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Capstone Finally Assignment

Essay 1

Title: Cognitive Science Semantic Nets

Neuroscience and artificial intelligence are fields found within the interdisciplinary scope of cognitive science, adding new perspectives and ways of thinking. Within both neuroscience and AI, there are many concepts and terms that are related to one another, exposing the function and interrelated structure of the different fields. Semantic networks are a very informative tool that can be used to model and understand how concepts or idea are related to one another. Semantic networks are "knowledge representation schemes involving nodes and links (arcs or arrows) between nodes" (McCann, n.d.). The nodes within a semantic network are objects, ideas, or concepts, and the links between the nodes represent the relationship found between the nodes. The links between nodes are shown as directed and labeled arcs, that connect all the nodes within the network, forming a congregate whole (McCann, n.d.). Semantic networks are used consistently while working within the field of artificial intelligence/neuroscience, and to fully understand exactly what a semantic net is and how it operates, I will construct a semantic network composed of the following terms/concepts: AI, Machine Learning, Deep Neural Networks, Big Data, Bias, and Scientific Method.

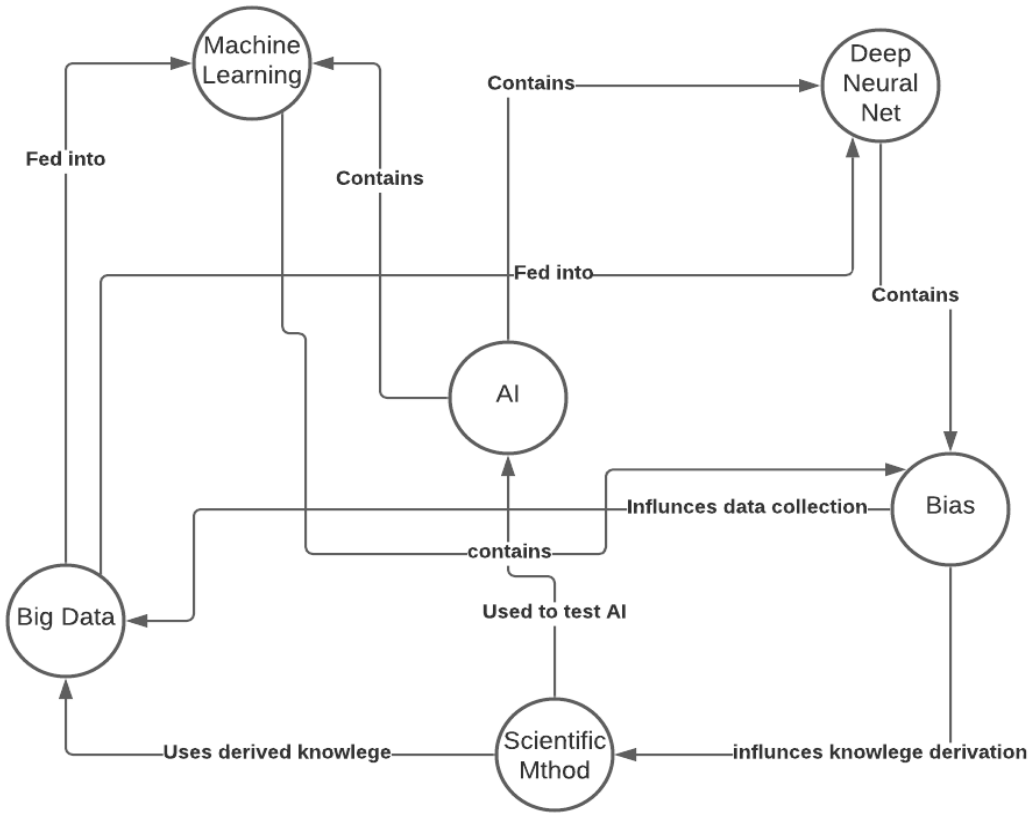
Before creating my network, exposing how all these concepts are related to one another, it is imperative that I first define each of the terms mentioned above. Starting from the beginning, AI or artificial intelligence is the idea that a machine can mimic and possess human like behavior and intelligence. For a machine to be considered intelligent, it must be able to problem solving,

