
# A Brief Introduction

## CmpE 220

**Cansu Satıcı**

**2020 – 2021 Fall**

# What is it?

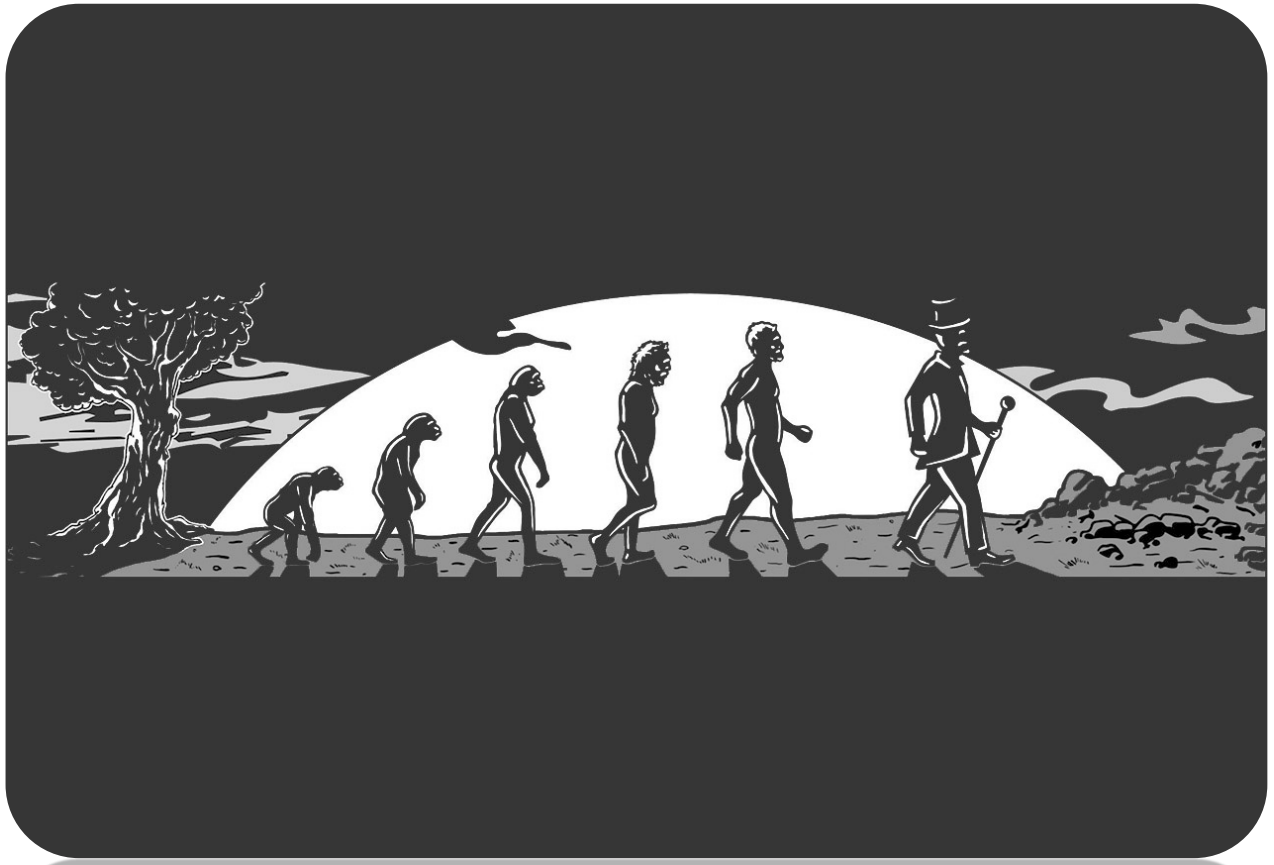
- Mathematical models of strategic interaction among rational decision-makers
- Formulate, structure, analyse and understand different strategical scenarios
- Conflict situations, interaction between agents and their decisions
- Game: Mostly finite number of players, given rules
- Players: Individuals, groups, companies, associations etc.


