

Name: \_\_\_\_\_  
Student ID: \_\_\_\_\_

**CSE 473 Autumn 2006: Practice Midterm Exam**  
(closed book, closed notes except for 1-page summary)  
Total: 100 points, 5 questions. Time: 50 minutes

Instructions:

1. Write your name and student ID on the first sheet (once you start, write your last name on all sheets). Write your answers in the space provided. If you need more space or scratch paper, you can get additional sheets from the instructor. Make sure you write down the question number and your name on any additional sheets.
2. Read all questions carefully before answering them. Feel free to come to the front to ask for clarifications.
3. *Hint 1:* You may answer the questions in any order, so if you find that you're having trouble with one of them, move on to another one.
4. *Hint 2:* If you don't know the answer to a question, don't omit it - do the best you can! You may still get partial credit for whatever you wrote down. Good luck!

Do not start until you are given the “go-ahead signal”...

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**1) (20 points) Agents and Environments**

- a) Give a PEAS description of the task environment for the following agents:
  - i) A part-picking robot
  - ii) An interactive English tutor
- b) For each of the agents above, characterize the environment according to whether it is fully or partially observable, deterministic or stochastic, episodic or sequential, static or dynamic, discrete or continuous, and single or multiagent.

[For a solution, see Figures 2.5 and 2.6 in the text]

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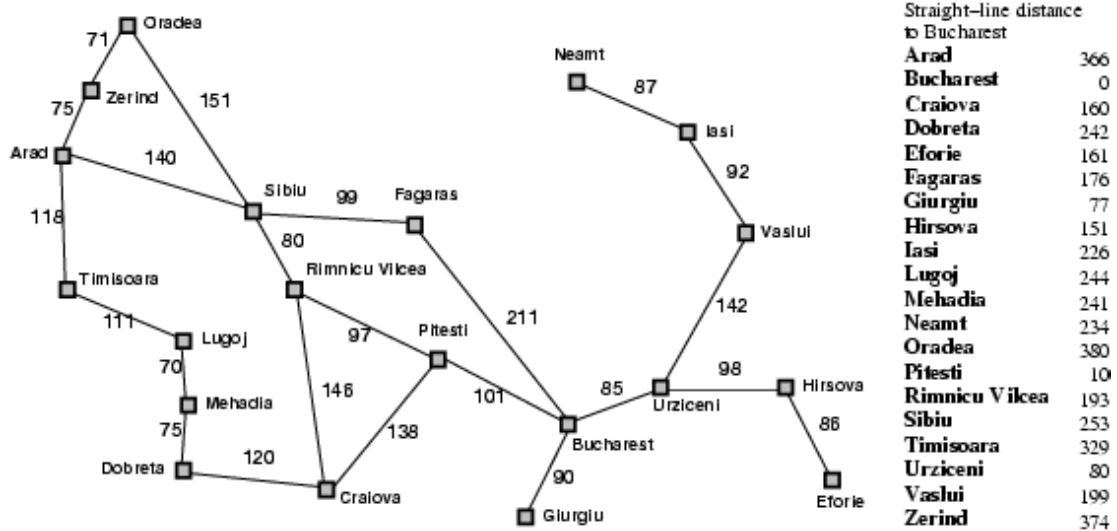
**2) (20 points) Uninformed Search**

Consider a state space where the start state is 1 and the successor function for state  $i$  returns two states:  $2i, 2i+1$ .

- a) Draw the state space for states 1 to 15.
- b) Suppose the goal state is 11. List the order in which nodes will be visited for: (i) breadth-first search, (ii) depth-limited search with depth limit 3, and (iii) iterative deepening search.

[For the solution, see similar problem in HW #1]

