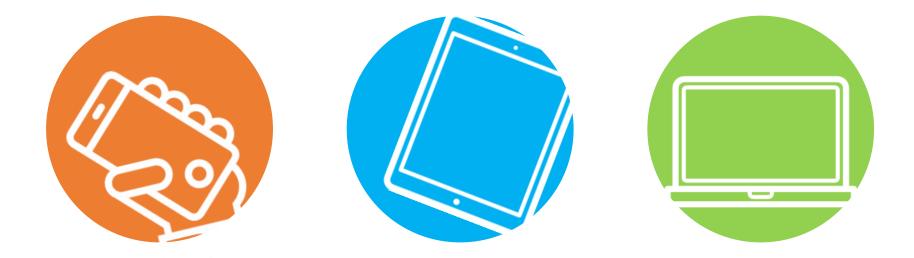# CSC304 Lecture 21

# Complete your course evaluations…



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# REVIEW
## (Of most concepts)

# Part I: Game Theory

- Normal (matrix) form games

- Strategies: pure & mixed

- Weak/strict dominance
  - ➤ Strategy A domi**nates** strategy B
  - ➤ Iterated elimination of domi**nated** strategy
  - ➤ Strategy A is domi**nant**

- 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 $\geq$ PoS $\geq$ 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$^{st}$ 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