

# CS540 Introduction to Artificial Intelligence

## Lecture 23

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Based on lecture slides by Jerry Zhu, Yingyu Liang, and Charles Dyer

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## Dark Knight Boat Game

Q1

- If the last digit of your ID is an odd number, you are on boat 1, otherwise, you are on boat 2.
- You have the detonator to the bomb on the other boat, and you are asked to vote whether to blow up the other boat. The Joker will blow up both boats if people on both boats voted no.
- A: You are on boat 1 and you vote yes to blow up boat 2.
- B: You are on boat 1 and you vote no.
- C: You are on boat 2 and you vote yes to blow up boat 1.
- D: You are on boat 2 and you vote no.

## Remind Me to Start Recording

→ A )

- Enter the last digit of your ID.
- Add the last digit of your ID to your Zoom name (for example, if your name is cat88 and the last two digits of your ID is 4, then change your name to cat88-4).

## Dark Knight Boat Game Again

Q2

- If the last digit of your ID is an odd number, you are on boat 1, otherwise, you are on boat 2. You will lose today's quiz points if your boat is blown up.
- You have the detonator to the bomb on the other boat, and you are ask to vote whether to blow up the other boat. The Joker will blow up both boats if people on both boats voted no.
- A: You are on boat 1 and you vote yes to blow up boat 2.
- B: You are on boat 1 and you vote no.
- C: You are on boat 2 and you vote yes to blow up boat 1.
- D: You are on boat 2 and you vote no.

## Split or Steal Game

- Watch the video and guess the outcome of the game (the action of the person on the left, the action of the person on the right).
- A: (Steal, Steal)
- B: (Steal, Split)
- C: (Split, Steal)
- D: (Split, Split)

# Prisoner's Dilemma

- The general form of a PD game is (C stands for Cooperate (Deny) and D stands for Defect (Confess):

—	C	D
C	$(x, x)$	$(0, y)$
D	$(y, 0)$	$(1, 1)$

- The game is PD is  $y > x > 1$ .

$(C, C)$

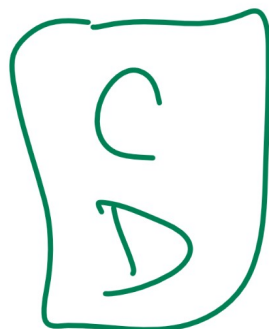
dominant  
strategies, NE

## Prisoner's Dilemma Example

Q8, 9, 10

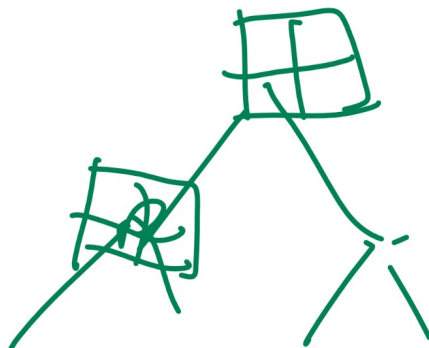
- We will repeat this 3 times. If the last digit of your ID is an odd number, you are the row player, otherwise, you are the column player. Choose C for Cooperate, D for Defect:

—	C	D
C	(2, 2)	(0, 3)
D	(3, 0)	(1, 1)





## Repeated Games



- Repeated games are sequential games with simultaneous move stages (rounds).
- The stage games do not need to be the same.
- A solution of a repeated game (also called Subgame Perfect Equilibrium) does not require the actions to form a Nash equilibrium in each stage.



# Repeated Prisoner's Dilemma Example 1

- Stage 1 (C for Cooperate, D for Defect):

-	C	D
C	(2, 2)	(0, 3)
D	(3, 0)	(1, 1)

- Stage 2 (N for Nice, M for Mean):

-	N	M
N	(3, 3)	(0, 0)
M	(0, 0)	(1, 1)

CGC

PD

combined game

$\delta = 1$

Solution  
NE

(C, C) → (2, 2)  
otherwise → (3, 0)

(N, N) → (3, 3)  
(M, M) → (1, 1)

# Repeated Prisoner's Dilemma Example 2

- Stage 1 (C for Cooperate, D for Defect):

—	C	D
C	(2, 2)	(0, 3)
D	(3, 0)	(1, 1)

- Stage 2 (C for Cooperate, D for Defect):

—	C	D
C	(2, 2)	(0, 3)
D	(3, 0)	(1, 1)

PD x 2

(C, C)  
otherwise

~~(C, C)~~

(D, D)

?  
not NE

## Infinite Repeated Prisoner's Dilemma

- If there are infinite number of stages, there are trigger strategies that can be solutions given sufficiently large discount factors.
- For example, (D, D) if any player played D in the previous stages and (C, C) otherwise is an SPE if the discount factor  $\delta$  satisfy:

$$\frac{x}{1-\delta} \geq y + \frac{\delta}{1-\delta}$$
$$\delta \geq \frac{y-x}{y-1}$$

# Infinite Repeated Prisoner's Dilemma Derivation

—	C	D
C	$(x, x)$	$(0, y)$
D	$(y, 0)$	$(1, 1)$

# Coordination Games

- Coordination games:

- ① Battle of Sexes.

