens up: “Please enter number of states’: 4
-click on ‘OK’ and it opens up: ‘Please enter name for state 1’: a1
-click on ‘OK’ and it opens up:’Please enter name for state 2’: a2
-click on ‘OK’ and it opens up:’Please enter name for state 3’: a3
-click on ‘OK’ and it opens up:’Please enter name for state 3’: a4
-click on ‘OK’ and it opens up:’Please enter probability distribution’:
[.1,.2,.3,.4]

-click on ‘Add Node’ and it opens up :”Please enter the name of the node’: b
-click on ‘OK’ and it opens up: “Please enter number of parents’: 0
-click on ‘OK’ and it opens up: “Please enter number of states’: 5
-click on ‘OK’ and it opens up: ‘Please enter name for state 1’: b1
-click on ‘OK’ and it opens up:’Please enter name for state 2’: b2
-click on ‘OK’ and it opens up:’Please enter name for state 3’: b3
-click on ‘OK’ and it opens up:’Please enter name for state 4’: b4
-click on ‘OK’ and it opens up:’Please enter name for state 5’: b5
-click on ‘OK’ and it opens up:’Please enter probability distribution’:
[.1,.2,.4,.2,.1]

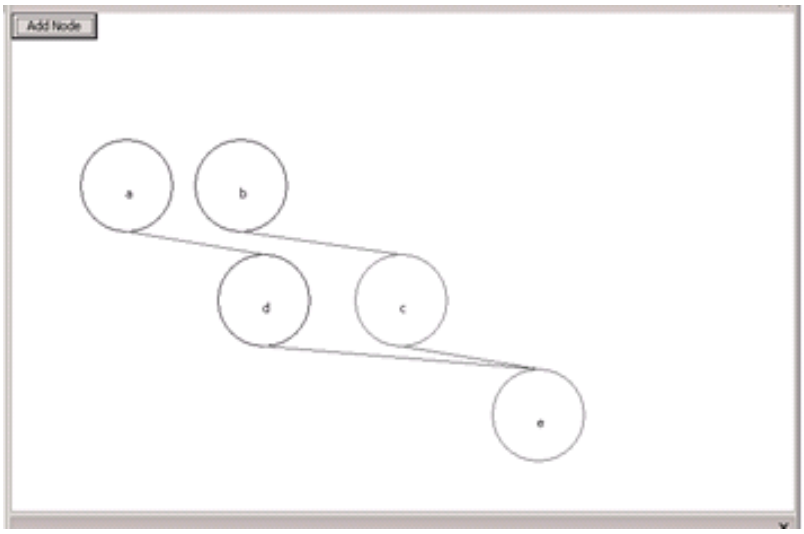


-click on ‘Add Node’ and it opens up :”Please enter the name of the node’: d
-click on ‘OK’ and it opens up: “Please enter number of parents’: 1
-click on ‘OK’ and it opens up: “Please enter name of parent 1’: a
-click on ‘OK’ and it opens up: “Please enter number of states’: 4
-click on ‘OK’ and it opens up: ‘Please enter name for state 1’: d1
-click on ‘OK’ and it opens up:’Please enter name for state 2’: d2
-click on ‘OK’ and it opens up:’Please enter name for state 3’: d3
-click on ‘OK’ and it opens up:’Please enter name for state 3’: d4
-click on ‘OK’ and it opens up:’Please enter probability distribution’:
[[.4,.2,.1,.3],[.3,.1,.2,.4],[.2,.1,.6,.1],[.1,.7,.1,.1]]



