

# Extensive-Form Games

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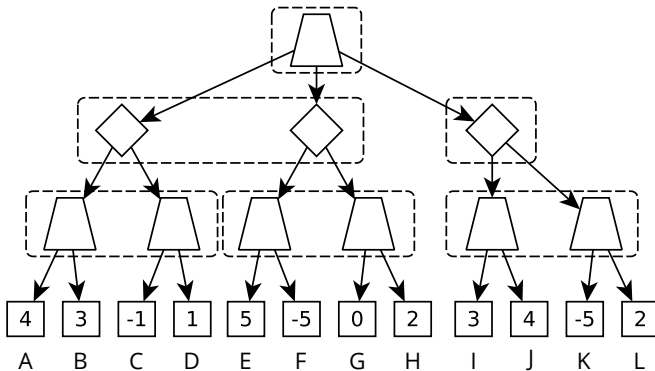
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Previously ... on multi-agent systems (tutorials and lectures).

- 1 Different representations:
  - Normal-Form Games (game matrixes)
  - Extensive-Form Games (game trees)
- 2 Algorithms for computing different solution concepts:
  - Nash equilibrium
  - Correlated equilibrium
  - Stackelberg equilibrium

Task 1: Consider following game. Write down a normal-form representation it.



Task 2: Formulate the following game of a small “poker” as an EFG.

- there is an ante of \$1
- there is a limited deck of cards  $\{J, J, Q, Q\}$
- each player receives a card
- player 1 either folds or bets \$2
- player 2 either calls or folds
- player with the higher card wins

Task 3: Write down a linear program for computing Nash equilibrium for player (I) for following zero-sum game:

	<b>L</b>	<b>M</b>	<b>R</b>
<b>U</b>	1	4	6
<b>D</b>	3	2	5

Task 4. Write down LP for player (II).

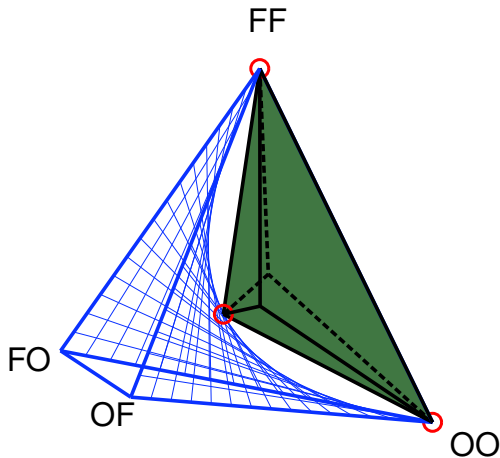
Task 5: Consider the game of chicken. Find a CE that is not a NE. Show that it is indeed not a NE.

	<b>Dare</b>	<b>Chicken</b>
<b>Dare</b>	0,0	7,2
<b>Chicken</b>	2,7	6,6

Task 6: Find another game which has CE that is not a convex combination of NE.

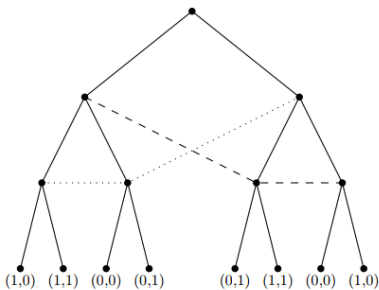
Task 7: Prove or disprove that all convex combinations of (two) NE are CE.

Geometry of NE and CE <sup>1</sup> for the game battle of sexes:



<sup>1</sup>From <https://www.cs.cmu.edu/~ggordon/CE/>

Optional Task 8: Consider following game. Write down a normal-form representation it.





Optional homework:

Write down EFG representation of Kuhn poker (see wikipedia for rules).

Don't look at the picture there, only to verify your solution.

Optional homework:

Implement linear program for computing Nash equilibrium for player (I) and (II) for the previously mentioned zero-sum game:

	<b>L</b>	<b>M</b>	<b>R</b>
<b>U</b>	1	4	6
<b>D</b>	3	2	5