**The subject of game theory is;**

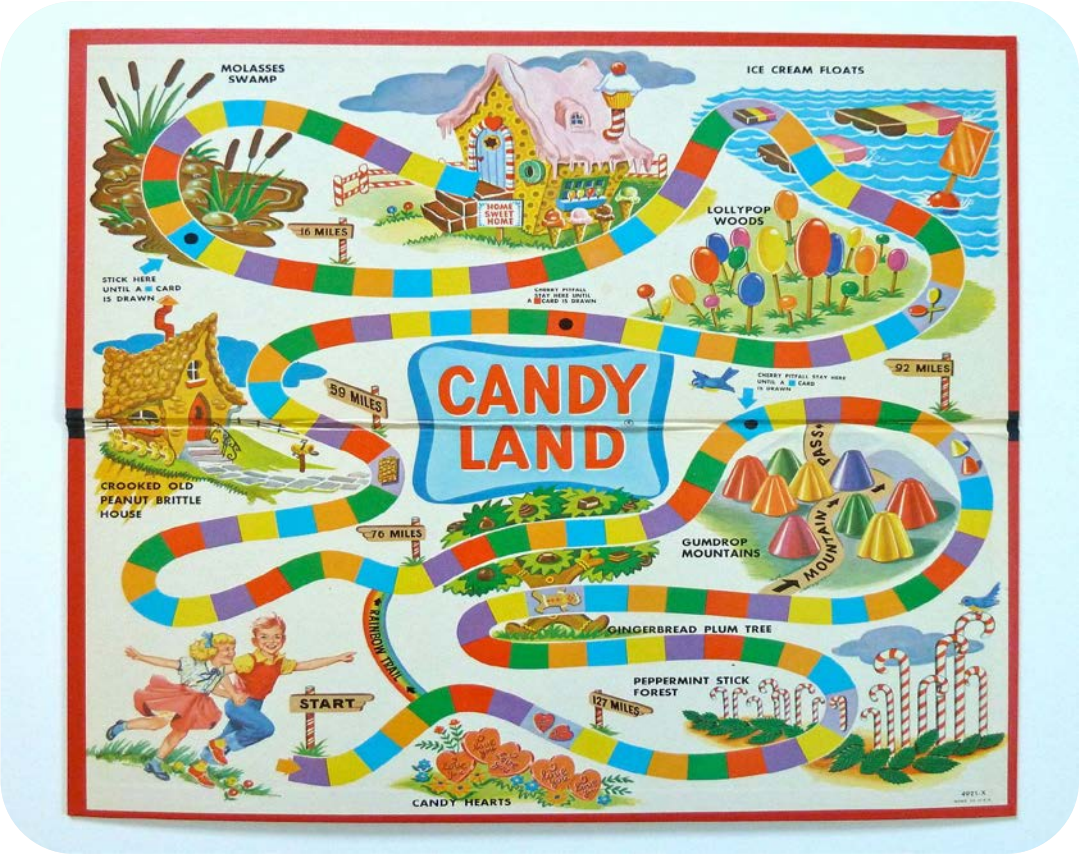
**situations, where the result for a player does not only depend on his own decisions, but also on the behaviour of the other players.**

# A Brief History

- 1928 - John von Neumann
- Theory of Games and Economic Behavior, 1944
- Applied mathematical theory to economic applications
- Publication of this book, the initial point of modern game theory
- Extensively developed
- Eleven game theorists have won the economics Nobel Prize