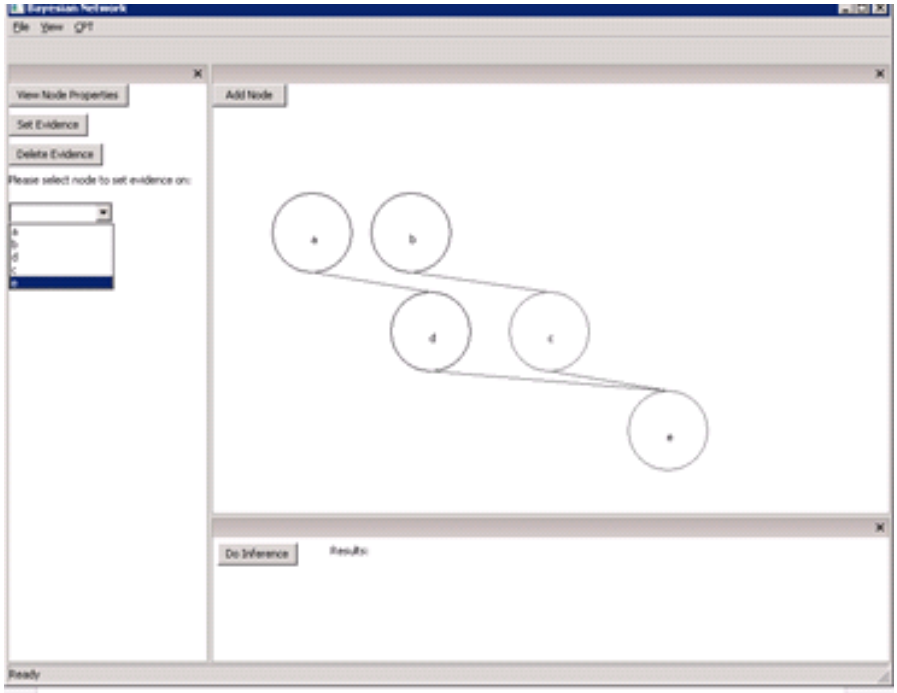
-click on ‘Add Node’ and it opens up :”Please enter the name of the node’: c
-click on ‘OK’ and it opens up: “Please enter number of parents’: 1
-click on ‘OK’ and it opens up: “Please enter name of parent 1’: b
-click on ‘OK’ and it opens up: “Please enter number of states’: 3
-click on ‘OK’ and it opens up: ‘Please enter name for state 1’: c1
-click on ‘OK’ and it opens up:’Please enter name for state 2’: c2
-click on ‘OK’ and it opens up:’Please enter name for state 3’: c3
-click on ‘OK’ and it opens up:’Please enter probability distribution’:
[[.1,.2,.7],[.1,.6,.3],[.3,.1,.6],[.4,.5,.1],[.1,.8,.1]]

-click on ‘Add Node’ and it opens up :”Please enter the name of the node’: e
-click on ‘OK’ and it opens up: “Please enter number of parents’: 2
-click on ‘OK’ and it opens up: “Please enter name of parent 1’: d
-click on ‘OK’ and it opens up: “Please enter name of parent 2’: c
-click on ‘OK’ and it opens up: “Please enter number of states’: 2
-click on ‘OK’ and it opens up: ‘Please enter name for state 1’: e1
-click on ‘OK’ and it opens up:’Please enter name for state 2’: e2
-click on ‘OK’ and it opens up:’Please enter probability distribution (order of parents must be respected)’:
[[[.1,.9],[.3,.7],[.5,.5],[.7,.3]],[[.5,.5],[.6,.4],[.7,.3],[.8,.2]],[[.9,.1],[.8,.2],[.7,.3],[.6,.4]]]



