

Sample questions for COMP-424 midterm exam

Doina Precup

These are examples of questions from past exams. Note that the exam also has questions similar to those on the homeworks.

1. Search algorithms

- (a) Suppose you have an admissible heuristic h . Is h^2 admissible? Is \sqrt{h} admissible? Would using any of these alternatives be better or worse than using h in the A^* algorithm?
- (b) Suppose you were using a genetic algorithm and you have the following two individual, represented as strings of integers:
1324421 and 2751421
Show the result of performing crossover between the 3rd and 4th digit.
- (c) Which of the following statements, contrasting genetic algorithms and simulated annealing, are true?
 - i. Genetic algorithms are used for minimization problems while simulated annealing is used for maximization problems
 - ii. Genetic algorithms maintain several possible solutions, whereas simulated annealing works with one solution.
 - iii. Genetic algorithms maintain one solution, whereas simulated annealing maintains several possible solutions.
 - iv. Simulated annealing is guaranteed to produce the best solution, while genetic algorithms do not have such a guarantee.

2. Bayes nets

The Starfleet academy has decided to create a class of android students. 90% of these androids study hard for their exams. Out of the androids who study hard for an exam, 80% get an A. Out of the androids who do not study, only half get an A. Androids who study hard have a 75% probability of depleting their battery in less than a day. Androids who do not study hard have a longer battery life: only 10% of them deplete their batteries within the next day.

- (a) Draw a Bayes net describing the problem statement above.
- (b) You notice that your android has depleted its battery in less than a day. What is the probability that it will get an A on the exam it had yesterday?

- (c) Your friend does not believe that androids are much good at studying. He says he is willing to pay you \$10 if your android gets an A in the class. Recharging the battery costs \$5. Suppose that you could program your android to study or not to study at will (this is not very ethical, but it is technically feasible). What is the best course of action for you?

3. Logic

- (a) Translate the following sentences in first-order logic:
- i. All citizens of Fredonia speak the same language.
 - ii. The Fredonese language has two dialects
 - iii. Each citizen of Fredonia speaks exactly one of the two dialects
- (b) Translate the knowledge base above into conjunctive normal form (using Skolem constants and functions as appropriate)

4. Problem formulation

You have been hired by a scientific computing center to help them manage the requests they get. Presently, m scientists have each submitted a list of n computations that they would like to complete. The center has 3 machines: a parallel supercomputer, a quantum computer and a cluster of regular computers. Each scientist submits, with each job, a list of the computers that would be suitable to execute it. There are $m \leq k < mn$ days on which to perform computations before the center closes for Christmas. To be fair, at least one computation from each scientist's list has to be performed. Each computation takes exactly one day. Each computer can only do one computation on any given day.

- (a) Describe this as a constraint satisfaction problem. Clearly specify what are the variables, the domains of the variables and the constraints.
- (b) Your manager also wants to minimize the total time in which the machines are idle (keeping all the same constraints as above). What kind of problem do you have? Specify one suitable solution method and motivate your choice in one sentence.

5. Logic

- (a) Translate the following sentences in first-order logic.
- i. Star Trek, Star Wars and The Matrix are science fiction movies.
 - ii. Every AI student loves Star Trek or Star Wars.
 - iii. Some AI students do not love Star Trek.
 - iv. All AI students who love Star Trek also love The Matrix.
 - v. Every AI student loves some science fiction movie.
 - vi. No science fiction movie is loved by all AI students.
 - vii. There is an AI student who loves all science fiction movies.
- (b) Based on the knowledge base above, prove formally that there exists some AI student who loves Star Wars.