

1. **If you leave any part of this question blank, your assignment will not be marked and its weight will be transferred to the final exam.** Print the name and ID number of each group member (at most 4) for this assignment:

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Acknowledge **all** sources, including all references and all people not in your group with whom you discussed any part of any question (for each discussion, list the relevant questions) (continue on the back of this page if there is insufficient space):

Each group member must read, agree to, and sign this statement:

**I am familiar with the Code of Student Behaviour. I understand that are significant penalties for any infraction of this Code.**

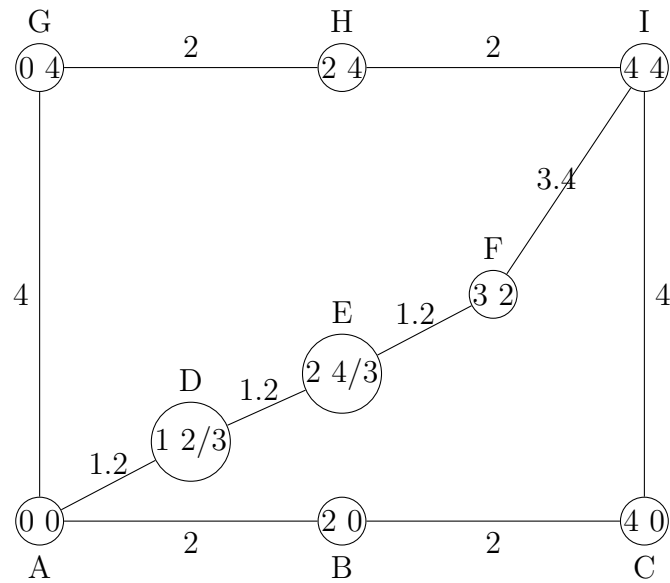
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2.



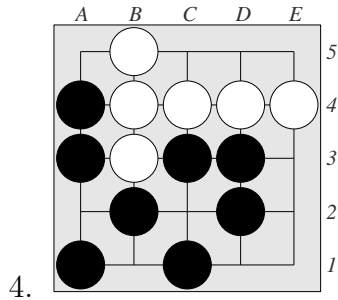
i) Starting from A, trace Dijkstra's algorithm on the graph above: list each node in the order in which the algorithm finalizes the distance to that node, and for that node, give the distance from A.

ii) Now trace A\*, and find the shortest distance from A to I: again, list each node in the order in which the algorithm finalizes the distance to that node, and for that node, give the distance from A. Use Euclidean distance to I as heuristic:

A	B	C	D	E	F	G	H	I
5.7	4.5	4	4.5	3.3	2.2	4	2	0

3. Consider a triangle with nodes A,B,C and edge lengths AB 3, BC 4, AC 5. On this graph, trace A\* for the problem of finding a path from A to C. Use this heuristic function  $f$  to estimate the remaining distance to C:  $f(A) = 2$ ,  $f(B) = 1$ .
- i) Show all operations performed (as in the webnotes A\* example: Arad to Bucharest).

