G52MAL
Machines and their Languages
Lecture 9: Proving Languages not to be Regular

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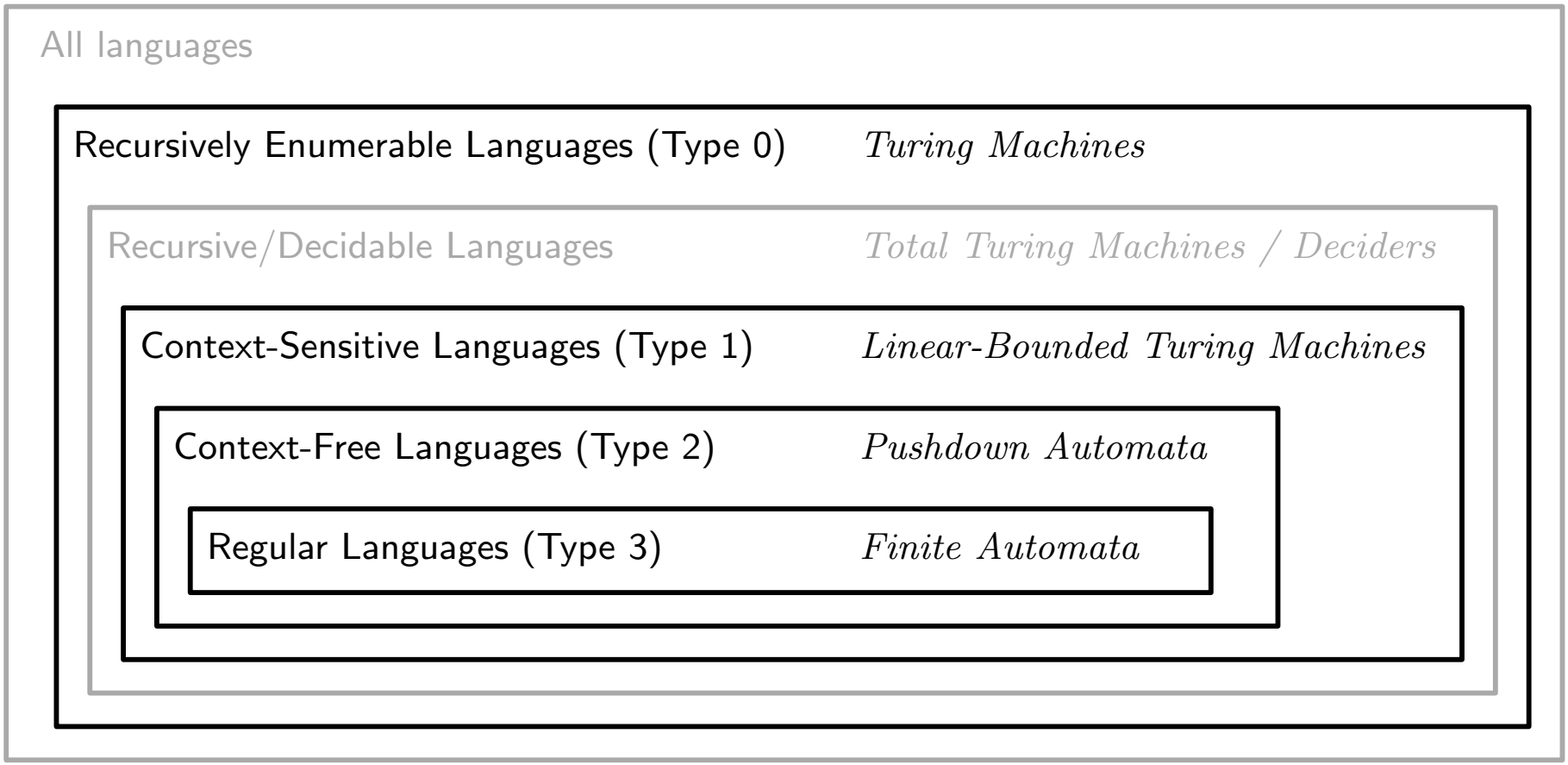
Regular Languages

- The Regular Languages are those that can be recognised by finite automata.
- Such machines have a finite number states (i.e. finite memory).
- But many languages are not regular.

The Chomsky Hierarchy



Proving Languages not to be Regular

- How do we prove a language is not regular?
- One technique: Using The Pumping Lemma
- Basic idea: Exploit the fact that, for any Regular Language, sufficiently long words are repetitive.

The Pumping Lemma for Regular Languages

Given a regular language L, there exists an $n \in \mathbb{N}$ such that all $w \in L$ of length at least n can be split into three words ($w = xyz$) satisfying:

- $y \neq \varepsilon$
- $|xy| \leq n$
- $\forall\, k \in \mathbb{N}.\ xy^k z \in L$

Recommended Reading

- Introduction to Automata Theory, Languages, and Computation (3rd edition), pages 127–131
- G52MAL Lecture Notes, pages 29–31