Cooperation and Collective Action

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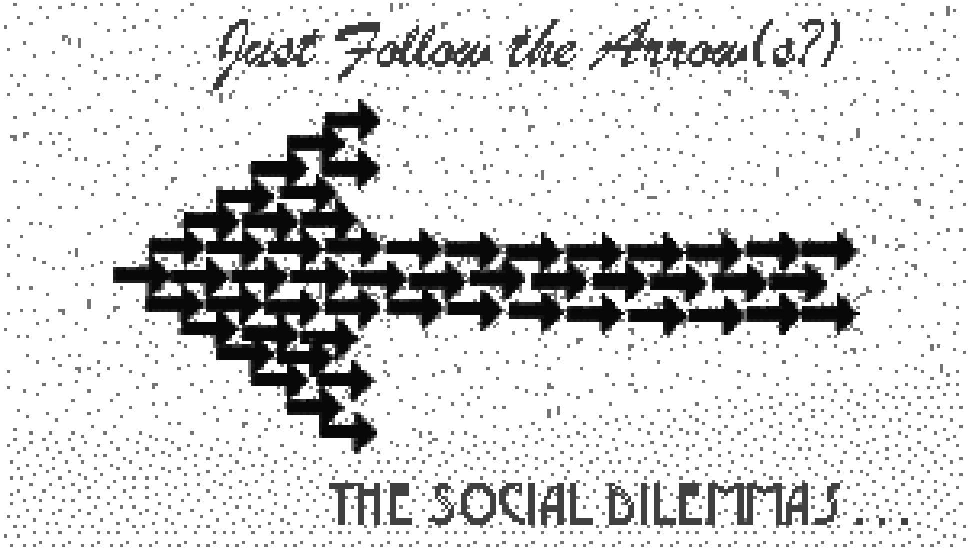
Concepts to Know

- **Social Dilemma**
- **Prisoners' Dilemma**
- **Public Goods Dilemma**
- **Commons Dilemma ('Tragedy of the Commons')**
- **Free-Riders**
- **Assurance/Coordination Games**
- **Game of Chicken**
- **Dominant Strategy**
- **Nash Equilibrium**
- **Matrix and Decision-Trees (how to read)**

Social Dilemmas (individual vs. group)

- **Social dilemmas**= are situations in which individual rationality leads to collective irrationality



Social Dilemmas (individual vs. group)

- **<u>Social dilemmas</u>**
  1. In other words, individually reasonable behavior leads to a situation in which everyone is ***<u>worse off</u>*** than they might have been otherwise.
  2. All social dilemmas have at least one ***<u>deficient equilibrium</u>***

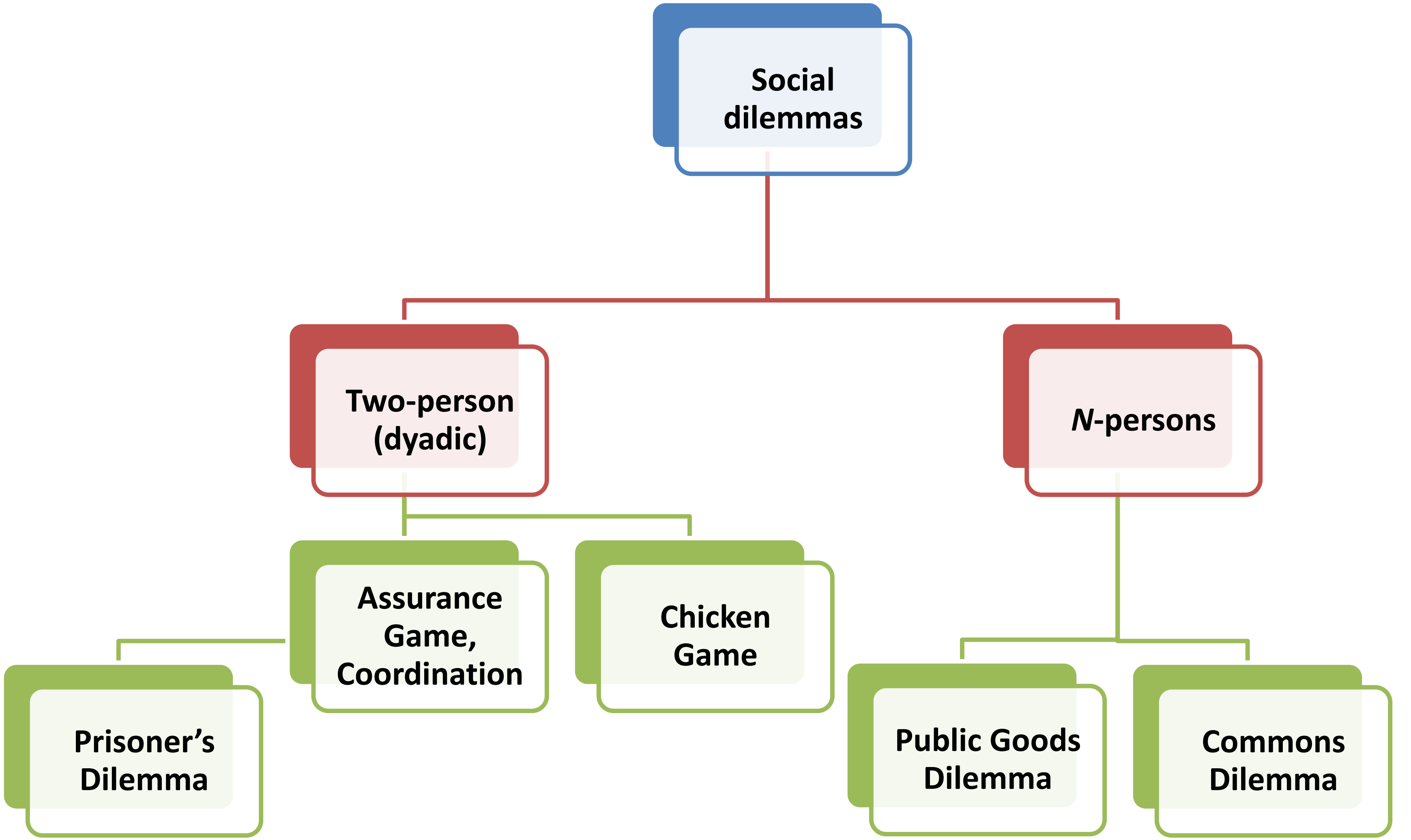
Social Dilemmas (individual vs. group)

