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THEORY OF COMPUTATION

- GODEL : Logic is limited
- Turing : Model for computation
- POST
- chomsky Heirarchy

→ 2 types of computer

Acceptors: Yes/NO ; given lang. Accept or Not Accept.

Transducer: computational
x is given f(x) can be computed.

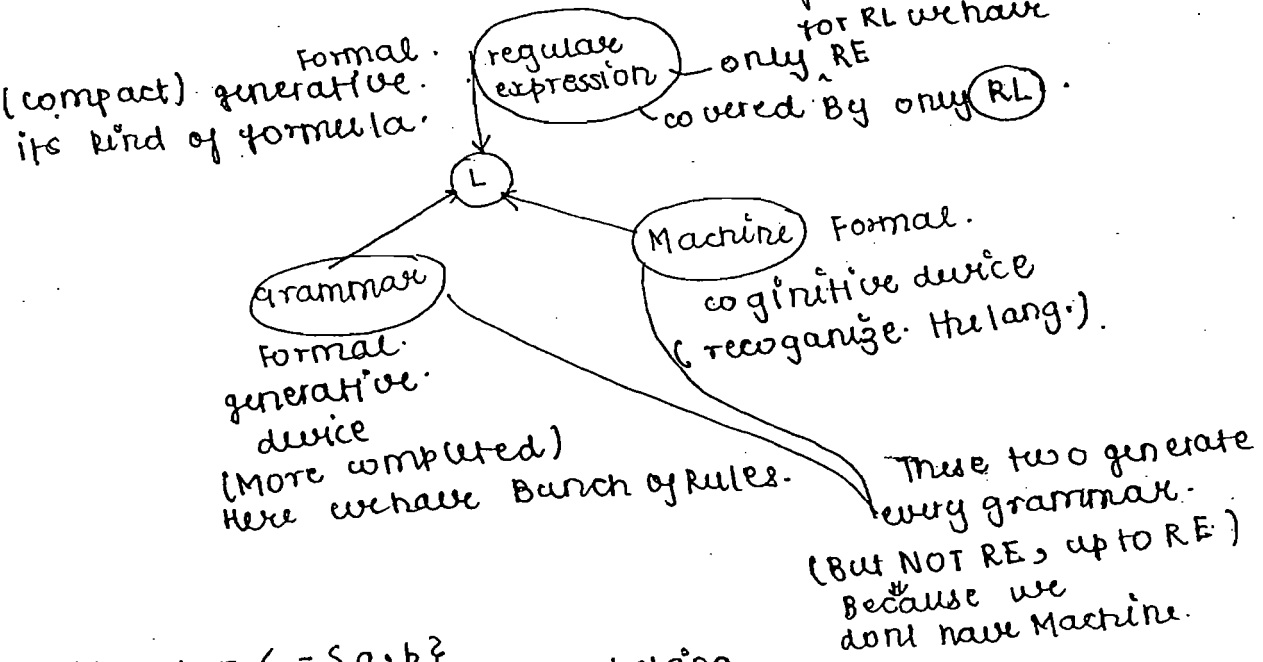
- every problem has associated with language.. we bother about acceptance of Language. if we can accept the language. we can say problem is solvable.

chapter - 0

- Language : collection of strings
  - grammar:
  - Machine:

Language can be described by grammar.

- (L) Informal (cant list all the things in language)



1. Alphabet = $\Sigma = \{a, b\}$
2. String
3. concatenation
4. Reversal
5. Length of a string
6. NULL string. = "ϵ"
7. PREFIX
8. SUFFIX
9. substring
10. substring.
11. Powers of a string $(\omega)^n$.
12. Σ^*, Σ^+
13. $L \subseteq \Sigma^*$.
14. CHOMSKEY HEIRARCHY
14. ~~operat~~ Representations of Language

- Language

1. alphabet:

14. Representation of Language 6 — 3 Formal, 3 Informal.

15. Operations on Language.
union, intersection, L, $L_1 - L_2$, $L_1 \oplus L_2$

16. concatenation of Lang.

$$L_1 \cdot L_2 = \{uv \mid u \in L_1, \& v \in L_2\}$$

17. $L^R = \{u^R \mid u \in L\}$ Reversal of language.

18. L^*, L^+ (Not contain ϵ)

$L^+ = L^* - (\epsilon)$ ⟶ This is Not correct statement.

L^* contain ϵ every possible combination of strings.

• **Alphabet**: a Non-empty finite set of symbols.

$\Sigma = \{\}$ Not alphabet.