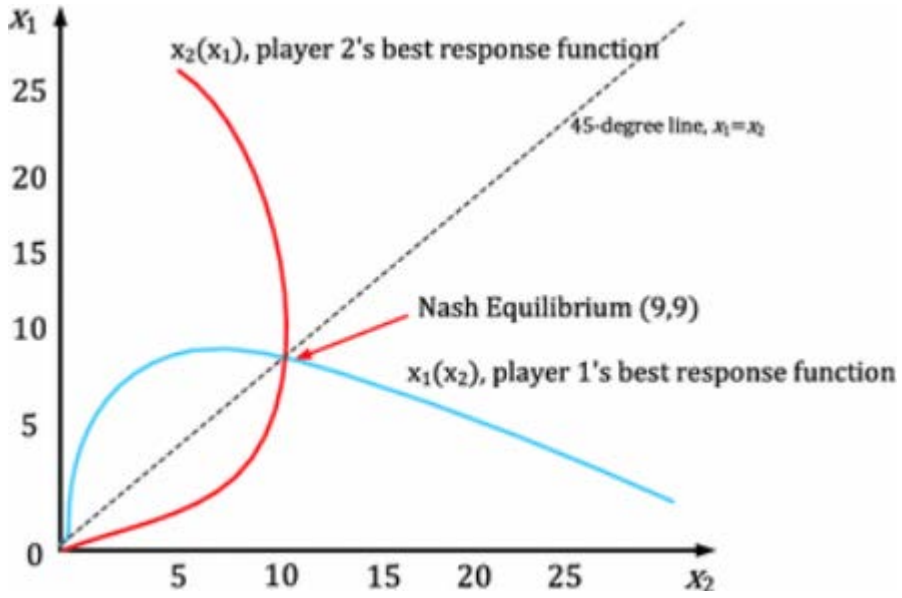


# Game Types

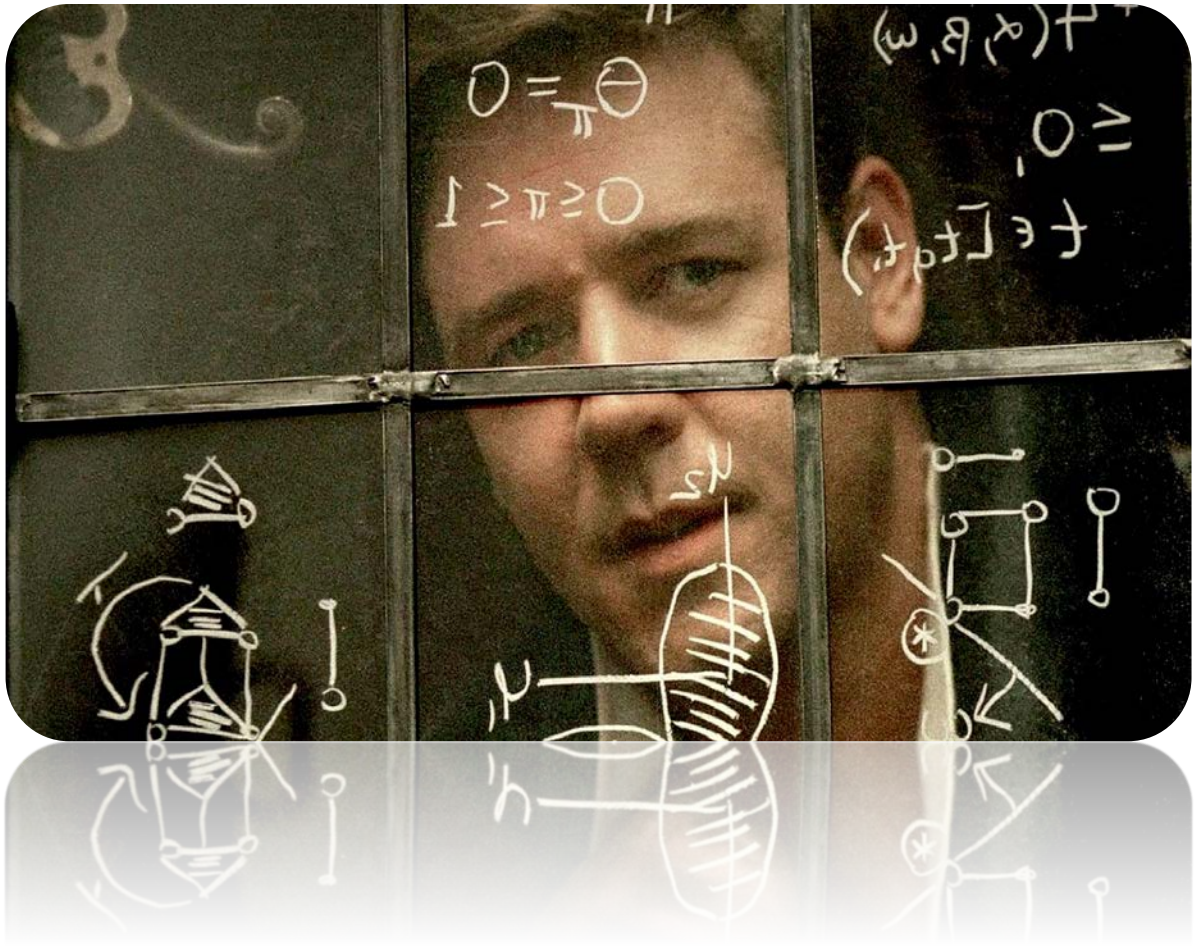



1. Cooperative / non-cooperative
2. Symmetric / asymmetric
3. Zero-sum / non-zero-sum
4. Simultaneous / sequential
5. Perfect information and imperfect information
6. Combinatorial games
7. Infinitely long games
8. Discrete and continuous games
9. Differential games
10. Evolutionary game theory
