GAMES

444 Lecture 13

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GAMES

GAMES

- A **game** is any situation where the the outcome is determined by the actions of the players, plus perhaps some impact from the outside world.
- If this seems really general, it is!

FORMAL GAMES

In a formal representation of a game we specify:

- How many players there are.
- How many moves they each have.
- What order those moves get made in.
- How many options they have at each move.
- What the payoff is for each player for each possible combination of moves by the players and ‘moves’ by nature.

TWO MAIN TYPES

- Each player makes 1 move, and these are made simultaneously.
- Players take turns making moves, and every move is revealed to all players when they are made.

An example of a turn taking game

An example of a one move game

A more familiar one move game

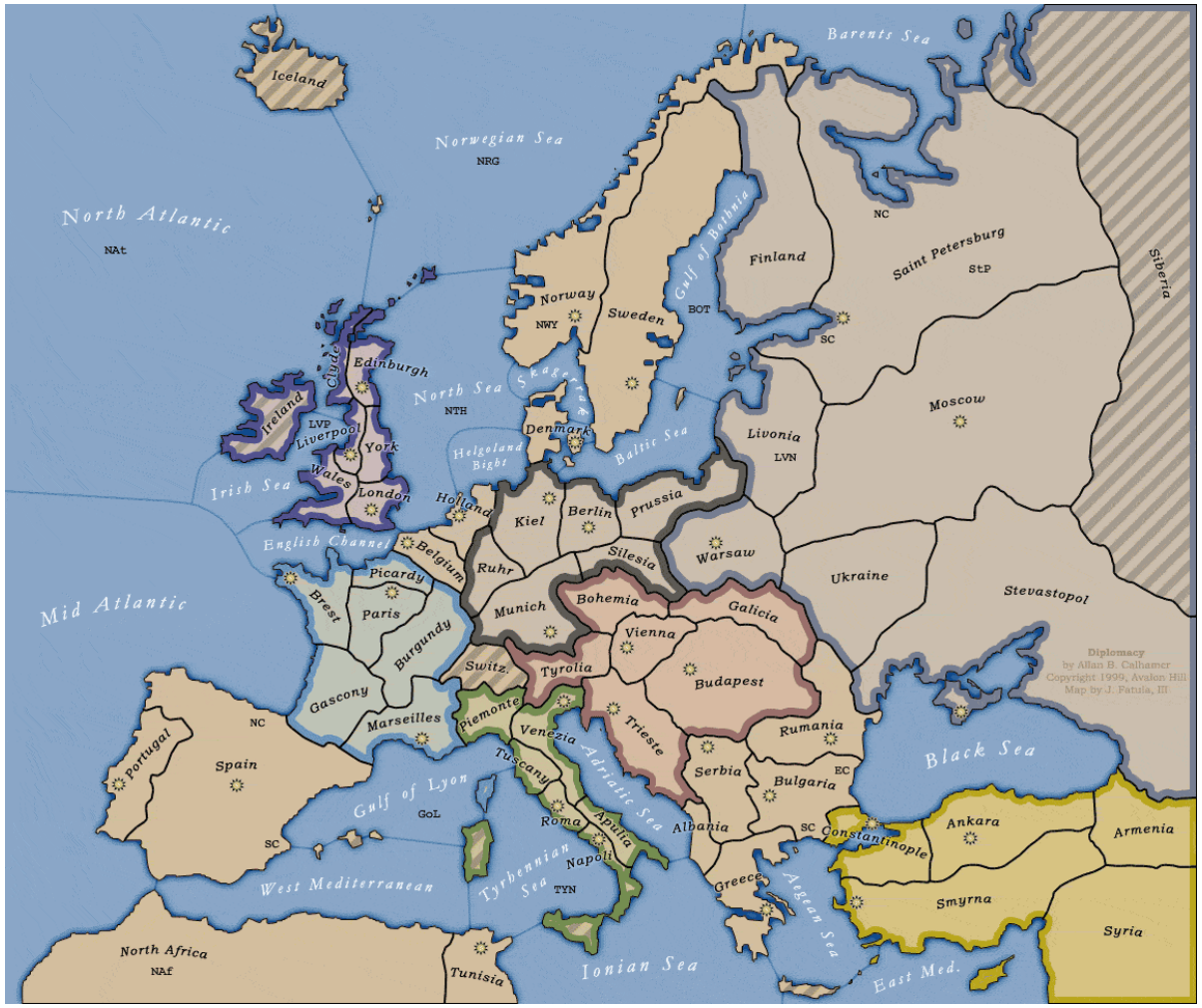
OTHER TYPES

- Nature gets involved.
- Nature gets involved and their move is only revealed to one of the players.
- A move made by a player is not revealed to the other player(s) straight away.
- Multiple sequential moves.

How nature can get involved in a public way.

How nature can get involved in a private way.

Moves that are not revealed



Multiple simultaneous moves

POSITIVE SUM GAME

- These instances are a bit non-representative in one crucial respect.
- They are all **zero-sum**.
- That is, someone doing well means someone else must be doing worse.
- This is not the general case.

POSITIVE SUM GAME

Most of the games we're going to look at have the following characteristic.

- There is a pair of possible outcomes such that every player is better off in the first outcome than the second.
