Welcome to Level-3 :)

A Typical Day in Level-3

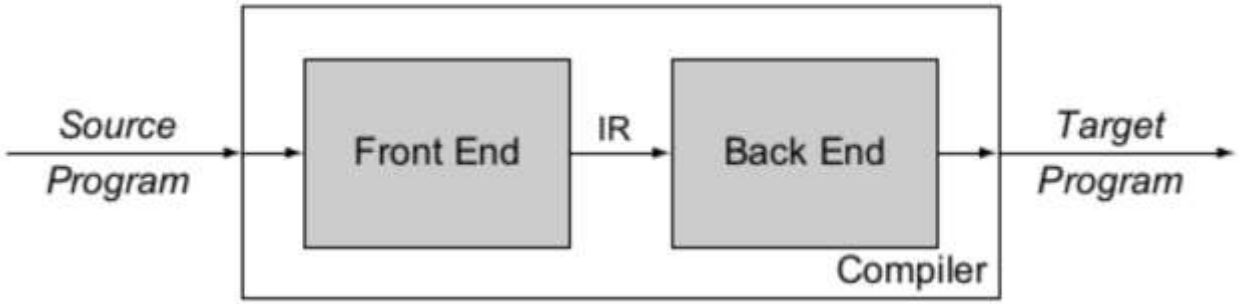
Things to Do

Things NOT to Do

Welcome to CSE 310

Compiler

- Convert a source program to a target program
- The compilation process usually divided into several phases



