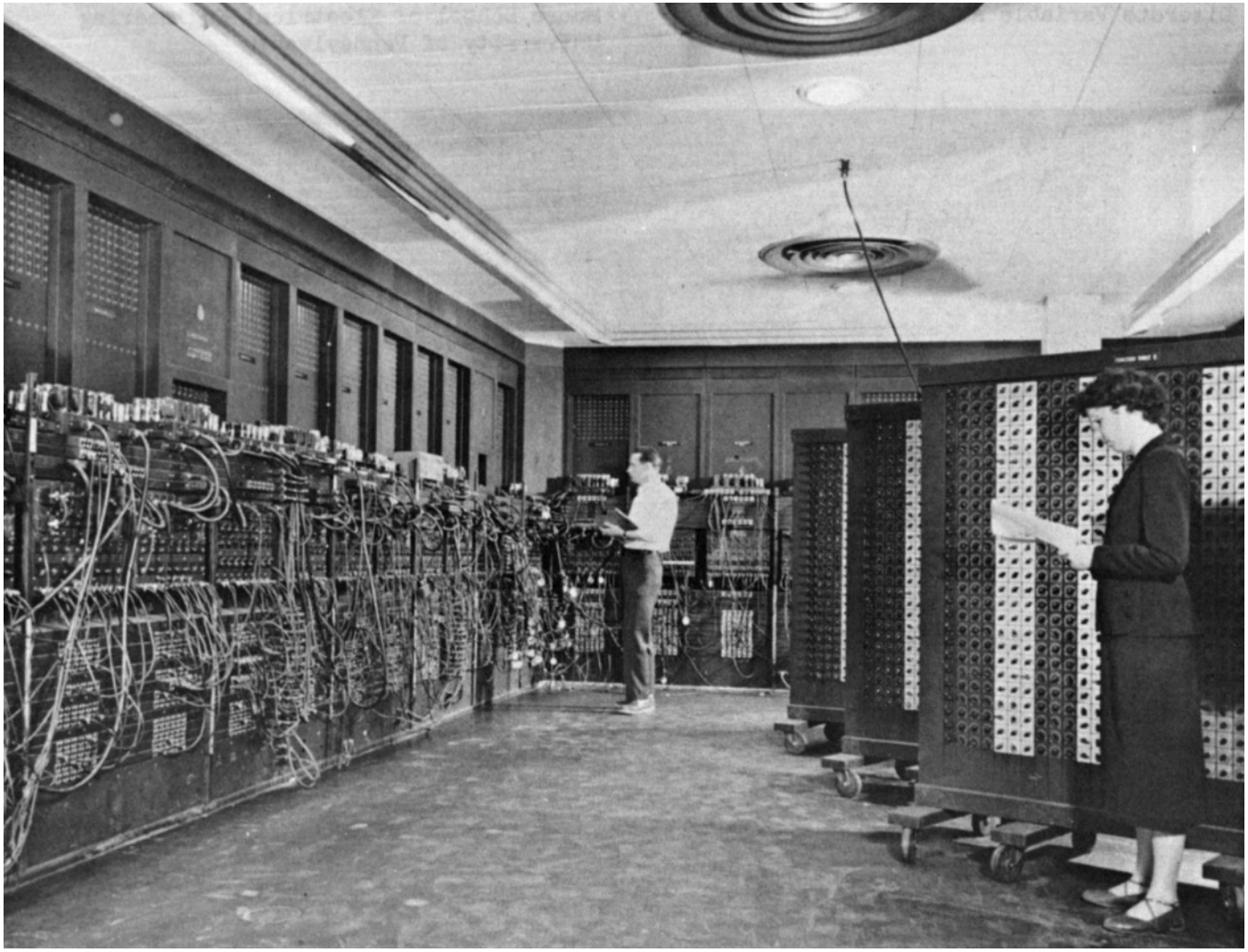
Part 0

Preliminaries

What is a Computer?



What is a Computer?