- That is, is a pair of possible outcomes such that every player **gets more utility** in the first outcome than the second.

UTILITY

GAME OUTCOMES

There are two natural ways to specify the outcome of a game.

1. Describe the physical situation that results.
2. Describe how much **utility** each player gets from that result.

UTILITY

- We are usually going to be focused on the second.
- That's because we want to know what makes sense from the players' perspectives.
- And just knowing the physical outcomes doesn't tell us that.

WHAT IS UTILITY

- It’s not score.
- The players are aiming to maximise their own number, not maximise the difference between the numbers.

A memorable scoreboard

WHAT IS UTILITY

- The players would prefer a 3-4 result (i.e., 3 for them, 4 for other player) to a 2-1 result.
- So this is very much unlike soccer, even though the numbers will often feel a lot like soccer scores.

WHAT IS UTILITY

- It’s not money, for two distinct reasons.
- First, the players might care how much money the other players get.
- Second, the value of an extra dollar is different to different people. Typically, it has less value the richer one is.

WHAT IS UTILITY

It is, more or less, desirability.

- Outcome $\mathbf{O_1}$ has more utility for player $\mathbf{X}$ than outcome $\mathbf{O_2}$ iff $\mathbf{X}$ prefers to be in $\mathbf{O_1}$ than $\mathbf{O_2}$.

2 BY 2 GAMES

THREE FAMOUS GAMES

1. Prisoners' Dilemma
2. Stag Hunt
3. Hawk-Dove

PRISONERS' DILEMMA

	C	D
C	3,3	0,5
D	5,0	1,1

	C	**D**
C	3,3	0,5
D	5,0	1,1

- Each player can choose **C** or **D**.
- If both choose **C**, both get 3.
- If both choose **D**, both get 1.
- If they make different choices, the one who chose **D** gets 5, and the other gets 0.

PRISONERS' DILEMMA

The big tension:

