The first practice on Game Theory

(Innopolis University, Fall Semester 2022, BS-III)

Description

It is a distance asynchronous individual programming test to check that students understand and can apply main definitions, concepts and techniques presented and discussed on weeks 1 and 2, namely

- Finite Position Games (FPG),
- Knaster-Tarski fix-point theorem,
- backward induction and solutions of FPG's

The test supplements the theory test and consists of a single task (parameterized by individual birth data). According to the Syllabus, overall cost of the test is 25 points.

Rules

The timeline

- Publication of the Description, Rules, and the task – by Wednesday September 14, 2024.
- Consultation on technical issues – during office hours with Mr. Munir Makhmutov (and in need – with Nikolay V. Shilov) prior to the submission date.
- Individual solutions to be uploaded to Moodle by Sunday October 2, 2022 (prior 11:59 PM Moscow time zone).
- Individual live grading – by appointment with Mr. Munir Makhmutov (and in need – with Nikolay V. Shilov) prior to the grade publication date.
- Publication of grades on Moodle – by Sunday October 16, 2022.

The main grading criteria

1. Completely implemented functional specification, easy to reuse code implementing backward induction for FPG's (50%)
2. Good design, quality English comments (10%)
3. Concise (2 pages) but complete report (with a short manual and design information and references to the theoretical test if needed) (40%).

Submission rules and formats

- Students must upload two files: the source file (Python 3+) and the report (PDF-file).
- Each submitted file should be named by student first name and surname (for example *NikolayShilov.py* and *NikolayShilov.pdf*)
- Source file and report should provide student first name and surname followed by birthdate (in the format $day.month.year$, for example $24.04.1961$).

Late Submission Policy

According to the Syllabus, "Students who do not take/submit on time any mid-term assignment without legal excuse (e.g., documented medical) may/can do it not later than one week after the scheduled date with 30% deduction from the grade for this assignment."

Task (25 points)

Consider the same position game (between Spoiler and Duplicator) as in the theory test.

- Positions of the game are integers in $[1..(day + month + year)]$, players move in turns Duplicator-Spoiler-Duplicator-Spoiler-etc.
- Moves (for both players) are $(+n)$ where n is any number in the range $[1..(day + month)]$ (within the admissible range $[1..(day + month + year)]$), e.g., a player can move from 1234 to 1235, 1236, … $\big(1234 + (day + month)\big)$.
- A player wins and the play stops as soon as the player moves to the final position $(day + month + year)$.

You should implement the following minimal functionality.

1. Each session with the program consists of several plays with opportunity to have next play on demand.
2. Each play in the session starts with an option to start at a random (decide by program) or specified (by user) position.
3. Then, prior to playing, program should ask user about playing mode:
   - smart (if possible, the program uses a winning strategy against user),
   - random (program makes random moves),
   - advisor (plays as in a smart mode and if possible, the program advises a winning strategy for the user).
4. Log file of each play should be available on demand after the play (to inspect it).
5. The program should check for invalid inputs and process them

In addition to the minimal functionality, it will be an advantage to implement an interface which allows to play with computer as Duplicator with buttons and boxes as specified below:

1. To start a new play press 'New' button, to stop the game press 'Bye' button.
2. Provide radio buttons to set a play mode (smart, random, or advisor) and initial position mode (a random or user-specified).
3. Start a play with setting (initial) position in the box 'position' and pressing 'start' button. (Don't change value in 'position' box after setting it in the start of the play.)
4. In the play 'position' box will always show the previous position.
5. You may make a move in reply to invitation "your turn" in 'your move box'.
6. 'Play status' box may contain a message, "Ready", "Play in progress", "Spoiler wins" or "You win".

Examples of buttons and boxes:

Position: Enter your move Start

Alice move is , it results in

Your move is (make), it results in

Play status: Ready

This advantage will allow to receive additional 10% at most for the assignment based. Thus, maximum grade you may receive is 110%, which will be rounded till 100% at most. The additional points are NOT counted as Bonus participation points. The GUI is not mandatory to get the full grade.