Compiler Constructions

Deterministic Parsing

Chapter 16: LL(k)Grammars

Part 2

Example

- **Give the $FIRST_2$ and $FOLLOW_2$ sets for each of the variables of the following grammar .**

- **Construct the length-two lookahead sets for the rules of the grammar.**

- Is G strong LL(2) grammar?

$$G:\ S \rightarrow A\#\#$$

$$A \rightarrow bBA \mid BcAa \mid \lambda$$

$$B \rightarrow acB \mid b$$

Solution

G: S→ A##

A→ bBA / BcAa /λ

B→ acB / b

First

$First_2(S) = \{ba,\ bb,\ ac\ ,\ bc,\ ##\}$

$First_2\ (A) = \{\ ba,\ bb,\ ac\ ,\ bc,\ \lambda\}$

$First_2(B) = \{b,\ ac\}$

Follow:

G: S→ A##

A→ bBA / BcAa /λ

B→ acB / b

$Follow_2$ (S) = {λ}

$Follow_2$(A) = {##, a#, aa}

$Follow_2$ (B) = { ba, bb, ac, bc, ##, a#, aa, cb, ca}

Lookahead

$G: S \rightarrow A\#\#$

$A \rightarrow bBA \,/\, BcAa \,/ \lambda$

$B \rightarrow acB \,/\, b$

$LA_2(S \rightarrow A\#\#) = \{ ba, bb, ac, bc, \# \}$

$LA_2(A \rightarrow bBA) = \{ bb, ba \}$

$LA_2(A \rightarrow BcAa) = \{bc, ac \}$

$LA_2(A \rightarrow \lambda) = \{ \#\#, a\#, aa \}$

$LA_2(B \rightarrow acB) = \{ ac \}$

$LA_2(B \rightarrow b) = \{bb, ba, b\#, bc \}$

G is strong LL(2)

Example

$$G_1: \; S \rightarrow Aabd \mid cAbcd$$

$$A \rightarrow a \mid b \mid \lambda$$

$$\text{FIRST}_3(S) = \{aab, bab, abd, cab, cbb, cbc\}$$

$$\text{FIRST}_3(A) = \{a, b, \lambda\}$$

$$\text{FIRST}_3(a) = \{a\}$$

$$\text{FIRST}_3(b) = \{b\}$$

$$\text{FIRST}_3(c) = \{c\}$$

$$\text{FIRST}_3(d) = \{d\}$$

$$\text{FOLLOW}_3(S) = \{\lambda\}$$

$$\text{FOLLOW}_3(A) = \{abd, bcd\}$$

lookahead

The set $\mathrm{LA}_3(S \to Aabd)$ is explicitly constructed from the sets $\mathrm{FIRST}_3(A)$, $\mathrm{FIRST}_3(a)$, $\mathrm{FIRST}_3(b)$, $\mathrm{FIRST}_3(d)$, and $\mathrm{FOLLOW}_3(S)$ using the strategy outlined in Theorem 16.2.5.

$$\begin{aligned}\mathrm{LA}_3(S \to Aabd) &= trunc_3(\mathrm{FIRST}_3(A)\mathrm{FIRST}_3(a)\mathrm{FIRST}_3(b)\mathrm{FIRST}_3(d)\mathrm{FOLLOW}_3(S)) \\ &= trunc_3(\{a, b, \lambda\}\{a\}\{b\}\{d\}\{\lambda\}) \\ &= trunc_3(\{aabd, babd, abd\}) \\ &= \{aab, bab, abd\}\end{aligned}$$

$$\mathrm{LA}_3(S \to Aabd) = \{aab, bab, abd\}$$

$$\mathrm{LA}_3(S \to cAbcd) = \{cab, cbb, cbc\}$$

$$\mathrm{LA}_3(A \to a) = \{aab, abc\}$$

$$\mathrm{LA}_3(A \to b) = \{bab, bbc\}$$

$$\mathrm{LA}_3(A \to \lambda) = \{abd, bcd\}.$$

G is Strong LL(3)

$$\mathrm{LA}_2(S, S \to Aabd) = \{aa, ba, ab\}$$

$$\mathrm{LA}_2(S, S \to cAbcd) = \{ca, cb\}$$

$$\mathrm{LA}_2(Aabd, A \to a) = \{aa\} \qquad \mathrm{LA}_2(cAbcd, A \to a) = \{ab\}$$

$$\mathrm{LA}_2(Aabd, A \to b) = \{ba\} \qquad \mathrm{LA}_2(cAbcd, A \to b) = \{bb\}$$

$$\mathrm{LA}_2(Aabd, A \to \lambda) = \{ab\} \qquad \mathrm{LA}_2(cAbcd, A \to \lambda) = \{bc\}.$$

Since the alternatives for a given sentential form are disjoint, the grammar is LL(2).

But G is not strong LL(2)

since the string ab is in both $\mathrm{LA}_2(A \to a)$ and $\mathrm{LA}_2(A \to \lambda)$. The length-two look-ahead sets for the sentential forms containing the variables S and A are