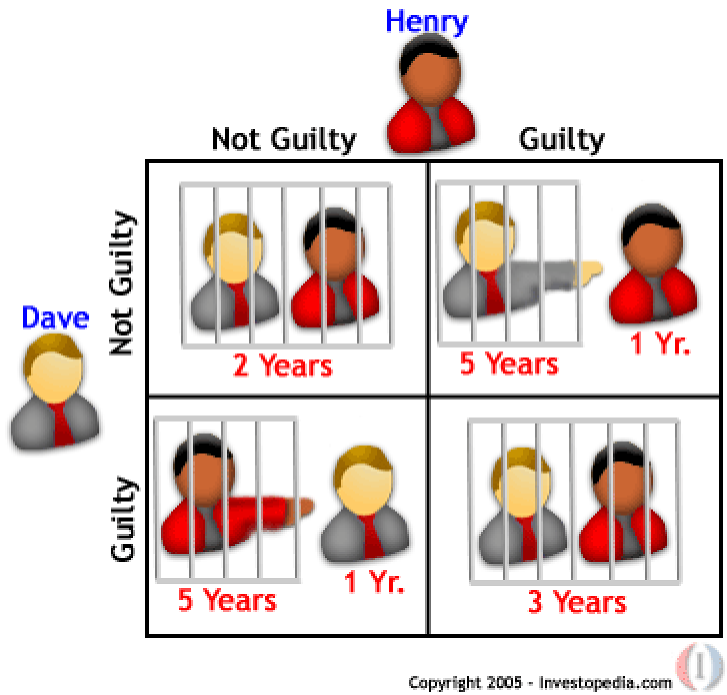
- **<u>Deficient Equilibrium?</u>**
  - **Equilibrium <u>(plural = equilibria):</u>** situation in which no individual has an incentive to change their behavior
    - (Equilibrium just means balance)
  - **Deficient =** means that there is at least one other outcome in which everyone is better off (examples below)

Social Dilemmas

- **Social Dilemmas are everywhere!**
  - **Cleaning dorm rooms:** best thing for you is other guy to tidy up; but worst outcome is to tidy up for other person. What do you do?
  - **Nuclear arms race (Prisoner's Dilemma)**
  - **Pollution, over-fishing, deforestation (Tragedy of the Commons)**
  - **Paying taxes, Pot Lucks, Charities (Public Goods Dilemmas)**

