CSC304 Lecture 21
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REVIEW
(Of most concepts)
Part I: Game Theory

• Normal (matrix) form games

• Strategies: pure & mixed

• Weak/strict dominance
  ➢ Strategy A dominates strategy B
  ➢ Iterated elimination of dominated strategy
  ➢ Strategy A is dominant

• Nash equilibrium: pure and mixed
  ➢ Nash’s theorem
Part I: Game Theory

• Price of anarchy and stability
  ➢ Anarchy: Worst NE vs social optimum
  ➢ Stability: Best NE vs social optimum
  ➢ PoA ≥ PoS ≥ 1

• Potential functions
  ➢ Cost-sharing games
  ➢ Braess’ paradox

• Zero-sum games
  ➢ The minimax theorem

• Stackelberg games, Stackelberg equilibrium
Part II: Mech Design w/ Money

• Goals: social welfare or revenue

• Incentive guarantees:
  ➢ Dominant strategy incentive compatibility (DSIC)
  ➢ Bayes-Nash incentive compatibility (BNIC)

• VCG mechanism
  ➢ DSIC + maximizes social welfare on every instance
  ➢ Sponsored search, comparison to GSP

• Myerson’s auction
  ➢ BNIC + maximizes expected revenue among all BNIC mechanisms
Part II: Mech Design w/ Money

• Revelation principle
• Revenue equivalence principle
• 1\textsuperscript{st} price auction and its equilibrium
• Ascending auction
Part III: Mech Design w/o Money

• Facility location
• Social cost
  ➢ The median mechanism
• Maximum cost
  ➢ The left-right-middle mechanism

• Stable matching
  ➢ Gale-Shapley deferred acceptance algorithm
Part IV: Voting

- Ranked voting
- Voting rules
- Gibbard-Satterthwaite theorem
- Axiomatic approach to voting
  - Strategyproofness
  - Strong / weak monotonicity
  - Consistency
  - Condorcet consistency
- Impartial selection
Part V: Fair Division

• Cake-cutting
  ➢ Proportionality and envy-freeness
  ➢ Robertson-Webb model

• 2-players
  ➢ Cut-and-choose

• 3+ players proportional
  ➢ Dubins-Spanier protocol
  ➢ Even-Paz protocol

• Pareto optimality

• Strategyproofness via perfect partition
Part V: Fair Division

• Indivisible goods
  ➢ Envy-freeness up to one good
  ➢ Maximum Nash Welfare allocation

• Computational resource allocation
  ➢ Dominant Resource Fairness (DRF)

• Classroom allocation
  ➢ The leximin mechanism

• Rent division
  ➢ Utilitarian allocation