Compilers: Symbol Collection and Type Checking

a topic in

DM565 – Formal Languages and Data Processing

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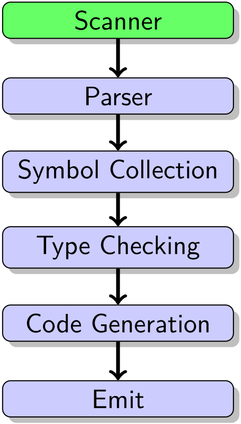
October, 2019

Compiler Phases (Recap)



Scanner (lexical analysis)

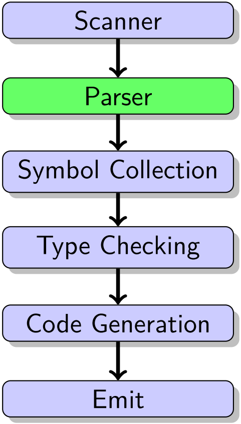
We have shown that

- regular expressions can be used to specify tokens,
- everything can be transformed to and combined into finite automata, and
- using appropriate ways to run the resulting DFA, we can find and return tokens.

We have seen that we can use tools to do this for us:

- `flex` (`lex`) for C (or Java, etc.) and
- the `ply` package for Python.

Compiler Phases (Recap)



Parser (syntax analysis)

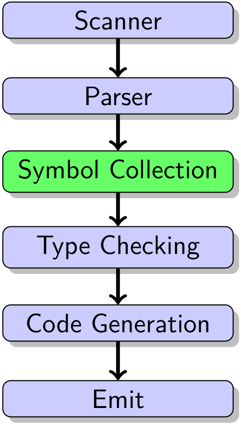
We have shown that we can

- construct top-down (predictive, LL(1)) parsers via the concepts of NULLABLE, FIRST, and FOLLOW, and the construction of either
  - a predictive parsing table, or
  - a recursive descent program.
- construct bottom-up (LR(1)/LALR(1)) parsers by
  - computing LR(1) states, and then
  - transforming into LR(1)/LALR(1) parsing tables.

We have seen that for bottom-up parsing, we can use tools to do this for us:

- `bison` (`yacc`) for C (or Java, etc.) and
- the `ply` package for Python.

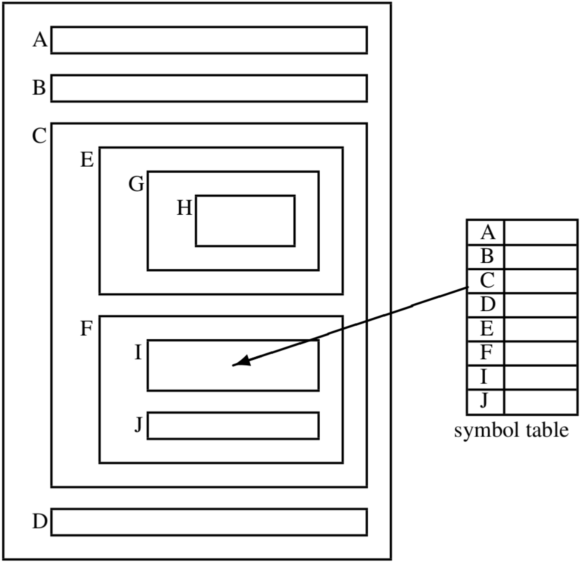
Compiler Phases



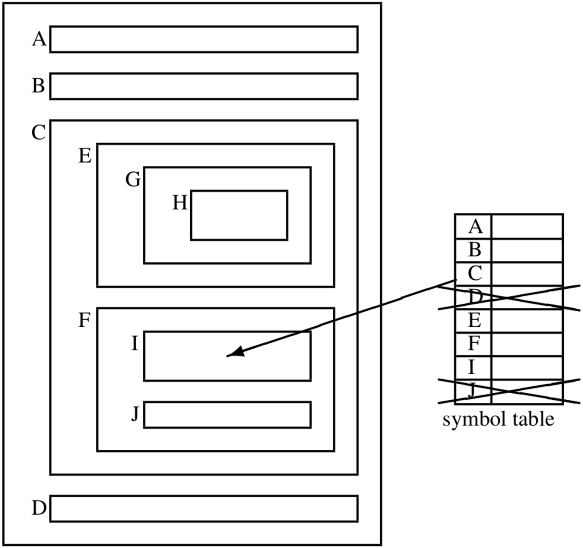
Scope: SCIL example

```
var a, dummy

function f(){

  function g(){

    var a

    function h(){
      a  = 0;
      print(a);   # 3rd output: 0
    }

    a = 2; print(a); # 2nd output: 2
    dummy = h(); print(a); # 4th output: 0
    return 0;
  }

  print(a); # 1st output: 1
  dummy = g(); print(a); # 5th output: 1
  return 0;
}

a = 1; dummy = f(); print(a); # 6th output: 1
return 0;
```

