

# CS536

Java CUP

# Last Time

- What do we want?
  - An AST
- When do we want it?
  - Now!



# This Time

- A little review of ASTs
- The philosophy and use of a *Parser Generator*

# Translating Lists

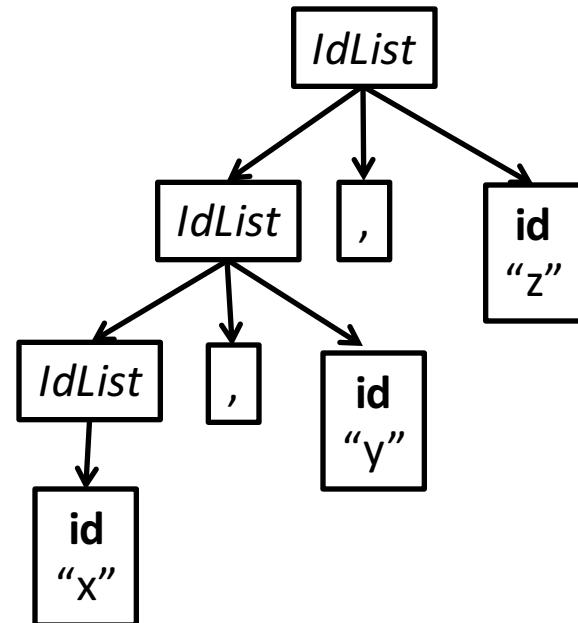
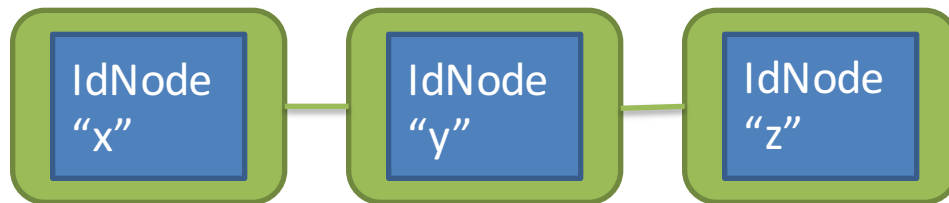
## CFG

*IdList*  $\rightarrow$  **id**  
| *IdList* **comma** **id**

## Input

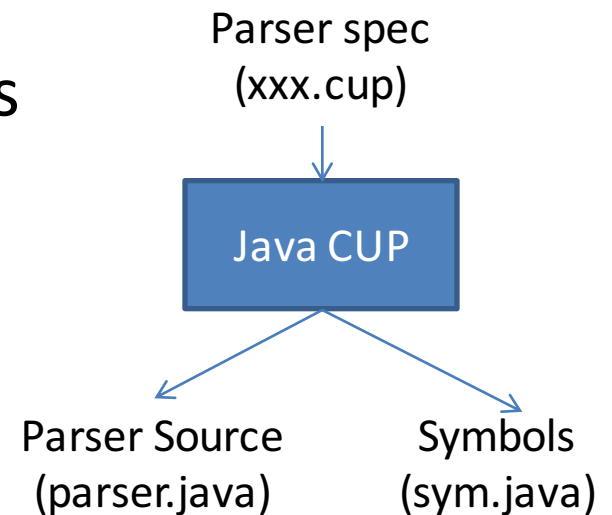
x, y, z

## AST



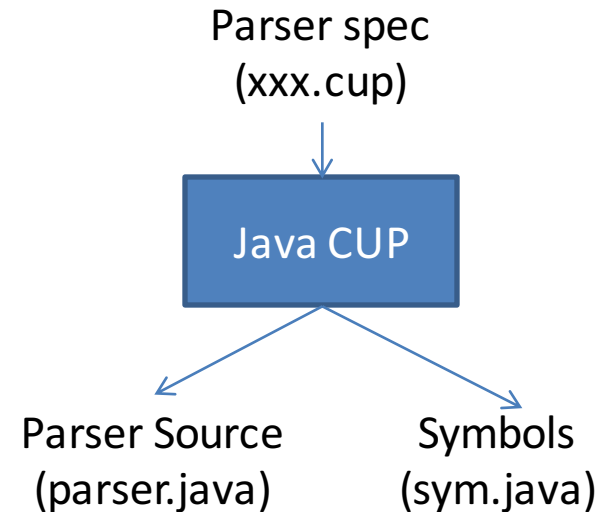
# Parser Generators

- Tools that take an SDT spec and build an AST
  - YACC: Yet Another Compiler Compiler
  - Java CUP: Constructor of Useful Parsers
- Conceptually similar to JLex
  - Input: Language rules + actions
  - Output: java code



# Java CUP

- Parser.java
  - Constructor takes arg of type Yylex
  - Contains parse method
    - return: Symbol whose value contains translation of root nonterm
  - Uses output of JLex
    - Depends on scanner and TokenVals
  - Uses defs of AST classes (ast.java)



# Java CUP Input Spec

- Terminal & nonterminal declarations
- Optional precedence and associativity declarations
- Grammar with rules and actions

## Grammar rules


```
Expr ::= intliteral
      | id
      | Expr plus Expr
      | Expr times Expr
      | lparens Expr rparens
```

## Terminal and Nonterminals

```
terminal intliteral;
terminal id;
terminal plus;
terminal times;
terminal lparen;
terminal rparen;
non terminal Expr;
```

