

# Scala – From Zero to Testing

<https://github.com/ericssmith/neb15>

Eric Smith

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# Goals

Understand library  
APIs

Write principled code

Organize larger  
programs

# Morning Agenda



Intro

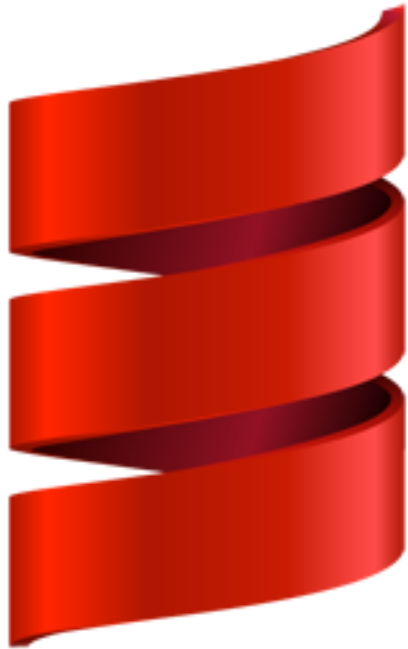
IntelliJ

Essentials

Collections

Sequencing

# Afternoon Agenda



Option

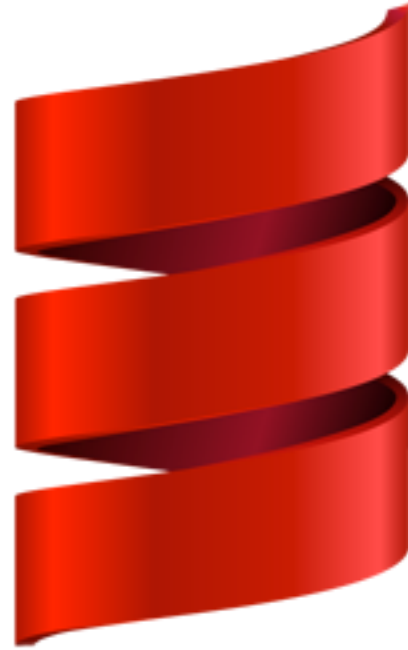
I/O

Java

Testing

Libraries

# Scalable language



# Scalable language



# Scaling

Features

Users

Servers

Developers

# Concepts

Expressions

Functions as values

Subtyping

Polymorphism

Algebraic types

Pattern matching


Abstract types

Modules



Use the worksheet (REPL)

# Code with expressions



... the thing an expression denotes, i.e., its  
"value", depends only on the values of its sub-  
expressions