• $\Sigma = \{a\}$, $\Sigma = \{1\}$, $\Sigma = \{2\}$ $\Sigma = \{3\}$ (1 symbol) unitary alphabet

• $\Sigma = \{a, b\}$, $\Sigma = \{1, 0\}$ Binary alphabet (2 symbol).

$\Sigma = \{1, 11, 111 \ldots\}$ This is Not allowed, No of symbols should be finite.

$\{0, 1, 2\} = \{0, 1, 2\}$

both alphabet same, order dont matter.

symbol $\Sigma = \{\underline{01}, \underline{10}\}$.

compound symbol

$\Sigma = \{01, 10, (1), (0)\}$

This is Not valid symbol 01 or 10 cant break further.

• **String**: sequence of 0 or more finite symbols taken from the alphabet

sequence : order is important.

$\Sigma = \{a, b\}$.

a^{100} is valid string ? ⇒ Yes.

aaa ... 100 times valid.

aabb(1) valid ? ⇒ No symbols can be taken from alphabet.

baab = baba Not equal string, 'sequence should be follow'

$(ab)^2 \neq a^2b^2$ Not valid in TOC.

$abab \neq aabb$

• **concatenation**:

if $u = 01$

$v = 100$

$uv = \underline{01}\underline{100}$ concatenation

Here $uv \neq vu$.

for all (u, v)

where $u = 00$

$v = 000$.

$uv = vu$ True Here

so Not for all (u, v); $uv \neq vu$.

• it is associative

$u(vw) = (uv)w$

• Not communicative.

• The length of $u \cdot v$ will always be equal to $(u+v)$.

$u = 01 = 2$

$v = 100 = 3$

$uv = 01100 \Rightarrow$ length is $(2+3) = 5$

• The length of u^i

$u = 100$ $u^R = 001 \Rightarrow u^R \neq u$

for all u and v $u^i \neq u$ False

• $v = v^R$ iff v is a palindrome.

Palindrome

• even (because length is integer). : EP

• odd. : OP.

Palindrome Language = $\{ \underset{EP}{w w^R} \cup \underset{OP}{w x w^R} \mid w \in \Sigma^*, \overset{x \text{ is 1 bit}}{x \in \Sigma} \}$

$\Downarrow$ $\Downarrow$

1001 10001

$\{ w \in \Sigma^* \mid w = w^{\overline{x}} \}$

• Properties of Reversal

$(v^R)^R = v$

(Reversal of Reversal).

$(u \cdot v)^R = v^R u^R$

$(xyz)^R = z^R y^R x^R$.

• Length :

No of symbols present in strings.

if $\Sigma = \{0, 1, 2\}$.

→ How many 5 length string possible. if $\Sigma = \{a, b\}$.

0 length → 1 (i.e ε)

1 length → a, b → $|\Sigma| = 2$

2 length → ab, ba, aa, bb → $|\Sigma|^2$. (cardinality of Σ.)

⋮

n length → $|\Sigma|^n$.

So of length '3' 3^3 ⇒ for $\Sigma = \{a, b, c\} \Rightarrow |\Sigma| = 3$

length '5' 3^5

ww^R How many even palindrome of length 10.

$\Sigma = \{0, 1\}$

$\underline{2}\ \underline{2}\ \underline{2}\ \underline{2}\ \underline{2}$ | — — — — —

(25)

even palindrome $= |\Sigma|^{n/2}$

- ODD ⇒ length 13. $\Sigma = \{0,1\}$
  check even → 12.

$|\Sigma|^{\frac{12}{2}}$ $\quad |2|^6 \Rightarrow 2^6 \times 2$ odd palindrome.

upto length 10, even palindrome. $\Sigma \{0,1\}$

0	length ⟶	$2^{0/2} = 1$
2	"	$2^{2/2} = 2$
4	"	$2^{4/2} = 4$
8	"	$2^{8/2} = 2^4$
10	"	$2^{10/2}$

- **NULL string:**
  it is only string of length '0'

lang with Null string. $|\{\varepsilon\}| \rightarrow$ cardinality.

$|\varepsilon| = 0$.

$|\{\}| = 0$.
empty language.

- language has cardinality.
  where
  Null Reverse is Reverse
  Null is identity element for concatenation.

- $(\Sigma^*, \cdot, \varnothing)$ — groupoid, operator, semi-group.
  ↓ Algebra.

- $|\{0,1\}|^5 \rightarrow |(0,1)|$
  How many f^n possible
  all string of length 5.

$|\Sigma|^5 \rightarrow \Sigma$ possible function.

cardina. $= 2^5$ $\qquad 2$.

$|B|^{|A|}$ function possible $= \underline{\underline{2^{(2^5)}}}$