COMP250: Artificial Intelligence

2: Designing AI behaviours

Noughts and Crosses

Clone the following repository:

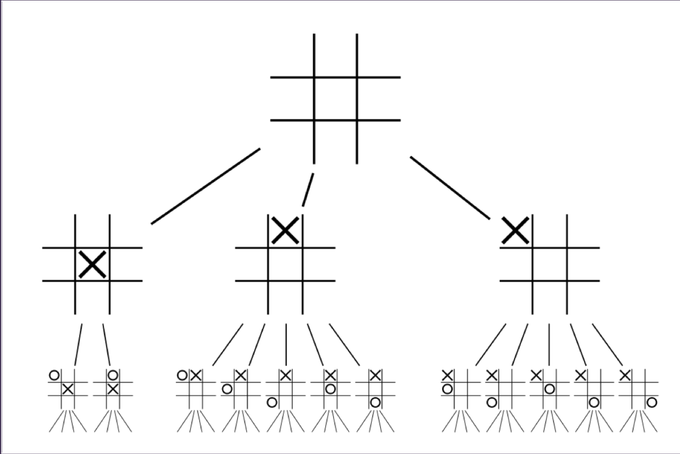
`https://github.com/Falmouth-Games-Academy/bsc-live-coding`

Open `COMP250/02_oxo` in PyCharm and run `oxo.py`

FALMOUTH UNIVERSITY

Minimax search

Game trees



Minimax

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- My opponent wants to **minimise** the value
- Therefore I want to **maximise** the **minimum** value my opponent can achieve
- This is generally only true for **two-player zero-sum** games

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Minimax search pseudocode

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        for each possible nextState **do**

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    if state is terminal **then**
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        for each possible nextState **do**
            v = MINIMAX(nextState, 3− currentPlayer)

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        for each possible nextState do
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        for each possible nextState do
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            bestValue = MAX(bestValue, v)
        end for
        return bestValue
    else if currentPlayer = 2 then
```

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        return value of state
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        for each possible nextState do
            v = MINIMAX(nextState, 3− currentPlayer)
            bestValue = MAX(bestValue, v)
        end for
        return bestValue
    else if currentPlayer = 2 then
        bestValue = +∞
        for each possible nextState do
            v = MINIMAX(nextState, 3− currentPlayer)
            bestValue = MIN(bestValue, v)
        end for
        return bestValue
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            v = MINIMAX(nextState, 3− currentPlayer)
            bestValue = MAX(bestValue, v)
        end for
        return bestValue
    else if currentPlayer = 2 then
        bestValue = +∞
        for each possible nextState do
            v = MINIMAX(nextState, 3− currentPlayer)
            bestValue = MIN(bestValue, v)
        end for
        return bestValue
    end if
end procedure
```

Stopping early

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for each possible nextState do
    v = MINIMAX(nextState, 3− currentPlayer)
    bestValue = MAX(bestValue, v)
end for
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- So if we ever have bestValue $= 1$, we can stop early
- Similarly when minimising if bestValue $= -1$

Using minimax search

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Using minimax search

- To decide what move to play next...
- Calculate the minimax value for each move
- Choose the move with the maximum score
- If there are several with the same score, choose one at random

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- Most games are too large to search fully, e.g. chess has $\approx 10^{47}$ states
- Later we will look at **heuristics** and **pruning** to cut down the size of the tree