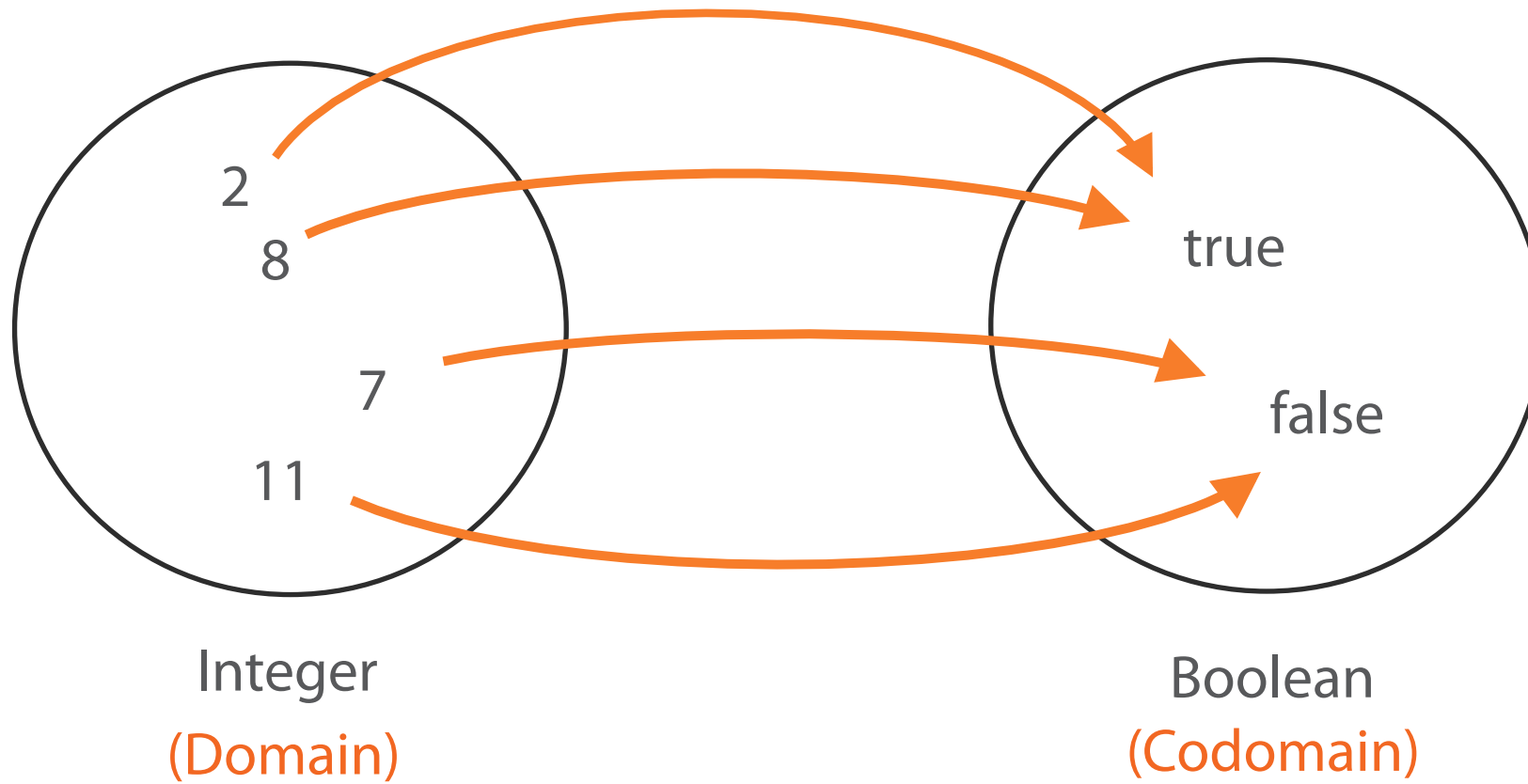
— Peter Landin



Think in functions

What is the relation?

"Even"



Domain	Image
....	???
-2	true
-1	false
0	true
1	false
2	true
3	false
4	true
....	???

# Scala has modules

# Modules

object keyword — no parameters to module

class keyword — parameterized module

Compile faster

Avoid name  
collisions

Hide things

Reasons we're interested in modules

# Use algebraic types

Making types from other types: compound types



# Algebra

Elements of one or  
more sets

Operations on  
elements of sets

Rules for relating  
the operations

# Cartesian Product

Combining elements from multiple sets

.

“Product type”

.

Struct, record, tuples — these are supported in most programming languages.

## Disjoint Union

Union of two or more sets without overlap

.

“Sum type”

.

These are not present in most programming languages.

```
data Shape = Circle Float | Rectangle Float Float
```

```
getShapeArea s = case s of
```

```
    Circle r -> 3.14 * r * r
```

```
    Rectangle l w -> l * w
```

## Haskell

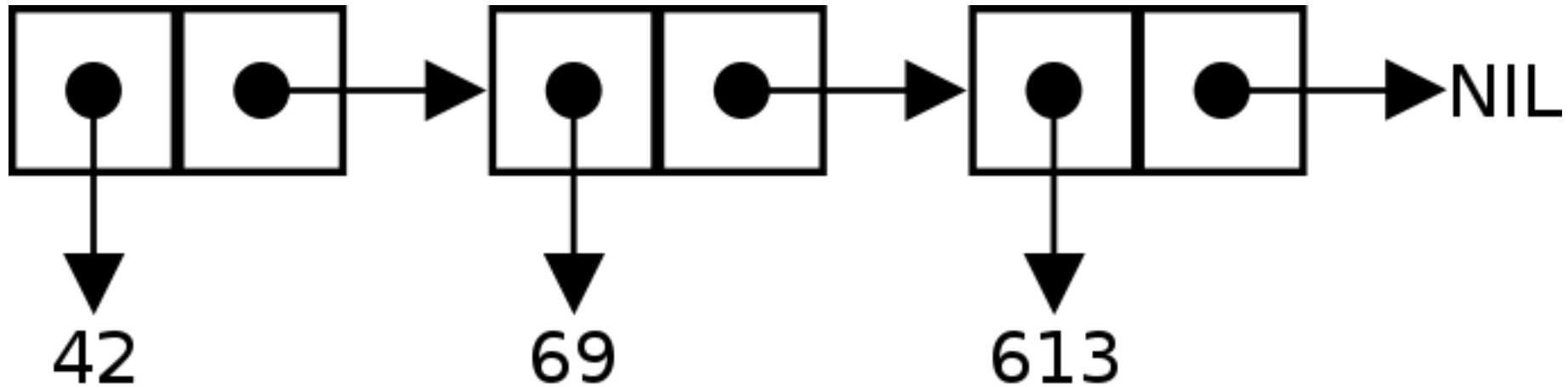
Eric likes Haskell. Haskell has nice motivating examples of many things.

```
type shape = Circle of float | Rectangle of (float * float)
```

```
let get_shape_area s = match s with  
  | Circle r -> 3.14 *. r *. r  
  | Rectangle (x, y) -> x *. y
```

