

Compilers Lab

THE GRAMMAR AND FLEX CODE

ANURAG RAMTEKE - 150101010

NEEL MITTAL - 150101042

PRASHANSI KAMDAR - 150101047

Start

- ▶ Function_declaration Start

Every line of the program will be a function declaration

- ▶ Object_declaration Start

Or an object declaration

- ▶ Function_declaration

- ▶ Object_declaration

object_declaration

- ▶ Dec_specifier IDENTIFIER ASGN_OP postfix_expression SEMI_COLON
Declaring a variable with an initialisation
- ▶ Dec_specifier IDENTIFIER ASGN_OP object_expression SEMI_COLON
Declaring an object with the corresponding constructor
- ▶ Dec_specifier IDENTIFIER SEMI_COLON
Declaring an object or a variable without an initialisation
- ▶ Dec_specifier array_expression ASGN_OP array_initializer SEMI_COLON
Declaring an array with initialisation
- ▶ Dec_specifier array_expression SEMI_COLON
Declaring an array without initialisation

Dec_specifier

- ▶ Type_specifier pointer

Generates pointer types

- ▶ Type_specifier

Generates data types

array_initialiser

- ▶ LEFT_CURLY array_initialiser RIGHT_CURLY

This rule generates the curly brackets enclosing an array initialising list

- ▶ expression COMMA array_initialiser

This rule generates the array initialising list, keeping in mind that the array can be multidimensional

- ▶ expression

This rule ends the array initialising list

Function_declaration

- ▶ Dec_specifier IDENTIFIER LEFT_PARENTHESIS argument_list RIGHT_PARENTHESIS body_or_proto
This generates functions with arguments.
- ▶ Dec_specifier IDENTIFIER LEFT_PARENTHESIS RIGHT_PARENTHESIS body_or_proto
This generates functions without arguments.

body_or_proto

- ▶ LEFT_CURLY statement_list RIGHT_CURLY

This will generate the body of the function.

- ▶ SEMI_COLON

This will generate the prototype of the function.

argument_list

- ▶ Dec_specifier identifier COMMA argument_list
Generating the argument list
- ▶ Dec_specifier identifier
Ending the argument list

type_specifier

- ▶ INT
- ▶ VOID
- ▶ FLOAT
- ▶ CHAR
- ▶ PROC
- ▶ CLUST
- ▶ JB
- ▶ MEM
- ▶ LNK

pointer

- ▶ MUL_OP pointer
- ▶ MUL_OP

Statement_List

- ▶ Statement Statement_List

This gives a statement and allows the language to have more number of statement following the first statement.

- ▶ Statement

This gives the last statement for the program.

Statement

- ▶ LEFT_CURLY Statement_List RIGHT_CURLY

This allows the program to have a block of statements encapsulated within curly brackets.

- ▶ Expression_Statement

Expression statement production gives algebraic and logical expressions defined in the program.

- ▶ Selection_Statement

Allows carrying out conditional operations within the program.

- ▶ Iteration_Statement

Allows the provision of iteration over a statement or a block of statements.

- ▶ Jump_statement

Generates jump statements

- ▶ Object_Declaration

Allows object declarations

jump_statement

- ▶ RETURN expression
Generates the return statement
- ▶ CONTINUE SEMI_COLON
Generates the continue statement
- ▶ BREAK SEMI_COLON
Generates the break statement

Selection_Statement

- ▶ IF LEFT_PARENTHESIS expression RIGHT_PARENTHESIS
LEFT_CURLY Statement_List RIGHT_CURLY else LEFT_CURLY
Statement_List RIGHT_CURLY

Generates the if statement with an else. The body of the if must be enclosed in curly brackets to solve issues like dangling else.

- ▶ IF LEFT_PARENTHESIS expression RIGHT_PARENTHESIS
LEFT_CURLY Statement_List RIGHT_CURLY

Generates the if statement without an else.

Iteration_Statement

- ▶ WHILE LEFT_PARENTHESIS expression
RIGHT_PARENTHESIS statement
program can use a while loop for iteration
- ▶ FOR LEFT_PARENTHESIS expression_statement
expression_statement RIGHT_PARENTHESIS statement
this production rule gives the user for loop to be used for iteration
- ▶ FOR LEFT_PARENTHESIS expression_statement
expression_statement expression RIGHT_PARENTHESIS
statement
A different way to use the for loop

Expression_Statement

- ▶ SEMI_COLON

this is an empty expression

- ▶ Expression SEMI_COLON

Allows user to have an expression followed by a semi colon to signify the end of the expression.

