Game Theory 01-01

An Introduction

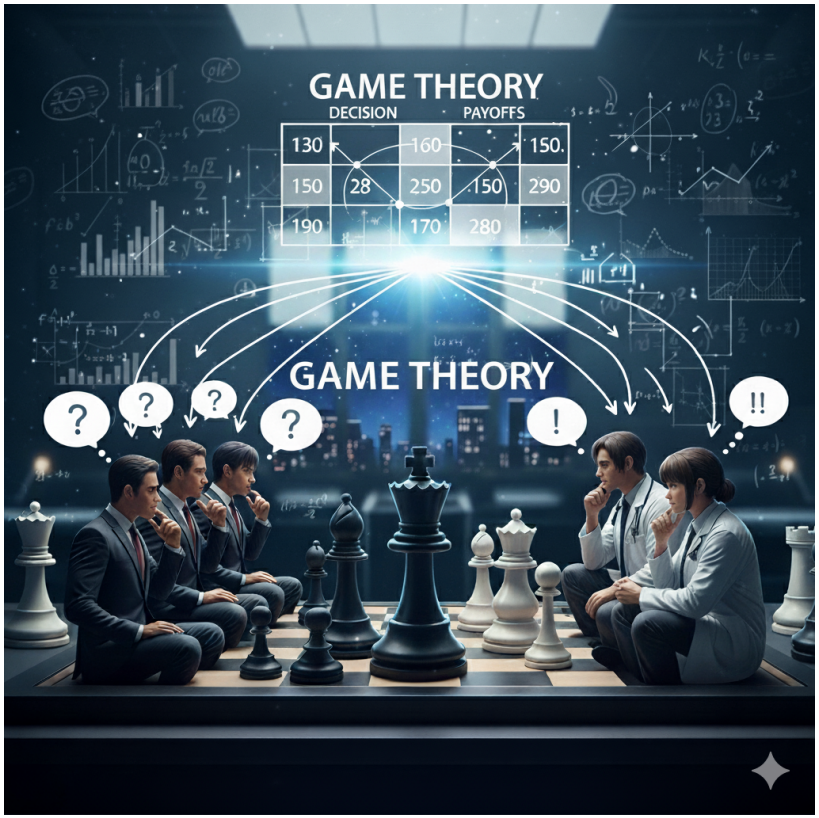
Author

Oct. 7, 2025

Today's Goals (01-01)

- Build intuition for strategic-form games using stories from class projects, esports, and business rivalries.
- Internalize key terms (players, strategies, payoffs) so we can describe any interactive situation quickly.
- Check our understanding with short exercises that mirror the questions researchers ask.

What is Game Theory?



What is your impression of Game Theory?

A Definition

Definition: Game Theory

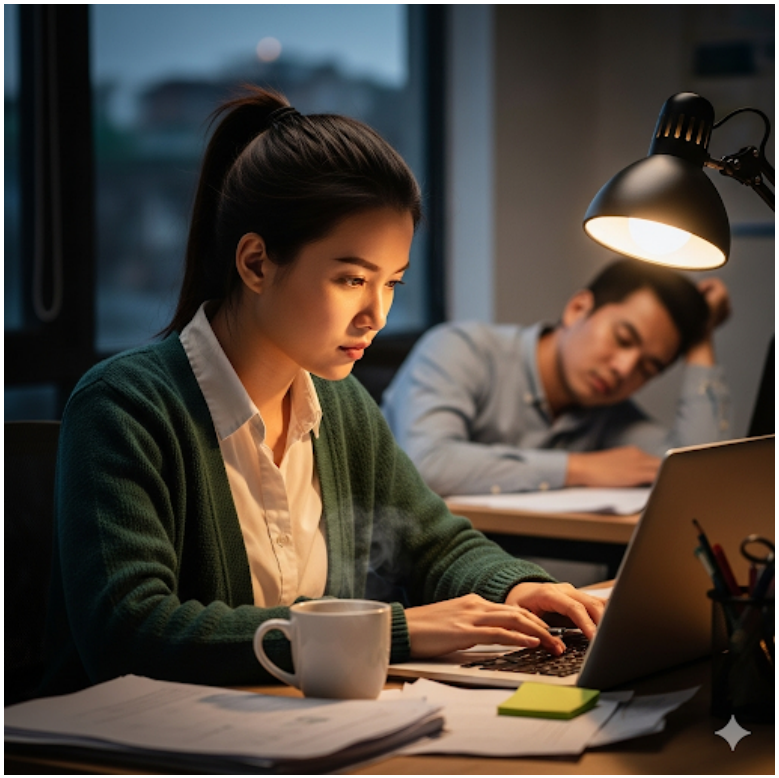
Game theory is the study of mathematical models of strategic interactions among rational decision-makers.

- It powers analyses in economics, computer science, public policy, biology, and even the design of online platforms.
- Today it is a broad term for studying rational decision-making by humans, animals, and computers—where choices intertwine.

This definition might feel abstract.
Let's look at a few examples to make it concrete.

Teamwork: Why is it so hard?