Compiler

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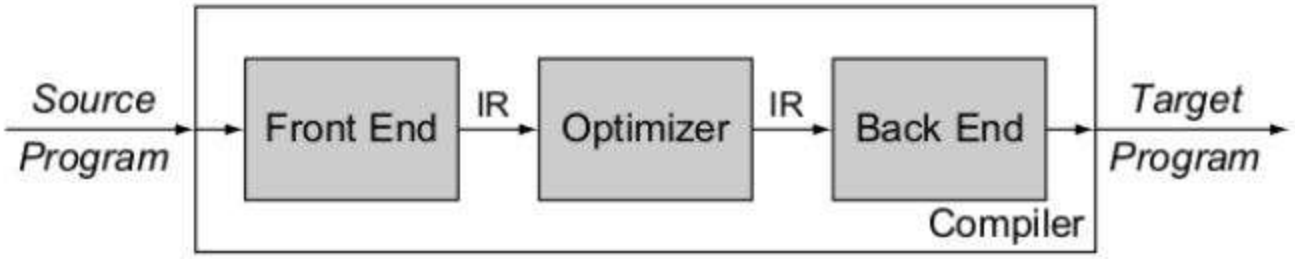
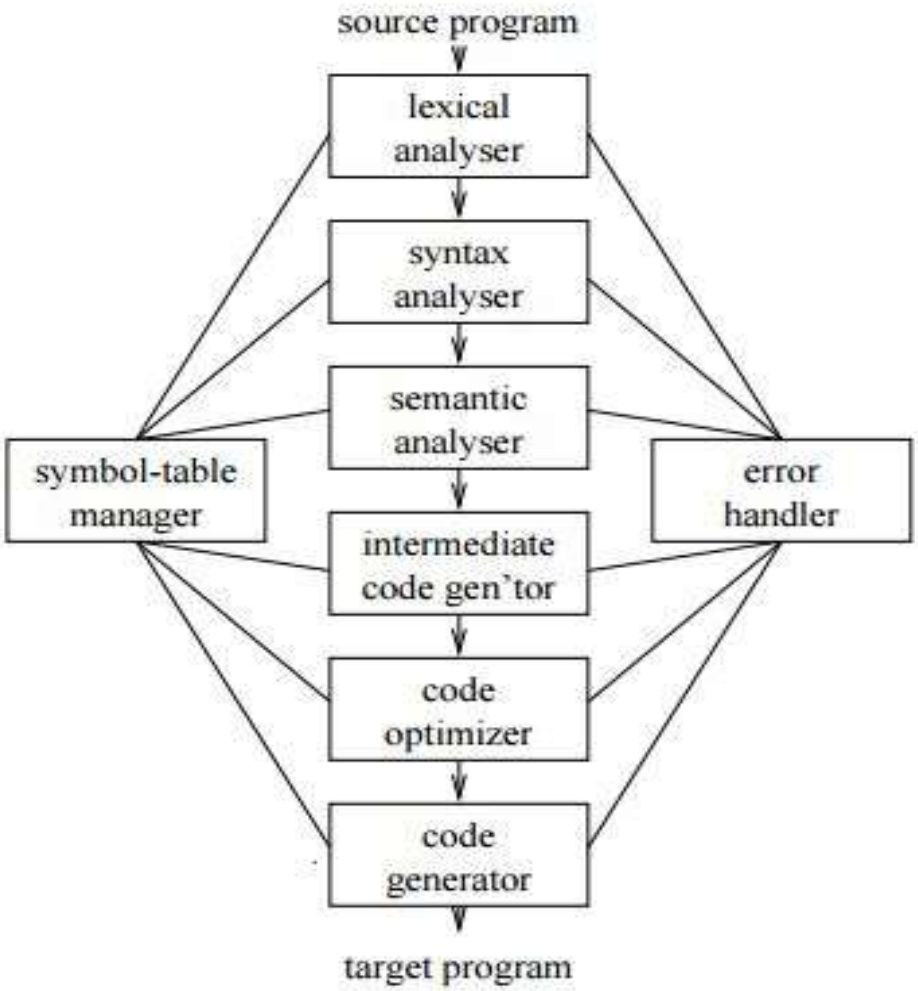
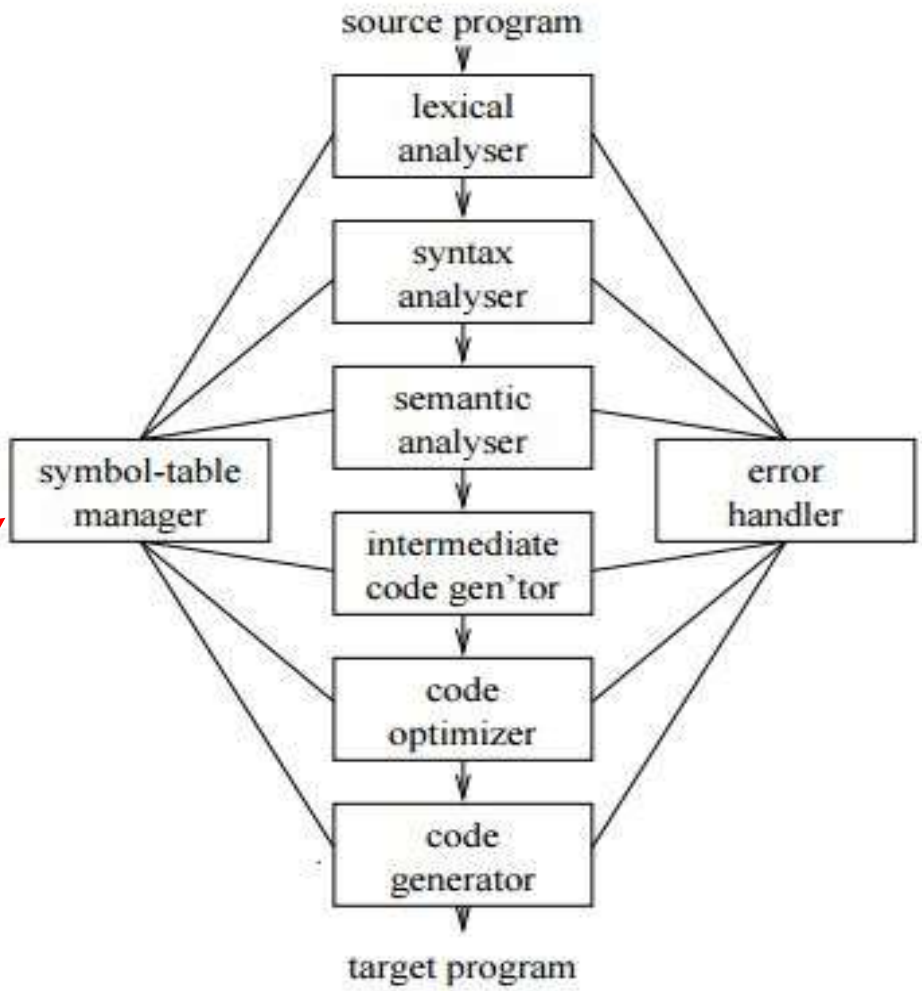


