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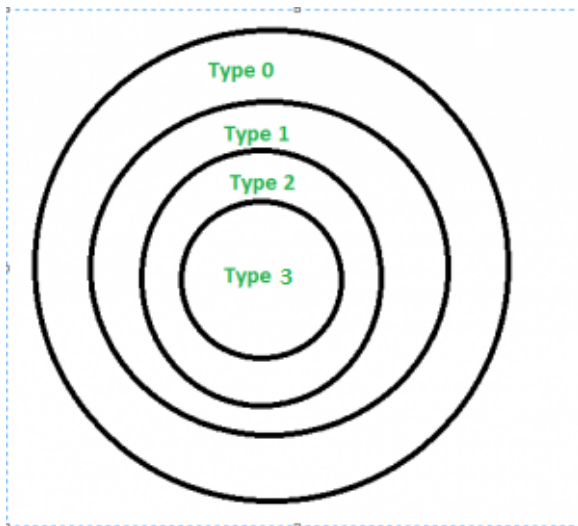
Theory of Computation | Chomsky Hierarchy





According to chomsky hierarchy, grammars are divided of 4 types:

Type 0 known as unrestricted grammar.
Type 1 known as context sensitive grammar.
Type 2 known as context free grammar.
Type 3 Regular Grammar.



Type 0 (Unrestricted Grammar)

In Type 0

Type-0 grammars include all formal grammars. Type 0 grammar language are recognized by turing machine. These languages are also known as the recursively enumerable languages.



Grammar Production in the form of

$$\alpha \rightarrow \beta$$

where

α is $(V + T)^* V (V + T)^*$

V : Variables

T : Terminals.

β is $(V + T)^*$.

In type 0 there must be at least one variable on Left side of production.

For example,

$Sab \rightarrow ba$

$A \rightarrow S$.

Here, Variables are S, A and Terminals a, b.

Type 1 (Context Sensitive)

Type-1 grammars generate the context-sensitive languages. The language generated by the grammar are recognized by the [Linear Bound Automata](#)

In Type 1

1. First of all Type 1 grammar should be Type 0.
2. Grammar Production in the form of

$$\alpha \rightarrow \beta$$

$$|\alpha| \leq |\beta|$$

i.e count of symbol in α is less than or equal to β

For Example,

$$S \rightarrow AB$$

$$AB \rightarrow abc$$

$$B \rightarrow b$$

Type 2 (Context Free)

Type-2 grammars generate the context-free languages. The language generated by the grammar is recognized by a **Non Deterministic Push down Automata**.

Type-2 grammars generate the context-free languages.

In Type 2,

1. First of all it should be Type 1.
2. Left hand side of production can have only one variable.

$$|\alpha| = 1.$$

There is no restriction on β .

For example,

$$S \rightarrow AB$$

$$A \rightarrow a$$

$$B \rightarrow b$$

Type 3 (Regular Grammar)

Type-3 grammars generate the regular languages. These languages are exactly all languages that can be decided by a finite state automaton.

Type 3 is most restricted form of grammar.

Type 3 should be in the given form only :

$V \rightarrow VT^* / T^*$.

(or)

$V \rightarrow T^*V / T^*$

for example :

$S \rightarrow ab$.

REFERENCES

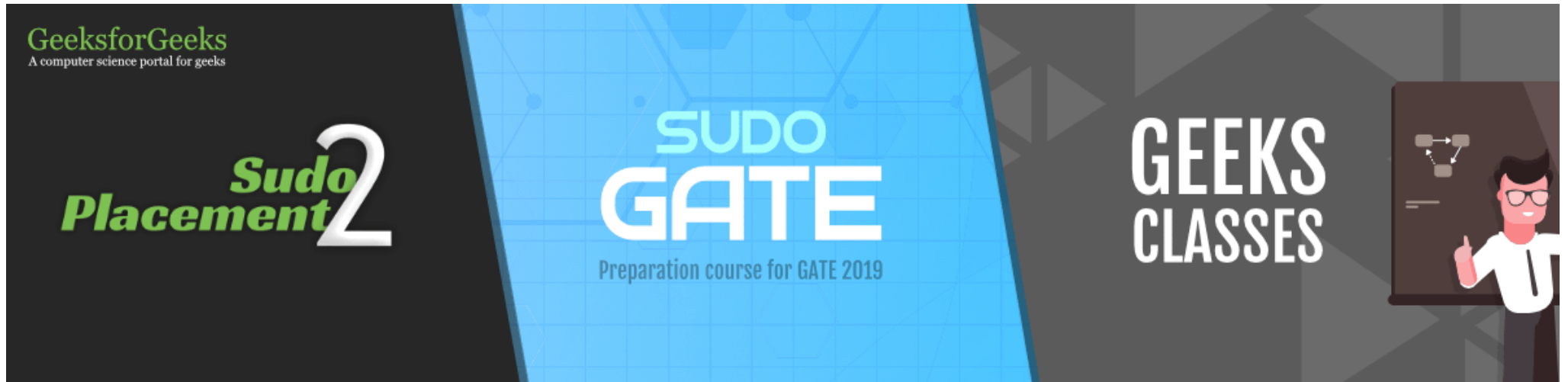
https://en.wikipedia.org/wiki/Chomsky_hierarchy

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NPDA for $L = \{0^i 1^j 2^k \mid i=j \text{ or } j=k; i, j, k \geq 1\}$

Turing Machine for subtraction | Set 2

Construct Pushdown automata for $L = \{0^n 1^m 2^{(n+m)} \mid m, n \geq 0\}$

Construct a Turing machine for $L = \{a^i b^j c^k \mid i*j = k; i, j, k \geq 1\}$

Construct Pushdown automata for $L = \{a^{(2^*m)} c^{(4^*n)} d^n b^m \mid m, n \geq 0\}$

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