

Game Theory



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1 warm up

Discuss these questions. Give extended answers with reasons and examples.

1. **The Decision Game:** Think of a time when you had to make a decision knowing the outcome depended on what someone else decided at the same time – without being able to communicate with them. How did you approach it, and what did you consider?

2. **Cooperation or Competition:** In your experience, when do people naturally choose to cooperate rather than compete? What conditions make cooperation more attractive than going it alone?

3. **The Bluffing Question:** In negotiations – whether in business, politics, or everyday life – people sometimes conceal their true intentions or exaggerate their position to gain an advantage. Where is the line between smart strategy and dishonesty? Does the context change your answer?

4. **Rational vs. Emotional Decisions:** Research shows that humans rarely make purely rational decisions – emotions, fairness, and social norms all play a role. Can you think of a real situation where an emotional decision actually led to a better outcome than a purely logical one would have?

5. **The Bigger Picture:** Game theory was originally developed for economics and military strategy. Now it is used to study social media, climate negotiations, and even biology. Why do you think the way humans make decisions under pressure tends to follow predictable patterns – regardless of the situation?

2 video comprehension

Scan Watch the video, then complete both parts below.



Video Link: <https://www.youtube.com/watch?v=9uDUvITpGxI>

Part A – True or False. Write T (True) or F (False). If the statement is false, write the correct version on the line below it.

#		T/F
1	A Nash equilibrium is a situation where no individual player can improve their outcome by changing only their own strategy.	---
	If false, correct it:	
2	In a zero-sum game, one player's gain always results in an equal loss for another player, so the total benefit remains constant.	---
	If false, correct it:	
3	In the classic Prisoner's Dilemma, the two prisoners always choose to cooperate because it leads to the best combined outcome.	---
	If false, correct it:	
4	When a game is repeated multiple times, players are more likely to cooperate because they can reward or punish each other in future rounds.	---
	If false, correct it:	
5	Game theory assumes that all players always behave with complete rationality and perfect knowledge of the other players' decisions.	---
	If false, correct it:	





Part B – Comprehension Questions. Answer in full sentences after watching the video.

1. What is the key difference between a zero-sum and a non-zero-sum game? Why does this distinction matter in real-world negotiations?

2. How does the concept of Nash equilibrium help us predict the behaviour of rational players – even when the outcome is not ideal for anyone?

3. Why do the two players in the Prisoner’s Dilemma fail to cooperate, even though cooperation would benefit both of them?

4. What effect does repeating the game multiple times have on how players behave? What strategy tends to emerge as most effective in repeated games?

5. Beyond economics, what other real-life situations or fields does the video suggest game theory can help us understand?



3 pre-reading vocabulary

All of these words appear in the text, check your pronunciation before you read the article.

- interdependence
- Nash equilibrium
- deterrence
- credible commitment
- free-ride
- reciprocity
- cognitive bias
- evolutionary stable strategy
- empirical
- adversary
- incentive
- collective action
- rationality
- allocation
- feedback loop

Match each word or phrase (1–15) with the correct definition (A–O). Write the letter in the answer column.

#	Word / Phrase	Ans.	Definition
1	interdependence	---	A. A strategic threat designed to prevent an opponent from taking a particular action by making the cost appear too high
2	Nash equilibrium	---	B. A systematic pattern of deviation from rational judgement, caused by how the mind processes information and experience
3	deterrence	---	C. A situation in which all players in a strategic interaction have chosen strategies from which no individual would benefit by unilaterally deviating
4	credible commitment	---	D. The practice of benefiting from a shared resource or collective effort without contributing to its cost or maintenance
5	free-ride	---	E. Based on verifiable evidence gathered through systematic observation or experiment, rather than on theory or assumption
6	reciprocity	---	F. The distribution of resources, rights, or responsibilities among competing parties, often through structured processes such as auctions
7	cognitive bias	---	G. The condition in which two or more agents are mutually reliant, such that each party's outcomes are influenced by the decisions of the other
8	evolutionary stable strategy	---	H. A pledge or course of action that is convincing to others precisely because it involves visible or irreversible costs to the party making it
9	empirical	---	I. A social or economic factor that motivates an individual to behave in a particular way by offering a reward or imposing a cost
10	adversary	---	J. The principle of exchanging actions or concessions in kind, in which cooperative or hostile behaviour is typically met with a similar response
11	incentive	---	K. The capacity to employ logic and structured reasoning in the pursuit of goals, often contrasted with emotional or intuitive decision-making
12	collective action	---	L. A causal chain in which the output of a system feeds back into it as an input, either amplifying or moderating subsequent behaviour
13	rationality	---	M. Coordinated effort by a group of individuals working toward a shared goal, particularly when individual incentives may conflict with group benefit
14	allocation	---	N. A behavioural pattern that, once adopted by a majority in a population, cannot be displaced by any alternative strategy because it consistently outperforms competing approaches
15	feedback loop	---	O. An opponent or rival whose interests are in direct or sustained conflict with one's own, particularly in political or strategic contexts

4 reading

Read silently and Infer meaning from context before checking vocabulary. Comprehension questions follow.

