CS480
Translators

Introduction to Lexical Analysis

Chap. 2

Odds and Ends

- Assignment #2 is posted
  - Please email me your teams, if not working alone
- Demo your Assignment #1

Quiz #2

Question 1

- What is the language of the following CFG:

  $S \rightarrow bSbb \mid A$

  $A \rightarrow aA \mid \varepsilon$

- Provide the parse tree for bbaaabbbb.

Question 2

- Provide the abstract syntax tree for the following:

  -1 + 2 * 3.0 ^ 4.7 / 6

- What is the post-order traversal of the tree.
- Explain how you would implement this in gforth.

Lexical Analysis

- What is its purpose?
- What is the difference in a token vs. lexeme?
- Example:
  - The Brown Fox
  - if (i !=32) then j := 12
- Are spaces important?

The Role of the Scanner…

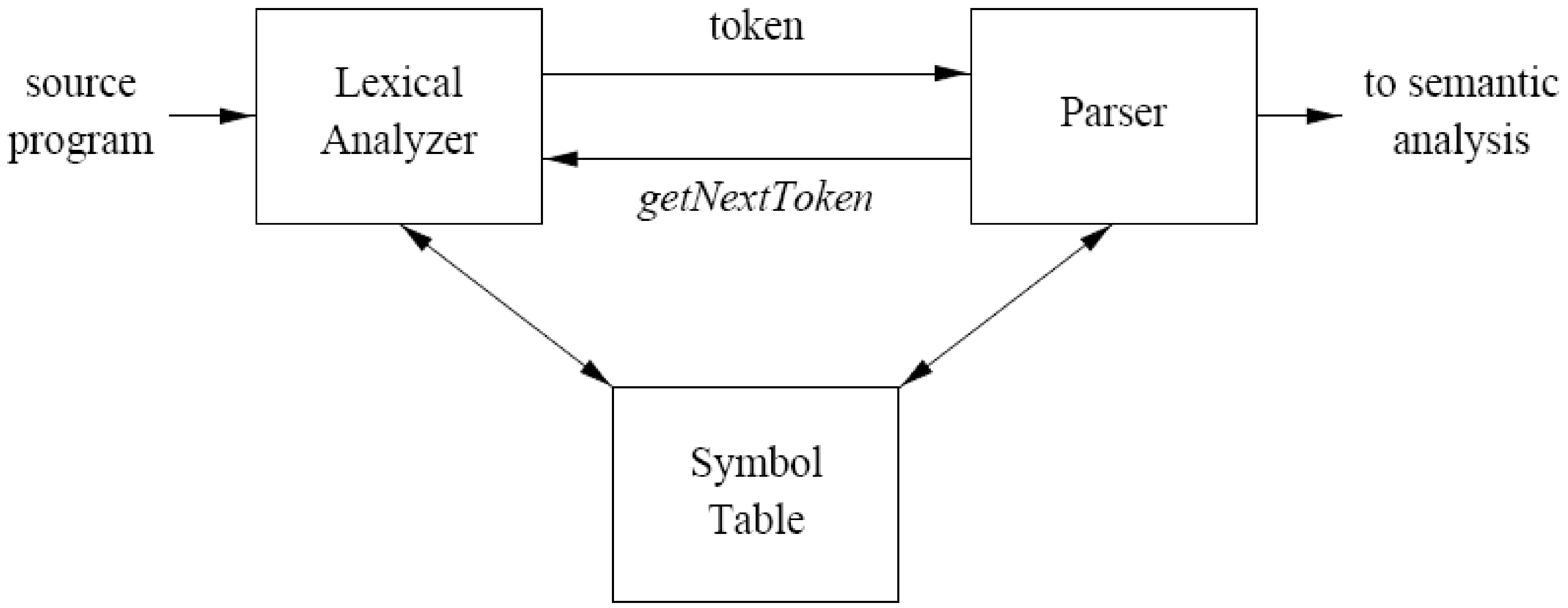
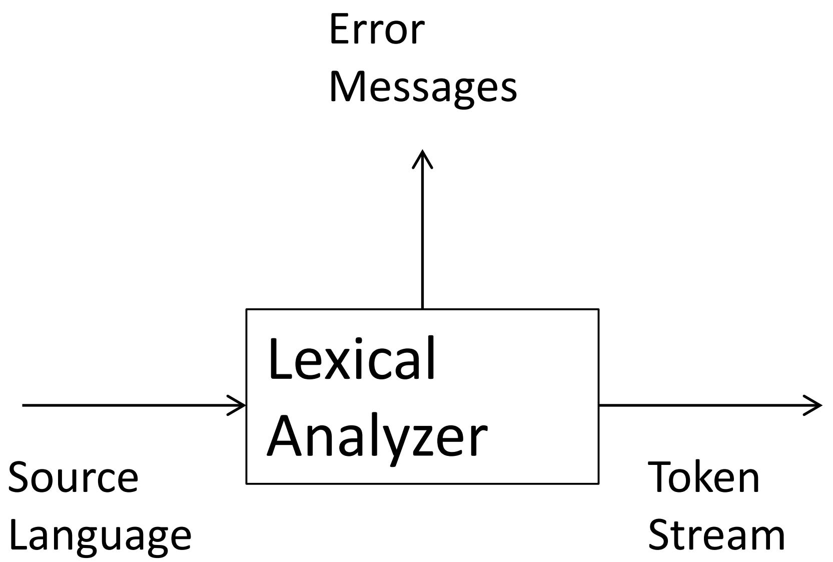


