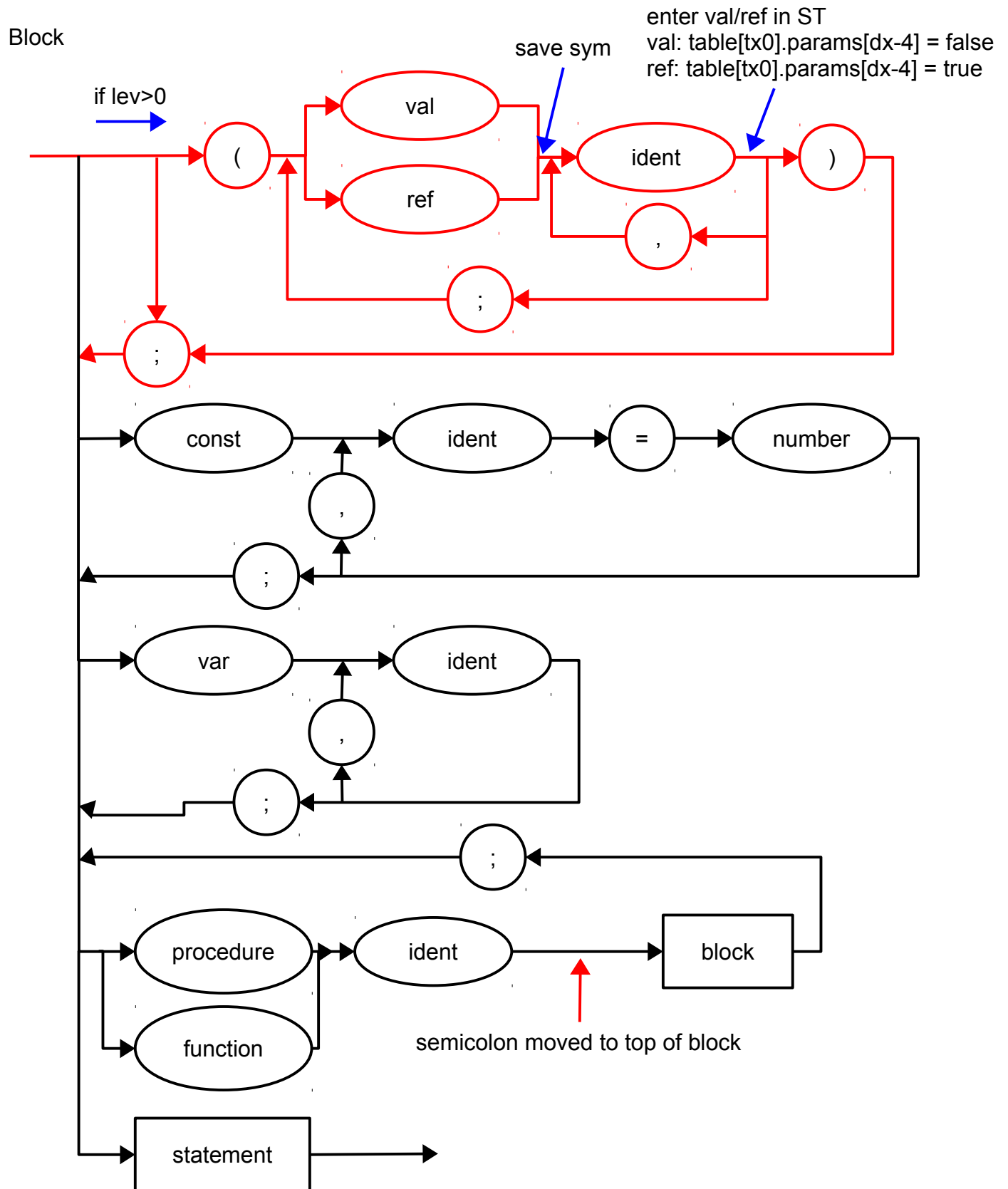