Game Theory: Strategic Thinking in an Interconnected World

Game theory has become an essential framework for understanding decision-making in an increasingly interconnected and strategic world. Originally formalized by John von Neumann and Oskar Morgenstern, it now extends far beyond abstract models into practical domains that shape everyday life. The importance of game theory today lies in its capacity to explain how individuals and institutions behave when outcomes depend on the actions of others. In a globalized environment marked by competition, cooperation, and uncertainty, such interdependence is unavoidable. From market behavior to political negotiations, strategic thinking has become a necessary skill rather than a specialized tool. Game theory thus provides a structured way to anticipate outcomes and design better decisions.

In economic systems, game theory plays a critical role in analyzing markets where firms must anticipate the reactions of competitors. Pricing strategies, product launches, and mergers often resemble strategic games in which each decision influences the behavior of others. The concept of Nash equilibrium helps economists identify stable outcomes, even when those outcomes are not optimal for all participants. Empirical research in industrial organization demonstrates how firms use strategic reasoning to maintain competitive advantage. Moreover, auction design, widely used in allocating public resources, relies heavily on game-theoretic principles to ensure efficiency and fairness. These applications show that modern economies cannot function effectively without an understanding of strategic interaction. The theory therefore underpins many of the mechanisms that sustain market stability.

The relevance of game theory is equally evident in political and international contexts, where decisions often carry high stakes and long-term consequences. During periods such as the Cold War, strategic models were used to analyze deterrence and the balance of power between nations. Today, similar frameworks are applied to issues such as trade negotiations, climate agreements, and conflict resolution. Political actors must constantly evaluate the probabilities of cooperation versus confrontation, often under conditions of incomplete information. Game theory provides tools to model these scenarios and identify strategies that minimize risk. Research in political science has shown that credible commitments and repeated interactions can foster cooperation even among adversaries. In this sense, game theory contributes directly to the management of global stability.

In the digital age, the importance of game theory has expanded into online platforms and technological systems. Social media networks, for example, operate as environments where users respond to incentives shaped by algorithms and peer behavior. Decisions about content sharing, engagement, and reputation can be analyzed through strategic frameworks. Similarly, cybersecurity relies on anticipating the actions of malicious actors and designing defenses accordingly. Game-theoretic models are used to predict attack patterns and optimize protective strategies. Studies in information systems highlight how competition for attention creates complex feedback loops that influence user behavior. These dynamics illustrate how digital environments are structured by strategic interaction at scale. As technology evolves, the relevance of game theory continues to grow.





From a sociological perspective, game theory helps explain how cooperation emerges in large and diverse societies. Public goods problems, such as environmental protection or public health compliance, require individuals to act in ways that benefit the collective. However, the incentive to free-ride often undermines such efforts. Models like the Prisoner's Dilemma illustrate why cooperation can be difficult to sustain without trust or enforcement. Empirical studies show that repeated interaction, social norms, and institutional oversight can significantly increase cooperative behavior. These findings are crucial for designing policies that encourage collective action. Game theory therefore provides a bridge between individual incentives and social outcomes.