11. Stochastic outcomes (and relation to other fields)
12. Metagames
13. Pooling games
14. Mean field game theory

# Cooperative / non-cooperative

# A Non-cooperative concept - Nash Equilibrium

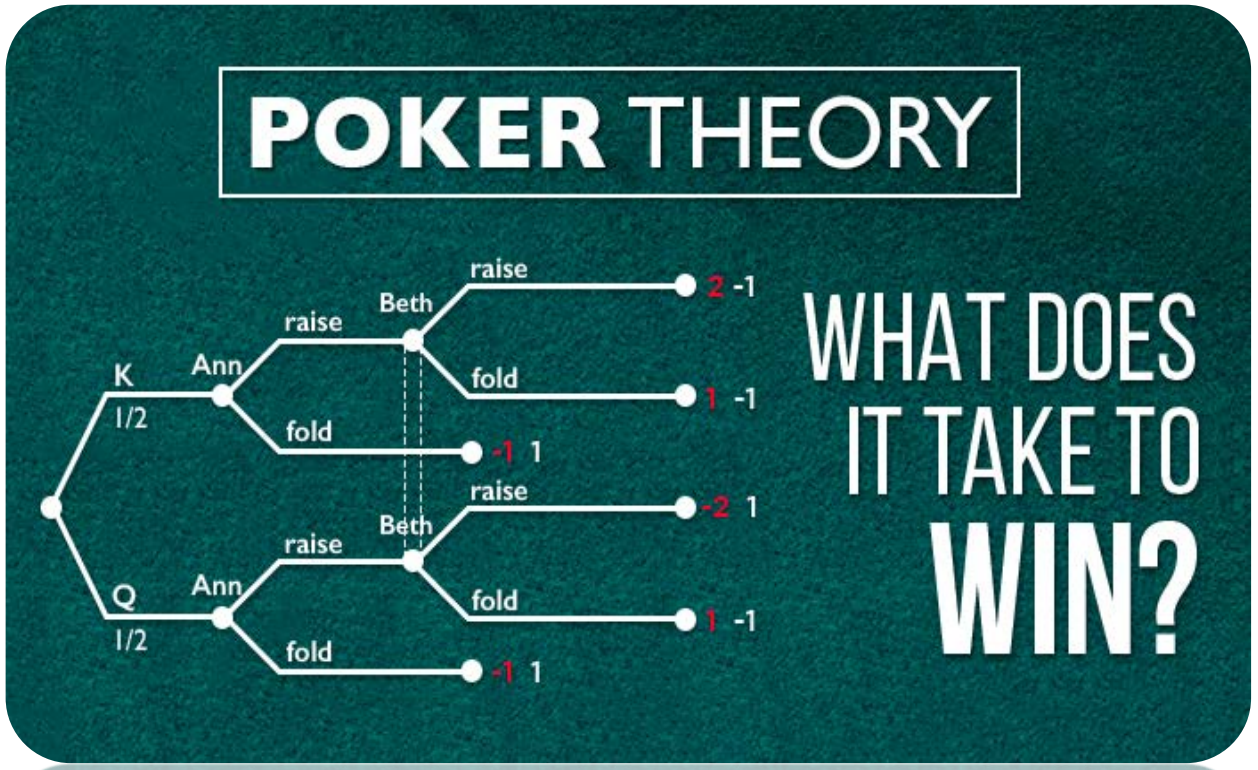


| Company A \ Company B | Advertise | Don't advertise |
|---|---|---|
| Advertise | 100 / 100 | 0 / 200 |
| Don't advertise | 200 / 0 | 0 / 0 |

