Introduction to Game Design

9/30/08: Other Social Dilemmas, Bluffing, Competing for the Common Good

Prisoner's Dilemma

	P2 cooperates	P2 defects
P1 cooperates	3, 3	0, 5
P1 defects	5, 0	1, 1

The Conceptual Abstraction

- Any game whose system of rules can be unequivocally described and where the players each fully know their own interests can be expressed in a numerical table
- Of all the 2 x 2 games possible, there are 6 which can be considered dilemmas, determined by how the payoffs ("scores") are ranked

A Non-Dilemma Game

	Strategy A	Strategy B
Strategy A	4, 4	2, 3
Strategy B	3, 2	1, 1

Social Dilemmas

Prisoner	C	D
C	3, 3	1, 4
D	4, 1	2, 2

Gift of the Magi	C	D
C	1, 1	3, 4
D	4, 3	2, 2

Leader	C	D
C	2, 2	3, 4
D	4, 3	1, 1

Chicken	C	D
C	3, 3	2, 4
D	4, 2	1, 1

Deadlock	C	D
C	2, 2	1, 4
D	4, 1	3, 3

Stag Hunt	C	D
C	4, 4	1, 3
D	3, 1	2, 2

Deadlock

Deadlock	C	D
C	2, 2	1, 4
D	4, 1	3, 3

Leader

Leader	C	D
C	2, 2	3, 4
D	4, 3	1, 1

Stag Hunt

Stag Hunt	C	D
C	4, 4	1, 3
D	3, 1	2, 2

Stag Hunt

"If it was a matter of hunting a deer, everyone well realized that he must remain faithfully at his post; but if a hare happened to pass within the reach of one of them, we cannot doubt that he would have gone off in pursuit of it without scruple, and, having caught his own prey, he would have cared very little about having caused his companions to lose theirs"

Stag Hunt	Stag	Hare
Stag	4, 4	1, 3
Hare	3, 1	2, 2

Chicken

"The number of subsequent films featuring variations of Chicken is staggering. Usually it was used as a device to get rid of the 'bad' kid - teens lost their lives driving over cliffs, running into trains, smacking into walls, and colliding with each other. The creative abilities of Hollywood scriptwriters were sorely taxed as they struggled to think of new ways to destroy the youth of the nation"

- Jim Morton

Chicken

Chicken	C	D
C	3, 3	2, 4
D	4, 2	1, 1

Cuban Missile Crisis

- Before WWII, Neville Chamberlain was so unwilling to enter England into a war, that Hitler was able to win several chicken-like scenarios
- Churchill eventually realized the situation and brought England into the war
- In 1962, Kennedy made it clear to the Russians that he would not compromise, persuading Khrushchev that the US would not back down from nuclear war

The Madman Theory

"I call it the Madman Theory, Bob. I want the North Vietnamese to believe I've reached to point where I might do anything to stop the war. We'll just slip the word to them that, 'for God's sake, you know Nixon is obsessed about Communism. We can't restrain him when he's angry – and he has his hand on the nuclear button' – and Ho Chi Minh himself will be in Paris in two days begging for peace."

-Richard Nixon

Volunteer's Dilemma

	At least one person volunteers	Everyone says, let someone else do it
You volunteer	2	-
You say, let someone else do it	3	1

