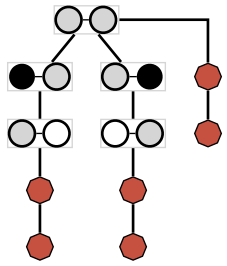
Name: Solution Guide **CCID:** _____

CMPUT 355 Quiz #4 **20 marks** **50 minutes** **closed-book** **no devices**

1. (a) **[2 points]** What is the minimax value for Black of the 2×2 Go position after the move `1.B[pass]`? Explain your answer. Assume positional superko, no suicide, and 0 komi.

   -1. We know from class that Black has a strategy in 2×2 Go that allows them to win by at least 1 point. If Black passes on the first turn, then White can execute that same strategy and win by at least 1 point, which is -1 for Black.

   (b) **[3 points]** Construct a proof tree that proves that the minimax value for 1×2 Go (*not* 2×2) is no larger than 0.
   This is a proof tree that shows how White can guarantee that Black gets no more than 0 points.



2. (a) **[2 points]** Is the Nim position `(2, 2, 3)` a winning or a losing position? Why?
   It is a winning position, because $\text{xorsum}(2,2,3) = 3 \neq 0$ (since $2 \oplus 2 = 0$, so $2 \oplus 2 \oplus 3 = 0 \oplus 3 = 3$).

   (b) **[2 points]** Is the Nim position `(2, 2, 3, 3)` a winning or a losing position? Why?
   It is a losing position, because $\text{xorsum}(2,2,3,3) = 0$. (Because $2 \oplus 2 = 0$ and $3 \oplus 3 = 0$, so $2 \oplus 2 \oplus 3 \oplus 3 = 0 \oplus 0 = 0$).

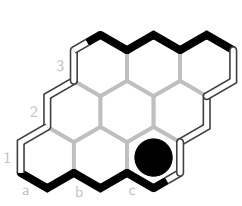
   (c) **[3 points]** List all the winning moves from the Nim position `(1, 5, 5)`.
   Take one from the first pile (leaving position $(0,5,5)$, with an xorsum of 0) or 1 from either of the second or third piles (leaving $(1,4,5)$ or $(1,5,4)$, both of which also have an xorsum of 0).

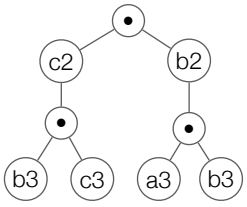
3. Consider the following AND/OR strategy after `1.B[c1]` on the 3×3 Hex board:

   (a) **[2 points]** What are this strategy's *cell sets*?
   This strategy has four cell sets:
   $\{c2, b3\}, \{c2, c3\}, \{b2, a3\}, \{b2, b3\}$.

   $$(c2 \wedge (b3 \vee c3)) \vee (b2 \wedge (a3 \vee b3))$$

   (b) **[2 points]** Does this strategy guarantee a win for Black from this position? Why or why not?
   This strategy does *not* guarantee a win for Black, because although every cell set connects the two borders, the cell sets for the two branches of the topmost OR are not disjoint; they both contain $b3$. So White can block both branches with a single move.





4. **[4 points]** Consider the following 6×6 Hex position. For each pair of nodes below, indicate whether they are **F**ully connected, **S**emi-connected, or **N**ot virtually connected:

node 1	node 2	virtually connected?
$a3$	$b4$	Fully connected
$a3$	$c1$	Semi-connected
$c1$	$f1$	Semi-connected
$b4$	$f1$	Not virtually connected