Introduction to Game Theory and Mechanism Design
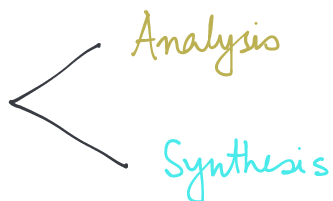
Objectives of the course

Engineering approach to Economic Theory

Typical Engineering approach $<$ Analysis / Synthesis

Examples:

   Circuit — analyze with different resistors, Capacitors
   find out voltage, current

   — synthesize a circuit with desired voltage, current

   Algorithms — analyze to find complexities, then design
   according to a desired complexity

In Game Theory, the setup is:

   Multiple agents with possibly conflicting objectives — GAME

Given a game – find most probable outcomes or responses of the agents/players : Game Theory.

— analysis part, predictive approach

Given a "reasonable" outcome – find/build the game that yields that as a probable outcome : Mechanism Design

— synthesis part, prescriptive approach.

Example of Game Theory : Neighboring Kingdom's Dilemma

Kingdoms A and B have limited options to invest wealth

① Agriculture : save people from starvation

② Warfare : ransack other kingdom and have their wealth

Outcome is dependent on the joint action of both
e.g., if A chooses Agri and B chooses War, then B gets all the agricultural produce of A since A has not developed techniques to protect itself.

A \ B	Agri	War
Agri	5, 5	0, 6
War	6, 0	1, 1

Question: What is a "reasonable" outcome of the above game?

Little more formally,

A game is a formal representation of the strategic interaction between multiple agents called players.

The choices available to the players are called actions.

The mapping from the state of the game → set of actions

strategy

Depending on the context, games can be represented in many ways:

Normal form, Extensive form, Repeated, Stochastic, ...

Game theory is the formal study of strategic interaction between players that are rational and intelligent.

A player is rational if she picks actions to achieve her most desired outcome, e.g., maximize her payoff.

A player is intelligent if she knows the rules of the game perfectly and picks action considering that there are other rational and intelligent players in the game.

___

Intelligence implies that the player has sufficient computational ability to find the "optimal" action.

against other players

Objectives of game theory:

provide predictions of an outcome