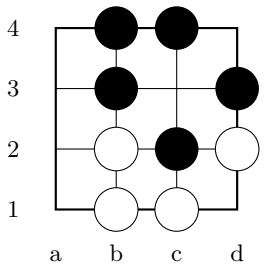
Name: Solution Guide **CCID:** _____

CMPUT 355 Quiz #1 **20 marks** **50 minutes** **closed-book** **no devices**

1. [5 points] Consider the following 4×4 Go position after 7 moves, with White stones at `b1`, `b2`, `c1`, `d2` and Black stones at `b3`, `b4`, `c2`, `c4`, `d3`.



   (a) List the liberties for the block containing `c4`. `a4, d4, a3, c3`

   (b) List the liberties for the block containing `c2`. `c3`

   (c) Suppose that White places a stone at `c3`. What stones, if any, does it capture? `c2`

   (d) Would it be legal for Black to reply by playing a stone at `c2`. Why or why not? No, this move is forbidden by superko. (Also forbidden by basic ko, any answer referencing ko is acceptable)

   (e) Would it be legal for Black to reply at `d1` instead? Why or why not? No, this move would be suicide. The stone at `d2` has two liberties after White's capture of `c2`, so Black's move on `d1` would not capture any stones, and would not have any liberties.

2. [5 points] The following line is from the go board initialization in `hexgo/stone_board.py`:

```
self.nbr_offset = ((-1,0),(0,1),(1,0),(0,-1))
```

   (a) Explain the purpose of this line. These are the coordinate offsets of every possible neighbouring point; adding each of these tuples elementwise to the row-column coordinates of a point will give coordinates which, if they are in range, will be the coordinates of a neighbouring point.

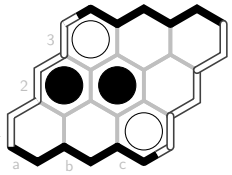
   (b) Give the corresponding line for Hex board initialization with neighbour order below left, below right, right, above right, above left, left. Full marks for *any* of

```
self.nbr_offset = ((-1,0),(-1,1),(0,1),(1,0),(1,-1),(0,-1)) or
self.nbr_offset = ((1,0),(1,1),(0,1),(-1,0),(-1,-1),(0,-1)) or
self.nbr_offset = ((-1,-1),(-1,0),(0,1),(1,1),(1,0),(0,-1)) or
self.nbr_offset = ((1,-1),(1,0),(0,1),(-1,1),(-1,0),(0,-1))
```

   (because lectures and example code are inconsistent about whether we count down from the top row or up from the bottom row, and because it's fine for above left to be in the same column and below left to be over one, or for above left to be over one and below left to be in the same column.)

   Half marks if all the elements are correct but the order is wrong.

3. [5 points] Here are the `parent[x]` values after the position below has been created by the moves `1.B[a2], 2.W[a3], 3.B[b2], 4.W[c1]`. Next, a black stone is played at `a1`. Recall that `Union(p,q)` sets the parent of the root of `q`'s component to the root of `p`'s component; assume *no* union-by-rank optimization. Below, show the new values of `parent[x]` after each union. `TP,BM,LF,RT` are the top, bottom, left, right borders respectively.



x	TP	BM	LF	RT	a1	b1	c1	a2	b2	c2	a3	b3	c3
current parent[x]	TP	BM	LF	RT	a1	b1	RT	a2	a2	c2	LF	b3	c3
after Union(a2,a1)	TP	BM	LF	RT	a2	b1	RT	a2	a2	c2	LF	b3	c3
then after Union(BM,a1)	TP	BM	LF	RT	a2	b1	RT	BM	a2	c2	LF	b3	c3

4. [5 points] Here is a portion of the `tromp_taylor_score` method in `go/go_helper.py`, with two lines missing. The method counts White territory into the variable `wt` and Black territory into the variable `bt`.

```
1     while (len(empty_points) > 0):
2       q = empty_points.pop()
3       for j in self.nbr_offsets:
4         x = j + q
5         b_nbr |= (self.brd[x] == BLACK)
6         w_nbr |= (self.brd[x] == WHITE)
7         if (self.brd[x] == EMPTY and
                x not in empty_seen):
8           empty_seen.add(x)
9           empty_points.append(x)
10          territory += 1
11    if b_nbr and not w_nbr:
12      ________line_(A)________
13    elif w_nbr and not b_nbr:
14      ________line_(B)________
```

(a) What should lines (A) and (B) be?

Line A should be `bt += territory` and
Line B should be `wt += territory`.

(b) Explain the purpose of line 6.

Line 6 sets `w_nbr` to `True` when a White stone is encountered and never sets it back to `False`; after the `while` loop completes it will be `True` iff `q` reaches any White stone.