SV National Institute of Technology Surat

CS 210 : ARTIFICIAL INTELLIGENCE

LAB 10 : Learning Agent

INSTRUCTION:
1. Please save your lab.doc as *LAB_No_Roll_No.doc*.
2. Use/paste the snapshot of the steps followed along with result/s.
3. Mention your observation/comment after results in the doc.

PART A: FUZZY LOGIC and Bayesian Network (30 [10+20]Points)

1 Using Fuzzy Inference System (FIS) editor in matlab, design model for tip value which should be given based on food quality and service. Food quality and service are taken as input and tip value as output.

Fuzzy logic has been used in numerous applications such as facial pattern recognition, air conditioners, washing machines, vacuum cleaners, antiskid braking systems, transmission systems, control of subway systems and unmanned helicopters, knowledge-based systems for multiobjective optimization of power systems, etc.

2 As part of a comprehensive study of the role of 10-601 : Machine Learning, on people's happiness Carnegie Mellon University [1] have been collecting important data from graduating students. In an entirely optional survey that all students are required to complete, we ask the following highly objective questions:

- Do you party frequently? [Party: Yes/No]
- Are you wicked smart? [Smart: Yes/No]
- Are you creative? [Creative: Yes/No]
- Did you do well on all your written homework assignments? [HW: Yes/No]
- Do you play any kind of musical instrument? [Music: Yes/No]
- Did you succeed in your Pacman Projects? [Project: Yes/No]
- Did you succeed in your most important class (which is COMP 341)? [Success: Yes/No]
- Are you currently Happy? [Happy: Yes/No]

You can obtain the comma-separated survey results from LAB_10_student.csv.

Each row in students.csv corresponds to the responses of a separate student. The columns in students.csv correspond to each question (random variable) in the order Party, Smart, Creative, HW, Mac, Project, Success, and Happy. The entries are either zero, corresponding to No response, or one, corresponding to a Yes response. After consulting a behavioral psychologist we obtained the following complete set of conditional relationships:

- HW depends only on Party and Smart
- Music depends only on Smart and Creative
- Project depends only on Smart and Creative

- Success depends only on HW and Project
- Happy depends only on Party, Music, and Success

2.1 Understanding The Model [4]:

(a) Draw the Bayesian network.

(b) Write joint distribution as a product of conditional probabilities.

(c) What is the number of independent parameters needed for each conditional probability table?

(d) What is the total number of independent parameters?

2.2 D-Separation [3]:

(a) Using only the Bayesian network structure from part 9.2.1, answer the following True/False questions and provide a brief explanation:
1. Party is independent of Success given HW.
2. Party is independent of Smart given Success.
3. Party is independent of Creative given Happy.

2.3 Confounded Intelligence [2]:

(a) Using only the data in students.csv and Python calculate the correlation between success on the homework HW and success on the project Project. You do not need to use the Bayesian network for this question. (Hint: Consider using the numpy.cov() function in Python)

2.4 Counting [4] :

(a) Use python and students.csv to calculate the parameters for each conditional probability table by counting with Laplace smoothing. Please consider formatting your conditional probability tables as shown in Table 1.

A	B	C	$\mathbf{P}(X = 1 \mid A, B, C)$
T	T	T	0.4
T	T	F	0.8
T	F	T	0.15
T	F	F	0.16
F	T	T	0.23
F	T	F	0.42
F	F	T	0.4
F	F	F	0.8

Table 1: An example conditional probability table for $\mathbf{P}(X \mid A, B, C)$.

2.5 Inference [7] : With your conditional probability table estimates, calculate the following probabilities:

(a) What is the probability of being happy?

(b) What is the probability of being happy given that you party often, are wicked smart, but not very creative?

(c) What is the probability of being happy given that you are wicked smart and very creative?

(d) What is the probability of being happy given you do not party, and do well on all your homework an class project?

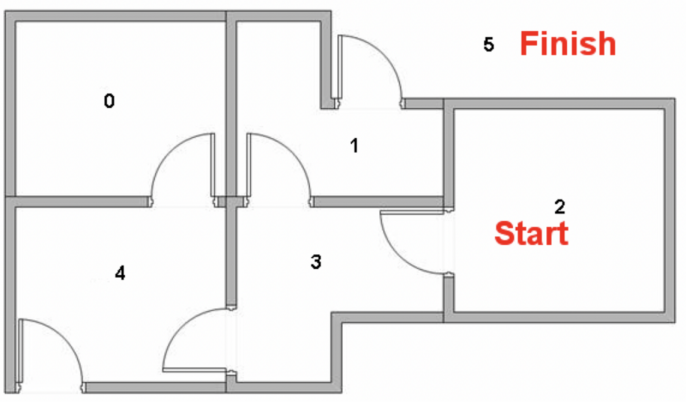
(e) What is the probability of being happy given you own a mac?

(f) What is the probability that you party often given you are wicked smart?

(g) What is the probability that you party often given you are wicked smart and happy?

PART B : Reinforcement Learning : PathFinder Bot [10]

3 As discussed in the class suppose we have 5 rooms A to E, in a building connected by certain doors : We can consider outside of the building as one big room say F to cover the building. There are two doors lead to the building from F, that is through room B and room E.

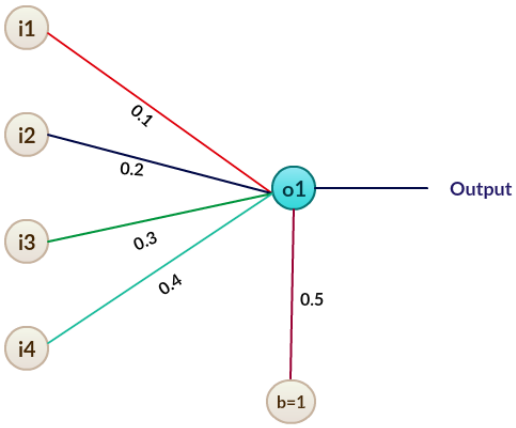


Modeling the environment that can be used for Reinforcement Learning for finding the best possible path. Fill the code in the shared 8_2_*RL*example .ipynb

PART C : Neural Network [10]

4 Predicting Virus Contraction with a Perceptron
Summarizing an Artificial Neural Network:
1.Take inputs
2. Add bias (if required)
3. Assign random weights to input features
4. Run the code for training.
5. Find the error in prediction.
6. Update the weight by gradient descent algorithm.
7. Repeat the training phase with updated weights.
8. Make predictions.

Person	Loss of Smell	Weight Loss	Runny Nose	Body Pain	Positive?
1	1	0	0	1	1
2	1	0	0	0	1
3	0	0	1	1	0
4	0	1	0	0	0
5	1	1	0	0	1
6	0	0	1	1	1
7	0	0	0	1	0
8	0	0	1	0	0



Apply the Delta Learning Rule for the above sample and printing the final weights after saturation / running the code 5000 times.

Check the output for three Test Person with values as following :
T1: <1,0,0,1>
T2: <0,0,1,0>
T3: <1,0,1,0>

Reference

http://ai.berkeley.edu/project_overview.html

Observation /Comments: