**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 2015A1PS0791P

Name Kabir Ahuja

1. Mention the names of Submitted files :
   1. <kabir\_driver.py>
   2. <kabir\_bnet.py>
   3. <2015A1PS0791P.docx>
   4. <input1.txt>
2. Total number of submitted files: 4
3. Name of the folder : Kabir\_2015A1PS0791P
4. Have you checked that all the files you are submitting have your name in the top?(yes/no) 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/no) yes
6. Modules implemented
   1. Created the Bayesian network? (yes/no) yes
   2. Created Markov blanket?( yes/no) yes
   3. Created expression from the inputs read ?(yes/no) yes
   4. Computed probability ? (yes/no) yes
7. Data structures used
   1. To represent the Bayesian network: A graph which is implemented as an Adjacency Hash map (instead of list I used a Dictionary to store nodes)
   2. To represent Markov blanket: Python List which is a doubly linked list
   3. To represent the variables: They are objects which contain their parents and conditional probabilities
   4. To represent the expression for probabilistic query: String
8. Implementation Details
   1. How did you create the CPT reading the data from the file? Using recursion. I took a list of all False and generated different cases by selecting the first element of the list, taking it as True and False and appending it with cases for the rest of the list. Base case was if length of the list was 1 return [True, False]
   2. How did you access the BN to obtain the Markov blanket? BN is a graph with nodes as variables and is connected to its children by maintaining a list of its children. Also each node maintains a list of its parents. Hence Markov blanket is obtained by selecting the children from the Bayesian network and parents from the node it self. Parents are then also used to find their children from Bayesian networks.
   3. How did you access the CPTs? I have maintained a dictionary with keys as the tuple of values of the parents and value of the key is the conditional probability.
   4. How did you expand the expression for the conditional dependence on variables?

First the expression was converted to joint distribution, which was then marginalized and finally chain rule of probability was applied to evaluate.

* 1. How did you marginalize the expression? Selected each element of the Bayesian network one by one if it is not in the query variables then it is marginalized by considering its all possible values and evaluating the expression and then added by them.
  2. How many terms does a query have? Give example. Query consists of two things effected( a list) and conditionals variables(for conditional values such that keys are the variables and values are true or false) . Eg P(A,B | ~C,D) so the query will contain a list of effected variables [A,B] and a dictionary [C: False, D: True]

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1. Graphics: Created the graphics (yes/no) 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) = 0.09974328676359073
* P(A)= 0.22758768058157092
* P(F,R|A,P)= 0.12814958359294057
* P(D)= 0.47212254678467136
* P(D|P)= 0.5065278266797953
* P(A|Y, C)= 0.04895618973565343
* P(A,D|O,R,P)= 0.22423210378837774
* Markov Blanket of A= [G, Y, A, H, X, D, C, N, F]

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/no) 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) kabir\_driver is the main script and it is to be executed for running the program. It uses the functions from the file kabir\_bnet.py and all these are imported in kabir\_driver.py
2. Driver Details: Does it take care of the options specified earlier(yes/no): Yes
3. Execution status (describe in maximum 2 lines): Executes without any error.
4. Declaration: I, Kabir Ahuja (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 2015A1PS0791P Name: Kabir Ahuja

Date: 28/11/2017

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