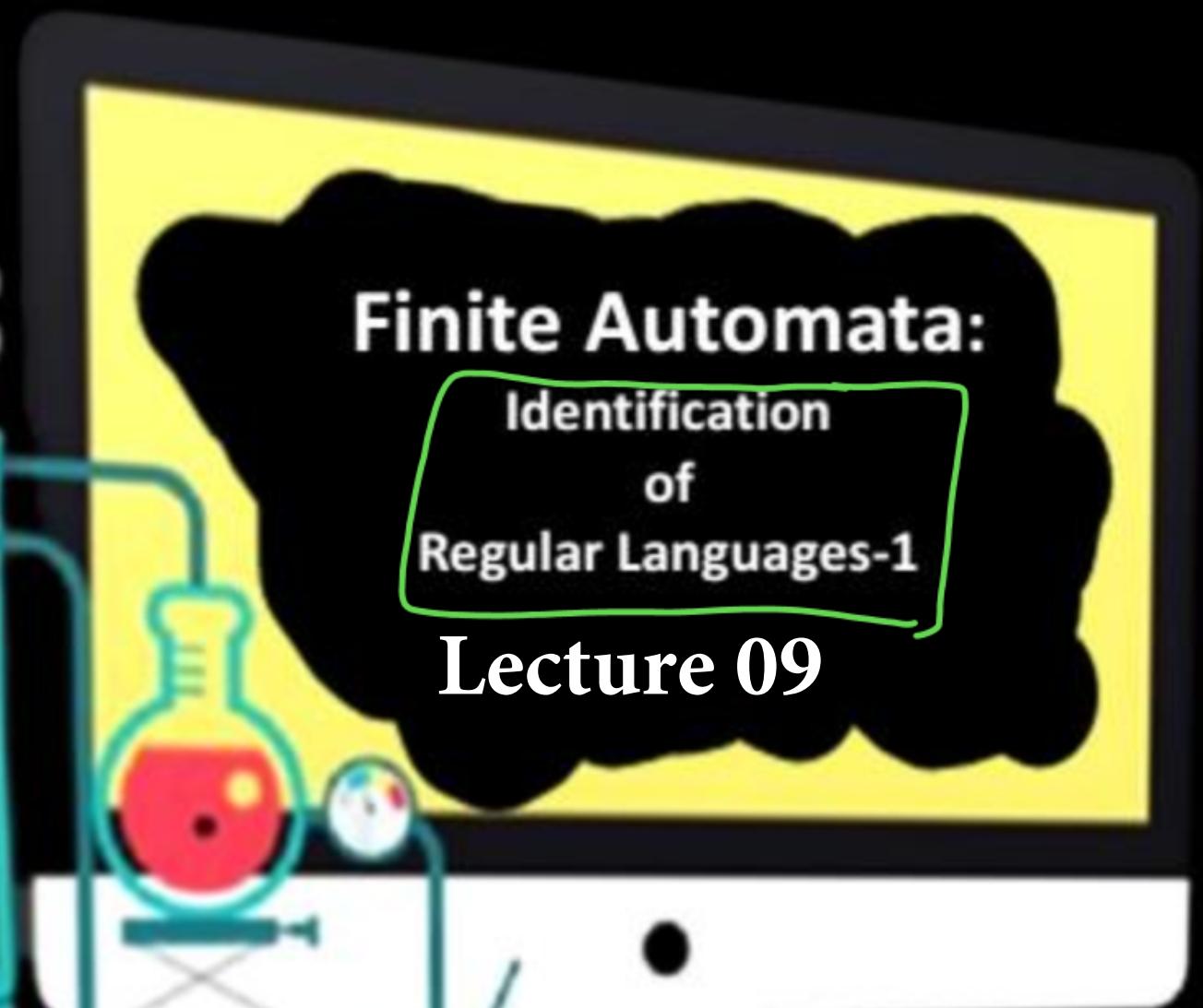
