Using ANTLR to Create a Simple Calculator

EECS 665 Compiler Construction
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ANTLR Introduction

- ANTLR (ANother Tool for Language Recognition) generates LL(*)
  - Recursive-Descent parsers, top-down parsers that parse from left to right
  - A recursive procedure is associated with each nonterminal in the grammar
  - Left recursion must be eliminated
- By default, creates Java-based lexers, parsers, or abstract syntax trees

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ANTLR Program Structure

grammer_type? grammar *grammar_name*

tokens { }

@header { }

@members { }

Lexer rules

Parser rules

tokens { }

- The tokens section lets you explicitly define literals
- A “token” may be keywords or operators
- Example

```
tokens {
    PLUS = '+';
    MINUS = '-';
}
```

Lexer Rules

- Rules must have a name beginning with an uppercase letter
- May specify actions when the rule is applied
- May be used by the parser rules
- Example Lexer Rules

```
fragment DIGIT : '0' .. '9';
fragment LETTER : 'a' .. 'z' | 'A' .. 'Z' ;
INT : DIGIT+ ;
ID : LETTER(LETTER | DIGIT)* ;
```

Parser Rules

- The start nonterminal is the first grammar rule you specify
- General parser rule syntax

  nonterminal : *body* { } ;

  OR

  nonterminal returns [*ret_type ret_name*] : *body* { } ;
- $ operator
- getText()
- EOF

Example Parser Rules Section

```
top : expr EOF
      | EOF
      ;

expr : term { System.out.println( $term.value ); } ;

term returns [int value] : l = digit { $value = $l.value; }
                           ( PLUS r = digit { $value += $r.value; } )* ;

digit returns [int value] : INTEGER { $value =
                           Integer.parseInt( $INTEGER.getText(), 10 ); } ;
```

Debugging Using ANTLRWorks

- A graphical grammar editor and debugger
- Features
  - Highlights grammar syntax errors
  - Check for conflicting rules
  - Displays a syntax diagram for the selected rule

ANTLR References

- ANTLR Reference Manual by Terence Pratt

  antlr.org/share/1084743321127/ANTLR_Reference_Manual.pdf
- ANTLR Tutorial by Ashley J.S. Mills

  http://supportweb.cs.bham.ac.uk/docs/tutorials/docsystem/build/tutorials/antlr/antlrhome.html
- An Introduction to ANTLR

  http://www.st.informatik.tu-darmstadt.de/pages/lectures/pl/ss04/ANTLR.pdf
- A (Long) Introduction to ANTLR

  cow.ceng.metu.edu.tr/Courses/download_courseFile.php?id=2036
- Lexical Analysis with ANTLR

  http://www.antlr2.org/doc/lexer.html
- ANTLRWorks Help

  http://www.antlr.org/works/help/index.html

Java References

- Brewing Java: A Tutorial

  http://www.cafeaulait.org/javatutorial.html

- Java Quick Reference Guide

  http://www.tutorialspoint.com/java/java_quick_guide.htm

- Some useful Java libraries:
  - Math
  - Float
  - Integer