Real Logic

ACCELERATING SOFTWARE

Practicing at the Cutting Edge

Learning and Unlearning about Performance

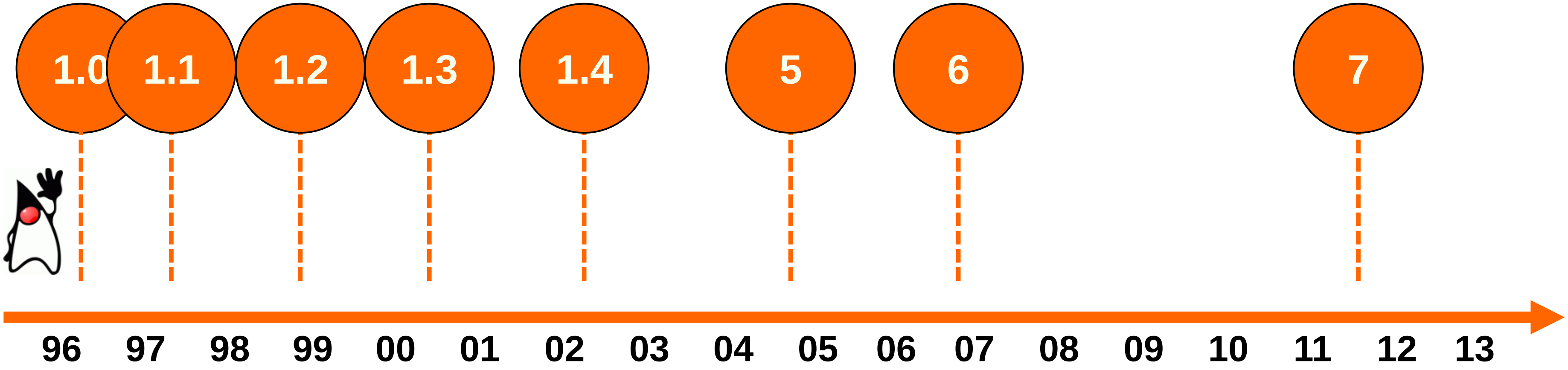
Martin Thompson - @mjpt777

Learning and Unlearning

1. Brief **History** of Java
2. Evolving **Design** approach
3. An evolving **Hardware** platform
4. Changes in **Culture**

1.
Brief History of Java

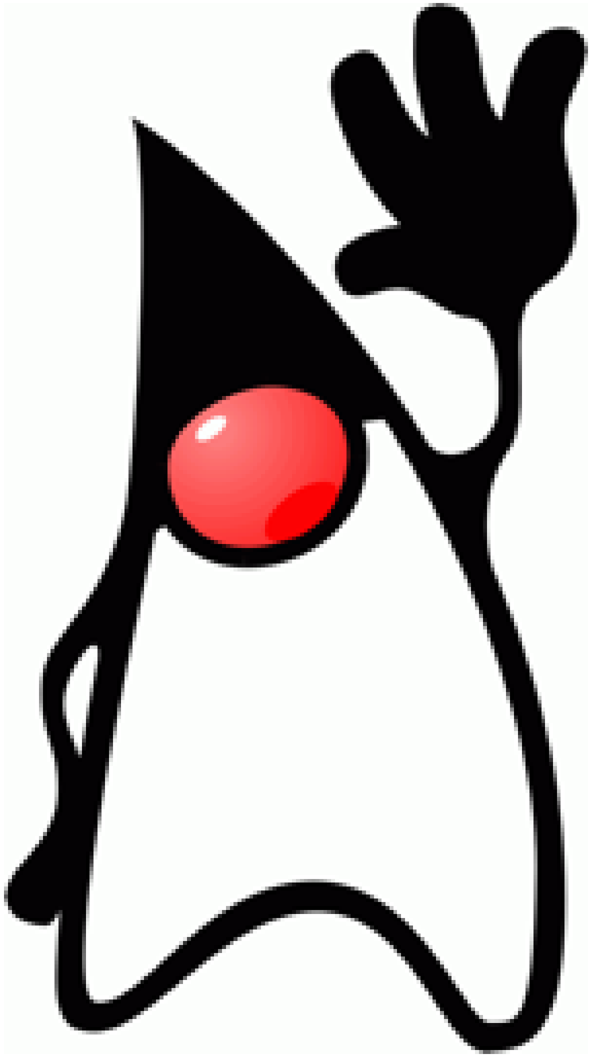
Java Timeline



In the beginning Java was Oak and Oak was slow

How did it all start?

JAVA



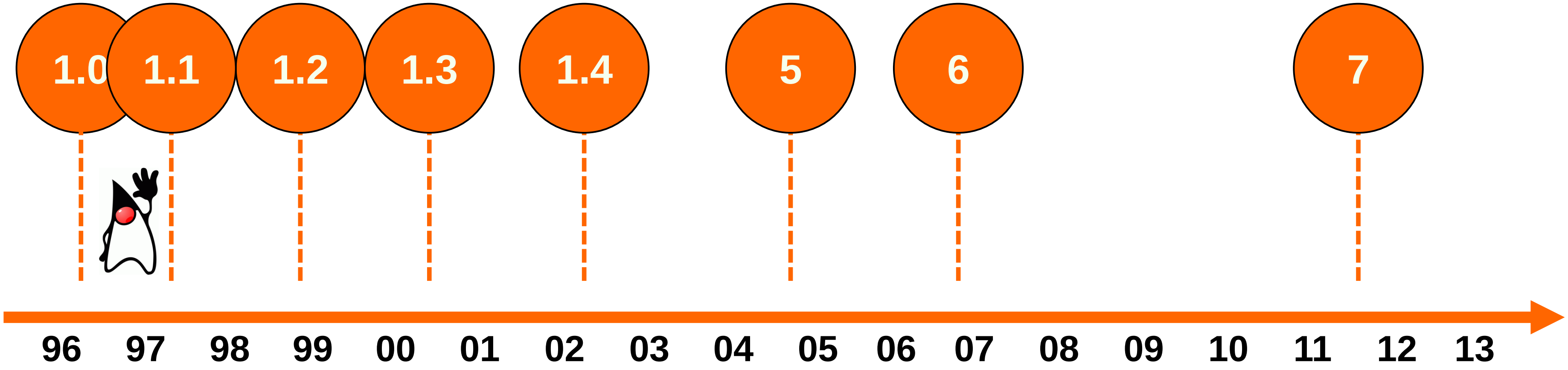
OK
⏻/I
Digital Cable Receiver
DVB

How did Java perform then?

nossr50

...but everything must have a beginning

Java Timeline



Netscape Navigator 2.0 & IE 3.0 with Applet support

Ma, I don’t need to worry about deleting objects any more...

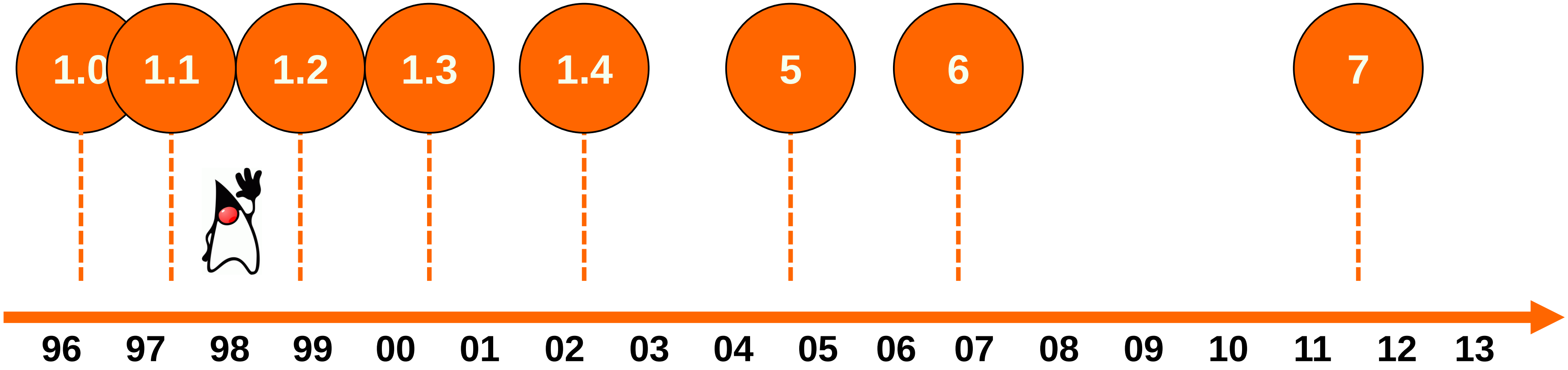
Coca-Cola
Diet Coke
Coca-Cola
Coca-Cola
Dr Pepper

LEARN TO RECYCLE

...but we can distribute rich GUIs without an installer

We could even do multi-threaded apps on Windows 3.11

Java Timeline



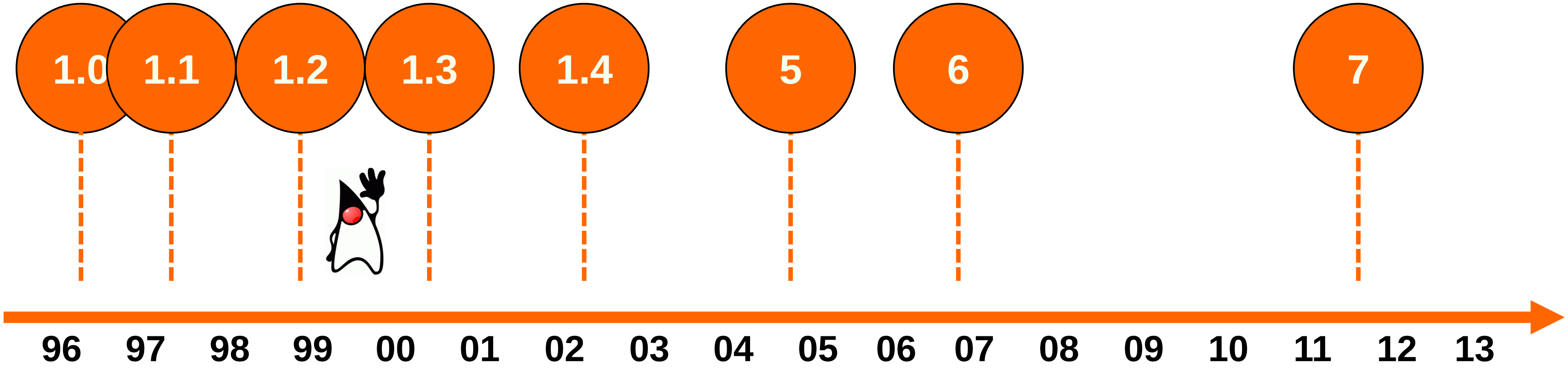
Symantec and Microsoft JIT Performance Wars