Expression

- ▶ Assignment_expression

gives program the independence to use conditional expressions or unary expression

- ▶ Expression COMMA Assignment_expression

allows to have an expression followed by more assignment expressions

assignment_expression

- ▶ unary_expression ASGN_OP assignment_expression
gives identifier values to some function or conditional statement or even a constant
- ▶ conditional_expression
generates all kinds of algebraic and logical expressions in the program.
- ▶ object_expression
generates the object assignment expression

Conditional_Expression

► logical_or_expression

logical or expression signifies the OR functionality for the language and is going to be at the highest level of the parse tree and thus placing it at the least priority.

Logical_or_expression

- ▶ `logical_or_expression OR_OP logical_and_expression`

The logical and expression must be evaluated before the or expression. Hence this expression has higher priority in the Language.

- ▶ `logical_and_expression`

To generate the last term in the or expression having and or some other operation having higher priority.

Logical_and_expression

- ▶ logical_and_expression
production rule to generate the last term for and expression
- ▶ bitwise_or_expression
production rule that can be used to create bitwise or in the terms
- ▶ logical_and_expression AND_OP bitwise_or_expression
used in the language for generation of bitwise or with the and expression as an AND operator

bitwise_or_expression

- ▶ bitwise_or_expression

create last or more terms with bitwise or operations in the expression

- ▶ bitwise_xor_expression

bitwise xor is higher priority than bitwise or expression and thus is produced after bitwise or expression and hence lower in the parse tree. This production rule gives bitwise xor terms added to the expressions

- ▶ bitwise_or_expression BTW_OR bitwise_xor_expression

creating bitwise xor terms with expression having bitwise or

bitwise_xor_expression

- ▶ `and_expression`

bitwise and has higher priority for the grammar defined for our language and hence follows in the production rule of bitwise xor expression

- ▶ `bitwise_xor_expression XOR_OP and_expression`

generates and expression term with bitwise xor expression terms

and_expression

- ▶ equality_expression
the equality expression allows for relational expressions to be used in the program.
- ▶ and_expression AMPERSAND equality_expression
Generates an AND expression along with equality expression which by itself can generate relational expressions.

equality_expression

- ▶ relational_expression

relational expression consists of combination of greater than, less than or equal to expressions to be generated in the code.

- ▶ equality_expression EQ_OP relational_expression

This allows generation of equality expression along with an equality operand and relational expression.

- ▶ equality_expression NE_OP relational_expression

This again allows the generation of an equality expression and relational expression but with a non-equality operand.

relational_expression

- ▶ `shift_expression`
generates binary shift operation expression in the program
- ▶ `relational_expression LESS_THAN shift_expression`
generates relational expression followed by less_than operand and binary shift expression(s).
- ▶ `relational_expression GREATER_THAN shift_expression`
generates relational expression and shift expression(s), where the binary shift is appended after a greater than symbol which is again a relational symbol.
- ▶ `relational_expression LE_OP shift_expression`
this production gives a relational expression with relational operands less_than_equal_to and followed by binary shift expression(s).
- ▶ `relational_expression GE_OP shift_expression`
the production rule gives relational and shift expression together joined using a greater than or equal to operand

shift_expression

- ▶ additive_expression

allows the user to generate addition/subtraction expressions in the program.

- ▶ shift_expression LEFT_OP additive_expression

allows the conjunction of shift and addition expression in the code using left_shift binary operation

- ▶ shift_expression RIGHT_OP additive_expression

allows the generation of conjunction of addition expression(which can further go to other expressions which are higher in priority than the addition/subtraction symbol) and binary shift expression using a right shift operand.

additive_expression

- ▶ `multiplicative_expression`
multiplicative expression has higher priority than additive expression and hence is lower in the parse tree according to this production rule for this grammar.
- ▶ `additive_expression PLUS multiplicative_expression`
generates conjunction of additive expressions with a multiplicative expression using an addition symbol.
- ▶ `additive_expression MINUS multiplicative_expression`
generates additive expression in the program followed by a subtract sign and a multiplicative expression.

multiplicative_expression

- ▶ unary_expression

unary into some data type has higher priority than multiplicative expression. Thus it is generated lower to the multiplicative production rule for the parse tree.