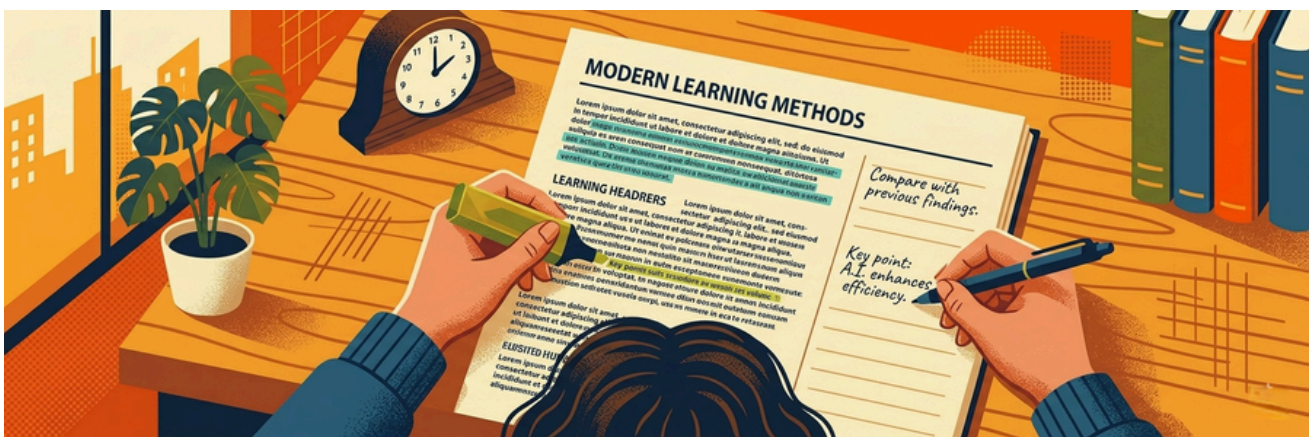
Philosophically, the growing importance of game theory raises questions about rationality and ethical responsibility in modern life. Traditional models assume that individuals act to maximize their own benefit, yet real-world behavior often reflects concerns for fairness, reciprocity, and reputation. Research by Daniel Kahneman and Amos Tversky has demonstrated that human decision-making is shaped by cognitive biases and social context. These insights suggest that

rationality is more complex than purely self-interested calculation. Ethical dilemmas arise when individually rational strategies produce harmful collective consequences. This tension challenges policymakers and institutions to design systems that align private incentives with public good. Game theory thus becomes a tool not only for prediction but also for ethical evaluation.

The field also plays a vital role in understanding biological and social evolution, particularly through the concept of evolutionary stable strategies. Introduced by John Maynard Smith, this approach explains how certain behaviors persist because they cannot be easily replaced by alternatives. In human contexts, similar dynamics can be observed in cultural

norms and institutional practices. Behaviors that prove stable over time often reflect underlying strategic advantages, even if they are not consciously chosen. Sociological research has drawn parallels between biological evolution and the persistence of social conventions. This perspective broadens the scope of game theory by linking it to long-term patterns of adaptation. It also reinforces the idea that strategic interaction shapes both immediate decisions and historical trajectories.

Despite its wide-ranging applications, game theory is not without limitations, particularly in its reliance on simplified assumptions about human behavior. Critics argue that models often fail to capture the complexity of emotions, identities, and cultural influences. However, contemporary research continues to refine these models by incorporating insights from psychology, sociology, and neuroscience. Experimental methods have improved the empirical grounding of the theory, making it more responsive to real-world conditions. For advanced learners, the importance of game theory lies not only in its practical applications but also in its capacity to provoke critical thinking. It encourages a deeper understanding of how choices are shaped by context, incentives, and interaction. In today's world, where decisions are rarely made in isolation, this understanding is more relevant than ever.



4 reading comprehension

Answer in full sentences. Use evidence from the article and your own reasoning.

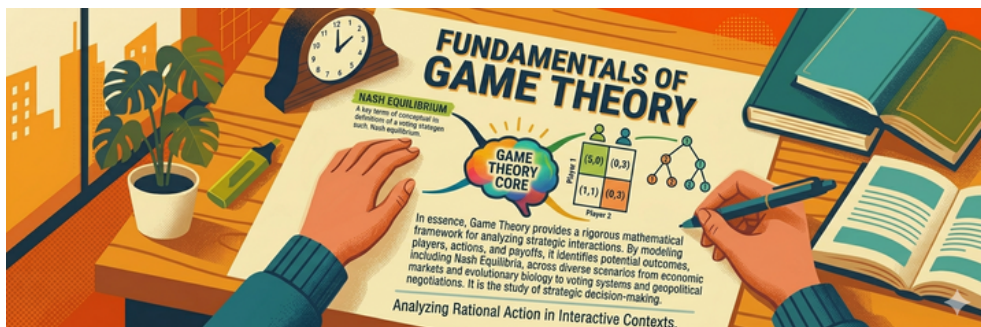
1. **Main Idea.** According to the article, why has game theory moved beyond being a specialized academic tool to become essential in everyday life? What kind of world makes it necessary?