BRITISH AIRWAYS

Life with early JIT Compilers

...cross platform GUIs are a real possibility

Java Timeline



Generational Garbage Collection

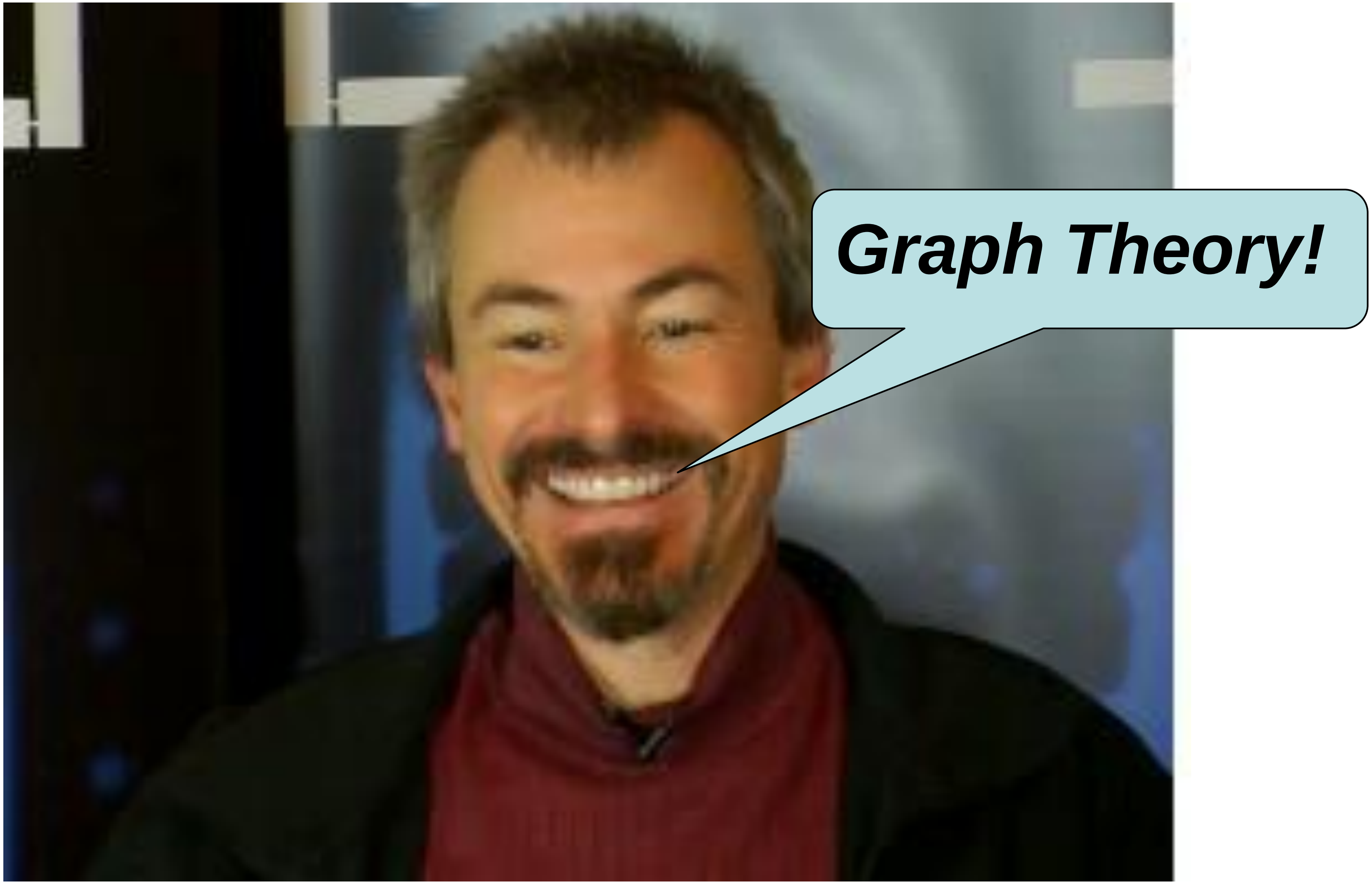
Servlets

0227
EER1
DE180227
FUJITSU
JAPAN
picoJava II
192
129
193
128
256
65
1
64
CPU1
DBCN2
1
10
20
30
40
41
50
60
40
30
20
10
1
DBCN1

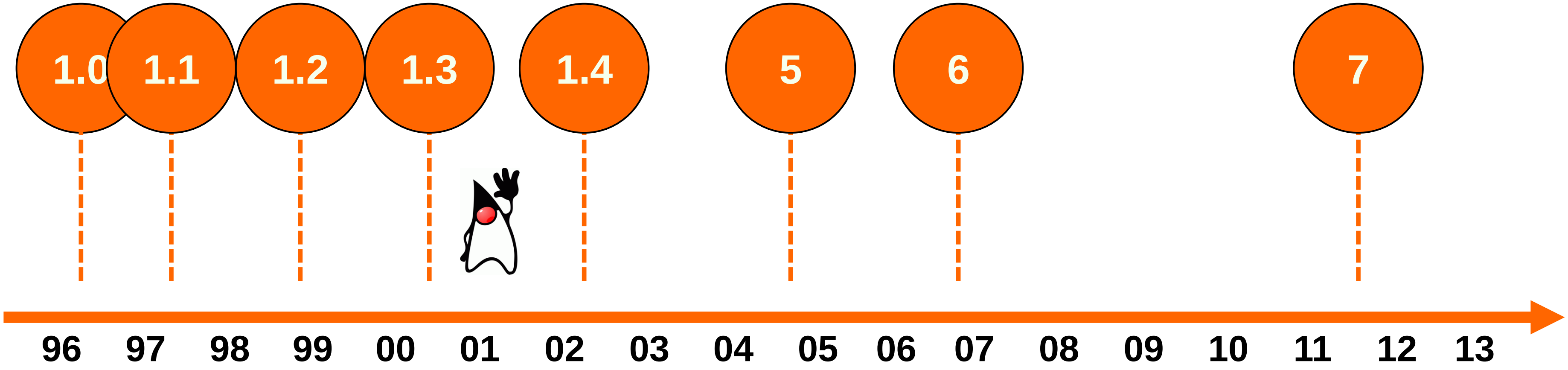
JavaStation
Sun
microsystems

But then came the surprise win

Servlets vs CGI

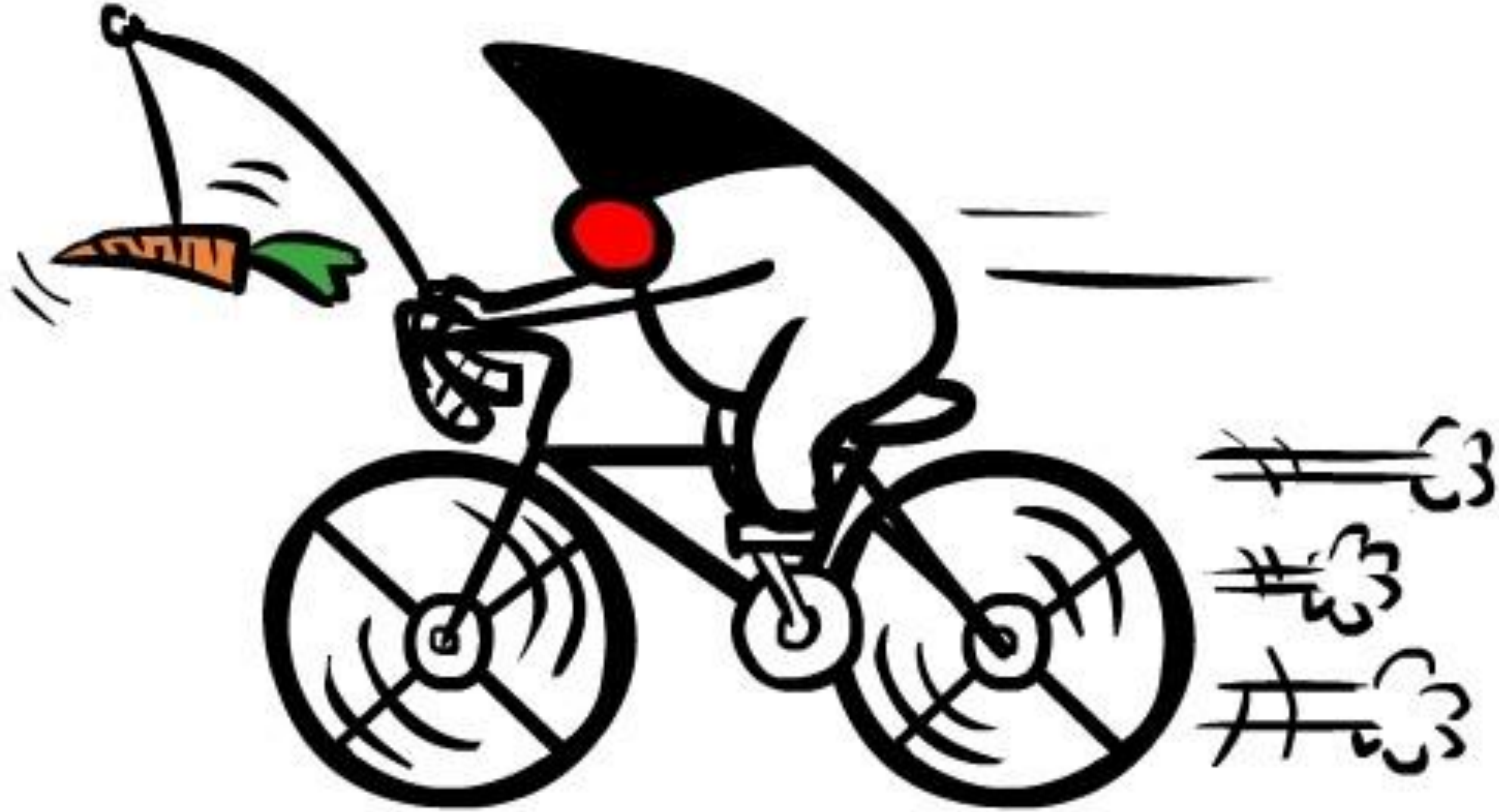

Graph Theory!

