Evaluation

Assignments	50	at least 6
Quiz	20	
Final Exam	30	

COPYING IS FATAL

Haskell

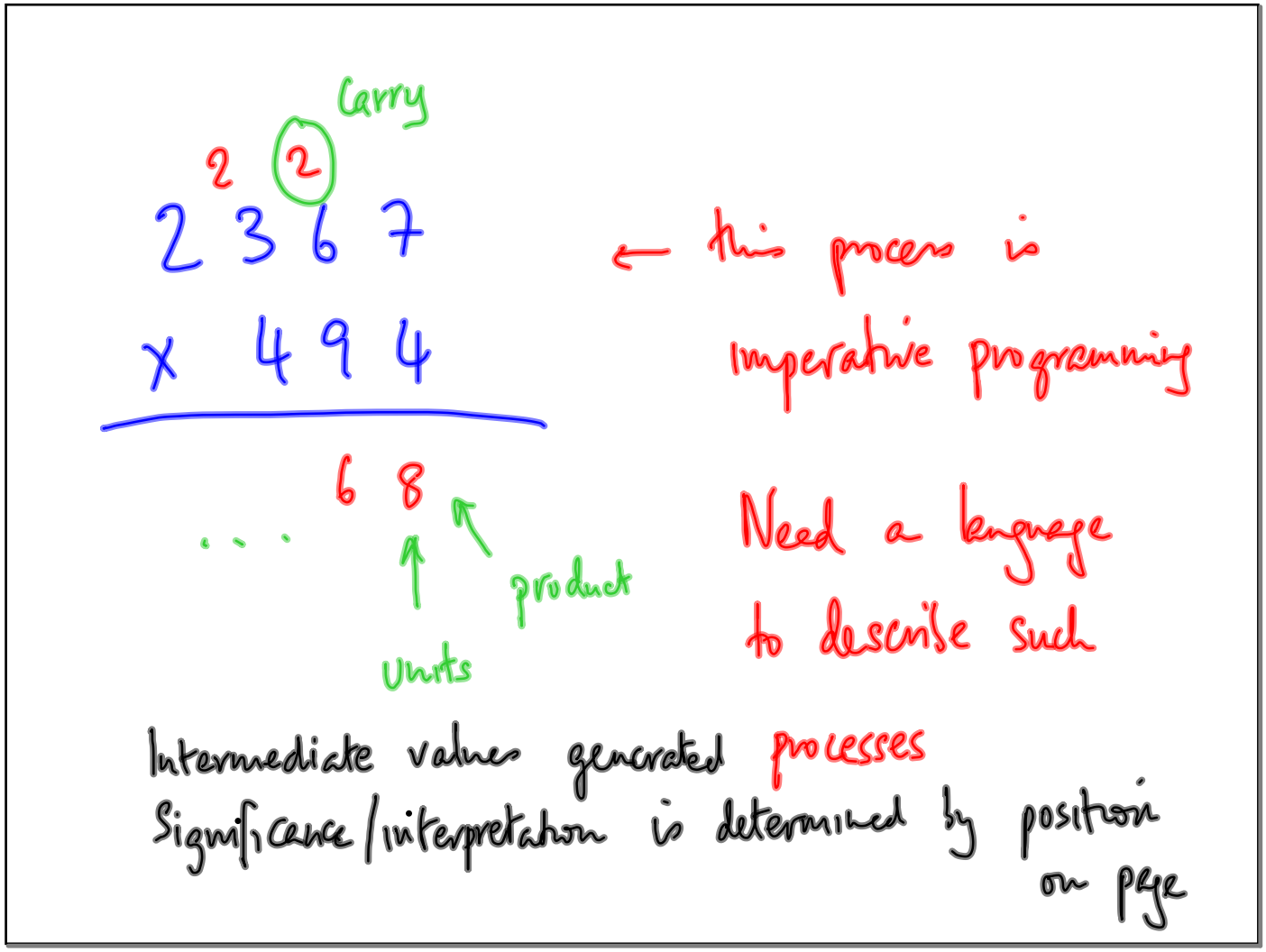
Functional Programming Language

DECLARATIVE What to do

vs

IMPERATIVE How to do it

C, C++, Java, Python, ...


carry
2 2
2 3 6 7
x 4 9 4
6 8
. . .
product
units
← this process is imperative programming
Need a language to describe such processes
Intermediate values generated
Significance/interpretation is determined by position on page

We can't use positional clues in a programming language!

Need names to refer to values

e.g. use "carry" to store current carry value when multiplying

Assignment — Repeatedly assign fresh values to the same name

Basic step in an imperative prog language

Assignment statement

Name ← Value ← an expression

$6 * x + 3$

y

In Python

$y = 6 * x + 3$

$x = x + 1$

Reassign to x its current value + 1

```
x = 2 * x + 4 * x
```

Both refer to current value of x

Data type

Int, Float, Bool, Char, ..

In Haskell, every name/variable has a fixed type

In Python

Values have types

Names have no type

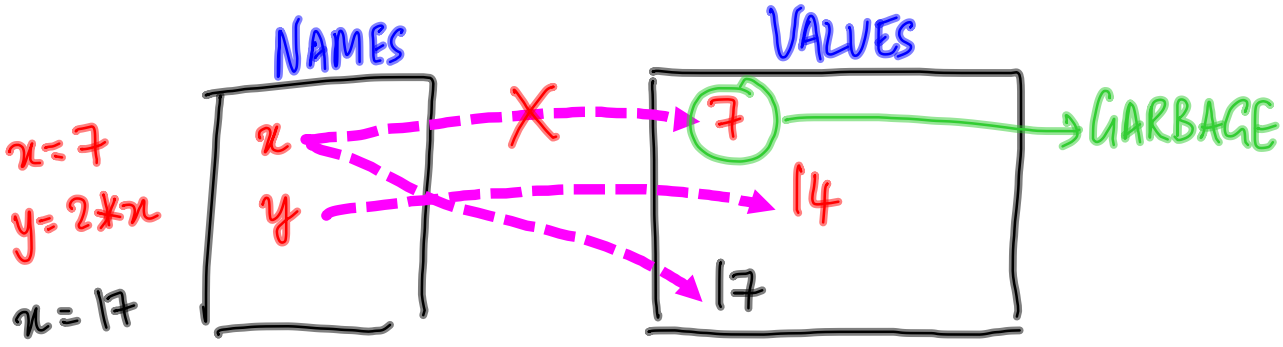
Type of a name is derived from its value

```
x = 6
y = 2 * x   ✓

x = True
y = 2 * x   X   x is not of the right type
```

Can freely assign values to names,

but, when a name appears in an expression (i.e. the name is "used") it must have a "sensible" value



Basic scalar values in Python are similar to Haskell

Int → arbitrary precision

Int, Float

Bool True, False

No Char type, only String

Write f(x) not f x as in Haskell

sin(x)

Python → 2.7 ...

→ 3. ... ✓

print x OK in 2.7, not in 3...

print (x) Must have () in 3...

Operations:

Arithmetic +, *, -, / Float division even if both args are int

3/2 → 1.5

// div of Haskell

% mod of Haskell

** exponentiation x**y ~> x^y

Comparison <, >, <=, >=, ==, !=

Boolean and (&), or (|), not

Collective values

List

Like Haskell [6,7,4,3]

Unlike Haskell [6,7.2,True,3.5]

[6,[2,4],3.6]

l = [6,7,7.5]

Access elements by position l[0], l[1], l[2]