Types of Social Dilemmas

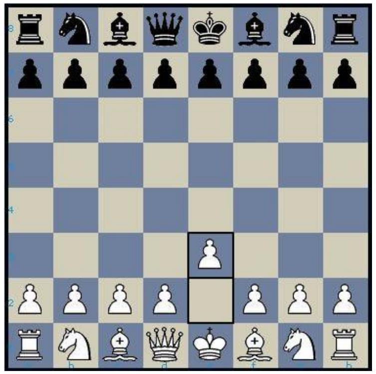


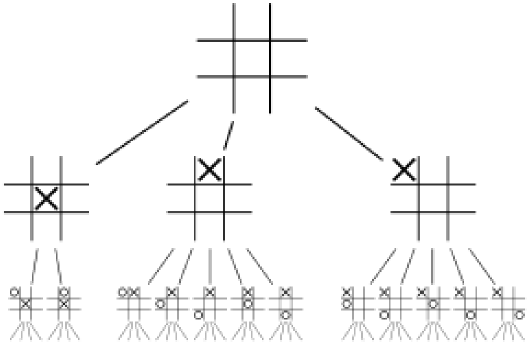


I. PRISONER'S DILEMMA AND OTHER TWO-PERSON GAMES

What are 'Games?'

- Game Theory = the study of interactive, strategic decision making among rational individuals.
  - A 'GAME' in this sense is any form of *strategic interaction!*
  - The Key idea is that players make decisions that affect one another.

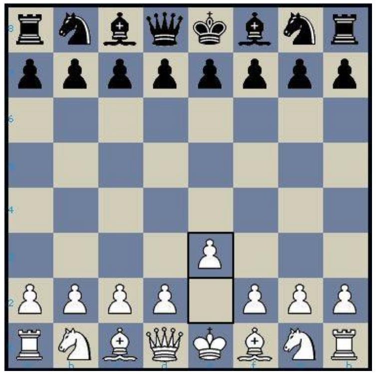


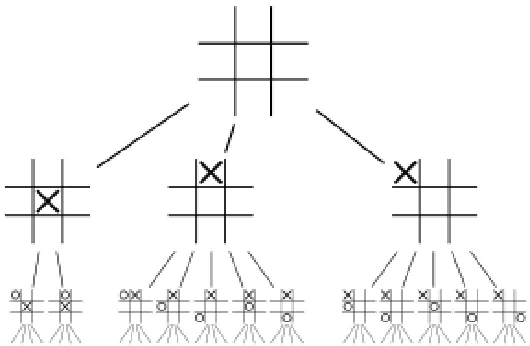


What are ‘Games?’

- **<u>Ingredients of a game:</u>**

1. **The Players**
2. **Options** (i.e. their options or possible ‘moves’)
3. **‘Payoffs’ –** the reward or loss a player experiences

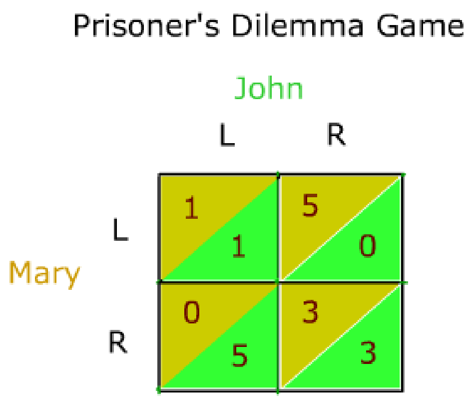


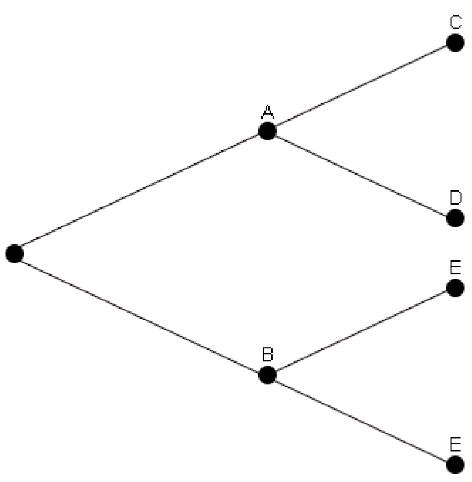


Describing Games

- We can describe ‘games’ in three ways:

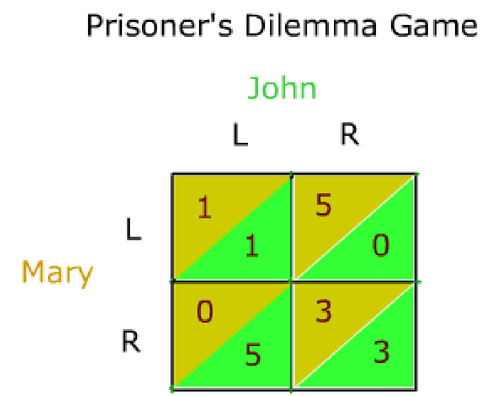
1. Verbally
2. Using a **matrix** (= table)
3. Using a **Tree diagram**



