

# Midterm Exam

---

- ▶ Time
  - ▶ In class (??am, 60 mins) on May. 5 (Thu)
- ▶ Location
  - ▶ Online: Blackboard + Take home 12 hours (released at noon, due midnight)
- ▶ Format
  - ▶ Open-book
  - ▶ 20 multiple-choices (online) + 5 problems (take-home)
- ▶ Grade
  - ▶ 25% of the total grade
  
- ▶ F2018 midterm exam paper is available at:
  - ▶ Blackboard menu → Previous Exams → Fall 2018 Midterm Exam





# Midterm Review



# Disclaimer

---

- ▶ Topics covered in this review may not appear in the exam.
- ▶ Topics not covered in this review may appear in the exam.



# Search

---

- ▶ Definitions
  - ▶ State space, successor function, start/goal states
  - ▶ Completeness, optimality
- ▶ Tree search
  - ▶ Uninformed Search
    - ▶ DFS, BFS, UCS
  - ▶ Informed Search
    - ▶ Heuristic, admissible heuristic
    - ▶ Greedy, A\*
- ▶ Graph Search
  - ▶ A\* with consistent heuristic



# Constraint Satisfaction Problems

---

- ▶ CSP
  - ▶ Find an assignment to a set of variables that satisfies a set of constraints
- ▶ Basic solution: backtracking search
- ▶ Speed-ups:
  - ▶ Filtering
    - ▶ Forward Checking, Arc Consistency
  - ▶ Ordering
    - ▶ Minimum Remaining Values, Least Constraining Value
  - ▶ Structure
    - ▶ Tree structured, Cutset conditioning
- ▶ Iterative min-conflicts (local search) is often effective in practice



# Adversarial Search

---

- ▶ Adversarial Search
  - ▶ Game tree, Minimax
- ▶ Resource Limits
  - ▶ Depth-limited search
  - ▶ Limiting branching factor
- ▶ Game Tree Pruning (alpha-beta pruning)
  - ▶  $\alpha$ : MAX's best option on path to root; prune if value of MIN  $\leq \alpha$
  - ▶  $\beta$ : MIN's best option on path to root; prune if value of MAX  $\geq \beta$
- ▶ Uncertain Outcomes
  - ▶ Expectimax



# Propositional logic

---

- ▶ Representation
  - ▶ Syntax
    - ▶ Proposition symbols, their compositions using connectives
  - ▶ Semantics
    - ▶ Each model specifies true/false for each proposition symbol
    - ▶ Rules for evaluating truth with connectives
- ▶ Inference
  - ▶ Resolution (for Conjunctive Normal Form)
- ▶ Concepts
  - ▶ Validity, satisfiability, entailment, proof, soundness, completeness, etc.



# Propositional logic - Horn logic

---

- ▶ Representation

- ▶  $P1 \wedge P2 \wedge P3 \dots \wedge Pn \rightarrow Q$

- ▶ Inference

- ▶ Modus Ponens

- ▶ Forward chaining

- ▶ Backward chaining





# First-order logic

---

- ▶ Syntax
  - ▶ Constant, predicate, function, variable, connective, quantifier (universal, existential), equality
- ▶ Semantics
  - ▶ A model contains: objects, relations, interpretation
- ▶ Inference
  - ▶ Propositionalization (universal/existential instantiation)
  - ▶ Unification
  - ▶ Forward/backward chaining
  - ▶ Resolution



# Bayesian networks

---

- ▶ Syntax
  - ▶ DAG + CPTs
- ▶ Semantics
  - ▶ Global semantics
  - ▶ Conditional independence semantics, Markov blanket
  - ▶ D-separation
- ▶ Markov networks
  - ▶ Undirected graph + potentials
  - ▶ Semantics



# Bayesian networks: Inference

---

- ▶ Exact inference
  - ▶ Inference by enumeration
  - ▶ Variable elimination
    - ▶ Interleave join (pointwise product) and elimination (summing out)
  - ▶ Efficient inference on polytrees
- ▶ Approximation inference
  - ▶ Prior Sampling
  - ▶ Rejection Sampling
  - ▶ Likelihood Weighting
  - ▶ Gibbs Sampling





*Good Luck!*

