

# Game Theory

## Static and Complete Information Games

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## Some Notes and Assumptions

- ▶ We assume that players are rational (means that selects the choice which gives him/her the maximum payoff).
- ▶ Other than rationality assumption, we also assume that each players know that all the other players are rational, which is a different and more strong assumption from the rationality assumption of each players.
- ▶ And for this case, the discreet games, there are finite numbers of strategies for each player.

# Mathematical Notations

Number of Players =  $n$

Set of Possible Strategies for  $i$ th Player =  $S_i = \{s_i^1, s_i^2 \dots s_i^m\}$

Utility of  $i$ th Player from the Strategies of Players =  $u_i(s_i, s_{-i})$

# Dominant Strategy Games

- ▶ In this kind of games, players will be able to eliminate some of their choices, which narrows down to the dominant strategy

# Dominant Strategy Games

	L	R
L	(0,0)	(0,2)
R	(2,0)	(1,1)

- ▶ Since in this game, for the first player, irrespective of second player's strategy, he/she should choose  $R$  because if second player choose  $L$ , in order to maximize its payoff, it should choose  $R$ , which is 2. And it is also valid if second play  $R$ . Thus we can eliminate the choice of  $L$  for first player, which means that the  $L$  is dominated by  $R$
- ▶ This interpretation should be carried for second player as well. Which eliminates the choice of  $L$  and means that  $R$  dominates  $L$ .

## Dominant Strategy Games

	L	R
L	(0,0)	(0,2)
R	(2,0)	(1,1)

- As we have indicated, irrespective of the choice of their competitors, both player will eliminate the choice of  $L$ . We can show it mathematically:

$$u_1(R, L) > u_1(L, L) \mid u_1(R, R) > u_1(L, R)$$

$$u_2(L, R) > u_2(L, L) \mid u_2(R, R) > u_2(R, L)$$

# Dominant Strategy Games

$$\{\nexists s'_1 \in S_1 : \forall i \ u_1(s'_1, s_{-i}) \geq u_1(s_1, s_{-i})\}$$

- ▶ The last mathematical notation tells us that there is not any other strategy for first player ( $s'_1$ ) which is an element of all strategies for first player ( $S_1$ ), such that for all  $i$  values ( $\forall i$ ) utility of first player for any other strategy of first player ( $s'_1$ ) is bigger than the utility of first player for a dominant strategy ( $s_1$ ).



# Dominant Strategy Games

- ▶ Thus, we have only the solution of right and right.

$$\{R, R\}$$

- ▶ We call this solution as Dominant Strategy Equilibrium.