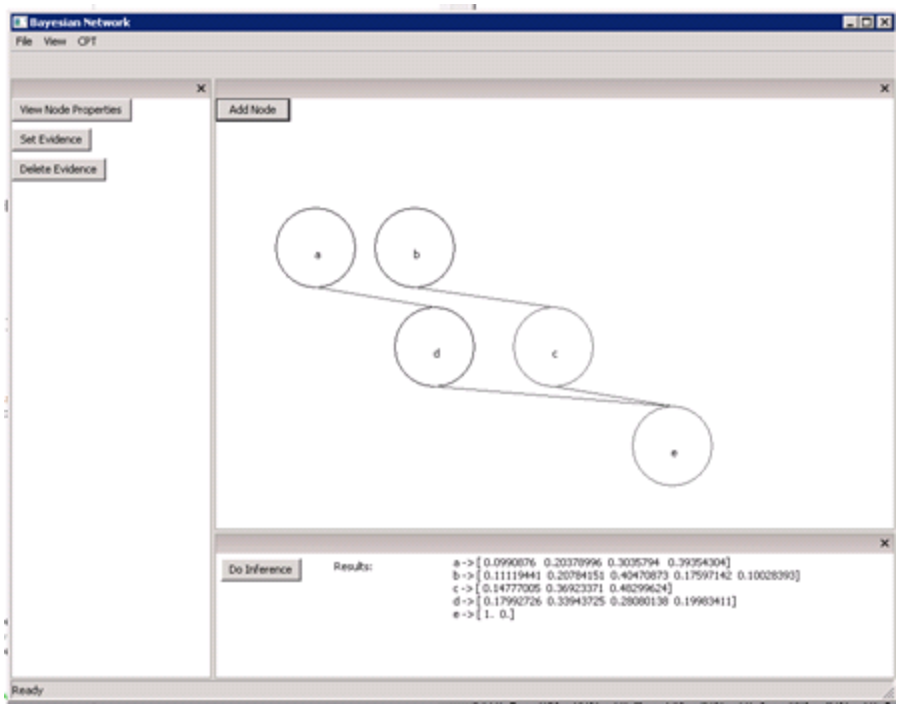
Step 2: Set Evidence on Node E, setting it to value e1

-click on ‘Set Evidence’ and it opens up: ‘Please select node to set evidence on’: e
-’Please select state for evidence’: e1



Step 3: Do Inference

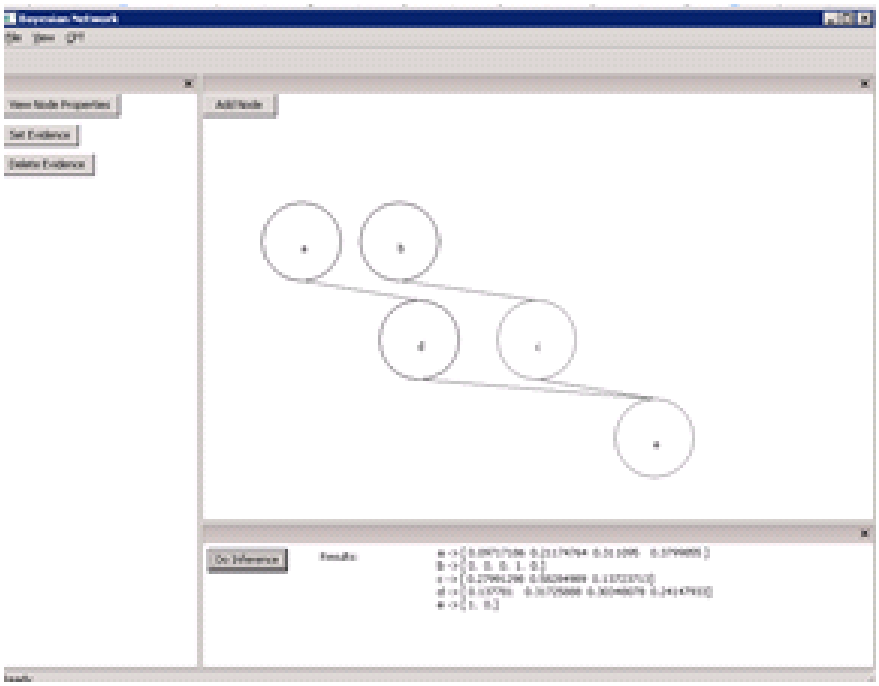
-click on ‘Do Inference’



