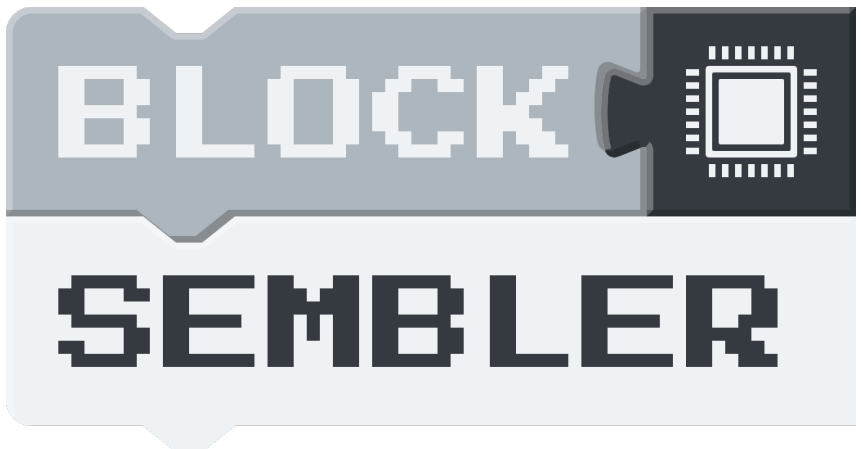
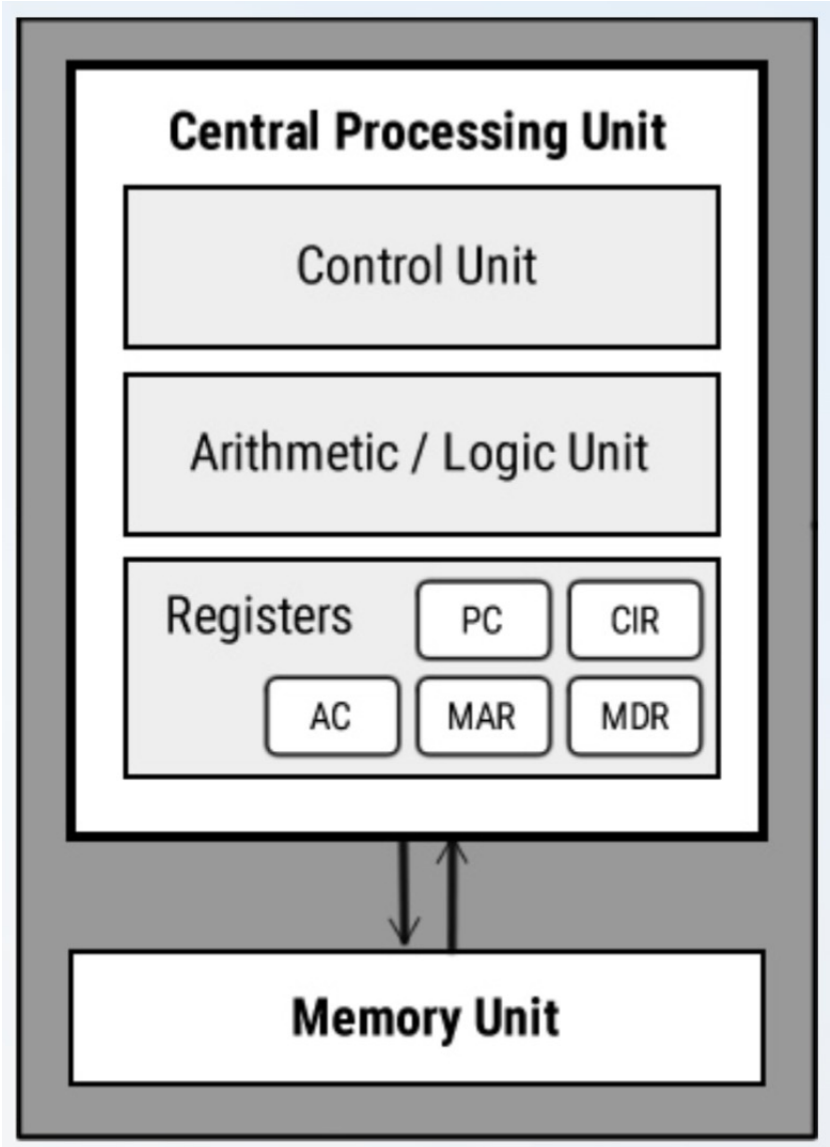
Assembly Programming with



