COGS 200 Assignment 1 Brian Taylor (UBC #52311859)

Hard copies to be submitted in class, and electronic copies via Connect, on 23rd September.

1. The three approaches of Cognitive Psychology can all contribute to our understanding of the human capacity to formulate questions (e.g. "Where is the dog?", or "Do you like potatoes?").

   a) Describe the experimentalist's contribution by designing an experiment, including defining an independent variable, a dependent variable and a hypothesis (3 points).

In my experiment subjects are shown a three-panel cartoon showing an interaction between two characters, one of whom is sitting at a computer. It's not clear exactly what is happening and there are many possible interpretations. Two kinds of subjects are recruited: the control group are those raised in urban North America, and the experimental group are those raised in rural sub-Saharan Africa. Subjects are asked to list questions that they arise from viewing the three-panel cartoon. The lists of questions are then examined and compared by number, and type (i.e. questions about the scene in general, or questions about specific characters or actions in the scene). The independent variable is the area in which the subject was raised, the dependent variables are the number of questions and the type of questions and they hypothesis is that the more familiar the scene (i.e. the computer scene is familiar to the North Americans) the greater the number of questions and the more scene specific the questions will be.

   b) Describe the computational modellers' contribution, by describing the input, output and goal of a computational model (3 points)

A computation model of question formation might have as its input a series of unrelated words and its output might consist of questions that seek to understand the connection between the words. The goal of the computational model would be to compare the types of questions generated by the computer with questions generated by humans given the same task.

   c) Then choose one neuroscientific method, and explain how that method could shed light on question formation (3 points)

For a neuroscientific approach we could have the subjects in the experiment described above in section (a) formulate their questions while in an fMRI machine. We could examine the different parts of the brain that light up during question formation and try to explore differences between the North Americans and the sub-Saharan Africans.

2. Does the presence of sound symbolism across languages contradict the arbitrariness of the linguistic sign? Briefly explain your answer. (3 points)

The fact that in many languages there are similar sounding words for things that are actual sounds does not contradict the arbitrariness of the linguistic sign. For the most part it is only things that are actual sounds that have similar sounding words, across languages or even within languages. And even with things that are actual sounds, such as the noises made by various animals, the words that different languages use are usually a bit different and sometimes completely different. Within a language it is not the case that similar concepts are necessarily connected to words that sound or look the same. There are a few examples of this as with the sn sound for things associated with the nose, but it's not exclusive, and these are more the exception than the rule. Certainly, for concepts or actions it would be hard to argue that the words used in different languages did not develop in an arbitrary way, with the exception of languages that descended from a common ancestor language.

3. Consider these two statements:

    I learned a new word today.
    I learned a new sentence today.

    Do you think you are equally likely to hear these two statements? Why or why not? What does your answer presuppose about the nature of language? (3 points)

The first statement is clearly more likely to be heard than than the second statement. In any language there are a finite, if large, number of words. However, in any language the number of possible sentences is essentially infinite.

In order to understand a sentence it is important to understand each word. Not knowing a single word can sometimes make it very difficult to understand the meaning of a sentence. (Conversely, knowing the meaning of each word does not necessarily mean the reader understands the meaning of the sentence, as is often true with those learning a new language.) So, one would probably not have a complete understanding of a sentence containing a new word. But to understand a sentence it is not necessary to have seen that sentence before. All that is required is a knowledge of each word and the rules that allow the words to be put together into a valid sentence.

4. In 'Is the Brain's Mind a Computer Program?' what does John Searle mean by 'weak AI'? (3 points)

Searle's distinction between strong AI and weak AI refers to a distinction between the notion that a computer program that passes the Turing test would be a model of the mind (weak AI) as opposed to literally being a mind (strong AI).

5. Turing proposed that, if we want to know whether a physical mechanism could think, we should instead ask whether a particular type of digital computer could win the imitation game. The second part of this thought is that we use the imitation game, as a way to

operationalise intelligence. What is meant by ‘operationalise’ here, and what by ‘the imitation game’ (3 points each)?

The ‘imitation game’ is a variant of a known game that Turing proposed be used to determine whether a computer could be said to be thinking. In the game an interrogator would ask questions of two parties (one human, one machine) and the responses in written form would then be assessed by the interrogator to try to distinguish the human from the machine. In the original game the interrogator was trying to distinguish between a male and a female.

Operationalise just means to define the variables so that something can be measured in an experiment and so that the experiment can be repeated. In Turing’s case he was suggesting operationalising the question of thinking machines by playing the imitation game.

Ref.: A. M Turing, ‘Computing machinery and intelligence’, Mind, 59(236), 433–460, (1950) (accessed on the web at http://phil415.pbworks.com/f/TuringComputing.pdf)

6. State the ‘verification principle’ as advocated by logical positivists. (2 points)

The verification principle is that only statements or theories about the world that are empirically verifiable, whose truth or falsehood can be established, can be considered as knowledge. Statements or theories that do not fall within this principle are merely opinion or emotional reactions to the world.

