The material in lectures 1 (game theory) through 8 (mechanism design II) will be tested in the first midterm. Neither algorithmic mechanism design no ad markets (10/9-10/16) will be tested on midterm 1.

The midterm should not be an exercise in memorization, and we will provide relevant formulas for things that are not marked as “things to know well.” The questions on the midterm should generally be more straightforward than those in homeworks. The example midterm is longer than you should expect, and these kinds of example questions will be mixed with shorter questions. The midterm will be closed book (and calculators not allowed).

The numbers below refer to chapters. Where proofs are not explicitly mentioned as out of scope, I suggest that you try to understand the high level idea (but you would not be expected to recreate a full proof).

**Things to know well.** You could sit down and work out things related to these concepts without hints.

- #2: preference orderings, utility functions, Normal form, Pareto optimality, DSE, Nash equilibria, support of a strategy, best-response analysis, correlated equilibria.
- #3: different motivations for algorithmic game theory, maximin and minimax strategies, algorithm for finding pure Nash eq., iterated elimination, idea for why mixed-strategy NE harder to find, the support enumeration method.
- #4: extensive-form games, subgame perfect equilibrium, single-deviation principle, backwards induction, repeated games, open loop strategies, discounting, idea of an automaton strategy.
- #5: connection between peer-to-peer and game theory, free-riding, design innovations in BitTorrent vs earlier systems, design of BitTorrent reference client.
- #6: different auction designs, allocative efficiency, quasi-linear utility, defn of DSE, analysis of SPSB auction (thm 6.1), IPV environment, defn of Bayes Nash equil., FPSB (thm 6.2, incl. BNE analysis for uniform distr.), idea of interim allocation and payment, statement (not proof) of revenue equivalence (Thm 6.4, Corr. 6.1), motivations for eBay auction design.
- #7: direct revelation mechanisms, strategy-proofness, idea of “implementation,” different possible design objectives, VCG mechanism and its applications (as illustrated throughout sec 7.2), idea of a single-parameter domain and its applications (as illustrated throughout sec 7.3).
Things to be familiar with.  If we wanted you to do anything especially technical we’d give some hints.

- #2: succinct representations (agent-graph, action-graph, congestion game)
- #3: LP formulation for finding a NE in a zero-sum game, LFP for NashSupport, LP for finding a correlated equilibrium, the class PPAD and approaches to showing a problem is in PPAD and PPAD-hard, the PPAD graph for Nash, the idea of reduction via game gadgets.
- #4: ideas of proofs of single-deviation principle (Thm 4.1), existence (Thm 4.2), uniqueness (Thm 4.4), open-loop Nash (Thm 4.7), Nash threat folk thm (Thm 4.8), and application (Thm 4.9).
- #5: main ideas (but not all specifics) of different attacks on BitTorrent.
- #6: analysis of interim allocation and payment on examples (e.g., Example 6.7), statement but not proof of characterization of interim quantities in BNE (Thm 6.3), idea of different ascending and descending designs (sec 6.6), eBay auction design, eBay vs Amazon closing rules (sec 6.7.3).
- #7: revelation principle including proof idea, argument for why VCG is SP and efficient (first part of thm 7.2 proof), working with strategy-proof mechanisms for single-parameter domains (summarization, monotonicity, payment identity, critical value, Thm 7.4 but not proof, Thm 7.5), idea of taxation principle and intuition for proof (Thm 7.6), deficit in VCG and proof argument for no-deficit (Thm 7.3).

Advanced topics – Out of scope for midterm

- #3: Section 3.5 potential games
- #4: critiques of SPNE, generalizations of extensive form (sec 4.3.2), Nash eq analysis of Grim Trigger (Thm 4.5), section 4.6 (‘bounded rationality’)
- #5: details on Napster and Gnutella; section 5.5 discussion
- #6: using characterization to find a BNE (section 6.5), interdependent and common value models (sec 6.1.2), proof of thm 6.3, idea of strategic equiv. (defn 6.10), learning from seller experiments (6.7.4), trend away from auctions (sec 6.7.5), ticketmaster (6.7.6).
- #7: proof VCG is IR (second half of Thm 7.3), proof of Thm 7.4, section 7.5 on Bayesian Implementation, Section 7.6 on Impossibility results, Tables 7.1 and 7.2.