Problem Set 3: Symbolic AI

Q1 [Total: 17 points]

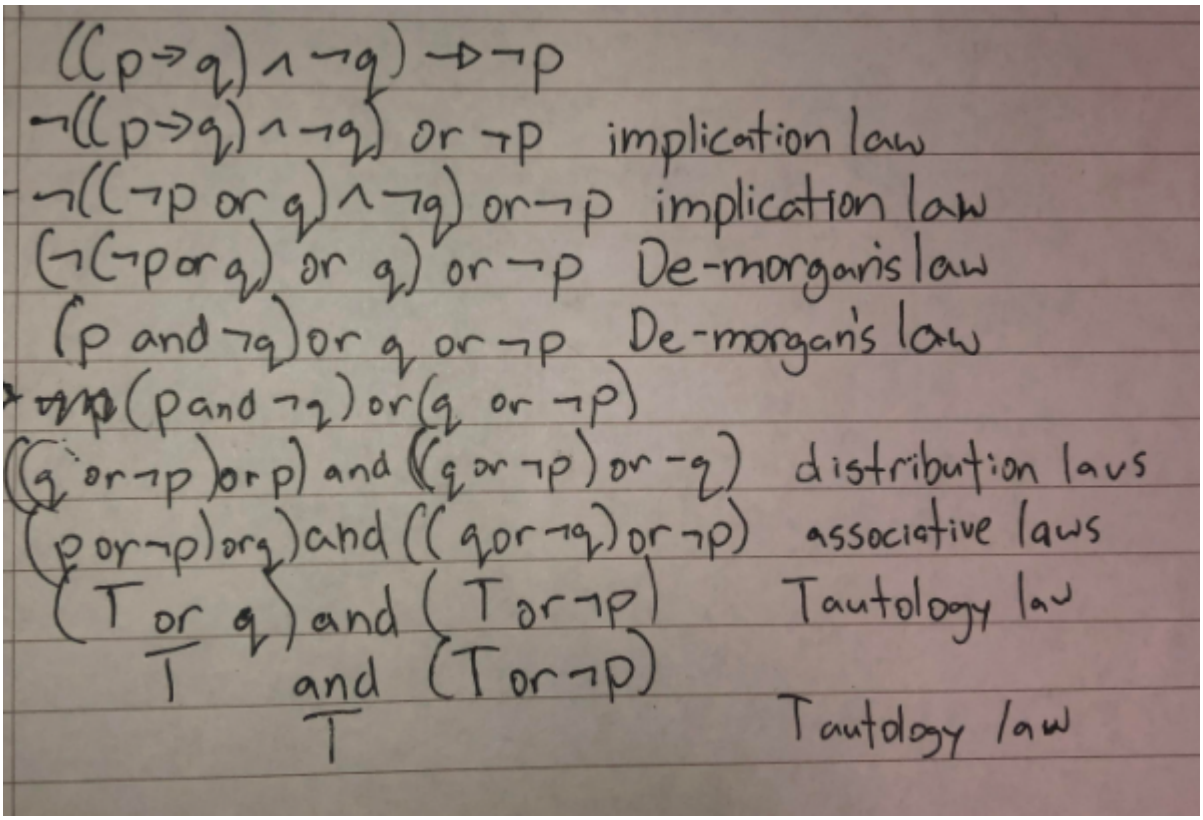
Q1a. [6 points]

Use a truth table to show that ¬(p∨¬(p∧q)) is a contradiction.

p	q	(p ∧ q)	¬(p ∧ q)	(p ∨ ¬(p ∧ q))	¬(p ∨ ¬(p ∧ q))
F	F	F	T	T	F
F	T	F	T	T	F
T	F	F	T	T	F
T	T	T	F	T	F

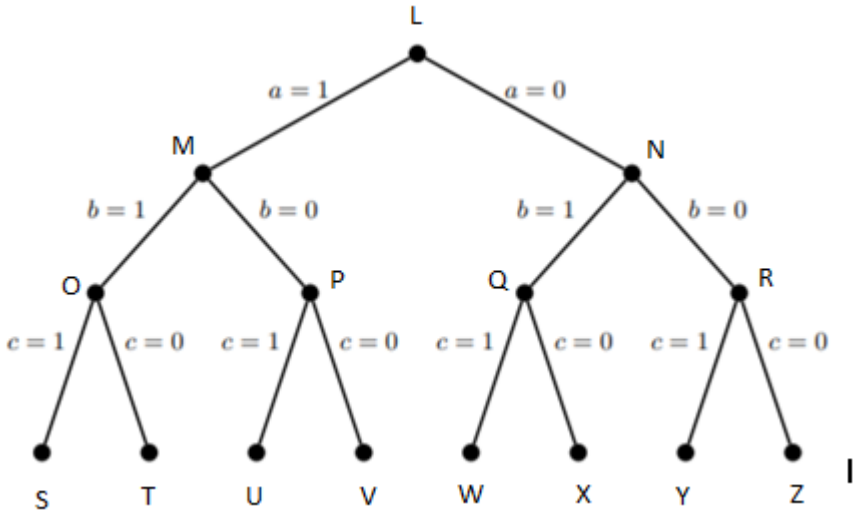
Q1b. [6 points]

Prove that ((p → q)∧ ¬q)→ ¬p is a tautology using propositional equivalencies.