Compiler


source program
lexical analyser
syntax analyser
semantic analyser
symbol-table manager
error handler
intermediate code gen'tor
code optimizer
code generator
target program

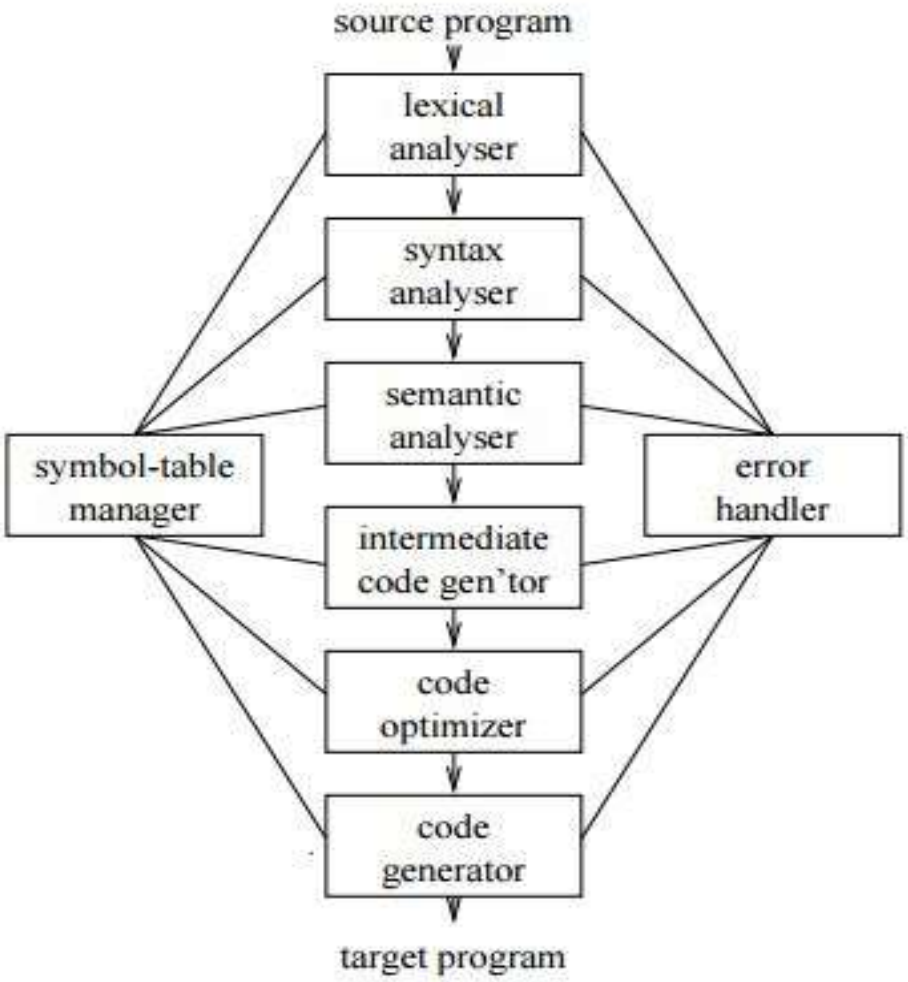
Compiler



Record keeper

Compiler

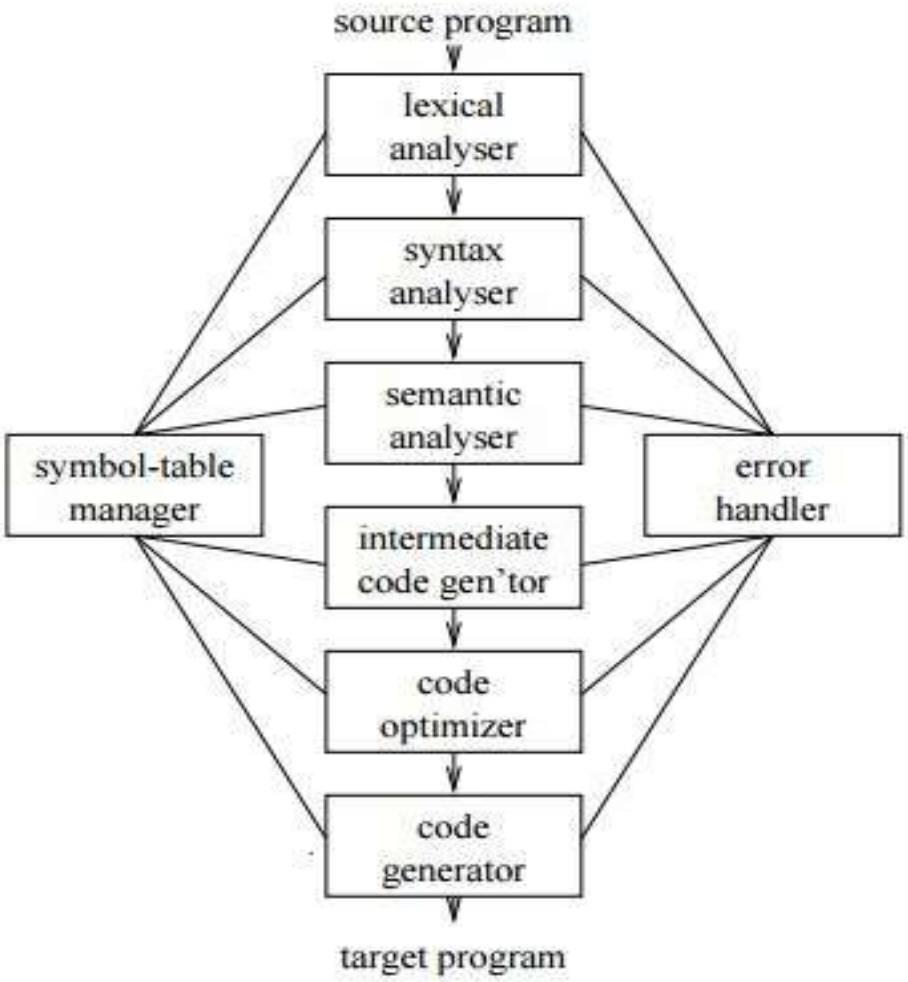
- **Lexical Analyzer** takes the source program as input and converts it into a stream of tokens
- To be used by the syntax analyzer later on
- Also detects some lexical errors
  - Ill formed number
  - Improper variable declaration
  - Unfinished string/comment etc.