Scenario



Imagine you are taking a Game Theory course and receive a group project.

Ms. Anh and Mr. Binh are on a team. They each have two choices:

- **Work Hard** 💻: Put in a lot of effort for the team.
- **Slack Off** 🛌: Do the bare minimum and hope the other person works hard.

Outcomes

The final outcome, or payoff, depends on both of their choices.

- If at least one person chooses to "Work Hard," the team gets a good grade.
- If both "Slack Off," they get a bad grade.
- "Working Hard" is costly; it means less time for other courses, resulting in a lower grade elsewhere.
- "Slacking Off" frees up time, allowing for a better grade in another course.

From Story to Matrix

1. **Identify players**: Anh and Binh.
2. **List strategies**: Work Hard or Slack Off for each.
3. **Translate outcomes**: For each combination, write the resulting grades for both courses. Higher numbers reflect better overall GPA.

Tip

The Payoff Matrix

		Binh	
		Work Hard	Slack Off
Anh	Work Hard	(3, 3)	(1, 4)
	Slack Off	(4, 1)	(2, 2)

Table: The first number in each cell is Anh's payoff, the second is Binh's.

- What is the most desirable outcome for the team?
- What is the least desirable outcome for the team?

Analyzing the Choices

The outcome (Work Hard, Work Hard) seems best for the team, while (Slack Off, Slack Off) seems the worst.

Exercise

Is the combination (Work Hard, Slack Off) undesirable for the team? We will leave this question for a later lecture.

Now ask whether the (Work Hard, Work Hard) outcome is achievable. On the next slide, take Anh's point of view.

Anh's Perspective

If Binh chooses to WORK HARD...

- If you Work Hard, your payoff is 3.
- If you Slack Off, your payoff is 4.
- Your best choice is to _____.

If Binh chooses to SLACK OFF...

- If you Work Hard, your payoff is 1.
- If you Slack Off, your payoff is 2.
- Your best choice is to _____.

Conclusion

In either case, your most rational choice is to _____.

Lingering Questions

This leads to some research-level questions we will revisit:

- Is cooperation within a team impossible to achieve?
- Even if the math says cooperation is unlikely, we still observe it. Why?
- Can mathematics explain the reasons why people cooperate?
- Could (Work Hard, Slack Off) ever be an acceptable outcome? What mechanism—bonuses, peer review, reputation—would make it happen?
- If you can talk with your partner in advance, will you choose Work Hard?

Communication

Exercise

If you can talk with your partner in advance, will you choose Work Hard?

Even if you talk before playing, Slacking Off still gives you the highest personal payoff, so a fully rational player would still pick Slack Off—unless the conversation introduces new incentives.

Communication

In game theory we often assume, implicitly, that players can communicate extensively before the game starts.

However, communication does not authorize commitments, side payments, or any rule-breaking behavior after the game. Communication is just talk without binding force—often called cheap talk.

A Formal Definition and Notations for Games

What makes a Strategic-Form Game?

Checklist for modelling a situation

1. **Players**: Who are the decision-makers?
2. **Strategy sets S_i**: Which actions can each player choose?
3. **Payoff functions u_i**: How does every action profile translate into outcomes or utility?
4. **Timing & information**: Do players move simultaneously? What do they observe before acting?

- Once these pieces are in place we can analyze incentives systematically and compare them across very different stories.
- Keep this list in mind—every example in this course will reference it explicitly, from boardroom negotiations to online matchmaking.

Main Assumptions

Rationality and Common Knowledge

- **Rationality**: Each player chooses a strategy that maximizes their own payoff given their beliefs.
- **Beliefs about others**: Predictions rely on expectations about how other players behave.
- **Common knowledge**: Everyone knows the rules, knows that everyone knows them, and so on. This assumption lets us repeat reasoning steps such as eliminating dominated strategies.

If real people act differently from what the model predicts, treat it as a signal that our model is missing something—not that our arithmetic went wrong.

Price Competition

Scenario

Let's consider price competition.

- Suppose Anh and Binh sell the same product.
- Each has two options: set a High Price or a Low Price.
- (High, High): Both earn high profits.
- (Low, Low): Both earn low profits.
- (High, Low): The high-price firm loses customers and has the lowest profit. The low-price firm captures the market and gets the highest profit.

The Payoff Matrix

		Binh	
		High Price	Low Price
Anh	High Price	(3, 3)	(1, 4)
	Low Price	(4, 1)	(2, 2)

