

## Coding Assignment

### Nash Equilibrium

**The Script** In this assignment, you are asked to code a Nash equilibrium solver for finite two-person games. Please write your code in Python. You have to write a script that does the following:

1. Define a variable  $n \geq 2$ .
2. Draw two (positive) random  $n \times n$  matrices  $A$  and  $B$  that represent the payoffs of the two players (interpretation below).
3. Defines and runs a function  $NashEquilibrium(A, B)$  that returns the pure strategy Nash equilibria in the game with the payoff matrices  $A$  and  $B$  (details below).

**The Matrices  $A$  and  $B$**  The input to your function are two matrices,  $A$  and  $B$ , of size  $n \times n$ , with  $n \geq 2$ . The matrix  $A$  contains the payoffs of Player 1, and the matrix  $B$  contains the payoffs of Player 2. An element  $A$  is denoted by  $a_{i,j}$  and an element of  $B$  is denoted by  $b_{i,j}$ , where  $i$  refers to the row and  $j$  refers to the column of the entry,

$$A = \begin{pmatrix} a_{1,1} & a_{1,2} & a_{1,3} & \dots \\ a_{2,1} & a_{2,2} & a_{2,3} & \dots \\ a_{3,1} & a_{3,2} & a_{3,3} & \dots \\ \vdots & \vdots & \vdots & \ddots \end{pmatrix} \quad B = \begin{pmatrix} b_{1,1} & b_{1,2} & b_{1,3} & \dots \\ b_{2,1} & b_{2,2} & b_{2,3} & \dots \\ b_{3,1} & b_{3,2} & b_{3,3} & \dots \\ \vdots & \vdots & \vdots & \ddots \end{pmatrix}$$

The interpretation of the matrix elements is as follows: The rows correspond to the respective Player's actions  $1, \dots, n$ , while the columns correspond to the opponent's actions  $1, \dots, n$ . That is, if Player 1 chooses action  $i$  and Player 2 chooses action  $j$ , then the payoff to Player 1 is  $a_{i,j}$  and the payoff to Player 2 is  $b_{j,i}$ .

**The Function  $NashEquilibrium(A, B)$**  Write a function that returns, for any two matrices  $A$  and  $B$ , the pure strategy Nash equilibria. Specifically, if choosing strategy  $i$  for Player 1 and strategy  $j$  for Player 2 is a Nash equilibrium, the output should be something like this: "The action profile  $(i, j)$  is a Nash equilibrium." If several Nash equilibria exist, another line is added to the output. If no pure strategy equilibrium exists, the output is "No pure strategy equilibrium exists."

**Grading** You can make 20 points with this assignment (group grading). The code should be clear (5 points), as simple as possible (5), bug-free (5), and well-documented (5).

**Due Date:** Please send me your scripts no later than **May 15**.