DIGITAL EDUCATION
MARTCOST

COMPUTER SCIENCE & ENGINEERING

INFORMATION TECHNOLOGY

Theory of Computation

Hand Notes For GATE, PSUs & Competitive Exam

Hand Notes

Page Length : 273

ZOOM
1 INTERNET

Theory of Computation

In formal language we give importance only for formation of string rather than meaning of string.

Σ → alphabet → finite set
Σ^* → set of all strings → Countable set
2^{Σ^*} → set of all formal language → Uncountable

S → Countable
2^S → Uncountable
Subset of countable set is countable.

REL → T.M Countable
CSL → LBA "
CFL → PDA "
RL → F.A "

Grammer :- Set of production rules which are used in generation of string is called a grammer.

eg. $S \rightarrow AB$
$A \rightarrow a$ → terminal
$B \rightarrow b$
↓
non Terminal.

1) Grammer is a generating device.

2) A grammer generates only one language.

$\alpha \rightarrow \beta$

No rules

At L.H.S & R.H.S

we can allow terminals & Non Terminals

$\alpha \rightarrow \beta$

$|\alpha| \leq \beta$

$\alpha \rightarrow \beta$

↓

Variables

T_0 T_1 T_2

Types of Grammers :-

1) Type 0 or R.E.

2) Type 1 or C.S.L

3) Type 2 or CFG

4) Type 3 or Regular Grammer.

$T_3 < T_2 < T_1 < T_0$ Chomsky Hierarchy

Alton

form

→ f

Type

1) Fi

2) P

3) L

4) -

Type

1) -

2) -

3)

4)

Automata → Accepting Device.

nguage

Automata :- Mathematical representation of formal Language is c/d Automata.

→ Automata is accepting Device.

3

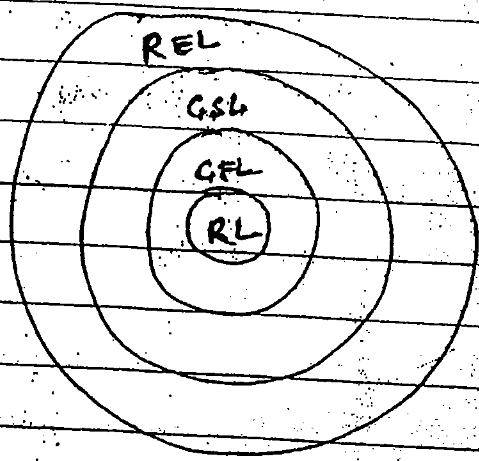
Types of Automata.

1) Finite Automata.
2) PDA
3) LBA
4) T.M. Turing M/c

Types of Formal Language:-

1) Type 0 R.E.L.
2) Type 1 C.S.L → Right side ki string Left se Humesha Badi Hogi
3) 2 CFL → Left me Humesha Variable
4) 3 Regular Lang → left me Teminal

ky Hierachy

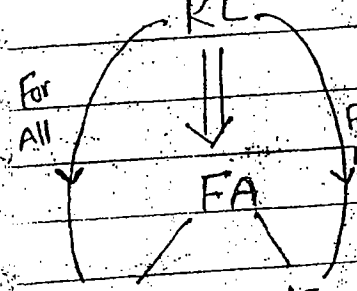


¶ Non deterministic M/c is more powerful than deterministic.

Expression power of acceptable power means the number of languages that is accepted by an Automata.

