The Predictive Parsing Table

- The predictive parsing table, for a given CFG, is a $|V| \times (|\Sigma| + 1)$ table M.
- Rows are indexed by V; columns are indexed by $\Sigma \cup \{\$\}$.
- $M[A, a] \subseteq \{(A \longrightarrow \alpha) \in R\}$.
- In particular, $(A \longrightarrow \alpha) \in M[A, a]$ if
  1. $a \in First(\alpha)$, or
  2. $\varepsilon \in First(\alpha)$ and $a \in Follow(A)$.
- $M[A, a] = \varnothing$ is an error entry.

From CFGs to PDA

Lemma (Sipser 2.21)

If a language is context-free, then some PDA recognizes it.

Proof Strategy

- Let L be a CFL and G a CFG such that $L(G) = L$.
- We construct a PDA P such that $L(P) = L$.
- P determines whether an input string is in L by trying to derive it (leftmost) using G.
- It uses the stack as a scratch pad where it records the steps of the derivation.
- At each transition, it rewrites the topmost variable on the stack.
- A variable is brought to the top of the stack by matching top-of-the-stack terminals to input symbols.

Parser

1. Given a CFG G, construct the parsing table M.
2. Construct the equivalent PDA P.
3. When variable A is on top of the stack and the head is pointing at a, use $M[A, a]$ to choose a transition.
4. If there are no more input symbols, use $M[A, \$]$.
5. If $M[A, a] = \varnothing$, report an error.
6. If we output the sequence of rules chosen, we may reconstruct the derivation and, hence, the parse tree.