WORKSHEET D: DATA STRUCTURES

Version 2.0
BSc Computing for Games
COMP110

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Introduction

In this worksheet, you will complete a Python implementation of the pen-and-paper game Noughts and Crosses (also known as OXO or Tic-Tac-Toe).

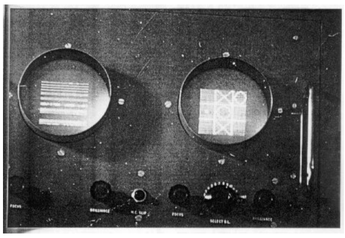
Noughts and Crosses is a two-player game played on a 3×3 grid. Players take turns to place their mark in an empty square of their choosing; usually player 1 marks `O` and player 2 marks `X`. The winner is the first player to get three marks in a row horizontally, vertically or diagonally.

To complete this worksheet:

(a) **Fork** the skeleton project and **open** `oxo.py` in your favourite Python IDE.
(b) **Choose** an appropriate data structure to represent the state of the board.
(c) **Implement** the following methods of the `OxoBoard` class:
   (i) `__init__()`, which should initialise the data structure and any other fields that are required.
   (ii) `get_square(x, y)`, which should return the current contents of the square at coordinates x, y. For this and other functions, x and y have values of 0, 1 or 2: $0, 0$ is the top left corner, $1, 0$ is the top middle, and so on. Cell contents are integers: 0 for an empty square, 1 for a player 1 mark, and 2 for a player 2 mark.
   (iii) `set_square(x, y, mark)`, which should check if the square at coordinates x, y is empty. If it is empty, fill it with the value of `mark` and return `True`; if the square is not empty, leave it alone and return `False`.
   (iv) `is_board_full()`, which should return a boolean indicating whether all spaces on the board are occupied.
   (v) `get_winner()`, which should check if either player has made three in a row. If they have, return the player number (1 or 2). If neither player has made three in a row, return 0. If the board state is such that both players have made three in a row (which cannot occur in a normal game), behaviour is undefined (i.e. your function does not need to handle this case).

It is anticipated that `get_winner()` will be the most challenging of these, so please plan your time accordingly.

The skeleton project contains a file `play.py`, which imports your `OxoBoard` class and uses it to graphically play a game of Noughts and Crosses. You may find this useful when testing your code.



OXO on the EDSAC computer, one of the earliest examples of a computer game.

Submission instructions

Begin by **forking** the GitHub repository at the following URL:

`https://github.com/Falmouth-Games-Academy/comp110-worksheet-D`

Edit `oxo.py`, implementing the required functions. When you have finished, open a **pull request**.

Do not move or rename `oxo.py`, and do not edit or delete any of the other files in the repository. Doing so will interfere with the automated testing scripts used to check your submission for correctness, and as a result may lead to you losing marks.

Attend the scheduled worksheet feedback session in **week 11**, ensuring that you have uploaded all material to GitHub and opened a pull request before this time.

Marking criteria

Remember that **it is better to submit incomplete work than to submit nothing at all**. Any attempt, even unfinished, will receive a passing grade.

Your work will be marked according to the following criteria:

- **Functional coherence**. Is your implementation correct? Your code will be run through TravisCI to verify that it gives the correct results for a large sample of input values.
- **Sophistication**. Have you made use of appropriate code structures and data structures? Note the emphasis is on **appropriate**; extra credit will **not** be given for unnecessarily complex solutions.
- **Maintainability: readability**. Is your code well commented? Are your identifier names appropriate and descriptive? Have you adhered to appropriate coding standards (e.g. PEP-8)?
- **Maintainability: expandability**. Suppose that we wanted to implement an $n \times n$ variant of Noughts and Crosses that works for any positive integer n. How easily could your code be adapted to this change in requirements? How about an $m \times n$ variant, where the objective is to get k in a row, for any positive integers m, n, k?