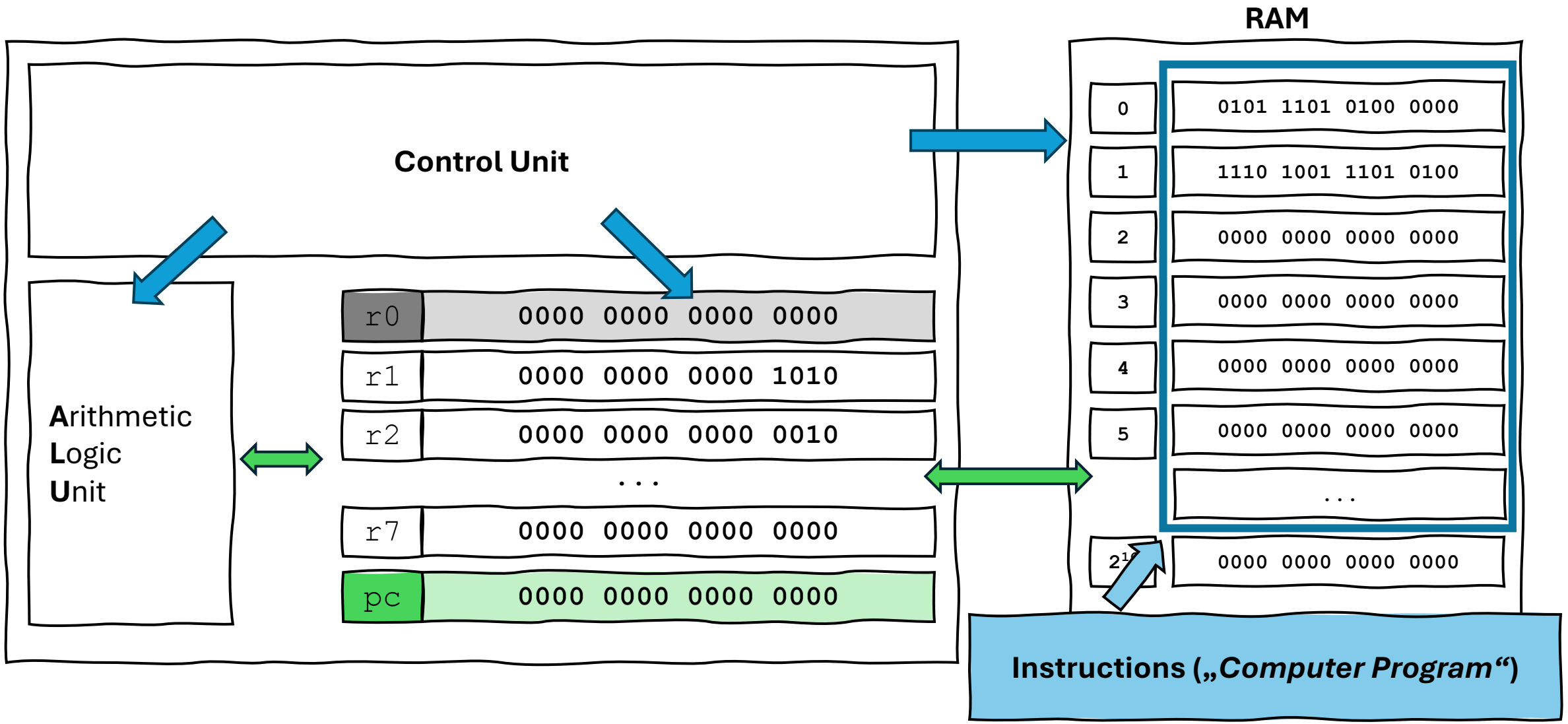
Recap


Central Processing Unit
Control Unit
Arithmetic / Logic Unit
Registers
PC
CIR
AC
MAR
MDR
Memory Unit

ANNA (A New Noncomplex Architecture)