- ② Stag Hunt (same as the exam question posting game).

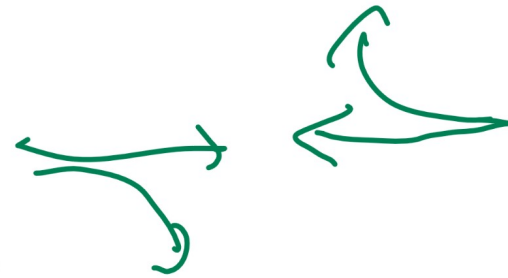
- ③ Matching Penny (dis-coordination game).

- Anti-Coordination Games

- ① Game of Chicken.

- ② Highway (crowding game).

- ③ El Farol Bar (same as the vaccination and pollution game on the exam).



# El Farol Bar Game

Q11

- If less than 60 percent of you go to the El Farol Bar, bar is more fun.
- If more than 60 percent of you go to the bar, staying home is more fun.

→ • A: stay home.

→ • B: go to the bar.

40%,  
60%

# Coordination Mechanisms

• Ways to coordinate:

① Mixed strategy.



② Repeated games.



③ Focal point.



④ Communication.

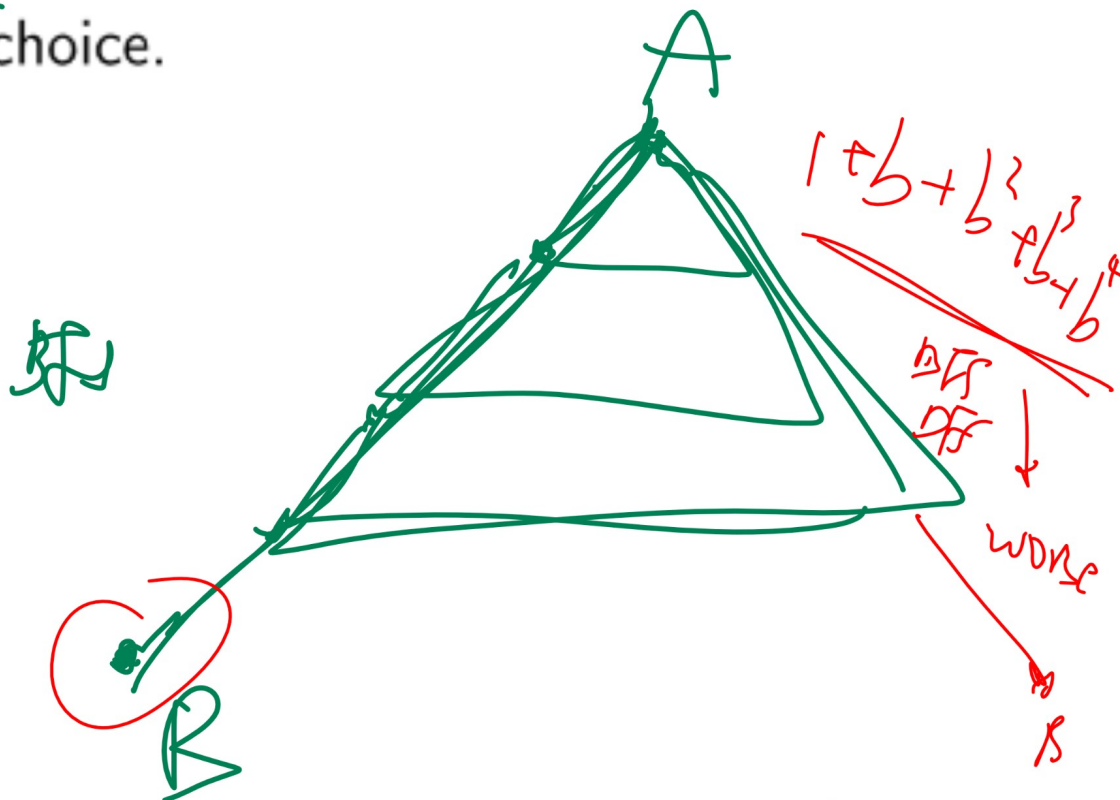




# Coordination Focal Point Example

Q13

- Do not discuss in the chat.
- Select the most popular choice.
- A: A
- B: B
- C: C
- D: D?
- E: E



