

CS 396: Online Markets

Course Review

Week 0: Allocating a Resource

Lecture 1: ride sharing, first-price auction, ascending-price auction, second-price auction.

- ride sharing problem
 - algorithms, online algorithms, mechanisms
 - first price auction
 - ascending auction
 - second price auction
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Week 1: Game Theory

Lecture 2: Bimatrix Games, Nash Equilibrium, Dominant Strategy Equilibrium

- game theory
- bimatrix games
- Nash equilibrium
- dominant strategy equilibrium

Lecture 3: Dominant-strategy, Nash, Bayes-Nash equilibria; first-price, second-price auctions, revisited

- auction theory
 - second-price auction
 - first-price auction
 - complete information analysis (Nash equilibrium)
 - incomplete information analysis (Bayes-Nash equilibrium)
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Weeks 2: Online Learning

Lecture 4: online learning, exponential weights.

- online learning
- best in hindsight
- regret
- exponential weights
- learning rates

Lecture 5: Multi-armed Bandit Learning

- multi-armed bandit learning
 - reduction to online learning
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Weeks 3: Learning and Game Theory

Lecture 6: learning in games, coarse correlated equilibria

- equilibrium of no-regret learning
- coarse correlated equilibrium
- online bidding as online learning

Lecture 7: Learning to bid, discretization, full feedback, partial feedback

- discretization
 - learning to bid
 - full feedback
 - partial feedback
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Week 4: Welfare and Revenue

Lecture 8: Welfare analysis in equilibrium, conversion ratio, individual efficiency.

- welfare
- analysis of equilibrium welfare
- conversion ratio
- welfare in Nash (deterministic bids)

Lecture 9: Randomized welfare analysis, second-price with reserve

- welfare in coarse correlated equilibrium (randomized bids)
 - revenue of auctions
 - optimal pricing
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Week 5: Optimal Auctions

Lecture 10: pricing revenue, virtual values, optimal reserves

- optimal pricings
- revenue of pricing
- virtual values and virtual welfare
- optimal reserves

Lecture 11: revelation principle, optimal auctions, virtual welfare maximization

- revenue of auctions
 - truthfulness and the revelation principle
 - optimization of truthful auctions
 - optimal first-price auctions.
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Week 6: Learning Auctions and Econometrics

Lecture 12: optimal auctions (review), learning to price, learning to auction

- optimization of truthful auctions (cont).
- learning to price.
- learning to auction.

Lecture 13: inferring values, inference for learning bidders.

- value inference (econometrics)
 - inference for learning bidders
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Week 7: Online Allocation

Lecture 14: online allocation, backwards induction, “the eBay problem” (prophet inequalities)

- online allocation
- backwards induction
- “the eBay problem” (prophet inequality)

Lecture 15: secretary problem, ski renter.

- secretary problem
 - ski renter
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Weeks 8: Matching Markets

Lecture DP1: Differential Privacy 1 (guest lecture)

- not private: de-identified data, summary statistics
- private: statistics with noise added
- (ϵ, δ) -differential privacy

- Laplace noise, Gaussian noise

Lecture DP2: Differential Privacy 2 (guest lecture)

- exponential mechanism
 - Exponential mechanism = exponential weights
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Week 9: Matching Markets

Lecture 16: Offline matching, matching algorithms, externality pricing mechanism

- matching markets
- maximum weight matching
- market clearing
- duality

Lecture 17: Duality, online matching, greedy online matching.

- ascending price mechanism
- externality pricing mechanism
(a.k.a, Vickrey-Clarke-Groves, VCG)
- online matching