reason, perform pattern recognition, plan, learn, and perform many more functions that are utilized by humans each and every day (Burnham, 2020). Machine learning is a type of AI, that processes large amounts of data (big data) by using algorithms that adapt and grow over time as more and more data is processed, and variables are manipulated (Burnham, 2020). Deep neural networks "use huge neural networks with many layers of processing units, taking advantage of advances in computing power and improved training techniques to learn complex patterns in large amounts of data" (*Artificial intelligence, machine learning, deep learning and more,* n.d.). Deep neural networks extend and are a part of machine learning, as they are used to understand complex sets of data and perform more in-depth pattern recognition. Common applications of deep neural networks are image and speech recognition, natural language processing, and much more (*Artificial intelligence, machine learning, deep learning and more,* n.d.). Both deep neural networks and machine learning algorithms rely on human input to direct the machine to process information in a set way. Big data is the large amount of information that is fed into machine learning programs and deep neural networks, to develop machines that possess intelligence (Burnham, 2020). Biases are inclinations or prejudice for or against someone or something, and all humans possess biases to a certain degree. Lastly, the scientific method is an empirical method for acquiring knowledge and testing theories, that has been used and taught in all sciences for decades.

After describing all six of the terms, you may begin to see how all the terms are connected, but I must make sure you, my audience, fully grasps the relationship all these terms have with one another. Everyone contains biases, as it is part of human nature to form them, although the severity of biases varies from person to person. Bias influences all the terms involved in our semantic network. Bias influences the process of the scientific method and

collection of big data, and as a result affects machine learning, deep neural networks, and AI as a whole. Biases affect how humans derive knowledge from the world, influence what big data is fed into deep neural networks and machine learning programs. Both machine learning and deep neural networks rely on biases, big data, and the scientific method to be provided with the information to function intelligently. Big data is what is fed into machine learning algorithms and deep neural networks to allow the machine to learn and perform in depth pattern recognition. Then AI uses deep neural networks and machine learning to begin to mimic and function as an intelligent human. All the terms than influence and construct machines that may begin to possess artificial intelligence. Bellow you will find an example of a semantic network that reflects the terms and their relationships I just described previously.

Semantic Net:



Sources:

Artificial intelligence, machine learning, deep learning and more. (n.d.). Retrieved December 10, 2020, from https://www.sas.com/en_us/insights/articles/big-data/artificial-intelligence-machine-learning-deep-learning-and-beyond.html

Burnham, K. (2020, November 10). Artificial Intelligence vs. Machine Learning: What's the Difference? Retrieved December 10, 2020, from https://www.northeastern.edu/graduate/blog/artificial-intelligence-vs-machine-learning-whats-the-difference/

McCann, J. (n.d.). Semantic Networks. Retrieved December 10, 2020, from http://people.duke.edu/~mccann/mwb/15semnet.htm

Essay 2

Title: Psychological Statistics

Throughout the cognitive science curriculum here at SUNY Oswego, there are a variety of different classes that you need to complete, each pertaining to one or multiple of the interdisciplinary fields that make up cognitive science. By taking both Psy280 and Psy290, these courses have prepared me with the skills and techniques to be well versed in statistics. Along with being educated in statistics, the courses and experiences had within the cognitive science program have allowed me to understand and complete work using cognitive computational modeling.

To complete the Psy290 course here at SUNY Oswego, each student with the assistance of a partner, must complete a psychological research project of their choosing. By completing this project, me and my partner showed that we had a strong grasp of statistics and that we understood how to properly conduct psychological research. The topic me and my partner choose to examine was whether or not nicotine withdrawal had a negative effect on a student's performance in a classroom setting. We hypothesized that nicotine withdrawal would have a negative effect on a student's performance in a classroom setting and that the negative effects would be more influential in longer classes. To test our hypothesis we created a questionnaire, with questions pertaining to student's nicotine use and classroom performance, and we distributed it to all the students taking the class. This allowed us to find the proper variables we needed to test our hypothesis and to see if our topic was even worth exploring. The variables we chose to focus our analysis on, were students focus and performance among nicotine and non-nicotine consumers, in both 55 minute and 80-minute class times. By using the statistical program SPSS, we were able to use the data collected through our questionnaire to conduct a

mixed repeated measures ANOVA. In the end our results went against our hypothesis, showing that there was no significant difference found between nicotine consumers and non-consumers focus and performance in a classroom setting. Even though we were unable to prove what we hypothesized, I was given a firsthand experience conducting statistical tests and performing ethical psychological research.