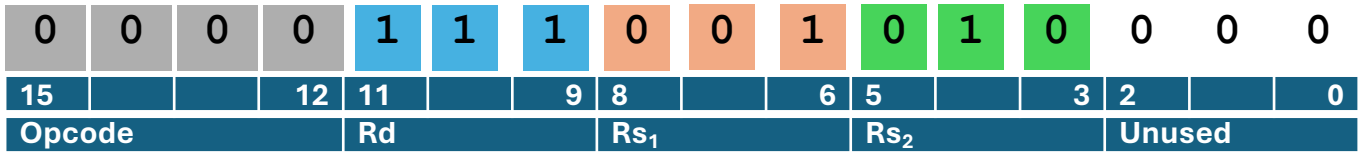
- 16-bit Architecture
- 8 Registers (`r0`, ..., `r7`)
- 16 Instructions
- 2^{16} x Words of RAM

ANNA Architecture (Overview)

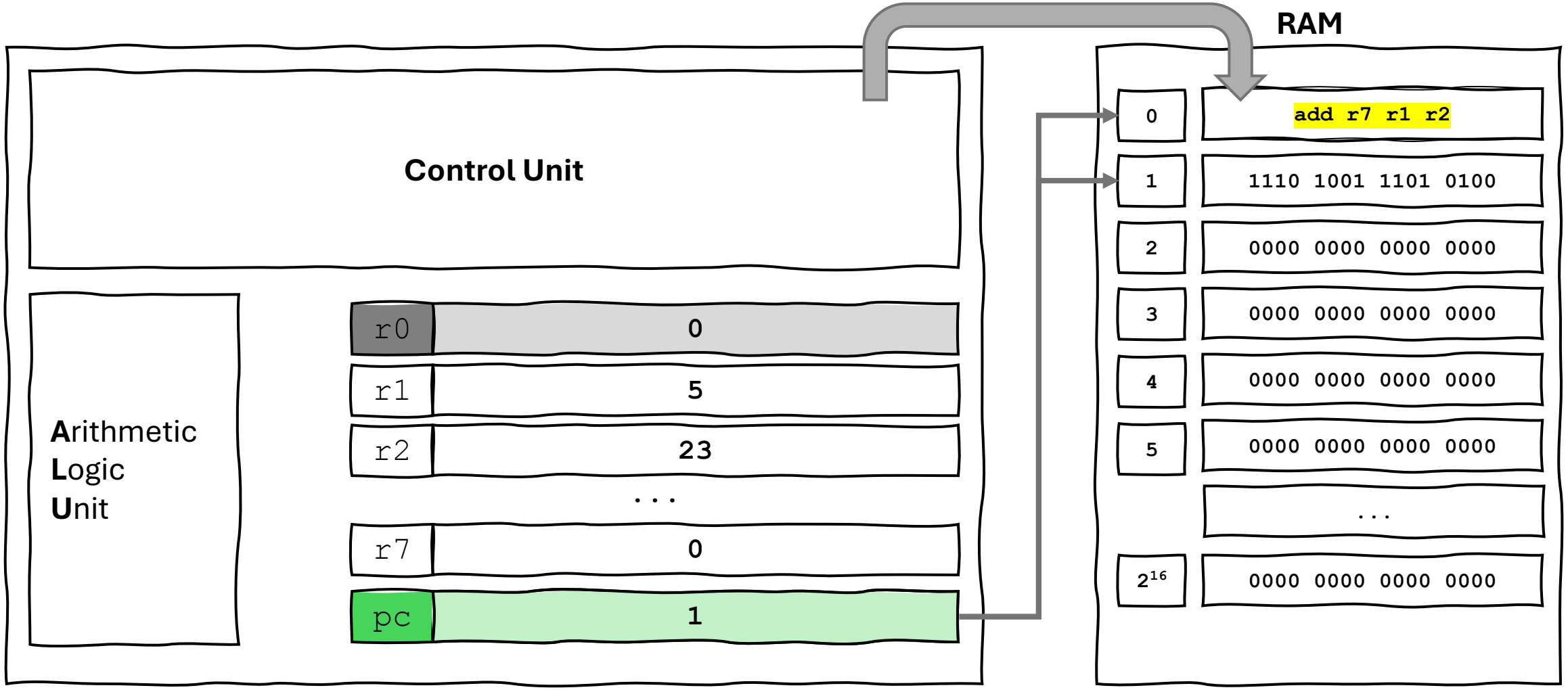


ADD Instruction

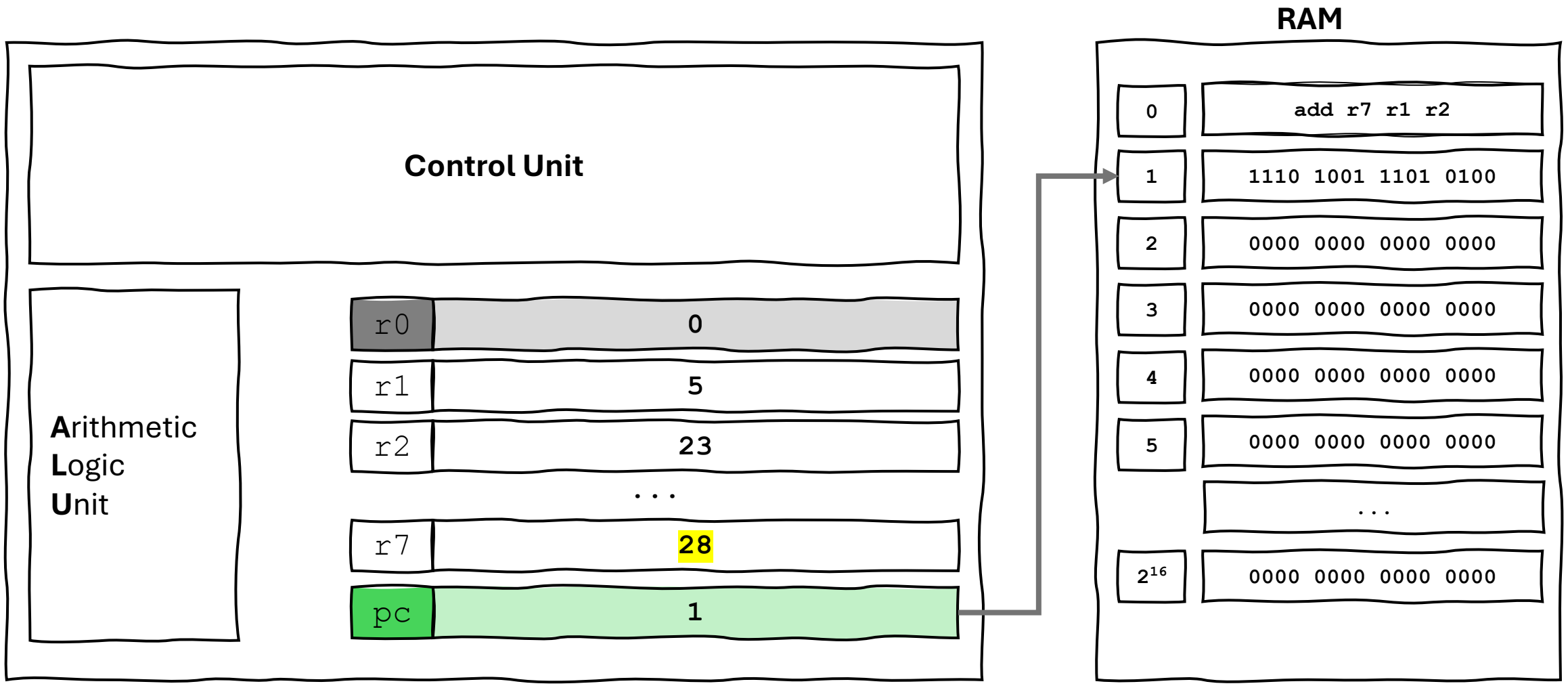

```
r7 = r1 + r2
```



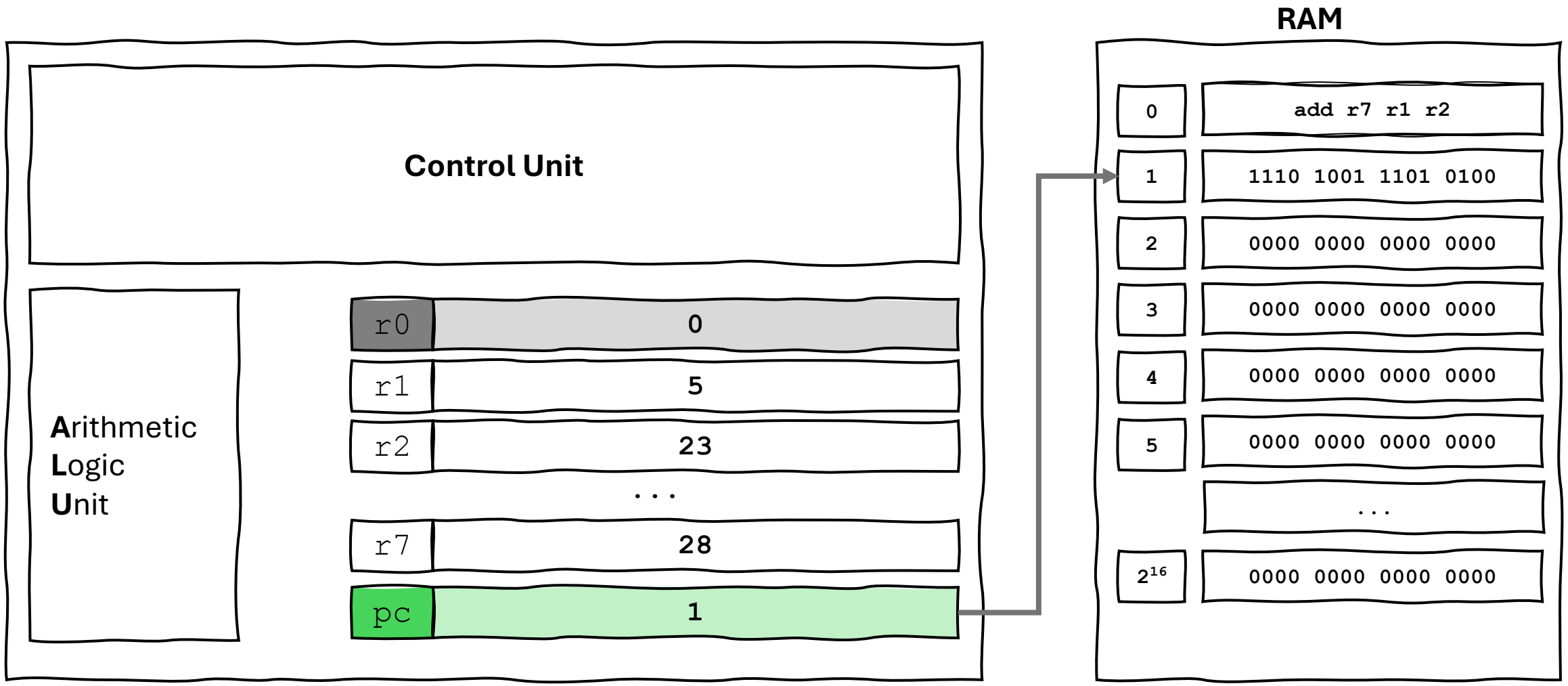
ANNA Architecture (Overview)



ANNA Architecture (Overview)



ANNA Architecture (Overview)



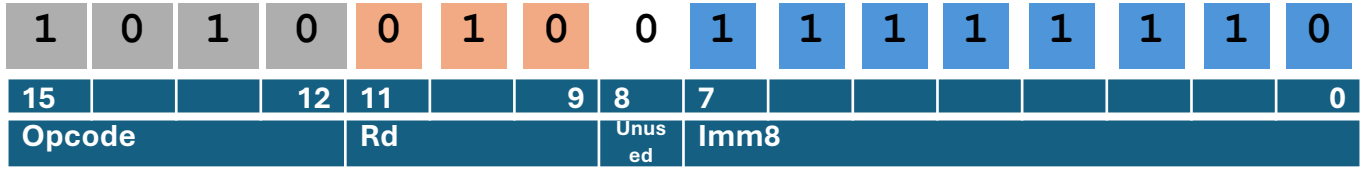
Assembly Code Example

```
add r7 r2 r3
shf r3 r1 4
and r2 r1 r3
or  r5 r6 r7
```