7. a) Is there a Turing Machine that, started anywhere on the tape, will eventually halt if and only if the tape originally had a 1 on it somewhere to the right of the place where the machine is started? If so, sketch the design of such a machine; if not, briefly explain why not. (3 points)

Yes. Basically the machine just needs to be programmed to continue moving to the right until it encounters a 1. The following single state table would perform that task. (I’m assuming that every cell on the tape contains either a 0 or a 1. In some explanations of a Turing Machine there are three possible states: blank, 0 or 1.)

Tape Symbol	**State 1**		
0	Write nothing	Move Right	Next State: 1
1	Write nothing	-	Next State: Halt

b) Is there a Turing Machine that, started anywhere on the tape, will eventually halt if and only if the tape originally was completely blank? If so, sketch the design of such a machine; if not, briefly explain why not. (3 points)

No. There is no way for a Turing Machine to determine if a tape of arbitrary length is completely blank without examining the entire tape. Since a Turing Machine can have a tape of infinite length (as specified in Turing's own definition of a Logical Computing Machine) it is impossible for it to determine if the tape is entirely blank. I believe this is an example of the 'halting problem'.

8. a) What two things might be meant when it is said that a Turing machine is universal? (4 points)

Turing wrote that the property that digital computers can mimic any discrete state machine is described by saying that they are universal machines. And a consequence of this is that all digital computers are in a sense equivalent.

Ref.: A. M Turing, 'Computing machinery and intelligence', Mind, 59(236), 433–460, (1950) (accessed on the web at http://phil415.pbworks.com/f/TuringComputing.pdf)

b) What is meant when we say that a NAND gate is universal? (2 points)

A NAND gate is universal because with NAND gates alone one can construct circuits equivalent to NOT, AND, and OR gates. Thus any circuit that can be constructed using NOT, AND, and OR gates can be constructed exclusively with NAND gates (or alternatively with NOR gates).

c) The Apollo Guidance Computer was built using only 3-input NOR gates. Why? (Note: You can do a bit of historical research to find out the actual reason. Full marks will also be given for speculations that demonstrate an awareness of the issues involved). (2 points)

Since NOR gates are universal you can build any circuit with NOR gates alone. When building the circuit you don't need to worry about an incorrect gate being used since every gate is the same. Also, if you use only one type of gate you can take advantage of scale manufacturing and (hopefully) reduce the error rate in manufacturing. The Apollo Guidance Computer was the first to use ICs.

d) The Apollo Guidance Computer could have been built using only 2 input NAND gates. Does this refute Searle's statement that "...the processes that define something as a computer... ...are completely independent of any reference to a specific type of hardware implementation"? Briefly explain your answer. (3 points)

No. Searle's reference to 'the processes' refers to what a computer is actually doing. A computer can run any number of programs (infinite variety) and a program can run on any number of computers. The computers need not even be silicon-based. The fact that you could build one computer to do a specific job (a guidance computer for instance) in a number of different ways is immaterial.

e) Searle treats the following two statements as axioms, “Axiom 1. Computer programs are formal (syntactic)”, and “Axiom 3: Syntax by itself is neither constitutive of nor sufficient for semantics.” Is his position refuted by the fact that the Apollo Guidance Computer successfully landed a man on the moon in 1969? Briefly explain your answer. (3 points)

Yes. I agree with Axiom 1, but I think that Axiom 3 is faulty. The fact that a computer (or human) does something gives it meaning. Syntax can lead to action, and that action has meaning. It doesn’t matter whether it’s a computer acting or a human acting. You could argue that the whole idea of meaning is different to a computer, but I think that is splitting hairs.

9. a) Winston asserts his “strong story hypothesis,” “strong perception hypothesis,” and “strong social animal hypothesis”. He claims these distinguish human intelligence from that of other primates. Briefly describe what Winston means by each of his three hypotheses. (3 points)

By ‘strong story hypothesis’ Winston asserts that it is our ability to combine, tell and understand stories that separates our intelligence from that of other animals. By ‘strong perception hypothesis’ Winston asserts that it is our ability to direct our attention and imagination that distinguishes us from other primates. By ‘strong social animal hypothesis’ Winston asserts that it is our strong social nature that amplifies the value of story telling and reuse of ideas.

b) Based on what you’ve learned in the course so far, briefly indicate the degree to which computational systems a) have, b) have not yet (but might someday) or c) will never satisfy these hypotheses. (4 points)

I think that to some degree computational systems have satisfied the first two hypotheses. It’s certainly possible for a computer system to combine ideas in unique, interesting and non-trivial ways. It’s also possible for computer systems to direct their attention and ‘imagination’, but it’s not clear to me that there is any social nature of computer systems. I suppose the fact that virtually every computer system in the world is now connected to every other computer system is a form of community, but in a very different way than we as humans would identify community.