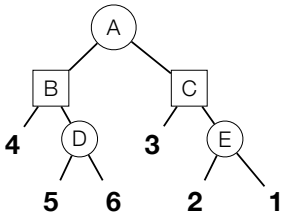
Name: _____ **CCID:** _____

CMPUT 355 Quiz #3 **21 marks** **50 minutes** **closed-book** **no devices**

1. **[6 points]** This alpha-beta search has just reached B. In table (a) below, list the new values of `so_far`, `alpha`, and `beta` in order, every time at least one of them changes. In table (b) below, give the value that alpha-beta search returns for each nonterminal node, or `n/a` if alpha-beta was not be called on that nonterminal. Leaf nodes are labelled with player 1's score (the MAX player).



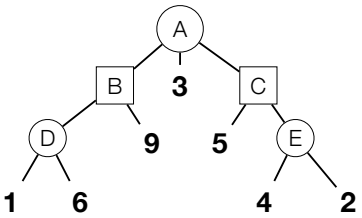
(a)

chg	node	so_far	alpha	beta
1	A	$-\infty$	$-\infty$	∞
2	B	∞	$-\infty$	∞
3	B	4	$-\infty$	4
4				
5				
6				
7				
8				

(b)

node	returns
A	
B	
C	
D	
E	

2. **[5 points]** Give the value that negamax returns for each nonterminal of the tree below in the table below. Leaf nodes are labelled with scores for the player to move.



node	A	B	C	D	E
negamax					

3. **[3 points]** Consider the follow code from `abeta/negamax.py`, with three missing expressions:

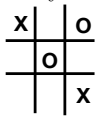
```
# leaf scores are for player-to-move
def negamax(d, T, V, v):
    if isTerminalNode(v,V):
        val = V[v]
        return val
    val = _____expression_(A)_____
    for c in T[v]: # for each child c of v
        nmx = negamax(d+1, T, V, c)
        val = max(_____expression_(B)_____,
                  _____expression_(C)_____)
    return val
```

(a) What should expression (A) be?

(b) What should expression (B) be?

(c) What should expression (C) be?

4. **[4 points]** Give a proof tree that proves that the following position is a win for X. You may prune isomorphic children, and you need not use any particular canonical representation.



5. **[3 points]** Consider the Nim position `(2,3,3,3)`:

(a) How many children does this position have?
There is no need to list the children.

(b) How many *non-isomorphic* children does this position have? List them all in canonical form.