CS 331 Midterm
Spring 2014

You have 50 minutes to complete this midterm. You are only allowed to use your textbook, your notes, your assignments and solutions to those assignments during this midterm. If you find that you are spending a large amount of time on a difficult question, skip it and return to it when you’ve finished some of the easier questions. Total marks for this midterm is 53.

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Section I: Agents (12 points)

1. Minesweeper is a single player game that involves anNxN grid. Certain cells in the grid are mines while other cells are empty. All cells are “covered” initially. A player can uncover a cell by clicking on it. If the player uncovers a mine, the game is over. If the player uncovers an empty square, a number is displayed in the uncovered grid cell showing the number of adjacent cells with mines. The goal is to determine the location of all the mines.

For each part below, circle the choice which best describes the environment for an agent that plays Minesweeper.

a) Fully observable or Partially observable [1 point]

b) Deterministic or Stochastic [1 point]

c) Episodic or Sequential [1 point]

d) Static or Dynamic [1 point]

e) Discrete or Continuous [1 point]

f) Single agent or Multi-agent [1 point]

2. What type of agent was the tic-tac-toe player in Programming Assignment #2? Choose from simple reflex agent, model-based reflex agent, goal-based agent and utility-based agent. Explain your answer. [2 points]
3. Can you design a simple reflex agent that is rational for the tic-tac-toe domain? Explain your answer. [4 points]

II. Propositional Logic [19 points]
1. Suppose you apply resolution to the following two sentences in your KB.
\[ A \lor \neg B \quad \text{...(1)} \]
\[ \neg B \lor \neg A \quad \text{...(2)} \]
What do you get? Is it the same as the empty clause? Explain your answer. [4 points]

2. The following questions deal with the statements below:
Either Bob is insane or (he is a genius and an AI Researcher)
If Bob is a genius, then he is not evil.
If Bob is insane, then he is evil
Bob is not a genius or he is not an AI Researcher

a) Convert the English sentences above into propositional logic. [5 points]
b) Convert the propositional logic sentences from part (a) into CNF. [5 points]

c) Does $KB \models (\text{Bob is evil})$? Show the resolution steps if it does. Otherwise, explain why it does not resolve. [5 points]
III. Search [10 points]
1. The resolution refutation algorithm (this was the algorithm we covered in class that uses resolution to complete a proof-by-contradiction) can determine if $KB \models \alpha$, provided the KB and the query $\alpha$ are in propositional logic. The resolution refutation algorithm can be modeled as a search problem.

a) If we formulate the resolution refutation algorithm as a search problem, what does a state in this search space look like? [2 points]

b) What is the initial state for the resolution refutation search problem? [2 points]

c) What is the goal state for the resolution refutation search problem? [2 points]

d) What is the successor function for the resolution refutation search problem? [4 points]
IV. Games [12 points]
1. Evaluation functions try to approximate the expected utility of the game at a non-terminal node. One problem with them is that they may not be a good approximation. Suppose I create a perfectly accurate evaluation function that generates the remainder of the search tree from the non-terminal node and computes its exact minimax value. Is this a good idea? Why or why not? [2 points]

2. Compute the expectiminimax value of the root node below. Show your intermediate work for partial credit. [10 points]

```
Max

Chance

P=0.1

P=0.5

100

-P=0.5

-Chance

2

P=0.9

Min

Max

4

6

-9

-5

100

-80

```