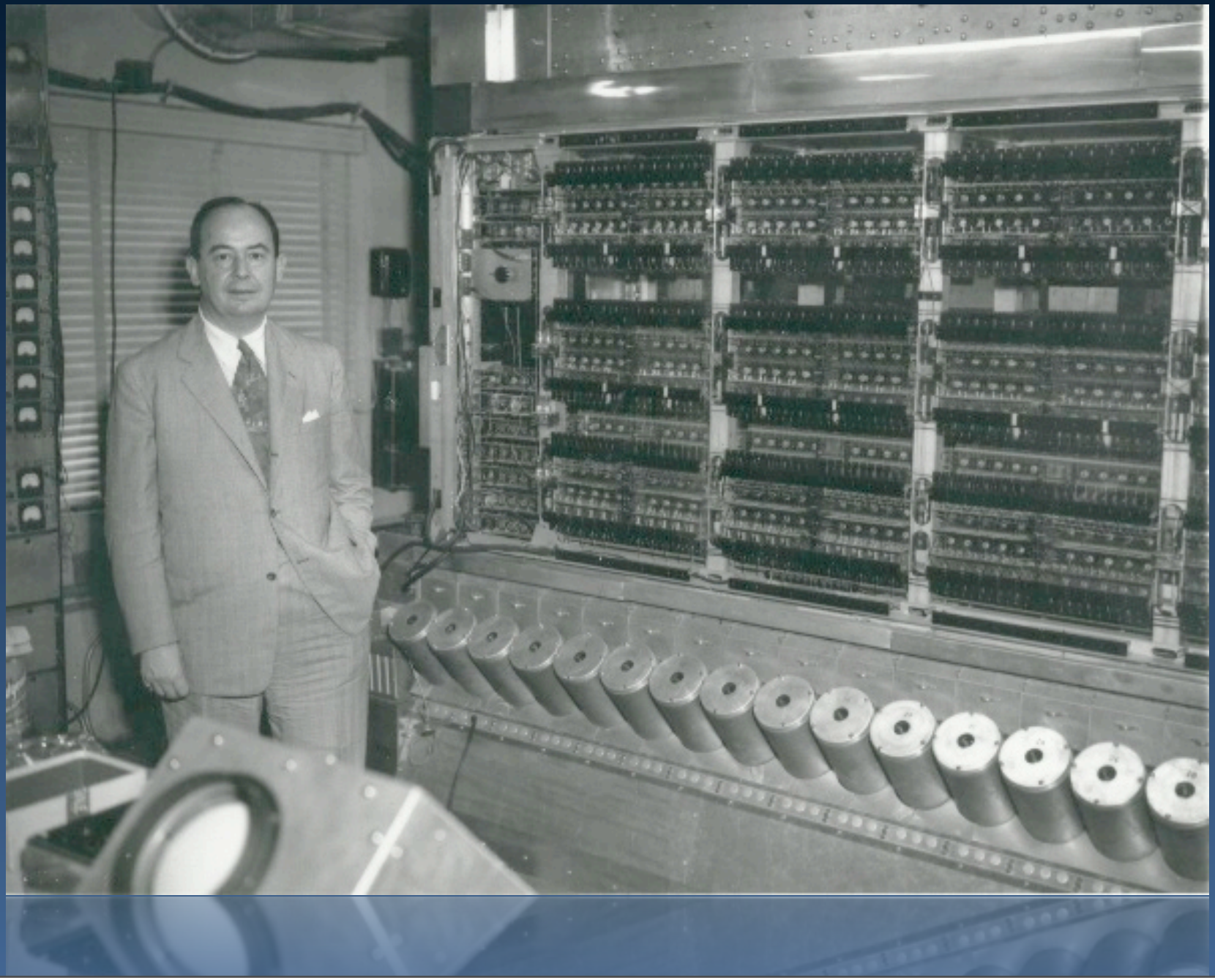
Gift of the Magi

Gift of the Magi	C	D
C	1, 1	3, 4
D	4, 3	2, 2

Asymmetrical Games

Multi-Game	Deadlock Player "Hers"	Deadlock Player "Mine"
Chicken Player "Hers"	2, 1	1, 3
Chicken Player "Mine"	3, 0	0, 2

Game Theory



John von Neumann

- Taught at Princeton University during the 1950's
- Colleague of Kurt Gödel
- Colleague of Albert Einstein
- Students called von Neumann "The Genius"