Throughout my time here at SUNY Oswego, I have been involved in a variety of activities that have encompassed cognitive computational modeling. The most salient experience I have encountered, that exposes this type of modeling, is the work I did as a research assistant under Professor Rhodes. I was lucky enough to be able to join his research team for a whole year, examining the foraging techniques found within humans. Similar to taking both Psy280 and Psy290, being a research assistant allowed me the skills and techniques to conduct proper psychological research. Although, along with gaining those skills, I was allowed the opportunity to work with cognitive computational modeling first-hand. To test and expose human foraging patterns, my team and I designed a foraging experiment where participants had to search for easter eggs in a controlled space. Each participant had a video camera attached to their head and a GPS tracker placed in their pocket, as they searched for eggs. Each participant was then asked to collect as many eggs as possible in a 10-minute timeframe. In doing so, we were able to generate a map laying out each participant's route while searching for the strategically placed eggs. Each map generated acts as a model representing the cognitive processes of the participant, as they reasoned and logically determined the most effective and efficient route for foraging.

Essay 3

Title: Human Logic

When making decisions, humans tend to not reason logically in abstract formal situations. Although, when placed in contextually rich situations, humans tend to reason very logically, as they can familiarize themselves with the situations at hand. There are a ton of reasons why this is generally the case among humans, a lot of it has to do with the cognitive biases that many humans pose, with or without the individual even knowing it, but that is not always the case. In 1966, Peter Wason developed *The Wason Selection Task*, which evaluated a subject's ability to find facts to violate a conditional hypothesis of the form *If P then Q*. In the original test four 'facts,' are presented as playing cards. Each card has two sets of information on it, one piece of information on one side and another on the other side. The hypothesis that's under evaluation is the relationship between the information on both sides of the cards and the 'facts' themselves. The subject being tested is then presented the four cards with one side up and the other down, and the task is to decide which cards should be flipped to violate/evaluate the conditional hypothesis. In Wason's original task, the information on the cards was very simple and abstract, it was often a color on one side and a letter on the other. This test has been replicated thousands of times and there is a lot of support for the fact that humans tend to do very poorly on this task. Due to the information in the original task being unstructured and abstract, humans tend to not reason logically. Subjects are placed into a situation that is abstract and formal, hindering their ability to reason logically.

There are a wide variety of variations created around the original concepts designed by Wason. Leda Cosmides is a psychologist that created a variation of this task that used related and contextual information on either side of the cards, placing the hypotheses into familiar and

unfamiliar context, based on social contracts. Subjects evaluating the familiar and unfamiliar hypotheses, verse the abstract hypotheses tested previously, tended to score substantially better. Leda Cosmides stated that because of social context and the information being familiar to them, humans are able to 'cheat' and reason logically, as they evaluate familiar hypothesis instead of abstract ones. Leda Cosmides showed through her variation of the task, that when subjects are placed in contextually rich situations they tend to reason logically. Overall, by examining *The Wason Selection Task*, and its variants, there is evidence to support the fact that humans tend not to reason logically in abstract, formal situations, but that they do tend to reason logically in certain contextually rich situations.

Sources:

Leda Cosmides and the Wason Selection Task. (n.d.). Retrieved December 10, 2020, from https://www.ling.upenn.edu/courses/hum100/evolutionary_psychology.html

Wason selection task. (2020, December 10). Retrieved December 10, 2020, from https://en.wikipedia.org/wiki/Wason_selection_task

Essay 4

Title: The Fundamentals of Java – For and While Statements

Within the Java programming language, there are a variety of different important loops that provide structure and functionality. Across programming languages, loops are used to execute a set of instructions or functions repeatedly until the conditions within the argument become true. Loops within java provide structure, save the programmer precious time, reduce user error, and make code clearer and more concise. For these reasons, loops are a necessity in java along with any other programming language one chooses to engage in.

One type of loop statement found and needed within the Java programming language is the for loop statement. The for loop is a compact way of iterating over a set range of values, seen as an argument, until a particular condition is satisfied. For statements are used when you have a set number of times you want iterate a block of code. The argument for a for loop is generally composed of 3 different parts, all delimited by ";". The first part is executed prior to running the loop, the second part defines the conditions/boundaries for the loop, and the third part is executed every time the loop is reiterated. An example of a for loop statement in the Java programming language can be seen bellow:

```
public static void main(String[] args){
    for(int i=0; i<5; i++){
        System.out.println(i);
    }
}
```

In the example above, the for loop is composed of the three critical parts previously described. In the first part of the argument the variable i is set equal to 0, the second part defines

the loops condition instructing the loop to iterate as long as i is less than 5, the third statement increases the value of i by 1 after each complete iteration of the loop. The last statement "System.out.println(i)," will print out the number 5, as that is the last value i could be set too before the for loops condition was satisfied.