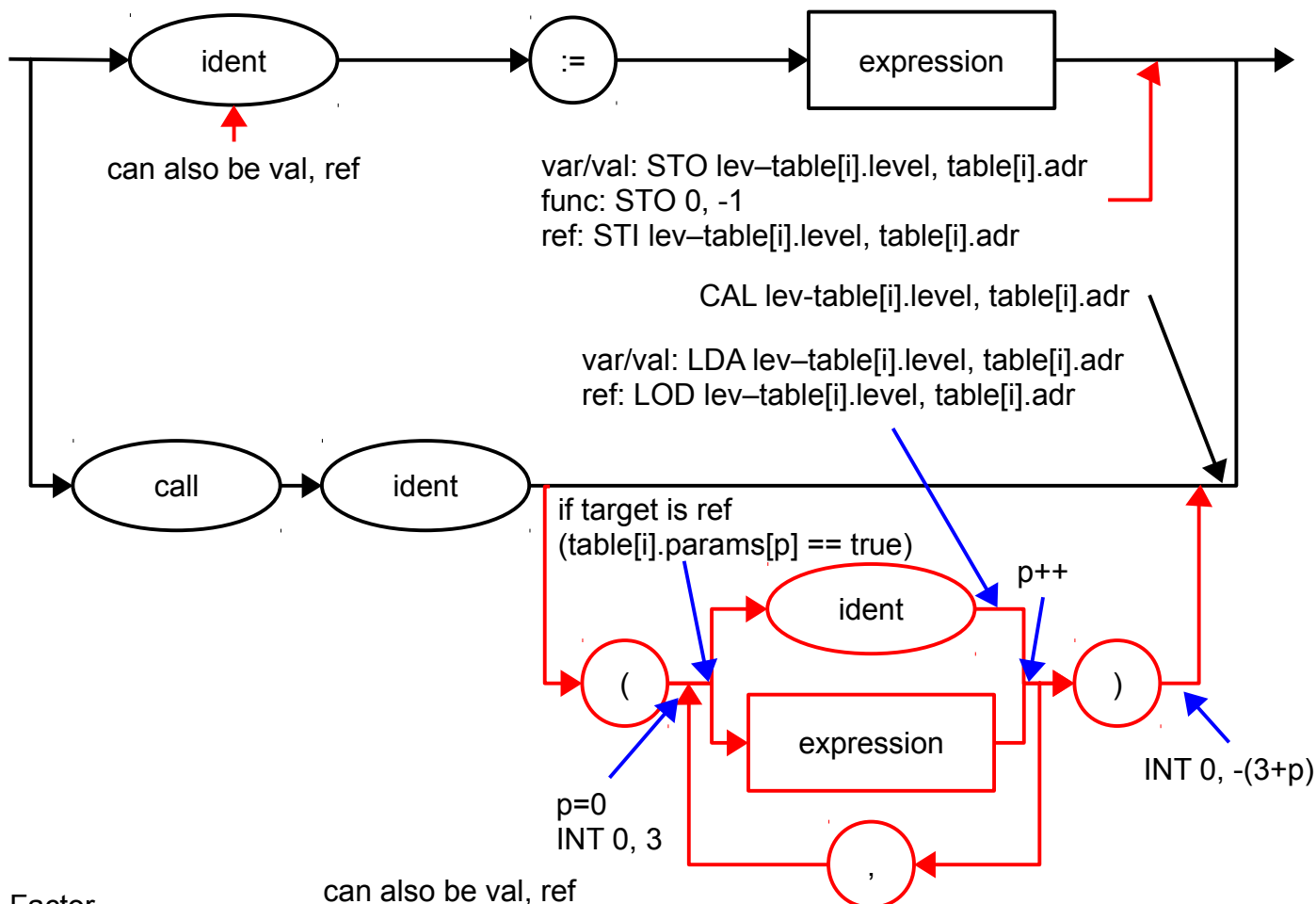


