Parsing Context Free Grammar

1. \[ S \to AB \mid BA \]
2. \[ A \to BA \mid a \]
3. \[ B \to cc \mid b \]
4. \[ C \to xB \mid a \]

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>A, C</th>
<th>A, C</th>
<th>B</th>
<th>A, C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>S, A</td>
<td>B</td>
<td>S, C</td>
<td>S, A</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>\emptyset</td>
<td>B</td>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>\emptyset</td>
<td>S, A,C</td>
<td></td>
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</tr>
<tr>
<td>5</td>
<td>A, S</td>
<td>C</td>
<td></td>
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</tr>
</tbody>
</table>

length_{i,j} : substring starting with x_{i\cdot j}

Eq. \[ S_{1,1} = b \]

If \( S \not\Rightarrow S_{i,n} \)?

\( S_{i,j} : \) substring starting with \( x_{i\cdot j} \) of length \( j \)

If \( S \not\Rightarrow baaba \) then

either \( S \not\Rightarrow AB \Rightarrow baaba \)

\( \) \( \not\Rightarrow \) \( BA \Rightarrow baaba \)
What is the number of steps to fill up the entry $ij$?

$\begin{array}{c}
\hline
\vdots \\
\hline
\end{array}$

$j^{-1}$ partials

$j \times m \times k$

$m = \max \text{ no. } j \text{ rules corresponding to a specific N.T.}$

For each rule we must check each path

$k = \# \text{ non terminals}$

Total time: $\sum_{j=1}^{n} (n-j) (j \times m \times k)$

$\leq mk \cdot n \cdot n^2$
\[ \leq m \cdot k \cdot n^3 \]

is \( O(n^3) \) if \( m, k \) are constants.

Space: The entire table has to be retained \( O(n^2) \).

CYK algorithm
Function Approximation

Discrete function defined at integral points

Representation of the function \( g \) is \((0, g_0), (1, g_1), (2, g_2), \ldots, (m, g_m)\). m points can be stored, say \( f \)

Minimise the sum of the squares of the difference of \( f \) and \( g \).