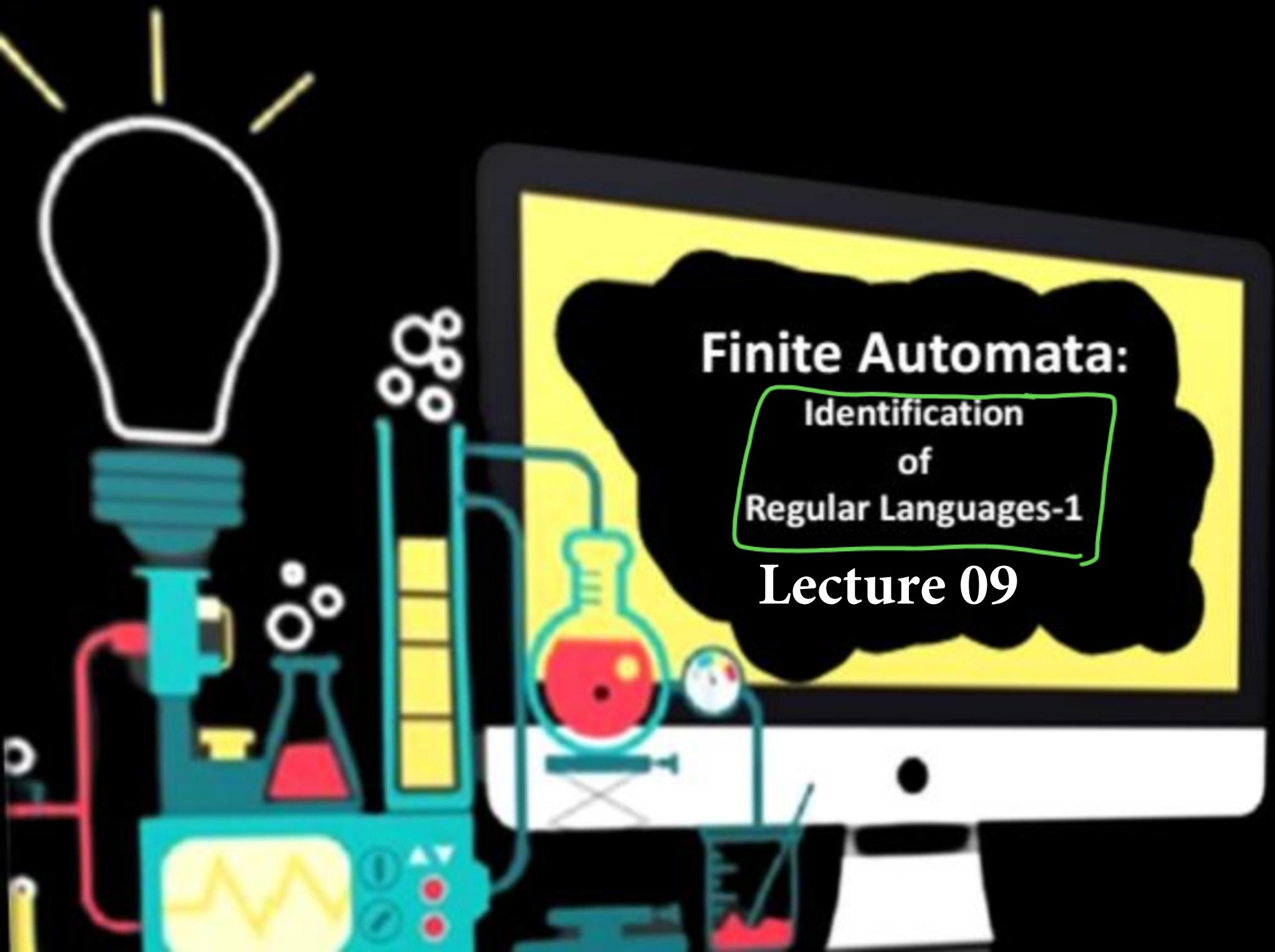