Compiler

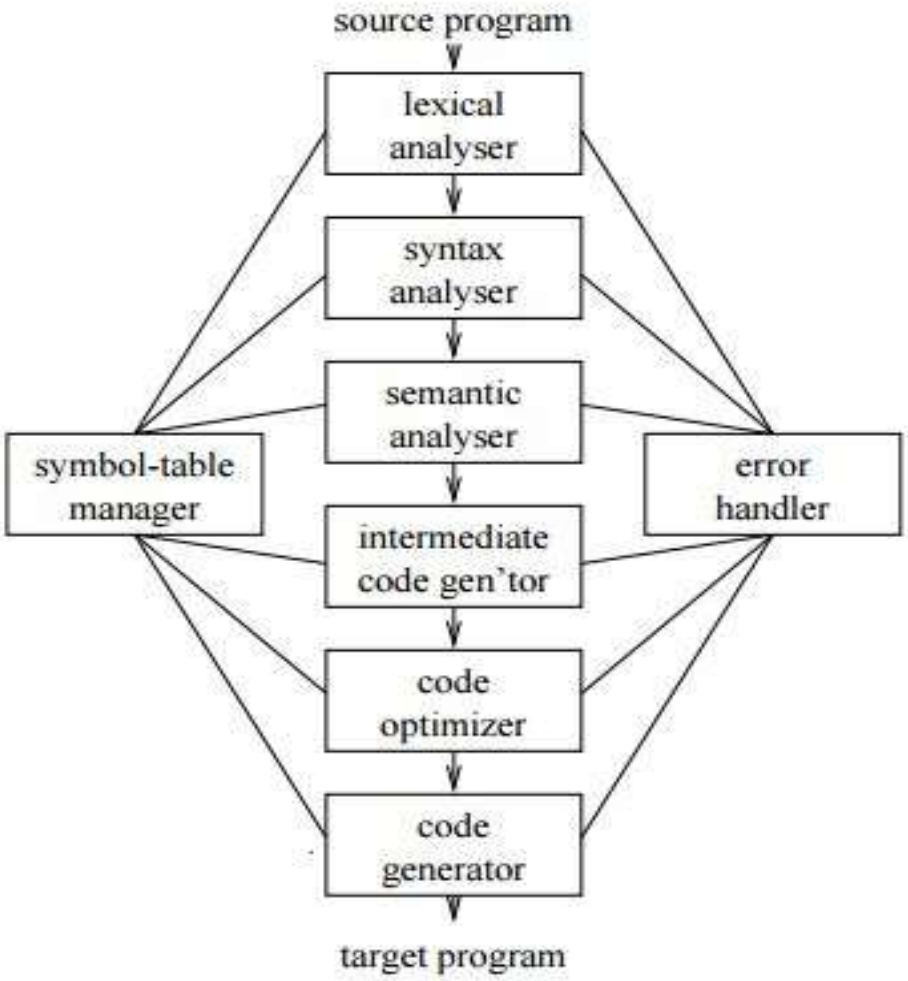
- **Syntax analyzer** uses the tokens produced by the lexical analyzer to depict the grammatical structure of the token stream
- Builds implicit syntax tree
- Detects syntax errors

CFG



Compiler

- **Semantic analyzer** uses the syntax tree and the information in the symbol table to check the source program for semantic consistency with the language definition
- Check semantic errors
  - Type checking
  - Variable declared as void
  - Undeclared variable
  - Error in no./type of function argument during call



What will we do in this course?

- Construct and manage symbol table
- Perform lexical analysis using flex
- Perform syntax analysis, semantic analysis, and intermediate code generation
- Some code optimization too
- So… We are going to build a COMPILER!

