

CS494/594, Artificial Intelligence Fall 2009

Study Guide for Exam #1

NOTE: This is being distributed as a study guide for Exam #1 to give you some idea of what to expect. These represent the style of questions you will be asked, or the type of information you should know, but they don't give specific questions. The questions you will be asked will come from this material. The exam is open book, open notes.

0. The exam covers Chapters 1 – 4.3, 6 – 7.5, and homeworks 1 and 2. You are expected to have read the assigned material in the text. Any basic knowledge you would obtain from a “tuned-in” reading of this material is “fair game” for the exam, for the topic areas listed below.

1. Intro to AI and Intelligent Agents:

- Know the general differences in viewing AI as systems that think like humans, act like humans, think rationally, and act rationally.
- Understand and be able to generate the PEAS description of task environments, and the properties of task environments.
- Understand and be able to develop and categorize agents as simple reflex agents, model-based reflex agents, and goal-based agents.
- Know the different properties of task environments (e.g., fully vs. partially observable, deterministic vs. stochastic, etc. (see pgs. 41-42)).

2. Problem solving:

- (For grads) Given a problem, be able to define the states of the system, the initial state, successor functions, goal test, and path cost.
- Understand and be able to apply, compare, and contrast the following search strategies, including their completeness, optimality, time complexity, and space complexity:
 - Breadth-first search
 - Uniform-cost search
 - Depth-first search
 - Iterative-deepening search
 - Greedy best-first search
 - A* search
 - Hill-climbing search
 - Simulated annealing search
 - Mini-max search
 - Alpha-beta pruning
 - Expectiminimax for games with chance
- Understand (and be able to apply) how to develop heuristic functions, including (for grads) the use of relaxed versions of problems, and show characteristics of heuristics, such as admissible, dominating, and consistent.
- Understand (and be able to apply) how to develop evaluation functions for states in a search.

3. Knowledge and reasoning:

- Understand, and be able to use and define, concepts of propositional logic, including concepts of entailment, models, equivalence, validity, and satisfiability.
- Understand, and be able to use, standard logical equivalences (e.g., de Morgan's laws) and inference techniques (e.g., Modus Ponens, Resolution) for propositional logic.
- Understand, and be able to use, concepts of resolution, resolution theorem proving, conjunctive normal form, forward and backward chaining, Horn clauses, as applicable for propositional logic.
- Given a problem definition, be able to formulate it in propositional logic and use the developed knowledge base to prove conjectures.

Examples of the style of problems to be asked:

Everyone should be able to work "mechanical" problems, which are of the style of:

- "Given this graph/tree, give the order that search procedure X would place nodes on the queue/fringe [or the order that the nodes would be removed from the fringe; or the goal node that would be found; or the cost of the solution, etc.]"
- "Given a possible A* heuristic, state whether or not it is admissible."
- "Given this game tree, show the minimax solution [or show which nodes would be pruned in an alpha-beta search, etc.]"
- "Given a statement in English, provide the equivalent statements in Propositional Calculus."
- "Given a set of sentences, convert to Conjunctive Normal Form."
- "Given a set of sentences of a knowledge base, apply Resolution to determine if a particular sentence is entailed."

Here are some example questions of this type; you might see similar questions on the exam (for both grads and undergrads):

- HW #1, undergraduate questions 4 and 5
- HW #2, undergraduate questions 1, 3a, 4, 5, 6, 7, 8; grad question #9

For undergraduates, the questions will all be of this objective, mechanical style of problem-solving.

For graduate students, I expect to see more of an ability to reason about the material at a higher level, not just mechanical working of algorithms. But, yes, I am aware (in case some of you are worried!) that you have much more time to work homework questions than you do exam questions. So, while the exam questions may be of the flavor of some of the homework questions below, the difficulty will be timed to be reasonable for an in-class exam. Some example questions of this type are the following:

- HW #1, grad questions 2, 3, 4, 5 (i.e., in the sense of knowing the relationships among various search techniques) 6 (i.e., giving an inconsistent heuristic, or determining whether a heuristic is consistent or admissible), 7 (i.e., reasoning about a new heuristic, or how it might be developed from a relaxed version of a problem).
- HW #2, grad questions 3, 5, 6, 9

However, graduate students should also be prepared to answer any novel application of the material listed above.