Java Timeline

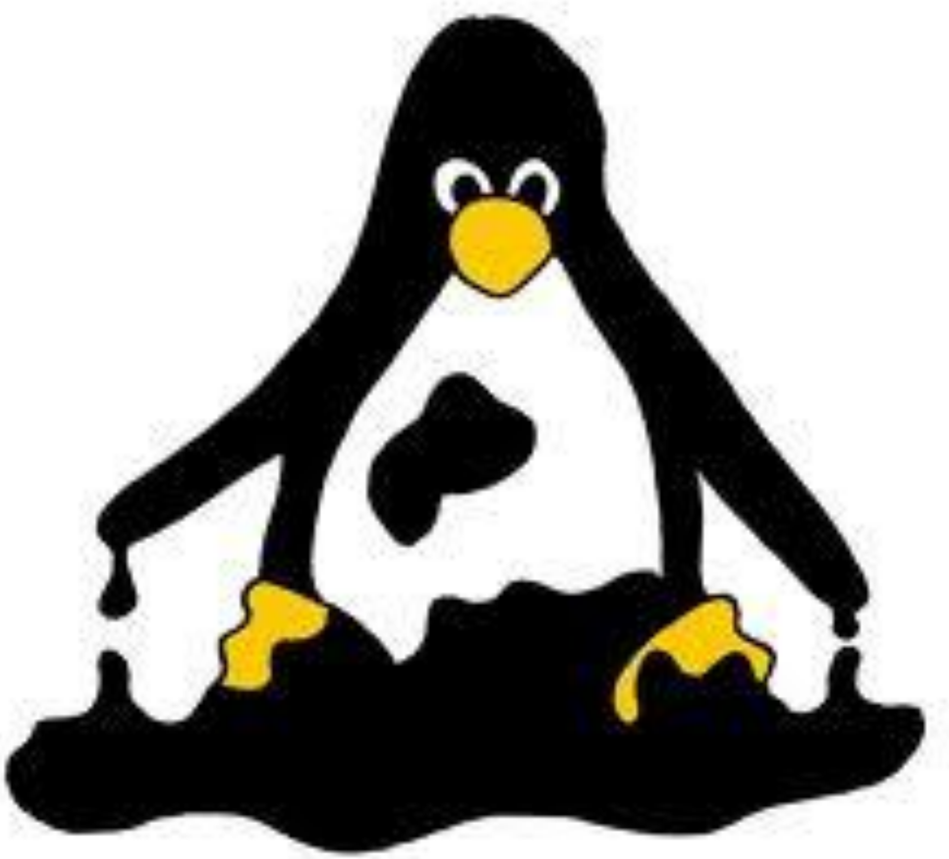


Hotspot Compiler

JRockit for x86

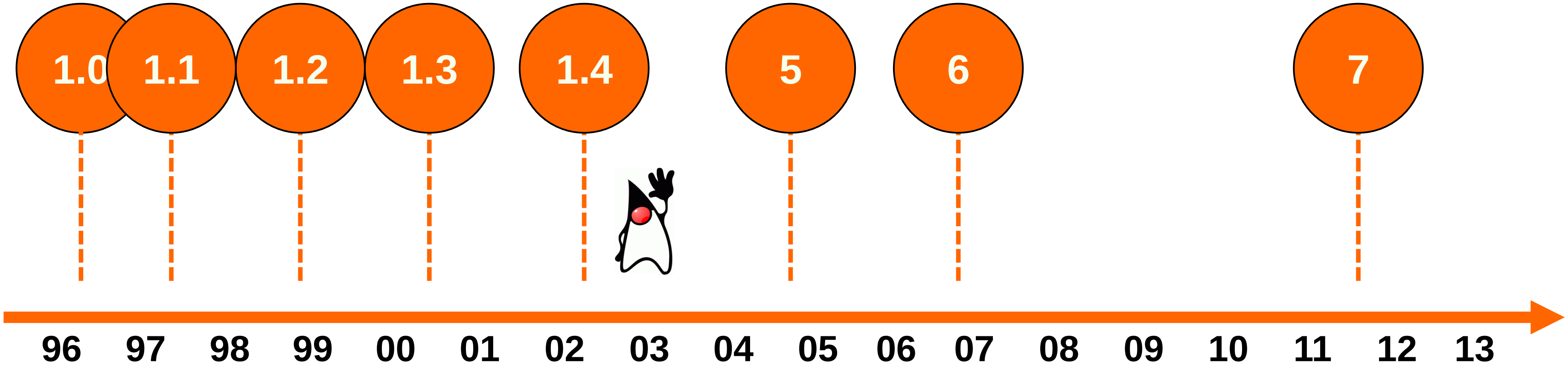


EJB



nossr50

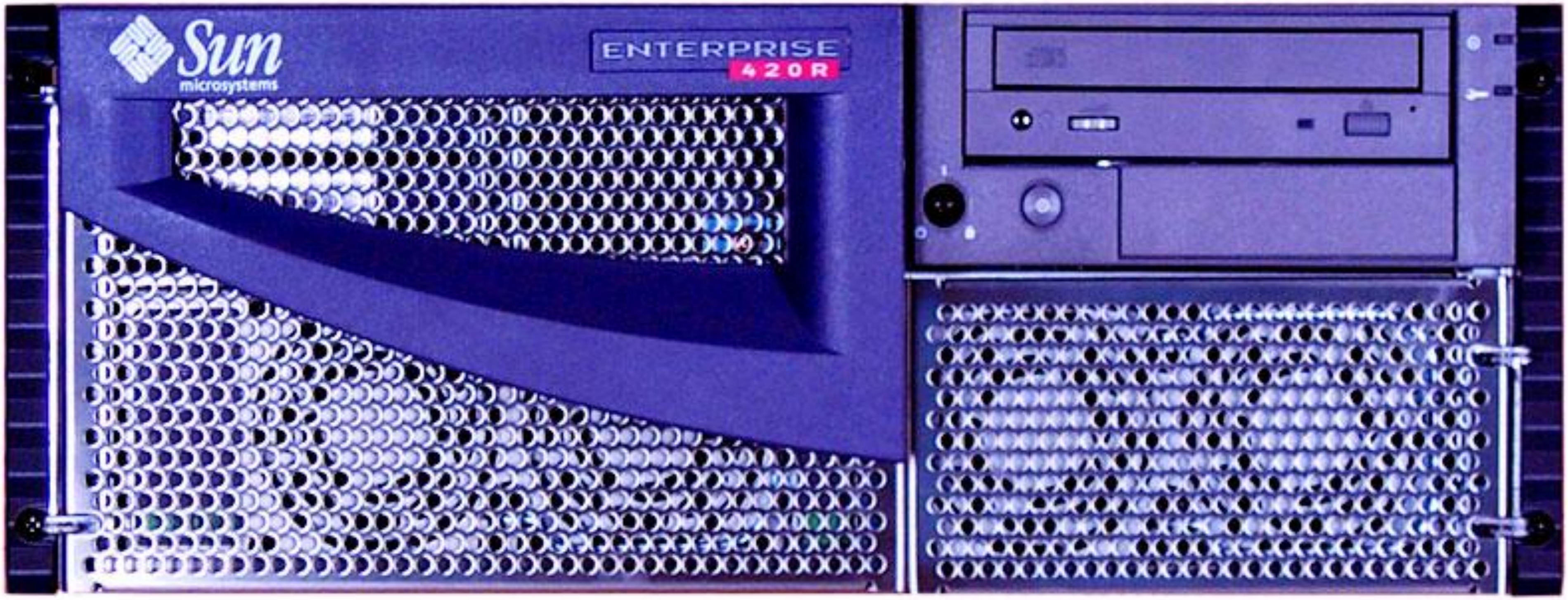
Java Timeline



Native Threads on Linux + epoll

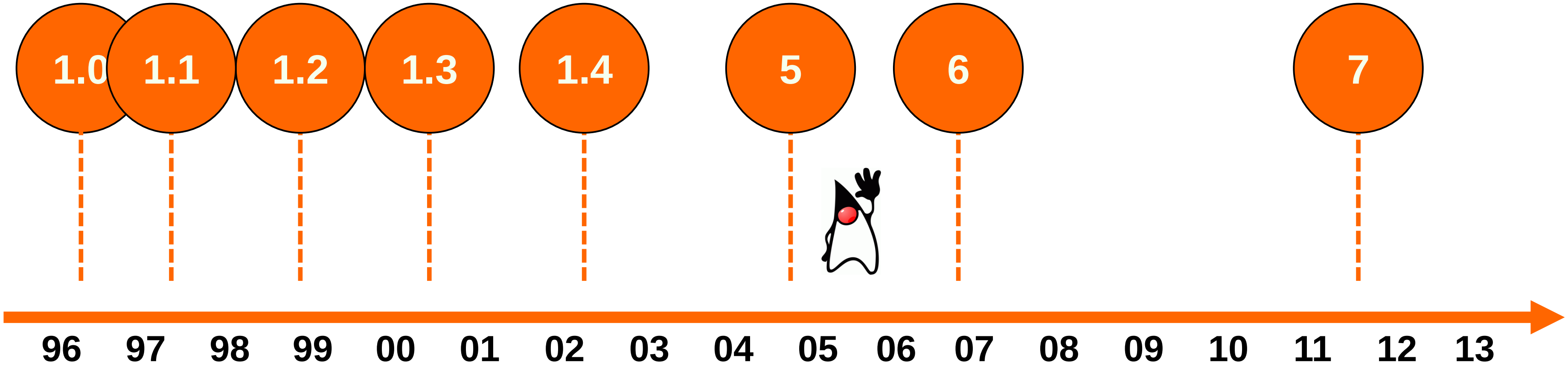
NIO

GREATEST DOTCOM DISASTERS


Sun
microsystems
ENTERPRISE
420R

Java Memory Model

Java Timeline



Java Util Concurrent + JMM

Class Data Sharing

Herb decided to write an essay...

The free lunch is over...