- ▶ multiplicative_expression MUL_OP unary_expression

this production rule allows the conjunction of multiplicative expressions (i.e. *, /, %) with unary expression using a multiply operand.

- ▶ multiplicative_expression DIV_OP unary_expression

this again allows conjunction of unary expressions with a multiplicative expression using a divide operand.

- ▶ multiplicative_expression MOD_OP unary_expression

Multiplicative expression(s) followed by mod(%) and unary expression

unary_expression

- ▶ postfix_expression
generates postfix expressions (variable++, variable--,variable etc.)
- ▶ INC_OP unary_expression
these give prefix expressions like ++variable.
- ▶ DEC_OP unary_expression
this again gives prefix expressions like --variable
- ▶ unary_operator unary_expression
gives unary operators like ~, !, + etc with a unary expression.

unary_operator

- ▶ PLUS
- ▶ MINUS
- ▶ BTW_NOT
- ▶ NOT_OP
- ▶ MUL_OP
- ▶ AMPERSAND

postfix_expression

- ▶ primary_expression
generates identifiers, constants, string_literals etc.
- ▶ array_expression
generates arrays for the programs
- ▶ function_expression
Function evaluation gets higher priority than every arithmetic or relational operation
- ▶ postfix_expression INC_OP
generates postfix expressions like variable++
- ▶ postfix_expression DEC_OP
Generates postfix decreasing expressions like variable—

array_expression

- ▶ `array_expression LEFT_BRACKET expression RIGHT_EXPRESSION`
This can generate multidimensional arrays.
- ▶ `Primary_expression LEFT_BRACKET expression RIGHT_BRACKET`
This will generate the array identifier.

primary_expression

- ▶ IDENTIFIER Deref_OP IDENTIFIER
- ▶ IDENTIFIER
- ▶ CONSTANT
- ▶ STRING_LITERAL
- ▶ LEFT_PARENTHESIS expression RIGHT_PARENTHESIS
Brackets get the highest priority

object_expression

- ▶ link_object
- ▶ memory_object
- ▶ job_object
- ▶ cluster_object

cluster_object

- ▶ CLUSTER LEFT_PARENTHESIS proc_arr_arg COMMA topology_arg
COMMA link_band_arg COMMA link_cap_arg narp
- ▶ processor_object

proc_arr_arg

- ▶ PROCESSORS ASGN_OP IDENTIFIER
- ▶ PROCESSORS ASGN_OP LEFT_BRACKET cluster_list RIGHT_BRACKET
- ▶ IDENTIFIER
- ▶ LEFT_BRACKET cluster_list RIGHT_BRACKET

cluster_list

- ▶ cluster_object COMMA cluster_list
- ▶ cluster_object

topology_arg

- ▶ TOPOLOGY ASGN_OP STRING_LITERAL
- ▶ STRING_LITERAL

link_band_arg

- ▶ LINK_BANDWIDTH ASGN_OP conditional_expression
- ▶ conditional_expression

link_cap_arg

- ▶ LINK_CAPACITY ASGN_OP conditional_expression
- ▶ conditional_expression

narp

- ▶ COMMA conditional_expression RIGHT_PARENTHESIS
- ▶ COMMA NAME ASGN_OP conditional_expression
- ▶ RIGHT_PARENTHESIS

processor_object

- ▶ PROCESSOR LEFT_PARENTHESIS isa_args COMMA clock_args
COMMA mem_args narp

Isa_args

- ▶ ISA ASGN_OP PROC_TYPE
- ▶ PROC_TYPE

Clock_args

- ▶ CLOCK_SPEED ASGN_OP CONSTANT
- ▶ CONSTANT

mem_args

- ▶ MEM1 ASGN_OP memory COMMA MEM2 ASGN_OP memory
- ▶ MEM1 ASGN_OP memory COMMA memory
- ▶ MEM1 ASGN_OP memory
- ▶ memory COMMA MEM2 ASGN_OP memory
- ▶ memory COMMA memory
- ▶ memory

memory

- ▶ memory_object
- ▶ IDENTIFIER

link_object

- ▶ LINK LEFT_PARENTHESIS start_args COMMA end_args COMMA link_band_args COMMA link_cap_args narp
- ▶ IDENTIFIER

