

# CMPUT 355 Quiz 4 Marking Rubric

## Grading Rubric

### Problem 1

+0.5 points for each item

### Problem 2

+2 points for each part

### Problem 3

+1 point for correct code modification

+1 point for correct explanation

### Problem 4

+1 point for correct number of winning moves

+1 point for correct winning move (number and pile)

+2 points for work shown, that demonstrates complete understanding

+ 1 point for work shown that demonstrates partial understanding

For full marks, must show the XOR value of the piles,  
and an XOR with one of the piles to get a winning move

### Problem 5

+0.2 points for each correct answer

### Problem 6

See below

### Problem 7

+0.33 points for each correct value

### Problem 8

a) Full marks are given for answers that demonstrate a strategy for Black that leads to the minimax score  $B-W=9$

b) 1 mark given if both the move and the  $B-W$  are correct

c) 2 marks given for sufficient explanation

## Quiz 4a

1.
  - a) Tree of all continuations: 600,000
  - b) Tree + isomorphism: 60,000
  - c) DAG + isomorphism: 8,000
  - d) DAG of all continuations: 16,000
2.
  - a) 14
  - b)  $1/6$
3. Here are a few examples of possible answers:
  - (a) Change lines 2, 3, and 4 to be == 'x' instead of == z
  - (b) Add before line 1:

```
if z == 'o':  
    return False
```

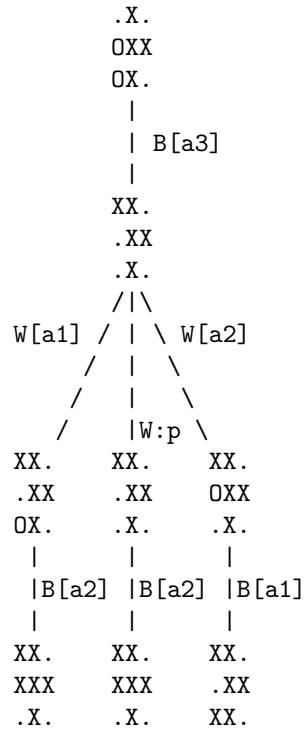
- (c) Add before line 2:

```
if z == 'x':  
    line2  
    line3  
    line4  
    ...
```

4. There are 3 winning moves.  
Remove 3 from pile *a*, or *b*, or remove 1 from *c*.
5. 

(0 0 0) L	(0 1 1) W	(1 1 1) L	(0 2 2) L
(0 0 1) L	(0 0 3) W	(0 0 4) W	(1 1 2) W
(0 0 2) W	(0 1 2) W	(0 1 3) W	
6. There is a winning move from a pile if the binary representation of the pile size has a 1 in the same bit position as the left-most 1 in the binary representation of the xorsum of all the piles (from the course notes). (1 point) For there to be exactly two winning moves, there would have to be only two piles with a 1 in this bit position, but that would make the xorsum of the piles 0 for that bit position, when it must be 1. (1 point) Therefore, it's not possible to have exactly 2 winning moves.
7. Score: 1, 0, 1, 0, 1, 0

8. a) Strategy tree (for Black) shows one strategy from Black, and all opposing moves from White.



- b)  $W[b2], B - W = 3$
- c) On a 3x3 board, if either player forms a middle-3 or bent-3 shape, they can win 9-0, because they have split the board into two regions that the other cannot play in. As Black already has a middle-3 shape by move 5, it knows that it will 9-0.

## Quiz 4b

- DAG of all continuations: 16,000
  - DAG + isomorphism: 8,000
  - Tree + isomorphism: 60,000
  - Tree of all continuations: 600,000
- 12
  - 1/5
- Here are a few examples of possible answers:
  - Change lines 21, 22, and 23 to be == 'x' instead of == z
  - Add before line 20:

```
if z == 'o':  
    return False
```

- Add before line 21:

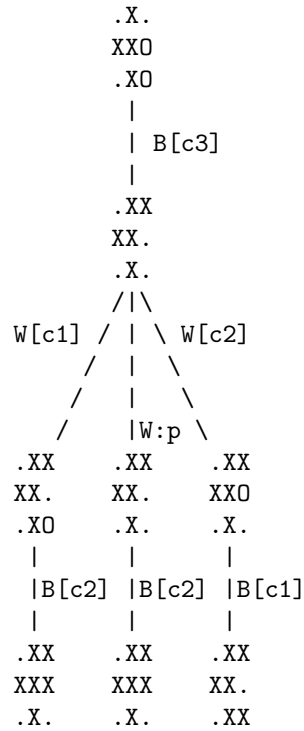
```
if z == 'x':  
    line2  
    line3  
    line4  
    ...
```

- There is 1 winning move.  
Remove 6 from pile  $d$ .

