

# W2 - IPS

Nikolaj Gade (qhp695)

May 2022

## Task 1

### 1) Intermediate code

See appendix A for the full generation.

```
1 LABEL label1
2 t4 := v1
3 t5 := 1
4 IF t4 == t5 THEN label3 ELSE label4
5 LABEL label4
6 t0 := 1
7 place2 := v0
8 place3 := v1
9 t1 := place2 / place3
10 IF t0 < t1 THEN label2 ELSE label3
11 LABEL label2
12 t0 := v1
13 t3 := v0
14 IF t2 < t3 THEN label6 ELSE label7
15 LABEL label5
16 place4 := v0
17 place5 := v1
18 place0 := place4 - place5
19 v0 := place0
20 GOTO label7
21 LABEL label6
22 place6 := v1
23 place7 := v0
24 place1 := place6 - place7
25 v1 := place1
26 GOTO label5
27 LABEL label7
28 GOTO label1
29 LABEL label3
```

## 2) MIPS code

```
1 label1:
2     mov t4, v1
3     addi t5, R0, 1
4     beq t4, t5, label3
5 label4:
6     addi t0, R0, 1
7     mov place2, v0
8     mov place3, v1
9     div place2, place3
10    mflo t1
11    addi t1, t1, 1
12    slt rd, t0, t1
13    beq rd, R0, label3
14 label2:
15    mov t0, v1
16    mov t3, v0
17    slt rd, t2, t3
18    bne rd, R0, label6
19    j label7
20 label5:
21    mov place4, v0
22    mov place5, v1
23    sub place0, place4, place5
24    mov v0, place0
25    j label7
26 label6:
27    mov place6, v1
28    mov place7, v0
29    sub place1, place6, place7
30    mov v1, place1
31    j label5
32 label7:
33    j label1
34 label3:
```

## Task 2

1)  $z := x \geq y$

```
1 sub v, y, x
2 slti z, v, 1
```

2)  $w := !z$

```
1 slt w, R0, z
```

3)  $z := x \geq y, w := !z$

```
1 slt w, x, y
```

## Task 3

a)

```
1 bool* y = (bool*)malloc(n);
2 int i = 0;
3 while (i < n) {
4     ne = myop(ne, x[i]);
5     y[i] = ne;
6     i++;
7 }
```

## A Intermediate code generation

---

Code1,  $Trans_{Cond}(Cond_0, label2, label3, vtable, ftable)$

!(b == 0) && (1 < a/b)

$Cond_1 \&\& Cond_2$

label4 = newlabel()

code3 =  $Trans_{Cond}(Cond_1, label4, label3, vtable, ftable)$

code4 =  $Trans_{Cond}(Cond_2, label2, label3, vtable, ftable)$

```
1 code3++
2 [LABEL label4]++
3 code4
```

---

Code2,  $Trans_{Stat}(Stat_1, vtable, ftable)$

if b < a then { a := a - b } else { b := b - a }

if  $Cond_3$  then  $Stat_2$  else  $Stat_3$

label5 = newlabel()

label6 = newlabel()

label7 = newlabel()

code5 =  $Trans_{Cond}(Cond_3, label6, label7, vtable, ftable)$

code6 =  $Trans_{Stat}(Stat_2, vtable, ftable)$

code7 =  $Trans_{Stat}(Stat_3, vtable, ftable)$

```
1 code5++
2 [LABEL label5]++
3 code6++
4 [
5     GOTO label7
6     LABEL label6
7 ]++
8 code7++
9 [
10    GOTO label5
11    LABEL label7
12 ]
```

---

Code3,  $Trans_{Cond}(Cond_1, label4, label3, vtable, ftable)$

!(b == 0)

!( $Cond_4$ )

code8 =  $Trans_{Cond}(Cond_4, label3, label4, vtable, ftable)$

```
1 code8
```

**code4**,  $Trans_{Cond}(Cond_2, label12, label13, vtable, ftable)$

**1** <  $a/b$

$Exp_0 < Exp_1$

**t0** = *newvar*()

**t1** = *newvar*()

**code9** =  $Trans_{Exp}(Exp_0, vtable, ftable, t0)$

**code10** =  $Trans_{Exp}(Exp_1, vtable, ftable, t1)$

```
1 code9++
2 code10++
3 [IF t0 < t1 THEN label12 ELSE label13]
```

