

Bluebird

1. Syntax

$\langle \text{expr} \rangle ::= \dots$
 $| \text{true} \mid \text{false}$
 $| \text{if } \langle \text{expr} \rangle \text{ then } \langle \text{expr} \rangle \text{ else } \langle \text{expr} \rangle$
 $| \langle \text{expr} \rangle \&\& \langle \text{expr} \rangle \mid \langle \text{expr} \rangle \parallel \langle \text{expr} \rangle$
 $| \langle \text{expr} \rangle < \langle \text{expr} \rangle \mid \langle \text{expr} \rangle > \langle \text{expr} \rangle \mid \langle \text{expr} \rangle = \langle \text{expr} \rangle$
 $| \text{isbool}(\langle \text{expr} \rangle) \mid \text{isint}(\langle \text{expr} \rangle)$

2. Semantics

$3 < 4 \implies \text{true}$
 $\text{if } 4 > 3 \text{ then } 2 \text{ else } 5 \implies 2$
 $(4 > 5) \parallel (3 < 6) \implies \text{true}$
 $\text{true} < 1 \implies \text{undefined}$
 $\text{isbool}(5) \implies \text{false}$
 $\text{isbool}(\text{false}) \implies \text{true}$

program

2

after(4)

Auklet compiler

mov rax, 2

mov rax, 4
add rax, 1 inc rax

Bluebird compiler

true

unbound variable

asm	64-bit	64-bit unsigned	64-bit signed ($-2^{63} \dots 2^{63}-1$)	
2	00000000 00000000	00000000 00000000	00000000 00000000	
-3	11111111 11111111	11111111 11111111	11111111 11111111	
Bluebird		63-bit signed ($-2^{62} \dots 2^{62}-1$)		
4 2	00000000 00000000	00000000 00000000	00000000 00000000	00000000 00000000
129 true	00000000 00000000	00000000 00000000	00000000 00000000	00000000 00000001
1 false	00000000 00000000	00000000 00000000	00000000 00000000	00000000 00000001

in-lecture repr (not lab)

tag bit

Bluebird values

5
7 $\rightarrow R \rightarrow$
true
false

machine values (binary representation)

..... 1010 10
14
..... 10000001 129 } lecture only
1

$$R(5) = 10$$

$$R(7) = 14$$

$$R(\text{true}) = 129$$

Bluebird

$$5 + 7 \Rightarrow 12$$

machine

$$R(5) + R(7) = 10 + 14 = 24 = R(12)$$

$$5 - 7 \Rightarrow -2$$

$$R(5) - R(7) = 10 - 14 = -4 = R(-2)$$

$$5 * 7 \Rightarrow 35$$

$$R(5) * R(7) = 10 * 14 = 140 = R(70) \neq$$

What about subtraction?
multiplication?

$$R(a) + R(b) =$$

$$2a + 2b =$$

$$2(a+b) =$$

$$R(a+b)$$

$$R(a) * R(b) =$$

$$2a * 2b =$$

$$4ab =$$

$$R(4ab)$$

- shift one operand right (sar)
- then multiply

$$R(a) * R(b) =$$

$$2a/2 * 2b =$$

$$2ab =$$

$$R(2ab)$$

compile: 5 * 6

mov rax, 10

sar rax, 1

mov [rsp-8], rax

mov rax, 12

imul rax, [rsp-8]

if $\frac{3 < 4}{\downarrow \text{true}}$ then 5 else 6