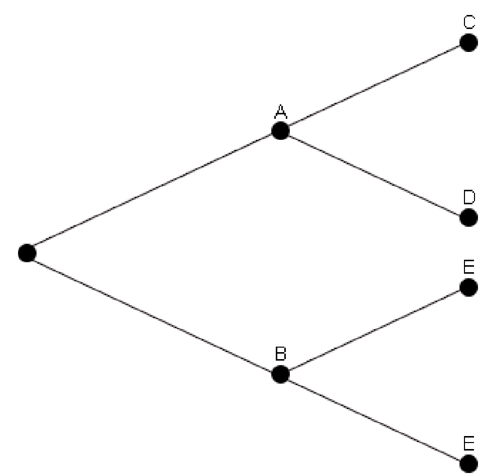


Describing Games

1. A **MATRIX** (table) most easily describes a ***simultaneous game*** (where players move at the same time, like the game ‘rock, paper, scissors’)
   – Note, however, that a matrix can also describe a sequential game; it’s just a little more complicated.



2. A **DECISION-TREE** is used to describe a ***sequential game*** (where players take turns).

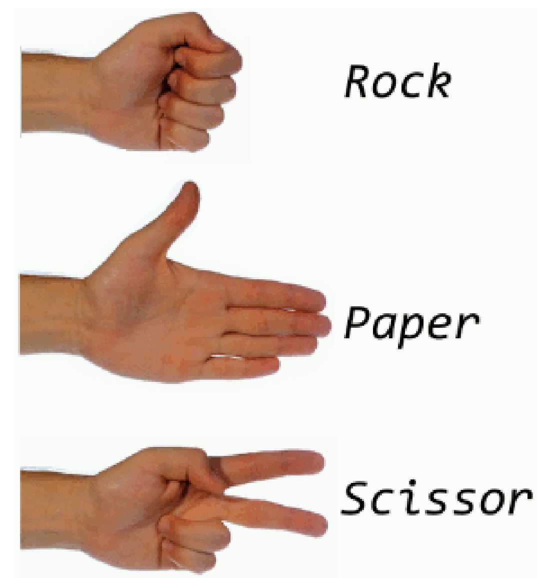


Matrix Descriptions
Rock, Paper, Scissors

STEP 1: Write down the options for both players in a table.

- Player 1 = row chooser
- Player 2 = column chooser

	ROCK	PAPER	SCISSORS
ROCK			
PAPER			
SCISSORS			



Matrix Descriptions
Rock, Paper, Scissors

STEP 2: Write down the 'payoffs' (i.e. preferences) for each possible joint outcome.

- Note that there are two different payoffs!