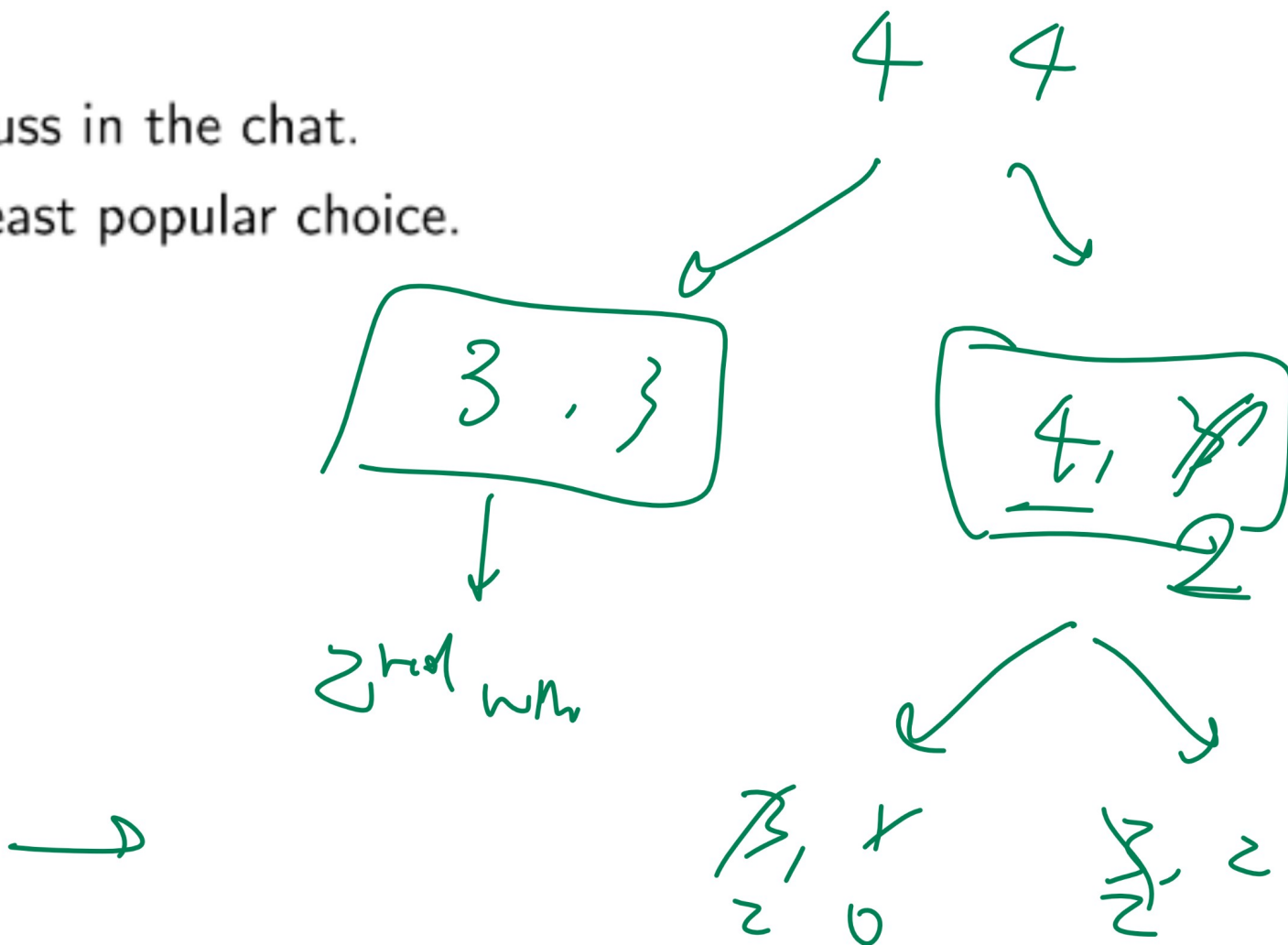
$$1 + b + b^2 + b^3 + 1$$

$$DTS \rightarrow 4$$

# Anti-Coordination Focal Point Example

Q14

- Do not discuss in the chat.
- Select the least popular choice.
- A: A
- B: B
- C: C
- D: D?
- E: E



## Crime Reporting

- Crime reporting:  $n$  witnesses of a crime, if one or more witnesses call the police, all of them will get a benefit  $b$ , the witnesses who called incur a cost of  $c$ .
- A: ask me to tell you another question on the exam, cost you 4 points on the exam.
- B: not ask me.

# Donation Game

- Final Exam Part 2 Question 14.
- You can discuss here.
- In the last two years, slightly less than a half of the students donated.