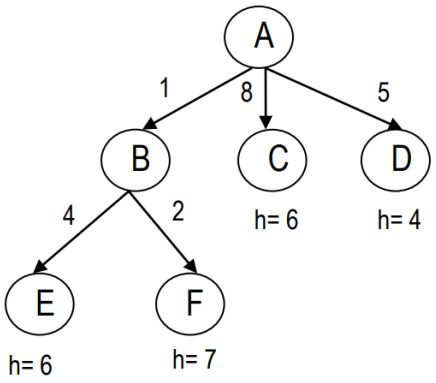
CS 404 – Artificial Intelligence
Spring 2019

HW3–Local Search – Adversarial Search Solution*

75pts

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

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

   Uniform-Cost Search considers the path cost (g(n)) which is found by summing up all the edges along the path to the nodes. It chooses the least total path cost node, which is F with g(F) = 3.

   Note: Node B is not selected since it is already expanded by the agent.

2. Greedy Best-First Search: D

   Greedy Best-First Search considers the heuristic function (h(n)). It chooses the most promising looking node, which is D with h(D) = 4.

3. A* Search: D

A* Search considers the sum of heuristic function (h(n)) and path cost g(n), denoted as f(n). By considering f(n) = h(n)+g(n) of each node, D has the least cost f(D) = 9.

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.

We know that number of visited nodes is found by

$$N = \frac{b^{(d+1)} - 1}{b - 1}$$

180 = b^3-1 / b-1

180*b – 179 = b^3

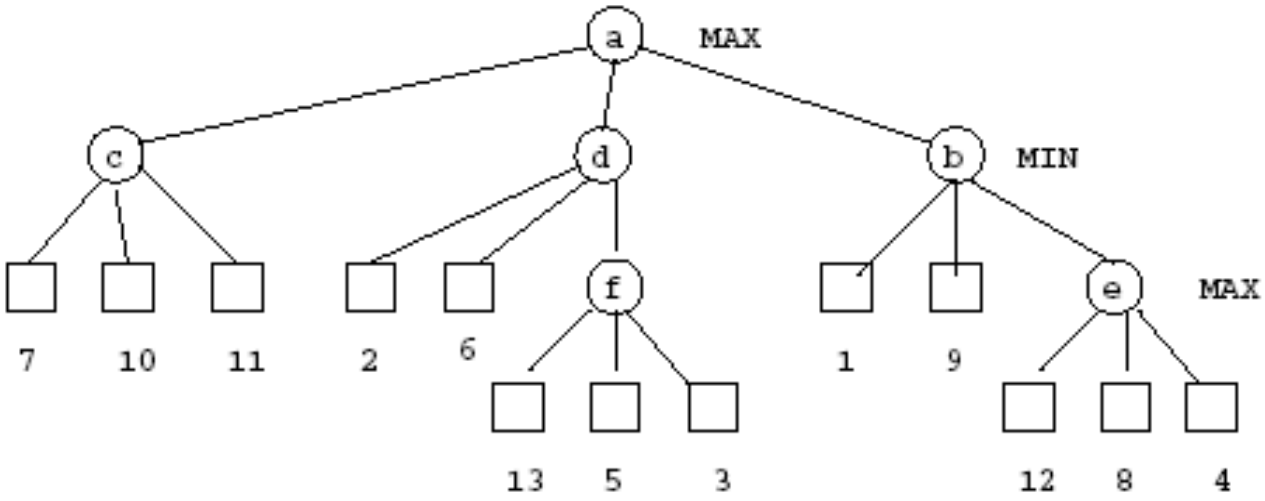
By solving the equality above, b = 12.88 which can be approximated as 13.

Hint:

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

4) 30pts - Game Playing

Using the following Minimax tree, answer the following questions:



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

Answer: 7 is guaranteed.

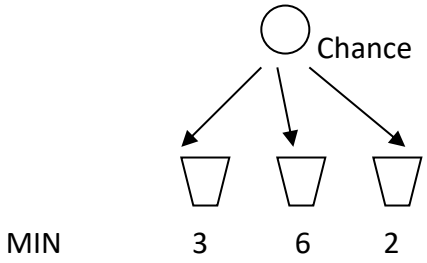
b) 15pt - Indicate **all the nodes** that are pruned using alpha-beta pruning? You can use the node name or values to indicate.

Answer: Nodes f,e,b-9,d-6 are pruned.

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 didn't prune)? Assume a perfect opponent.

Answer: No, a-b is optimal play against an optimal opponent.

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



Expected max value for max is 3*(1/3)+6*(1/3)+2*(1/3) = 11/3

*) 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,