Figure 3.1: Interactions between the lexical analyzer and the parser

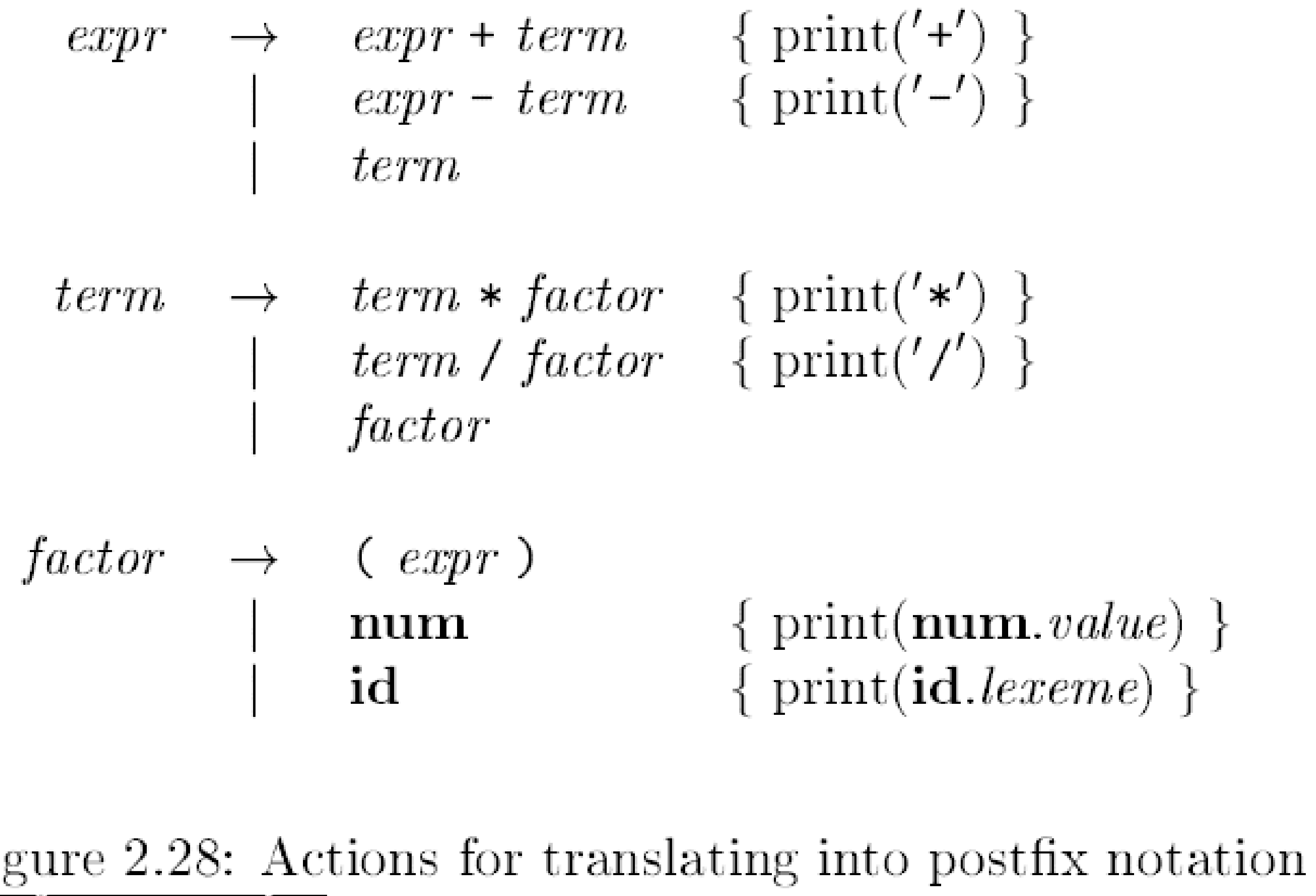
Mini-Translator

```
while (i > 0)
  i = i - 2;
```



