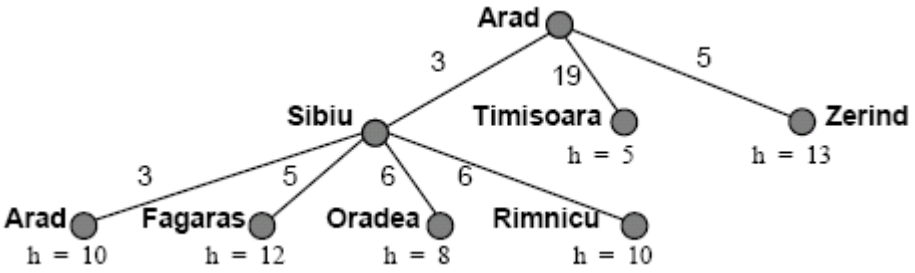
CSE 537: Sample Mid-Term Questions

Question 1
Consider a state space where the start state is number 1, and the successor function for state *n* returns two states labeled 2*n* and 2*n*+1.

a) Draw the portion of the state space for states 1 to 15.
b) Suppose that the goal state is 11. List the order in which nodes will be visited for breadth-first search, depth-limited search with depth limit 3, and iterative deepening search.
c) Can you apply best-first search to this problem? What would be a good heuristic? List the order in which nodes are visited in searching for the goal of 11 using your heuristic.

Question 2
Consider the problem of constructing crossword puzzles: fitting words into a grid of intersecting horizontal and vertical squares. Assume that a list of words (i.e., a dictionary) is provided, and that the task is to fill in the squares using any subset of this list. Go through a complete goal and problem formulation for this domain, and choose a search strategy to solve it. Specify the heuristic function, if you think one is needed.

Question 3
The following diagram shows a partially expanded search tree. Each arc is labeled with the corresponding step cost and the leaves are labeled with the h value.



i. Which leaf will be expanded next by a greedy search?
ii. Which leaf will be expanded next by a uniform-cost search?
iii. Which leaf will be expanded next by an A* search?

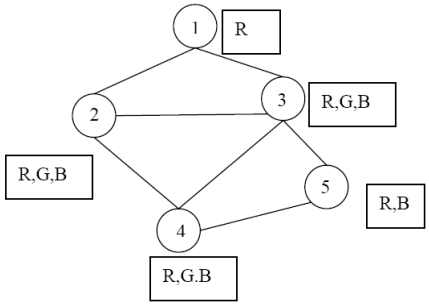
Question 4
Are the following statements true or false? Provide a brief explanation for your answer.

a) Breadth-first is an optimal search algorithm.
b) Truth tables can be used to establish the truth or falsehood of any well formed propositional formula.
c) Minimax and alpha-beta can sometimes return different results.
d) alpha-beta search keeps all explored nodes in memory
e) Depth-first iterative deepening always returns the same solution as breadth-first search if b is finite and the successor ordering is fixed.
f) If h1 and h2 are two admissible heuristics then so is h7 = h1*h2.

Question 5
Prove that if a heuristic is consistent, it must be admissible. Construct an admissible heuristic that is not consistent.

Question 6

Consider the following constraint graph for a graph coloring problem (the constraints indicate the connected nodes cannot have the same color). The domains are shown in boxes next to each variable node.



1. What are the variable domains after full constraint propagation?
2. Show the sequence of variable assignments during a pure backtracking search (do not assume that the propagation above has been done). Assume that the variables are examined in numerical order and the values are assigned in the order shown next to each node. Show assignments by writing the variable number and the value, e.g. 1R. Don't write more than 10 assignments, even if it would take more to find a consistent answer.
3. Show the sequence of variable assignments during backtracking with forward checking. Assume that the variables are examined in numerical order and the values are assigned in the order shown next to each node. Show assignments by writing the variable number and the value, e.g. 1R.

Question 7

1. Is the following sentence in Propositional Logic valid, unsatisfiable, satisfiable, or none of these? Explain your answer and provide details.

$$(A \Rightarrow \neg B) \Rightarrow (C \Rightarrow B)$$

2. Let KB be defined by the clauses from (d) plus the additional clauses: (¬E ∨ D), (¬C ∨ ¬F ∨ ¬B), (¬E ∨ B), (¬B ∨ F), (¬B ∨ C). Proof that the query sentence ¬B is true given KB using the Resolution Refutation algorithm.