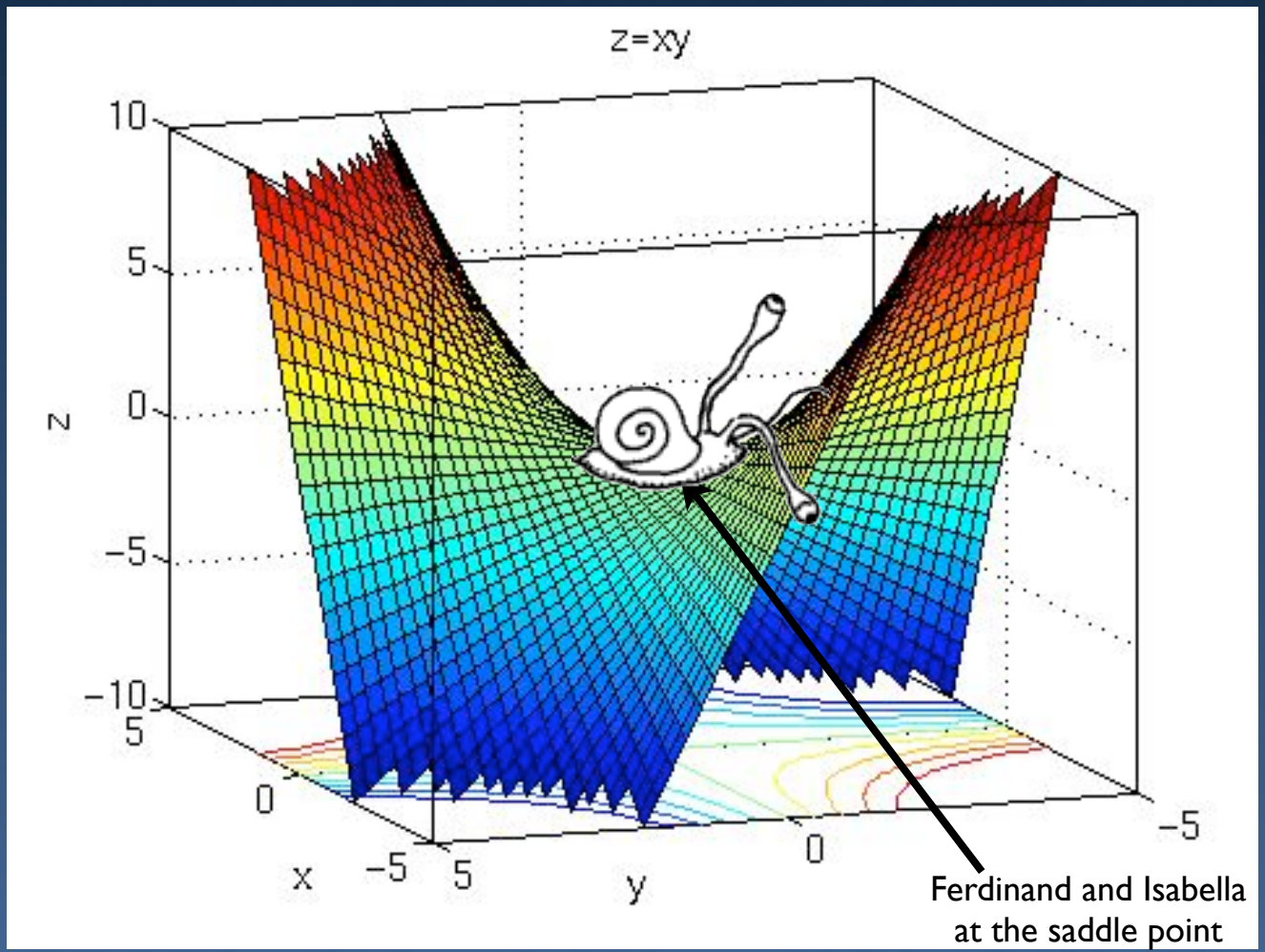
The Theory

- It is always possible to find an equilibrium from which neither player should deviate unilaterally in any game that satisfies the following criteria:
  - The game is finite – both in number of options at each move, and in total number of moves to the end of the game
  - The game is zero-sum – one player's gain is exactly the other's loss
  - The game is one of complete information – each player knows all options available to her and to her opponent, as well as outcome values and scale of values

Cutting the Cake

	Choose bigger piece	Choose smaller piece
Cut cake as evenly as possible	Half the cake minus a crumb	Half the cake plus a crumb
Cut one piece bigger than the other	Small piece	Big piece

Finding the Saddle Point



Rock-Paper-Scissors

- Simple, symmetric two-player game
- Rock defeats scissors
- Scissors defeat paper
- Paper defeats rock
- Same item results in a tie
- Von Neumann equilibrium – play at random with probability 1/3

	R	P	S
R	0	-1	1
P	1	0	-1
S	-1	1	0

John Nash

- Generalized coalition-free games for several players
- Nash equilibrium is the strategy that results in all parties being satisfied by playing the strategy allotted to them
- i.e., With such a strategy, no player, after learning the moves of all his opponents, cannot come up with something better, provided the opponents do not change their strategies

Nash Equilibrium

	P2 Strategy 1	P2 Strategy 2
P1 Strategy 1	1, 100	0, 1
P1 Strategy 2	2, 0	5, 2

Nash and the Prisoner's Dilemma

	P2 cooperates	P2 defects
P1 cooperates	3, 3	0, 5
P1 defects	5, 0	1, 1

Nash and Chicken

	P2 cooperates	P2 defects
P1 cooperates	3, 3	2, 4
P1 defects	4, 2	1, 1

Strategies (?)

