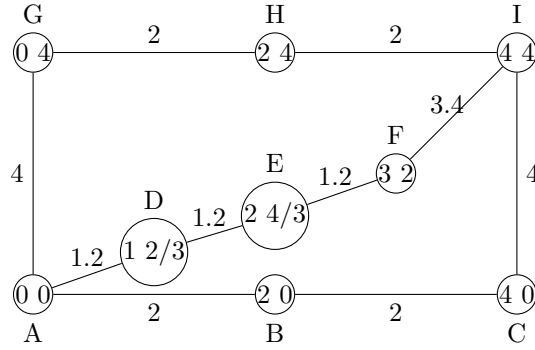


2.



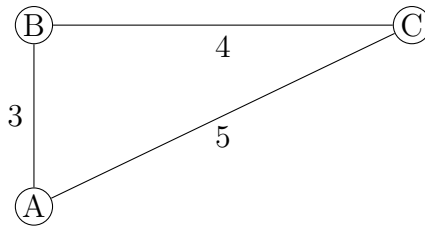
i) traces below show order in which distance from A finalized

	A	B	C	D	E	F	G	H	I	
dist	0									min: A
dist	*	2		1.2			4			min: D
dist	*	2		*	2.4		4			min: B
dist	*	*	4	*	2.4		4			min: E
dist	*	*	4	*	*	3.6	4			min: F
dist	*	*	4	*	*	*	4		7	min: C (or G)
dist	*	*	*	*	*	*	4		7	min: G (or C)
dist	*	*	*	*	*	*	*	6	7	min: H
dist	*	*	*	*	*	*	*	*	7	min: I

ii)

	A	B	C	D	E	F	G	H	I	
dist	0									
heur	5.7									
pri	5.7									min: A
dist	*	2		1.2			4			
heur		4.5		4.5			4			
pri		6.7		5.7			8			min: D
dist	*	2		*	2.4		4			
heur		4.5		*	3.3		4			
pri		6.7		*	5.7		8			min: E
dist	*	2		*	*	3.6	4			
heur		4.5		*	*	2.2	4			
pri		6.7		*	*	5.8	8			min: F
dist	*	2		*	*	*	4		7	
heur		4.5		*	*	*	4		0	
pri		6.7		*	*	*	8		7	min: I

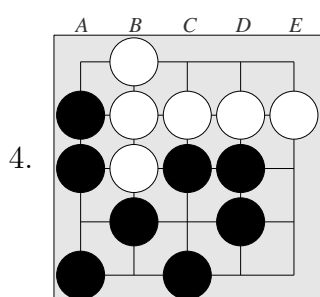
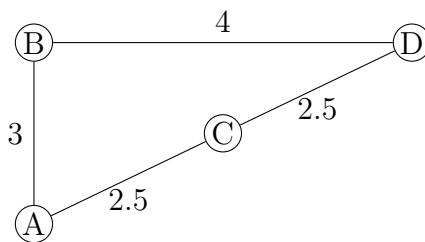
3.



	A	B	C	
dist	0			
heur	2			
pri	2			min: A
dist	*	3	5	
heur	*	1	0	
pri	*	4	5	min: B
dist	*	*	5	[min of 5, 3+4]
heur	*	*	0	
pri	*	*	5	min: C

ii) Here the heuristic underestimated the true remaining distance for each node, so the path found by A^* was shortest. Eg. remaining distance from A is 5 (heuristic said 2), remaining distance from B is 4 (heuristic said 1). But if the heuristic is bad enough, A^* can select a non-shortest path.

Eg. the network below, with this heuristic function: $f() = 0, 3, 4, 0$ for A, B, C, D . Exercise: check that the path found by A^* from A to D is ABD .