T_WHILE
T_LPAREN
T_IDENTIFIER
T_LESSTHAN
T_INTCONSTANT
T_RPAREN
T_IDENTIFIER
T_EQUALS
T_MINUS
T_INTCONSTANT
T_SEMICOLON

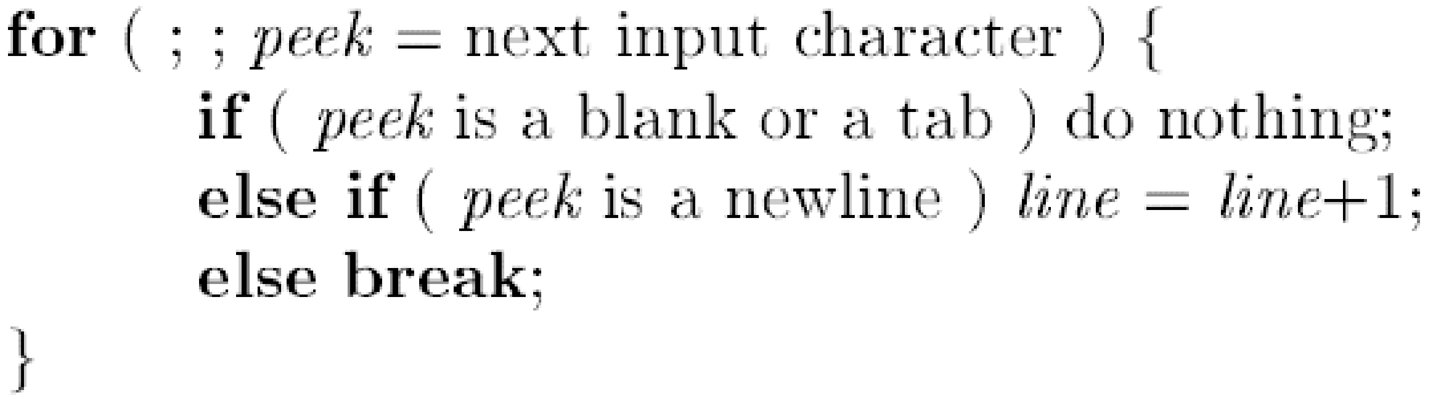
What’s new in this grammar?



$$\begin{array}{lcll}
expr & \rightarrow & expr + term & \{\ \text{print}('+')\ \} \\
 & | & expr - term & \{\ \text{print}('-')\ \} \\
 & | & term & \\
 & & & \\
term & \rightarrow & term * factor & \{\ \text{print}('*')\ \} \\
 & | & term\ /\ factor & \{\ \text{print}('/')\ \} \\
 & | & factor & \\
 & & & \\
factor & \rightarrow & (\ expr\ ) & \\
 & | & \textbf{num} & \{\ \text{print}(\textbf{num}.value)\ \} \\
 & | & \textbf{id} & \{\ \text{print}(\textbf{id}.lexeme)\ \}
\end{array}$$

Figure 2.28: Actions for translating into postfix notation

The Scanner



```
for ( ; ; peek = next input character ) {
        if ( peek is a blank or a tab ) do nothing;
        else if ( peek is a newline ) line = line+1;
        else break;
}
```

Figure 2.29: Skipping white space

- What is the purpose of line?
- What is the purpose of peek?

