

Introduction to Intelligent Systems: Homework 3

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Problem 1

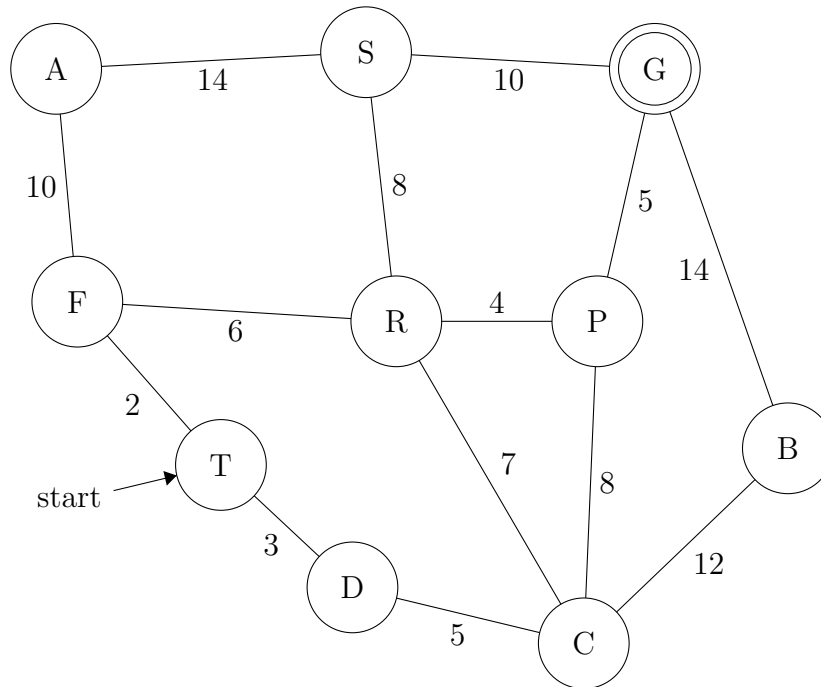
Trace the operation of (a) Greedy Best First Search and (b) A* to the problem of getting from node T to node G below using the heuristic of straight-line distance. Show the sequence of nodes that the algorithms will consider and the f, g, h values for each node. For paths that would result in loops, only show the repeated node, do not expand its children. (c) You may have noted that A* seems to return a sub-optimal path. Why is that?

h_{SLD} :

$A = 20$ $B = 10$ $C = 12$

$D = 13$ $F = 25$ $P = 4$

$R = 10$ $S = 8$ $T = 22$



(a) Greedy Best First Search

Path	Current Node	Neighbors	Choice
\emptyset	T	D; $f(D) = h(D) = 13$ F; $f(F) = h(F) = 25$	D
T	D	T; $f(T) = h(T) = 22$ C; $f(C) = h(C) = 12$	C
T,D	C	D; $f(D) = h(D) = 13$ R; $f(R) = h(R) = 10$ P; $f(P) = h(P) = 4$ B; $f(B) = h(B) = 10$	P
T,D,C	P	C; $f(C) = h(C) = 12$ R; $f(R) = h(R) = 10$ G; $f(G) = h(G) = 0$	G

Path: T,D,C,P,G

(b) A* Search

Path	Current Node	Neighbors	Choice
\emptyset	T	D; $g(D) = 3; h(D) = 13; f(D) = 16$ F; $g(F) = 2; h(F) = 25; f(F) = 27$	D
T	D	T; $g(T) = 6; h(T) = 22; f(T) = 28$ C; $g(C) = 8; h(C) = 12; f(C) = 20$	C
T,D	C	D; $g(D) = 13; h(D) = 13; f(D) = 26$ R; $g(R) = 15; h(R) = 10; f(R) = 25$ P; $g(P) = 16; h(P) = 4; f(P) = 20$ B; $g(B) = 20; h(B) = 10; f(B) = 30$	P
T,C,D	P	C; $g(C) = 24; h(C) = 12; f(C) = 36$ R; $g(R) = 20; h(R) = 10; f(R) = 30$ G; $g(G) = 21; h(G) = 0; f(G) = 21$	G

Path: T,D,C,P,G

- (c) The optimal solution is the path T,F,R,P,G. A* returns a suboptimal path because it factors $h(n)$ too heavily into the heuristic, and $h(n)$ overestimates the cost for some nodes. This is evident since $h(F) > h(D)$ which causes $f(F) > f(D)$ even though F is the node that has the lowest cost to get to the goal.