CS & IT Engineering



Deva sir

Topics to be covered Today:

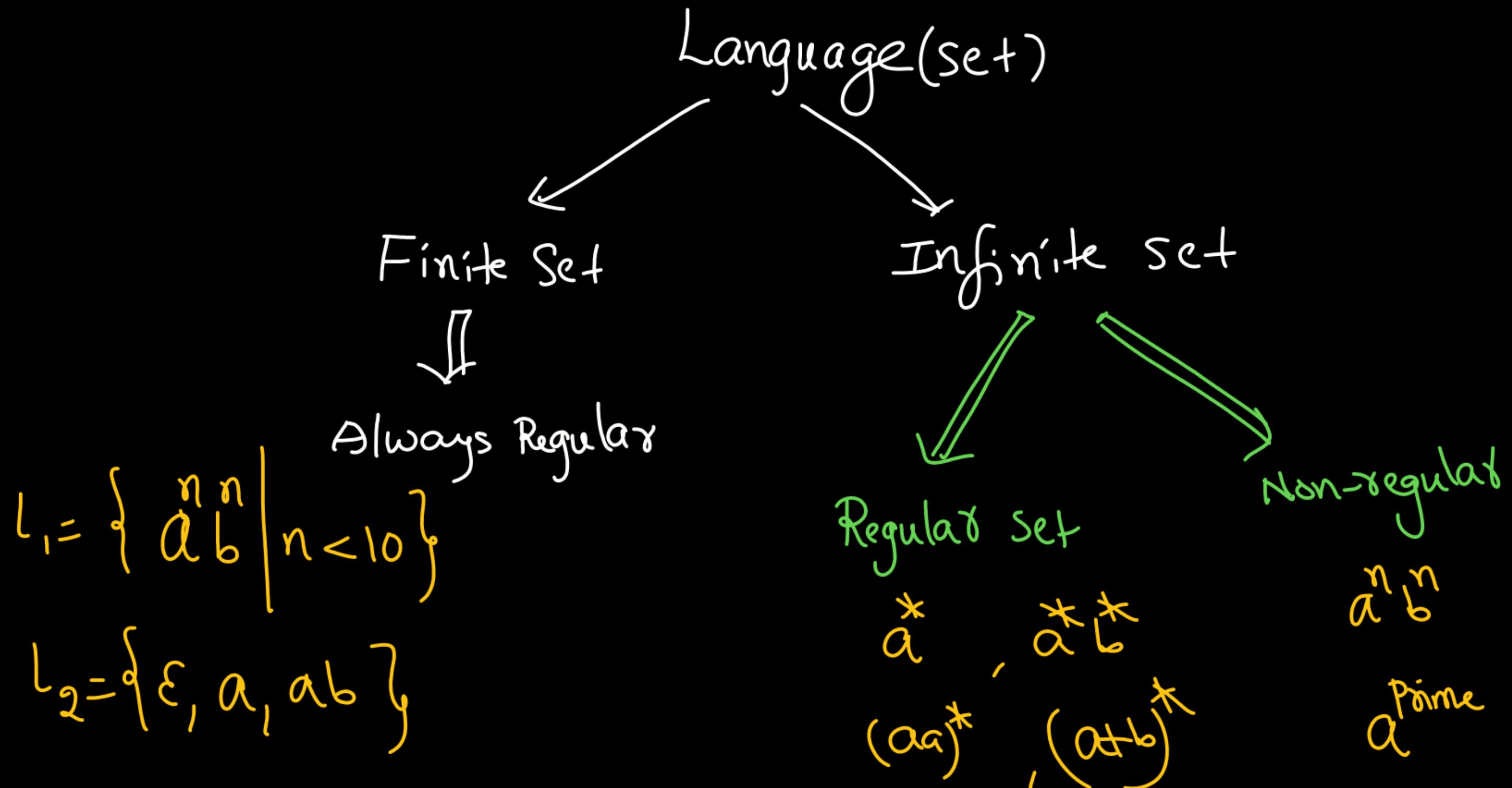
Language \Rightarrow Regular or not regular

Previous Class Summary:

