$$S \rightarrow aB \mid bA$$

CNF $A \rightarrow BC \mid a$

$$S \rightarrow C_a B \mid C_b A$$

$$A \rightarrow a \mid aS \mid bAA$$

$$A \rightarrow a \mid C_a S \mid C_b D$$

$$B \rightarrow b \mid bS \mid aBB$$

$$B \rightarrow b \mid C_b S \mid C_a E$$

$$C_a \rightarrow a \qquad C_b \rightarrow b$$

$$D \rightarrow AA$$

$$E \rightarrow BB$$

Membership problem   Given $G = (V, T, S, P)$ in CNF

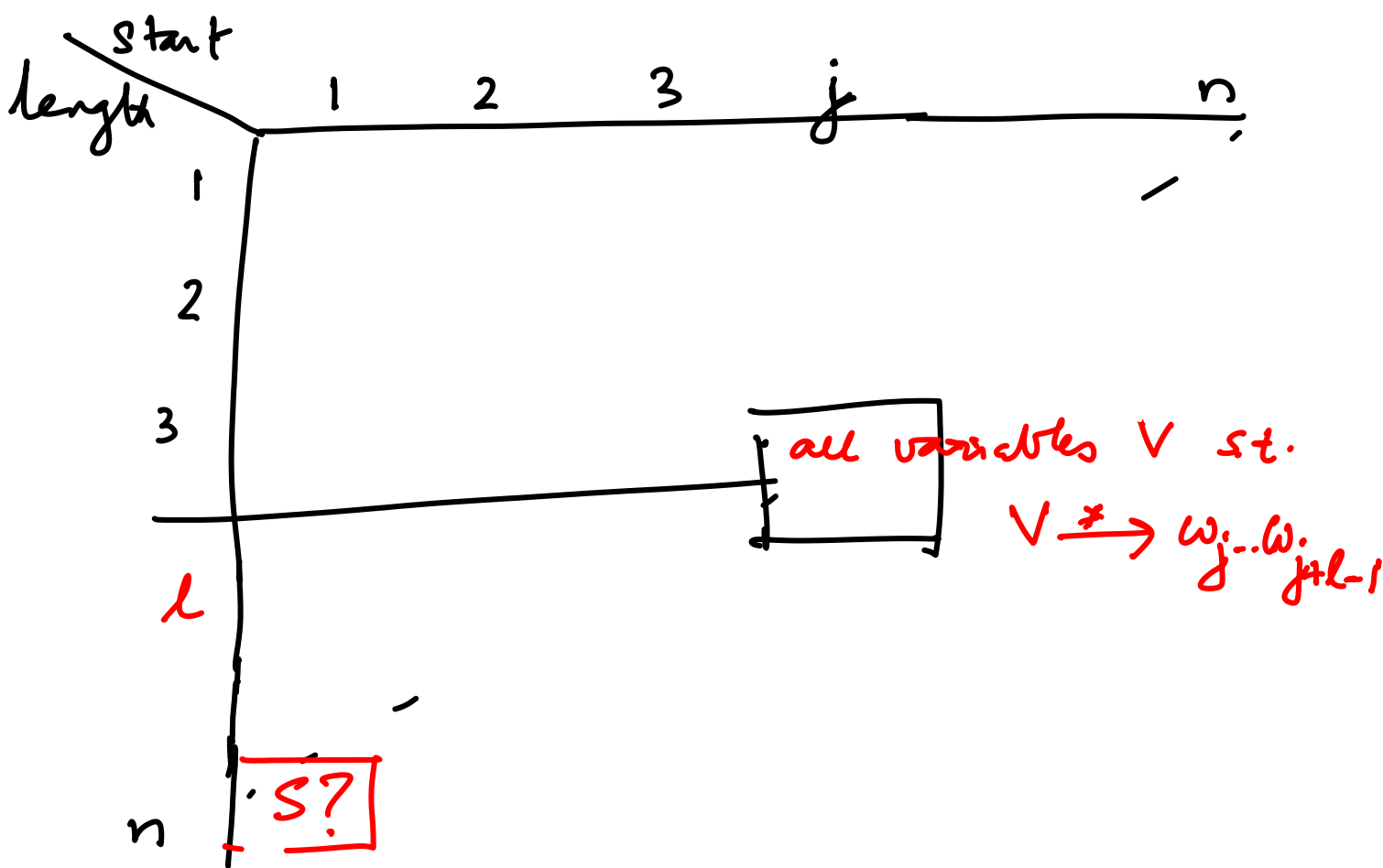and a string $w \in \Sigma^*$ does $S \xrightarrow{*} w$

$$|w| = n \qquad w_1 \, w_2 \, w_3 \ldots \qquad w_n$$

$$w_i \in T$$

$$S \xrightarrow[\,*\,]{?} w$$

$S \xrightarrow{*} w$ iff   there is a j st.

$$S \rightarrow AB \quad \text{and } A \xrightarrow{*} w_1 w_2 \ldots w_j$$

$$\text{and } B \xrightarrow{*} w_{j+1} w_{j+2} \ldots w_n$$

$$w_{ij} = w_i \, w_{i+1} \ldots w_j$$

length   1   2   3   j   n

1

2

3

all variables V st.

$V \xRightarrow{*} \omega_j ... \omega_{j+l-1}$

l

n   ·S?

$S \to C_a B \mid C_b A$

$A \to a \mid C_a S \mid C_b D$

$B \to b \mid C_b S \mid C_a E$

$D \to AA$

$E \to BB$

$C_a \to a$

$C_b \to b$

Ex. baab

(1,1)   (2,3)

b	a	a	b
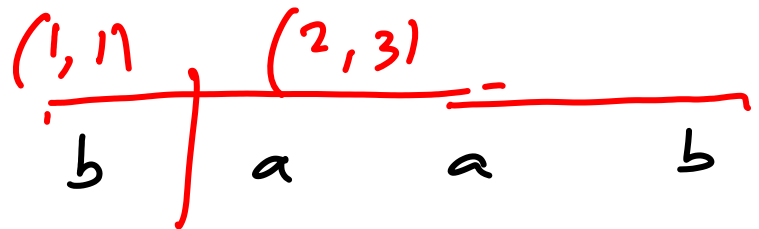
length	1	2	3	4
1	B, C_b	A, C_a	A, C_a	B, C_b
2	S	D	S	
3	A	A		
4	S			

$S \to C_b A$.
$C_b \to b \quad A \to aab$

The D.P. takes $O(n^3)$ steps (considering the size of grammar to be constant and ignoring data structure cost)

CYK algorithm