HW11

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1. You are employed as a programmer, and you are asked to write a program that:

(a) receives in input a generic C program x, and counts the number of statements in x.

Y

(b) receives in input a generic C program x and an input string w, and counts the number of statements executed at least once when x runs on input w.

N

(c) receives in input a generic C program x and an input string w, and counts the number of statements never executed when x runs on input w

N

(d) receives in input a generic C program x and decides whether x is syntactically correct.

Y

(e) receives in input two natural numbers and computes a specific function $f : N^2 \to N$

N

(f) receives in input a generic arithmetic expression e composed of integers and the four arithmetic operators, and computes its value.

Y

(g) halts on the empty string.

Y

(h) receives in input a generic C program x and decides whether x halts only on the empty string.

N

(i) receives in input two generic regular expressions and decides whether they are equivalent.

Y

(j) receives in input a generic C program x and the name of one of its functions, f, and decides whether x can ever call f.

N

(k) receives in input a generic C program x, an input string w, and the name of one of its functions, f, and decides whether x calls f when runnning on input w.

N

(l) receives in input two generic C programs x_1 and x_2 and an input string w, and decides whether x_1 and x_2 produce the same output when running on input w.

N

(m) receives in input two generic C programs x1 and x2, and decides whether x1 and x2 produce the same output when running on every possible input.

N

(n) receives in input two generic C programs x1 and x2, and decides whether x1 and x2 produce the same output when running on at least one input.

N

(o) receives in input a generic C program x, an input string w, and a natural number n, and decides whether x uses less than n bytes of memory when running on input w.

Y

(p) receives in input a generic C program x, an input string w, and decides whether there is $n \in N$ such that x uses less than n bytes of memory running on input w.

N

2. Use reduction to prove that the language

Suppose by contradiction that L is decidable. We will reduce the halting problem to L. To reduce we will create a new machine that is the same as the halting problem with a machine that takes L. We will assume that machine $M^{'}$ takes L. If the machine M with input w enters its inital state more than once then if it was given to $M^{'}$ it would return true. Suppose that the machine we are making is $M^{''}$. We will create $M^{''}$ with $M^{'}$. In order to do this $M^{''}$ will append a transition to the initial state to w. In otherwords for all inputs to $M^{'}$ if it halts it will be true. If $M^{'}$ does not halt it will never return to the initial state and since we assume its decidable it would be false. This is a contradiction because this machine $M^{''}$ is the halting problem because it returns true if it halts and false if it does not. Therefore by reduction L is not decidable.