# Project #3. Semantic Analysis Symbol Table & Type Checker

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# Symbol Table & Type Checker

- **Implement symbol table and type checker**
- **Traverse syntax tree created by parser**
- **Files to modify**
  - globals.h
  - main.c
  - ytil.h, util.c
  - scan.h scan.c
  - parse.h, parse.c
  - symtab.h, symtab.c
  - analyze.h, analyze.c

# main.c

- **Modify NO_ANALYZE, TraceParse, and TraceAnalyze to suit your assignment**

# symtab.h, symtab.c

- **Add scope and type to symbol table**
- **Implement hash table**

```
-void st_insert( char * name, int lineno, int loc );
+void st_insert( char * scope, char * name, ExpType type, int lineno, int loc );

 /* Function st_lookup returns the memory
  * location of a variable or -1 if not found
  */
-int st_lookup ( char * name );
+BucketList st_lookup ( char * scope, char * name );
+BucketList st_lookup_excluding_parent ( char * scope, char * name );
```

```
typedef struct BucketListRec
   { char * name;
     ExpType type;
     LineList lines;
     int memloc ; /* memory location for variable
     struct BucketListRec * next;
   } * BucketList;

/* The record for each scope,
 * including name, its bucket,
 * and parent scpoe.
 */
typedef struct ScopeListRec
   { char * name;
     BucketList bucket[SIZE];
     struct ScopeListRec * parent;
```

# analyze.c

- **Modify symbol table generation**
  - buildSymtab(), insertNode(), traverse(), ... , scope and type concept
- **Modify the checkNode() function to check the semantics of C-Minus**
- **Insert built-in function**
  - Input(), output()

# Symbol Table in Tiny

```
 1: { Sample program
 2:   in TINY language -
 3:   computes factorial
 4: }
 5: read x; { input an integer }
 6: if 0 < x then { don't compute if x <= 0 }
 7:   fact := 1;
 8:   repeat
 9:     fact := fact * x;
10:     x := x - 1
11:   until x = 0;
12:   write fact  { output factorial of x }
13: end
```

| Variable Name | Location | Line Numbers | | | | | |
|---|---|---|---|---|---|---|---|
| x | 0 | 5 | 6 | 9 | 10 | 10 | 11 |
| fact | 1 | 7 | 9 | 9 | 12 | | |

# Location

- Counter for variable memory locations.
- Never overlapped in a scope.

# Symbol Table in C-Minus

```
 1:  /* A program to perform Euclid's
 2:    Algorithm to computer gcd */
 3:
 4:  int gcd (int u, int v)
 5:  {
 6:      if (v == 0) return u;
 7:      else return gcd(v,u-u/v*v);
 8:     /* u-u/v*v == u mod v */
 9:  }
10:
11: void main(void)
12: {
13:     int x; int y;
14:     x = input(); y = input();
15:     output(gcd(x,y));
16: }
```

| Name | Type | Location | Scope | Line Numbers |
|---|---|---|---|---|
| output | Void | 0 | global | 0 15 |
| Input | Integer | 1 | global | 0 14 14 |
| gcd | Integer | 2 | global | 4 7 15 |
| main | Void | 3 | global | 11 |
| u | Integer | 0 | gcd | 4 6 7 7 |
| v | Integer | 1 | gcd | 4 6 7 7 7 |
| x | Integer | 0 | main:11~16 | 13 14 15 |
| y | Integer | 1 | main:11~16 | 13 14 15 |

