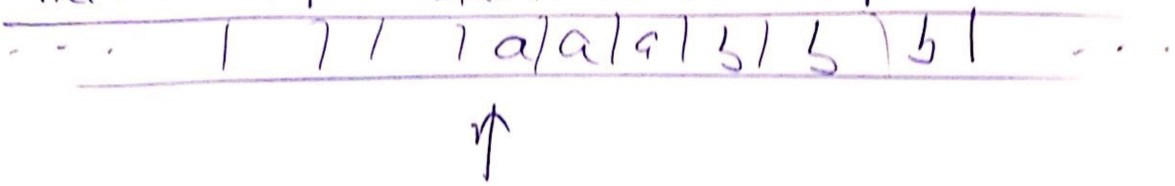
Formalizing computation : Turing Machines

infinite tape starts with the input on it



with a finite-state controller that can read/write/move the tape head

the program

# of steps of computation = # of transitions of the controller

— unambiguous

For us : imagine # of assembly language instructions is the # of basic steps (a bit ambiguous)

A time bound on a program is a function specifying the number of basic steps allowed for each input size.

$f: \mathbb{N} \to \mathbb{N}$ where $f(|w|)$ gives # of steps allowed for input w.

A time bound is polynomial if $f(x) = \sum_{i=0}^{k} a_i x^i$ for some $a_i \in \mathbb{R}$, $k \in \mathbb{N}$

we will consider a program to run in polynomial time if there is a polynomial time bound the program finishes within for all inputs. (a worst case time bound)

A language L is decidable in polynomial time iff there is some program P that says yes to input w exactly when $w \in L$ and P runs in polynomial time. (always finishes within $f(|w|)$ for some polynomial bound f)

The class of all such L is called $\mathbb{P}$.

Let "$\varphi;\rho$" be a string encoding of a Boolean formula φ and a truth assignment ρ

The language FORMULA_EVAL = $\{$"$\varphi;\rho$" $\mid \varphi$ is true under $\rho\}$

– can be decided in polynomial time. (e.g. use recursion and solve recurrence)

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related question:

FORMULA_SATISFIABILITY = $\{$ "φ" $|$ There is ρ s.t φ is true under ρ $\}$
_SAT

obvious algorithm:
try every ρ to see if φ is true

How many truth assignments ~~do we~~ are there?

$\sim 2^{|\varphi|}$. exponential in $|\varphi|$

FORMULA-SAT $\in$ P is OPEN.