

Game Theory Review Part 1

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Game theory is the mathematical study of interactions between rational and self-interested agents.

It makes heavy use of the notion of utility, which gives us a way to quantify agents' preferences over states of the world.

$$\Omega = \{ \text{"sunny"}, \text{"cloudy"}, \text{"rainy"}, \text{"snowy"} \}$$

$$\begin{aligned} u(\text{sunny}) &= 10 & u(\text{rainy}) &= 0 \\ u(\text{cloudy}) &= 5 & u(\text{snowy}) &= -10 \end{aligned}$$

$$u(\text{sunny}) > u(\text{rainy}) \rightarrow \text{I prefer sun to rain}$$

A rational agent chooses actions to maximize his expected utility: $\sum_{\omega \in \Omega} P(\omega) u(\omega)$

We won't focus on the theory behind this, but Shoham + Leyton-Brown give a nice description for anyone who is curious (section 3.1)

Game theory deals with interacting agents whose utility depends on their joint actions

Example: prisoner's dilemma

2 players, 2 actions

cooperate = "stay silent"

defect = "confess and testify"

	C	D
C	0, 0	-5, 0
D	0, -5	-4, -4

If you had to play this game one time, what would you do?

2) D is a dominant strategy - always maximizes (expected) utility no matter what action the other player chooses

Tragedy of the Commons - extends idea to more than two players

e.g. should a particular country enforce anti-pollution laws?

should I contribute to Wikipedia?

Not all games have a dominant strategy

Example: coordination games

m = movie, preferred by row
b = bar, preferred by column

	m	b
m	4,4 5,4	2,2
b	4,4 4,1	4,5

Two "stable points"
or Nash equilibria

We'll define some of these concepts more formally next time...