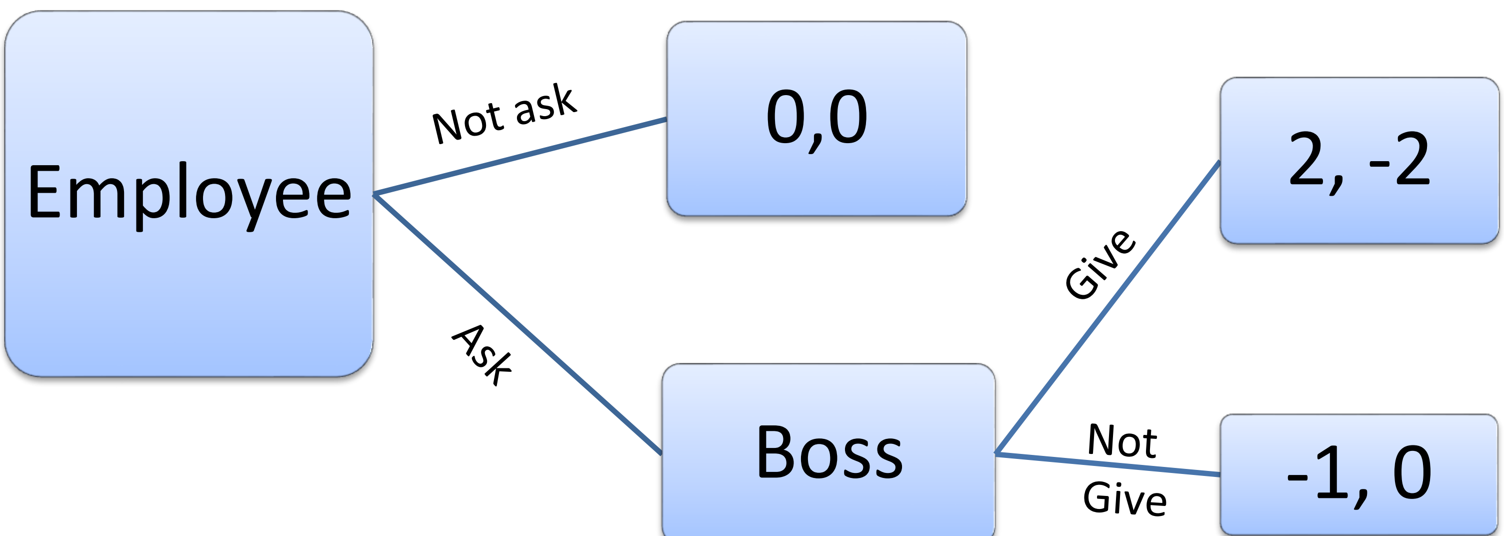
PLAYER 2

PLAYER 1

	ROCK	PAPER	SCISSORS
ROCK	tie, tie	lose, win	win, lose
PAPER	Win, lose	tie, tie	lose, win
SCISSORS	lose, win	win, lose	tie, tie

Decision-trees

- **Decision-trees (aka tree diagrams)** are useful depictions of situations involving *sequential turn-taking* rather than *simultaneous* moves.
- ***<u>Asking Boss for a Raise?</u>***



Prisoners' Dilemma

(verbal description)

- Imagine you are one of two guilty prisoners. You and your partner in crime are being interrogated by the police, separately. You cannot communicate with your partner. Each of you faces a choice: you can either **CONFESS (defect)** or **NOT CONFESS (cooperate).**
- If neither of you confess, there will be insufficient evidence against you, and you will both receive only 1 year in prison. If both of you confess, you will each receive 5 years in prison. If you confess and your partner does not confess, however, you do not go to prison, but your partner goes to prison for 10 years. If, on the other hand, you don't cooperate and confess, but your partner confesses ('rats you out'), then your partner does not go to prison, and you go to prison for 10 years.
- QUESTION: DO YOU CONFESS (defect) OR NOT (cooperate)? WHY, WHY NOT? (Note: "Cooperate" here means 'cooperate with your partner!)

Prisoners’ Dilemma

(matrix form)

	CONFESS (defect)	NOT CONFESS (cooperate)
CONFESS (defect)	**5 YRS, 5 YRS**	**0 YRS, 10 YRS**
NOT CONFESS (cooperate)	**10 YRS, 0 YR**	**1 YR, 1 YR**

Prisoners' Dilemma

- **Another prisoner's dilemma:**
  - Two students are asked to take $1 out of their wallets. Each, in secret, decides whether to place the money in an envelope (**cooperate**) or to keep the money in one's pocket (**defect**).
  - Each envelope is then given to the other person, and I double whatever money has been given, with possible amounts given below:

	cooperate	defect
cooperate	**$2, $2**	**$0, $3**
defect	**$3, $0**	**$1, $1**

PRISONER'S DILEMMA

- **ALL SITUATIONS WITH THE FOLLOWING PAYOFFS ARE CALLED 'PRISONER'S DILEMMAS'**
  - *DC > CC > DD > CD*

	COOPERATE	DEFECT
COOPERATE	SECOND, SECOND	WORST, BEST
DEFECT	BEST, WORST	THIRD, THIRD

Payoffs written in RED are payoffs for player 1 (row-chooser)
Payoffs written in BLACK are payoffs for player 2 (column-chooser)

The Dark Knight Rises

		Prisoners' Ship	
		COOPERATE (not detonate)	DEFECT (detonate)
"Decent People" Ship	**COOPERATE (not detonate)**	DIE (0), DIE (0)	DIE(0), LIVE (1)
	DEFECT (detonate)	LIVE (1), DIE (0)	DIE (0), DIE (0)

Payoffs written in RED are payoffs for player 1 (row-chooser)
Payoffs written in BLACK are payoffs for player 2 (column-chooser)

Assurance Games and Coordination

- **ASSURANCE GAME= any situation in which mutual cooperation leads to a better outcome than unilateral defection.**
- **'Assurance Games' have the following payoff order:**
  - *CC > DC > DD > CD*

	COOPERATE	DEFECT
COOPERATE	BEST, BEST	WORST, SECOND
DEFECT	SECOND, WORST	THIRD, THIRD

Payoffs written in RED are payoffs for player 1 (row-chooser)
Payoffs written in BLACK are payoffs for player 2 (column-chooser)

Assurance Games and Coordination

- **EXAMPLE:**
  - **The $100 button game (if played between two people) would be an assurance game.**
  - **These situations are called *<u>assurance</u>* games because the best outcomes depend on mutual *<u>TRUST.</u>***

Game: $100 Button

Pushing this button has two effects:

1. When you push your button, every other player loses $2.
2. If you lose money because other players push their buttons, pushing your button will cut those losses in half.

