

Quick Reference to the P machine Instructions

Datatypes	
a	Address
b	Boolean
c	Character
i	Integer
r	Real
N	Numeric = i, r
T	Type = a, b, c, i, r

		Conditions	Result
Arithmetic instructions			
add N	STORE[SP-1] := STORE[SP-1] + _N STORE[SP] SP := SP - 1	(N, N)	(N)
sub N	STORE[SP-1] := STORE[SP-1] - _N STORE[SP] SP := SP - 1	(N, N)	(N)
mul N	STORE[SP-1] := STORE[SP-1] * _N STORE[SP] SP := SP - 1	(N, N)	(N)
div N	STORE[SP-1] := STORE[SP-1] / _N STORE[SP] SP := SP - 1	(N, N)	(N)
neg N	STORE[SP] := - _N STORE[SP]	(N)	(N)
Logical instructions			
and	STORE[SP-1] := STORE[SP-1] <i>and</i> STORE[SP] SP := SP - 1	(b, b)	(b)
or	STORE[SP-1] := STORE[SP-1] <i>or</i> STORE[SP] SP := SP - 1	(b, b)	(b)
not	STORE[SP] := <i>not</i> STORE[SP]	(b)	(b)
Comparison instructions			
equ T	STORE[SP-1] := STORE[SP-1] = _T STORE[SP] SP := SP - 1	(T, T)	(b)
geq T	STORE[SP-1] := STORE[SP-1] ≥ _T STORE[SP] SP := SP - 1	(T, T)	(b)
leq T	STORE[SP-1] := STORE[SP-1] ≤ _T STORE[SP] SP := SP - 1	(T, T)	(b)
les T	STORE[SP-1] := STORE[SP-1] < _T STORE[SP] SP := SP - 1	(T, T)	(b)
grt T	STORE[SP-1] := STORE[SP-1] > _T STORE[SP] SP := SP - 1	(T, T)	(b)
neq T	STORE[SP-1] := STORE[SP-1] ≠ _T STORE[SP] SP := SP - 1	(T, T)	(b)
Store and load instructions			
ldo T q	SP := SP + 1 STORE[SP] := STORE[q]	Type(q) = a	(T)
ldc T q	SP := SP + 1 STORE[SP] := q	Type(q) = T	(T)

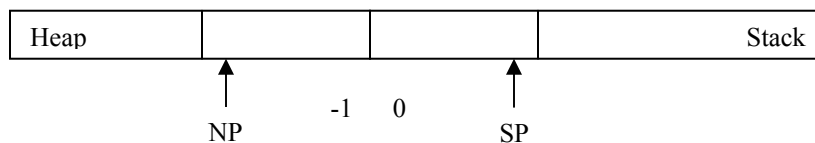
Input of a character value:

- ldc c 'a'
- ldc c ASCII-value (e.g.: for exotic characters of escape characters)

ind T	STORE[SP] := STORE[STORE[SP]]	(a)	(T)
sro T q	STORE[q] := STORE[SP] SP := SP - 1	Type(q) = a, (T)	

sto T	STORE[STORE[SP - 1]] := STORE[SP] SP := SP - 2	(a, T)	
Conditional and unconditional branches			
ujp label	PC := label		
fjp label	if STORE[SP] = false then PC := label fi SP := SP - 1	(b)	
Indexed branch			
ixj label	PC := STORE[SP] + label SP := SP - 1	(i)	
Computation of indexed address			
ixa q	STORE[SP - 1] := STORE[SP - 1] + STORE[SP] * q SP := SP - 1	(a, i) Type(q) = i	(a)
Increment and decrement			
inc T q	STORE[SP] := STORE[SP] + q	(T) and Type(q) = i	(T)
dec T q	STORE[SP] := STORE[SP] - q	(T) and Type(q) = i	(T)
Boundary check			
chk p q	if(STORE[SP] < p) or(STORE[SP] > q) then error('value out of range') fi	(i), Type(p) = Type(q) = i	(i)
Instructions for dynamic arrays			
dpl T	SP := SP + 1 STORE[SP] := STORE[SP - 1]	(T)	(T, T)
ldd q	SP := SP + 1 STORE[SP] := STORE[STORE[SP - 3] + q]	(a, T ₁ , T ₂) Type(q) = i	(a, T ₁ , T ₂ , i)
sli T ₂	STORE[SP - 1] := STORE[SP] SP := SP - 1	(T ₁ , T ₂)	(T ₂)

Memory organization: the memory organization has been slightly changed with regard to the original P-machine specification found in Compiler Design by Reinhard Wilhelm and Dieter Maurer.



