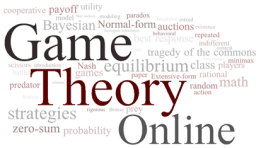


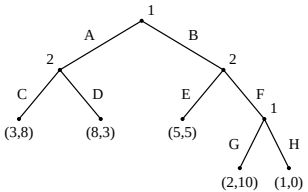
Mixed and Behavioral Strategies

Game Theory Course:
Jackson, Leyton-Brown & Shoham

Randomized Strategies

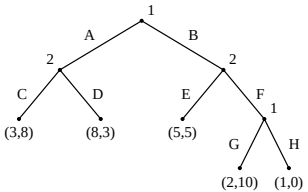
- There are two meaningfully different kinds of randomized strategies in imperfect information extensive form games
  - mixed strategies
  - behavioral strategies
- Mixed strategy: randomize over pure strategies
- Behavioral strategy: independent coin toss every time an information set is encountered

Randomized strategies example



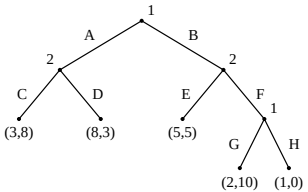
- Example of a behavioral strategy:
  - A with probability $.5$ and G with probability $.3$

Randomized strategies example



- Example of a behavioral strategy:
  - A with probability $.5$ and G with probability $.3$
- Example of a mixed strategy that is not a behavioral strategy:
  - $(.6(A, G), .4(B, H))$ (why not?)

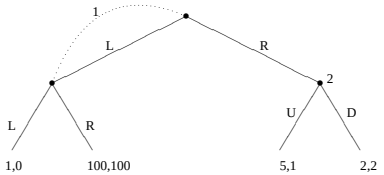
Randomized strategies example



- Example of a behavioral strategy:
  - A with probability $.5$ and G with probability $.3$
- Example of a mixed strategy that is not a behavioral strategy:
  - $(.6(A, G), .4(B, H))$ (why not?)
- In this game every behavioral strategy corresponds to a mixed strategy...

Games of imperfect recall

Imagine that player 1 sends two proxies to the game with the same strategies. When one arrives, he doesn't know if the other has arrived before him, or if he's the first one.



- What is the space of pure strategies in this game?

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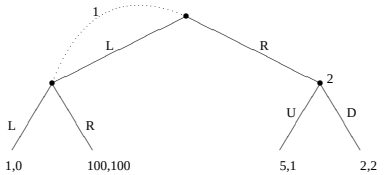

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  - 1: (L, R); 2: (U, D)

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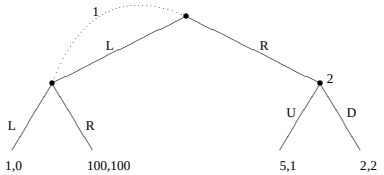

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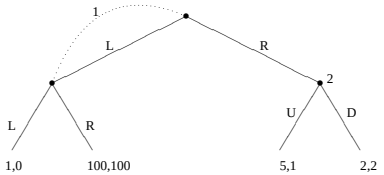
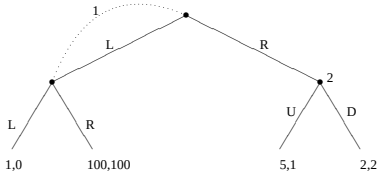


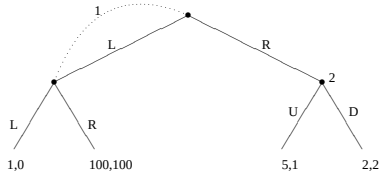
- What is the space of pure strategies in this game?
  - 1: (L, R); 2: (U, D)
- What is the mixed strategy equilibrium?
  - Observe that D is dominant for 2. R, D is better for 1 than L, D, so R, D is an equilibrium.

Games of imperfect recall



- What is an equilibrium in behavioral strategies?

Games of imperfect recall



- What is an equilibrium in behavioral strategies?
  - again, D strongly dominant for 2
  - if I uses the behavioural strategy $(p, 1-p)$, his expected utility is $p2 + 100p(1-p) + 2(1-p)$
  - simplifies to $-99p^2 + 98p + 2$
  - maximum at $p = 98/198$
  - thus equilibrium is $(98/198, 100/198), (0, 1)$
- Thus, we can have equilibria in behavioral strategies that are different from equilibria in mixed strategies.