Assurance Games and Coordination

- **Coordination games** (closely related to assurance games) **refer to situations in which the best choice to make is the choice the other player makes.**
  - The potential problem is figuring out what the other player will choose.
- Example: Which side of the road to drive on?

	Left	Right
Left	10, 10	0, 0
Right	0, 0	10, 10

Assurance Games and Coordination

- **Example: Shake hands or Bow?**

	Shake	**Bow**
Shake	Best, Second	Worst, Worst
Bow	Worst, Worst	Second, Best

‘CHICKEN’

- **GAME of Chicken = any situation in which mutual defection yields worse outcome than unilateral cooperation.**
- **‘Games of Chicken’ have the following payoff order:**
  - *DC > CC > CD > DD*

	COOPERATE	**DEFECT**
COOPERATE	SECOND, SECOND	THIRD, BEST
DEFECT	BEST, THIRD	WORST, WORST

Payoffs written in RED are payoffs for player 1 (row-chooser)
Payoffs written in BLACK are payoffs for player 2 (column-chooser)

'CHICKEN'

- **Examples:**

USSR

COLD WAR

USA

	Nuke	**Don't Nuke**
Nuke	-200, -200	-1, -100
Don't Nuke	-100, -1	0, 0

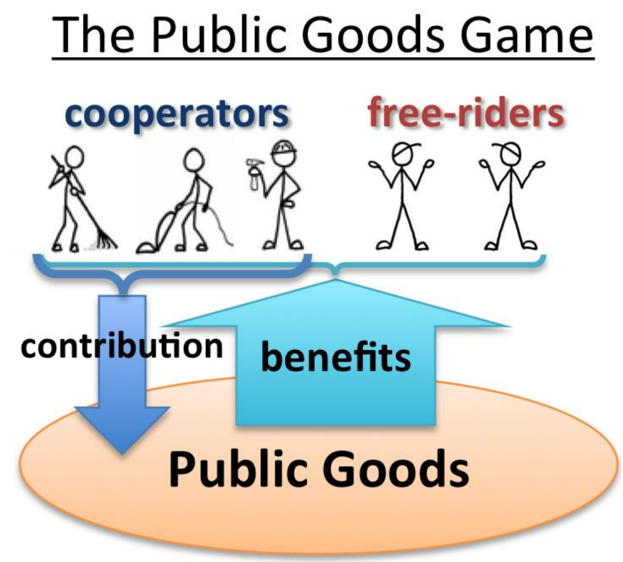
ORIGINAL 'CHICKEN'

	DRIVE	**VEER (turn away)**
DRIVE	-200, -200	5, -2
VEER (turn away)	-2, 5	0, 0

II. N-PERSON DILEMMAS (PUBLIC GOODS AND COMMONS)

Public Goods Dilemma

- **Public Good:** any resource which benefit everybody regardless of whether they have helped provide the resource.
  - Everyone has a temptation to **free-ride**, i.e. to enjoy the good without actually contributing to it.