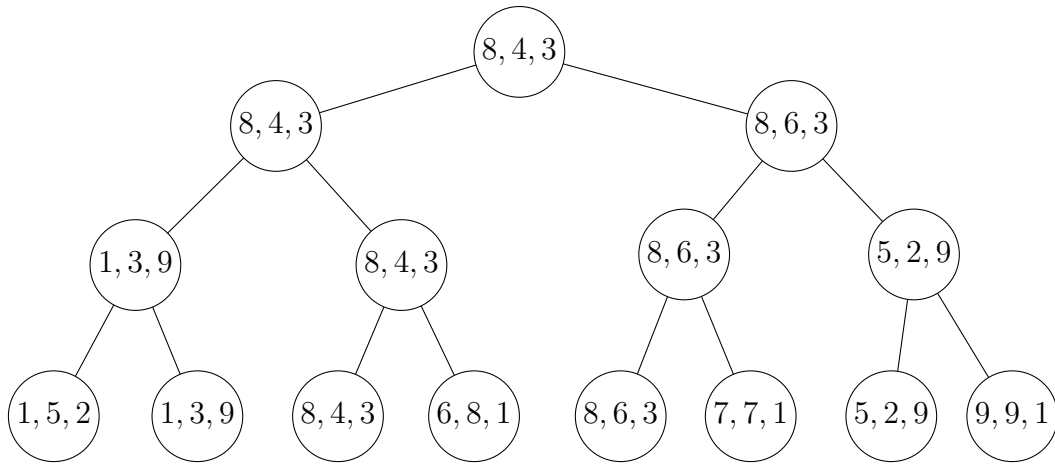
Problem 2

Describe Hill-climbing search. What are some of its limitations?

Hill-climbing search would traverse the nodes and choose a path according to whichever got it closer to the goal (by some heuristic). If the path to the goal requires taking a node that the heuristic considers to be further away, the hill-climbing algorithm would get stuck and never even consider that path.

Problem 3

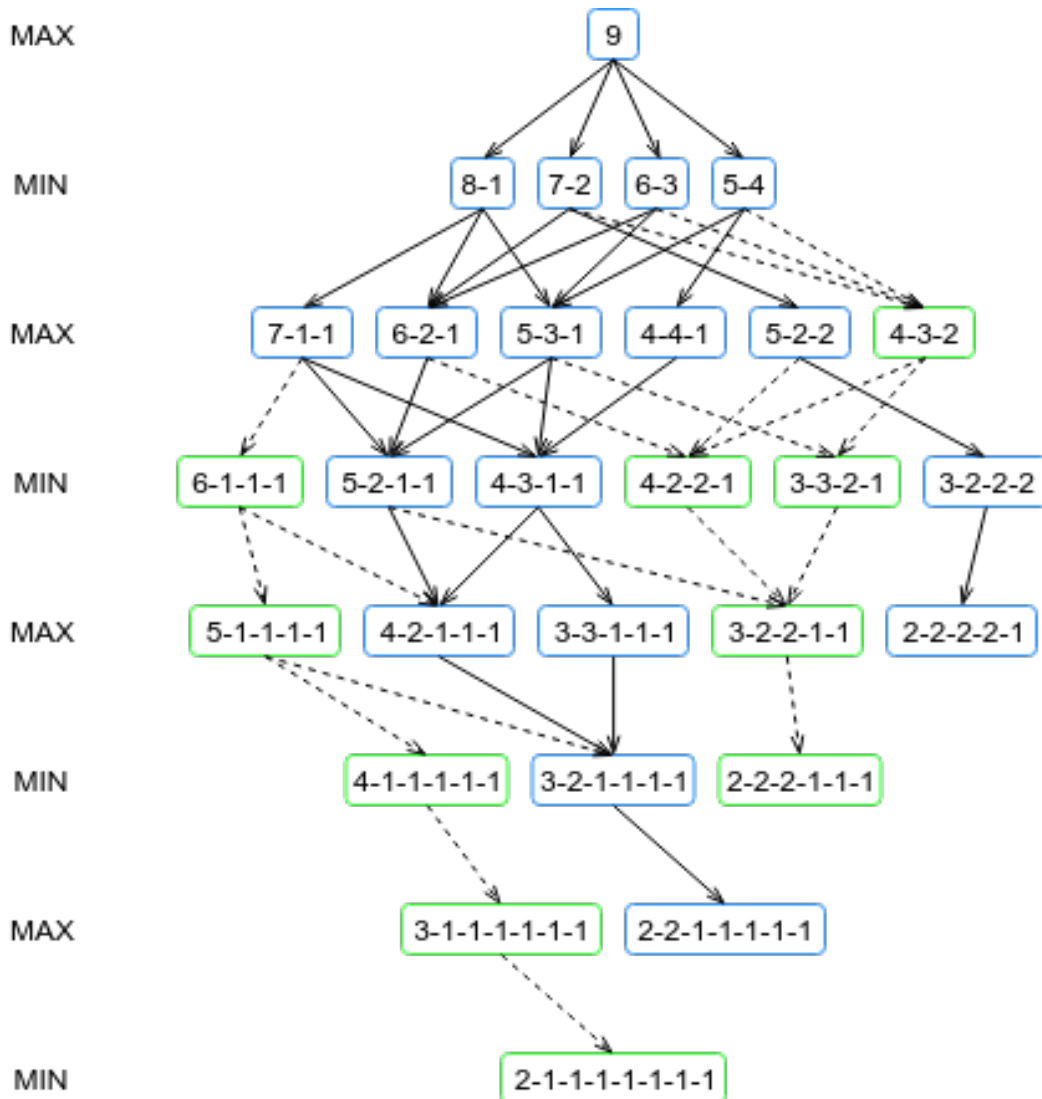
Look at *Figure 5.4* on Page 166 of the R&N book. Fill in the following **3 player** minimax search tree.



Problem 4

Create and fill-in a Minimax search tree for a 9 token game of Nim. Assume that MAX makes the first move. Fill in the utility value for each node generated.

Nodes colored blue have a utility of 1 and can lead to MIN's victory if played right.



If you have any questions, comments, or concerns, please contact me at alvin@omgimanagerd.tech