Pascal P4 System

model for most other Pascal systems (UCSD)

compiler generates assembly language P4 intermediate code

assembler/interpreter assembles and executes P4 code

advantages

- readable intermediate code
- resolving of forward references in single pass in interpreter
- portable system

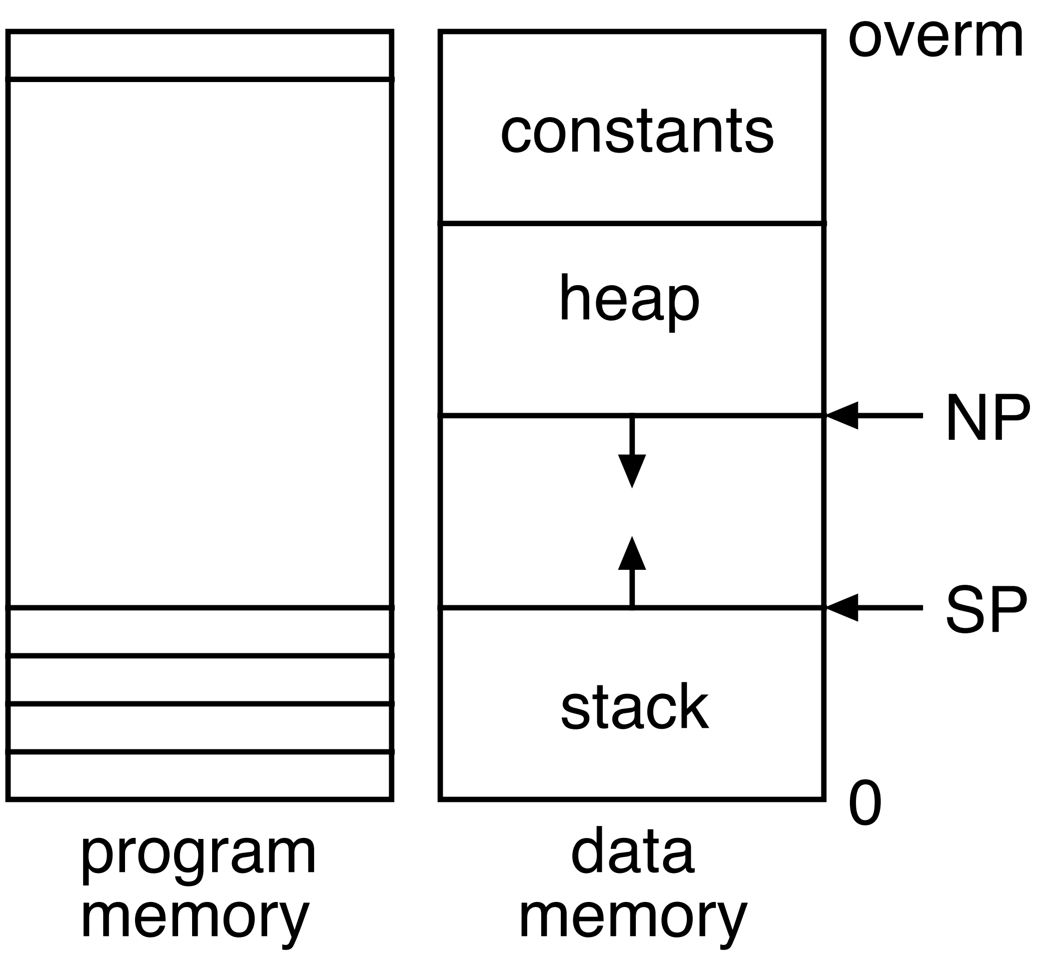
problems

- very slow

possible improvements

- compiler generates binary P4 code
- direct threaded code interpreter or JIT compiler

