GP - GEB Problem Set: The MIU-system

Name: Franklyn Sanchez

Abstract: This problem set is based on Chapter 1 of Hofstadter's GEB. In this chapter DRH presents his first Postproduction System, the MIU-System.

The 25 Questions and Answers

1. What, does Hofstadter claim, is one of the most central notions running through GEB?

    - A formal system.

2. Who invented the sort of formal system that Hofstadter features in his book (the sort of system that the MIU-system exemplifies), and when did this invention take place?

    - Emil Post in the 1920's.

3. In one four-word question, state the puzzle that is featured in this chapter.

    - Can you produce MU?

4. What is the given string in the MIU-system?

    - MI

5. What is the goal string of the MU-puzzle?

    - To achieve MU

6. How many rules in the MIU-system?

    - Four rules.

7. Carefully, precisely, write down the first rule of the MIU-system, and give two examples of its use, one directly from the chapter, and one that does not appear explicitly in the chapter.

    Rule: if you possess a string whose last letter is I, you can add on a U at the end.

- Chapter example: MI -> MIU
- My example: MUI -> MUIU

8. Carefully, precisely, write down the second rule of the MIU-system, and give two examples of its use, one directly from the chapter, and one that does not appear explicitly in the chapter.

Rule: Suppose you have Mx. Then you may add Mxx to your collection.

- Chapter example: MIU -> MIUMIU
- My example: MI -> MII

9. Carefully, precisely, write down the third rule of the MIU-system, and give two examples of its use, one directly from the chapter, and one that does not appear explicitly in the chapter.

Rule: If III occurs in one of the strings in your collection, you may make a new string with U in place of III.

- Chapter example: MIIII -> MIU
- My example: III -> U

10. Carefully, precisely, write down the fourth rule of the MIU-system, and give two examples of its use, one directly from the chapter, and one that does not appear explicitly in the chapter.

Rule: If UU occurs inside one of your strings, you can drop it.

- Chapter example: UUU -> U
- My example: IMUUU -> IMU

11. What is the word used to describe strings that are producible by the rules of a formal system from strings that have already been produced?

- Theorems.

12. What is the technical term for the string MI in the MIU-system?

- Axiom

13. In a formal system, is it more appropriate to say that theorems are proven or that theorems are produced?

- Its more appropriate to say that it is produced.

14. How does Hofstadter define the term derivation?

- It "is an explicit, line-by-line demonstration of how to produce that theorem according to the rules of the formal system" (Hofstadter, 1979, pg. 36).

15. Reproduce, line by line, character by character (including "reasons" (rule citations)) Hofstadter's derivation of the string MUIIU.

1) MI → Given Axiom
2) MII → Rule two states that the string Mx can be converted to Mxx.
3) MIIII → Rule two states that the string Mx can be converted to Mxx.
4) MIIIIU → Rule one states if I is the last letter in a string you can add U to the end.
5) MUIU → Rule three states that three consecutive I's in a string can be converted to a U.
6) MUIUUIU → Rule two states that the string Mxx can be converted to Mxxxx.
7) MUIIU → Rule four states that two consecutive U's can be dropped from the string.

16. Write down, line by line (including "reasons" (rule citations)) a derivation of the string MIIUIIU.

1) MIIUIIU → Given
2) MIIUIIUIIUIIU → Rule two states that the string Mx can be converted to Mxx.

17. On page 37, Hofstadter claims that there is a fundamental difference between a machine and a human? What is that difference?

- The difference that Hofstadter claims is true is that programmed machines may be unaware of the task its performing while a human cannot help but notice and register the actions they do.

18. With respect to formal systems, what is the difference between “working inside the system” and “working outside the system”.

- Working inside the system represents actions that are expected of someone given a scenario. For example, a student at the library might prefer to look up a question on scientific material on a desktop for ease of use. On the other hand, an elderly man wants to do research but does not like to use desktops. Working outside the system the man would be likely to search the library’s science section to retrieve the information.

19. Are there any theorems in the MIU-system that do not start with the letter M?

- No.

20. How is the previous question answered, by working within the system or by working outside the system.

- The previous answer was answered by working outside the system because it had to be thought about intuitively rather than done practically.

21. What does “M-mode” refer to? What does “I-mode” refer to?

- M refers to mechanical mode.

- I refers to intelligent mode.

22. Do you think that humans can work in M-mode? Please defend your answer.

- I don't think that humans can work on mechanical mode because humans have a finite amount work that they can produce. Humans will have to tire out mentally and physically over time even if the thinking and decision making was being done for them.

23. Do you think that machines can work in I-mode? Please defend your answer.

- I think there may have been a time when machines couldn't work on intelligent mode but in 2022, they do. An example of a machine on intelligent mode are Teslas. These cars have a self-driving AI that uses image processing for decision making. Humans need to have to decision procedure with respects to driving to drive on the roads these days. The AI in Tesla vehicles also must have decision procedure to be a reliable self-driving vehicle.

24. Two of the rules of the MIU-system are lengthening rules. What does this mean? Two of the rules of the MIU-system are shortening rules. What does this mean?

- Lengthening rules are applied to increase the size of the string and they are in rule one and two.

- Shortening rules are rules applied to shorten the size of the string and are in rules three and four.

25. Define "decision procedure" with respect to a formal system.

- From what I was able to understand, having decision procedure with respect to a formal system means having more then just practical knowledge on it. It involves knowing the possible outcomes of a decision and using that intuitive knowledge to calculate your next decision.