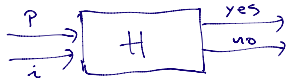
Chomsky Hierarchy

Machine	Language	Grammar
DFA NFA ε-NFA finite state space no external memory	regular languages regular expressions	A ::= 'a' A ::= A 'a'
PDA finite states external memory: stack	context-free languages	context-free gr. E ::= E '+' E one non-terminal on the left
	context sensitive	context-sensitive right hand side is longer than the left
Turing Machines	recursively enumerable	general rules

Halting Problem

Can we decide at "compile time" whether a program p terminates / halts on all inputs? No

Ass: There is program H

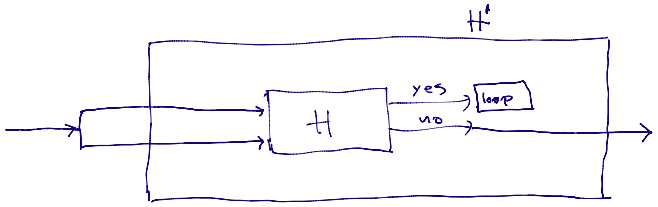


which decides whether p terminates on i

Idea: Derive contradiction from the assomption.

Building H' from H

Run H' on itself as input



Now we make a case distinction:

- H' does halt on H' ⇒
  H' does not halt on H'

- H' does not halt on H' ⇒
  H' does halt on H'

Both cases give a contradiction.

Hence H cannot decide for all p and i whether p halts on i.