OMSCS 7637
Rohan Kekatpure
Mid-Term Examination

Q1: Let us suppose that Will^{m} Shakesper has many semantic networks in his mind. Why might his semantic networks not work in the modern world?

Following are the two reasons I feel semantic networks in Shakespeare's mind may not work 'out of the box' in the modern world:

1. Semantic networks are a form of knowledge representation. Intelligent persons perhaps have more of these networks and their networks may be deeper (more layers) than ordinary folks. However, knowledge representation is passive: by itself, it has no mechanism to self-evolve (add more nodes). The knowledge representation must be coupled with a problem solving method that can in turn feed back knowledge into representation.

2. Semantic networks are anchored to a context. The context can be geographic, cultural or temporal. Semantic networks in Shakespeare's mind, which by all indications were advanced compared to his contemporaries, were still spatially and temporally local to him (17th Century Britain). In the same way that we cannot be expected to operate effectively in 3rd century (BC) Sparta, it is not surprising that Shakespeare's semantic networks weren't automatically applicable to 20th century America.

Q2: Let us suppose that Will^{m} Shakesper knows about and can execute means ends analysis. Why might his means ends analysis method not work in the modern world?

Means-end analysis is a problem-solving method. It presupposes that we already have an appropriate knowledge representation for the problem at hand and sufficient knowledge of the goal state. As we saw above in Q1, Shakespeare would be hard pressed to come up with an appropriate knowledge representation. He may also not have an accurate knowledge of the goal state (for example, eateries today look very different than in his times so he may not know that the funny red-colored building with a cartoon standing outside is actually where you get food). This difficulty is compounded by the following two factors as well:

1. Effective means-end analysis depends on knowing what operators are available for transitioning between states. For instance, assuming that Shakespeare knows his destination address, he may not know to use an IPhone to actually get a map to it.

2. Real world problems give rise to an exponential number of states in every problem-solving step. If we're to arrive at a solution, the means-end analysis must be coupled with domain knowledge to prune these states. As mentioned

earlier, Shakespeare's knowledge representation may not have nodes (or frames) for this domain knowledge. As a result, his means-end analysis may prove ineffective because of inadequate knowledge.

Q3: Let us suppose that Will^{m} Shakesper has many production rules in his mind. Why might his production system not work in the modern world?

Productions systems work on the fundamental tenet of computing actions based on a history of percepts, symbolically represented as f: P* → A. where P* is the history of percepts (P*) and A is the deduced action.

The rules themselves are generated from the knowledge of world that the agent (Shakespeare) resides in. The production systems in Shakespeare's mind, while mature for his world, have not been subjected to the modern world.

Stated another way, 'behavior' is the combination of "architecture" and "content." In this case, the architecture is fixed, but the content is out of context.

Because of the mismatch of the knowledge content, his production rules may not be effective immediately. However, after a reasonable period of training (say a year), he may be able to infer rules for operating in the modern world.

Q4: Let us suppose that Will^{m} Shakesper has many frames in his mind? Why might his frames not work in the modern world?

The frames will not work for essentially the same reason that the semantic networks will not work. Frames are merely knowledge representation. By themselves, they don't have any mechanism to self-evolve. Specifically, even though Shakespeare's mind may have frames, many may not have content relevant to operating in the modern world.

In addition to the lack of relevant frames, there may be few connections between the frames. For example, everyone living post 2010 has an implicit connection between a phone and a car: we use our phone to find directions to reach a destination using our car. This way the "phone" frame is linked to the "car" frame. We were not born with this knowledge; we have formed this connection purely from the context of the world we live in. This context is not relevant the Shakespeare's world.

In summary, frames in Shakespeare's mind may not work in the modern world 'as is', because the set of frames in his mind and their interconnections cannot be expected to be adequate for operating in modern world.

Q5: Let us suppose that Will^{m} Shakesper has many cases in his mind? Why might his case application not work well in the modern world?

Learning by recording cases is one way a knowledge representation can evolve. Case-based learning works by retrieving prior cases closest ('nearest-neighbour') to the problem under consideration. Naturally, for case-based approach to be effective, there

must be cases close enough to the problem at hand. In the absence of such cases, case application will not work.

Shakespeare may have many cases relevant to his geographical and temporal context. However, in that collection there may only be a few cases that could be considered helpful for operating in the modern world.

Case-retrieval is a problem-solving method. However, a solution method is ineffective without adequate knowledge representation and knowledge content.

Q6: Let us suppose that Will^{m} Shakesper has many cases in his mind? Why might even his case adaptation not work in the modern world?

Two fundamental assumptions for case adaptations to work are: (1) a sufficiently similar case has already been retrieved and (2) the adaptation is a small perturbation to the retrieved case.

Both these assumptions are unlikely to hold in our present example. First a sufficiently similar case may not be present in the set of cases in Shakespeare's mind (as answer to Q5 covered). Even if retrieval process were to return a case, it is unlikely that the adaptation to the modern will be a 'small' change. Given the large difference in (spatio) temporal contexts between 17th and 20th centuries, the required adaptation would be enormous and may lead to instabilities in computation. For these reasons, Shakespeare's case adaptation might not work.

Q7: Let us suppose that Will^{m} Shakesper has many concepts in his mind. Why might his classifications not work in the modern world?

Concepts in all our minds (including Shakespeare's) are subdivided into axiomatic, prototypical and exemplar. All three are essential to successful operation in the real world.

While it is likely that axiomatic concepts in Shakespeare's mind could be similar to ours, prototypical and exemplar concepts are strongly tied to a context. A lot of modern conveniences that we take for granted may be foreign concepts to Shakespeare. While we intuitively understand expected behavior of prototypes around us, someone from remote past may be hard-pressed to recognize the prototypes and infer their behavior. As an example, Shakespeare may not be able to abstract out "phone"-ness of an Ipad, Iphone, landline, and a cordless phone classify them into the "phone" or communication-device. In other words, concepts are only useful if there is a 'training set' (set of labeled examples) of pre-classifications of these concepts into well-defined classes.

Exemplar concepts, such as cultural norms present even more difficulty. Notions or beauty, propriety, politeness and language are markedly different across his era and ours.

Q8: Let us suppose Will^{m} Shakesper can learn new concepts via incremental concept learning. Why might even incremental concept learning not work very well in the modern world?

Incremental concept learning will require availability of labeled examples of concepts classified into positive and negative categories. We can assume that Shakespeare has many cases in his mind. But these cases will likely not be classified because he lacks adequate experience in the modern world to have these cases classified. This would require him to associate for a while with a person from the modern world who can essentially act as his teacher or spend enough time in the modern world to self label the cases.

Once he has a repository of labeled cases for the concept he is trying to learn, he may be able to use incremental concept learning. But incremental concept learning by itself will not be adequate to help him begin operating quickly in the modern world.