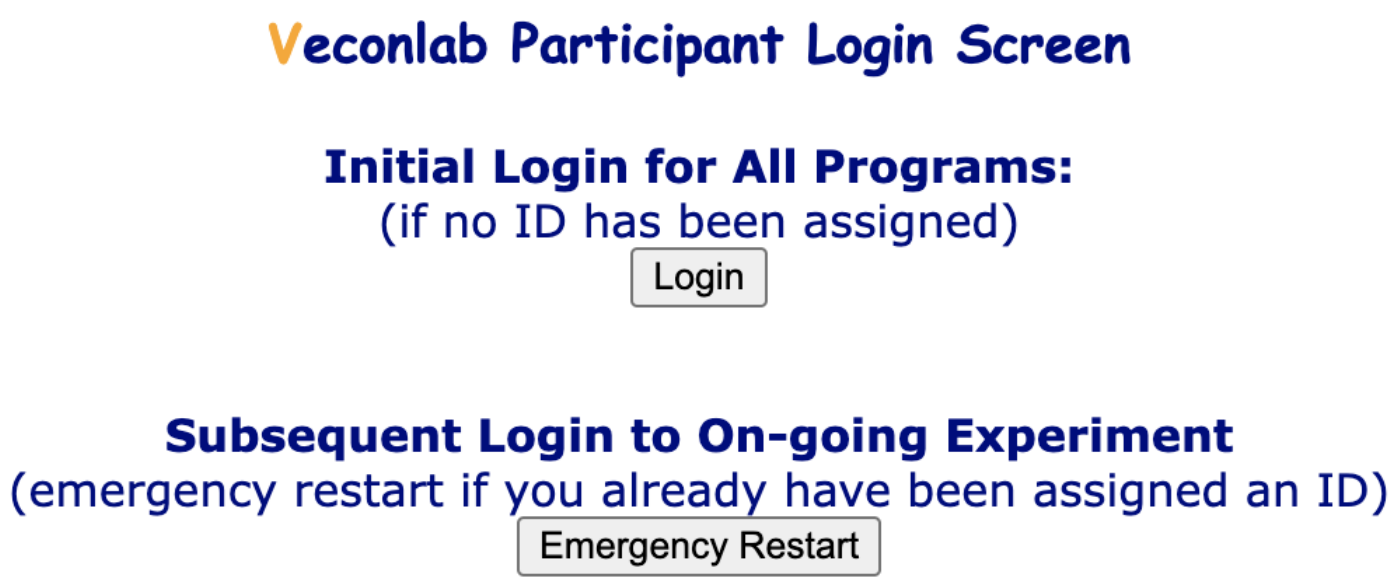
- Both doing **C** makes both better off than both doing **D**.
- Whatever the other person does, each person is better off doing **D** than **C**.

QUESTION

What real life situations might be like this? I.e., which real life situations have these features:

- There is an option that leaves everyone fairly well off if everyone does it.
- There is another option that leaves everyone badly off if everyone does it.
- No matter what everyone else does, each person is better off doing the second thing.