OCaml

## List from *cons* cells



List(42, 69, 613)

42 :: 69 :: 613 :: NIL

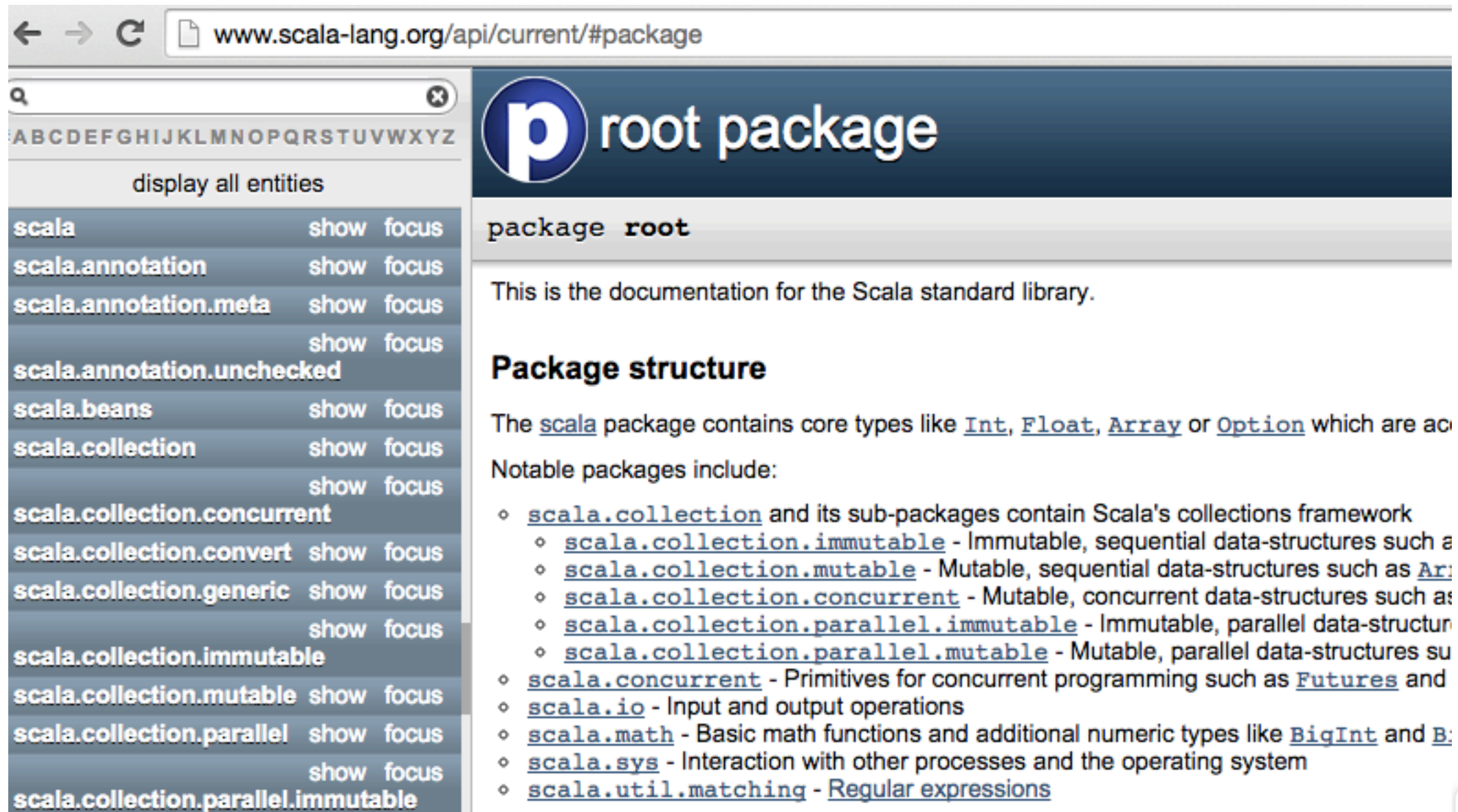
Cons(42, Cons(69, Cons(613, NIL))) We're going to create this

# Know the Collections

It is big! RTFM

Immutable collections are a big deal.

