**BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI**

Batch No. :

**DEPARTMENT OF COMPUTER SCIENCE AND INFORMATION SYSTEMS**

**Artificial Intelligence (BITS F444/ CS F407)**

**I Semester 2017-18**

**Programming Assignment-5**

**Coding Details**

**(November 28, 2017)**

*Instruction: Type the details precisely and neatly*

1. ID : 2015A7PS0072P

Name: Bhavanam Sravan Kumar Reddy

1. Mention the names of Submitted files :
   1. <main.py>
   2. <logic.py>
   3. <gui.py>
   4. <input1.txt>
   5. <input2.txt>
   6. <2015A7PS0072P.docx>
2. Total number of submitted files: 6
3. Name of the folder : 2015A7PS0072P
4. Have you checked that all the files you are submitting have your name in the top? (Yes)
5. Have you checked that all the files you are submitting are in the folder as specified in 4 (and no subfolder exists)? (Yes)
6. Modules implemented
   1. Created the Bayesian network? (Yes)
   2. Created Markov blanket? (Yes)
   3. Created expression from the inputs read? (Yes)
   4. Computed probability? (Yes)
7. Data structures used
   1. To represent the Bayesian network: A class called “BayesianNetwork” was defined. It includes a node list where all the nodes of the Bayesian network are stored. It includes functions like to “getnode”,” addnode”,” findchildren”, etc. to help with the functionality.
   2. To represent Markov blanket: A list was used. It contains all the nodes of a Markov blanket of a particular node.
   3. To represent the variables: A class called “node” was defined. It stores the node-name (e.g. A), parent-list (e.g. [G, X, N, H], conditional probability table for the particular node (e.g. [0.0001 0.05 0.09 0.25 …]), parent-pointers and children-pointers (as the name suggests – links to parents and children from that node)
   4. To represent the expression for probabilistic query: Two global list called “quer\_v” and “cond\_v” were defined. The first stores all the query variables while the second stores all the conditional variables.
8. Implementation Details
   1. How did you create the CPT reading the data from the file?

The CPT of variable was stored as list in node corresponding to that variable. Each node has its own CPT.

CPT is list of floating point numbers. There were split from input file using the delimiter – “ >> ”.

* 1. How did you access the BN to obtain the Markov blanket?

The “BayesianNetwork” class has a “getnode” function which accepts a variable name in capital letters and returns the node of the variable in the Bayesian network. Also, the same class contains “findchildren” function which returns the list of children of a variable name (capital letters) which is fed as input. The list contains variable names in capital letters. The same class can be used to gets the nodes of each variable respectively. At the same time each node has a parent list stored in it (list of variables in capital letters). By using the “getnode” we can get the node in the network. All the nodes are appended into the Markov Blanket which is in turn a list of nodes.

* 1. How did you access the CPTs?

A string of binary digits was generated from variables whenever required (~ -> 0 else 1). This string was converted into an integer which was used to index into the condition probability table (stored as a list in the node) of the particular node.

* 1. How did you expand the expression for the conditional dependence on variables?

P(X|Y) = P (X, Y)/P(X)

* 1. How did you marginalize the expression?

P (X, Y) = P(i|Parentsi) \*… for each i in [(X, Y) +generate\_combos (markov\_blanket (X, Y,..elements which get added into the list) – (X, Y))] {use (1-P(~i|Parentsi) if i is negation}

All the new elements which are added into the list (because of computing Markov Blanket for variables in the list) are to be marginalized. By using “itertools” library which has functions to generate binary string lists of length “n” (“n” is input). By applying negations appropriately to the marginal variables using the binary variables as reference we are able to generate all combinations. (marginalization)

* 1. How many terms does a query have? Give example.

A query is comprised of two parts – Query variables and Conditional variables. Query variables should be a minimum of 1 and a maximum of 10. Conditional variables range from 0 to 10.

e.g. P (X, ~T, O|~P, ~N, L, D)

1. Graphics: Created the graphics (Yes)
2. Output
   1. Execute your program to answer the following probabilistic queries. Mention the answer obtained by your program. Also compute the Markov blanket of the variable A.

* P (D, A, L| R, X, P, O) = 0.0997432867636
* P(A)= 0.227587680582
* P (F, R|A,P) = 0.128149583593
* P(D)= 0.472122546785
* P(D|P) = 0.50652782668
* P (A|Y, C) = 0.0489561897357
* P (A, D|O,R, P) = 0.224232103788
* Markov Blanket of A= {A, C, B, D, G, F, H, L, N, Y, X}

1. Compilation Details:
   1. Code Compiles (Yes/ No): Yes
   2. Mention the .py files that do not compile: None
   3. Any specific function that does not compile: None
   4. Ensured the compatibility of your code with the specified Python version (Yes)
   5. Instructions for compilation of your files mentioning the multi file compilation process used by you (We may use the replica of these for compiling your files while evaluating your code)

Run main.py on console. Input file name directly if the input file is in same directory else mention the whole path. Enter a variable name in capital letters to find its Markov’s blanket else input ‘n’ to not find Markov blanket of any node. Use the options in the GUI appropriately.

1. Driver Details: Does it take care of the options specified earlier(yes/no): (Yes)
2. Execution status (describe in maximum 2 lines)

All the modules are working without any issues. Some extra features have been incorporated into the GUI which can be used as per convenience.

1. Declaration: I, Bhavanam Sravan Kumar Reddy (name) declare that I have put my genuine efforts in creating the python code for the given programming assignment and have submitted only the code developed by me. I have not copied any piece of code from any source. If the code is found plagiarized in any form or degree, I understand that a disciplinary action as per the institute rules will be taken against me and I will accept the penalty as decided by the department of Computer Science and Information Systems, BITS, Pilani.

ID: 2015A7PS0072P Name: Bhavanam Sravan Kumar Reddy

Date: 27/11/2017

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* Should not exceed three pages