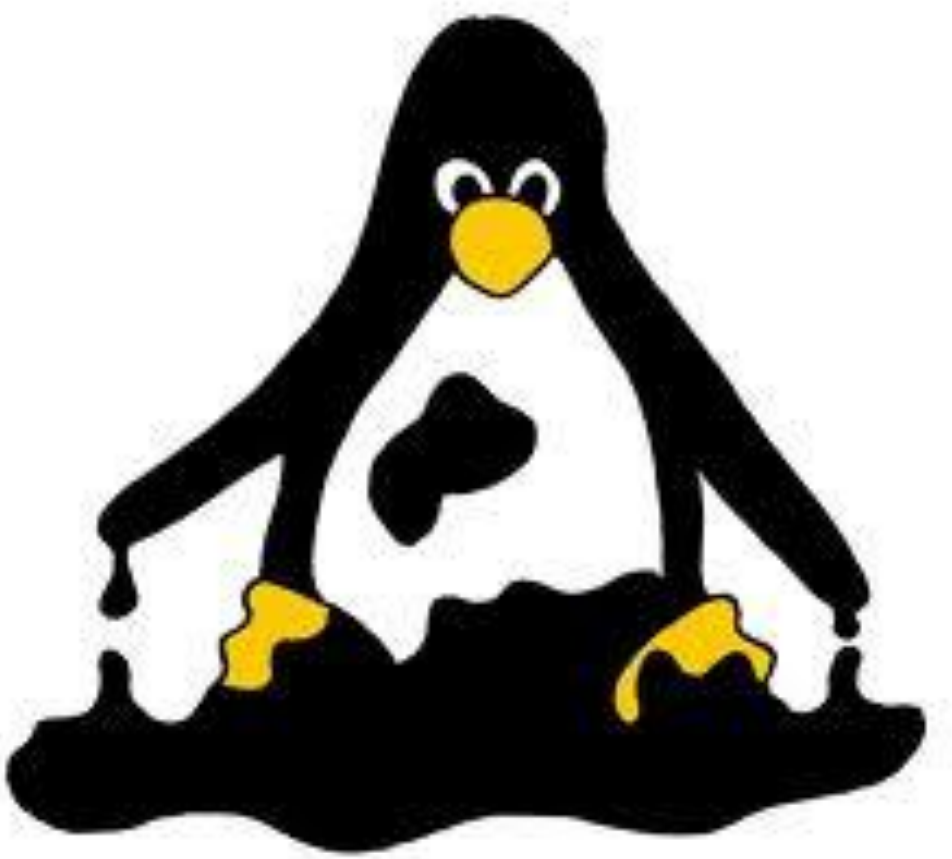
Java finds its way into our poor little mobile phones

J2ME

Déjâ vue?

What about life on the Server?

EJB

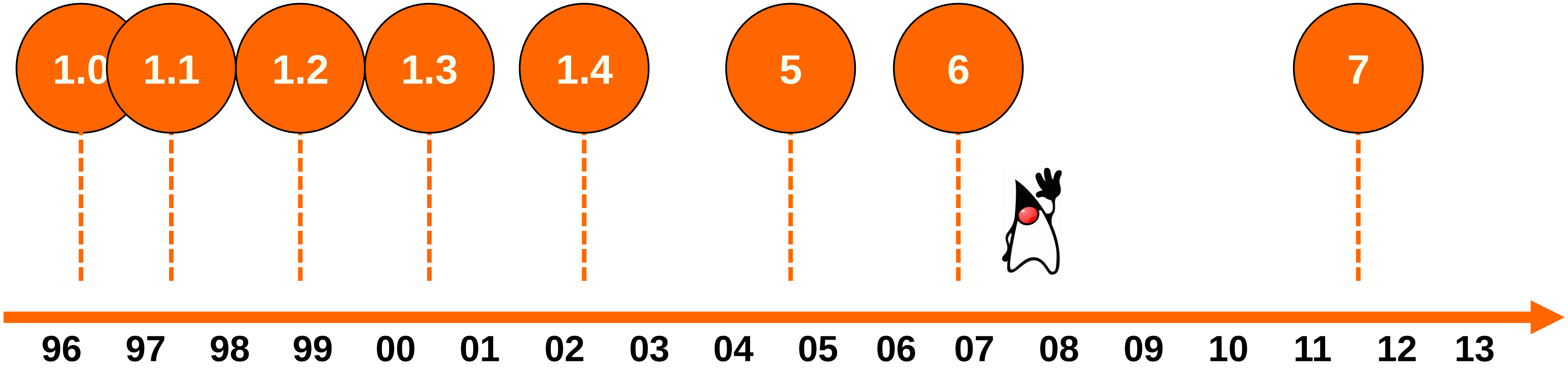


Spring

Java Application Framework

EJB

Java Timeline



Escape Analysis

Register Allocation

Split Bytecode Verification

ORACLE®
Java™

What about our hero who freed us from the EJB tar pit?

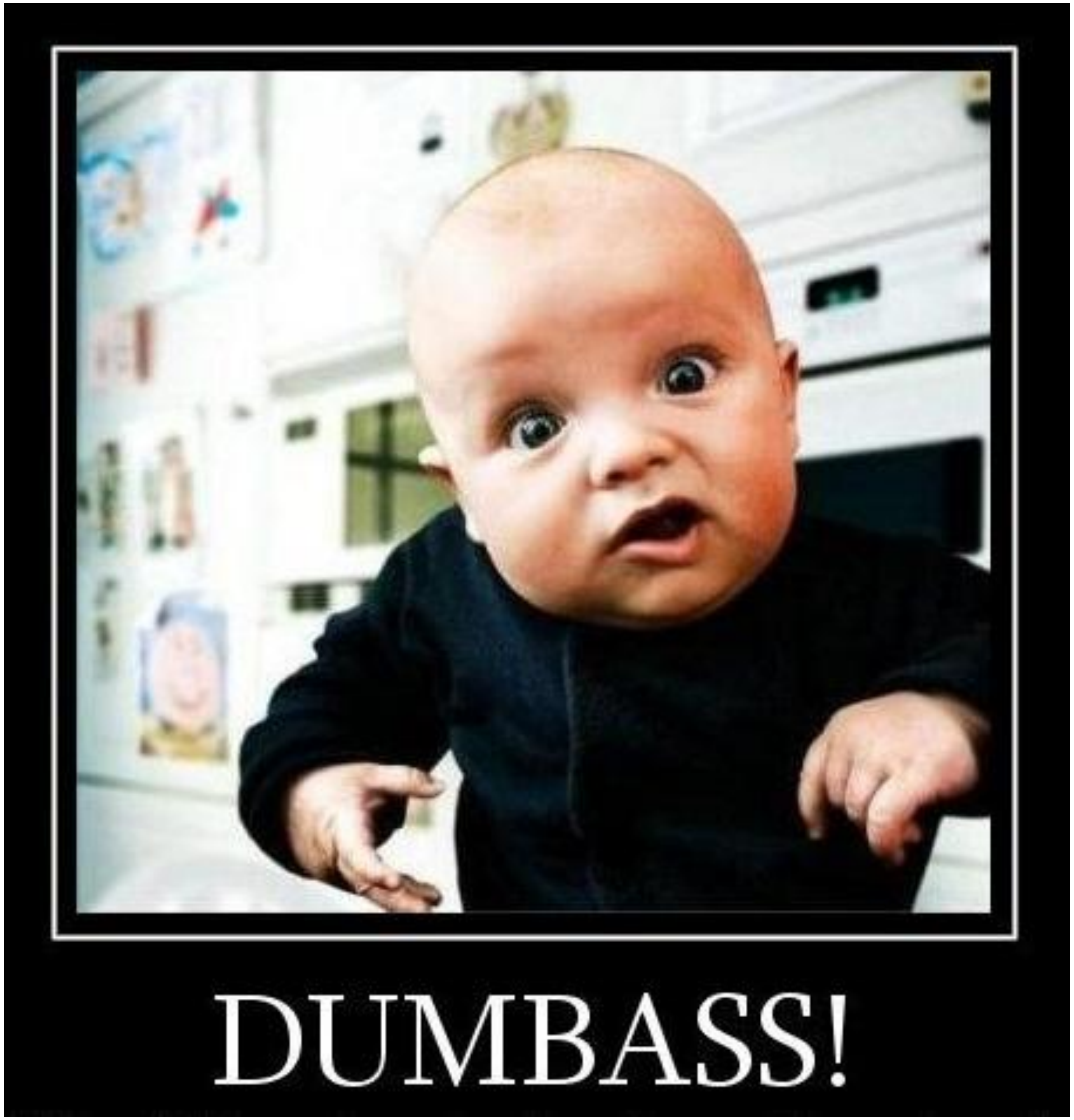
Spring

Java Application Framework

nossr50

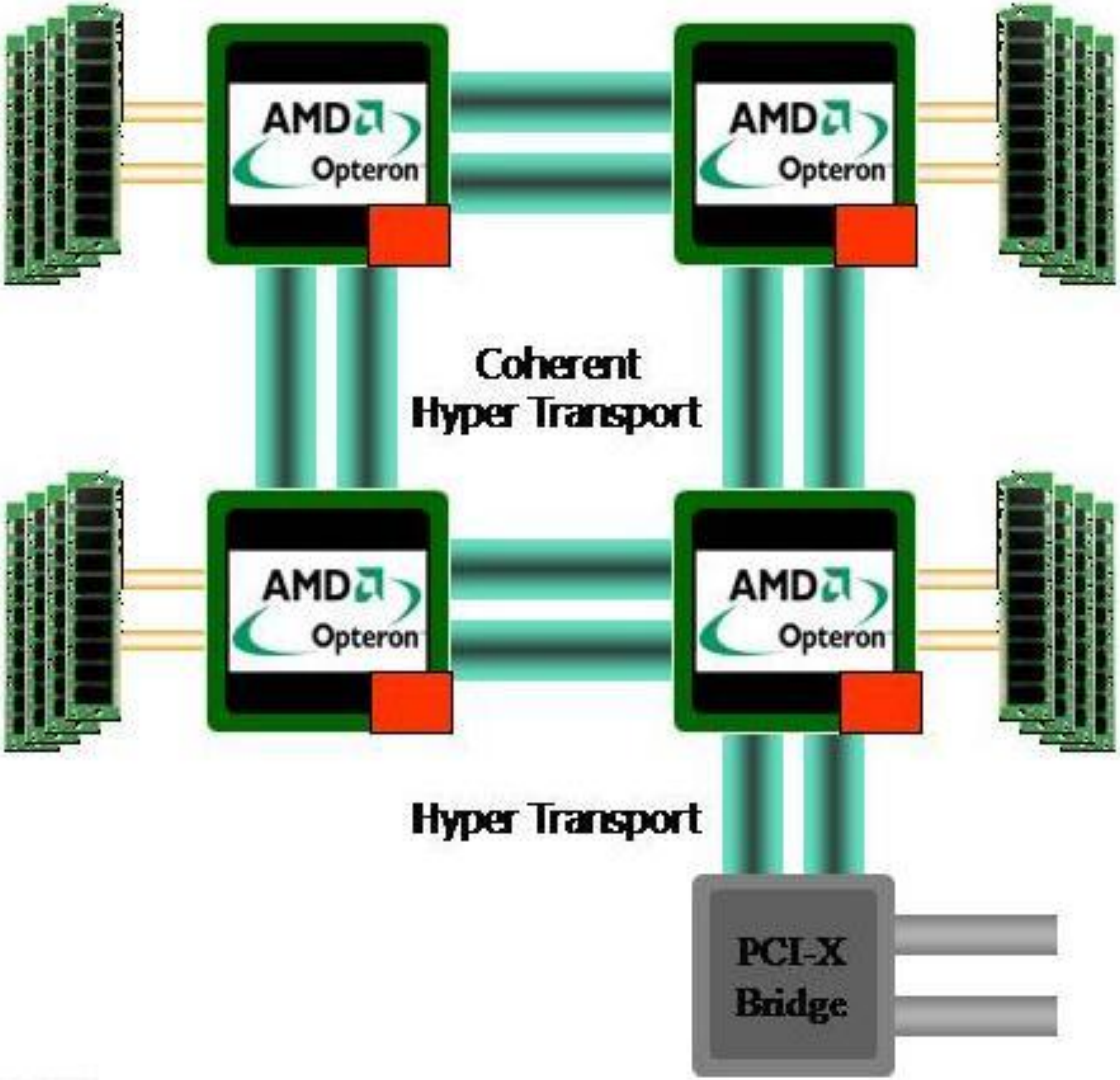
BLOATWARE
BLOATWARE EVERYWHERE
memegenerator.net

HIBERNATE



SQL too difficult?

