

C240 Computability and Complexity Tutorial 5

The Halting Problem is very important. If you are not sure about it, please ask a tutor. Then try these questions.

1. Show that there is no Turing machine H' such that for all standard Turing machines S and word w of C :

$$F_{H'}(\text{code}(S)*w) = 1 \text{ if } S \text{ halts on input } w, \\ 0 \text{ otherwise.}$$

(The 'usual' machine H prints 1 if S *halts and succeeds* on w).

2. Show that there is no Turing machine EO (standing for "empty output") such that for all standard Turing machines S and words w of C :

$$F_{EO}(\text{code}(S)*w) = y \text{ if } f_S(w) = \square \\ n \text{ otherwise.}$$

3. Show there is no Turing machine H'' such that for all standard Turing machines S and words w of C :

$$F_{H''}(\text{code}(S)) = 1 \text{ if } S \text{ halts and succeeds on input} \\ \text{code}(S), \\ 0 \text{ otherwise.}$$

(The 'usual' machine H takes input $\text{code}(S)*w$, i.e.2 items).

4. Can you show there is no H'' as in (3) by using the method of reduction: reducing HP to the problem that H'' solves?