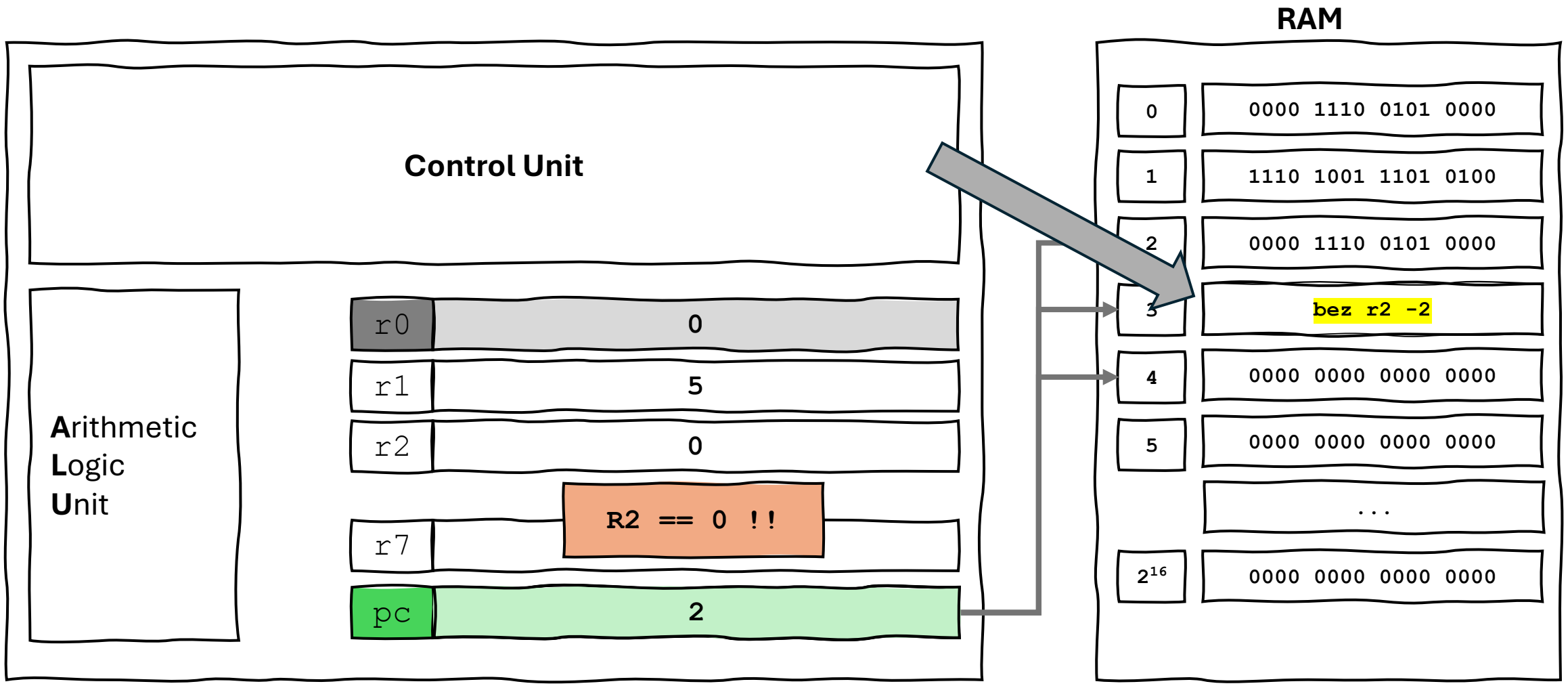
BEZ Instruction
(branch equal zery)

Mnemonic | Destination Rd | 8-bit Immediate Imm8

```
if (r2 == 0){
    pc -= 2;
}
```



ANNA Architecture (Overview)