No maximum sizes for Stack or Heap are defined. They are simply bounded by the size of a standard positive integer on your platform.

Dynamic memory			
new	if NP - STORE[SP] ≤ EP then error('store overflow') else NP := NP - STORE[SP] STORE[STORE[SP - 1]] := NP SP := SP - 2 Fi	(a,i)	

Definition: $base(p, a) = \text{if } p = 0 \text{ then } a \text{ else } base(p - 1, STORE[a + 1]) \text{ fi.}$

Loading and storing for difference in nesting depths			
lod T p q	SP := SP + 1 STORE[SP] := STORE[base(p, MP) + q]		
lda p q	SP := SP + 1 STORE[SP] := base(p, MP) + q		

str T p q	STORE[base(p, MP) + q] := STORE[SP] SP := SP - 1		
Instructions for calling and entering procedures			
mst p	STORE[SP + 2] := base(p, MP) STORE[SP + 3] := MP STORE[SP + 4] := EP SP := SP + 5	Static link Dynamic link The parameters can now be evaluated starting from STORE[SP + 1]	
cup p label	MP := SP - (p + 4) STORE[MP + 4] := PC PC := label	p is the storage requirement for the parameters save return address branch to procedure start	
ssp p	SP := MP + p - 1	p size of static part of data area	
sep p	EP := SP + p if EP ≥ NP then error('store overflow') fi	p max. depth of local stack Check for collision of stack and heap	
ent p q	SP := MP + q - 1 EP := SP + p if EP ≥ NP then error('store overflow') fi	q data area size p max. depth of local stack Collision of stack and heap	
Return from function procedures and proper procedures			
retf	SP := MP PC := STORE[MP + 4] EP := STORE[MP + 3] if EP ≥ NP then error('store overflow') fi	Function result in the local stack Return branch Restore EP	
retp	SP := MP - 1 PC := STORE[MP + 4] EP := STORE[MP + 3] if EP ≥ NP then error('store overflow') fi MP := STORE[MP + 2]	Proper procedure with no results Return branch Restore EP Dynamic link	
Block copy instructions			
movs q	for i := q - 1 down to 0 do STORE[SP + i] := STORE[STORE[SP] + i] od SP := SP + q - 1	(a)	
movd q	for i = 1 to STORE[MP + q + 1] do STORE[SP + i] := STORE[STORE[MP + q] + STORE[MP + q + 2] + i - 1] od STORE[MP + q] := SP + 1 - STORE[MP + q + 2] SP := SP + STORE[MP + q + 1]		
Instructions for procedures			
smp p	MP := SP - (p + 4)		
cupi p q	STORE[MP + 4] := PC PC := STORE[base(p, STORE[MP + 2]) + q]	Return address	
mstf p q	STORE[SP + 2] := STORE[base(p, MP) + q + 1] STORE[SP + 3] := MP STORE[SP + 4] := EP SP := SP + 5		
Halt instruction			
hlt		Halts the P machine	

Input/Output instructions		
in i in r in c in b	SP := SP + 1 STORE[SP] := value	value = input from stdin Booleanvalue: either t or f
out r i	SP := SP – 2	condition: (r,i) → the real at STORE[SP – 1] is written with precision found at STORE[SP] Output is written to stdout
out i out r out c out b out a	SP := SP – 1	The real is written with standard precision. STORE[SP] is written to stdout
Conversion instruction		
conv T ₁ T ₂	precondition: Type(STORE[SP]) = T ₁ postcondition: Type(STORE[SP]) = T ₂	Converts the element at STORE[SP]. Conversions follow the standard C++-conversion-rules.