Chomsky Hierarchy

Type	Grammar	Language	Automata
3	Finite State	Regular	Finite
2	Context-Free	C-F	Pushdown
1	Context-Sensitive	C-S	Linear-Bounded
0	General Rewrite	Unrestricted	Turing Machines

- occasionally referred to as Chomsky–Schützenberger hierarchy
- described by Noam Chomsky in 1956
- hierarchy of grammars
    - Type 3 $\subset$ Type 2 $\subset$ Type 1 $\subset$ Type 0

Alphabets and Languages

An alphabet is a finite non-empty set.

Let S and T be alphabets.

$S \bullet T = \{ s\ t \mid s\ \varepsilon\ S,\ t\ \varepsilon\ T \}$

(We'll often write ST for S•T.)

λ = empty string, string of length one

$S^0 = \{\lambda\}$

$S^1 = S$

$S^n = S^{(n-1)} \bullet S,\ n > 1$

$S^+ = S^1 \cup S^2 \cup S^3 \cup \ldots$

$S^* = S^0 \cup S^+$

A language L over an alphabet S is a subset of S*.

Definition of a Grammar

A grammar G is a 4 tuple G = (N, Σ, P, S), where

- N is an alphabet of nonterminal symbols
- Σ is an alphabet of terminal symbols
- N and Σ are disjoint
- S is an element of N; S is the start symbol or initial symbol of the grammar
- P is a set of productions of the form α -> β where
  - α is in (N U Σ)* N (N U Σ)*
  - β is in (N U Σ)*