# Scala Libraries



The screenshot shows the Scala API documentation website. The browser address bar displays `www.scala-lang.org/api/current/#package`. On the left, there is a search bar and an alphabetical index (A-Z). Below the index is a table listing various Scala packages, each with 'show' and 'focus' links. The main content area features a large 'p root package' header. Below this, it states 'This is the documentation for the Scala standard library.' and 'Package structure'. A paragraph explains that the `scala` package contains core types like `Int`, `Float`, `Array`, or `Option`. It then lists notable packages including `scala.collection` (with its sub-packages), `scala.concurrent`, `scala.io`, `scala.math`, `scala.sys`, and `scala.util.matching`.

← → ↻ `www.scala-lang.org/api/current/#package`

q ×

ABCDEFGHIJKLMNOPQRSTUVWXYZ

display all entities

<a href="#">scala</a>	<a href="#">show</a>	<a href="#">focus</a>
<a href="#">scala.annotation</a>	<a href="#">show</a>	<a href="#">focus</a>
<a href="#">scala.annotation.meta</a>	<a href="#">show</a>	<a href="#">focus</a>
<a href="#">scala.annotation.unchecked</a>	<a href="#">show</a>	<a href="#">focus</a>
<a href="#">scala.beans</a>	<a href="#">show</a>	<a href="#">focus</a>
<a href="#">scala.collection</a>	<a href="#">show</a>	<a href="#">focus</a>
<a href="#">scala.collection.concurrent</a>	<a href="#">show</a>	<a href="#">focus</a>
<a href="#">scala.collection.convert</a>	<a href="#">show</a>	<a href="#">focus</a>
<a href="#">scala.collection.generic</a>	<a href="#">show</a>	<a href="#">focus</a>
<a href="#">scala.collection.immutable</a>	<a href="#">show</a>	<a href="#">focus</a>
<a href="#">scala.collection.mutable</a>	<a href="#">show</a>	<a href="#">focus</a>
<a href="#">scala.collection.parallel</a>	<a href="#">show</a>	<a href="#">focus</a>
<a href="#">scala.collection.parallel.immutable</a>	<a href="#">show</a>	<a href="#">focus</a>

## p root package

package **root**

This is the documentation for the Scala standard library.

### Package structure

The [scala](#) package contains core types like [Int](#), [Float](#), [Array](#) or [Option](#) which are accessible from any Scala program.

Notable packages include:

- [scala.collection](#) and its sub-packages contain Scala's collections framework
  - [scala.collection.immutable](#) - Immutable, sequential data-structures such as [List](#)
  - [scala.collection.mutable](#) - Mutable, sequential data-structures such as [Array](#)
  - [scala.collection.concurrent](#) - Mutable, concurrent data-structures such as [ConcurrentHashMap](#)
  - [scala.collection.parallel.immutable](#) - Immutable, parallel data-structures such as [ParList](#)
  - [scala.collection.parallel.mutable](#) - Mutable, parallel data-structures such as [ParArray](#)
- [scala.concurrent](#) - Primitives for concurrent programming such as [Futures](#) and [Promises](#)
- [scala.io](#) - Input and output operations
- [scala.math](#) - Basic math functions and additional numeric types like [BigInt](#) and [BigDecimal](#)
- [scala.sys](#) - Interaction with other processes and the operating system
- [scala.util.matching](#) - [Regular expressions](#)



# Collections – Performance

	head	tail	apply	update	prepend	append	insert
<b>immutable</b>							
List	C	C	L	L	C	L	-
Stream	C	C	L	L	C	L	-
Vector	eC	eC	eC	eC	eC	eC	-
Stack	C	C	L	L	C	C	L
Queue	aC	aC	L	L	L	C	-
Range	C	C	C	-	-	-	-
String	C	L	C	L	L	L	-

<b>C</b>	The operation takes (fast) constant time.
<b>eC</b>	The operation takes effectively constant time, but this might depend on some assumptions such as maximum length of a vector or distribution of hash keys.
<b>aC</b>	The operation takes amortized constant time. Some invocations of the operation might take longer, but if many operations are performed on average only constant time per operation is taken.
<b>Log</b>	The operation takes time proportional to the logarithm of the collection size.
<b>L</b>	The operation is linear, that is it takes time proportional to the collection size.
<b>-</b>	The operation is not supported.

