Membership problem. Given \( G = (V, \Sigma, S, \delta) \) in CNF and a string \( w \in \Sigma^* \), does \( S \xrightarrow{*} w \)?

\[ |w| = n \quad \omega_1, \omega_2, \omega_3, \ldots, \omega_n \]

\[ S \xrightarrow{*} w \quad \text{iff} \quad \text{there is an } i, j \text{ such that} \]

\[ S \rightarrow A \ B \quad \text{and} \quad A \rightarrow \omega_1, \omega_2, \ldots, \omega_i \]

\[ \text{and} \quad B \rightarrow \omega_{i+1}, \omega_{i+2}, \ldots, \omega_n \]

\[ \omega_{ij} = \omega_i \omega_{i+1} \ldots \omega_j \]
The image contains a hand-drawn grammar with production rules and a parsing table. The grammar rules are:

- $S \rightarrow C_aB | C_bA$
- $A \rightarrow a | C_aS | C_bD$
- $B \rightarrow b | C_bS | C_aE$
- $D \rightarrow AA$
- $E \rightarrow BB$
- $C_a \rightarrow a$
- $C_b \rightarrow b$

An example string is given as $baaab$.

The parsing table is a 4x4 grid with entries indicating non-terminal symbols at each cell. The table is used for parsing a string based on the grammar rules.
The D.P. takes $O(n^3)$ steps (considering the size of grammar to be constant and ignoring data structure cost).

CYK algorithm