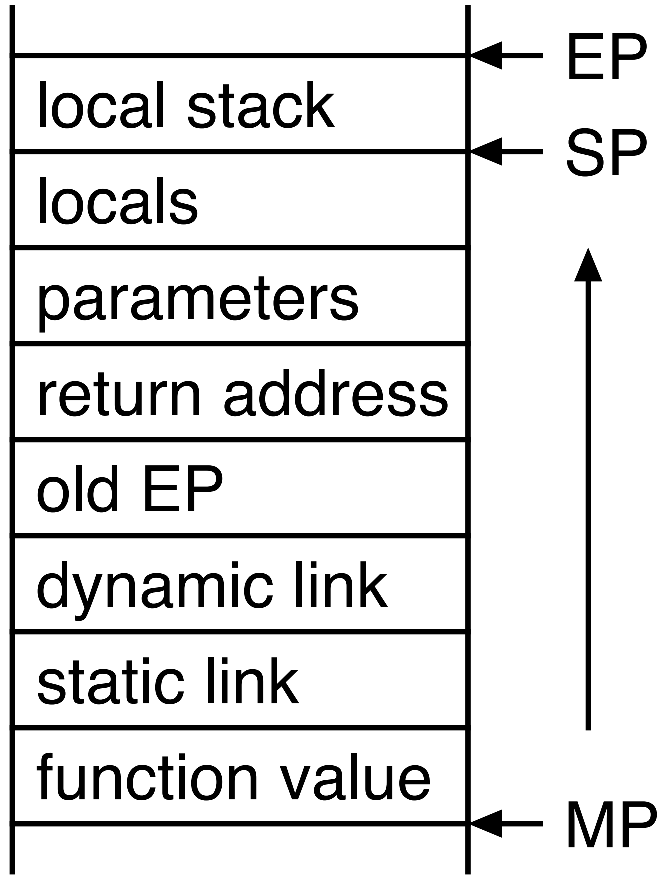
The P4 Virtual Machine



5 registers

PC	program counter
SP	stack pointer
MP	mark stack pointer
EP	extreme stack pointer
NP	new pointer