2. **Interpretation.** The article states that Nash equilibrium identifies "stable outcomes, even when those outcomes are not optimal for all participants." What does this mean in practice? Can you think of a real-world situation that fits this description?

3. **Critical Thinking.** The article claims that "individually rational strategies can produce harmful collective consequences." Using the Prisoner's Dilemma or any other example from the text, explain this idea in your own words. Do you agree with this claim?

4. **Social Purpose.** The article argues that repeated interaction, social norms, and institutional oversight can overcome the free-rider problem. What does this suggest about the role of trust in making cooperation sustainable? How does this apply to global challenges like climate change?

5. **Evaluation.** The final paragraph acknowledges that game theory has limitations. How convincing do you find this self-critique? Does acknowledging weaknesses strengthen or weaken the article's overall argument?



5 language point: future in the past

Describing future plans, predictions, and intentions from a past point of view.

What is "Future in the Past"?

We use "future in the past" when we describe something that **felt like the future at a past moment in time** – a plan, prediction, or intention that was made in the past and may or may not have happened. It is common in storytelling, reporting past speech, and reflecting on events.

Structure	Use	Example
was / were going to + infinitive	A plan or intention that existed at a past moment (often unfulfilled or changed)	"The negotiators were going to sign the agreement, but talks broke down."
would + infinitive	A prediction or expectation made in the past (often in reported speech or narrative)	"Economists predicted that prices would stabilize within months."
was / were about to + infinitive	Something on the verge of happening at a specific past moment (immediate future)	"The deal was about to collapse when a compromise was finally reached."
was / were supposed to + infinitive	Something that was expected, scheduled, or obligated – but often didn't happen	"The meeting was supposed to start at nine, but it was delayed by two hours."

Key contrast: *Was going to* implies a conscious plan that was abandoned. *Would* (in this use) implies a future seen from a past narrative viewpoint – often without implying failure. "She knew it would work" ≠ "She was going to try it but didn't."

Part B – Controlled Practice. Choose the correct option (a, b, or c) to complete each sentence accurately.

- The twocompanies_____merge,but the regulatory authority blocked the deal at the last moment.
a) would b) were going to c) were supposed to

- Nobodyanticipatedthataingleleakeddocument _____ change the entire course of the negotiations.
a) was going to b) was about to c) would

- Thesummit_____beginwhenreports of a new development forced a postponement.
a) was about to b) would c) was supposed to

- Thereport_____bepublishedlastThursday, but the team needed more time to verify the data.
a) would b) was supposed to c) was about to

- Game theorists in the 1950s predicted that strategic models _____ eventually reshape global diplomacy.
a) were going to b) would c) were about to



Part C – Guided Practice. Read each situation and write 1–2 sentences using an appropriate "future in the past" structure. The structure to use is suggested in brackets.

1. A government had planned a major policy reform. Just before it was announced, a political scandal forced a delay. [was going to / was about to]

2. In the 1990s, analysts believed that the internet would create a more democratic, equal society. [would]

3. Two rival firms agreed to attend a joint meeting. One of them cancelled at the last minute without explanation. [was supposed to]

Part D – Free Practice. Answer each prompt in 3–5 sentences. Use at least one "future in the past" structure in each response. Speak or write freely.

1. **Changed Plans:** Describe a time when you or someone you know had a clear plan or goal that did not go as expected. What was supposed to happen? What changed?

2. **Past Predictions:** Think about a major prediction that experts or society made in the past – about technology, politics, or the economy. How accurate was it? What did people think would happen?

3. **The Turning Point:** Describe a situation – personal or global – where something was about to happen and then something else changed the outcome at the last moment.

6 discussion

Give extended answers. Connect ideas from the video and article. Support every opinion with a reason.

1. The article suggests that social media platforms are shaped by game-theoretic principles — algorithms create incentives that influence how users behave. In what ways do you think you have been influenced by these incentives without being fully aware of it?

2. The article argues that "credible commitments and repeated interactions can foster cooperation even among adversaries." Do you believe this applies to international relations today — for example, between rival powers? What conditions need to be in place?

3. Research by Kahneman and Tversky shows that human decision-making is shaped by cognitive biases rather than pure logic. Does this make game theory less useful — or more important? How does it change how we should design policies and systems?

4. The article describes how the free-rider problem makes collective action difficult — whether in environmental agreements, public health, or shared resources. What real-world mechanisms have you seen that successfully overcome this problem?

5. The article ends by suggesting that in today's world, "decisions are rarely made in isolation." Do you think most people genuinely understand how interconnected their choices are? What would change if they did?