- |           |           |           |           |
|-----------|-----------|-----------|-----------|
| (0 0 0) W | (0 1 1) L | (1 1 1) W | (0 2 2) W |
| (0 0 1) W | (0 0 3) W | (0 0 4) W | (1 1 2) W |
| (0 0 2) L | (0 1 2) W | (0 1 3) W |           |

- There is a winning move from a pile if the binary representation of the pile size has a 1 in the same bit position as the left-most 1 in the binary representation of the xorsum of all the piles (from the course notes). (1 point) For there to be exactly two winning moves, there would have to be only two piles with a 1 in this bit position, but that would make the xorsum of the piles 0 for that bit position, when it must be 1. (1 point) Therefore, it's not possible to have exactly 2 winning moves.
- Score: 0, 1, 0, 1, 0, 1

8. a) Strategy tree (for Black) shows one strategy from Black, and all opposing moves from White.



- b)  $W[b2], B - W = 3$
- c) On a 3x3 board, if either player forms a middle-3 or bent-3 shape, they can win 9-0, because they have split the board into two regions that the other cannot play in. As Black already has a middle-3 shape by move 5, it knows that it will 9-0.

## Quiz 4c

- DAG + isomorphism: 8,000
  - Tree of all continuations: 600,000
  - DAG of all continuations: 16,000
  - Tree + isomorphism: 60,000
- 9
  - 1/7
- Here are a few examples of possible answers:
  - Change lines 15, 16, and 17 to be == 'x' instead of == z
  - Add before line 14:

```
if z == 'o':  
    return False
```

- Add before line 15:

```
if z == 'x':  
    line2  
    line3  
    line4  
    ...
```

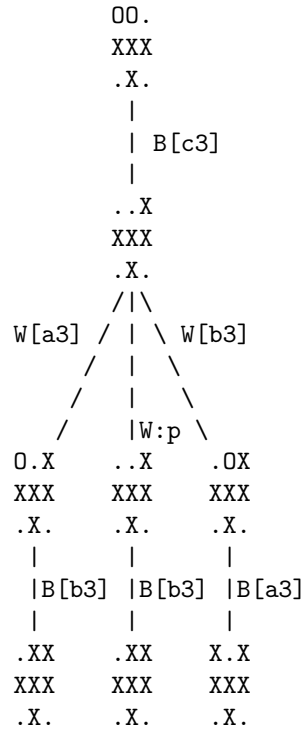
- There are 3 winning moves.

Remove 2 from pile *a*, *b*, or *c*.

- |           |           |           |           |
|-----------|-----------|-----------|-----------|
| (0 0 0) W | (0 1 1) W | (1 1 1) L | (0 2 2) L |
| (0 0 1) L | (0 0 3) W | (0 0 4) W | (1 1 2) W |
| (0 0 2) W | (0 1 2) W | (0 1 3) W |           |

- There is a winning move from a pile if the binary representation of the pile size has a 1 in the same bit position as the left-most 1 in the binary representation of the xorsum of all the piles (from the course notes). (1 point) For there to be exactly two winning moves, there would have to be only two piles with a 1 in this bit position, but that would make the xorsum of the piles 0 for that bit position, when it must be 1. (1 point) Therefore, it's not possible to have exactly 2 winning moves.
- Score: 0, 1, 0, 1, 0, 1

8. a) Strategy tree (for Black) shows one strategy from Black, and all opposing moves from White.



- b)  $W[b2], B - W = 3$
- c) On a 3x3 board, if either player forms a middle-3 or bent-3 shape, they can win 9-0, because they have split the board into two regions that the other cannot play in. As Black already has a middle-3 shape by move 5, it knows that it will 9-0.