

Generating Code for the Virtual Machine VM

A small example

Daniela Carneiro da Cruz Pedro Rangel Henriques

{danieladacruz,prh}@di.uminho.pt
Departamento de Informática, CCTC
Universidade do Minho

The purpose of this document is twofold. On one hand we want to present an example of a VM program in its assembly language; that program shows how to use a subset of assembly instructions, and illustrates their operational semantics.

On the other hand we intend to illustrate a translation scheme from a high-level programming language to assembly code.

1 A LISS Source Program

Suppose we have the following program, written in the high-level programming language LISS (Language of Integers, Sequences and Sets), and we want to execute it.

For that it is necessary to translate that program into the code (assembly or binary) of a target machine.

```
"Integers.liss" 1 ≡  
  
  program IntegerTest {  
  
    Declarations  
  
      intA := 4, intB, intC := 6 -> integer;  
      c := [1,2,3], vector -> Array size 8;  
      flag := false -> boolean;  
  
    Statements  
  
      intA = -3 + intC * (7 + c[1]);  
      writeln(c);  
      c[5] = 1;  
  
      /* logic operations */  
  
      bool = !( (intA == intB) || (intA != intC) && (c[1] < 6) ) || flag;  
  }  
}
```

2 Generated VM Code

To run the program above in the VM virtual machine, it should be translated to VM assembly code, either manual or automatically.

Bellow, we list the code generated by our LissCompiler.

```
"Integers.v" 2 ≡

// Line 6: intA := 4, intB, intC := 6 -> Integer
PUSHI 4

PUSHI 0

PUSHI 6

// Line 7: c := [1,2,3], vector -> Array size 8
PUSHI 1
PUSHI 2
PUSHI 3
PUSHI 0
PUSHI 0
PUSHI 0
PUSHI 0
PUSHI 0

PUSHI 0
PUSHI 0
PUSHI 0
PUSHI 0
PUSHI 0
PUSHI 0
PUSHI 0
PUSHI 0

// Line 8: flag := false -> Boolean
PUSHI 0

START

// Line 13: intA = -3 + intC * (7 + c[1])
PUSHI -3
PUSHG 2
PUSHI 7
PUSHGP
PUSHI 3
PADD
PUSHI 1
PUSHI 1
MUL
DUP 1
CHECK 0,7
LOADN
ADD
MUL
ADD
STOREG 0
```

"Integers.vm" 3 ≡

```
// Line 14: writeln(c)
PUSHS "]"
PUSHG 10
STRI
PUSHS ","
PUSHG 9
STRI
PUSHS ","
PUSHG 8
STRI
PUSHS ","
PUSHG 7
STRI
PUSHS ","
PUSHG 6
STRI
PUSHS ","
PUSHG 5
STRI
PUSHS ","
PUSHG 4
STRI
PUSHS ","
PUSHG 3
STRI
PUSHS "["
CONCAT
CONCAT
CONCAT
CONCAT
CONCAT
CONCAT
CONCAT
CONCAT
CONCAT
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WRITES
```

"Integers.vm" 4 ≡

```
// Line 15: c[5] = 1
PUSHGP
PUSHI 3
PADD
PUSHI 5
PUSHI 1
MUL
DUP 1
CHECK 0,7
PUSHI 1
STOREN

// Line 19: bool = !((intA == intB) || (intA != intC) && (c[1] < 6)) || flag
PUSHG 0
PUSHG 1
EQUAL
PUSHG 0
PUSHG 2
EQUAL
NOT
PUSHGP
PUSHI 3
PADD
PUSHI 1
PUSHI 1
MUL
DUP 1
CHECK 0,7
LOADN
PUSHI 6
INF
AND
OR
NOT
PUSHG 20
OR
STOREG 19

STOP
```

3 Files in document

"Integers.liss" Defined by part 1.

"Integers.vm" Defined by parts 2, 3, 4.