The world of hardware undergoes big changes!


AMD
Opteron
AMD
Opteron
Coherent
Hyper Transport
AMD
Opteron
AMD
Opteron
Hyper Transport
PCI-X
Bridge

High Frequency Trading

Milliseconds Matter...

...Microseconds Matter...

...right from market open...

...and especially after a quiet period...

...it is like being at War

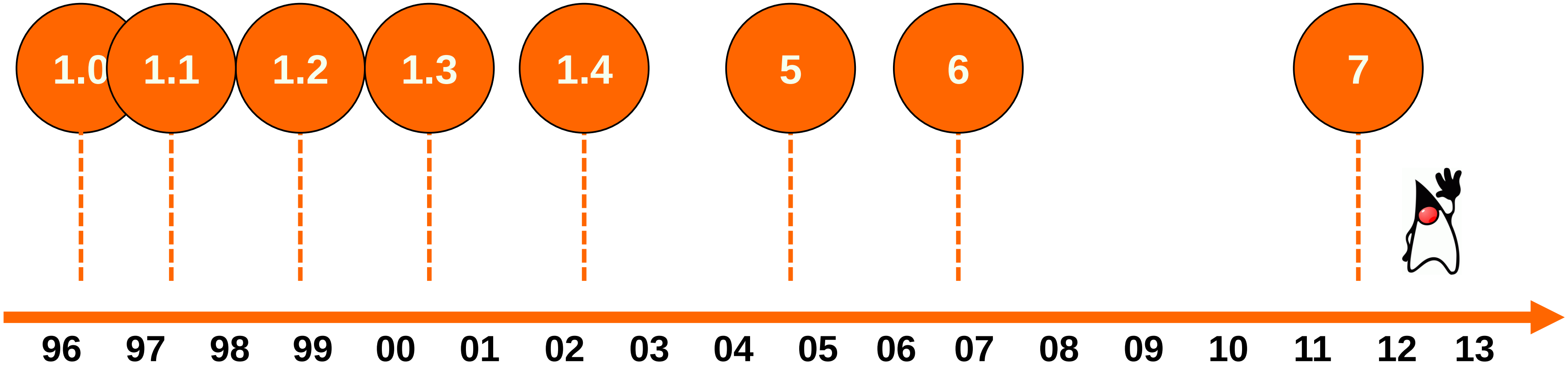
Coca-Cola
Diet Coke
Coca-Cola
Dr Pepper

Memory Cliff

Locks and Multi-core

Safepoints!!!

Java Timeline



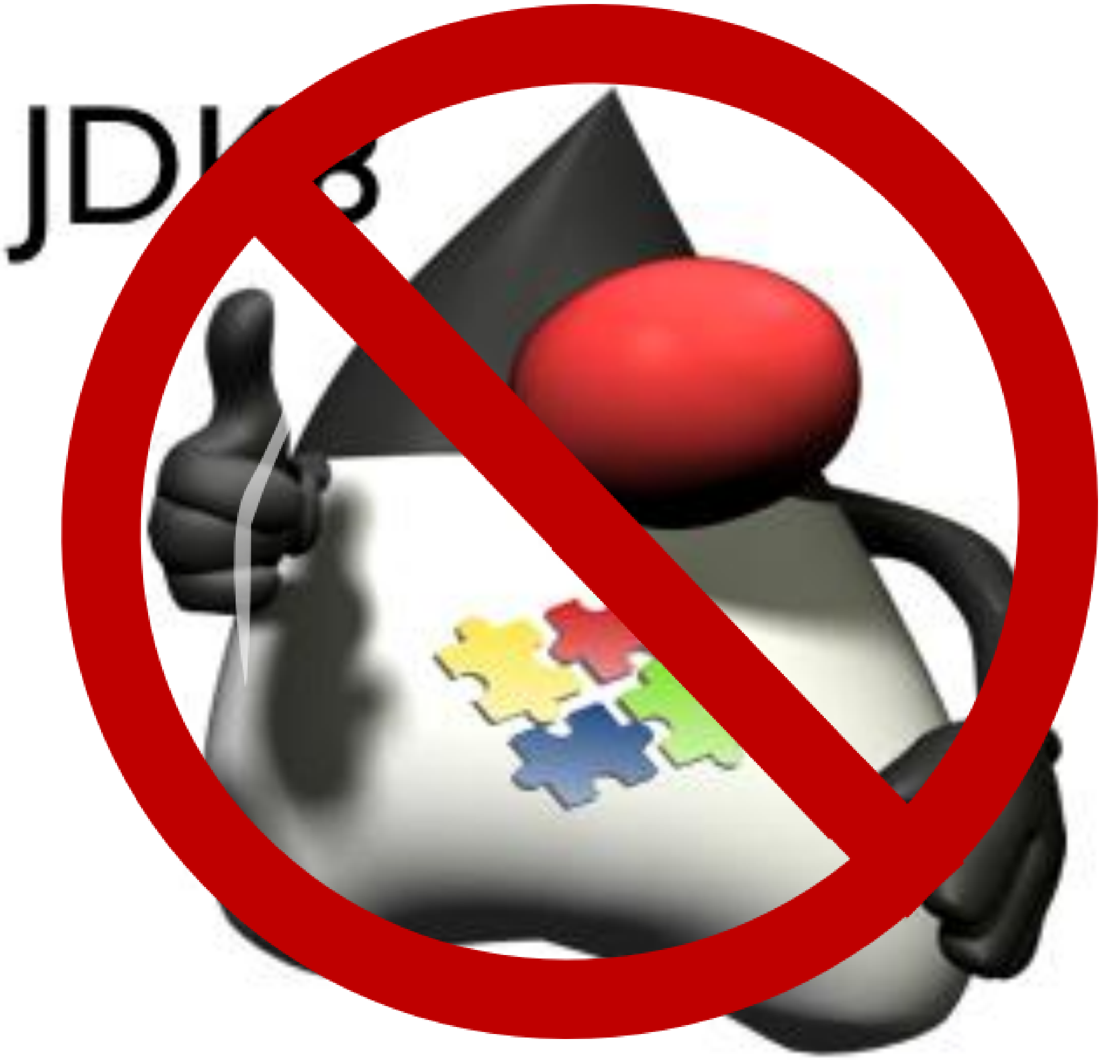
Tiered Compilation

G1 Garbage Collector

Compressed Pointers

What does the near future hold?

JDK8

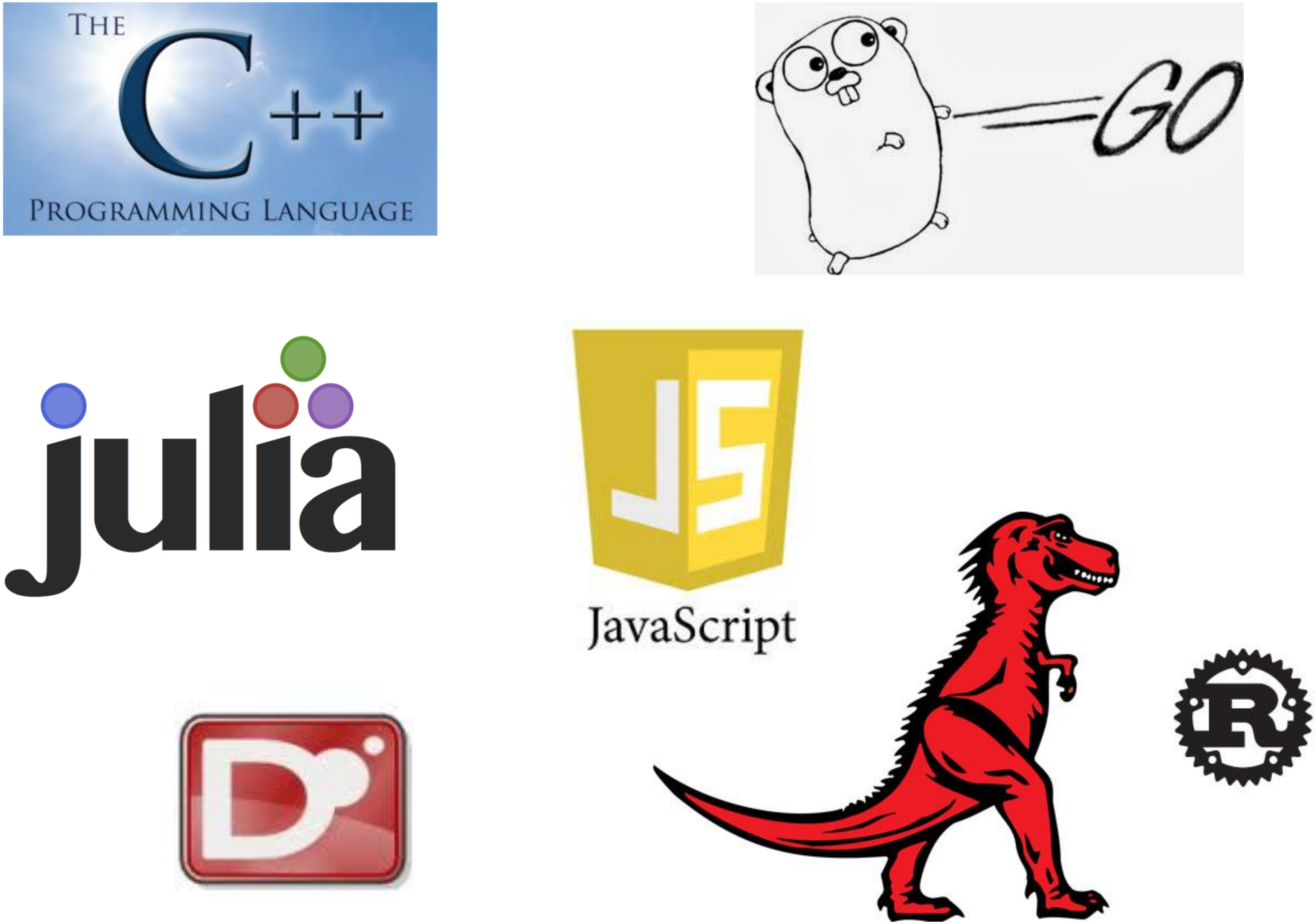

JDK 8

WTF?!?!