Jump Example

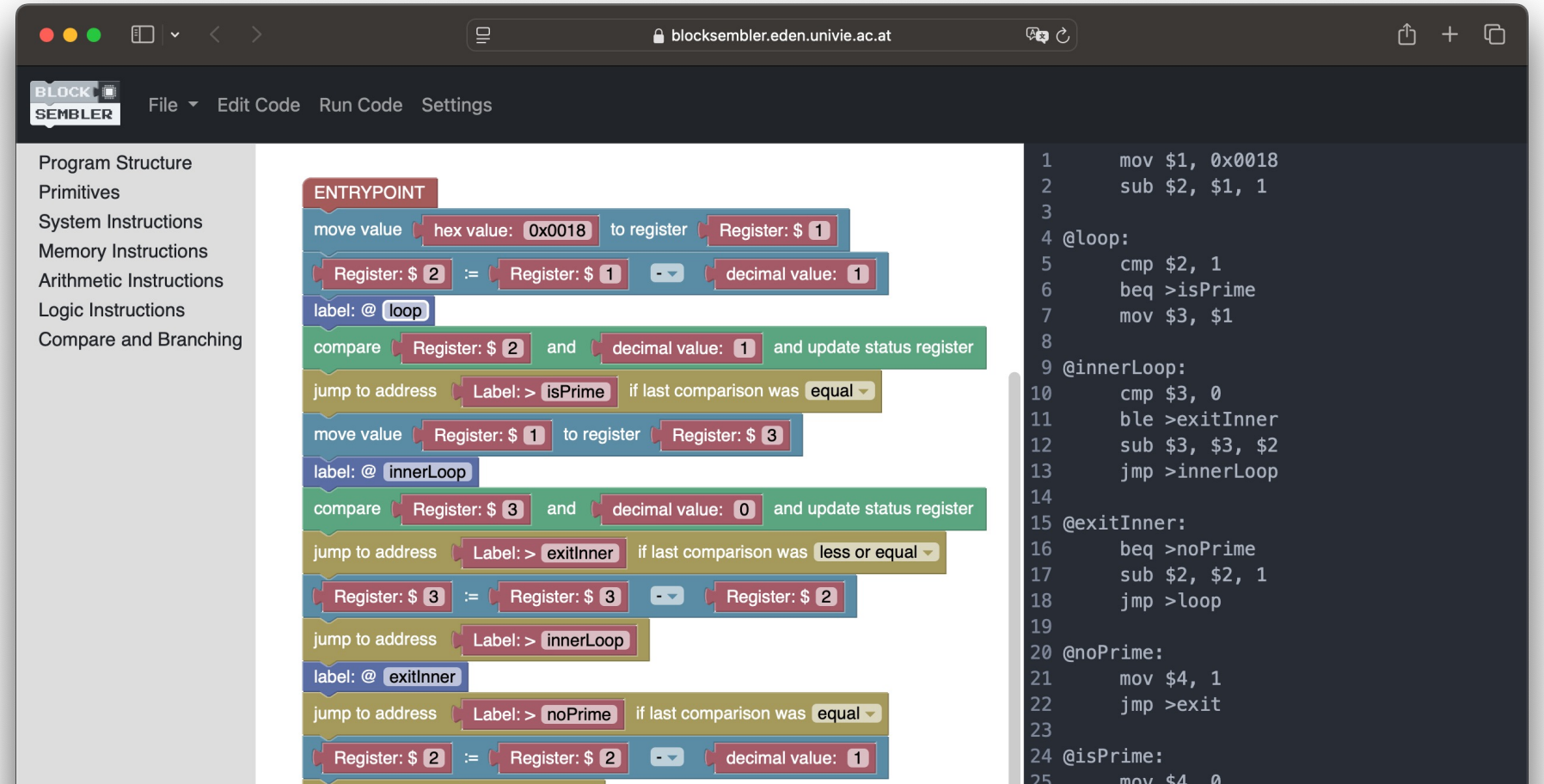
```
loop:    addi r1 r1 -1
         out r1
         bgz r1 -2

         .halt
```

Anna Instruction Set
(Overview)

- add
- sub
- and
- or
- not
- shf *(shift)*
- lli *(load lower immediate)*
- lui *(load upper immediate)*
- lw *(load word)*
- sw *(store word)*
- bez *(branch equal zero)*
- bgz *(branch greater zero)*
- addi *(add immediate)*
- jalr *(jump and link register)*
- in
- out

Blocksembler



Blocksembler Instructions

Start/Halt

- Blocksembler programs always begin with a **`start`** block.

