

Ma/CS 117a HW #3

Due Tuesday, October 29th, at 1pm

- 1) Show that every program P for a register machine on an alphabet A can be replaced by an equivalent program P' on the same alphabet which uses only instructions of types “ ADD_j ” “ DEL ” “ $IF\ FIRST_j$ ” “ $GOTO\ l$ ” and “ $STOP$.”

(*Equivalent* here means that on any input $(w_1, \dots, w_n)$ either both P, P' do not halt, or else they both halt and produce the same output, where by “output” we mean the content of the first register R1 when the computation terminates. The intermediate steps of the computation however might be different. Also the program P' can use more registers than P .)

- 2) Find explicitly a Turing machine M on the alphabet $A = \{1\}$ such that on each input $n \in \mathbb{N}$, the output is $2n$.

Note. Here $n = \underbrace{11 \dots 1}_n$.

Note. The alphabet of M for this problem is *not* supposed to contain the symbol “,”.

- 3) For every alphabet A , find explicitly a Turing machine M such that on each non-empty input $w \in A^*$, M terminates iff w is a palindrome.