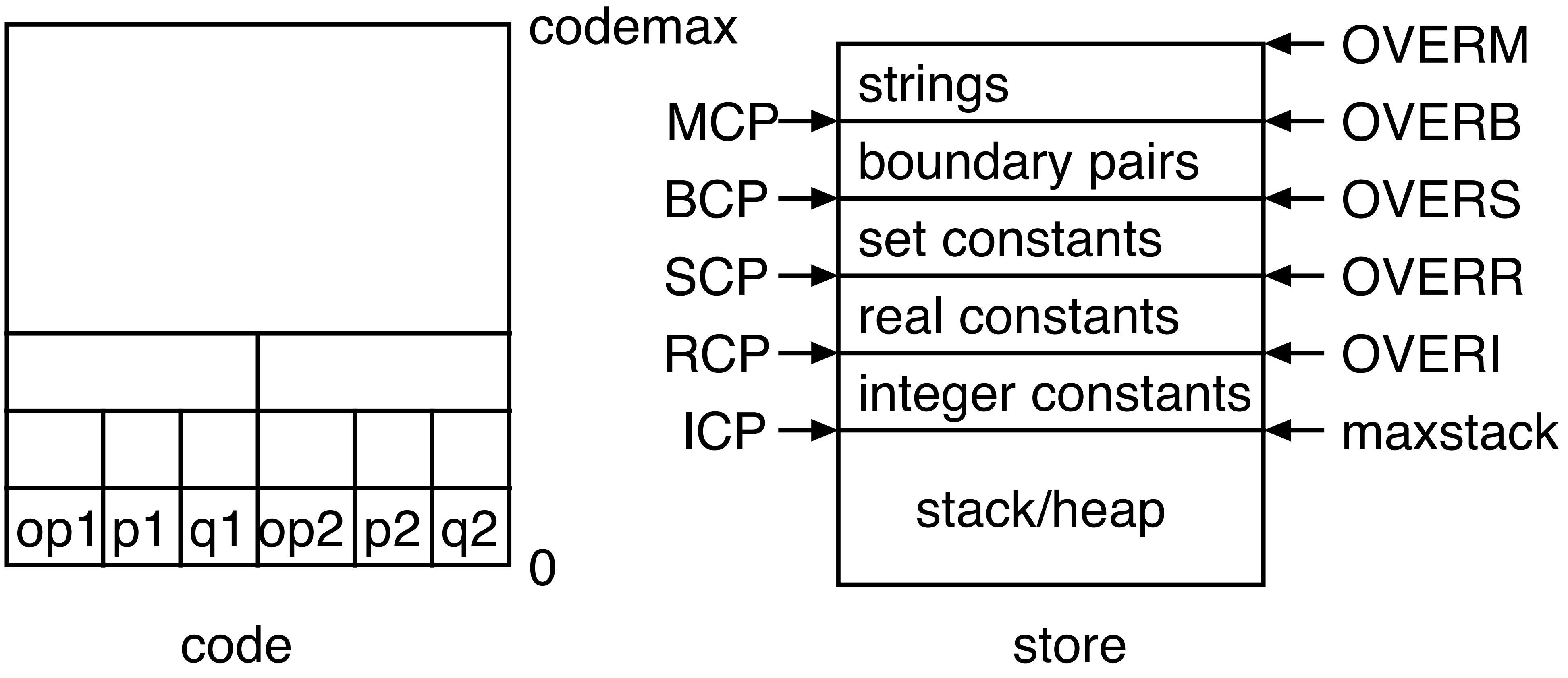
Stack Frame



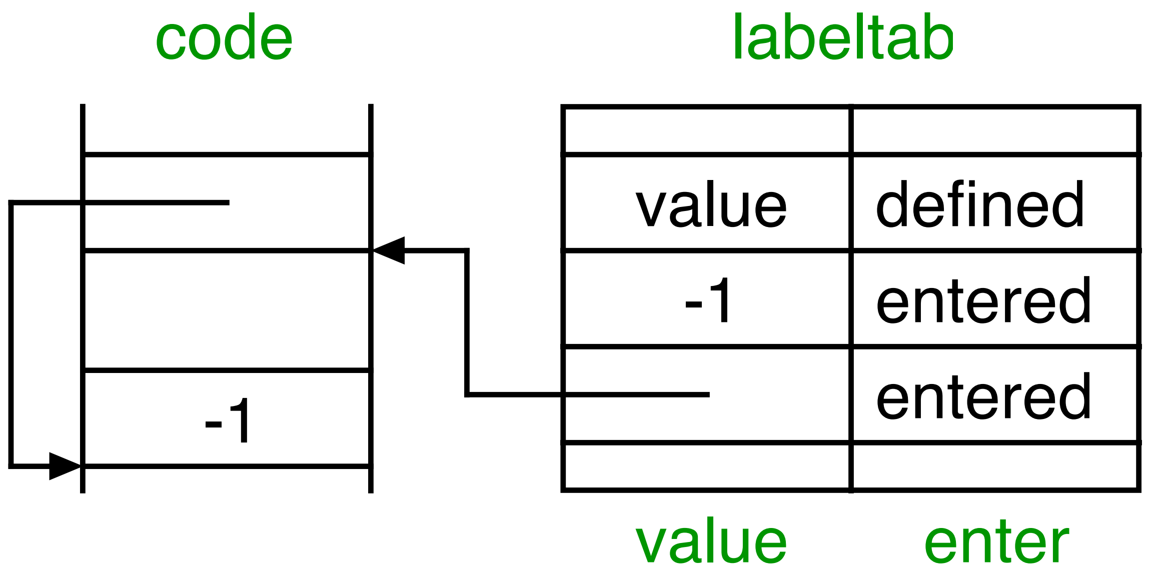
mst	mark stack
cup	call user procedure
ent	enter block
ret	return

Assembler/Interpreter

2 instructions with 2 operands are stored in one machine word



Assembler



instruction names stored in linear table

multiple type instructions are translated into different instructions

identical constants are stored only once

Interpreter

maximum of 4 files

subroutines for

- post mortem dump
- computation of base
- string comparison
- standard input/output procedures

instruction fetch

case statement

Pascal P4 Compiler

single pass compiler

control part: syntactic analysis calls lexical analysis (insymbol), semantic check and code generation

generated code: assembly language source

about 4000 lines of Pascal code

portable through constant definitions

Lexical Analysis

program driven lexical analysis (main routine: insymbol)

determines identifiers, keywords, numbers and other symbols

skips comments (option recognition)