Transcript

Game theory as we know it today came about in part because of one man's interest in poker. This man was not just your average man on the street. He was a mathematician, physicist, and computer scientist named John von Neumann. His goal was loftier than becoming a better poker player. According to a Forbes article, he "was only interested in poker because he saw it as a path toward developing a mathematics of life itself." He "wanted a general theory – he called it 'game theory' – that could be applied to diplomacy, war, love, evolution or business strategy." He moved closer toward that goal when he collaborated with economist Oskar Morgenstern on a book called *A Theory of Games and Economic Behavior* in 1944. The Library of Economics and Liberty (Econlib) states that "in their book, von Neumann and Morgenstern asserted that any economic situation could be defined as the outcome of a game between two or more players." What is a game according to game theory? Yale economics professor Ben Polak notes a game has three basic components: players, strategies, and payoffs. As we just mentioned, game theory applies to games involving two or more players. In a game, players share "common knowledge" of the rules, available strategies, and possible payoffs of a game. However, it is not always the case that players have "perfect" knowledge of these elements of a game. Strategies are the actions that players take in a game. Strategy is at the heart of game theory. Forbes describes the theory presented in *A Theory of Games and Economic Behavior* as "the mathematical modeling of a strategic interaction between rational adversaries, where each side's actions would depend on what the other side would do." The concept of strategic interdependence – the actions of one player influencing the actions of the other players -- is one important aspect of von Neumann's version of game theory that is still relevant today. And then there are payoffs, which one source describes as the "outcome of the strategy applied by the player." Payoffs could be a wide range of things depending on the game. It could be profits, a peace treaty, or getting a great deal on a car. One limitation of Von Neumann's version of game theory is that it focused on finding optimal strategies for one type of game called a zero-sum game. In a zero-sum game, "one player's loss is the other player's gain" according to Forbes. Another source notes that "players can neither increase nor decrease the available resources" in zero-sum games. Critics have noted that life is often not as simple as a zero-sum game. More complicated game scenarios are possible in the real world. For example, players can do things like find more resources or form coalitions that increase the gains of several players. Game theory has evolved to analyze a wider range of games such as combinatorial games and differential games, but we have time to look at only one. A classic example of a game often studied in game theory is called *The Prisoner's Dilemma*. Different versions of this game are available on the Internet. This version is from the Fundamental Finance website: "There are two prisoners, Jack and Tom, who have just been captured for robbing a bank. The police don't have enough evidence to convict them, but know that they committed the crime. They put Jack and Tom in separate inter[r]ogation rooms and lay out the consequences: If both Jack and Tom confess they will each get 10 years in prison. If one confesses and the other doesn't, the one who confessed will go free and the other will spend 20 years in prison. If neither person confesses, they will both get 5 years for a different crime they were wanted for." *The Prisoner's Dilemma* contains the basic elements of a game. The two players are Jack and Tom. There are two strategies available to them: confess or don't confess. The payoffs of the game range from going free to serving 5, 10, or 20 years in prison. As Fundamental Finance explains, "it is easier to see and compare these outcomes (payoffs) if they are put into a matrix: Since Tom's strategies are listed in rows, or the x-axis, his payoffs are listed first. Jack's payoffs are listed second because his strategies are in columns, or on the y-axis. 'C' means 'confess' and 'NC' means 'not confess.' This matrix is called 'Normal Form' in game theory. Moves are simultaneous, which means that neither player knows the other's decision and decisions are made at the same time (in this example, both prisoners are in separate rooms and won't be let out until they have both made their decision)." One common solution to simultaneous games is known as "dominant strategy." Fundamental Finance defines it as the "strategy that has the best payoff no matter what the other player chooses." Tom does not know if Jack will confess or not. He takes a look at his options. If Jack confesses and Tom does not, Tom will get 20 years in prison. If both Jack and Tom confess, Tom will get only 10 years. If Jack does not confess and Tom does, Tom will go free. The best strategy for Tom is to confess because it leads to the best payoffs regardless of Jack's actions. Confessing will cause Tom to either go free or serve less prison time than if he did not confess. Jack is in the same situation and has the same options as Tom. As a result, the best strategy for Jack is also to confess because it leads to the same best payoffs that Tom will get. One economics website states that a "dominant strategy equilibrium is reached when each player chooses their own dominant strategy." Why is the strategy of both not confessing not the best choice? While this option would give both of them less prison time than if they confessed, it would work only if each of them could be sure the other one would not confess. It is unknown whether Tom and Jack would be able to work together with that level of cooperation. In addition, both are unlikely to choose the strategy of not confessing because it has a greater penalty than they would get if they confessed.



