LECTURE 1 AAD

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What is Time? not manmade → sub optimal understate

Q Whats an Algorithm?
(1995) Sequence of instructions when followed give a predictable result.
Answer to whats an algorithm? will lead to the following revelation
→ Whats a computer?
→ Separate hardware and software
→ Programming language?
→ Compilers

"The more closer we come to truth, better unimaginable technology will pop out"
— K.S.

Now lets understand latest defn of algorithm

Axioms (Assumptions) [Turing machine]

1 Information travels @ finite speed.

2 Finite volume of memory/space can be used to store/retrieve only finite amt of information reliably.

3 Only finitely many instructions can be packed a priory.

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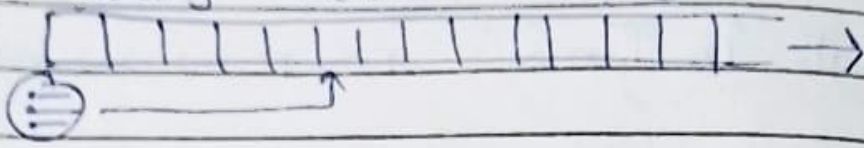
Turing machine memory



Memory is like a tape. Reader/writer can move only 1 step left or right. Every cell stores a finite set of tape alphabets.

Example — 'Sept' - our very own Turing Machine

Sept is a 7 tuple TM

Alphabet set $< Q, \Gamma, \delta, q_{start}, q_{accept}, q_{reject} >$ (Σ)

not part of tape

Σ → Finite set of input symbols ($\Sigma \notin \Gamma$)

Γ → Finite set of tape alphabets

Q → set of states

$\delta : \Gamma \times Q \rightarrow \Gamma \times Q \times \{L, R\}$ → function/programming lang

Defn — Church-Turing Thesis - anything that can be stimulated by TM is a valid algorithm.

~~Computer is same~~ Because TM is defined by a finite set of alphabets ~~them~~, here we can input a TM to another TM

TextBook - Algorithms by DasGupta, Papdimitrion, Vazirani.

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Universal TM

$U_{TM}(\langle M \rangle, x) = M(x)$

$\langle M \rangle$ - type casting the defn of TM to a string of alphabets
x - output of any TM
$M(x)$ - output of TM M.

Universal TM takes a TM_M as input and gives output of M.

Universal TM gave birth to the idea of General Purpose Hardware whose software is the defn of Universal TM.

Algorithm is something that is stimulatable by TM.

Fun fact

$$Fib_i = \frac{1}{\sqrt{5}}(\phi)^n - \frac{1}{\sqrt{5}}(\bar{\phi})^n$$

$\phi \to \frac{\sqrt{5}+1}{2}$ $\quad$ $\bar{\phi} \to \frac{\sqrt{5}-1}{2}$

$$\begin{bmatrix} F_n \\ F_{n+1} \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ 0 & 0 \end{bmatrix}^m \begin{bmatrix} F_1 \\ F_0 \end{bmatrix}$$

"Why questions are deadly, no valid answer to why question"