Knuth-Morris-Pratt
Knuth-Morris-Pratt construction

Include one state for each character in pattern (plus accept state).

Constructing the DFA for KMP substring search for A B A B A C
Knuth-Morris-Pratt construction

**Match transition:** advance to next state if c == pat.charAt(j).

Constructing the DFA for KMP substring search for A B A B A C.
**Mismatch transition:** back up if \( c \neq \text{pat.charAt}(j) \).

### Knuth-Morris-Pratt construction

#### Constructing the DFA for KMP substring search for A B A B A C

<table>
<thead>
<tr>
<th>( j )</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \text{pat.charAt}(j) )</td>
<td>A</td>
<td>B</td>
<td>A</td>
<td>B</td>
<td>A</td>
<td>C</td>
</tr>
<tr>
<td>dfa[][][j]</td>
<td>A</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>0</td>
<td></td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Diagram:**

- **States:** 0 to 6
- **Transitions:**
  - \( B.C \) from state 1 to 2
  - \( A \) from state 0 to 1
  - \( A \) from state 2 to 3
  - \( B \) from state 3 to 4
  - \( A \) from state 4 to 5
  - \( C \) from state 5 to 6

**Construction:**

- \( dfa[\text{pat}[j]] = j+1 \) if \( \text{dfa}[\text{pat}[j]] = j \) if \( \text{pat}[j] \neq \text{pat}[\text{X}+1] \)
Knuth-Morris-Pratt construction

Mismatch transition: back up if \( c \neq \text{pat.charAt}(j) \).

Constructing the DFA for KMP substring search for A B A B A C
Knuth-Morris-Pratt construction

Mismatch transition: back up if \( c \neq \text{pat.charAt}(j) \).

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<td>A</td>
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<td>A</td>
<td>B</td>
<td>A</td>
<td>C</td>
</tr>
<tr>
<td>\text{dfa[][]}[j]</td>
<td>B</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>\text{dfa[][]}[X]</td>
<td>C</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6</td>
</tr>
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Constructing the DFA for KMP substring search for A B A B A C
Knuth-Morris-Pratt construction

Mismatch transition: back up if $c \neq \text{pat.charAt}(j)$.
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<td>1</td>
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<tr>
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<td>2</td>
<td>0</td>
<td>4</td>
<td>0</td>
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Knuth-Morris-Pratt construction
Knuth-Morris-Pratt
Knuth-Morris-Pratt construction

Include one state for each character in pattern (plus accept state).

Constructing the DFA for KMP substring search for A B A B A C
**Knuth-Morris-Pratt construction**

**Match transition.** For each state $j$, $\text{dfa}[\text{pat.charAt}(j)][j] = j+1$.

- First $j$ characters of pattern have already been matched
- Now first $j+1$ characters of pattern have been matched

**Constructing the DFA for KMP substring search for A B A B A C**
Mismatch transition.

Constructing the DFA for KMP substring search for A B A B A C
**Mismatch transition.** For each state $j$ and character $c \neq \text{pat.charAt}(j)$, 
\[
dfa[c][j] = dfa[c][X];
\]
then update $X = dfa[\text{pat.charAt}(j)][X]$.
Knuth-Morris-Pratt construction

Mismatch transition. For each state $j$ and char $c \neq \text{pat.charAt}(j)$, $\text{dfa}[c][j] = \text{dfa}[c][X]$; then update $X = \text{dfa[pat.charAt(j)]}[X]$. 

Constructing the DFA for KMP substring search for A B A B A C
Knuth-Morris-Pratt construction

**Mismatch transition.** For each state $j$ and char $c \neq \text{pat.charAt}(j)$,
\[ \text{dfa}[c][j] = \text{dfa}[c][X]; \] then update $X = \text{dfa[pat.charAt(j)]}[X]$. 
Knuth-Morris-Pratt construction

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<tr>
<td>dfa[][j]</td>
<td>A</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>5</td>
</tr>
<tr>
<td>B</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>C</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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