CPU (Central Processing Unit)

registers

R0
R1
R2
R3
R4
R5
R6
R7

ALU

math

control unit

PC
SP

load

store

memory

data

```
5548 89e5 897d
fc00 0f8e 1800
45f8 8b45 fc83
8b45 f85d c300
```

program

```
ADD R1, R2, R3
SUB R3, R4, R5
...
STO R5, (R6)
```

What is a Computer?

- Computers are not especially "smart"
- Glorified calculator (with program memory)
- Example:

```
2 + 3 * 4 - 5

MOV 2, R1              ; R1 = 2
MOV 3, R2              ; R2 = 3
MOV 4, R3              ; R3 = 4
MUL R2, R3, R4         ; R4 = R2 * R3 = 3 * 4 = 12
ADD R1, R4, R5         ; R5 = R1 + R4 = 2 + 12 = 14
MOV 5, R6              ; R6 = 5
SUB R5, R6, R7         ; R7 = R5 - R6 = 14 - 5 = 9
```

What is Computation?

"Computer Science is no more about computers than astronomy is about telescopes."

What does it actually mean to "compute" something?

What can be computed?

What is Computation?

- It's a process or procedure

```
Compute: 5!    -> 5 * 4 * 3 * 2 * 1

result = 1
n = 5
while n > 0:
    result = result * n
    n = n - 1
```

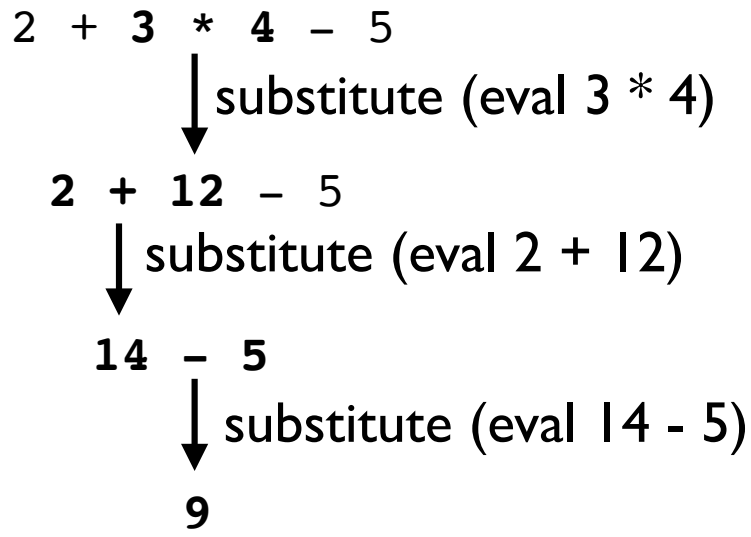
- Step-by-step sequence of operations

What is Computation?

- But, what is the actual essence of "computation?"
- Give me a minimal definition of it...

Deep Idea

- Perhaps computation is repeated substitution



- Maybe overly simplified, but computation is a process of substituting one thing for another
- Stop when no more steps are possible