start_args

- ▶ START_POINT ASGN_OP conditional_expression
- ▶ conditional_expression

end_args

- ▶ END_POINT ASGN_OP conditional_expression
- ▶ conditional_expression

memory_object

- ▶ MEMORY LEFT_PARENTHESIS mem_type_args COMMA
mem_size_args narp

mem_type_args

- ▶ MEMORY_TYPE ASGN_OP MEM_TYPES
- ▶ MEM_TYPES

mem_size_args

- ▶ MEMORY_SIZE ASGN_OP conditional_expression
- ▶ conditional_expression

job_object

- ▶ JOB LEFT_PARENTHESIS job_id_args COMMA flops_args COMMA deadline_args COMMA mem_required_args COMMA affinity_args RIGHT_PARENTHESIS

job_id_args

- ▶ JOB_ID ASGN_OP conditional_expression
- ▶ conditional_expression

flops_args

- ▶ FLOPS_REQUIRED ASGN_OP conditional_expression
- ▶ conditional_expression

deadline_args

- ▶ DEADLINE ASGN_OP conditional_expression
- ▶ conditional_expression

mem_required_args

- ▶ MEM_REQUIRED ASGN_OP conditional_expression
- ▶ conditional_expression

affinity_args

- ▶ AFFINITY ASGN_OP LEFT_BRACKET list RIGHT_BRACKET
- ▶ LEFT_BRACKET list RIGHT_BRACKET

list

- ▶ CONSTANT
- ▶ CONSTANT COMMA list

function_expression

- ▶ RUN LEFT_PARENTHESIS cluster_list RIGHT_PARENTHESIS
- ▶ WAIT LEFT_PARENTHESIS RIGHT_PARENTHESIS
- ▶ DISCARD_JOB LEFT_PARENTHESIS jon_list RIGHT_PARENTHESIS
- ▶ STOP LEFT_PARENTHESIS IDENTIFIER RIGHT_PARENTHESIS
- ▶ IDENTIFIER LEFT_PARENTHESIS RIGHT_PARENTHESIS
- ▶ IDENTIFIER LEFT_PARENTHESIS argument_expression_list
RIGHT_PARENTHESIS
- ▶ IDENTIFIER DOT object_function.

object_function

- ▶ processor_function
- ▶ job_function
- ▶ link_function
- ▶ memory_function

memory_function

- ▶ GET_AVAILABLE_MEMORY LEFT_PARENTHESIS RIGHT_PARENTHESIS

Job_function

- ▶ GET_JOB_AFFINITY LEFT_PARENTHESIS RIGHT_PARENTHESIS
- ▶ GET_JOB_MEMORY LEFT_PARENTHESIS RIGHT_PARENTHESIS
- ▶ GET_FLOPS LEFT_PARENTHESIS RIGHT_PARENTHESIS
- ▶ GET_DEADLINE LEFT_PARENTHESIS RIGHT_PARENTHESIS

These production rules are added to give user a better simulation. The functions when made into the language will let user get the information about the job.

processor_function

- ▶ IS_RUNNING LEFT_PARENTHESIS RIGHT_PARENTHESIS
- ▶ SUBMIT_JOBS LEFT_PARENTHESIS job_list RIGHT_PARENTHESIS
- ▶ GET_CLOCK_SPEED LEFT_PARENTHESIS RIGHT_PARENTHESIS
- ▶ GET_PROC_TYPE LEFT_PARENTHESIS RIGHT_PARENTHESIS
- ▶ IS_PROCESSOR LEFT_PARENTHESIS RIGHT_PARENTHESIS

The last two production rules are again added to the language for letting the user create his own scheduling algorithms in the language creating a better simulation.

cluster_function

- ▶ GET_PROCESSOR LEFT_PARENTHESIS RIGHT_PARENTHESIS
- ▶ GET_PROCESSOR LEFT_PARENTHESIS primary_expression RIGHT_PARENTHESIS
gives the list of processor of the cluster, a function in the language that will be checked by the lexer
- ▶ IS_PROCESSOR LEFT_PARENTHESIS RIGHT_PARENTHESIS
this is a string in the language that allows functionality of checking a cluster or a processor
- ▶ SUBMIT_JOBS LEFT_PARENTHESIS job_list RIGHT_PARENTHESIS

job_list

- ▶ IDENTIFIER COMMA job_list
- ▶ IDENTIFIER
- ▶ job_object COMMA job_list
- ▶ job_object