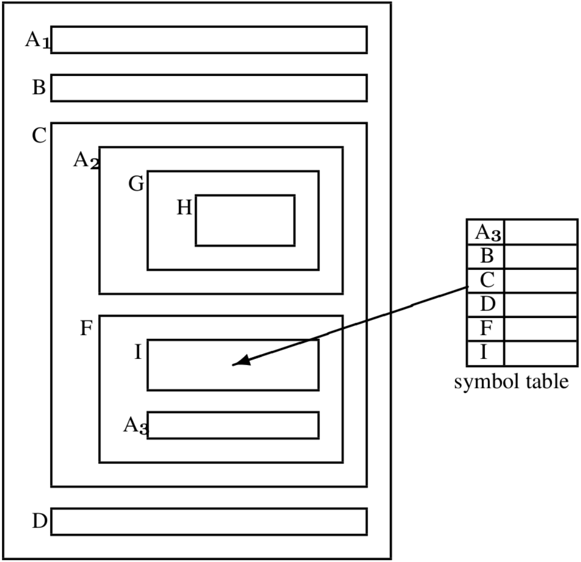
Scope: Static, nested scope



Scope: Old-fashioned



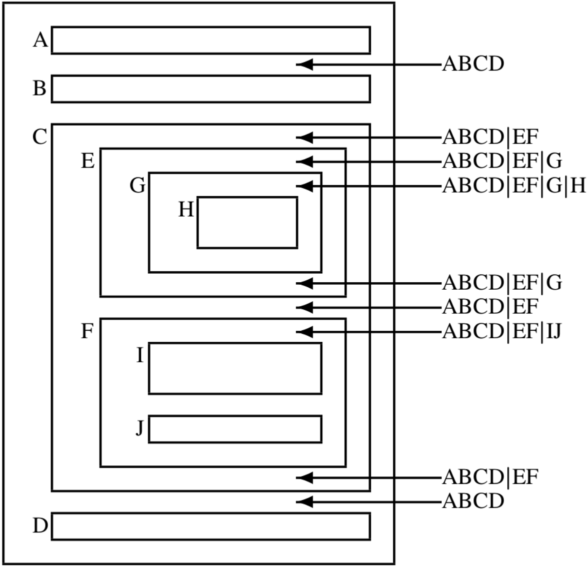
Scope: Name hiding



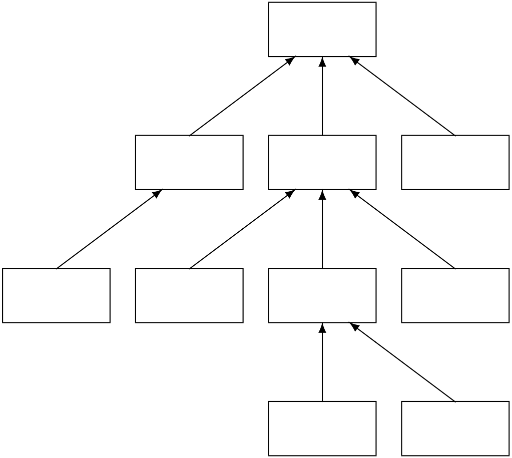
A_3	
B	
C	
D	
F	
I	

symbol table

Scope: Stack behavior



Symbol Table Structure



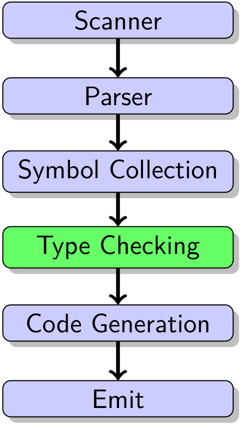
Symbol Table Realization in C (example)

```
#define HashSize 317
#define NEW(type) (type *)malloc(sizeof(type))
void *malloc(unsigned n);

typedef struct SYMBOL {
  char *name;
  int value;
  struct SYMBOL *next;
} SYMBOL;

typedef struct SymbolTable {
    SYMBOL *table[HashSize];
    struct SymbolTable *next;
} SymbolTable;

int Hash(char *str);

SymbolTable *initSymbolTable(SymbolTable *t);

SYMBOL *insert(SymbolTable *t, char *name, int value);

SYMBOL *lookup(SymbolTable *t, char *name);
```

Symbol Table Realization in Python (example)

```
class SymbolTable:
    """Implements a classic symbol table for static nested
       scope. Names for each scope are collected in a
       Python dictionary. The parent scope can be accessed
       via the parent reference.
    """
    def __init__(self, parent):
        self._tab = {}
        self.parent = parent

    def insert(self, name, value):
        if name in self._tab:
            return None
        self._tab[name] = value

    def lookup(self, name):
        if name in self._tab:
            return self._tab[name]
        elif self.parent:
            return self.parent.lookup(name)
        else:
            return None
```

Compiler Phases



Type Checking

In addition to simple type rules covered in the lecture notes, advanced type checking questions such as those related to structural equivalence can be answered using our DFA tool base.