Some Info

- Linux Platform
- No Plagiarism

Symbol Table

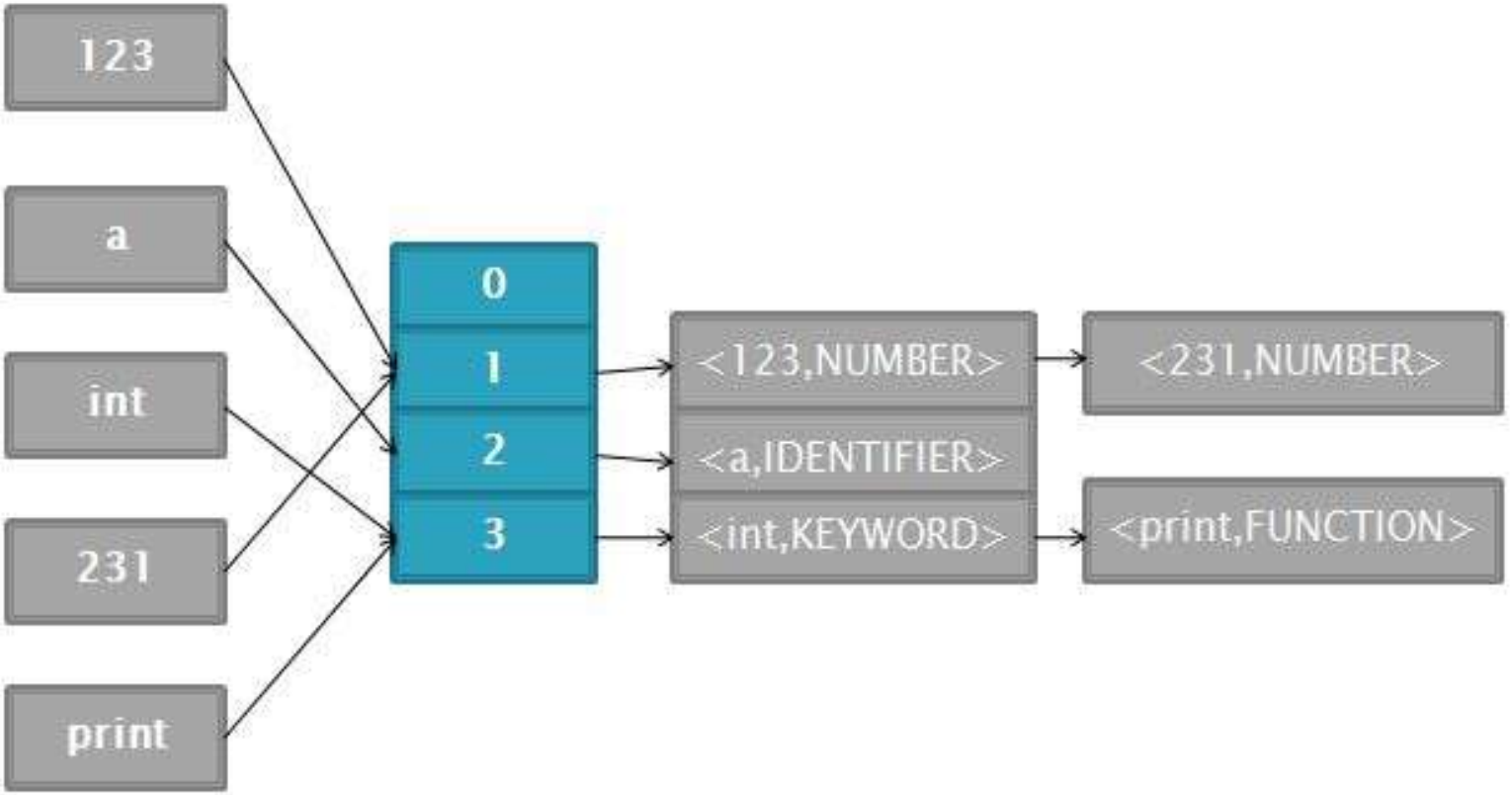
- A table storing information of occurrence of various entities in the source program
- Function names, return type, no. parameters; variable name, type etc.
- Information are:
  - Symbol Name
  - Type
  - Scope

- Used in almost all phases of a compilation

Offline 1: Symbol Table Management

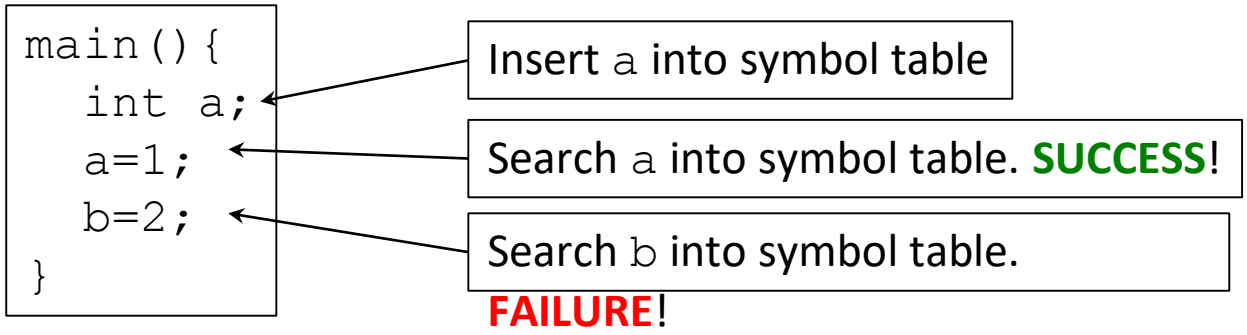
- Implement a simple symbol table
- Hash based (Chaining)
- Each entry is **mainly** a two tuple <Symbol Name, Symbol Type>
- Use Symbol Name as key of hash table

Offline 1: Symbol Table Management



How Symbol Table Helps?