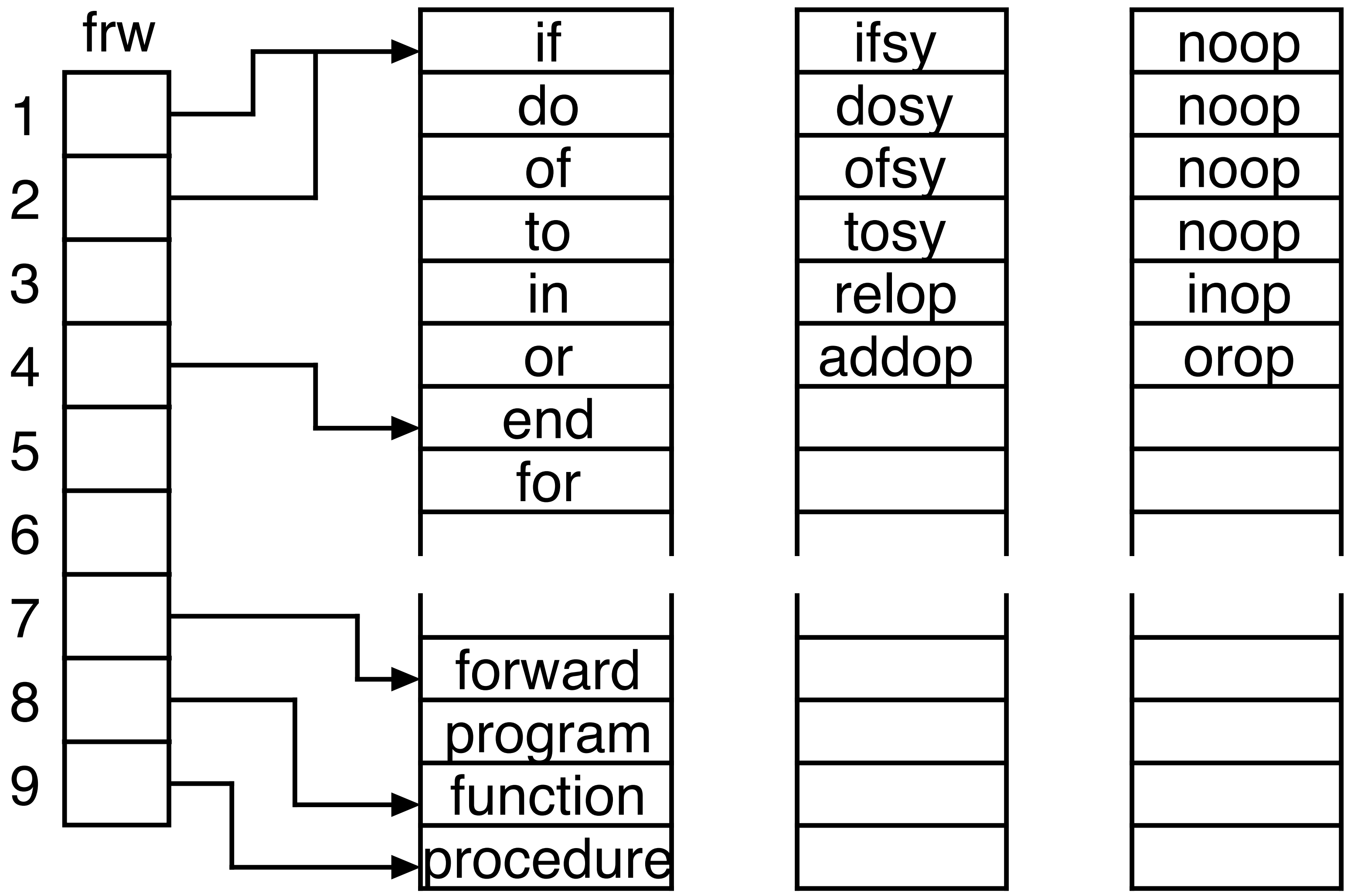
output of source and error messages

spaces in identifiers are added economically

storate of constants

integer computation can cause overflow

Tables of Lexical Analysis



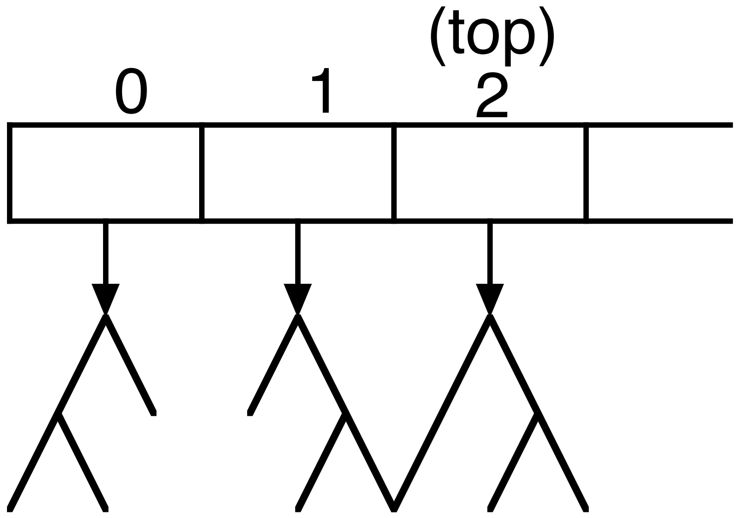
Syntax Analysis

program driven: recursive descent parser

```
procedure whilestatement;
begin
   expressioin (fsys+[dosy]);
   if sy = dosy
   then insymbol
   else error (54);
   statement(fsys)
end;
```

skip skips symbol until continuation is possible

Semantic Analysis



`enterid`, `searchid`, `searchsection`, `getbounds`, `equalbounds`, `comptypes`

no endless recursion for cyclic date structures (pointers)

Code Generation

`gen0`, `gen1`, `gen2`, `gen0t`, `gen1t`, `gen2t`

generate code for 0, 1 or 2 parameters with or without types

`mes`: computes maximum stack depth

`genfjp`, `genujpxjp`, `gencupent`: branch switch and procedure call

`alignquot`, `align`: address computations

`load`, `store`, `loadaddress`: operand loads and stores

`checkbnds`: checks bounds

`genlabel`, `putlabel`: generation of labels