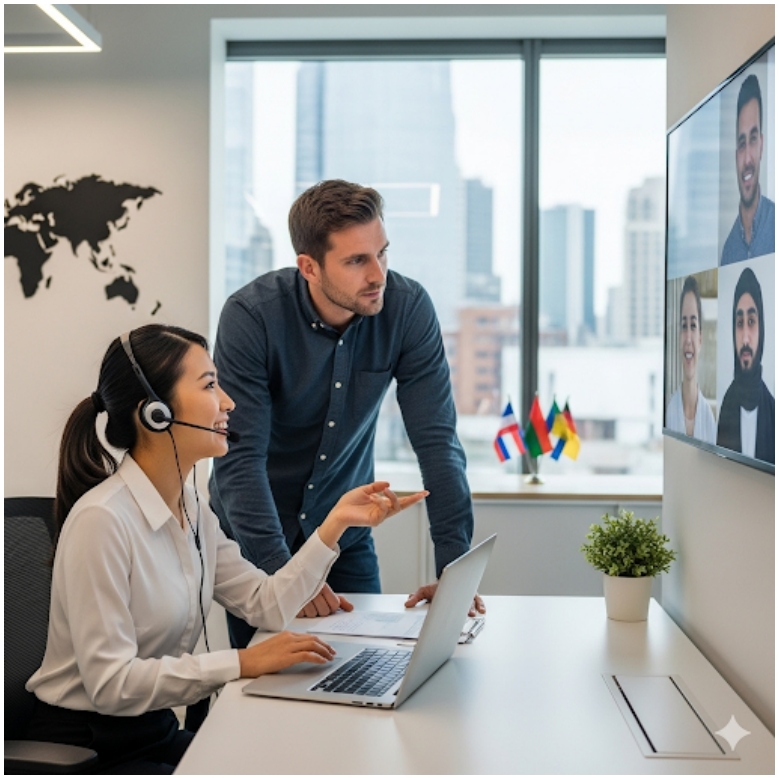
Notice a Pattern?

You've seen this table before. The structure is identical to the teamwork problem.

Analyzing cooperation and analyzing competition are two sides of the same coin.

Cross-Cultural Understanding

Scenario



Consider a team with Vietnamese and Japanese members. Their work styles can differ in noticeable ways.

For simplicity, imagine a company with just two employees, Anh and Binh. Each must choose which work style to adopt.

(Work style details are on the next slide.)

Work Styles and The Payoff Matrix

- **Vietnamese work style**: Flexible, relationship-focused, and quick to adapt when problems appear.
- **Japanese work style**: Punctual, carefully planned, and guided by group priorities and hierarchy.

		Binh	
		Vietnam Style	Japan Style
Anh	Vietnam Style	(3, 3)	(1, 1)
	Japan Style	(1, 1)	(2, 2)

- First, check whether the (Vietnam, Vietnam) combination can be achieved. If Binh chooses the Vietnam style, you (Anh) choose _____.
- Next, ask whether the (Japan, Japan) combination can be achieved. If Binh chooses the Japan style, you (Anh) choose _____.

Analyzing the Choices

Exercise

Suppose both are currently working in the (Japan, Japan) style. They could both be better off if they moved to the (Vietnam, Vietnam) style.
If you were Anh, would you switch?

Coordination is Key

For the project to succeed, the team needs to coordinate and adopt the same work style. If they fail to do so, communication breaks down and delays follow.

Summary

What is Game Theory?

What is Game Theory?

Decision-making in groups has the following characteristics:

1. Each outcome matters for the team as a whole and for every individual.
2. Each person acts to improve their own outcome.
3. The attractiveness of an outcome depends not only on one's own actions but also on the actions of others. This is a **strategic interaction**, or a **game**.

As a result, people need to make decisions while anticipating the actions of others. This is **Strategic Thinking**.

What is Game Theory?

Game theory studies mathematical models of strategic interaction and helps answer questions such as:

- Can this problem be analyzed mathematically? Under what conditions?
- When are people likely to cooperate? How can we promote competition?
- What measures can be taken to encourage cooperation?
- What different forms of cooperation exist?
- How do others' actions affect my decisions? Should I act first or wait?

Broader Implications

Through the analysis in this course, we will also address questions such as:

- What is culture?
- What is leadership?
- What is necessary for better communication?

Appendix

Appendix: Nobel Laureates in Game Theory (I)

Game theory is a vital analytical tool in many social sciences, especially economics. A number of pioneering theorists have been recognized with the Nobel Prize.

- **1994**: John Nash, Reinhard Selten, John Harsanyi — formalized equilibrium reasoning in strategic-form and extensive-form games, showing how rational expectations can line up in both competitive and cooperative settings.
- **2005**: Robert Aumann, Thomas Schelling — clarified how repeated interaction and credible commitments shape conflict and cooperation, influencing bargaining theory and international relations.
- **2007**: Leonid Hurwicz, Eric Maskin, Roger Myerson — established mechanism design as a blueprint for institutions that draw out truthful information and implement desirable outcomes.

Appendix: Nobel Laureates in Game Theory (II)

Applications in market design and regulation continue to expand the reach of game-theoretic ideas.

- **2012**: Alvin Roth, Lloyd Shapley — connected matching theory to real-world platforms, designing school-choice and kidney-exchange systems that balance fairness, stability, and strategic simplicity.
- **2014**: Jean Tirole — applied dynamic game theory to regulate dominant firms, analyzing optimal pricing, entry deterrence, and incentives for innovation under asymmetric information.
- **2020**: Paul Milgrom, Robert Wilson — extended auction theory to complex goods and spectrum sales, crafting bidding formats that reduce the winner's curse and raise efficiency for governments.