Report
Topic: Operator Precedence Parsing(3rd Sep)

- Shashank Rajput (11CS10042)

Precedence Relations

Bottom-up parsers for a large class of context-free grammars can be easily developed using *operator grammars*.

Operator Grammars have the property that **no production right side is empty or has two adjacent non-terminals**.

Consider:

E-> E op E | id
op-> + | *

Not an operator grammar but:

E-> E + E | E * E | id

This parser relies on the following three precedence relations:

Relation	Meaning
$a \lessdot b$	*a* yields precedence to *b*
$a = b$	*a* has the same precedence as *b*
$a \gtrdot b$	*a* takes precedence over *b*

	id	+	*	$
id		·>	·>	·>
+	<·	·>	<·	·>
*	<·	·>	·>	·>
$	<·	<·	<·	·>

Precedence Table

Example: The input string:

$\mathbf{id}_1$ + $\mathbf{id}_2$ * $\mathbf{id}_3$

After inserting precedence relations becomes:

$ <· $\mathbf{id}_1$ ·> + <· $\mathbf{id}_2$ ·> * <· $\mathbf{id}_3$ ·> $

Basic Principle

Having precedence relations allows identifying handles as follows:

1. Scan the string from left until seeing ·> and put a pointer.
2. Scan backwards the string from right to left until seeing <·
3. Everything between the two relations <· and ·> forms the handle
4. Replace handle with the head of the production.

Operator Precedence Parsing Algorithm

Initialize: Set *ip* to point to the first symbol of the input string *w*\$
Repeat: Let *b* be the top stack symbol, a the input symbol pointed to by *ip*

```
if (a is $ and b is $)
        return
else
        if a ·> b  or  a =· b  then
                push a onto the stack
                advance  ip  to the next input symbol
else if  a <· b then
                repeat
                        c ← pop the stack
                until (c .> stack-top)
        else error
end
```

Making Operator Precedence Relations

The operator precedence parsers usually do not store the precedence table with the relations; rather they are implemented in a special way.
Operator precedence parsers use **precedence functions** that map terminal symbols to integers, and so the precedence relations between the symbols are implemented by numerical comparison.

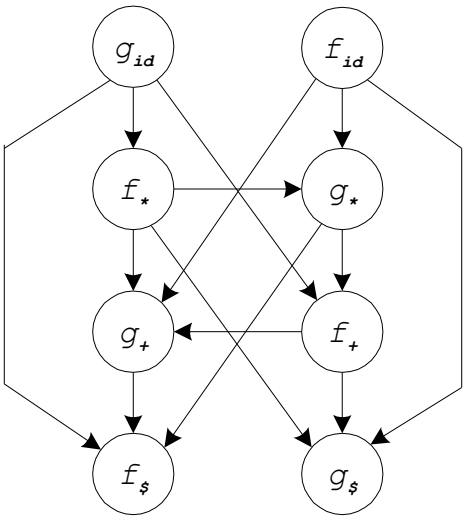
Algorithm for Constructing Precedence Functions

1. Create functions f_a for each grammar terminal *a* and for the end of string symbol.
2. Partition the symbols in groups so that f_a and g_b are in the same group if $a =\cdot b$ (there can be symbols in the same group even if they are not connected by this relation).
3. Create a directed graph whose nodes are in the groups, next for each symbols a and b do: place an edge from the group of g_b to the group of f_a if $a <\cdot b$, otherwise if $a \cdot> b$ place an edge from the group of f_a to that of g_b.
4. If the constructed graph has a cycle then no precedence functions exist. When there are no cycles collect the length of the longest paths from the groups of f_a and g_b respectively.

Example: consider the following table

	id	+	*	$
id		·>	·>	·>
+	<·	·>	<·	·>
*	<·	·>	·>	·>
$	<·	<·	<·	·>

Using the algorithm leads to the following graph:



From which we extract the following precedence functions:

	id	+	*	$
f	4	2	4	0
g	5	1	3	0