Another type of loop statement found within the Java programing language, that is used by the masses, is the while loop statement. As we have seen previously, the for loop is used when the programmer knows how many times, they want to loop a block of code. A while loop statement on the contrary is used when the programmer does not have a set number of iterations they wish to complete. Instead, a conditional argument is set within the loop and the block of code will recursively run over and over until the condition within the loop is satisfied. An example of a while loop statement in the Java programming language can be seen bellow:

```
public static void main(String[] args){
    int n = 0;
        while (n<5){
        System.out.println(i);
       n++
    }
}
```

The example above is a very simple example of a while loop statement that will iterate recursively until the condition n<5 is satisfied. The first statement within the block of code sets the variable n to 0, and will be the starting value of n. Each iteration of the block of code shown will first check if the value of n is less than 5 and it will increase the value of n by 1 if the first

part of the statement is true. The condition of this while loop states that this block of code will run until the value of n is no longer less than 5. The output after running this block of code is a list of numbers from 0 to 4. The last value outputted by this block of code is 4 because the print statement comes before the statement that increases the value of n by 1, and due to the conditional statement n will never be set to 5.

There are a variety of different reasons to use either loops described above, and often programmers will use both several times to construct syntactically correct code. For loop statements are utilized when the programmer knows how many times they would like to iterate over a block of code before a condition is satisfied. While loop statements are useful when the programmer does not know how many they need to iterate over a block of code before a condition is satisfied. As you can see through my examples and descriptions, both the for and while statements found in Java, and many other programming languages, can save the programmer time as they effectively and efficiently construct code.

Sources: https://docs.oracle.com/javase/tutorial/java/index.html

Essay 5

Title: Consciousness and Controversies

One of the most salient and controversial debates found within the realm of cognitive science is whether or not a machine could possess intelligence. This would mean that the machine would be capable of reasoning and understanding meaning the same way a human does. John Searles proposed in his Chinese Room Argument, that machines merely mimic human behavior by being symbol manipulation machines. The basis of the Chines Room Argument is as follows: an English speaker who does not know the natural language Chinese is placed into a room with a book filled with Chinese to English translations. A Chinese speaker outside the room composes messages in Chinese and gives them to the English speaker in the separate room. The English speaker is than able to respond to the messages in Chinese because he can manipulate the Chinese symbols using the book of translations. The person in the room does not understand any Chinese, but appears as though they do, by following English instructions for manipulating Chinese symbols (Cole, 2020). The English speaker may begin to understand the syntax of the natural language Chinese but has no sense of semantics. The heart of Searle's argument suggests that like the English speaker, computers and machines only understand syntax and not semantics (Cole, 2020). Searle's extends his argument and claims there is 'Weak AI' and 'Strong AI.' Weak AI merely mimics human intelligent by following syntactic rules for manipulate symbols but lacks the understanding for semantics or meaning. Strong AI replicates human intelligence and understands natural language by possessing mental capabilities. Opposing views to this argument include critics claiming that running a natural language program, as proposed by Searles, does no produce any understanding (Cole, 2020). Other critics to the argument claim that the English speaker in the room may not have any understanding for

Chinese at the moment, but an understanding for the language may begin to develop (Cole, 2020).

There are many different disciplines that contribute perspectives to both side of this debate. Psychology is a very influential field for this debate because the field explores how humans think and reason which provide foundational information for this debate. By not understand how humans think and reason, which is the basis for intelligence, no one would be able to compare the abilities of a machine to human intelligence. Another field that contributes perspectives to this debate is the field of linguistics. The field of linguistics is very influential for this debate as it describes how humans manipulate the symbols of a natural language to derive meaningful words, sentences, and phrases. Linguistics provides insight into how humans derive meaning, which is an ability only intelligence beings possess, allowing the concepts of weak and strong AI to be created.

Source:

Cole, D. (2020, February 20). The Chinese Room Argument. Retrieved December 10, 2020, from https://plato.stanford.edu/entries/chinese-room/