Step 4: Set Evidence on Node b, setting it to value b4

-click on ‘Set Evidence’ and it opens up: ‘Please select node to set evidence on’: b
-’Please select state for evidence’: b4

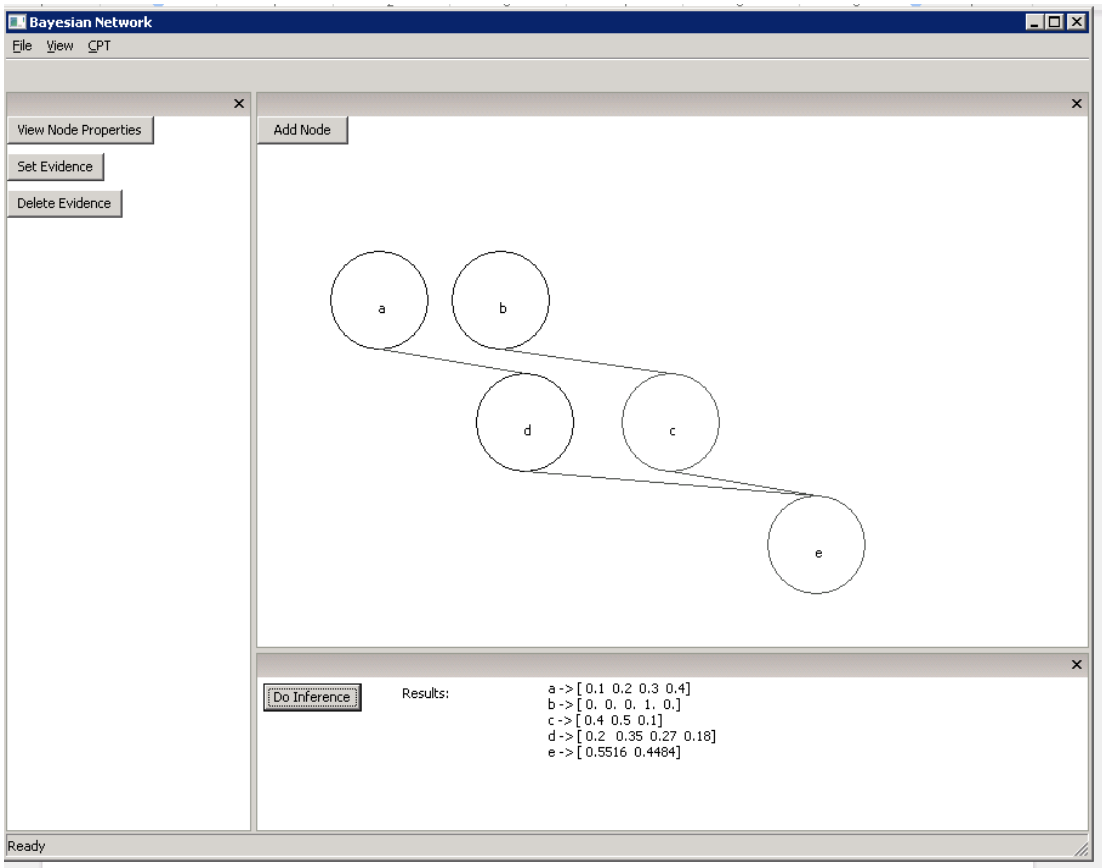
Step 5: Do Inference
-click on ‘Do Inference’



Step 6: Delete Evidence on Node e

-click on ‘Delete Evidence’ and it opens up: ‘Please enter name of node for evidence removal’: e

Step 7: Do Inference
-click on ‘Do Inference’


Bayesian Network
File View CPT
View Node Properties
Set Evidence
Delete Evidence
Add Node
a
b
d
c
e
Do Inference
Results:
a -> [0.1 0.2 0.3 0.4]
b -> [0. 0. 0. 1. 0.]
c -> [0.4 0.5 0.1]
d -> [0.2 0.35 0.27 0.18]
e -> [0.5516 0.4484]
Ready