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COG 366

CCM Reading Assignment #2

The Architecture of Jumbo

Part 1 - Relatively Short Answer

1. What is the main topical theme of the chapter, and why is it of significance.

The main topical theme of the chapter is the architecture of Jumbo. Jumbo, as written by Hofstadter, is an artificial-intelligence research project with a concrete purpose and an abstract motivation.

2. Do your best to describe (in more than two words) the long term-goal shared by Jumbo and some of Hofstadter's other AI projects.

Jumbo shares a goal with many of Hofstadter's other projects, which is to demonstrate the equivalence of cognition with "deep perception". Deep perception are the layers of perception which are often non-verbalizable and difficult to describe. It also states that intelligence stems from many thousands of parallel processes that may take place in just milliseconds and are unable to be modelled and viewed by ourselves. The phrase "cognition equals recognition", which simply says without cognifying something it is impossible to recognize it.

3. What is Herb Simon's perspective on Hofstadter's architecture and the aspect of cognition that it purports to study?

Herb Simon does not support Hofstadter's architecture and the aspect of cognition that it purports to. Simon said it is pointless and meaningless to capture those tiny milliseconds of cognition. Simon proposes we should have a better basis for studying it, and rather than starting at Hofstadter's proposed layers of perception, we should go beyond Jumbo's capabilities. However it also stated that Jumbo is just the beginning of a bigger project.

4. What does Hofstadter claim is the core mystery of all of intelligence?

Hofstadter claims that low level vision or hearing which is connected to a syntactic-semantic transition zone, is the core mystery of all of intelligence. This zone written by Hofstadter is a murky area where syntactic sensations interface with semantic categories.

5. What is the "concrete purpose" of Jumbo?

The "concrete purpose" of Jumbo is to imitate human skills used in the newspaper game known as "Jumble". Jumble is a game which has the goal of solving anagrams.

6. Hofstadter states that Jumbo is a building program. Explain what he means by this.

Hofstadter states that Jumbo is a building program because the program itself has no dictionary of English. It is given knowledge about consonants and vowels clusters are formed out of letters and syllables of words. The program starts by presenting letters of the alphabet, then creating gloms. The gloms are split into three levels which are clusters, syllables, and words.

7. What is the “serious purpose” of Jumbo?

The “serious purpose” of Jumbo is to be a model of the mental processes of assembly and transformation. It is not to be an expert system for playing a simple word game. Jumbo is the hope that these abstract processes are notions that are able to be formed into more significant domains.

8. What is the significance of Jumbo’s task domain?

The significance of Jumbo’s task domain is to replicate human perception. How do humans create larger words out of smaller ones? When we play around with letters we are constantly trying to make sensible words that can be understood one’s self or to a target audience.

9. Hofstadter suggests that in any type of perception, much back-and-forth motion must occur. What does he mean by this?

Hofstadter says much back-and-forth motion must occur because when thinking we have to construct, deconstruct, reconstruct, group things, and rearrange our thoughts. Even while reading this there are many tricky mini problems. For example Hofstadter, instead of writing mumbo jumbo, he writes murnbo jurnbo. The r and n can be combined together, creating the letter m. Humans always have subtle decisions whenever we process a thought. The more stable the thought, the better we are able to express them.

10. Jumbo rests on two basic analogies. One is the way that complex molecules are constructed inside a living cell; the other to the way that bonds of human friendship or romance are formed in a chaotic world.

a. Describe the biological analogy.

The biological analogy is that some tight consonant clusters such as “th”, “ng”, or “ck” are comparable to covalent bonds. Whereas the amino acids which are loosely tied together bonds are related to higher level clusters such as “thr”, “ngth”, or “cks”. Let's analyze these clusters, “th” can be used for a variety of words but the most used one in my daily verbal usage is thing, which also includes the next one “ng”. “Ck” is mostly added towards the end of a word in our English language, such as clock. Next, our higher level clusters, which have “thr” can be used in the word through. The next one is “ngth” which is associated with endings such as the word strength. The last one is “cks” which is not far from its predecessor “ck” because it only adds a letter “s” to it, making the resulting word to be plural, clocks.

b. Describe the sociological analogy.