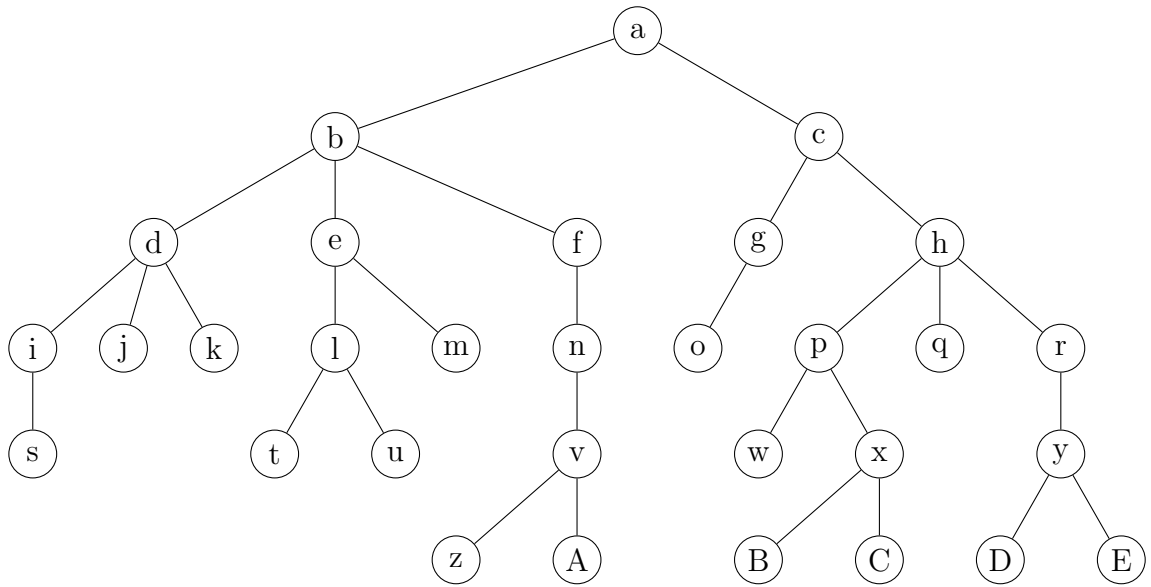
ii) How is it possible for A\* to return a path that is not a shortest path? Explain briefly.



i) For this diagram, give the current Tromp-Taylor score? (The komi is 0.) Explain briefly.

ii) Black moves next: what move maximizes Black's final score? What will that score be? Explain briefly.

5. Here is a 2-player game tree  $T$ . Players are p1 (who moves first) and p2. Leaf scores are for p1.



leaf	s	j	k	t	u	m	z	A	o	w	B	C	q	D	E
score	-3	2	4	7	-1	9	-5	6	8	-9	-2	-4	3	-7	-6

a) give the leaf node scores if they are for the player-who-would-move-next, instead of p1.

leaf	s	j	k	t	u	m	z	A	o	w	B	C	q	D	E
score															

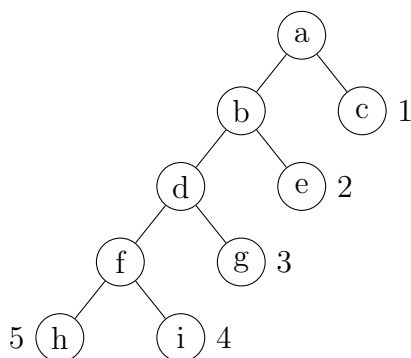
b) For each non-leaf node  $v$  of  $T$ , determine the minimax value of  $v$ .

node	a	b	c	d	e	f	g	h	i	l	n	p	r	v	x	y
value																

c) What property determines whether a traversal sequence is suitable for computing minimax values? E.g. which of these three orders are suitable: level order, reverse level order, postorder, preorder.

d) If you compute the minimax value of the root of  $T$  using  $\alpha\beta$  search, what nodes are pruned? (Hint: to check your answer, modify the program `alphabetalpha.py` so that it makes the first input label the root node.)

6. i) Find the minimax value of a. Scores show are for p1. Show your work.



ii) If `alphabetalpha` executes on this tree in the usual way (neighbour lists stored in alphabetic order), which (if any) edges are pruned?

iii) Repeat ii) if lists are stored in reverse alphabetic order.

7. i) What is the minimax value of the corner opening move in tic-tac-toe? (-1 for a loss, 0 for a draw, 1 for a win) Explain briefly.
- ii) Repeat i) for the middle opening.
- iii) Repeat i) for the other opening (not corner, not middle).
- iv) So why is the corner opening considered the best opening? Explain briefly.
8. Draw the dag for nim(2 2 3). Use the same form as in the webnotes, which shows the dag for nim(2 2 2) (so all arcs should go from right to left). Also, put an x under each losing state, and an arrow on each winning edge.