- When the Control Unit encounters a **`halt`** instruction (represented by the *Halt* block), the program terminates.

- Using multiple *Halt* blocks within a program is allowed.

JUMP/Branch Instructions

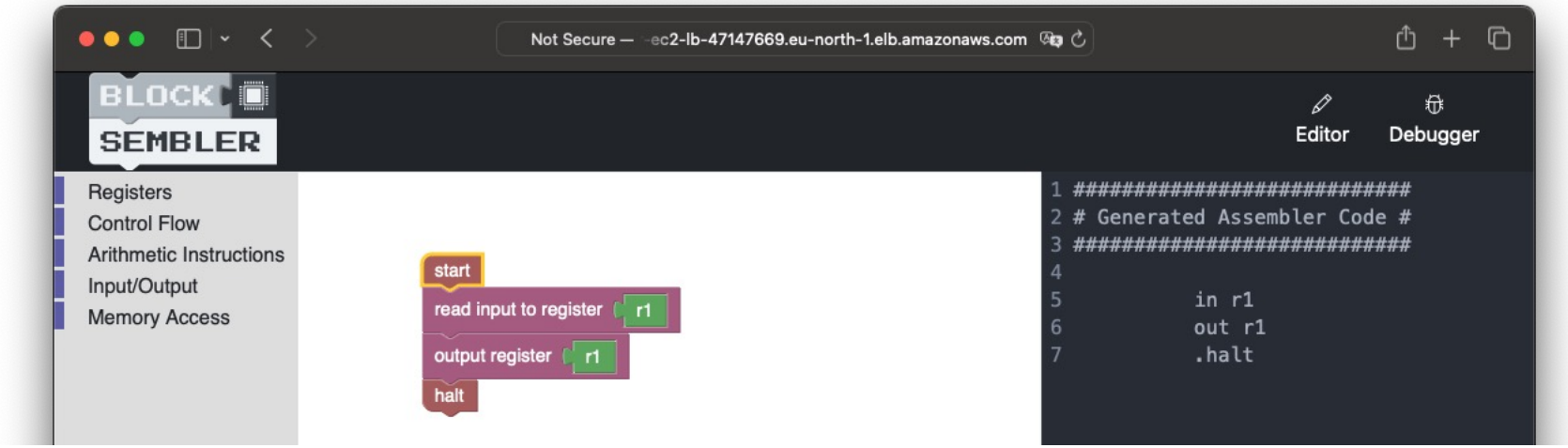
There are instructions that cause the program flow to jump to a specific line in the program when a certain condition is met.

Label

To define the target of such a jump, `labels` are used.

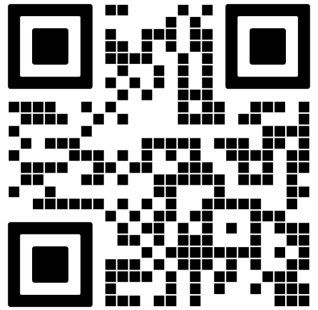

```
1 ##############################
2 # Generated Assembler Code #
3 ##############################
4
5
6 abc:       in r1
7           bez r1 &abc
```

Live Demonstration



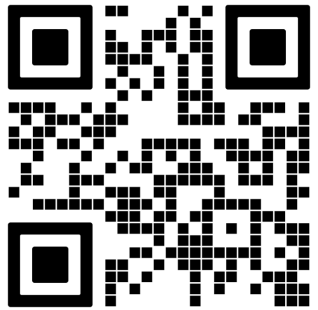
Resources

Presentation:
https://blocksembler.github.io/presentation.pdf

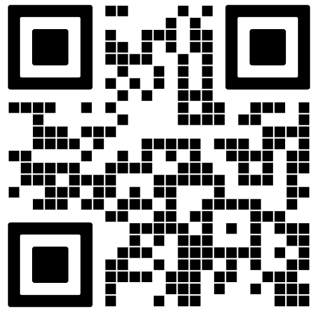


ANNA Documentation:

https://blocksembler.github.io/anna.pdf



Blocksembler:
https://blocksembler.eden.univie.ac.at



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