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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ID

- Enter the last two digits of your campus ID (or you can use two random digits too).
- Write this number down somewhere.

Exam

- Make-up Exam time, select one of the following:
- A : I can make the exam on August 22 Monday.
- B : I prefer a make-up exam on August 24 Wednesday.
- C : I prefer a make-up exam on August 26 Friday.

Exam Content

- $X7$ is posted, I will go through the questions this Wednesday.
- We will play games this lecture to earn the last quiz point $Q12$ (multiple chances, but you can only earn 1 point).
- Please share solutions to $X4$ and $X5$ to earn more points for $D11$ and $D12$.

Dark Knight Boat Game

- 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 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.

Dark Knight Boat Game Again

- If the last digit of your ID is an odd number, you are on boat 1, otherwise, you are on boat 2. You will earn 1 point for $Q12$ if you survive.
- 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 $y > x > 1$.

Prisoner's Dilemma Example

- We will repeat this 3 times. If the last digit of your ID is an odd number, you are the row player (choose A or B), otherwise, you are the column player (choose C or D). The group that gets a higher total value will earn 1 point for $Q12$.

–	C	D
A	$(2, 2)$	$(0, 3)$
B	$(3, 0)$	$(1, 1)$

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	$(0,0)$	$(1,1)$

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	$(3,0)$	$(1,1)$

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 δ satisfy:

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

$$\delta \geqslant \frac{y-x}{y-1}$$

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 $X5$).

Game of Chicken

- If the last digit of your ID is an odd number, you are on car 1, otherwise, you are on car 2.
- Two cars heading towards each other on a single lane, if both keep going or both yield, there will be a crash; otherwise, both cars are safe.
- A : You are on car 1, keep going.
- B : You are on car 1, yield.
- C : You are on car 2, keep going.
- D : You are on car 2, yield.

Game of Chicken

- Traffic lights are coordination devices.
- An equilibrium that relies on a random coordination devices (called signal) is called a correlated equilibrium.

El Farol Bar Game

- 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.
- You can earn 1 point for $Q12$ if you go to the place that is more fun.
- A : stay home.
- B : go to the bar.

Highway, Vaccination, and Pollution

- Questions see $X7$.

Coordination Mechanisms

- Ways to coordinate:

1. Mixed strategy.
2. Repeated games.
3. Focal point.
4. Communication.

Coordination Focal Point Example

- Select the most popular choice.
- A : A
- B : B
- C : **C**
- D : D
- E : E

Anti-Coordination Focal Point Example

- Select the least popular choice.
- A : A
- B : B
- C : **C**
- D : D
- E : E

Crime Reporting

- On March 13, 1964, Kitty Genovese was stabbed outside the apartment building. There are 38 witnesses, and no one reported. Suppose the benefit of reported crime is 1 and the cost of reporting is $c < 1$.
- Suppose every witness uses the same mixed strategy of not reporting with probability p and reporting with probability $1 - p$. Then the mixed strategy Nash equilibrium is characterized by the following expression.

$$p^{37} \cdot 0 + \left(1 - p^{37}\right) \cdot 1 = 1 - c \Rightarrow p = c^{\frac{1}{37}}$$

Donation Game

- $Q29$ on the exam: You will receive 4 points for this question and you can choose to donate x points (a number between 0 and 4). Your final grade for this question is the points you keep plus twice the average donation (sum of the donations from everyone in your section divided by the number of people in your section, combining both versions). Enter the points you want to donate (an integer between 0 and 4).

Generative Adversarial Network

- Generative Adversarial Network (GAN):

1. Generative part: input random noise and output fake images.
2. Discriminative part: input real and fake images and output labels real or fake.
3. The two parts compete with each other.