The sociological analogy relates to relationships of people, mainly relating to a romantic bond. Before reading this, I related the sociological analogy to the six degrees of separation and assumed it would be something like this because the previous biological analogy spoke about how closely clusters were bonded to each new word. Romantic bonds start off by seeing by some chance or by relation of meeting your romantic interest or partner. If they meet they may lead to dating,

which evolves to marriage which may take different amounts of time for each couple. This is similar to how someone is able to recognize a crypto problem or solving an anagram. The time it takes for us to recognize something or regroup something is varied for each person. People may break up before they marry, which results in the bonds breaking. Similar to how we may give up or stop at a solution in the making. We have to reboot and restart from step one.

11. Jumbo is a parallel processing system. Describe the nature of its parallelism.

The nature of Jumbo's parallelism is modeled on the distributed parallelism of a cell. Unlike a cell which takes place in a biological level, Jumbo is run on a computer, thus it is virtual or emulated. Jumbo has many different processes just like a cell, it has the option to make clusters, stop and solve them, and spit out a glom.

12. Central to Hofstadter's modelling of unconscious juggling of mental objects are the nations of "sparks" and "affinities".

a. Describe, in words and by means of examples, what Hofstadter means by "sparks".

Hofstadter uses the word "sparks" in order to relate to how the letters generated by Jumbo are able to bump into each other and interact. Sometimes some consonants or vowels may not spark with each other in the English language due to its affinity. Often times some letters of the alphabet are rarely used or incompatible with each other.

b. Describe, in words and by means of examples, what Hofstadter means by “affinities”.

When Hofstadter says affinities, it is almost comparable to the periodic table of elements. Some elements love to interact but some can only interact if there are multiple copies of themselves. Creating water or H₂O requires two hydrogen atoms and one oxygen atom, it makes them happy and react normally and not explode. Similar to our start symbols and terminal symbols when using context free grammars. You can not skip the start symbol and just begin with a terminal symbol. The production rules of a CFG are the affinities, it allows for the mix of symbols or symbolic atoms to mesh together.

13. What is a codelet?

A codelet is a piece of code which is able to be put onto a coderack. Hofstadter compares codelets to coats, which the coderack is a coat hanger or coat rack. The codelets are to be removed when used it analyzes the spark and decides whether or not it should begin that “journey”. This journey is similar to how we solve problems. We start by giving variables and then combining the variables. If one of the combinations are not worthwhile we skip it.

14. It is the queue-like structure in which all codelets are placed while they are waiting to be run. What is it called?

The queue-like structure in which all codelets are placed while waiting to be run is called a coderack.

15. Are codelets selected for execution in a deterministic fashion? Elaborate on some on your “yes/no” answer.

Yes because like in real life, you would not wear a winter coat on a summer day.

A codelet can be used during a random moment but if it is not suited for that situation, the codelet automatically returns to the coderack in order to give another codelet a chance to be run. You may use multiple codelets in accordance to its urgency or priority.

16. Is all processing in programs that adhere to Hofstadter’s architecture implemented via codelets? Elaborate some on your “yes/no” answer.

Not all programs adhere to Hofstadter’s architecture implemented via codelets because you can use a calculator which uses the numbers from 0 to 9. These numbers are the codelets and can be interchanged and mingled with each other at any moment. There may be rules for the arithmetic functions but it does not impact how the numbers are used.

Part 2 - Very Short Answer

1. When a codelet is run, it ...
 - a. is taken off the “queue”
 - b. Can cause changes to the “knowledge base”
 - c. may place follow-up codelets onto the “queue”
 - d. all of the above

2. The self-propagating nature of codelets enable lengthy processes to be carried out in small disjoint steps, each step setting up its own possible continuation. It resembles the way that long chains of chemical reactions get carried out in independent small steps in the cell. (TRUE or FALSE)

3. In Prolog, processing is carried out by means of rules which operate on the knowledge base. By analogy, in Hofstadter's architecture, processing is carried out by codelets that operate on the cytoplasm.