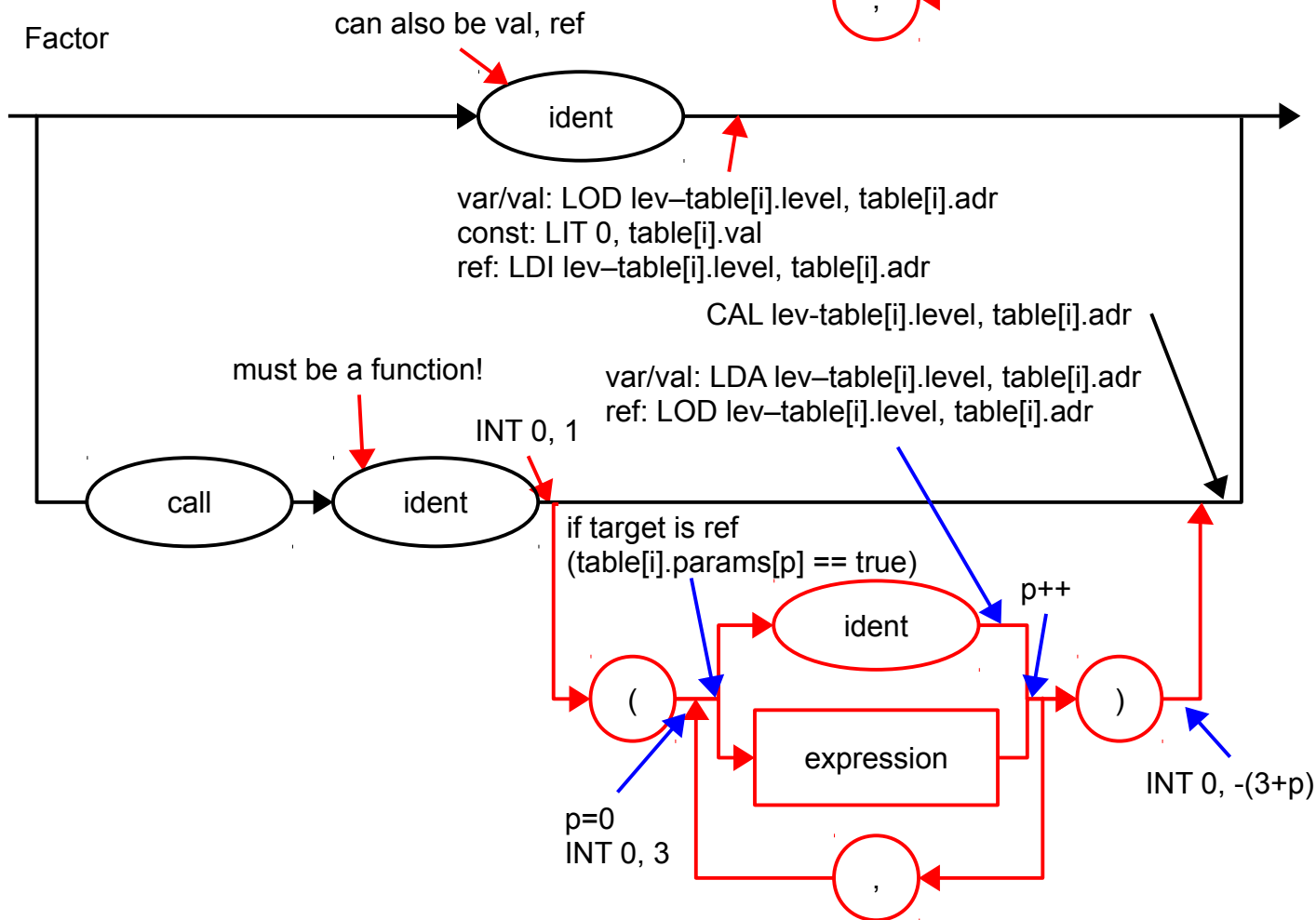
Syntax Diagrams (adding Value and Reference Parameters)