The Categorical Imperative

- Immanuel Kant, *Foundations of the Metaphysics of Morals*
- "Act as though the maxims according to which you live should by your will become universal natural law"
- *treat people the way everyone should treat each other*
- Universal cooperation is better than universal competition

The Golden Rule

- First known to be written by Confucius circa 500 BCE
- Versions appear in the works of Plato, Aristotle, and Seneca
- "Whatsoever ye would that men should do to you, do ye even so to them"

  -Matthew 7:12
- *treat people the way you want to be treated*

Prisoner's Dilemma

- GR works well – I don't want my accomplice to rat me out, so I won't rat him out.
  - In effect, by using the golden rule, the game ceases to be a dilemma
- CI works well - If we both think this way, we each get the second-best outcome
- Merrill Flood's administrative assistants
  - $100 to assistant-A or $150 to A/B if both can agree how to split it

Chicken

- GR works great! - I don't want to crash so I'll swerve.
  - Universal cooperation much better than universal competition!
- CI works great! - If everyone swerved, no one would die. I will swerve

The Largest Number Game

- GR doesn't work - I don't want others to enter, so I wont enter... I can only lose.
  - Both universal cooperation and universal competition lead to no one winning (or if so, less than a penny)
  - Mixed strategy
- CI works - if everyone rolls a random number to enter, then there is the greatest chance of maximum prize. I will roll a random number.

Gift of the Magi

- GR is Disastrous!
  - Both husband and wife followed the Golden Rule, and both "lost"
  - Universal cooperation and universal competition lead to the worst two results
  - Ethics is complicated!
- CI works - it would be terrible if both people sold their prized possessions - therefore I wont sell.

Competing for the Common Good

Dunkin' Donuts vs. Starbucks

- Competing, but not a zero-sum game – when one closes, the other will sink
- Interests of players are neither completely complimentary nor completely competitive
- Almost every human interaction (work, conversation, strife, etc.) is a mixture of opposing and common interests
- Non zero-sum games are called games with mixed motives

Mr. and Mrs.

Mr. and Mrs.

- Many strategies available
- The worst tactic was for both husband and wife to be honest
- Slightly better was for each to choose what they thought the other would choose
- Best were couples that answered completely asymmetrically (e.g. the husband is honest, and the wife says what she thinks he will say)

Stock Exchange

- Professional investors follow a similar strategy when trading
- Observe (what passes for) public opinion – the price of a company's shares are not based on actual value, but on perceived value
- The expectation of inflation (which the laws of economics cannot touch) can generate real inflation

Silent Cooperation

- Two strangers are asked to say "heads" or "tails" independently of each other
- If they give the same response, they get $1, else nothing
- 95% of participants said "heads"
- Choice of heads in real life (e.g. a football game) is closer to 60%

Majority Thinking They're in the Minority

- (Given to a white parent) Your daughter has asked if her black classmate could come over and play.

  a) My child should not play with black children

  b) My child can play with black children, but only in school

  c) Why not?

- only 70% said "c" (yes, quite alarming)
- When asked what they thought the majority picked, only 30% said "c" (!!)

Mutual Fate Control

- Classic social psychology experiment
- 2 participants (players) are kept in separate rooms without any communication possible
- Each has a box with two buttons, L and R. They are told to push a button when they hear a tone, then the results are announced
- Reward can be money, punishment was either an unpleasant sound, an electric shock (w00t!) or simply nothing

Mutual Fate Control

- The essence of the experiment is that the players send punishments and rewards to each other
- Pressing R gives the other player a reward, pressing L sends a punishment, but neither player knows this
- Will cooperation develop?
- While it's true that it makes no difference to a player if they send rewards or punishments, continually sending punishments while receiving rewards is an unlikely development