What is everyone excited about?

λ

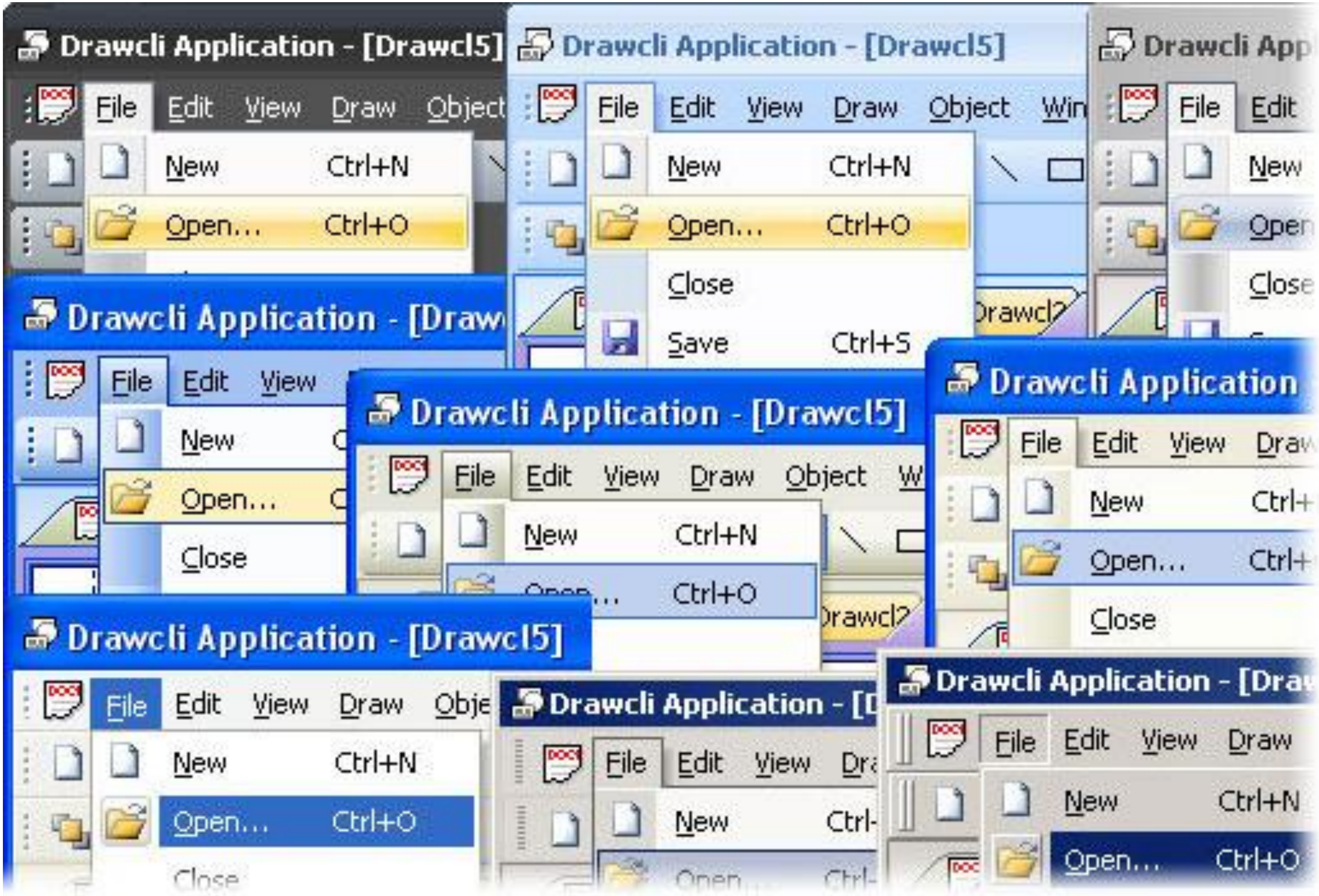
What about other languages?

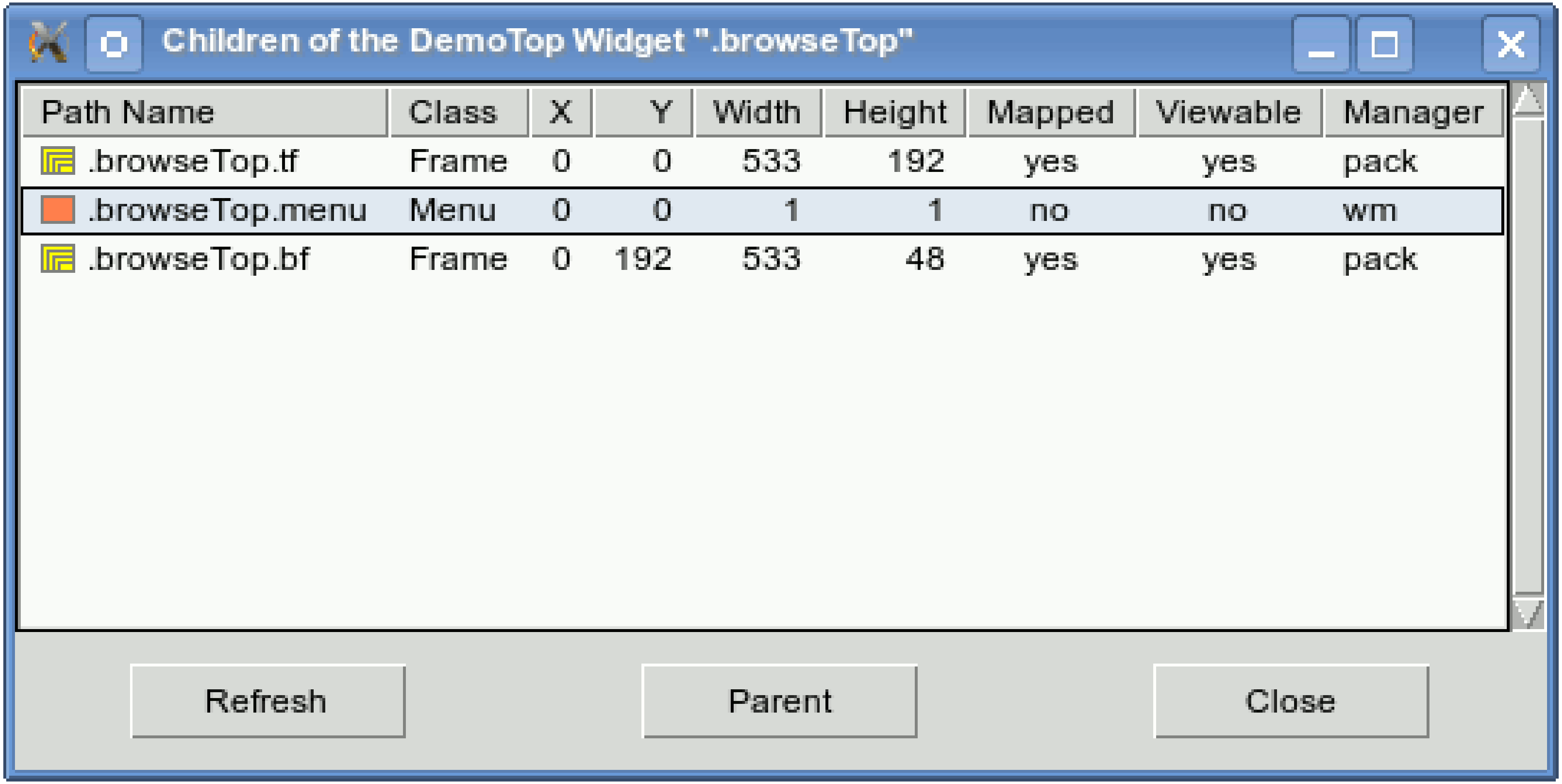

THE
C++
PROGRAMMING LANGUAGE
GO
julia
JS
JavaScript
D
R

Now on with the story...

2.
Evolving Design Approach

GUI Era

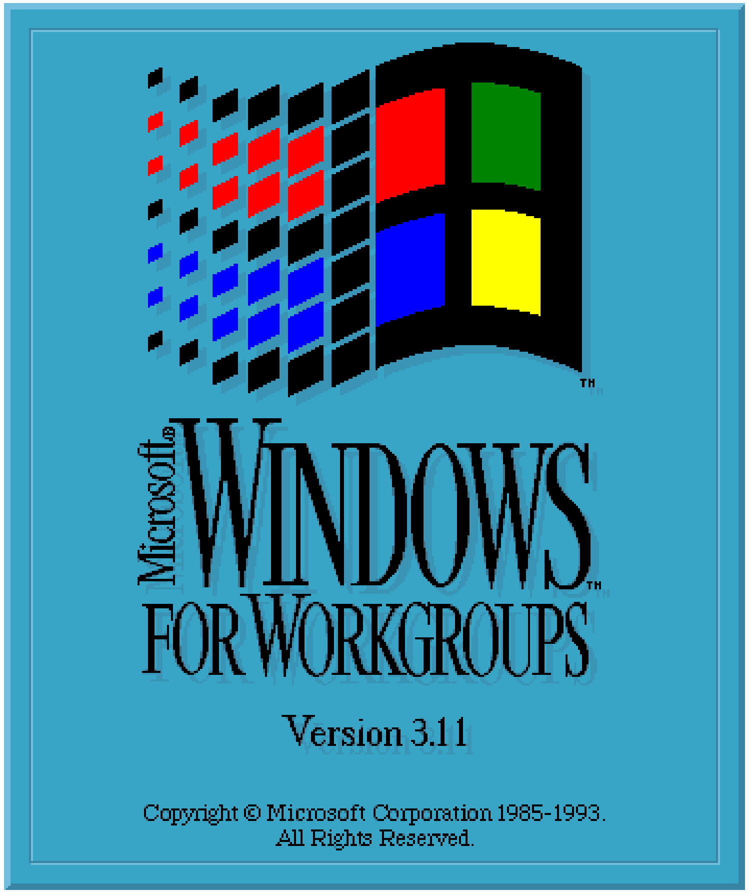

Drawcli Application - [Drawcl5]
File
Edit
View
Draw
Object
Win
New Ctrl+N
Open... Ctrl+O
Close
Save Ctrl+S
Drawcl2



Children of the DemoTop Widget ".browseTop"