Statement



Factor



we need to add two new types to the symbol table (VAL, REF)
also add symbols and reserved words

how do we know whether a parameter is VAL/REF in the ST?

have an array of bools for each procedure/function parameter:

0/F->VAL; 1/T->REF

table[i].params[j] where i is the procedure/function ST index and j is the parameter index

we should not be able to pass constants or numbers to REF parameters

parameter loading

value: LOD (normal load)

reference: LDI (a new load indirect)

parameter storing

value: STO (normal store)

reference: STI (a new store indirect)

calling:

caller / callee	VAL	REF
VAL	LOD	LDA
REF	LDI	LOD
VAR	LOD	LDA
CONST	LIT	---
NUM	LIT	---

LDA (a new load address)

note how VAL and VAR are similar—we can simply treat them the same!

so we need 3 new instructions

remember that base(x) finds the base, x levels down

existing instructions:

LOD: t++;

s[t] = s[base(table[i].level)+table[i].adr];

STO: s[base(table[i].level)+table[i].adr] = s[t];

t--;

new instructions:

STI: s[s[base(table[i].level)+table[i].adr]] = s[t];

t--;

LDI: t++;

s[t] = s[s[base(table[i].level)+table[i].adr]];

LDA: t++;

s[t] = base(table[i].level)+table[i].adr;

we must allow declaration of value and reference parameters

they just behave like normally declared variables

the first parameter is at an offset of 3 in the segment, the second at 4, etc

additional declared variables in the block increment from there
it's hard to parse for parameters in the normal block syntax diagram

because the level of parameters is incorrect

and also the variable address offset is only valid for the current block

so let's just move that part to the top of block and allow "entrance" only if lev>0

which means we're in the current procedure or function

we also move the semicolon after the procedure/function ident to the top of block

now we can just use dx as normal to set the correct address!

one additional thing is to set the parameter boolean of the procedure/function properly

we do this when we enter the parameters in the ST

```
if (sym == valsym)
{
    enter(value);
    table[tabinx0].params[dx-4] = false;
}
...
```

why dx-4?

dx starts at 3

bool params starts at 0 (we need to shift it back)

but dx increments right after we add a val/ref parameter

so if we modify the param array right after adding a parameter

we need dx-3-1 = dx-4

of course we could reverse the two instructions and it would be dx-3 (right?)

for the designer (geek), we put it where it is most efficient and easiest

for the user (ignoramus), we put it where s/he expects it to be

we then have to figure out how to handle storing to val/ref within procedures and functions

this is done in statement

we modify ident := <expression> to also allow assigning to VAL/REF

if the ident is variable/value: STO lev-table[i].level, table[i].adr

if the ident is a function: STO 0, -1 (so long as we're in the proper function!)

if the ident is REF: STI lev-table[i].level, table[i].adr

we also need to figure out how to handle loading of val/ref within procedures and functions

this is done in factor

we modify ident to allow loading VAL/REF

if the ident is variable/value: LOD lev-table[i].level, table[i].adr

if the ident is const: LIT 0, table[i].val

if the ident is ref: LDI lev-table[i].level, table[i].adr

we need to allow calling procedures and functions while passing parameters

we do this in both statement (for procedures) and factor (functions)

in either case, we preliminarily INT 0, 3 to temporarily make space for SL, DL, RA

this is like a "fake call" just to load parameters

then we LOD, LIT, LDI, or LDA depending on type

this really depends on two things:

what type is the variable we're trying to pass

what type is the procedure/function parameter (receiver)

if the receiver is VAL then just call expression (we only need either LOD or LDI)

if the receiver is REF then we use LDA for VAL, VAR and LOD for REF

once we're done loading parameters, we decrement the stack to undo the fake call

INT 0, -(3+# parameters)