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CS 404 – Artificial Intelligence
Spring 2019

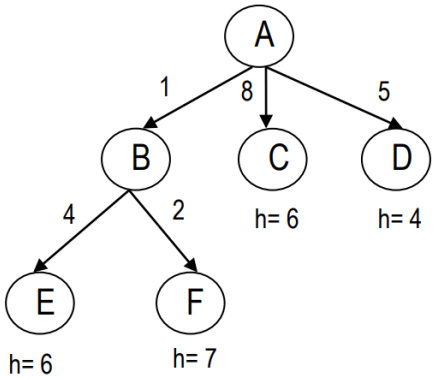
HW3–Local Search – Adversarial Search

75pts

1) **5pts –** Give the name of the algorithm that results when you do a local beam search with k = 1.

   Answer: Hill-climbing search

2) **30pts** - Consider the following **partial** search tree (we are in the middle of the search), where each edge is labeled with the cost of the corresponding operator and the leaves (fringe nodes) are labeled with the value of a heuristic function, h, estimating the remaining cost to the goal. Which node will be expanded next by each of the following search methods? Give a very small explanation or show your work.



1. Uniform-Cost Search: **F**
2. Greedy Best-First Search: **D**
3. A* Search: **D**

Uniform-Cost Search finds the optimal solution and optimal solution is F since it is actual cost is only 3.

Greedy Best-First Search uses just the heuristic function and minimum cost according to heuristic function is 4 with node D.

A* Search is combining the actual cost and heuristic cost ($f(n)=g(n)+h(n)$). According to that D is expanded since it's sum of actual and heuristic cost is minimum.

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3) 10pts A heuristic results in exploring N=180 nodes and finds the solution at depth d=2. What is its effective branching factor? Give an **approximate** answer, but you must show your work.

$\mathbf{N + 1 = 1 + b^* + (b^*)^2 + \ldots + (b^*)^d}$

$\mathbf{180 + 1 = 1 + b^* + (b^*)^2}$
$\mathbf{180 = b^* + (b^*)^2}$

$\mathbf{b^* \sim 13}$ **because** $\mathbf{13+13^2 = 182}$

Hence, the effective branching factor 13

Hint:

$9^3 \sim 720$
$10^3 = 1000$
$11^3 \sim 1300$
$12^3 \sim 1800$
$13^3 \sim 2200$
$14^3 \sim 2750$

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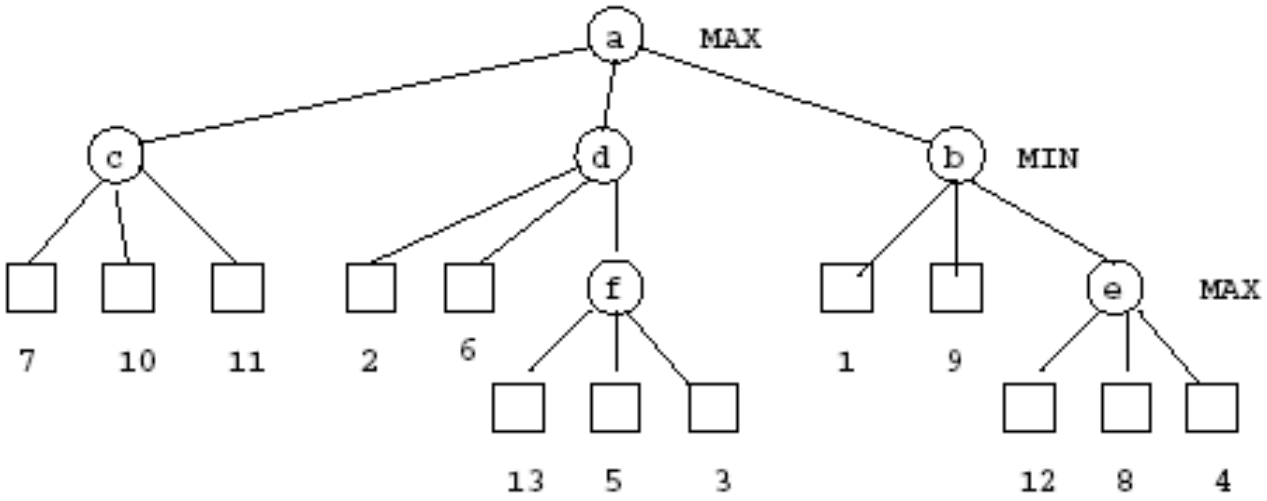
4) 30pts - Game Playing

Using the following Minimax tree, answer the following questions:



a) 5pt - What score is guaranteed for MAX?

Answer: 7

b) 15pt - Indicate **all the nodes** that are pruned using alpha-beta pruning? You can use the node name or values to indicate.

Answer: node with value 6, F node and it's children, node with value 9, E node and it's children

c) 5 - True or False: If Max uses alpha-beta pruning in Minimax, can s/he miss the chance of a better play (if s/he did't prune)? Assume a perfect opponent.

Answer: False, alpha-beta pruning does not affect the best solution.

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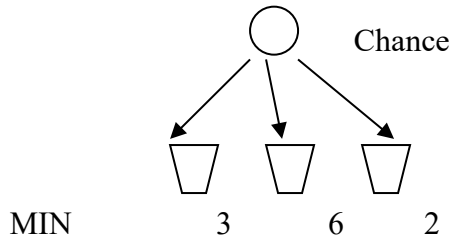
d) 5pt - What is the expectimax value for the following chance node (circle)? Assume equal probability for each of the chance outcome and the given expectimax values for the MIN node.



(3+6+2) / 3 = 11/3 ~ 3.66

*) For those who have requested extra study questions, other good questions to work on (from the topics we covered) are: AIMA 3rd ed: 4.9 (topic not covered, but in the slides) 5.12, 5.15, 5.18, 5.19, 5.21,