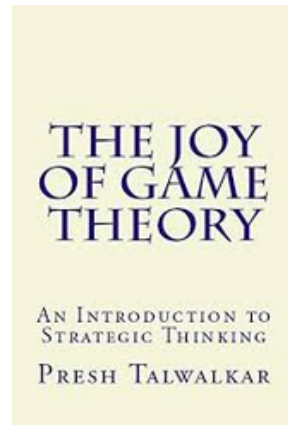
Transcript

Confessing also gives each of them the possibility of serving no prison time, which is even less than 5 years in prison. The Prisoner's Dilemma is a good example of how rationality can be problematic in game theory. University of British Columbia - Vancouver researcher Yamin Htun calls it "one of the most debatable issues in game theory." Htun points out that "almost all of the theories are based on the assumption that agents are rational players who strive to maximize their utilities (payoffs)," yet studies demonstrate that players do not always act rationally and that "the conclusions of rational analysis sometimes fail to conform to reality." As we can see from this game, the most rational strategy that would give both players less prison time was not the best choice, while a choice that involves both players doing more prison time was. The Prisoner's Dilemma also reflects how other game theorists were able to fix some of the problems with Von Neumann's version of game theory. One of them was mathematician John Nash. He found a way to determine optimal strategies in any finite game. A New Yorker article describes the Nash equilibrium as "a particular solution to games—one marked by the fact that each player is making out the best he or she (or it) possibly can, given the strategies being employed by all of the other players." When Nash equilibrium is reached in a game, none of the players wants to change to another strategy because doing so will lead to a worse outcome than the current strategy. In the Prisoner's Dilemma, the Nash equilibrium is the strategy of both players confessing. There is no other better option for either player to switch to. From this game, we can also see another interesting aspect of the Nash equilibrium. Mathematician Iztok Hozo points out that "any dominant strategy equilibrium is also a Nash equilibrium." He explains that this is because "the Nash equilibrium is an extension of the concepts of dominant strategy equilibrium." However, he notes that the Nash equilibrium can be used to solve games that do not have a dominant strategy. Nash received great praise for the Nash equilibrium and his other work in game theory – but not from John von Neumann. According to Forbes, "Von Neumann, consumed with envy, dismissed the young Nash's result as 'trivial'-- meaning mathematically simple." Others did not share in Von Neumann's assessment of Nash's work. Nash, Reinhard Selten, and John Harsanyi went on to share the 1994 Nobel Memorial Prize in Economic Sciences for their work in game theory. When Nash died in 2015, one academic news website summed up his accomplishments this way: "Nash's most fundamental contribution to game theory was in opening the field up to a wider range of applications and different scenarios to be studied. [...] Without his breakthrough, much of what followed in game theory might not have been possible." What is your experience with game theory? Let us know in the comments! Also, be sure to check out our other video called Could Aliens 65 Million Light Years Away from Earth See Dinosaurs Alive?! Thanks for watching, and, as always, don't forget to like, share, and subscribe. See you next time!






Recommended Reading for Continued Growth



As you conclude this exploration of the “Game Theory”, I’d like to recommend a fantastic book that brings these abstract concepts to life: *The Joy of Game Theory: An Introduction to Strategic Thinking* by Presh Talwalkar. This book is a brilliant entry point for anyone who wants to understand the hidden math behind human interaction and how to make better choices in competitive or cooperative situations.

 **About the Book:** *The Joy of Game Theory* breaks down complex mathematical models into relatable, real-world scenarios. Presh Talwalkar, the mind behind the popular *Mind Your Decisions* channel, distills the essentials of strategic logic—like the famous Prisoner’s Dilemma, Nash Equilibria, and auction strategies—into clear, bite-sized lessons.

The book covers a wide array of fascinating topics, including:

- **The Art of Strategy:** How to anticipate what others will do and react accordingly.
- **Rationality vs. Reality:** Why humans sometimes act against their own best interests.
- **Practical Applications:** Using game theory in everything from salary negotiations and sports to everyday social interactions and business competition.

Through engaging puzzles and simple explanations, Talwalkar removes the intimidation factor from the “dismal science” of economics. Whether you are a student, a professional looking for a competitive edge, or just a fan of logic puzzles, this book will sharpen your analytical skills and provide a new lens through which to view the world.



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