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Knowledge Based AI

Final Exam

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Will not answer 4, 7, 8

# Question 1

Version spaces is a method for learning a concept incrementally, usually from a limited number of examples. However, it differs from pure incremental concept learning in that version spaces operate on two concepts simultaneously – a general and a specific concept. As positive and negative examples are provided, these two versions of the concept towards each other. When these two concepts meet (in terms of abstraction) the concept is now learned. The primary advantages of version spaces are that convergence is guaranteed (given enough examples) and the level of abstraction at which the concept is learned is ideal, neither too general nor too specific.

In this case the “concept” is “pump is malfunctioning” and the examples are the state of the pump as measured by the sensors. The examples should not only be negative examples (malfunctions) but also positive examples, when the pump is operating normally. (If only negative examples are provided to the version space agent, only one concept will move, and the two concepts may never meet.)

The primary difficulty with using version spaces is the number of examples necessary to reach convergence. In lecture the most dimensions of any example was 4, and each of those dimensions could only take on a few values. In this case there are almost 3 times as many dimensions and the values are continuous. It could take more than 8 malfunctioning examples to converge, effectively leaving JCA without any usable model for the cause of the malfunction.

One alternative would be to simply use incremental concept learning. While the concept that is learned after 8 malfunction examples may not be completely correct, at least there would be a usable concept that could be used to predict a malfunction.

# Question 2

Representing knowledge is extremely difficult when ambiguity is involved, and very few things are as ambiguous as human language. In lecture we discussed ambiguity of words within a language, but in an increasingly globalized world, translating between languages is becoming increasingly common. This can lead to ambiguity when certain phrases in one language are translated literally into another. For example, assume we have an agent that only knows the grammar and dictionary of English and Spanish. Someone asks this agent to translate the English phrase “What’s up?” into Spanish. The agent uses its syntactical knowledge stored in frames to perform this translation, but the result would not make much sense to a native Spanish speaker. That is because the phrase “What’s up” is not valid in a context outside of the English language, even though Spanish has equivalent words for each of English words.

In lecture we discussed frames solely in the context of verbal knowledge. However, frames could be used to organize visual and audio information as well. However, even these can be applied out of context. Take for example a butler robot that has learned to answer the door when the doorbell rings. That evening its master is watching some television when it hears a sound similar to what it has learned as the doorbell. So the robot goes to the door and opens it to find no one there. This is because the sound of the doorbell came from the television, not the doorbell. In this case the context was more than likely the same (doorbell sound heard within a house) but the robot failed to take into account a specific part of the context (television is on) that would have permitted the disambiguation here.

# Question 3

# Question 5

# Question 6

Both explanation based learning and learning by correcting mistakes operate on the same knowledge representation – a hierarchical semantic network. The primary difference between these two is how this knowledge is used. Explanation based reasoning attempts to classify a new example given the knowledge that it has. In lecture, the knowledge structure was used to classify objects as cups. It is assumed that this knowledge is correct, or at least that it represents all the knowledge available to the agent at the given time.

With learning by correcting mistakes, an example is provided where the classification was wrong. So in lecture, an object was classified as a cup that should not have been classified as a cup. As such, it is known that the knowledge representation is flawed. Something needs to be added or removed in order to correctly classify the example.

In this manner, these systems operate in something of a feedback loop.

Both add and remove elements from their knowledge representations in order to clarify a concept