# Zero-sum / non-zero-sum

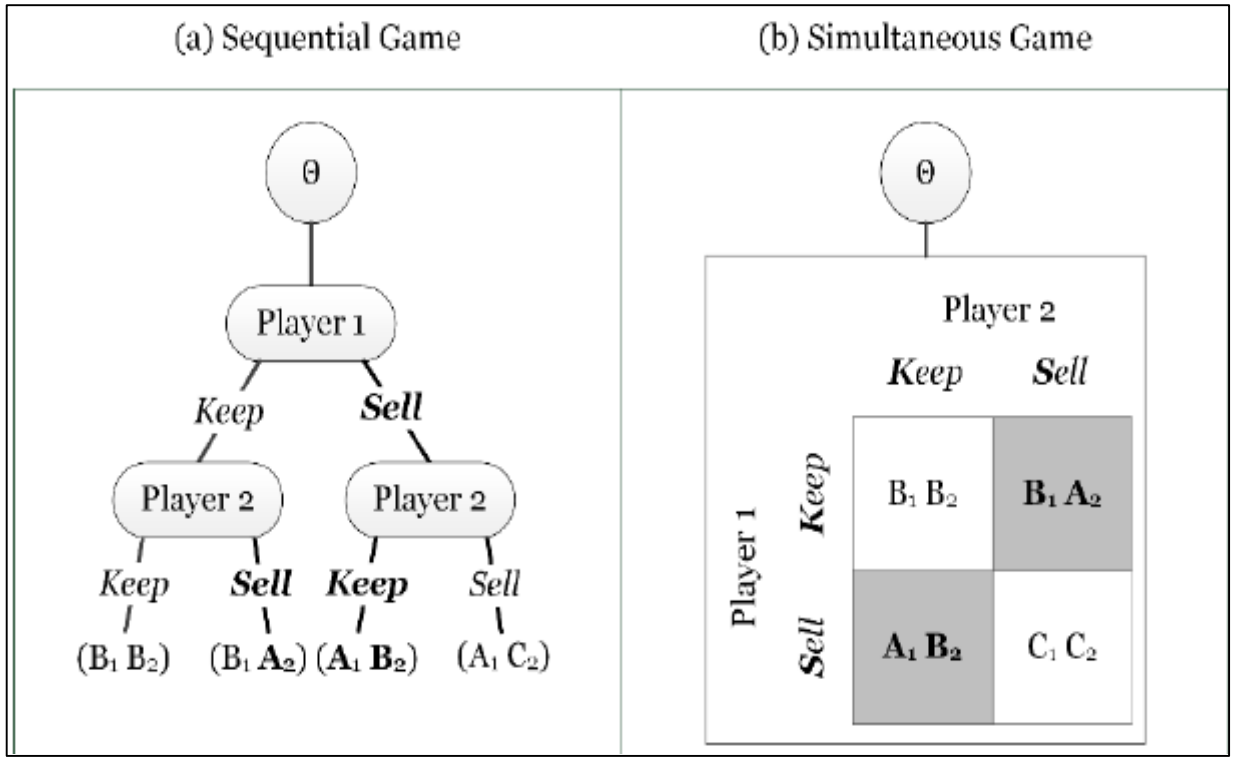
| | A | B |
|---|---|---|
| A | –1, 1 | 3, –3 |
| B | 0, 0 | –2, 2 |

*A zero-sum game*




# Simultaneous / sequential

| | Sequential | Simultaneous |
|---|---|---|
| Normally denoted by | Decision trees | Payoff matrices |
| Prior knowledge of opponent's move? | Yes | No |
| Time axis? | Yes | No |
| Also known as | Extensive-form game<br>Extensive game | Strategy game<br>Strategic game |