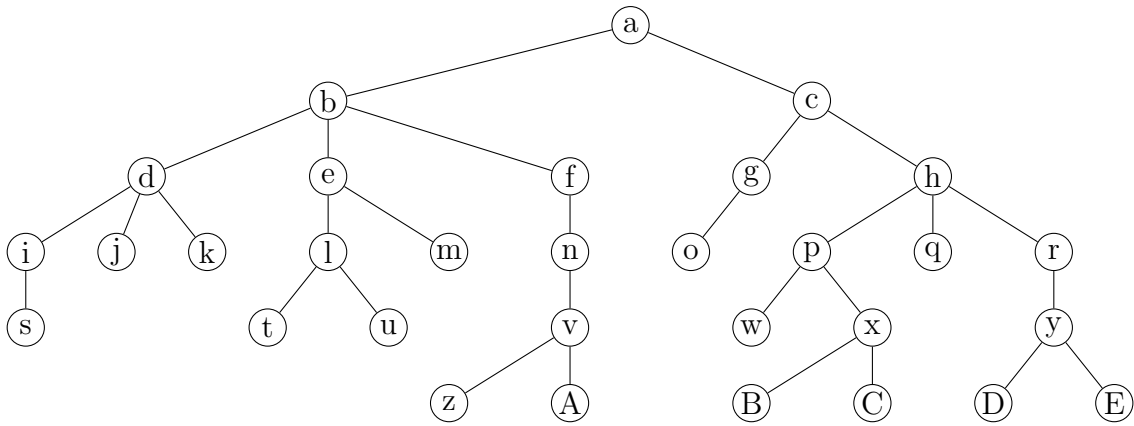


i) Tromp-Taylor score is White 9, Black 11. White: 6 stones plus points C5, D5, E5. Black: 8 stones plus 3 points A2, B1, C2.

ii) A classic life-and-death problem: Black D5, final score Black 25, White 0. (White can capture D5, but only by putting stones at both C5 and E5: but then Black can capture the White group by playing A5 and D5 again.)

If Black does not play D5, White plays D5 on the next move, and now the White group has two eyes (C5, E5), and can never be killed. No Black can win 16 to 9, not as good as 25 to 0.

5.



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) For each node whose distance to the root is odd, its score is negated. For each node whose distance to the root is even, its score is unchanged.

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

b) Here are the minimax values, from the point of view of p1.

node	a	b	c	d	e	f	g	h	i	l	n	p	r	v	x	y
value	4	4	3	4	9	6	8	3	-3	-1	6	-9	-6	6	-2	-6 (max)
value	"	-4	-3	"	"	"	"	"	3	1	-6	9	6	"	"	" (ptm)

c) To find a node's minimax value, you first need to find the minimax values of all children. So, any traversal sequence which processes all children of a node before processing the node will work. Among the sequences listed, only postorder has this property.

d) If you run `alphabeta.py`, and read the output, you learn what is shown below. Eg. `abneg(a)` calls `abneg(b)` calls `abneg(e)` calls `abneg(m)`, and after that call completes, the remaining children of `e` are pruned.

```

a:b:e:m      then prune remaining children of e *
a:b:f:n:v:A then prune remaining children of v *
a:b:f:n      then prune remaining children of f *
a:c:h:p:w    then prune remaining children of p
a:c:h:r:y    then prune remaining children of r *
a:c:h        then prune remaining children of c *

```

The * indicates that there were no remaining children at that point, so no actual pruning occurred there. So the only point in which pruning occurs is here: when backing up from `w`, the branch `p-x` is pruned.

However, notice: if we added any child, say `Z`, to node `e` after child `m`, then the branch to that child would have been pruned. A similar statement holds for all other pruning statements above.

6. i) $m(f) = \min(5,4) = 4$
 $m(d) = \max(4,3) = 4$
 $m(b) = \min(4,2) = 2$
 $m(a) = \max(2,1) = 2$

ii) no edges are pruned

- iii) $m(c) = 1$, so $m(a) \geq 1$
 $m(e) = 2$, so $m(b) \leq 2$
 $m(g) = 3$, so $m(d) \geq 3$
 now Min prefers e (2) to d (≥ 3), so
 branch d--f is pruned
 $m(a) = \max(2, 1) = 2$

7. in each case, the value is 0 (a draw).

- i) second player plays in the middle (all other 8 replies lose)
 ii) second player plays in a corner (the other 4 replies lose)
 iii) second player plays beside first player (the other 5 replies lose)
 iv) presumably because it leaves the opponent with the fewest non-losing moves

8.