3) (20 points) Informed Search



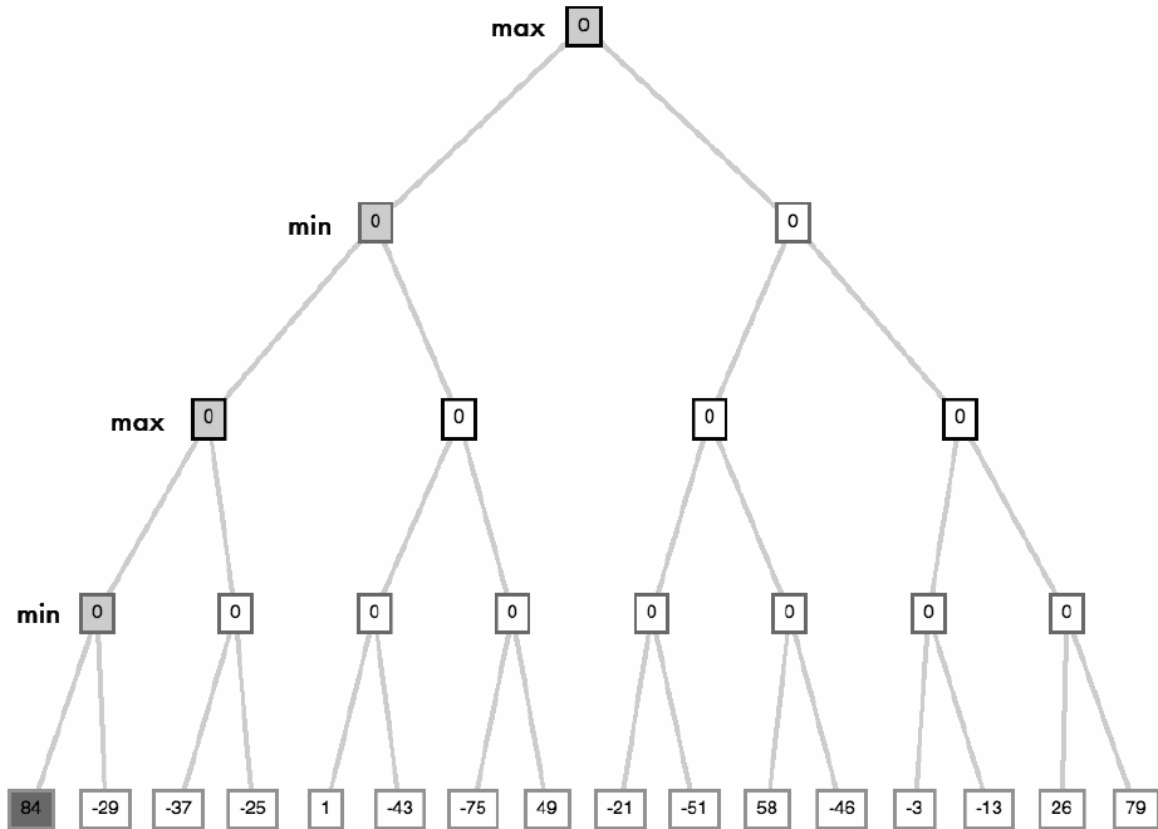
Consider the route-finding problem of computing the cheapest path from Arad to Bucharest in the map depicted above.

For the straight-line distance heuristic, draw the search tree after expansion of each node until the termination of the algorithm for:

- Greedy best-first search (label all nodes with their h values). What is the solution found by the algorithm?
- A\* search (label all nodes with their f values). What is the solution found by the algorithm?

[For the solution, see lecture slides on Informed Search or Figures 4.2/4.3 in text]

4) (15 points) Adversarial Search



Consider the 4-ply game tree above for a two-person game.

- Fill in the minimax values of all nodes marked 0.
- Label the path in the tree that results if max and min each make optimal moves.
- Draw the tree that results if alpha-beta pruning is used.

[For the solution, see lecture slides on Adversarial Search]

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**5) (25 points) Logic**

Any American who sells weapons to hostile nations is a criminal. The nation Nono is an enemy of America. Any enemy of America is considered hostile. Nono has some missiles. Missiles are weapons. All of Nono's missiles were sold to it by Colonel West. West is American.

- a) Convert the statements above to sentences in first-order logic. There should be seven sentences. Use the following vocabulary:
- American(x), Weapon(x), Hostile(x), Criminal(x), Missile(x):  
predicates satisfied by members of the corresponding categories
  - Sells(x,y,z): x sells y to nation z
  - Owns(x,y): nation x owns y
  - Enemy(x,y): nation x is an enemy of nation y
  - West: constant denoting Colonel West
  - Nono, America: constants denoting corresponding nations
- b) First, make sure your sentences in (a) are definite clauses (if not, make them so). Then, using forward chaining, infer that West is a criminal: draw the proof tree with initial facts at the bottom, facts inferred on the 1<sup>st</sup> iteration at the next level, and so on.
- c) Convert the sentences in (a) to CNF.
- d) Using the CNF sentences in (c), construct a resolution proof that West is a criminal.

[For the solution, see Section 9.3, Figure 9.4, Section 9.5, and Figure 9.11 in the text]