4. Intelligence in programs that exploit Hofstadter’s architecture, if indeed they have any, clearly has not been directly programmed; rather, it emerges as a statistical consequence of the way that many small program-fragments interact with each other.
(TRUE or FALSE)

5. Intelligence in Jumbo and Copycat and other such programs is like a chess program that has a subtle tendency, but one that is crystal-clear to sufficiently keen chess observers, of “liking to get its queen out early” -- a tendency taking its programmers completely by surprise as they never knowingly or explicitly put any such strategic concept into their program. (TRUE or FALSE)

6. The phenomenon suggested in the previous question that has been referred to as ...
- a. an “innocently emergent” quality by Daniel Dennett
 - b. “epiphenomenon” by Douglas Hofstadter
 - c. both of the above
7. Early in his discussions of Jumbo, Hofstadter indicates that its strategy is based on two analogies: Which are they? (Choose TWO!)
- a. the way that complex molecules are constructed inside a living cell (cellular biology)
 - b. the way that macroscopic order emerges naturally from the statistics of microscopic disorder (statistical mechanics)
 - c. the way that bonds of friendship or romance are formed in a chaotic world (sociology)
8. Later on in his discussion of Jumbo, Hofstadter indicates that a third analogy is relevant to Jumbo’s strategy: Which is it? (Choose ONE!)
- a. the way that complex molecules are constructed inside a living cell (cellular biology)
 - b. the way that macroscopic order emerges naturally from the statistics of microscopic disorder (statistical mechanics)
 - c. the way that bonds of friendship or romance are formed in a chaotic world (sociology)

9. According to Hofstadter, the reliable emergence of macro-laws from micro-chaos could even be summarized in a metaphorical equation: *thermodynamics = statistical mechanics*. (TRUE or FALSE)
10. The philosophy on which Hofstadter's architecture is based goes against the grain of traditional AI work, which seeks to find explicit rules (not emergent or statistical ones) governing the flow of thoughts. (TRUE or FALSE)
11. Hofstadter uses the term "thinkodynamics" to refer to laws governing thoughts at their own level. (TRUE or FALSE)
12. Hofstadter uses the phrase "statistical mentalics" to refer to the laws governing subcognitive events that form the basis of higher-level thought. (TRUE or FALSE)
13. What corny but (hopefully) catchy *equation* does Hofstadter use to articulate his vision of the essential mission of AI should be in the future?
Thinkodynamics = statistical mentalics
14. It was the first of Hofstadter's programs to make clear use of the architecture with which he is so closely associated. What is its name?
Jumbo
15. It is a parallel investigation of many possibilities to different levels of depth, quickly throwing out bad ones and homing in rapidly and acceruatre on good ones. What is it?
Parallel terraced scan

16. The idea articulated in the previous question was Hofstadter's, but much of it was already present in:

a. GPS

b. SOAR

c. Hearsay II

Part 3 - More Relatively Short Answer

1. What I find particularly interesting about codelets is that they can be compared to many relations. Codelets can be coats/clothing or can be individual plates of food. When used in Jumbo they are the clusters.
2. Coderacks are just a place where codelets live or rest. Codelets scattered can be a mess, and without the coderack it can be hard to organize themselves.
3. In order of salience, most salient, write down what you think are 7 particularly salient things about Hofstadter's architecture for computationally modeling cognitive processes.
 - a. Deep perception and trying to analyze it through Jumbo
 - b. Why deep perception is an untouched or unsolved problem of artificial intelligence
 - c. Solving anagrams was just a short term goal of Jumbo and its long term goal was to integrate the results of Jumbo into more complex domains
 - d. Comparing a cell and a sociological relation to Jumbo's coded strategy
 - e. Codelet and the coderack, new vocabulary that I learned
 - f. Syntactic-semantic transition zones and creating a language that can be understood for one's mind or communications
 - g. The different types of gloms known as clusters, syllables, and words