Pure Nash Equilibria Finder for 2-Player Normal-Form Games

Git link:

https://github.com/razvanbaboiucs/BMDC-game-theory-assginment/tree/master/1-nash-eq

Algorithm Explanation:

Pseudocode:

```
FOR i FROM 0 TO rows-1 DO
    FOR j FROM 0 TO cols-1 DO
        isEquilibrium ← TRUE

        // Check if Player 1 can improve by deviating
        FOR k FROM 0 TO rows-1 DO
            IF payoffMatrix1[k][j] > payoffMatrix1[i][j] THEN
                isEquilibrium ← FALSE
                BREAK
            END IF
        END FOR

        // If still an equilibrium, check if Player 2 can improve
        IF isEquilibrium THEN
            FOR k FROM 0 TO cols-1 DO
                IF payoffMatrix2[i][k] > payoffMatrix2[i][j] THEN
                    isEquilibrium ← FALSE
                    BREAK
                END IF
            END FOR
        END IF

        // If neither player can improve, it's a Nash equilibrium
        IF isEquilibrium THEN
            ADD [i+1, j+1] TO equilibria
        END IF
    END FOR
END FOR

RETURN equilibria
```

Explanation:

1. The algorithm examines each cell (i,j) in the payoff matrices.

2. For each cell, it checks if it represents a Nash equilibrium by verifying:
    - Player 1 cannot improve by unilaterally changing their strategy (row)
    - Player 2 cannot improve by unilaterally changing their strategy (column)
3. If neither player can improve their payoff by deviating, the strategy profile is a Nash equilibrium.
4. The algorithm returns all Nash equilibria found in the game.

Game 1

Pure Nash Equilibria Finder for 2-Player Normal-Form Games

Enter number of strategies for Player 1: 2 Enter number of strategies for Player 2: 2 Do you want random payoffs? (yes/no): yes

Payoff Matrix (Player 1, Player 2)

	Player 2: Strategy 1	Player 2: Strategy 2
Player 1: Strategy 1	(3, 6)	(3, 8)
Player 1: Strategy 2	**(4, 3)**	**(6, 3)**

Pure Nash Equilibria: Found 2 pure Nash Equilibria: 1. Strategy profile: (2, 1) 2. Strategy profile: (2, 2)

Game 2

Pure Nash Equilibria Finder for 2-Player Normal-Form Games

Enter number of strategies for Player 1: 2 Enter number of strategies for Player 2: 3 Do you want random payoffs? (yes/no): yes

Payoff Matrix (Player 1, Player 2)

	Player 2: Strategy 1	Player 2: Strategy 2	Player 2: Strategy 3
Player 1: Strategy 1	(1, 9)	(4, 8)	(5, 0)
Player 1: Strategy 2	(4, 6)	**(8, 9)**	(0, 3)

Pure Nash Equilibria: Found 1 pure Nash Equilibria: 1. Strategy profile: (2, 2)

Game 3

Pure Nash Equilibria Finder for 2-Player Normal-Form Games

Enter number of strategies for Player 1: 3 Enter number of strategies for Player 2: 2 Do you want random payoffs? (yes/no): yes

Payoff Matrix (Player 1, Player 2)

	Player 2: Strategy 1	Player 2: Strategy 2
Player 1: Strategy 1	(4, 4)	(6, 9)
Player 1: Strategy 2	(0, 1)	**(8, 3)**
Player 1: Strategy 3	(2, 6)	(1, 9)

Pure Nash Equilibria: Found 1 pure Nash Equilibria: 1. Strategy profile: (2, 2)

Game 4

Pure Nash Equilibria Finder for 2-Player Normal-Form Games

Enter number of strategies for Player 1: 3 Enter number of strategies for Player 2: 3 Do you want random payoffs? (yes/no): yes

Payoff Matrix (Player 1, Player 2)

	Player 2: Strategy 1	Player 2: Strategy 2	Player 2: Strategy 3
Player 1: Strategy 1	(3, 1)	(2, 1)	**(7, 9)**
Player 1: Strategy 2	(0, 3)	**(8, 8)**	(4, 6)
Player 1: Strategy 3	(6, 5)	(6, 8)	(4, 3)

Pure Nash Equilibria: Found 2 pure Nash Equilibria: 1. Strategy profile: (1, 3) 2. Strategy profile: (2, 2)

Game 5

Pure Nash Equilibria Finder for 2-Player Normal-Form Games

Enter number of strategies for Player 1: 2 Enter number of strategies for Player 2: 2 Do you want random payoffs? (yes/no): yes

Payoff Matrix (Player 1, Player 2)

	Player 2: Strategy 1	Player 2: Strategy 2
Player 1: Strategy 1	(1, 9)	(8, 8)
Player 1: Strategy 2	**(8, 9)**	(7, 4)

Pure Nash Equilibria: Found 1 pure Nash Equilibria: 1. Strategy profile: (2, 1)

Game 6

Pure Nash Equilibria Finder for 2-Player Normal-Form Games

Enter number of strategies for Player 1: 4 Enter number of strategies for Player 2: 4 Do you want random payoffs? (yes/no): yes

Payoff Matrix (Player 1, Player 2)

	Player 2: Strategy 1	Player 2: Strategy 2	Player 2: Strategy 3	Player 2: Strategy 4
Player 1: Strategy 1	(6, 1)	(7, 6)	(4, 7)	(0, 6)
Player 1: Strategy 2	(5, 7)	(5, 8)	**(7, 9)**	(8, 5)
Player 1: Strategy 3	(9, 2)	**(9, 5)**	(0, 1)	(9, 0)
Player 1: Strategy 4	(2, 5)	(4, 3)	(1, 3)	**(9, 8)**

Pure Nash Equilibria: Found 3 pure Nash Equilibria: 1. Strategy profile: (2, 3) 2. Strategy profile: (3, 2) 3. Strategy profile: (4, 4)