Thorndike's Law of Effect

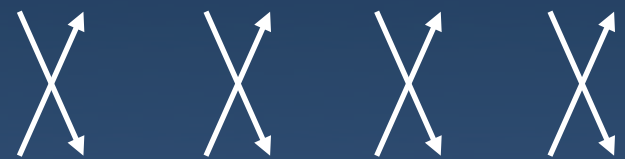
- Law of psychology
- "Of several responses made to the same situation, those which are accompanied or closely followed by satisfaction are more firmly connected with the situation… those which are accompanied or closely followed by discomfort… have their connections with the situation weakened"
- Do not abandon a winning strategy
- If it ain't broke, don't fix it!
- This will be on the test

Predictions

- Polarized law of effect
- Very similar to TFT – only difference is now we don't know when we're sending reward or punishment

Both Press R Initially

Player 1: R + R + R + R + …



Player 2: R + R + R + R + …

Both Press L Initially

Player 1: L - R + R + R + …

Player 2: L - R + R + R + …

Each Press a Different Button

Player 1: **L + L - R + R + …**

Player 2: **R - L - R + R + …**

- Thus, we predict cooperation will always develop by the 3rd round
- In reality, it's more like the 50th round!

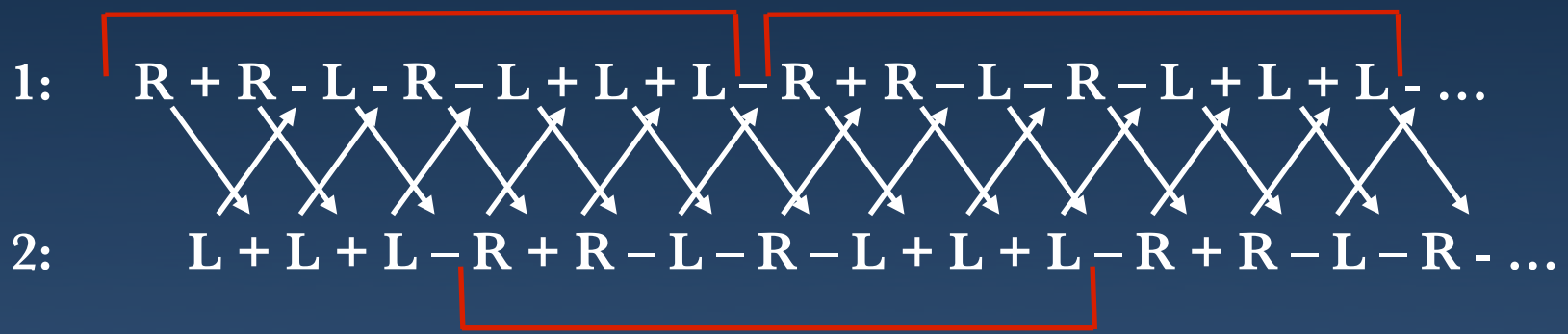
Experimental Evidence

- Mutually pressing R would only happen after mutually pressing L
- Is mutual mistreatment a precondition for mutual cooperation?
- Trust between gang members develops only after a violent fight
- Oscar Wilde observes that women who come to call each other "sister" do so only after they've called each other less pleasant things first

Asynchronous Decisions

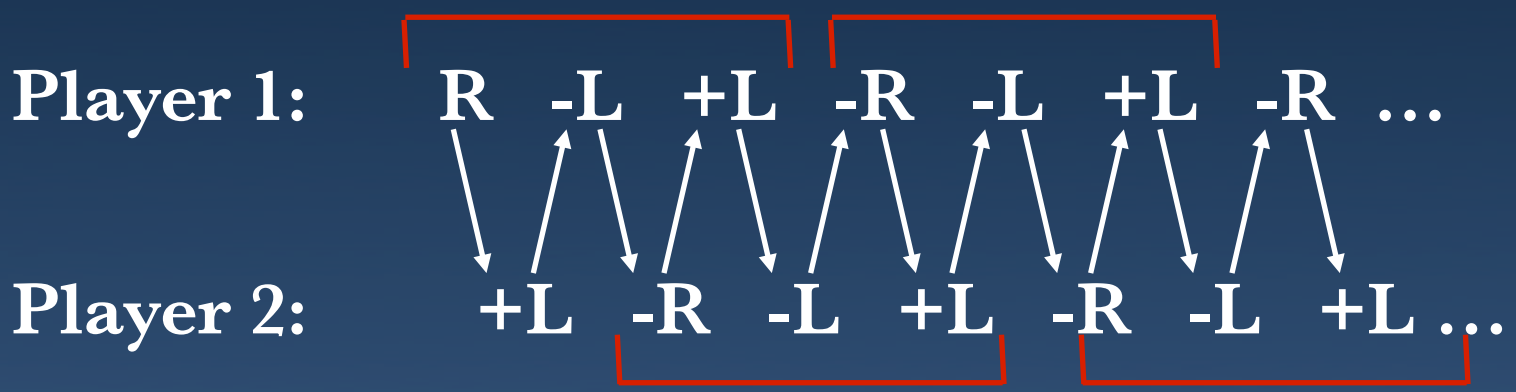
- What happens when we change the timing of the tones in the experiment?
- Since the players aren't aware of each other's existence, and no connection is ever made outside of their own control box, it shouldn't make a difference