## Precedence and Associativity

```
precedence left plus;
precedence left times;
prededence nonassoc less;
```



# Java CUP Example

- Assume ExpNode

## Subclasses

- PlusNode, TimesNode have 2 children for operands
- IdNode has a String field
- IntLitNode has an int field

### Step 1: Add types to terminals

```
terminal IntLitTokenVal intliteral;  
terminal IdTokenVal id;  
terminal plus;  
terminal times;  
terminal lparen;  
terminal rparen;
```

- Assume Token classes

- IntLitTokenVal with field intVal for int literal token
- IdTokenVal with field idVal for identifier token

```
non terminal ExpNode expr;
```



# Java CUP Example

```
Expr ::= intliteral
      { :
        : }
| id
      { :
        : }
| Expr plus Expr
      { :
        : }
| Expr times Expr
      { :
        : }
| lparen Expr rparen
      { :
        : }
;
```

# Java CUP Example

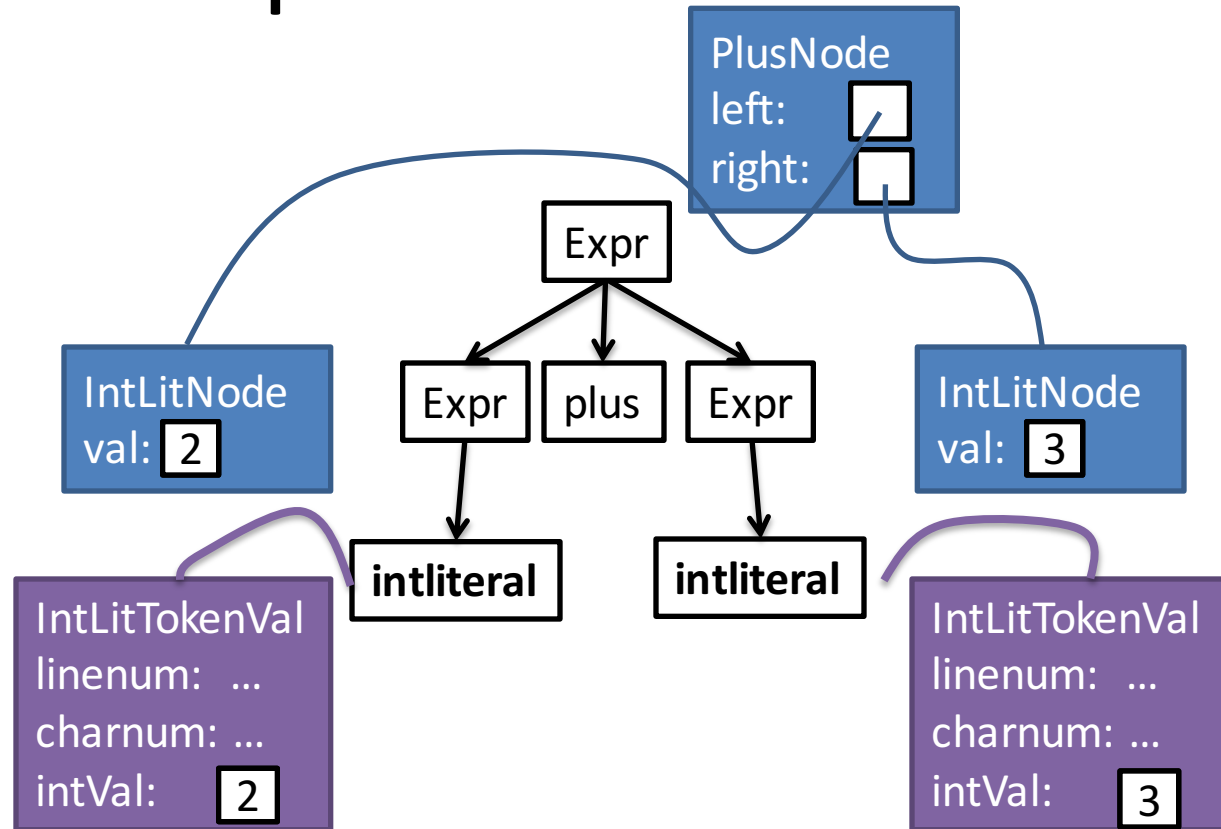
```
Expr ::= intliteral:i
      { :
        RESULT = new IntLitNode(i.intVal);
      : }
| id
  { :
    : }
| Expr plus Expr
  { :
    : }
| Expr times Expr
  { :
    : }
| lparen Expr rparen
  { :
    : }
;
```

# Java CUP Example

```
Expr ::= intliteral:i
      { :
        RESULT = new IntLitNode(i.intVal);
      : }
| id:i
  { :
    RESULT = new IdNode(i.idVal);
  : }
| Expr:e1 plus Expr:e2
  { :
    RESULT = new PlusNode(e1,e2);
  : }
| Expr:e1 times Expr:e2
  { :
    RESULT = new TimesNode(e1,e2);
  : }
| lparen Expr:e rparen
  { :
    RESULT = e;
  : }
;
```

# Java CUP Example

Input: 2+ 3



Purple = Terminal Token (Built by Scanner)

Blue = Symbol (Built by Parser)

# Java CUP Demo

