

## GP - GEB Problem Set: The MIU-system

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

### The 25 Questions and Answers

Craft a nicely formatted document consisting of both the questions that you see below, and, immediately following each question, your answer to the question. Please see the accompanying partial template, which is intended to suggest a sound formatting scheme for your work on this assignment. Please save your document as a pdf file.

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

Hofstadter claims that a formal system is one of the most central notions through GEB, and it is also often called a "Post production 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 invented this sort of formal system 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?

The string given in the MIU-system is MI.

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

The goal string is MU.

6. How many rules in the MIU-system?

There are four rules in the MIU-systems.

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.

The first rule of the MIU-system is that if you possess a string whose last letter is I, you can add a U on the end. An example is if you have MIII, you can get MIIIU. Another example is if you have MUI, you can get 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.

The second rule of MIU-system is that if you have  $Mx$ , then you can add  $Mxx$  to your collection. An example in the chapter is, from MIU, you can get MIUIU. An example not explicitly in the chapter is if you have MUMU, then you can get MUI, then you can get MUIUI.

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.

The third rule of MIU-system is that if III occurs in one of the strings in your collection, you may make a new string with U in place of III. An example from the chapter is from UMIIIMU, you can make UMUMU. An example not explicitly in the chapter is from MUIII, you can make MUU.

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.

The four rule of MIU-system is that if UU occurs inside one of your strings, you can drop it. An example from the chapter is from UUU, you can get U. An example not explicitly in the chapter is from MIUUU, you can get MIU.

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?

Words used to describe strings that are producible by rules are call theorems.

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

MI is a "free" theorem called an axiom.

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

It is more appropriate to say that theorems are produced since in its definition is something that is producible by the rules of the formal system.

14. How does Hofstadter define the term derivation?

Hofstadter defines the term derivation that derivation of a theorem is an explicit, line-by-line demonstration of how to produce that theorem according to the rules of the formal system.

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

- (1) MI                    axiom
- (2) MII                 from (1) by rule II
- (3) MIII                from (2) by rule II
- (4) MIIIIU             from (3) by rule I
- (5) MUIU                from (4) by rule III
- (6) MUIUUIU         from (5) by rule II
- (7) MUIIU              from (6) by rule IV

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

- (1) MI                    axiom
- (2) MII                 from (1) by rule II
- (3) MIIU                from (2) by rule I
- (4) MIIUIIU            from (3) by rule II

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

The difference between a machine and a human is that, it is possible for a machine to act unobservant while it is impossible for a human to act unobservant.

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

Working inside the system means that you have no other information other than the given rules of the system while working outside the system means you have information or you make observations outside of the system.

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

No, there are no theorems in the MIU-system that do not start with M.

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

By working outside the system.

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

M-mode refers to mechanical mode and I-mode refer to Intelligent mode.

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

I do think humans can work mechanically and doing things machines can, just might be slower.

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

No, I don't think machines can think intelligently like humans by themselves, so it's not truly intelligent.

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 allow us to increase the size of the string (rule I and II), while shortening rules allow us to shrink the strings (rule III and IV).

25. Define “decision procedure” with respect to a formal system.

Decision procedure for a given formal system is a test that always terminates in a finite amount of time.