- How can this type of Symbol Table help?
  - Detect undeclared variable



  - Type checking
    - Add an extra field for each symbol named **datatype**
    - During an assignment operation, check datatype field of RHS and LHS

How Symbol Table Helps?

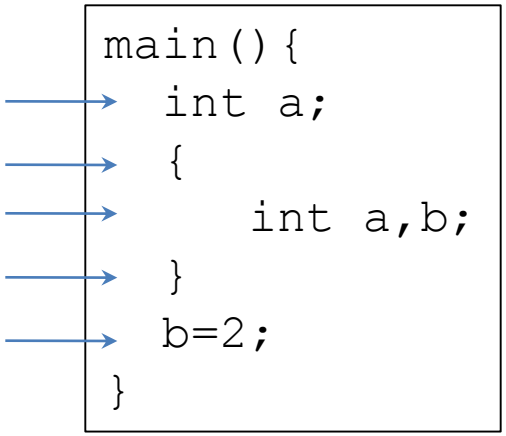
- How can this type of Symbol Table help?
  - Scope Management

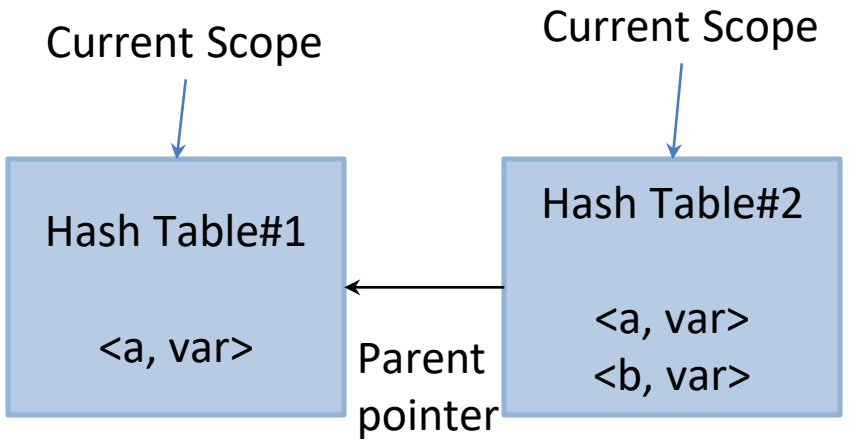
```
main(){
   int a;
   {
      int a,b;
   }
   b=2;
}
```

- Need to allow duplicate entry in symbol table
- Also delete some entries when a block ends
- How to accommodate this??

Symbol Table for Scope Management

- List of Hash Tables





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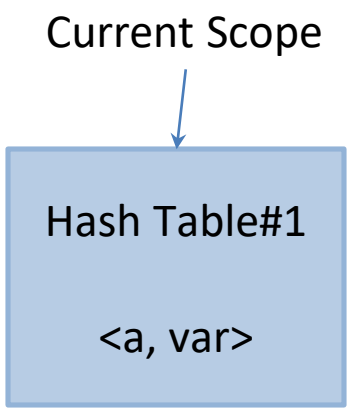