Q1c. [5 points]

Using a depth-first search, list all the nodes that will be visited to solve the satisfiability problem using the following clauses to be satisfied: ¬a ∨ b and ¬b ∨ c.

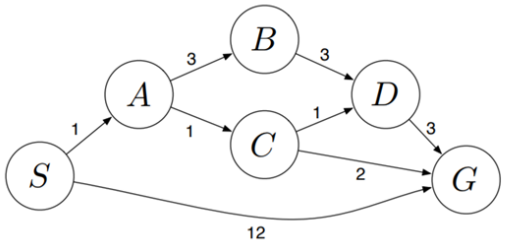


Solution here

L-N-P-R-T-V-X-Z

Q2 [Total: 10 points]

Answer the following questions about the search problem shown below. Break any ties alphabetically. For the questions that ask for a path, please give your answers in the form 'S − A − D − G' where S is the start state and G is the goal state.



Q2a. [2 points]

What path would breadth-first search return for this search problem?

Solution here S-A-C-B-D-G

Q2b. [2 points]

What path would uniform cost search return for this search problem?

What path would uniform cost search return for this search problem

Solution here S-A-C-D-G

Q2c. [2 points]

Which of the following two heuristics, h_1 and h_2, is admissible? Why?

State	h_1	h_2
S	5	4
A	3	2
B	6	6
C	2	1
D	3	3
G	0	0

h_2 is admissible the minimum cost path is not overestimated. It is not too optimistic for the function to choose a seemingly less expensive path.

Q2d. [2 points]

What path would greedy search follow using the admissible heuristic from c) above?

Solution here S-A-C-G

Q2e. [2 points]

What path would the A* search follow using the admissible heuristic from c) above?

Solution here S-A-C-D-G

Q3 [Total: 14 points] ¶

Suppose we want to schedule some final exams for CS courses with the following course numbers: 1007, 3137, 3157, 3203, 3261, 4115, 4118, 4156

Suppose also that there are no students in common taking the following pairs of courses:

1007-3137

1007-3157, 3137-3157

1007-3203

1007-3261, 3137-3261, 3203-3261

1007-4115, 3137-4115, 3203-4115, 3261-4115

1007-4118, 3137-4118

1007-4156, 3137-4156, 3157-4156

Q3a. [4 points]

What type of AI problem can this be mapped to? What is the mapping

Solution here Constraint Satisfaction Problem. What are the variables? The variables would be the course numbers. what are the values the variables can take, i.e. domain? The values the courses can take are time slot, and date. what are the constraints? The constraints are classes that have common students shouldn't be paired on the same date. can this be presented as a graph? Yes this can be presented as a graph. can it be mapped to a similar problem covered in class? This can be mapped to Symbiotic AI problem.

Q3b. [10 points]

How many exam slots are necessary to schedule exams?

Solution here 4

Q4 [Total: 9 points]

Q4a. [3 points]

List the main benefits and limitations of Symbolic AI.

Solution here Symbolic AI involves the explicit embedding of human knowledge and behavior into computer programs. Symbols play a vital role in human thought and they can be organized into hierarchies. Benefits: We can easily visualize the logic of rule-based programs, communicate them and troubleshoot them. (Explainable) Good for settings where rules are clear cut and transform input into symbols. Limitations: Symbolic AI starts to break when you deal with messiness of world, like computer vision, when you have a picture of a dog and you want to detect images that contain your dog. This will only work for an exact copy of your dog, another angle would prove disasterous for the program.

Q4b. [3 points]

List the main benefits and limitation(s) of Neural Networks.

Solution here They can deal with messy and unstructured data. Manually laboring through the rules of detecting cat pixels, you can train a deep learning algorithm on many pictures of cats. Neural Network develops a statistic model for cat images, it will return probability. NNs created a revolution in computer vision applications. language related tasks and reinforcement learning (trial and error) Limitations: It is difficult to interpret and investigate the output of NNs, where automated decisions is a legal requirement. NNs have no notion of symbols and hierarchical representation of knowledge. (hard to apply logic). Very data hungry for information (constantly needing more). NNs can be the target of adversarials (malware)

Q4c. [3 points]

What is the main motivation behind combining Neural Networks and Symbolic AI in recent approaches?

Solution here The hybrid AI can learn new tasks with less data and is explainable. Unlike symbolic-only models, NSCL doesnt strug