CS7637: Final Exam (Summer 2016)

Due: July 31st, 2016 at 11:59PM UTC-12 ([Anywhere on Earth](#) time)

Final Exam

Choose five of the eight questions below, and answer each in ~300 words.

Question 1

Welcome to your first day as a systems engineer at Joyner Confectionary Automation! Your first job is to figure out why the new GT-7637 Chocolate Fountain Pump is occasionally exploding in our test facility, spewing liquified chocolate in all directions and catching on fire. The good news is that the GT-7637 engineering team built 11 different sensors into the product's test harness. These sensors record the important operating conditions: manifold pressure, chocolate viscosity and temperature, pump speed, amount of flow, and so forth. The bad news is that so far we haven't even been able to characterize the conditions under which the pump fails; the sensor readings from the 8 failures we've seen so far don't point to a simple rule (such as "every failure happens when the chocolate temperature is above 90F"). Thus, your first task is to figure out the conditions under which these failures are happening.

I've heard about some newfangled algorithm called "version spaces" which helps people figure out complicated problems like this one. Would that be good for this problem? If so, how would it work? Are there any changes you'd have to make? If it's not a good choice, then why not, and can you suggest an alternative?

JCA, Inc. and its millions of chocolate-loving customers are counting on you!

Question 2

We've seen various means of representing and understanding knowledge. That understanding is often based on the context in which that knowledge is learned. However, given a different context, that understanding may not be valid. Demonstrate two examples, in the terms of our KBAI concepts like frames and common sense reasoning, in which the knowledge and understanding gained in one context would lead to an invalid understanding within a different context.

Question 3

One of the challenges in solving Raven's Progressive Matrices is to determine which objects correspond with each other between figures. This problem is especially relevant to agents which reason verbally. Please describe, at a general level, a solution to the correspondence problem. Identify both a knowledge representation and problem solving strategy that would combine to feasibly solve the problem.

Question 4

A common mistake we saw during the assignments in the middle portion of this course was the usage of scripts as a way of describing effectively any algorithm. Like algorithms, scripts consist of repeated steps or actions over input that may differ, but fits certain structures. For example, an algorithm may be able to operate over any real numbers, and a script may be able to operate within any fast food restaurant. However, treating scripts as a representation for algorithms risks losing the value and usefulness of scripts. Contrast scripts with algorithms. Comment specifically on the strengths and weaknesses of scripts, and the kinds of problems for which they're suited.

Question 5

Incremental concept learning and version spaces are two methods that agents may use to learn from a small number of examples analyzed one at a time. In our lessons, we discussed incremental concept learning in terms of figures of blocks, and we discussed version spaces in terms of identifying the cause of an allergic reaction or food poisoning. Take one of these examples -- either identifying arrangements of blocks or identifying the cause of allergic reactions -- and attempt to resolve it using the other method. Use this attempt to compare and contrast the two methods: what are the strengths and weaknesses of each method? What kinds of problems are each method better suited to solve?

Question 6

Explanation-based learning and learning by correct mistakes were each shown using similar knowledge structures. Thus, the difference between these two learning methods is not the knowledge structure they use. First, contrast the two methods: despite being shown with the same knowledge representation, how do the methods differ? What types of problems are they

better suited to address? Then, compare learning by correcting mistakes with version spaces. Despite the differing knowledge representations, how are they similar?

Question 7

Demonstrate the process of analogical reasoning. Take an existing system, and by analogy extend its design and solution to a new problem. In doing so, walk through all the steps of analogical reasoning. Finally, contrast this process with how you might address this problem by case-based reasoning.

Question 8

Metacognition is the process by which agents can reason about their own reasoning. As we discussed in the lesson on metacognition, metacognition is a loop at the top of the relationship between metacognition, cognition, and reaction: metacognition can reason over cognition, or metacognition can reason over metacognition itself. In order to participate in this reasoning, however, an agent must have a knowledge representation for its own reasoning, and even a knowledge representation for its own metacognition. Choose any concept from the course, and discuss how that knowledge representation could be used to represent metacognition. How would an agent use this knowledge representation to reason over its own meta-reasoning?

Submission

Select **five** of the questions above and answer each in ~300 words in a single document. Make sure to very clearly label which answers are in response to which questions. To submit the final exam, go to the exam submission page and upload your document. Then, in the textbox on the assignment submission page, write the numbers for the questions that you chose to answer so the graders can identify whether they need to open your document.

All submissions must be received by the due date and time. Late work will not be accepted, although we have built in a little lag time in T-Square to account for slow upload times. Please see the syllabus for more information on the course late policy.

The final exam should be submitted as a PDF. Most modern word processors allow you to save a document as a PDF. If yours does not, we recommend copying or uploading your

assignment to Google Docs and downloading it as a PDF. There also exist other freely-available PDF converters online.

Grading

Each question will be evaluated according to the following criteria:

- To what extent did the response explicitly *leverage* the assigned topic(s) in its answer?
- To what extent did the response explicitly *apply* the assigned topic(s) to the problem?
- To what extent did the response successfully *examine* the assigned topic(s)?
- To what extent did the response ultimately *succeed* in answering the question, separate from the course topics themselves?