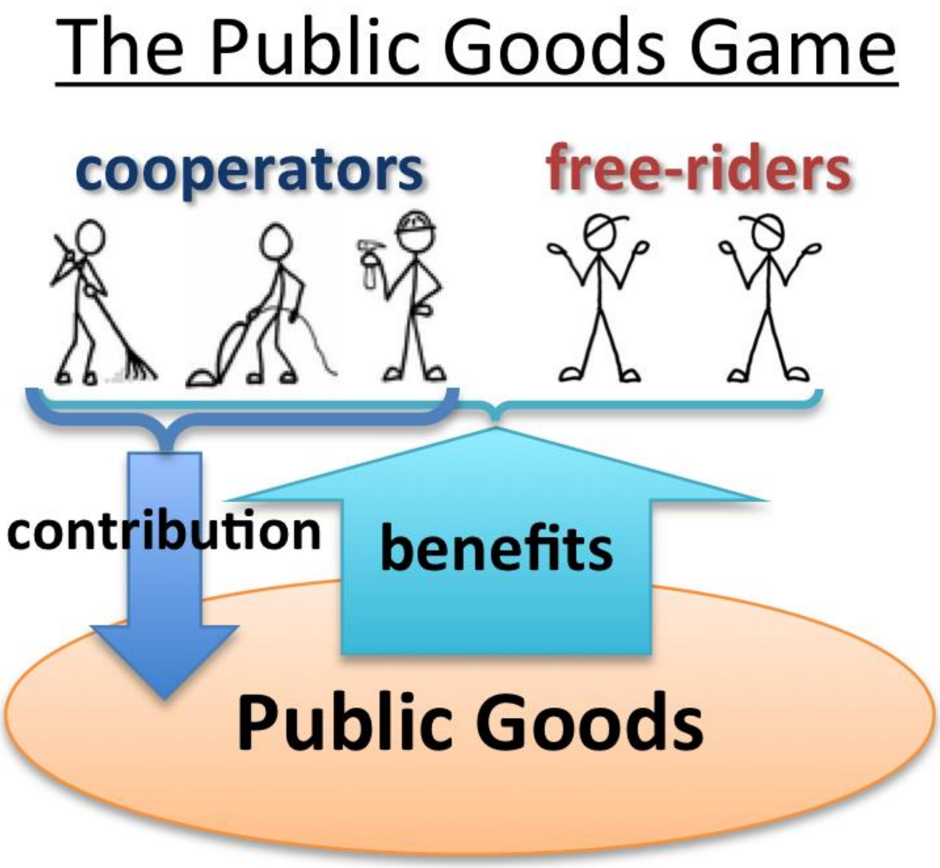
Public Goods Dilemma

- **Public goods** are both:
  - **'non-excludable'-** it is difficult to exclude those who don't contribute from using it.
  - **'non-rival'-** one person using it doesn't diminish its availability for someone else.

Example: I can enjoy a city park without paying taxes to support it.

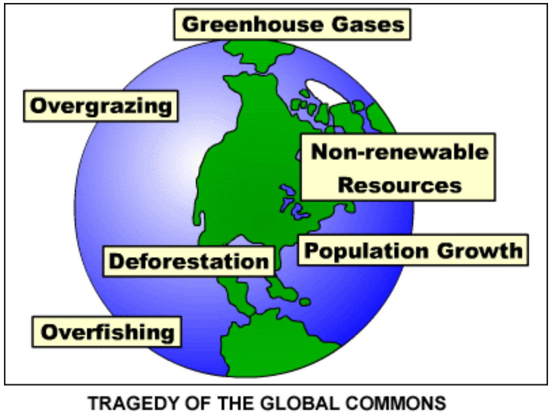
Public Goods Game

- An experimental game in which people secretly decide to contribute or not to a public pot.
- The tokens in the pot are then multiplied by some amount, and divided evenly to all participants, whether or not they contributed.



Commons Dilemmas

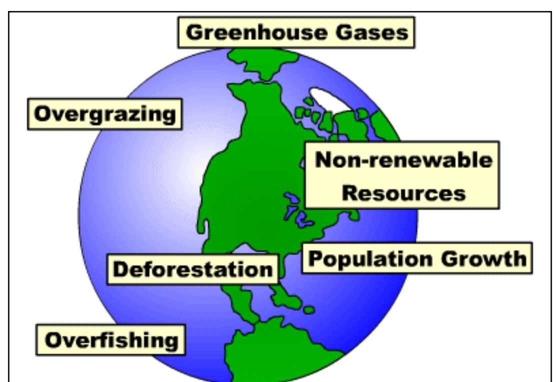
- **Tragedy of the Commons**: individuals, acting independently and rationally according to each one's self-interest, behave contrary to the whole group's long-term best interests by depleting some common resource.



TRAGEDY OF THE GLOBAL COMMONS

Commons Dilemma vs Public Goods Dilemma

- **Public Goods Dilemma** involve the ***production*** of a resource; **Commons Dilemma** involves ***joint use*** of a resource.
- Public goods are **non-rivalrous**
- Common goods are **rivalrous-** using it diminishes its availability for others (‘uses it up’)



TRAGEDY OF THE GLOBAL COMMONS

III. DOMINANT STRATEGY AND NASH EQUILIBRIUM

Dominant Strategy

- In Game Theory, a player's ***dominant strategy*** is a choice that ***always leads to a higher payoff, regardless of what the other player(s) choose.***
  - In the game **prisoner's dilemma**, both players have a dominant strategy. Can you determine which choice *dominates* the others? (defect, or confess)
  - *Not all games have a dominant strategy,* and games may exist in which one player has a dominant strategy but not the other.

