

Exercise 18 NonLoop 2021

Question 1

- a) For each of these payoff matrices identify
- Pure strategy Nash eq.
 - Pareto optimal outcomes
 - Maximal social outcome

* Pure strategy Nash eq.:

Two strategies s_i and s_j of agent i and j are Nash eq.

- if player i plays s_i , player j can do no better than s_j
- if player j plays s_j , player i can do no better than s_i .

(PD)

		j	
		D	C
i	D	<u>2, 2*</u>	<u>4, 1</u>
	C	1, 4	3, 3

⇒ (D, D) is Nash in PD

(MP)

		j	
		H	T
i	H	1, -1	-1, 1
	T	-1, 1	1, -1

⇒ No Nash in MP

(GL)

		j	
		D	C
i	D	1, 1	<u>4, 2*</u>
	C	<u>2, 4*</u>	3, 3

⇒ (D, C) and (C, D) are Nash eq in GL

(PD)

		j	
		D	C
i	D	<u>2,2*</u>	<u>4,1</u>
	C	1,4	3,3

\Rightarrow (D,D) is Nash in PD

(MP)

		j	
		H	T
i	H	1,-1	-1,1
	T	-1,1	1,-1

\Rightarrow No Nash in MP

(GC)

		j	
		D	C
i	D	1,1	<u>4,2*</u>
	C	<u>2,4*</u>	3,3

\Rightarrow (D,C) and (C,D) are Nash eq in G

* Pareto optimal outcome is the solution where no improvement is possible without making someone else worse off.

j

(PO)

		D	C
i	D	2, 2	4, 1+
	C	1, 4+	3, 3+

⇒ (D, C), (C, D) and (C, C) are PO in PO

j

(MP)

		H	T
i	H	1, -1+	-1, 1+
	T	-1, 1+	1, -1+

⇒ All outcomes are PO (in the sense of strong dominance) in MP

i

		j	
		D	C
i	D	1, 1	4, 2 ⁺
	C	2, 4 ⁺	3, 3 ⁺

⇒ (C,D), (D,C) and (C,C) are PO in GC

* Social welfare optimum

$$sw(w_i) = \sum_{j \in A_j} u_j(w_i)$$

(PD)

		j	
		D	C
i	D	2, 2 4	4, 1 5
	C	1, 4 5	3, 3 <u>6</u>

⇒ (C,C) is SO in PO

MP

	H	T
H	1, -1 ^o	-1, 1 ^o
T	-1, 1 ^o	1, -1 ^o

⇒ All outcomes are SO in MP

GC

	D	C
D	1, 1 ^o	4, 2 ^o
C	2, 4 ^o	3, 3 ^o

⇒ (D,C), (C,D) and (C,C) are SO in GC

Let's sum up

PO

		j		
		D	C	* Nash
i	D	*	+	+ PO
	C	+	+0	□ SO

⇒ Rational outcome is not PO or SO, why is SO stable in many real world PDs?

MP

	H	T
H	+0	+0
T	+0	+0

⇒ No rational outcome, all outcomes are PO and SO. Only solution is in mixed strategy Nash eq, guaranteed by Nash's theorem.

GC

		j	
		D	C
i	D		# + \square
	C	# + \square	+ \square

⇒ There are multiple rational outcomes that are also SO and PO. Which one to pick?

↳ "Program equilibria make cooperation possible in one-shot PD". Explain and critically assess this statement.

Program equilibrium:

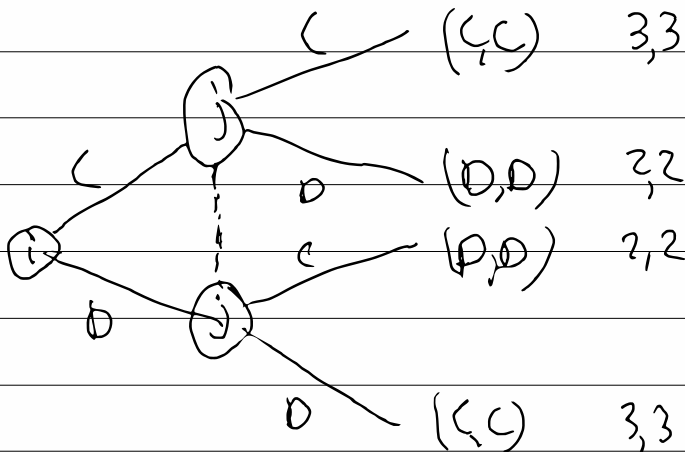
Basic idea is to compare strategies (programs) before conditional action is taken by moderator
"I will cooperate if you will"

if $p_1 \geq p_2$ $p_1 = \text{program 1 (string 1)}$
 do (C, C) $p_2 = \text{program 2 (string 2)}$
 else
 do (D, D) ;
 end

Max Π_i and Π_j

		D	C
i	D	2, 2	4, 1
	C	1, 4	3, 3

Let's view the possible payoff Π using extensive form



$\Rightarrow (C, C)$ or (D, D) are rational strategies