HW3 Report

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IsFiveInLine()

```
def IsFiveInLine(self, x, y):
    player = self.board[x][y]
    count = 1
    for i in range(1, y + 1):
        if self.board[x][y - i] == player:
            count = count + 1
        else:
            break
    for i in range(1, self.size - y):
        if self.board[x][y + i] == player:
            count = count + 1
        else:
            break
    if count >= 5:
        return True
    '''
    other parts
    '''
```

This is how I determine if there are five in a line, which is the part of the vertical line. I check if there are more than five same stones by using `count` to count the numbers of same numbers in a line. The parts of horizonal and diagonal line are the same as this.

Bonus

```
def cal(board, x, y, size, num, lines, player):
    line = 0
    count = 1
    for i in range(1, y + 1):
        if board[x][y - i] == player:
            count = count + 1
        else:
            break
    for i in range(1, size - y):
        if board[x][y + i] == player:
            count = count + 1
        else:
            break
    if count >= num:
        line += 1
    '''
    other parts
    '''
    return line >= lines
```

```
def win(board, x, y, size, player):
    return cal(board, x, y, size, 5, 1, player)

def doubleFour(board, x, y, size, player):
    return cal(board, x, y, size, 4, 2, player)

def four(board, x, y, size, player):
    return cal(board, x, y, size, 4, 1, player)

def doubleThree(board, x, y, size, player):
    return cal(board, x, y, size, 3, 2, player)

def three(board, x, y, size, player):
    return cal(board, x, y, size, 3, 1, player)
```

This is how I determine if there are better moves than the UCT result. `cal()` is similar to the part in `IsFiveInLine()`, but with two more arguments, num and lines, to determine if there are multiple lines of fives, fours or threes. With these functions, I determine the best moves in the order of `win`, `doubleFour`, `four`, `doubleThree` and `three`.

Performance

In the original method, the game usually ends in more than 30 rounds and algorithm often chooses some useless moves, or misses victories.
With the bonus part, the game mostly ends in 20 rounds and never misses victories, which is a great improvement.