# Use Option


Prefer Option functions  
over pattern matching

# Use Scalaz Disjunction

$\vee$

Keep side-effecting code  
on the outside of the program

Avoid statements and  
variable assignment

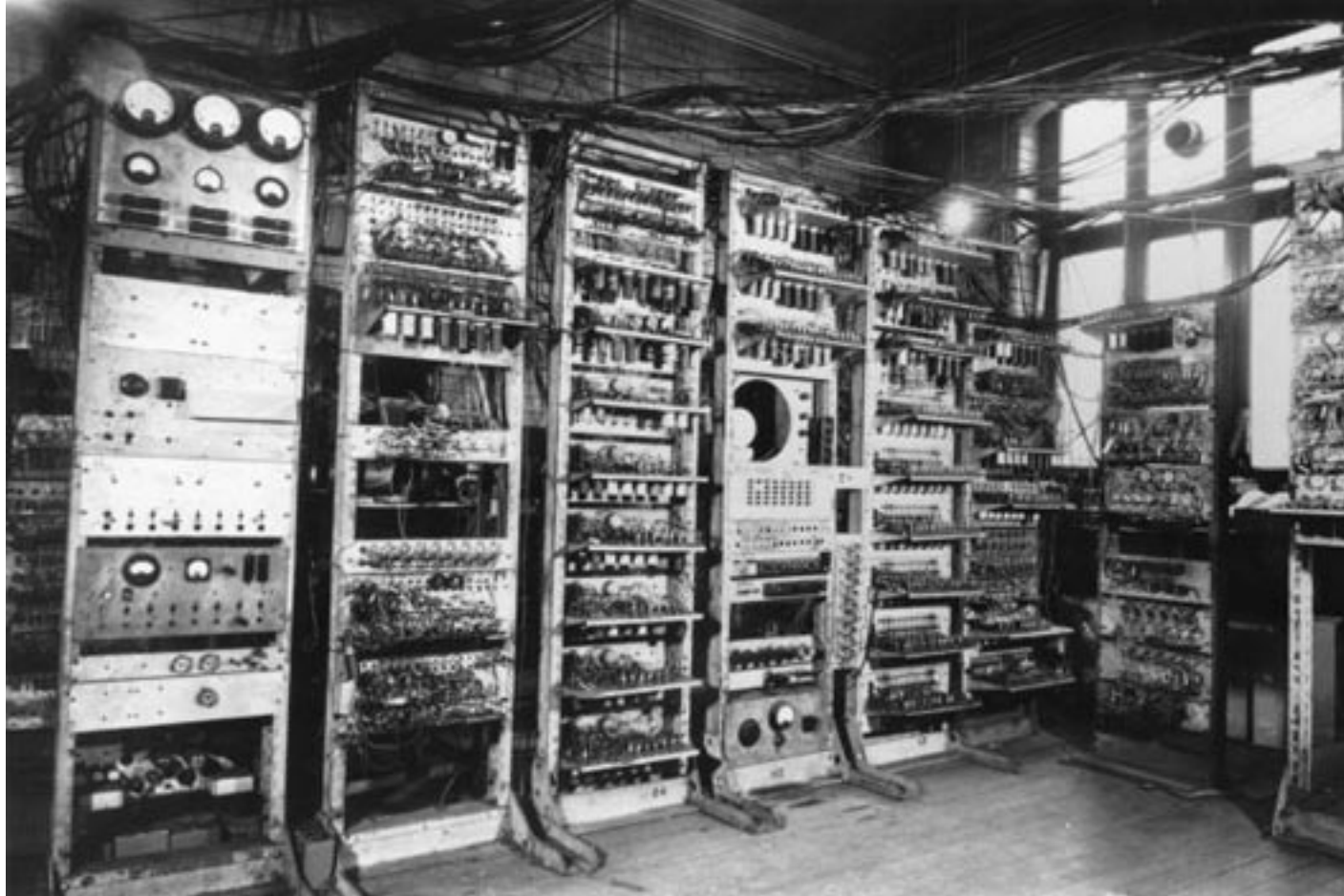


Von Neumann programming languages use variables to imitate the computer's storage cells; control statements elaborate its jump and test instructions; and assignment statements imitate its fetching, storing, and arithmetic.


— John Backus



# Manchester "Baby"








But one day it stopped, and there, shining brightly in the expected place, was the expected answer. It was a moment to remember. This was in June 1948, and nothing was ever the same again.

— Frank Williams





... the realization came over me with full force  
that a good part of the remainder of my life  
was going to be spent in finding errors in my  
own programs.

— Maurice Wilkes