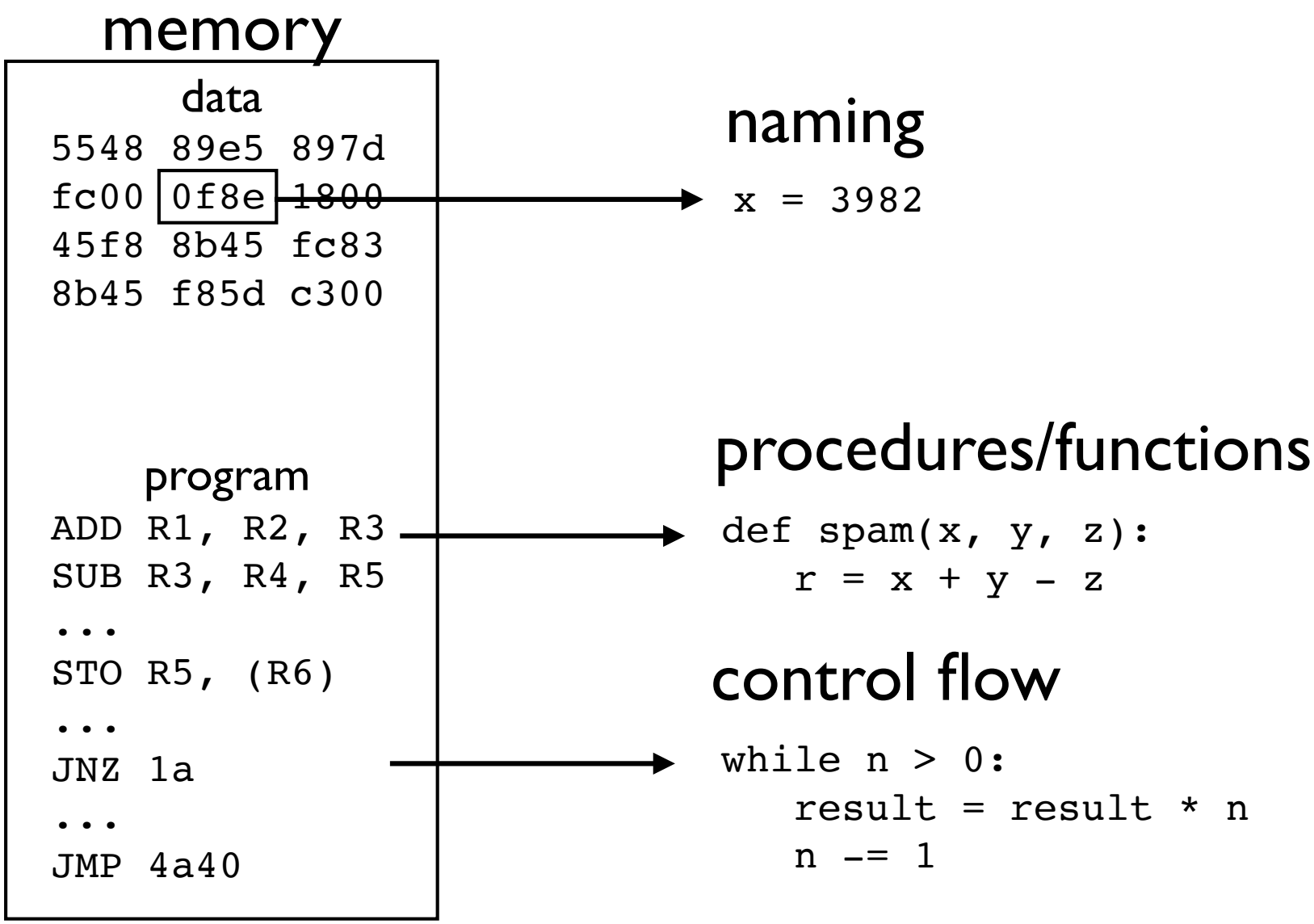
Substitution

- Substitution is a major facet of compiler writing
- "High level" things are replaced by "lower level" things (repeat until you can't go any further)
- Part of moving from an abstract programming language down to the real world
- Also a major part of the mathematical foundations of programming languages.

What is Programming?

- Describes a computational process. Yes.
- How? By banging random keys on a keyboard??
- Key feature: Abstraction