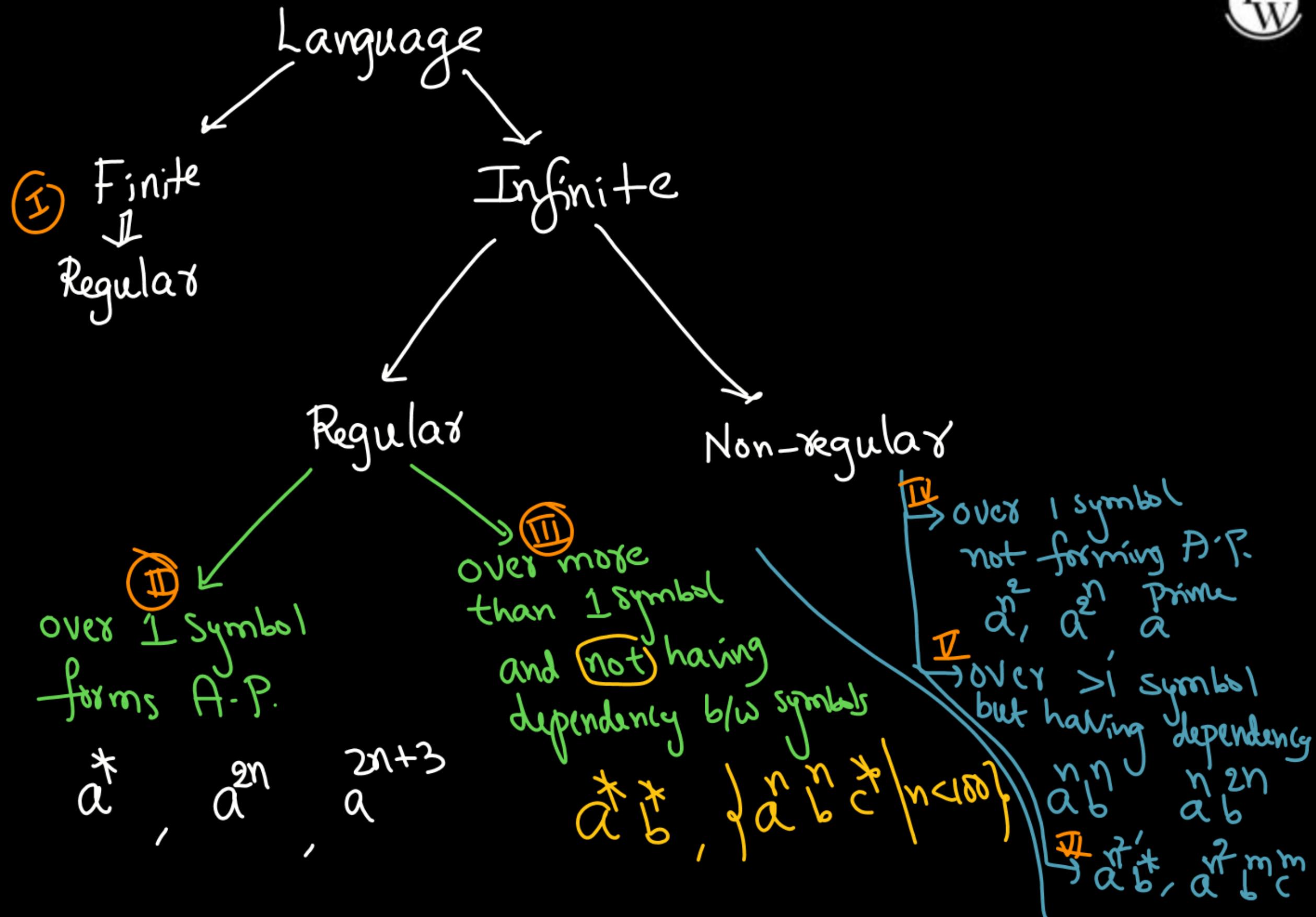
Regular Grammar ✓

P.L. ✓

Languages Identification:



Languages Identification:



Languages Identification:



① $L = \{w \mid w \in \{a, b\}^*\}$ \Rightarrow Infinite and Regular language

$$L = (a+b)^*$$

② $L = \{w \mid w \in a^*b^*\} = \{a^m b^n \mid m, n \geq 0\}$

$$L = a^*b^*$$

Infinite language
Regular language

Languages Identification:

③ $L = \{a^m b^n \mid m=n\}$ → Infinite, non-regular

$\uparrow \downarrow$
Dependency till infinite

④ $L = \{a^m b^n \mid m < n\}$

⑤ $L = \{a^m b^n \mid m > n\}$

⑥ $L = \{a^m b^n \mid m=2n\} = \{a^{2n} b^n\}$

Languages Identification:

⑦ $\{a^m b^n \mid m \neq n\}$ \rightarrow Infinite, Not regular

$m < n$ or $m > n$

⑧ $\{a^m b^n \mid m \leq n \text{ or } m \geq n\} = \{a^* b^*\} \Rightarrow$ Regular, Infinite

$m < n$ or $m = n$ or $m > n$

⑨ $\{a^m b^n \mid m \leq n \text{ and } m \geq n\} = \{a^n b^n\} \Rightarrow$ non regular
Infinite

