



1-10-Pareto-2

2020年6月5日 星期五 下午2:28



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Pareto Optimality

Game Theory Course:
Jackson, Leyton-Brown & Shoham

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Analyzing Games



- We've defined some canonical games, and thought about how to play them. Now let's examine the games from the **outside**
- From the point of view of an outside observer, can some outcomes of a game be said to be **better** than others?

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Analyzing Games

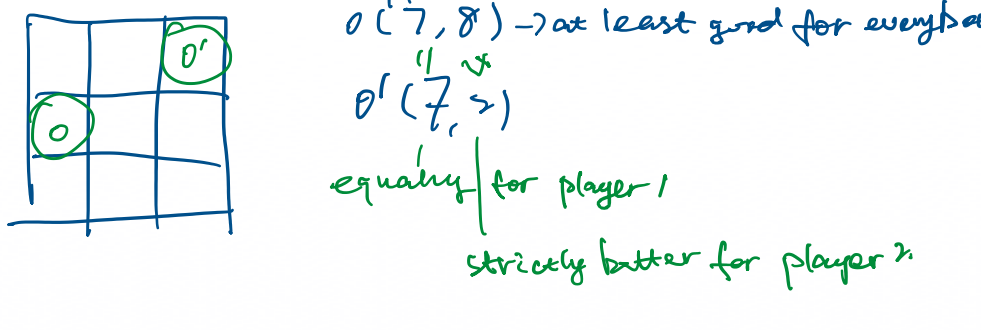


- We've defined some canonical games, and thought about how to play them. Now let's examine the games from the **outside**
- From the point of view of an outside observer, can some outcomes of a game be said to be **better** than others?
 - can't say one agent's interests are more important than another's
 - imagine trying to find the revenue-maximizing outcome when you don't know what currency is used to express each agent's payoff
- Are there ways to still prefer one outcome to another?

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Pareto Optimality

- Idea:** sometimes, one outcome o is at least as good for every agent as another outcome o' , and there is some agent who strictly prefers o to o'
 - in this case, it seems reasonable to say that o is better than o'
 - we say that o **Pareto-dominates** o' .



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Pareto Optimality

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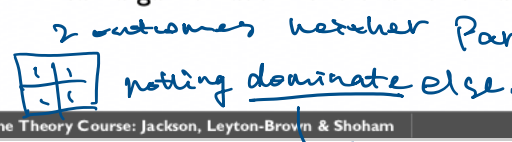
Definition (Pareto Optimality)
An outcome o^* is **Pareto-optimal** if there is no other outcome that Pareto-dominates it.
nothing else prefers to it

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Pareto Optimality

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Definition (Pareto Optimality)
An outcome o^* is **Pareto-optimal** if there is no other outcome that Pareto-dominates it.

- can a game have more than one Pareto-optimal outcome? \checkmark
2 outcomes neither Pareto-dominate each other

sh strictly prefer each

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Pareto Optimality

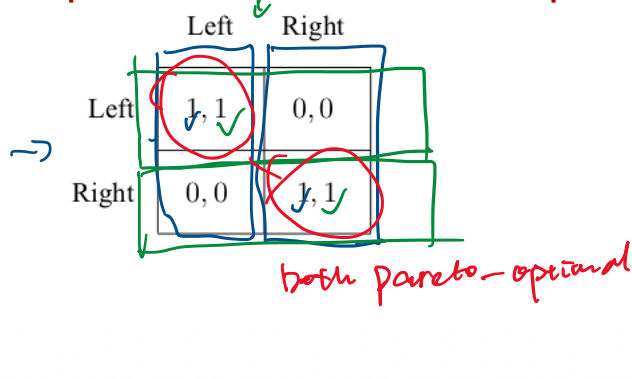
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 - we say that o **Pareto-dominates** o' .

Definition (Pareto Optimality)
An outcome o^* is **Pareto-optimal** if there is no other outcome that Pareto-dominates it.

- can a game have more than one Pareto-optimal outcome?
- does every game have at least one Pareto-optimal outcome? \checkmark
cycle in Pareto-dominance - every game p.d. exists!

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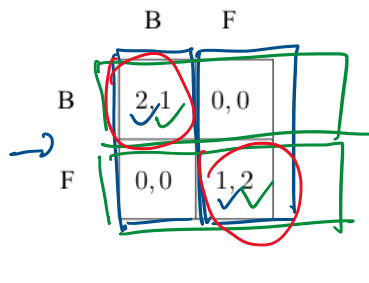
Pareto Optimal Outcomes in Example Games



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Pareto Optimal Outcomes in Example Games

	Left	Right
Left	1, 1	0, 0
Right	0, 0	1, 1



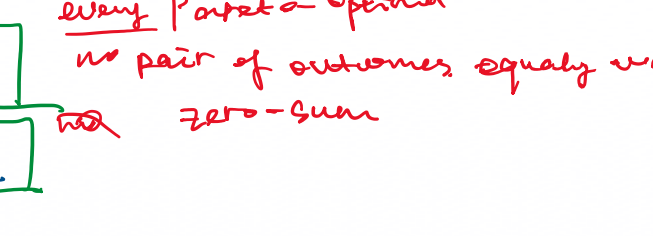
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Pareto Optimal Outcomes in Example Games

	Left	Right
Left	1, 1	0, 0
Right	0, 0	1, 1

	B	F
B	2, 1	0, 0
F	0, 0	1, 2

	Heads	Tails
Heads	1, -1	-1, 1
Tails	-1, 1	1, -1



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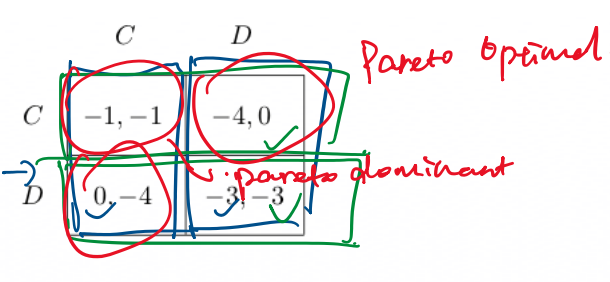
Pareto Optimal Outcomes in Example Games

	Left	Right
Left	1, 1	0, 0
Right	0, 0	1, 1

	B	F
B	2, 1	0, 0
F	0, 0	1, 2

	Heads	Tails
Heads	1, -1	-1, 1
Tails	-1, 1	1, -1

	C	D
C	-1, -1	-4, 0
D	0, -4	-3, -3



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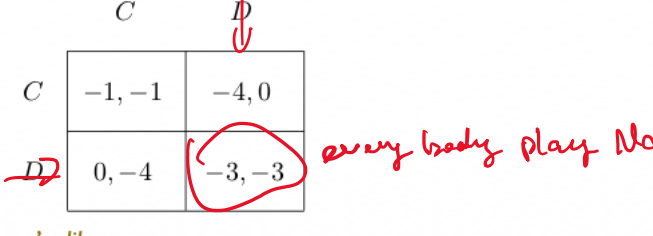
Pareto Optimal Outcomes in Example Games

	Left	Right
Left	1, 1	0, 0
Right	0, 0	1, 1

	B	F
B	2, 1	0, 0
F	0, 0	1, 2

	Heads	Tails
Heads	1, -1	-1, 1
Tails	-1, 1	1, -1

	C	D
C	-1, -1	-4, 0
D	0, -4	-3, -3



Dominant strategy
The paradox of Prisoner's dilemma:
the (DS) Nash equilibrium is the only non-Pareto-optimal outcome!

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