Programming is Abstraction



Programming is Abstraction

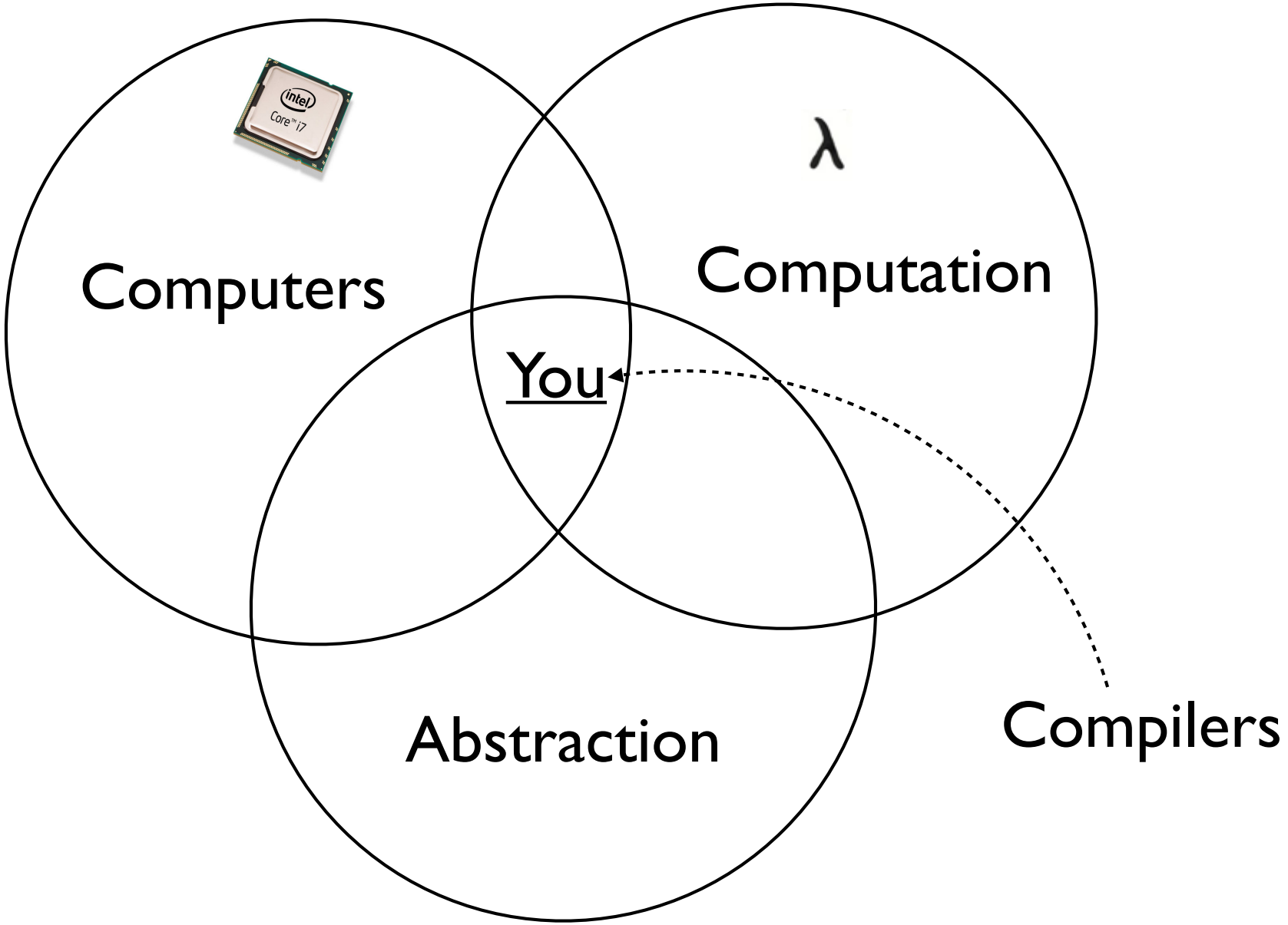
C Python Go Perl Rust Java Lisp Haskell Scala Javascript

Abstraction

"Metal"

```
010111111                    00001111
110001111                    11011111
011111011   Bits              11111111
1101111111000000000000000000000000
1100000000000010000000000000000000
```

Big Picture



Project 0

Find the file `metal.py`

Follow the instructions found inside.

Project 0.25

Find the file `mental.py`

Follow the instructions found inside.

Project 0.5

Play with wabbit

Find the directory `SillyWabbit/`

Follow instructions in the README