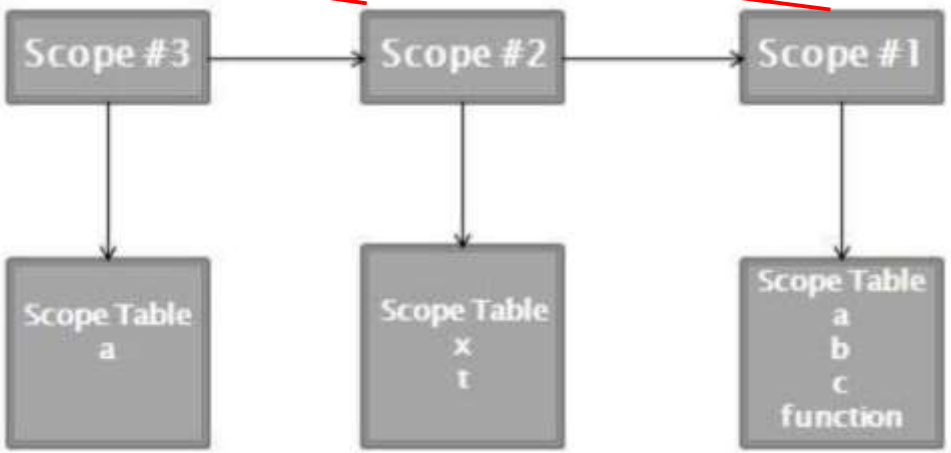
Symbol Table for Scope Management

- Stack of Hash Tables
- How does accessing work?
  - Search the topmost scope table
  - If fail, search its parent scope table and so on

Symbol Table for Scope Management

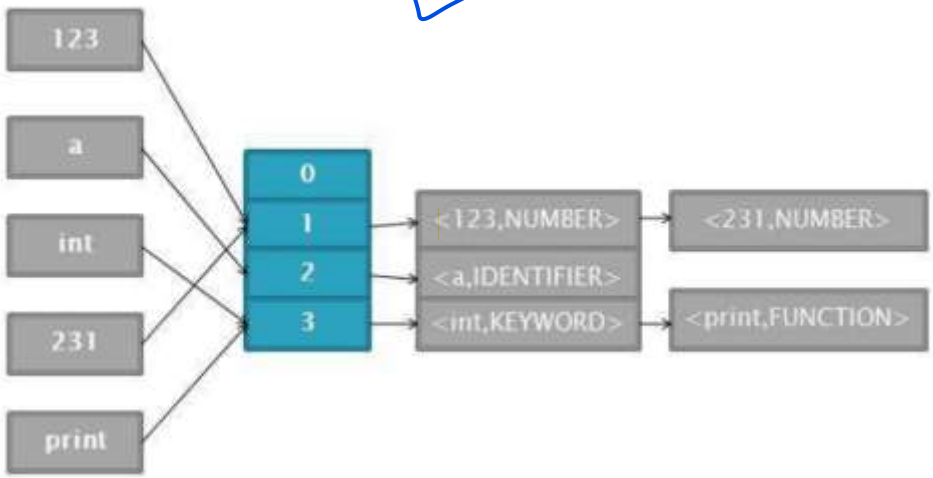
- Stack of Hash Tables

```
1. int a, b, c;
2. int func(int x) {
3.    int t = 0;
4.    if(x == 1) {
5.        int a = 0;
6.        t = 1;
7.    }
8.    return t;
9. }
10.int main() {
11.    int x = 2;
12.    func(x);
13.    return 0;
14.}
```



Offline 1: Symbol Table Management

- Three Classes
  1. SymbolInfo
     - Each entry of symbol table is an instance of SymbolInfo (Remember two tuples!!!)
     - Three member vars
       - name, type, pointer to SymbolInfo (separate chaining)



Offline 1: Symbol Table Management

- Three Classes
  2. ScopeTable
     - This class is the implementation of a hash table.
     - Represents each scope
     - Implement four operations
       - » Insert
       - » Lookup
       - » Delete
       - » Print

Offline 1: Symbol Table Management

- Three Classes
  3. SymbolTable
     - Maintains a list of Scope Tables
     - Implement six operations
       - » Enter Scope
       - » Exit Scope
       - » Insert
       - » Delete
       - » Print All Scope Tables
       - » Print Current Scope Table

No Memory Leak

- use -fsanitize=address flag

Acknowledgement

- Ajmain Yasar Ahmed Sahil