Dominant Strategy

YOUR OPPONENT

YOU

	left	right
top	*Third*, 2nd	*2nd*, Worst
bottom	*Worst*, Best	*Best*, Third

(for PLAYER 1 = YOU = row-chooser)

1. **WHAT IS THE BEST ROW (top or bottom) IN THE LEFT COLUMN?**
2. **WHAT IS THE BEST ROW (top or bottom) IN THE RIGHT COLUMN?**
3. **WOULD YOU CHOOSE THE SAME ROW (=action) BOTH TIMES? IF YES, THEN THAT ROW IS A DOMINANT STRATEGY!**

Dominant Strategy

YOUR OPPONENT

YOU

	left	right
top	*Third*, 2nd	*2nd*, Worst
bottom	*Worst*, Best	*Best*, Third

(for PLAYER 2 = YOUR OPPONENT = column-chooser)

1. **WHAT IS THE BEST COLUMN (left or right) IN THE TOP ROW?**
2. **WHAT IS THE BEST COLUMN (left or right) IN THE BOTTOM ROW?**
3. **WOULD YOUR OPPONENT CHOOSE THE SAME COLUMN (=action) BOTH TIMES? IF YES, THEN THAT COLUMN IS A DOMINANT STRATEGY!**

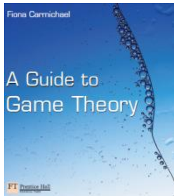
Dominant Strategy

Matrix 1.1 Robina's pay-offs in hide-and-seek

		Tim	
		look in house	look in garden
Robina	hide in house	0	50
	hide in garden	50	0

(for PLAYER 1 = Robina = row-chooser)

1. **If Tim *looks in the house*, where should Robina hide?**
2. **If Tim *looks in the garden*, where should Robina hide?**
3. **Should Robina *always* hide in the house, or always hide in the garden? NO!**



Dominant Strategy

Matrix 1.2 Tim's pay-offs in hide-and-seek

Robina		Tim: look in house	Tim: look in garden
	hide in house	50	0
	hide in garden	0	50

(for PLAYER 2 = Tim = column-chooser)

1. **If Robina *hides in the* house, where should Tim look?**
2. **If Robina *hides in the garden*, where should Tim look?**
3. **Should Tim *always* look in the same place, regardless of where Robina hides?**
   NO!

Dominant Strategy

Matrix 1.3 The pay-off matrix for hide-and-seek

		Tim	
		look in house	look in garden
Robina	hide in house	0, 50	50, 0
	hide in garden	50, 0	0, 50

- The COMPLETE PAYOFF MATRIX includes the payoffs (outcomes) for BOTH Robina and Tim.
- The payoffs for Robina (Player 1) are written first – **here they are written in BLUE**.
- The payoffs for Tim (Player 2) are written second, after the comma – **here in black**.

Dominant Strategy
(PLAYER 1)

1. **Assume Player 2 Cooperates (look only at first column)- *Is cooperate or defect better?***
   - **Defect beats cooperate: *BEST is better than SECOND best.***

vs

	COOPERATE	~~DEFECT~~
COOPERATE	SECOND	~~WORST~~
DEFECT	BEST	~~THIRD~~

2. **Assume Player 2 Defects (look only at second column)- *Is cooperate or defect better?***
   - **Defect still beats cooperate! *THIRD is better than WORST!***

	~~COOPERATE~~	DEFECT
COOPERATE	~~SECOND~~	WORST
DEFECT	~~BEST~~	THIRD

vs

IN BOTH CASES, 'DEFECT' IS THE BEST CHOICE AND THEREFORE A DOMINANT STRATEGY.

Dominant Strategy
(PLAYER 2)

1. **Assume Player 1 Cooperates (look only at first row)-**
Is cooperate or defect better?
   - **Defect beats cooperate:** ***BEST is better than SECOND best.***

	COOPERATE	DEFECT
COOPERATE	SECOND	BEST
~~DEFECT~~	~~WORST~~	~~THIRD~~

2. **Assume Player 2 Defects (look only at second row)-**
Is cooperate or defect better?
   - **Defect still beats cooperate!** ***THIRD is better than WORST!***

	COOPERATE	DEFECT
~~COOPERATE~~	~~SECOND~~	~~BEST~~
DEFECT	WORST	THIRD

IN BOTH CASES, 'DEFECT' IS THE BEST CHOICE AND THEREFORE A DOMINANT STRATEGY.

Nash Equilibrium

- **Nash Equilibrium:** an outcome is a Nash Equilibrium if no player has anything to gain by changing only their own choice.
  - In other words, a Nash Equilibrium is a situation in which neither player can improve his position given what the other player has chosen.

Nash Equilibrium

Procedure:

- Pretend you are one player (row chooser or column chooser)
- Suppose that you believe your opponent is playing Veer. Find your *best response* to "Veer". In this example, your best response is to play "Drive", because 5 > 0.
- Do the same for each of your opponent's actions
- Now pretend you are the *other* player. Repeat steps 2 and 3.
- For a Nash equilibrium, you need each player to be "best-responding" to what the other player is doing. My action is my best response to what you're doing, and your action is your best response to what I am doing.

GAME OF CHICKEN

	DRIVE	**VEER (turn away)**
DRIVE	-200, -200	5, -2
VEER (turn away)	-2, 5	0, 0