CS 540: Introduction to Artificial Intelligence
Homework Assignment 5

Matthew Klebenow
CSL: klebenow
Section 1
0 Late Days Used

December 13, 2012

Abstract

Questions 1, 2, and 3 are answered here. Question 4 has been handed in electronically.

Contents

List of Figures

List of Tables

1 Game Playing

1.1 Part a

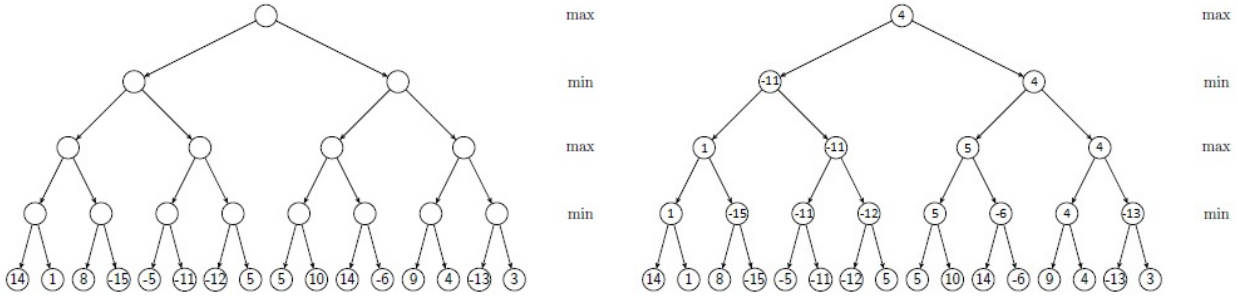
Use the Minimax algorithm to compute the minimax value at each node for the game tree in Figure 1a.

Answer

The theoretical solution has been provided in Figure 1b. The final theoretical game value is 4.

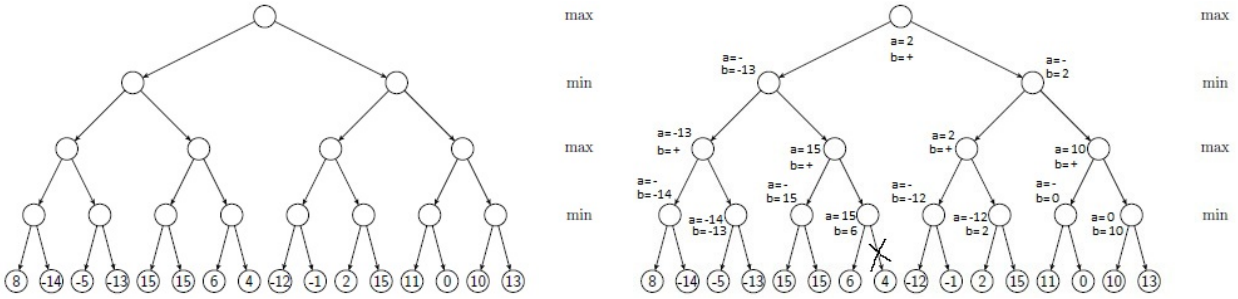
1.2 Part b

Use Alpha-Beta Pruning to compute the minimax value at each node for the game tree below, assuming children are visited left to right. Show the alpha and beta values at each node. Show which branches are pruned.



(a) Initial game tree (b) Solution to the game tree in Figure 1a

Figure 1: Game trees associated with 1-a.



(a) Initial game tree (b) Solution to the game tree in Figure 2a

Figure 2: Game trees associated with 1-b.

Answer

The solution has been provided in Figure 2b. The final theoretical game value is 2, and the branch leading from the deepest min layer to the leaf with value 4 was pruned during the process.

2 A*

2.1 Part a

In Figure 3, let A be the start state and E by the goal state. The weights on the edges reflect the cost to traverse them. Show the ordered contents of the open and closed queues for each stage of the A^* algorithm. The heuristic function values are given by Table 1.

Table 1: Heuristic function values 2-a

node	A	B	C	D	E	F	G
$h(n)$	10	3	9	5	0	1	1

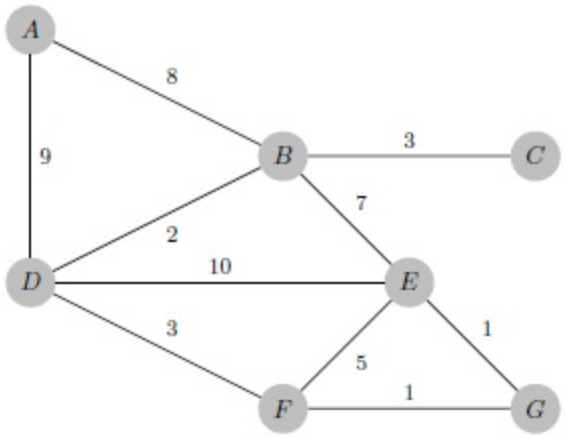


Figure 3: Graph for Problem 2

Answer

A step by step solution is provided in Table 2[1]. The final solution path is **ADFGE**.

2.2 Part b

What path is produced by running the best first greedy algorithm?

Answer

A step by step solution is provided in Table 3. The final solution path is **ABE**.

3 Simulated Annealing

Consider the function $f(x) = \max\{4-|x|, 2-|x-6|, 2-|x+6|\}$. It has three peaks with one forming a unique global maximum. Perform 8 rounds of simulated annealing using 4 as your start point *and 2 as your initial temperature*, letting the temperature decrease by a factor of 0.9 each round. A point x has four successors: $\{x+2, x+1, x-1, x-2\}$. Show all of your work, including the current point, the successor chosen, the round temperature, and the probability of changing position given the successor and the temperature.

Answer

A step by step solution is provided in Table 4.

[1] Strikethroughs in Table 2 represent updated paths with better values of $g+h$

Table 2: Solution steps for 2-a

Queue	Contents	g	h	$g+h$
CLOSED	empty			
OPEN	A	0	10	10
CLOSED	A			0
OPEN	B	8	3	11
	D	9	5	14
CLOSED	A, B			
OPEN	D	9	5	14
	C	11	9	20
	E	15	0	15
CLOSED	A, B, D			
OPEN	C	11	9	20
	E	15	0	15
	~~E~~	~~19~~	~~0~~	~~19~~
	F	12	1	13
	~~B~~	~~11~~	~~3~~	~~14~~
CLOSED	A, B, D, F			
OPEN	C	11	9	20
	E	15	0	15
	~~E~~	~~17~~	~~0~~	~~17~~
	G	13	1	14
CLOSED	A, B, D, F, G			
OPEN	C	11	9	20
	~~E~~	~~15~~	~~0~~	~~15~~
	E	14	0	14
CLOSED	A, B, D, F, G, E			
FINAL	**ADFGE**			

Table 3: Solution steps for 2-b

Queue	Contents	h
CLOSED	empty	
OPEN	A	10
CLOSED	A	
OPEN	B	3
	D	5
CLOSED	A, B	
OPEN	D	5
	C	9
	E	0
CLOSED	A, B, E	
FINAL	**ABE**	

Table 4: Solution steps for 3

Current Point	$f(x)$	Rand #	Succ	Temp	Prob(change)
4	0	3	3	2.00	0.607
3	1	4	1	1.80	0.329
1	3	3	0	1.62	0.539
0	4	4	0	1.46	0.254
0	4	1	0	1.31	0.218
0	4	3	-1	1.18	0.429
-1	3	2	0	1.06	0.390
0	4	2	0	0.96	0.352