$m = n$

⑩ $\{a^m b^n \mid m < n \text{ or } m > n\} = \textcircled{7} \Rightarrow$ Infinite, non-regular

$m \neq n$

⑪ $\{a^m b^n \mid m < n \text{ and } m > n\} = \{\} = \emptyset \Rightarrow$ finite, regular

⑫ $\{a^m b^n \mid m = n \text{ or } m \neq n\} = a^* b^* = \textcircled{8} \Rightarrow$ Regular, Infinite

Languages Identification:

$$\textcircled{13} \quad \{a^m b^n \mid \underbrace{m < n < 10}\} \Rightarrow \text{Finite, Regular}$$

$$\textcircled{14} \quad \{a^m b^n \mid \underbrace{m > n > 10}\} \Rightarrow \text{Infinite, Non-regular}$$

- Finite, Regular
- $\textcircled{15} \quad \{a^m b^n \mid \underbrace{\begin{array}{l} m < n, \\ m < n < 10 \end{array}}\} = \textcircled{13}$
- $\textcircled{16} \quad \{a^m b^n \mid \underbrace{\begin{array}{l} n < 10, \\ m < n < 10 \end{array}}\} = \textcircled{15} = \textcircled{3}$
- $\textcircled{17} \quad \{a^m b^n \mid m=n, n < 10\} = \{a^n b^n \mid n < 10\} \Rightarrow \text{Finite Regular}$
- $\textcircled{18} \quad \{a^m b^n \mid \underbrace{m > 10, n > 100}\} = a^{*} b^{*} \Rightarrow \text{Infinite Regular}$

Languages Identification:

$$\text{GCD}(m, n) = 1$$

$$\begin{array}{r} 2 \\ 3 \\ 3 \\ 5 \\ 5 \\ 3 \\ 5 \\ 3 \end{array}$$

$$\text{LCM}(m, n) = 2$$

$$\begin{array}{r} 1 \\ 2 \\ 2 \\ | \end{array}$$

⑯ $\{a^{n^2}b^*\} \rightarrow \text{Infinite, Non-regular}$

⑰ $\{a^2b^*\}$

** ⑱ $\left\{ \underbrace{a^{n^2}}_{n \text{ is finite}} b^* \mid n < 100 \right\} \rightarrow \text{Infinite, Regular}$

⑲ $\left\{ a^m b^n \mid \underbrace{\text{LCM}(m, n) = 2} \right\} = \{ab^2, a^2b\} \Rightarrow \text{Finite, Regular}$

⑳ $\left\{ a^m b^n \mid \underbrace{\text{LCM}(m, n) = 1000}_{\text{combination for } m, n \Rightarrow \text{finite}} \right\} \Rightarrow \text{Finite, Regular}$

㉑ $\left\{ a^m b^n \mid \underbrace{\text{GCD}(m, n) = 1}_{\text{Inf combinations}} \right\} \Rightarrow \text{Infinite, Non-regular}$

Languages Identification:

$$\textcircled{25} \quad \{a^n\} = \{\epsilon, a, \overset{4}{a}, \overset{9}{a}, \dots\}$$

$$\textcircled{26} \quad \{a^{2^n}\} = \{a, a^2, a^4, a^8, \dots\}$$

$$\textcircled{27} \quad \{a^{\text{prime}}\} = \{a^2, a^3, a^5, a^7, a^{11}, \dots\}$$

Not A.P. Series:

$$n^2, n^3, \dots$$

$$2^n, 3^n, 4^n, \dots$$

$$n!, (n+1)!, \dots$$

$$n^n, \dots$$

$$2^{n^2}, 3^{n^2}, \dots$$

$$\textcircled{28} \quad \{a^{n!}\} = \{a^1, a^2, a^6, a^{24}, \dots\}$$

$$\textcircled{29} \quad \{a^{n^n}\} = \{a^1, a^4, a^{27}, \dots\}$$

$$\textcircled{30} \quad \{a^{2^{n^2}}\} = \{a^1, a^2, a^{16}, \dots\}$$

Infinite language
Non regular language

Do not form A.P.