Asynchronous #1



- Thus, the theory predicts the players will be rewarded 3 out of every 7 rounds
- Worse than random!

Asynchronous #2



- Rewarded 1 out of every 3 rounds – yikes!
- In prediction and in reality, mutual cooperation never results!

Bluffing

Bluffing

- A special form of lying or deception
- Bluffing is about behavior, not language
- Try to get opponent to draw erroneous conclusions
  - that the causes that would normally produce such behavior are really there
- No untrue statement is actually made
- CIA: white propaganda
- Essence is found in non-verbal behavior

Bluffing

- If you come to class unprepared, and look at me as if you read the reading for today, you're bluffing
- If you openly tell me you read the reading, you're lying
- The real difference is in how I react to each situation if I discover your deception
- If you were bluffing, next time I will challenge you and give you a chance to let me change my opinion of you
- If you were lying, I will label you as a liar and won't believe you again, even if you're telling the truth

Bluffing and the Categorical Imperative

- Lies should ethically be condemned under the categorical imperative
- If everyone lied continually, this would contradict the notion that statements have meaning, and that conclusions can be drawn from them
  - While it's true that lies often contain information from which true conclusions can be drawn, it's an unreliable strategy
- However, certain types of optimal mixed strategies necessitate the use of bluffing (!!)

Bluffing and Motivation

- Bluffers have different motivations than liars
- A liar aims to have others believe the lie, have things rearranged accordingly, and directly profit from it
- A bluffer sometimes wants the bluff called, for next time, she can gamble for high stakes
- One who bluffs for immediate gain is not much different from a liar and will suffer in the long run
- Bluffing is a long-term strategy – while a bluff can win, it's really only a happy side effect.
- THE CHIEF GOAL IS TO LEAVE DOUBT REGARDING FUTURE BLUFFS!!!

Poker

- It's terribly boring (but highly profitable) to play poker with people who never bluff
- Those who don't bluff can only lose
- Following the cards exclusively will allow opponents to see right through you
- Everybody has lucky and unlucky streaks, but long term results don't depend on luck-of-the-draw
- One doesn't lose much from a bad hand – the greatest loss is when you have a good hand, but an opponent has a better hand when you thought they were bluffing – because previous bluffs left doubt!

How much Should you Bluff?

- Like just about anything else – use in moderation
- Those who bluff too much invest too much in later profit, and lose in the long run
- Two ways to look at it – through the eyes of philosophy, or the eyes of game theory

A Simple Model

- Two players – I am the challenger, you are the challenged
  - Roles can be interchanged throughout play if desired
- I roll a d6 – if I roll a 6, I win, but if I roll anything else, you win
- Well, okay – it's not that simple

The Rules

- At the beginning of each round, I put $10 on the table, you put down $30
- I roll the die so you cannot see the result
- Having seen the result, I either fold or raise. If I fold, you win and take my $10. If I raise, I must add $50 to the table
- If I raise, you can either fold or call. If you fold, I get your $30. If you call, you must also put down $50 (me: $60, you: $80)
- If I raise and you call, I must reveal the die. If it's a six, I win your $80, if I bluffed, you win my $60

A Game about Bluffing

- If I never bluff, you will eventually always believe me – I would lose 5 x $10 for every 1 x $30 won
- If I bluff poorly (you see through me), it's even worse (for me) – if bluff succeeds, I win $30, if bluff fails, I lose $60
- If I bluff too much, you will eventually never fold – I would lose 5 x $60 for every 1 x $80 won
- Which position would you prefer?

