

Cooperation 2

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Meanwhile in sunny Milton Keynes ...



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Recap from Tuesday

Cooperation

- between humans

- between humans and AI

- (between AI & AI?)

Reputation

Game theory

- cooperation versus defection



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Prisoner's Dilemma

| | | Bonny | |
|--------|----------------------|--------|-----------------------|
| | | Defect | Cooperate with Adrian |
| Adrian | Defect | 3 3 | 1 10 |
| | Cooperate with Bonny | 10 1 | 2 2 |

Nash Equilibrium

For a profile of actions to be a Nash equilibrium then no player can profitably deviate, given the actions of the other players

The rule of no regrets

A game of chicken

- Two players drive towards each other from opposite ends of a road
- The goal is to be the last one to swerve
- If one player swerves, they are considered a "chicken"
- If neither player swerves, they crash into each other



Hawk/Dove



- In the Hawk/Dove game, two players compete over a limited resource.
- If they are doves then they split the resource.
- Competing is expensive, it takes energy and may not be successful.
- If they both compete then the energy spent matches any gain in resource.
- If one competes and the other is a dove then there is a large payoff for the competitor and a small payoff for the dove.



Hawk Dove payoff matrix

| | | Dana | |
|-------|------|------|------|
| | | Dove | Hawk |
| Colin | Dove | 3 3 | 1 4 |
| | Hawk | 4 1 | 0 0 |

Hawk Dove Equilibria

| | | Dana | |
|-------|------|------|------|
| | | Dove | Hawk |
| Colin | Dove | 3 3 | 1 4 |
| | Hawk | 4 1 | 0 0 |

Stag Hunt


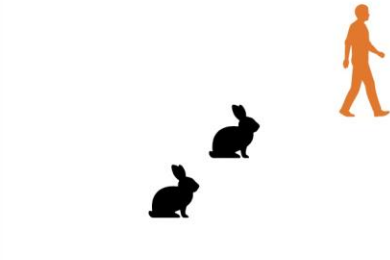
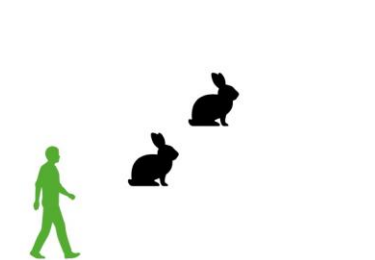
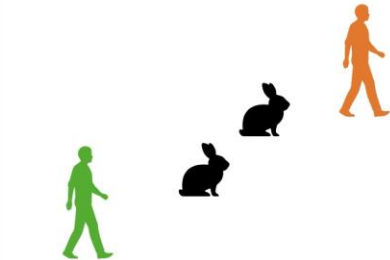


Two hunters go out to catch dinner.

- There are two rabbits in the range and one stag.
- The hunters can each bring the equipment necessary to catch only one type of prey.
- The stag has more meat than the two rabbits combined, but both hunters must chase the stag to catch it.
- A rabbit hunter can catch all the prey by themselves.



Stag Hunt Pay off Matrix

| | | Sian | |
|------|-------------------|---|--|
| | | Cooperate Stag | Defect Rabbit |
| Jean | Cooperate Stag |  |  |
| | Defect Rabbit |  |  |

| | | Sian | |
|------|-------------------|-------------------|------------------|
| | | Cooperate Stag | Defect Rabbit |
| Jean | Cooperate Stag | 3, 3 | 0, 2 |
| | Defect Rabbit | 2, 0 | 1, 1 |

What would you do?

| | | | |
|------|-------------------|-------------------|------------------|
| | | Sian | |
| | | Cooperate Stag | Defect Rabbit |
| Jean | Cooperate Stag | 3, 3 | 0, 2 |
| | Defect Rabbit | 2, 0 | 1, 1 |

Exercise

- In the future Autonomous vehicles (AV's) will be expected to maximally protect pedestrians — stopping immediately and with high reliability if there is a danger of collision.
- However, if AVs stop every time a pedestrian obstructs them, then pedestrians will learn that they can always take priority, and the AV will make little or no progress.
- Model this situation with game theory and derive the Nash Equilibrium.
- Propose a solution that will permit AVs to make progress while also providing enhanced pedestrian protection.

The battle of the sexes

Two people are dating. They like to be with each other.

They can decide how to spend their time.

- A likes gaming, hates dancing.
- B likes dancing, hates gaming.
- How can this relationship survive?



Iterated Prisoner's Dilemma



Iterated Prisoner's Dilemma

- In some situations, the same two individuals may meet repeatedly.
- If there is memory for the previous interactions then the situation becomes an iterated prisoner's dilemma.
- Players have the opportunity to apply a strategy that is conditioned on memory.

A strategy is a decision rule that specifies the probability of cooperation or defection as a function of memory.



Robots in LA ...



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Thank you.



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