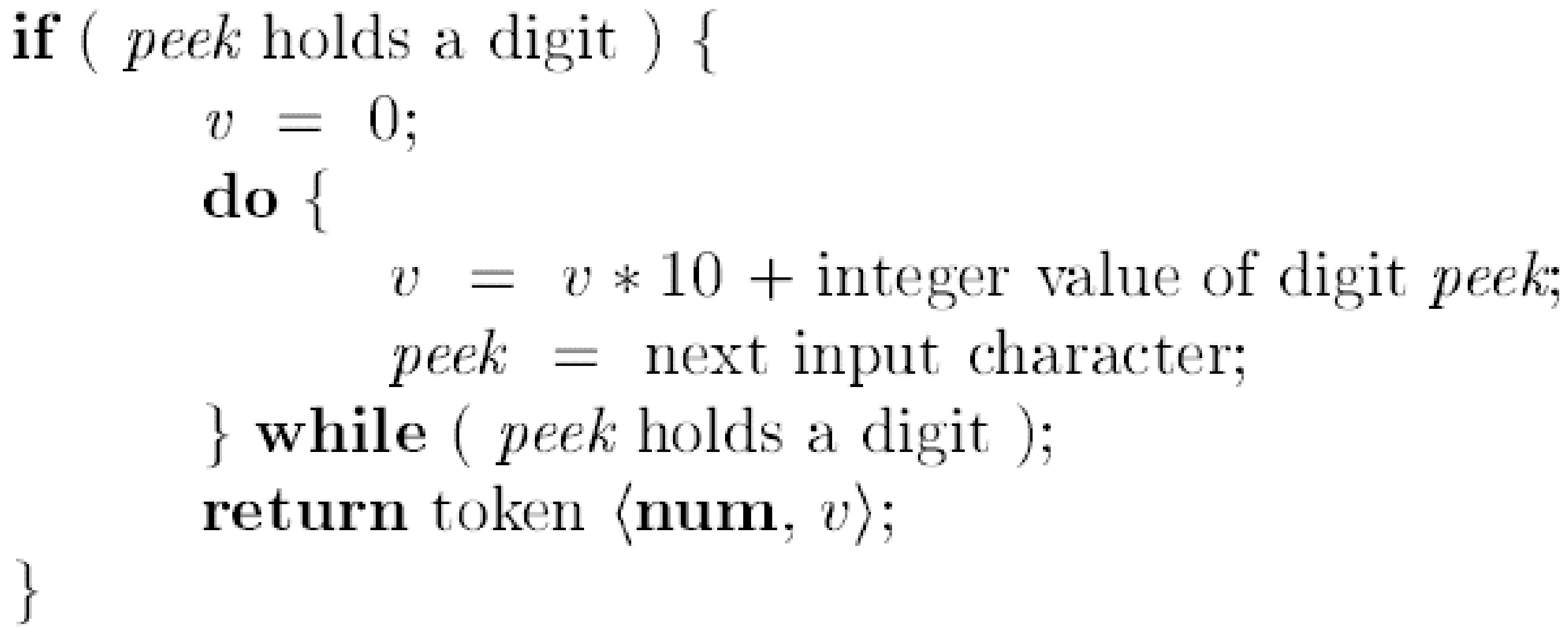
Reading Ahead

- Read the next char, it is an “i”
- Could be int, if, or an identifier, so read next char, “f”
- Could be if, could still be an identifier, so read next char, “(”
- Oops, we’ve gone too far, push back “(”

Buffers

- Why is this important?
- Ways to implement:
  - Two pointers into buffer (start_char, look_ahead)
  - Push back buffer (peek)

The Lexical Analyzer



```
**if** ( $peek$ holds a digit ) {
        $v = 0$;
        **do** {
                $v = v * 10 +$ integer value of digit $peek$;
                $peek =$ next input character;
        } **while** ( $peek$ holds a digit );
        **return** token $\langle \textbf{num}, v \rangle$;
}
```

Figure 2.30: Grouping digits into integers

Keywords vs. Identifiers

- count = count + increment;

  <id, “count”> <=> <id, “count”> <+> <id, “increment”> <;>

- How do we know count is an id vs. keyword?
- Why use a hash table?
- What is in the hash table?

How to distinguish words?

```
if ( $peek$ holds a letter ) {
        collect letters or digits into a buffer $b$;
        $s$ = string formed from the characters in $b$;
        $w$ = token returned by $words.get(s)$;
        if ( $w$ is not null ) return $w$;
        else {
                Enter the key-value pair ($s$, ⟨id, $s$⟩) into $words$
                return token ⟨id, $s$⟩;
        }
}
```

Figure 2.31: Distinguishing keywords from identifiers

Reading/Assignment

- Milestone 2
- Read Chap. 2.6 - 2.7 and Chap. 3