Path Name	Class	X	Y	Width	Height	Mapped	Viewable	Manager
.browseTop.tf	Frame	0	0	533	192	yes	yes	pack
.browseTop.menu	Menu	0	0	1	1	no	no	wm
.browseTop.bf	Frame	0	192	533	48	yes	yes	pack

Battle for the Desktop

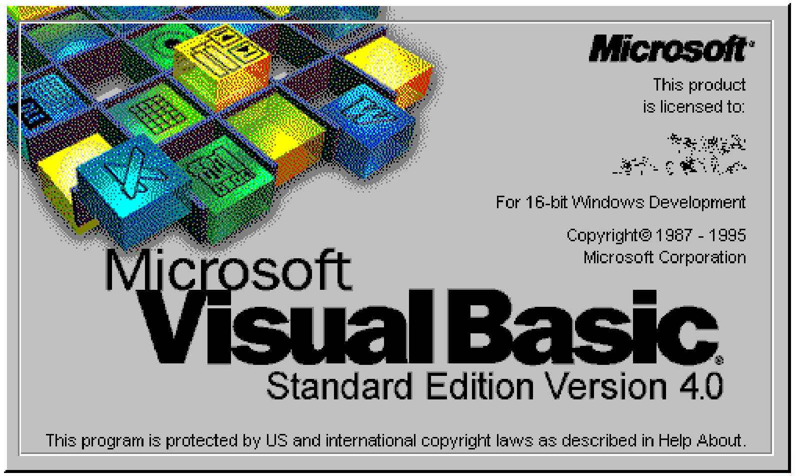


Microsoft® WINDOWS™ FOR WORKGROUPS

Version 3.11

Copyright © Microsoft Corporation 1985-1993.
All Rights Reserved.

Battle for the Desktop



Microsoft

This product
is licensed to:

For 16-bit Windows Development

Copyright© 1987 - 1995
Microsoft Corporation

Microsoft
Visual Basic®
Standard Edition Version 4.0

This program is protected by US and international copyright laws as described in Help About.

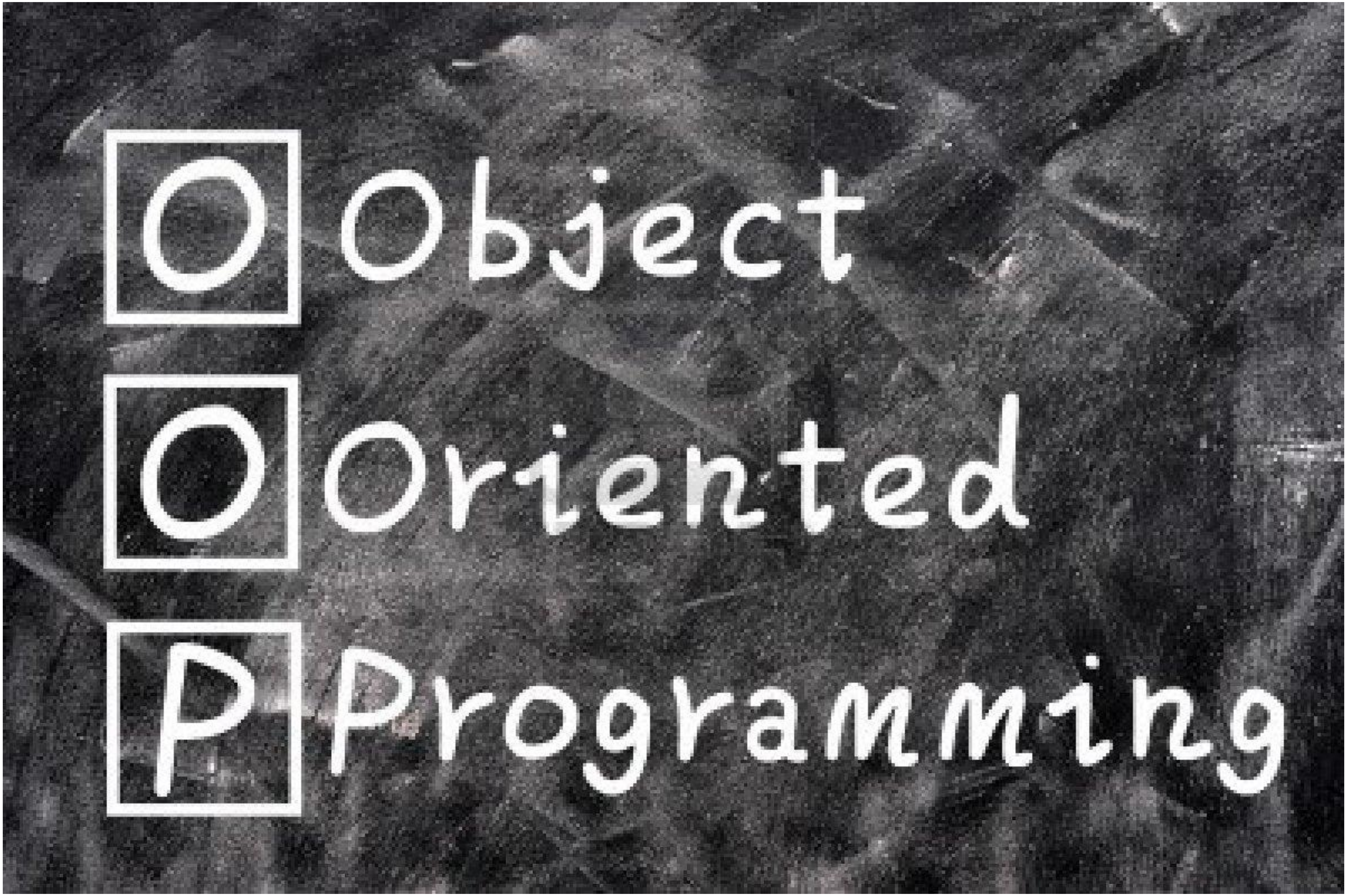
What was the biggest factor in performance?

People

Comms design is significant to GUIs

Users love responsive interfaces

Modelling



O Object

O Oriented

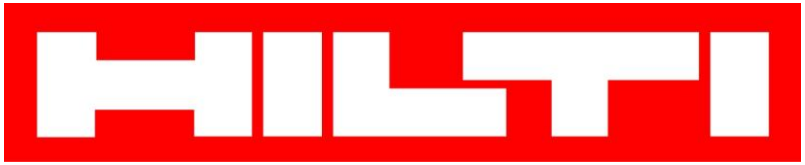
P Programming

“Big” Data Era

What do the following companies have in common?