REGISTRATION INSTRUCTIONS

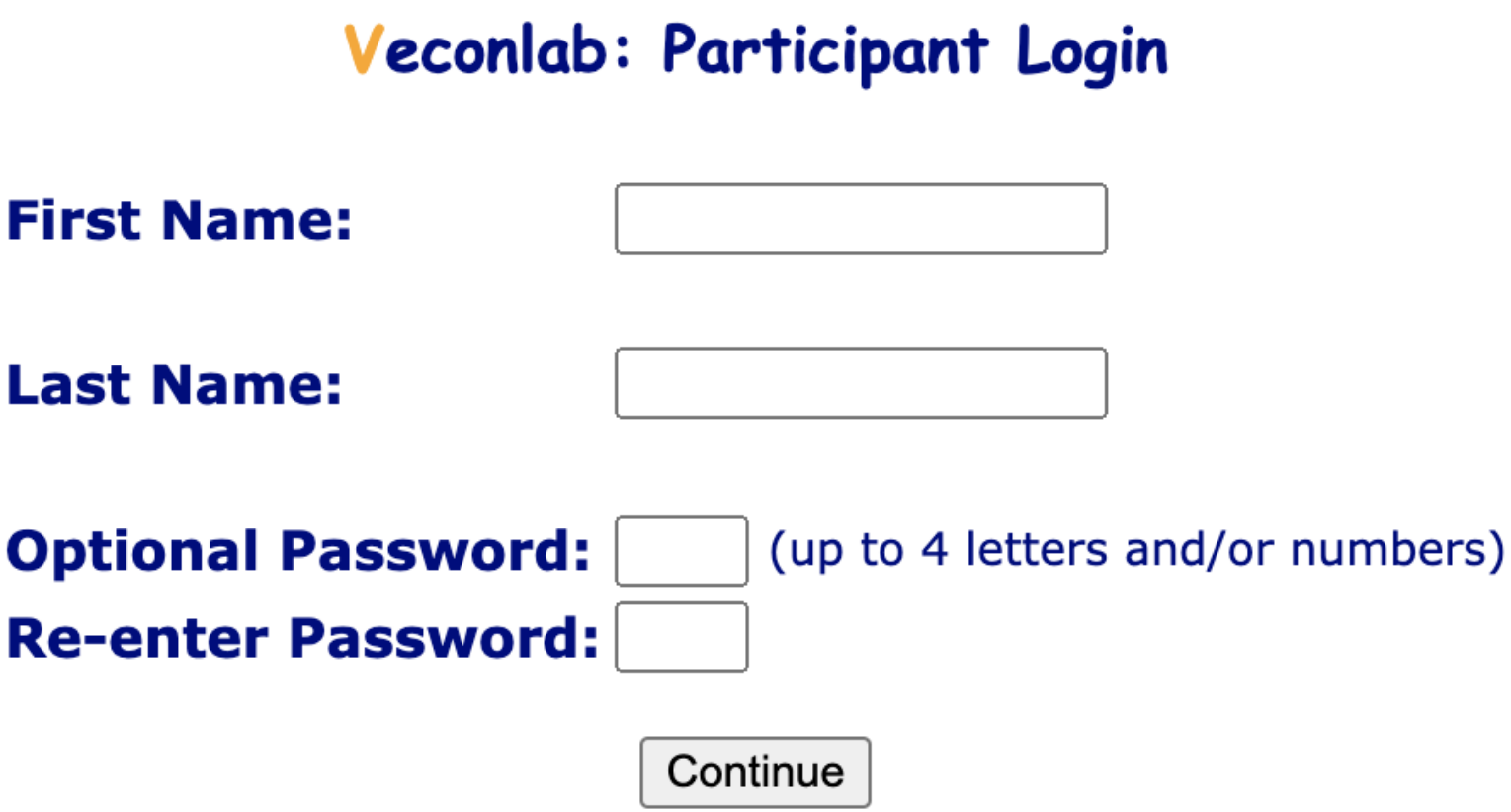


Go to https://veconlab.econ.virginia.edu/login.html

SESSION NAME - PBW9

Enter the session name **pbw9**. (This will change day-by-day)

REGISTER REAL NAME



Enter your real name (for credit purposes)

ICLICKER

Were you able to register:

a. Yes

b. No

I'll change the numbers to allow the game to start.

INSTRUCTIONS

You'll be randomly paired with someone else in the room, and you'll play Prisoners' Dilemma 5 times. After each play, you'll see what the other person did the previous round.

Your aim is to get as many points (or 'dollars') as possible over the five rounds.

INSTRUCTIONS

You'll be randomly assigned Row or Column; the game is symmetric so this doesn't make a different to strategy.

FEEDBACK

- How did it go?
- What strategies did you use?

STAG HUNT

	C	D
C	20,20	0,20
D	15,0	15,15

- Two **equilibria**.
- Both play C is more beneficial. D no longer **dominates**.
- But D is **safer**.

INSTRUCTIONS

Go back into veconlab, and you should be set up with a different person from the PD rounds to play a **single** round of Stag Hunt.

FEEDBACK

- How did it go?
- Why did you play what you did?

HAWK-DOVE

	C	**D**
C	0,0	0,1
D	1,0	-20,-20

- No (pure strategy) **equilibrium**.
- If the other plays C, a small gain to playing D.
- But if you both play D, watch out.

INSTRUCTIONS

Go back into veconlab, and you should be set up with a different person again from the last two rounds to play a 5 rounds of Hawk-Dove.

FOR NEXT TIME

Lessons from Iterated Prisoners' Dilemma