# Implementation Notes

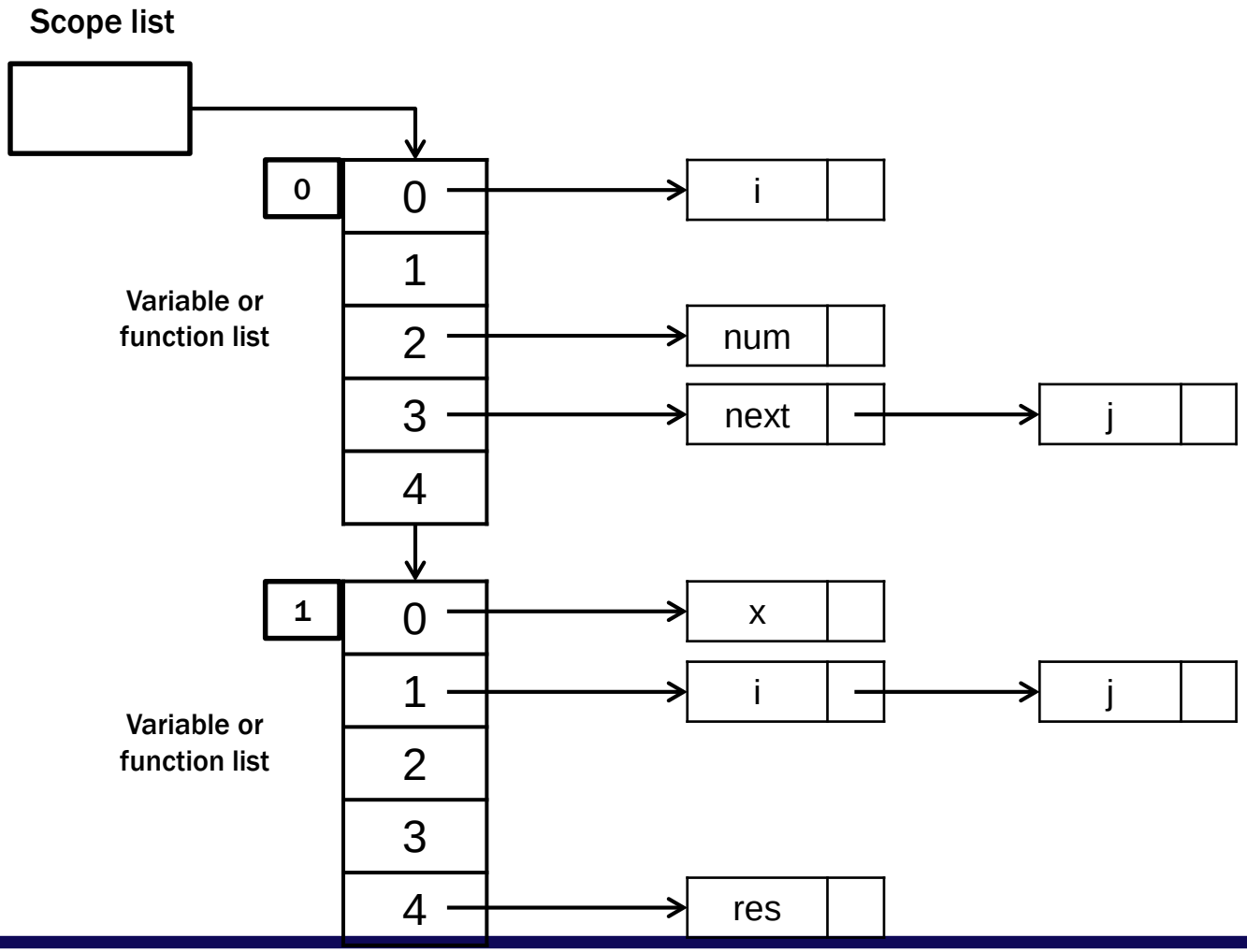
- Variables follow scope of each compound statement.
- Throws an error when an undeclared variable is used.
- Built-in functions should be always accessible.
- As long as the scope concept is implemented properly, you can use any implementation or output form.

# Built-in function

- **int input()**
  - One integer value is input from the user.
- **void output()**
  - Prints the value of arg.

- **These two functions are considered to be global functions defined by default.**

# Symbol Table in C-Minus (Sample)



# Type Checker

- **Type checking for functions and variables.**
  - The type “void” is only available for functions.
  - Check return type.
  - Verify the type match of two operands when assigning.
  - Check the argument number when calling function.
  - Check if conditional of “If” or “While” has a value.
  - Check other things by referring to C-Minus syntax.

# Report & Full Source Tree

- **Contents**
  - Build environment(OS, compiler, …).
  - Semantic analysis implementation process and source code description of principal parts.
- **Format**
  - hwp, doc, pdf, …
- **Submission deadline (Updated!!!)**
  - Push until Wednesday, December 13, 2017, 23:59:59.
  - Master branch will be cloned at 0:00 on Thurssday, December 14, 2017.