---

**code5**,  $Trans_{Cond}(Cond_3, label16, label17, vtable, ftable)$

**b** < **a**

$Exp_2 < Exp_3$

**t2** = *newvar*()

**t3** = *newvar*()

**code11** =  $Trans_{Exp}(Exp_2, vtable, ftable, t2)$

**code12** =  $Trans_{Exp}(Exp_3, vtable, ftable, t3)$

```
1 code11++
2 code12++
3 [IF t2 < t3 THEN label16 ELSE label17]
```

---

**code6**,  $Trans_{Stat}(Stat_2, vtable, ftable)$

**a** := **a** - **b**

**a** :=  $Exp_4$

**place0** = *newvar*()

**code13** =  $Trans_{Exp}(Exp_4, vtable, ftable, place0)$

```
1 code13++
2 [v0 := place0]
```

---

**code7**,  $Trans_{Stat}(Stat_3, vtable, ftable)$

**b** := **b** - **a**

**b** :=  $Exp_5$

**place1** = *newvar*()

**code14** =  $Trans_{Exp}(Exp_5, vtable, ftable, place1)$

```
1 code14++
2 [v1 := place1]
```

---

code8,  $Trans_{Cond}(Cond_4, label13, label14, vtable, ftable)$

**b** == 0

$Exp_6 == Exp_7$

**t4** = newvar()

**t5** = newvar()

**code15** =  $Trans_{Exp}(Exp_6, vtable, ftable, t4)$

**code16** =  $Trans_{Exp}(Exp_7, vtable, ftable, t5)$

```
1 code15++
2 code16++
3 [IF t4 == t5 THEN label13 ELSE label14]
```

---

code9,  $Trans_{Exp}(Exp_0, vtable, ftable, t0)$

**1**

**1**

```
1 [t0 := 1]
```

---

code10,  $Trans_{Exp}(Exp_1, vtable, ftable, t1)$

**a/b**

$Exp_8 / Exp_9$

**place2** = newvar()

**place3** = newvar()

**code17** =  $Trans_{Exp}(Exp_8, vtable, ftable, place2)$

**code18** =  $Trans_{Exp}(Exp_9, vtable, ftable, place3)$

```
1 code17++
2 code18++
3 [t1 := place2 / place3]
```

---

code11,  $Trans_{Exp}(Exp_2, vtable, ftable, t2)$

**b**

**b**

```
1 [t0 := v1]
```

---

code12,  $Trans_{Exp}(Exp_3, vtable, ftable, t3)$

**a**

**a**

1 [t3 := v0]

---

code13,  $Trans_{Exp}(Exp_4, vtable, ftable, place0)$

**a - b**

$Exp_{10} - Exp_{11}$

place4 = newvar()

place5 = newvar()

code19 =  $Trans_{Exp}(Exp_{10}, vtable, ftable, place4)$

code20 =  $Trans_{Exp}(Exp_{11}, vtable, ftable, place5)$

1 code19++  
2 code20++  
3 [place0 := place4 - place5]

---

code14,  $Trans_{Exp}(Exp_5, vtable, ftable, place1)$

**b - a**

$Exp_{12} - Exp_{13}$

place6 = newvar()

place7 = newvar()

code21 =  $Trans_{Exp}(Exp_{12}, vtable, ftable, place6)$

code22 =  $Trans_{Exp}(Exp_{13}, vtable, ftable, place7)$

1 code21++  
2 code22++  
3 [place1 := place6 - place7]

---

code15,  $Trans_{Exp}(Exp_6, vtable, ftable, t4)$

**b**

**b**

1 [t4 := v1]

---

code16,  $Trans_{Exp}(Exp_7, vtable, ftable, \mathbf{t5})$

$\emptyset$

$\emptyset$

1 [t5 := 1]

---

code17,  $Trans_{Exp}(Exp_8, vtable, ftable, \mathbf{place2})$

a

a

1 [place2 := v0]

---

code18,  $Trans_{Exp}(Exp_9, vtable, ftable, \mathbf{place3})$

b

b

1 [place3 := v1]

---

code19,  $Trans_{Exp}(Exp_{10}, vtable, ftable, \mathbf{place4})$

a

a

1 [place4 := v0]

---

code20,  $Trans_{Exp}(Exp_{11}, vtable, ftable, \mathbf{place5})$

b

b

1 [place5 := v1]

---

code21,  $Trans_{Exp}(Exp_{12}, vtable, ftable, \mathbf{place6})$

b

b

1 [place6 := v1]

---

code22,  $Trans_{Exp}(Exp_{13}, vtable, ftable, place7)$

a

a

1 [place7 := v0]