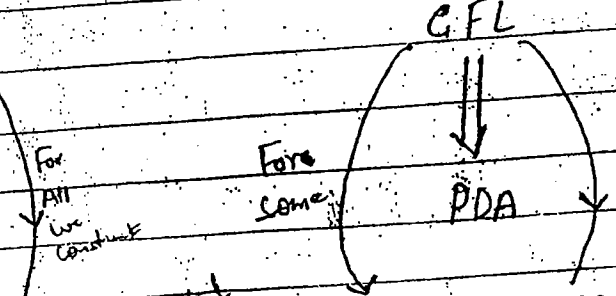
E(FA) = 1 E(LBA) = 3

E(PDA) = 2 E(TM) = 4



DFA = NFA ⇒ Powerful

↓ efficient



DPDA < NPDA

↓ Capabilities

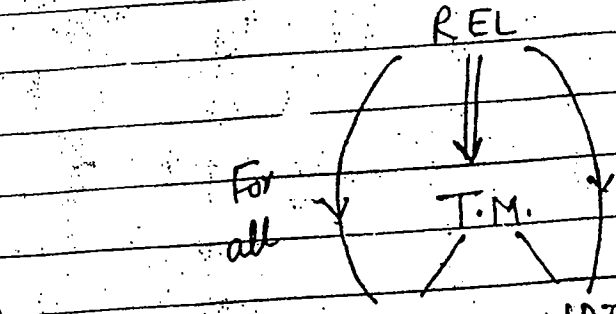
CSL

↓

LBA

DLBA NLBA

Undecidable



DTM = NDTM

↓ Capabilities

LBA { Non deterministic Turing M/c }.

Gate 2

Q:-

a) Co

b)

c)

d) T

NPI

Q:- I

a)

Ans

Q:-

a) r

b) N

vt [

d)

Gate 2009.

Q:- Which of following is false.

a) Capabilities of DFA & NFA same.
b) " " DPDA & NPDA is same ✓
c) " " DTM & NTM is same.
d) None

NPDA is more powerful than PDA.

Q:- Which of following cases can we construct an automata in both deterministic & Non Deterministic mode to accept same language.

a) RL b) CFL c) CSL d) REL

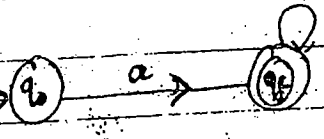
Ans a, d. (2 No. R ke case me hum Deterministic aur Non Deterministic bana skte hai aur 2 No ki power bhi same hoti hai).

Q:- Which of following is incorrect.

a) DFA is more efficient than NFA.
b) NPDA is more powerful than DPDA.
c) DTM is more powerful than NTM.
d) None.

∴ FA has limited & static Memory b/c of limited of memory FA can't accept some of formal Language.

$L = \{ a^n / n \geq 1 \}$



PDA = FA + 1 stack.

T.M = PDA + 1 stack = FA + 2 stacks
= FA + n stacks $\{ n \geq 2 \}$.

$L = \{ a^n b^n / n \geq 1 \}$ → PDA

for every a push in stack.
for every every b pop a. If stack is empty accept string.

a
a

$L = \{ a^n b^n c^n / n \geq 1 \}$ → TM

for a & b push in 2 seperate stacks
for every c pop a & b. If both stack are empty accept string.

a	b
a	b

Q:- Which of following statement is wrong.

a) PDA is more powerful than FA.
b) TM is more powerful than PDA.
c) FA+3 stack is morepowerful than T.M.
d) None

Alphabet :- A called Σ

Ex :- Σ = {
Σ = { 0

STRING :- Σ is calle

Ex :- { 0, 1
ω = 102

|W| = les

If ω is No. of is ca denoted

Note :- 1

Empty stri called

Denoted

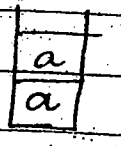
W = ∈
W ≠ ∈

Date: 30/08/10

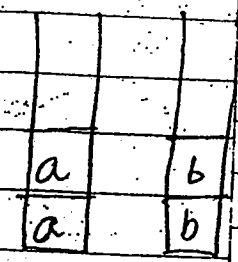
b/c of limitat

Core of formal

$w \{n \geq 2\}$.-



Stack is empty



is wrong.

FA.

PDA.

than T.M.

Alphabet :- A non empty set of symbol is called an Alphabet & denoted by Σ

Ex :- $\Sigma = \{a, b, \ldots x, y, z\}$ $\Sigma = \{0, 1, 2, 3 \ldots 9\}$

$\Sigma = \{0-9, a-z\}$.

STRING :- Sequence of symbols from alphabet Σ is called a string.

Ex :- $\{0, 1\}$ $w = 011, 1011, 101010$. i.e. any comb. of 0 & 1.

$w = 102, 3012$ Not string.

$|w|$ = length of string 3, 4, 6.

If w is any string over alphabet Σ the No. of symbols involved in string w. is called Length of string & denoted by $|w|$.

Note :- $|w| \geq 0$

Empty string :- A string of length 0 is called empty string.

Denoted by ϵ (epsilon or Null).

$w = \epsilon \Rightarrow |w| = |\epsilon| = 0$ empty.

$w \neq \epsilon \Rightarrow |w| = |\epsilon| \neq 0$