The Strategy

- It's better to be me (really!)
- When I throw a six, I will raise. If not, I will raise at random with a probability of 1 in 9
- I will not simulate emotion, and remain expressionless – not explicitly falsifying any facts

Why 1 in 9?

- Balance sheet of a 54-round game using this strategy (makes the calculation easier)
- First, we calculate how much I am expected to win or lose if you accept or decline all challenges

You Call

- I am expected to roll a six 9 times in the 54 rounds
- If you accept all challenges, I will win $80 each time (9 x $80 = $720)
- In one-ninth of the remaining 45 rounds, I bluff (for a total of 5 times)
- You accept, and I lose $60 each time (5 x -$60 = -$-300)
- I fold first in the remaining 40 rounds (40 x -$10 = -$400)
- In the end, I profit $20 ($720 - $300 - $400)

You Fold

- My 9 sixes will yield me 9 x $30 = $270
- With the 5 bluffs, I wins 5 x $30 = $150
- I fold first in the remaining 40 rounds – (40 x -$10 = -$400)
- My balance at the end is $270 + $150 - $400 = $20
- Thus, provided I give you no additional information, long term profit is ensured!

Equilibrium Point

- If I bluff more often, you call more often, resulting in a deficit for me
- If I bluff less often, you won't risk the additional $50, and I wind up with a deficit again
- If I am satisfied with a $20 profit, you are essentially hosed.
- What should you do?

Your Strategy

- Accept every challenge with a probability of 4/9
- If I always raise, of the 9 sixes, I will win $80 for each of the 4 challenges you call, and $30 for each of the 5 folds (4 x $80 + 5 x $30 = $470)
- Of the remaining 45 rounds, I will win 25 x $30 = $750 (since you fold 5/9 of the time), and will lose 20 x $60 = $1200 (when you call my bluff). I wind up with $470 + $750 - $1200 = $20
- If I never raise, I will win $470 with my 9 sixes, and I will lose 45 x $10 = $450 in the remaining rounds, for a total of $20

Unbalanced!

- To make the game more just, change the raise amounts of each player from $50 to $40
- My strategy changes to bluff 1 in every 10 non-six rounds
- Your strategy changes to accept ½ of all challenges

Novice Poker Bluffers

- Player tries to create a false impression
- Manipulate appearance of confidence, overcompensates, bets too quickly.
- Players deliberate over a good hand
- Confidence speaks for itself
- **Insecurity breeds boastful behavior**

Test Review

Test Review

- Multiple Choice (10 x 3 points)
- Short Answer (4 x 5 points)
- 1-2 paragraph Short Essay (5 x 10 points)
- Covers material starting with the Dollar Auction

Sample Multiple Choice

	C	D
C	2, 2	3, 4
D	4, 3	1, 1

- What social dilemma does this payoff table represent?
  - Stag Hunt
  - Leader
  - Prisoner's Dilemma
  - Problem of Common Pastures

Leader

Leader	C	D
C	2, 2	3, 4
D	4, 3	1, 1

Sample Short Answer

In an iterated Prisoner's Dilemma game, a program that only chose the _____ strategy would utterly crush one that only chose the _____ strategy

Sample Short Answer

In an iterated Prisoner's Dilemma game, a program that only chose the __defect__ strategy would utterly crush one that only chose the __cooperate__ strategy

Sample Short Essay

Give an argument as to why civilization would collapse if, all of a sudden, everybody collectively stopped following the Golden Rule, whether consciously or unconsciously.

Advice

- I am NOT trying to trick you with questions. Trick questions are pointless and serve no purpose. Poorly worded questions can always appear to be tricky, but I try hard to avoid that.
- If the question includes a comparison or contrast between two things, be sure to address both of them in your answer—don't discuss one and assume I know about the other, because I can't assume that.

Advice

- Don't beg the question—that is, don't give as an answer a reworded version of the question. For example, if you're asked why such-and-such is true, don't answer that such-and-such is true (using different wording): say WHY.
- In most cases (other than multiple choice and true-false) use complete sentences, or at least complete phrases. On the other hand, if the question specifically asks you just to name three of something, listing those three will be good enough.

NO CLASS FRIDAY!

go see the EMPAC opening