FEBRUARY 2022

02 Wednesday

Week 6 ■ 033-332

JANUARY 2022

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30	31					1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
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23	24	25	26	27	28	29

Formal Languages & Automata Theory

Module 5 - Context Sensitive Languages, Turing Machines

Context Sensitive grammar & language

Grammar, $G = (V, T, P, S)$ is CSG, if it satisfies all of the following:

i) LHS may contain terminals
ii) RHS should not contain $\in$.
iii) $|\alpha| \leq |\beta|$

V - variables
T - terminals
$P : \alpha \to \beta$, $\alpha, \beta \in (V \cup T)^+$ (Production)
S - Start symbol.

Language produced by CSG → CSL.
Automata - Linear Bounded Automata.
Type 1 grammar

Properties of CSL

1) Union
2) Intersection
3) Concatenation
4) Complement.

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2022 FEBRUARY

Thursday 03

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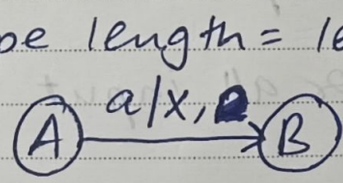
Linear Bounded Automata

$M = (Q, \Sigma, T, \delta, q_0, M_L, M_R, F)$
Q - set of states
Σ - input symbols
T - Tape alphabets
δ - transition function → tape symbol
$\delta(q, \text{tape symbol}) \to (q, t_1, c)$
c → 0, +1, -1.

$\delta : (Q - F) \times T \to Q \times T \times \{L, R\}$
(Q - F) → excluding final state
{L, R} → direction

q_0 - Start state
M_L - left marker
M_R - Right marker
F - final state

Tape length = length of input symbols.



$\delta(q, a) = (q, X, D)$

a - Input symbol
X - Replacement (tape symbol)
D - direction.

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04 Friday
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Turing Machine

$M = (Q, \Sigma, \Gamma, \delta, q_0, B, F)$

Q - set of state
Σ - input symbols
Γ - tape symbols
δ - Transition function
$\delta(q, X) = (p, Y, D)$
D: L R
q_0 - start symbol
B - Blank symbol
F - set of final states

Recursive language: Accepts all strings in 'L' & reject all strings not in 'L'.
Will halt every time & give an answer.

Recursively enumerable: Accepts for all input strings in 'L'
May or may not halt for all input strings not in 'L'.

Decidable language ⇔ Recursive language
Partially decidable → Recursively enumerable
Undecidable → could be partially decidable but not decidable.

not mandatory

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Saturday 05
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Universal Turing Machine

Input: M = Turing machine
W = string given as input.

Action: Simulate M
May accept, reject or loop.

UTM is a recognizer (not a decider) for
$A_{TM} = \{ \langle M, w \rangle \mid M \text{ is a TM \& } M \text{ accepts } w \}$

The Halting problem

→ Undecidable.

Let
H(P,I)
- Halt
- Not Halt

```
C(x)
if (H(x,x) == Halt)
    Loop forever;
else
    return;
```

C(C)
H(C,C) == Halt → Halt
H(C,C) == Not Halt → Halt

Sunday 06
Week 7 ■ 037-328

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07 Monday

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Chomsky Hierarchy