Languages Identification:

*Finite languages
Regular Sets*

- (31) $\{a^n \mid n < 100000\}$
- (32) $\{a^{2^n} \mid n < 100\}$
- (33) $\{a^{n!} \mid n < 100\}$
- (34) $\{a^{\text{prime}} \mid \text{prime} < 10^{100}\}$
- (35) $\{a^{n^n} \mid n < 100\}$
- (36) $\{a^{m^n} \mid m, n \geq 1\} = a^+ \rightarrow \text{Infinite, Regular}$

Languages Identification:

37

$$\left\{ a^{m^n} \mid m, n \geq 1, m > n \right\}$$

$$= \left\{ \cancel{a}, \cancel{a^2}, \underset{n=1}{a^2}, \underset{n=1}{a^3}, a^4, a^5, \dots \right\}$$

$\boxed{m > n}$

$$= a^2 a^*$$

$$= aaa^*$$

$$= aa^+$$

→ Infinite, Regular

Languages Identification:

$$(aa)^* \leftarrow 38 \quad \{a^{2n}\}$$

$$(aaa)^* \leftarrow 39 \quad \{a^{3n}\}$$

$$(aa)^{1000} a^* \leftarrow 40 \quad \{a^{2n+1000}\}$$

$$(a^{1000})^* a^5 \leftarrow 41 \quad \{a^{1000n+5}\}$$

$$42 \quad \{a^{3n+5} b^m\}$$

Infinite languages
Regular languages

$$(aaa)^* a^5 b^*$$

Languages Identification:

43 $\{a^{2n}\}^* \rightarrow \epsilon, a^2, a^4, a^6, \dots = (aa)^* = a^{2n} \Rightarrow \text{Infinite, Regular}$

44 $\{a^{n^2}\}^* \rightarrow a^* \Rightarrow \text{Infinite, Regular}$

45 $\{a^{n^n}\}^* \rightarrow a^*$

46 $\{a^{\text{prime}}\}^* \rightarrow \{\epsilon, \cancel{\alpha}, a^2, a^3, a^4, a^5, \dots\} \Rightarrow \overline{\{a\}} = \epsilon + aa^*$

47 $\{a^{2^n}\}^* \rightarrow a^* \Rightarrow \text{Infinite, Regular}$

48 $\{a^{100n^2}\}^* \rightarrow a^*$

49 $\{a^{n^2}\}_{\text{prime}}^* \rightarrow a^*$

50 $\{a^n \cdot a^*\} \rightarrow a^*$

Languages Identification:

$$\textcircled{51} \quad \{a^m b^n \mid m=\text{even}, n=\text{even}\} = (aa)^* (bb)^*$$

$$\textcircled{52} \quad \{a^m b^n \mid m=\text{odd}, n=\text{even}\}$$

$$\textcircled{53} \quad \{a^m b^n \mid m=\text{even}, n=\text{odd}\}$$

$$\textcircled{54} \quad \{a^m b^n \mid m=\text{odd}, n=\text{odd}\}$$

$$\textcircled{55} \quad \{a^m b^n \mid m+n=\text{even}\}$$

$$\textcircled{56} \quad \{a^m b^n \mid m+n=\text{odd}\}$$

$$\textcircled{57} \quad \{w \mid w \in \{a, b\}^*, \text{na}(w) = \text{even}\}$$

$$\textcircled{58} \quad \{w \mid w \in \{a, b\}^*, |w| = \text{even}\}$$

Languages Identification:

⑤⁹ $\{ w \mid w \in \{a, b\}^*, n_a(w) = \text{even}, n_b(w) = \text{even} \}$

⑥⁰ $\{ w \mid \text{""}, n_a(w) + n_b(w) = \text{even} \}$

⑥¹ $\{ w \mid \text{""}, n_a(w) + n_b(w) = \text{odd} \}$

⑥² $\{ w_1 w_2 \mid w_1, w_2 \in \{a, b\}^* \}$

*** ⑥³ $\{ w_1 w_2 \mid w_1, w_2 \in \{a, b\}^*, w_1 = w_2 \}$

*** ⑥⁴ $\{ w_1 w_2 \mid w_1, w_2 \in \{a, b\}^*, |w_1| = |w_2| \}$

⑥⁵ $\{ w \mid w \in \{a, b\}^*, n_a(w) = n_b(w) \}$

Languages Identification:

⑥6 $\{ww \mid w \in \{a,b\}^*\}$

⑥7 $\{ww \mid w \in a^*\}$

⑥8 $\{w\#w \mid w \in \{a,b\}^*\}$

⑥9 $\{w\#w \mid w \in a^*\}$

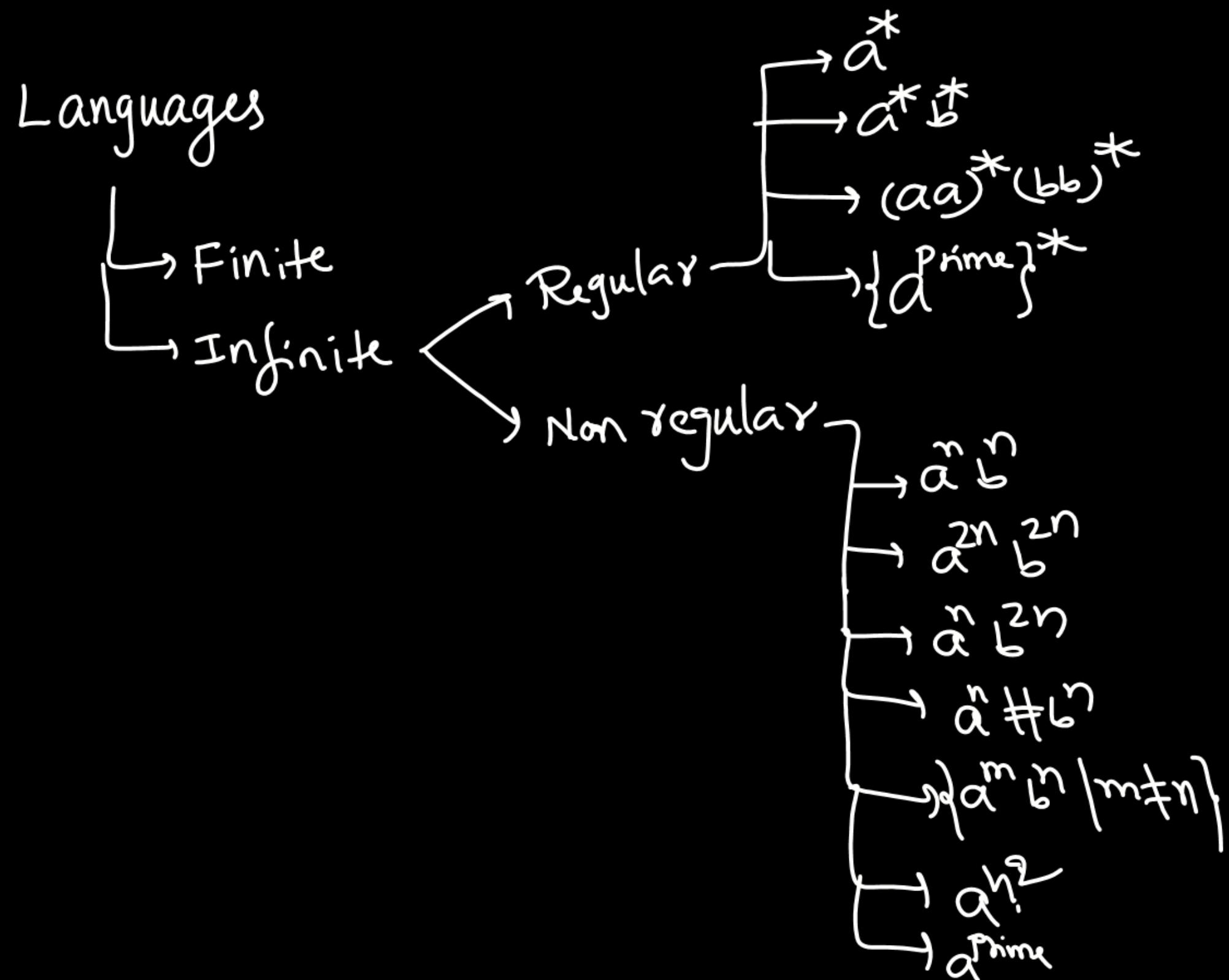
⑦0 $\{ww^R \mid w \in \{a,b\}^*\}$

⑦1 $\{ww^R \mid w \in a^*\}$

⑦2 $\{w\#w^R \mid w \in \{a,b\}^*\}$

⑦3 $\{w\#w^R \mid w \in a^*\}$

Summary



Thank you