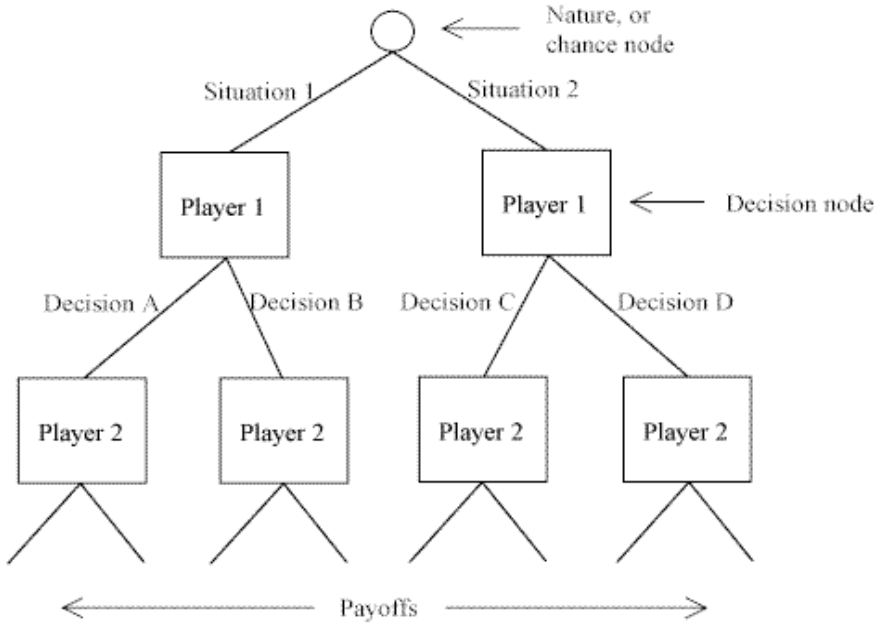


# Representation of Games

## Normal Form

| Alan \ Ben | Silent | Confess |
|---|---|---|
| Silent | A:-1, B:-1 | A:-15, B:0 |
| Confess | A:0, B:-15 | A:-10, B:-10 |

## Extensive Form



| Game | Players | Strategies per player | No. of pure strategy Nash equilibria | Sequential | Perfect information | Zero sum | Move by nature |
|---|---|---|---|---|---|---|---|
| Battle of the sexes | 2 | 2 | 2 | No | No | No | No |
| Blotto games | 2 | variable | variable | No | No | Yes | No |
| Cake cutting | *N*, usually 2 | infinite | variable[1] | Yes | Yes | Yes | No |
| Centipede game | 2 | variable | 1 | Yes | Yes | No | No |
| Chicken (aka hawk-dove) | 2 | 2 | 2 | No | No | No | No |
| Gift-exchange game | *N*, usually 2 | variable | 1 | Yes | Yes | No | No |
| Coordination game | *N* | variable | >2 | No | No | No | No |
| Cournot game | 2 | infinite[2] | 1 | No | No | No | No |
| Deadlock | 2 | 2 | 1 | No | No | No | No |
| Dictator game | 2 | infinite[2] | 1 | N/A[3] | N/A[3] | Yes | No |
| Diner's dilemma | *N* | 2 | 1 | No | No | No | No |
| Dollar auction | 2 | 2 | 0 | Yes | Yes | No | No |
| El Farol bar | *N* | 2 | variable | No | No | No | No |
| Game without a value | 2 | infinite | 0 | No | No | Yes | No |
| Guess 2/3 of the average | *N* | infinite | 1 | No | No | Maybe[4] | No |
| Kuhn poker | 2 | 27 & 64 | 0 | Yes | No | Yes | Yes |
| Matching pennies | 2 | 2 | 0 | No | No | Yes | No |
| Muddy Children Puzzle | *N* | 2 | 1 | Yes | No | No | Yes |
| Nash bargaining game | 2 | infinite[2] | infinite[2] | No | No | No | No |
| Optional prisoner's dilemma | 2 | 3 | 1 | No | No | No | No |
| Peace war game | *N* | variable | >2 | Yes | No | No | No |
| Pirate game | *N* | infinite[2] | infinite[2] | Yes | Yes | No | No |

# General and Applied Uses

- Competition for resources to be analysed
- To explain existing behaviour or to improve strategies
- Applied by
    - Sciences to analyse long term situations like biology or sociology (i.e. Mutual living life forms)
    - Companies improve strategical situations
    - Computer science, cyber security, cloud computing
    - Politics and warfare
    - Philosophy, psychology and cultural anthropology

# Thank you for listening