CS 536 Announcements for Monday, March 18, 2024

Midterm 2
- Thursday, March 21, 7:30 – 9 pm
- S429 Chemistry
- bring your student ID

Last Time
- static semantic analysis
- name analysis
  - symbol tables
  - scoping

Today
- name analysis
- exam review

Next Time
- type checking

Static Semantic Analysis

Two phases
- name analysis
- type checking

Name analysis
- for each scope
  - process declarations – add entries to symbol table
  - process statements – update IdNodes to point to appropriate symbol table entry
- each entry in symbol table keeps track of: kind, type, nesting level, runtime location
- identify errors
  - multiply-declared names
  - uses of undeclared variables
  - bad `tuple` accesses
  - bad declarations

Scoping
- **scope** = block of code in which a name is visible/valid
- kinds of scoping
  - **static** – correspondence between use & declaration made at compile time
  - **dynamic** – correspondence between use & declaration made at run time

Name analysis and `tuples`

Symbol tables and `tuples`

- Compiler needs to
  - for each field: determine type, size, and offset with the tuple
  - determine overall size of tuple
  - verify declarations and uses of something of a `tuple` type are valid
- Idea: each `tuple` type definition contains its own symbol table for its field declarations
  - associated with the main symbol table entry for that `tuple`'s name

Relevant base grammar rules

```
decl          ::= varDecl
              | fctnDecl
              | tupleDecl     // tuple defs only at top level
              ;
varDeclList   ::= varDeclList varDecl
              | /* epsilon */
              ;
varDecl       ::= type id DOT
              | TUPLE id id DOT
              ;
...
tupleDecl     ::= TUPLE id LCURLY tupleBody RCURLY DOT
              ;
tupleBody     ::= tupleBody varDecl
              | varDecl
              ;
...
type          ::= INTEGER
              | LOGICAL
              | VOID
              ;
loc           ::= id
              | loc COLON id
id            ::= ID
              ;
```

Definition of a `tuple` type

```
tuple Point {
    integer x.
    integer y.
}.

tuple Color {
    integer r.
    integer g.
    integer b.
}.

tuple ColorPoint {
    tuple Color color.
    tuple Point point.
}.
```

Declaring a variable of type `tuple`

```
tuple Point pt.
tuple Color red.
tuple ColorPoint cpt.
```

Accessing fields of a `tuple`

```
pt:x = 7.
pt:y = 8.
pt:z = 10.

red:r = 255.
red:g = 0.
red:b = 0.

cpt:point:x = pt.x.
cpt:color:r = red.r.
cpt:color:g = 34.
```

<u>If L child is an identifier</u>

- check identifier
- get symbol table
- lookup

<u>If L child is a colon-access</u>

- recursively process L child
- if symbol table in

  then

  else

<u>If R child is a tuple type</u>

- then

- else

Name analysis: handling classes

Similar to handling aggregate data structures

- also need to be able to search the class hierarchy

Idea:

Symbol table for each class with two nesting hierarchies

1) for lexical scoping within methods
2) for inheritance hierarchy

To resolve a name

- first
- then

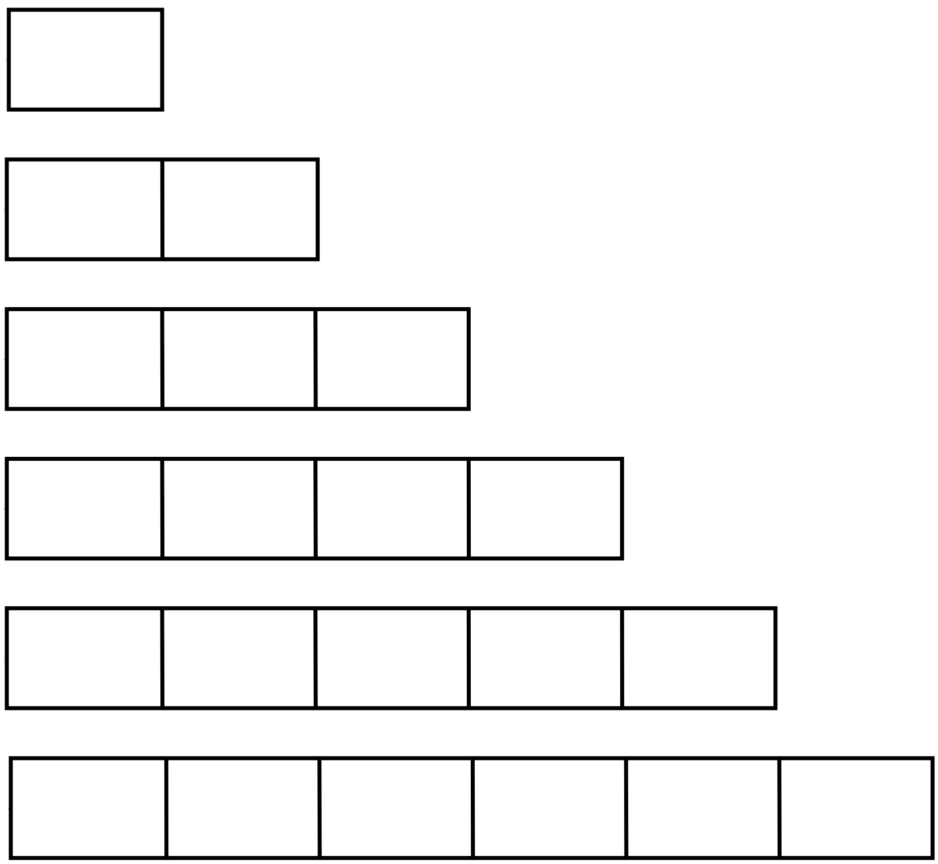
CYK example

CFG

s → a C
  | b a
a → A B
  | C s
b → D
  | ε

Convert to CNF

Run the CYK algorithm to parse the input: `D C C A B C`



FIRST/FOLLOW Example

Original CFG

expr → expr + term
| term
term → term * factor
| factor
factor → INTLIT
| (expr)

Transformed CFG

expr → term expr'
expr'→ + term expr' | ε
term → factor term'
term' →* factor term' | ε
factor → INTLIT | (expr)

	FIRST	FOLLOW
expr		
expr'		
term		
term'		
factor		

Parse table

	+	*	(	)	INTLIT	EOF
expr						
expr'						
term						
term'						
factor						

Building the parse table

```
for each production x → α

   for each terminal T in FIRST(α)
      put α in table[x][T]

   if ε is in FIRST(α)
      for each terminal T in FOLLOW(x)
         put α in table[x][T]
```