Last update: December 11, 2008

Review for the Final Exam

CMSC 421: Final Review

Final Exam Date

According to the university exam schedule,
the final exam is on Saturday Dec 20, 10:30-12:30, in our usual classroom

Two commencement ceremonies come soon after this:

- ♢ university commencement, Dec 20 in the evening
- ♢ college commencement ceremonies, Dec 21.

- ♢ There's nothing I can do about it (I've tried)

Format and Content

- ♢ Open book, open notes
- ♢ No electronic devices
- ♢ We've covered the following chapters/sections:
  ~~1, 2~~, 3–9, (11–12) from my lecture slides rather than the book, 13, 14.1–14.5, 16, 17.1–17.3, 17.6, 18.1–18.3, 20.5, 22, 24, ~~25~~ and Common Lisp
- ♢ I won't ask you questions about Chapters 1, 2, 25
- ♢ I won't ask much (if anything) about Chapters 22, 24
- ♢ Chapters 1–6 and 17.6 were already on the midterm exam
- ♢ The final exam may include them, but will emphasize the other chapters
- ♢ Several other chapters and/or sections that you won't need to know; I'll let you know later which ones

Chapter 3: Search

♢ Problem types: deterministic/nondeterministic, fully/partially observable
    example: vacuum world

♢ Tree-search algorithms
    Breadth-first search
    Uniform-cost search
    Depth-first search
    Depth-limited search, iterative deepening

♢ tree search versus graph search

Common Lisp

- lists, atoms, list notation, dot notation
- defining your own Lisp functions
- built-in Lisp operators (functions, predicates, special forms, macros)
- loops and recursion
- functions as arguments
- sequences (lists, vectors, strings)
- destructive operators (e.g., `setf`, `nconc`)
  versus nondestructive operations (e.g., `setq`, `append`)
- programming style

Chapter 4: Informed Search and Exploration

♢ Heuristic search algorithms
- Greedy search
- A* (two versions)
- IDA*

♢ Heuristic functions
- admissibility
- consistency
- dominance
- problem relaxation

♢ Iterative improvement algorithms
- Hill climbing, simulated annealing,
- local beam search, genetic algorithms

Things you don't need to know (we didn't cover them):
sections 4.4 (continuous spaces) and 4.5 (online search)

Chapter 5: Constraint Satisfaction

- ♢ Definition: variables, constraints
- ♢ Representation: constraint graphs
- ♢ Backtracking search

- ♢ Selection heuristics
  - most constrained variable
  - most constraining variable
  - least constraining value

- ♢ Pruning heuristics
  - forward checking
  - constraint propagation
  - arc consistency

- ♢ problem structure:
  - independent subproblems
  - tree-structured CSPs, conditioning

Chapter 6: Adversarial Search

- ♢ What type of game:
  deterministic, turn-taking, 2-player, perfect information, zero sum
- ♢ Game trees, minimax values
- ♢ Alpha-beta pruning
- ♢ Depth-bounded search, static evaluation functions
- ♢ Node ordering
- ♢ Nondeterministic game trees (e.g., backgammon) and expectiminimax

Chapter 7: Logical agents

- ♢ Knowledge-based agents
- ♢ Wumpus world
- ♢ Logic in general—models and entailment
- ♢ Propositional (Boolean) logic
- ♢ Equivalence, validity, satisfiability
- ♢ Inference rules and theorem proving
  - Horn clauses, forward chaining, backward chaining
  - resolution
- ♢ Completeness, complexity

Chapter 8: First-Order Logic

- ♢ Syntax: symbols, atomic sentences, quantifiers, equality, sentences
- ♢ Semantics: interpretations, models, truth
- ♢ Substitutions
- ♢ Wumpus world in FOL

Chapter 9: Inference in First-Order Logic

- ♢ Reducing first-order inference to propositional inference
- ♢ Unification
- ♢ Generalized Modus Ponens
- ♢ Forward and backward chaining
- ♢ Logic programming
- ♢ Resolution

Planning

Related to Chapters 11 and 12 of the book, but based mainly on my lecture slides

- ♢ Classical planning
- ♢ Classical planning algorithms:
  forward & backward search, PSP, GraphPlan
- ♢ Task-list planning: the TFD algorithm

Things you don't need to know:

- ♢ The conceptual model and restrictive assumptions
- ♢ Lifting

Chapter 13: Uncertainty

- ♢ Random variables, propositions
- ♢ Prior and conditional probability
- ♢ Inference by enumeration
- ♢ Independence and conditional independence
- ♢ Bayes' rule
- ♢ Wumpus example

Chapter 14: Bayesian networks

- ♢ Syntax - what the networks look like
- ♢ Global semantics: joint distribution
- ♢ Local semantics: conditional independence, Markov blanket
- ♢ constructing Bayesian networks
- ♢ Exact inference: enumeration, variable elimination

Things you won't need to know (we didn't cover them):

hybrid networks

Markov chain Monte Carlo

Chapter 16, Rational Decisions

- ♢ Rational preferences
- ♢ Utilities
- ♢ Multiattribute utilities
- ♢ Value of information

Things you don't need to know

- ♢ Is money a utility function?
- ♢ Decision networks

Sections 17.1–17.3: MDPs

Sequential decision problems

- ♢ Markov decision processes
- ♢ Policies
- ♢ Policy iteration

Things you don't need to know:

- ♢ Value iteration
- ♢ Partially observable MDPs

Section 17.6: Game theory

- ♢ Strategies (pure, mixed)
- ♢ Dominant strategy equilibria
- ♢ Nash equilibria
- ♢ Pareto optimal equilibria
- ♢ Examples: Morra, Prisoner's Dilemma, etc.
- ♢ Iterated Prisoner's Dilemma (IPD)

Things you don't need to know:

- ♢ IPD with Noise

Chapter 18: Learning from Observations

We only covered Sections 18.1–18.3

♢ Decision tree learning: attributes, information gain

Things you don't need to know:

♢ Curve fitting

♢ Performance measurement

♢ Anything after Section 18.3

Section 20.5: Neural Networks

- ♢ Units, activation functions, feed-forward networks
- ♢ Perceptrons
- ♢ Multilayer feed-forward networks
- ♢ Back-propagation

Things you don't need to know:

- ♢ Brains
- ♢ Recognizing hand-written digits

Chapter 22: Communication and Language

- ♢ Grammar
- ♢ Syntactic analysis:
  context-free parsing
  logical grammars

Things you won't need to know:

- ♢ Communication
- ♢ Problems

If there are questions about this chapter, they will be relatively simple

Chapter 24: Vision

- ♢ Perception generally
- ♢ Vision "subsystems"
- ♢ Image formation
- ♢ Convolution, edge detection
- ♢ Cues from prior knowledge (motion, stereo, texture, shading, color)
- ♢ Inferring shape from edges (Huffman-Clowes line labeling) ⇐
- ♢ Object recognition, digit recognition
- ♢ Shape context matching

I might ask a question about Huffman-Clowes line labeling, but not about anything else

Chapter 25, Robotics

- ♢ what is a robot?
  definition, various examples
- ♢ robots with/without planning capabilities
- ♢ path and motion planning
  configuration space
  cell decomposition, voronoi diagrams
  probabilistic roadmaps:
    how to generate, how to use them for path planning
- ♢ robot control
  sensory-motor functions, modalities

I won't ask you any questions about this chapter