CONRAD

Office
DEPOT


HILTI

ABB

RS Components

Huge product catalogues

Logistics

Partners

Catalogues

Sales

PCM

Websites

Warehousing

e-Procurement

Manufacturing

Parsing

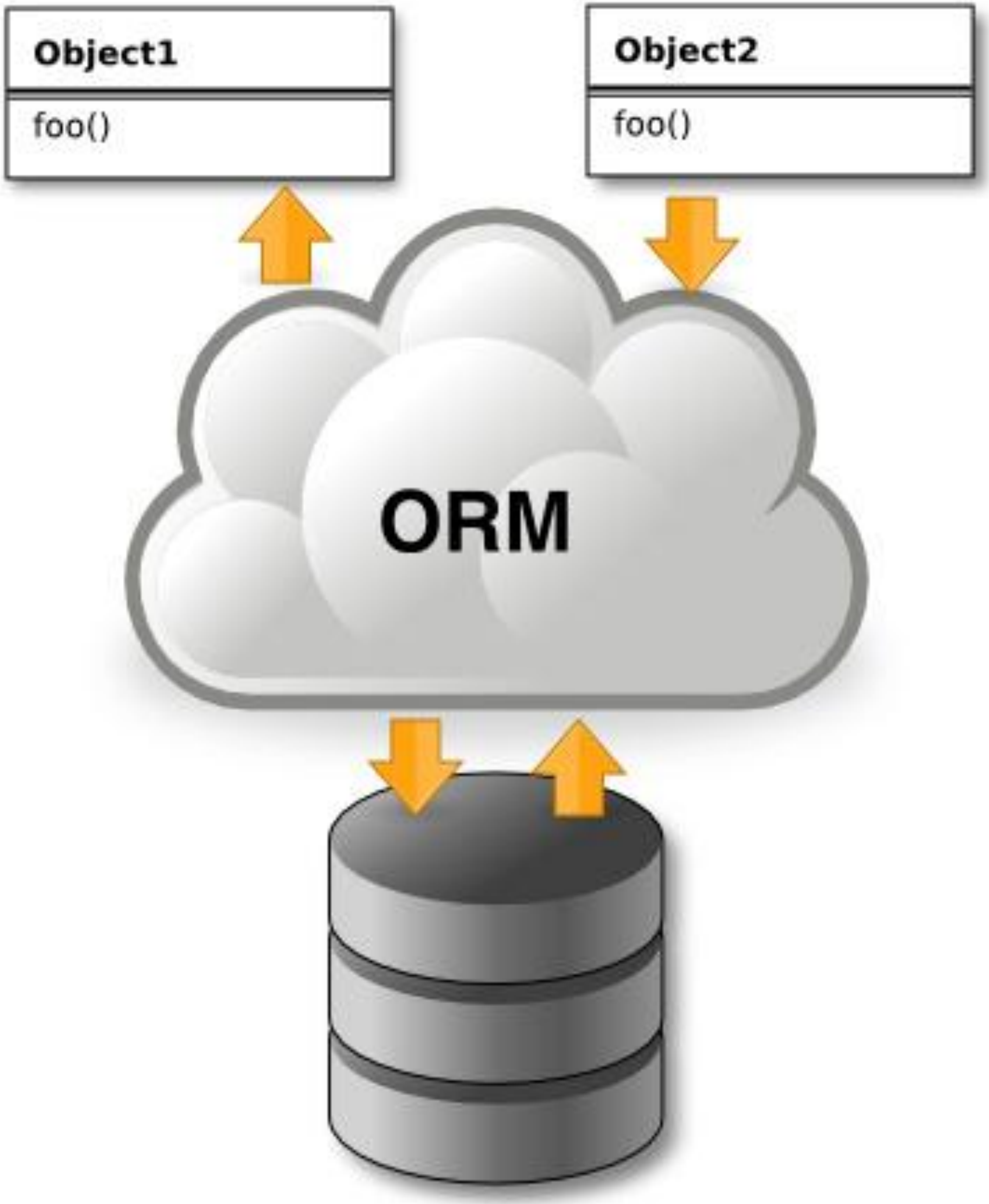
Data

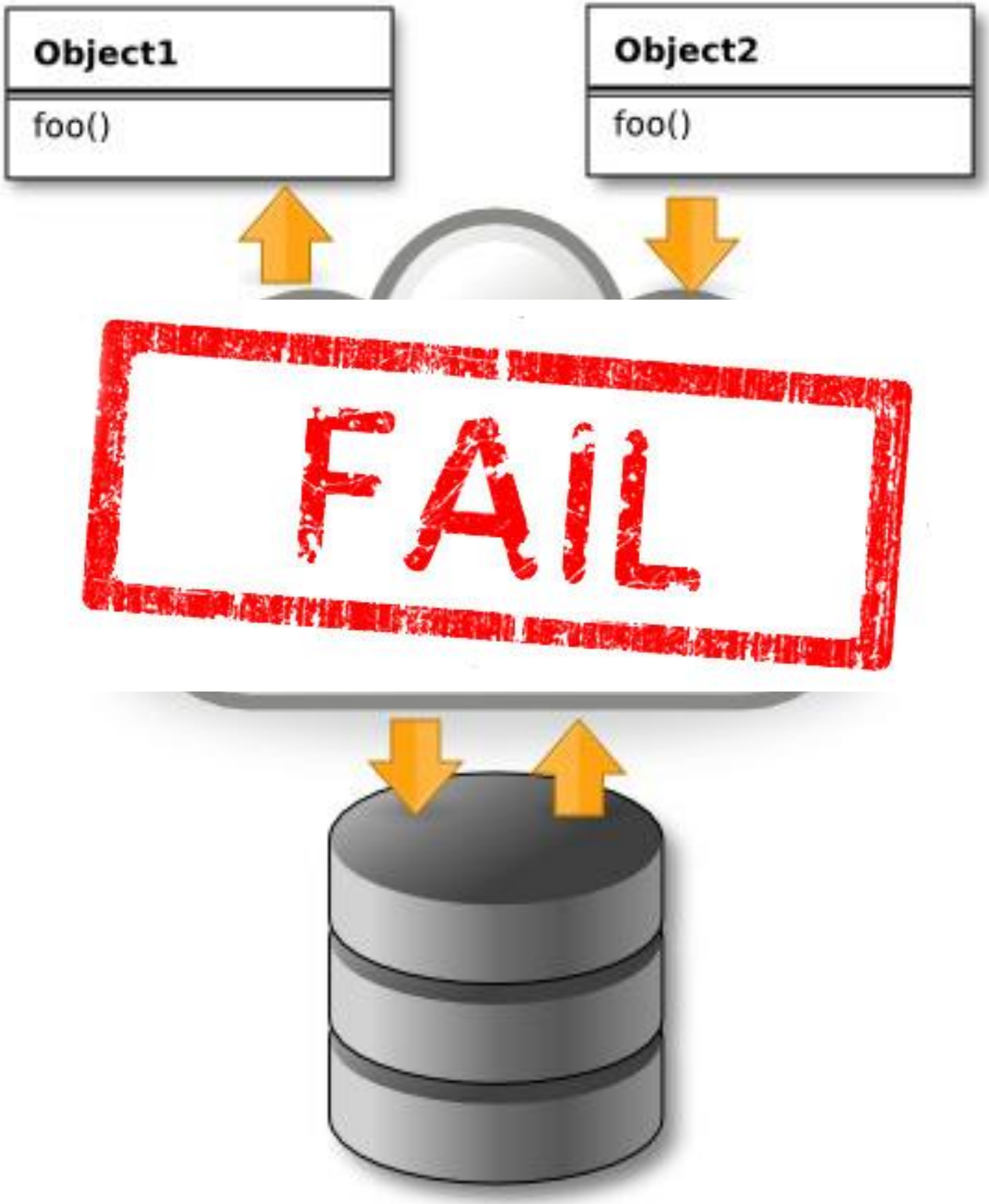
Search

Diff

Time is not

Returnable...


Object1
foo()
Object2
foo()
ORM


Object1
foo()
Object2
foo()
FAIL

Set Theory Rocks!

Databases are very powerful!

Immutable Data Rocks!

JDBC Drivers Suck!!!

Stream Processing Rocks!

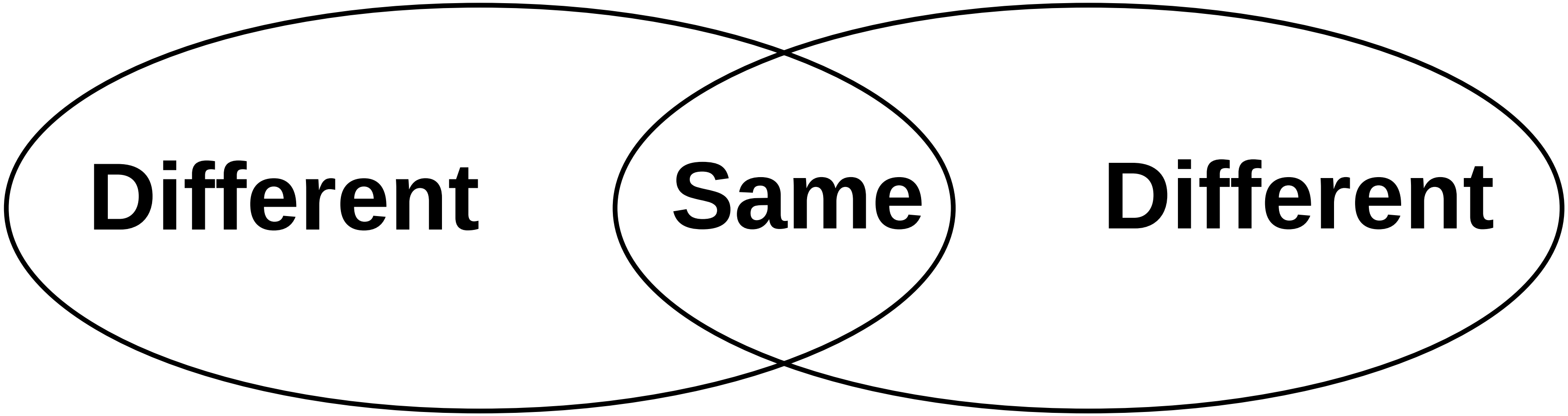
```
public void characters(char[] ch,
                       int start,
                       int length)
    throws SAXException
```

```
public void characters(char[] ch,
                       int start,
                       int length)
    throws SAXException

public void startElement(String uri,
                         String localName,
                         String qName,
                         Attributes atts)
    throws SAXException
```

```
public String[] split(String regex)
public String[] split(String regex)

public Iterable<String> split(String regex)
public String[] split(String regex)

public Iterable<String> split(String regex)

public void split(String regex,
                  Collection<String> dst)
```

Modelling

Design Paradigms



Different

Same

Different

Transaction Processing Era

betfair

sports casino poker

LMAX™

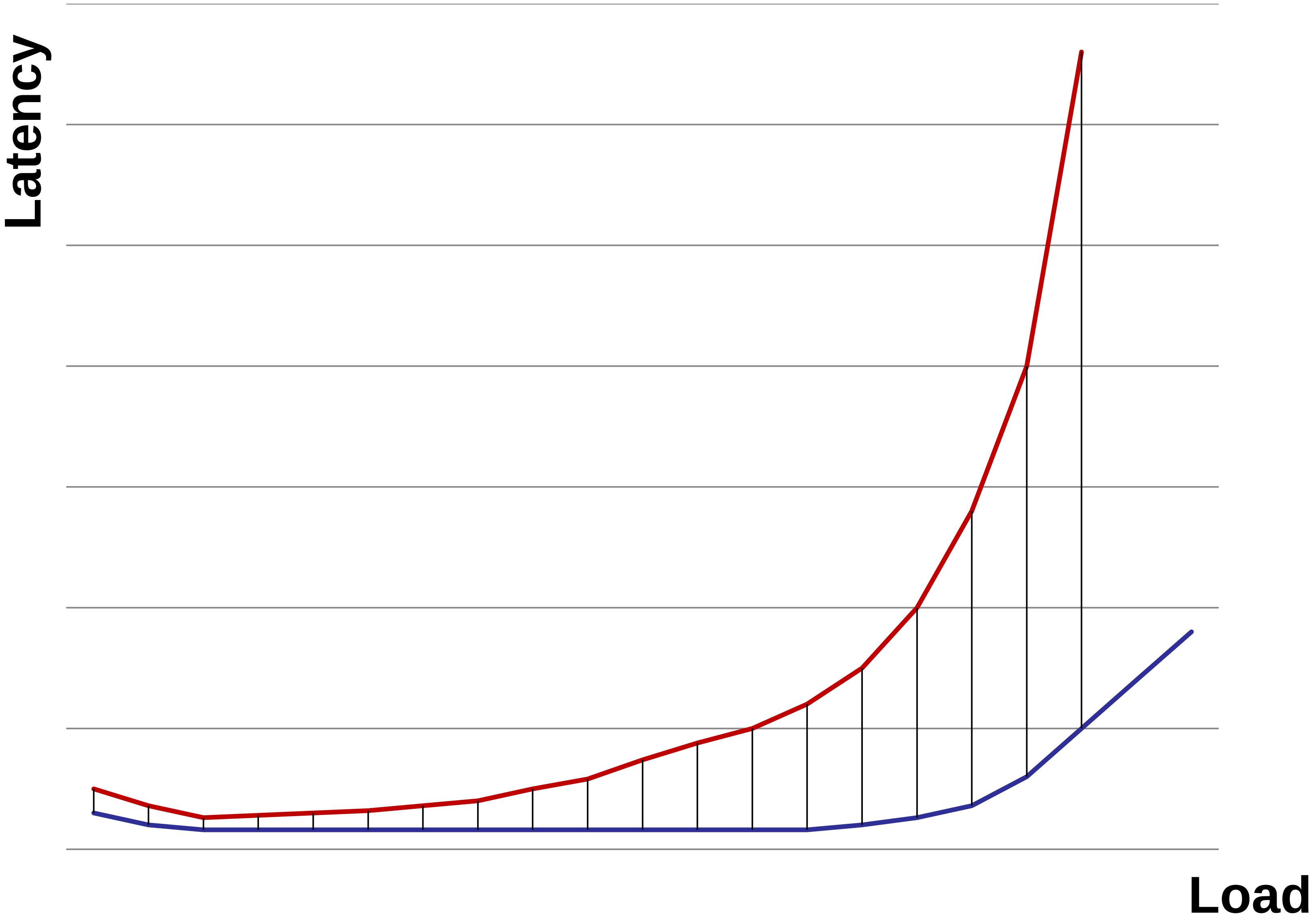
EXCHANGE

Synchronous designs are seriously limited

Staged Event Driven Architecture

The importance of Latency

Latency given Throughput



The issues with Concurrency

The Disruptor

The value of Determinism

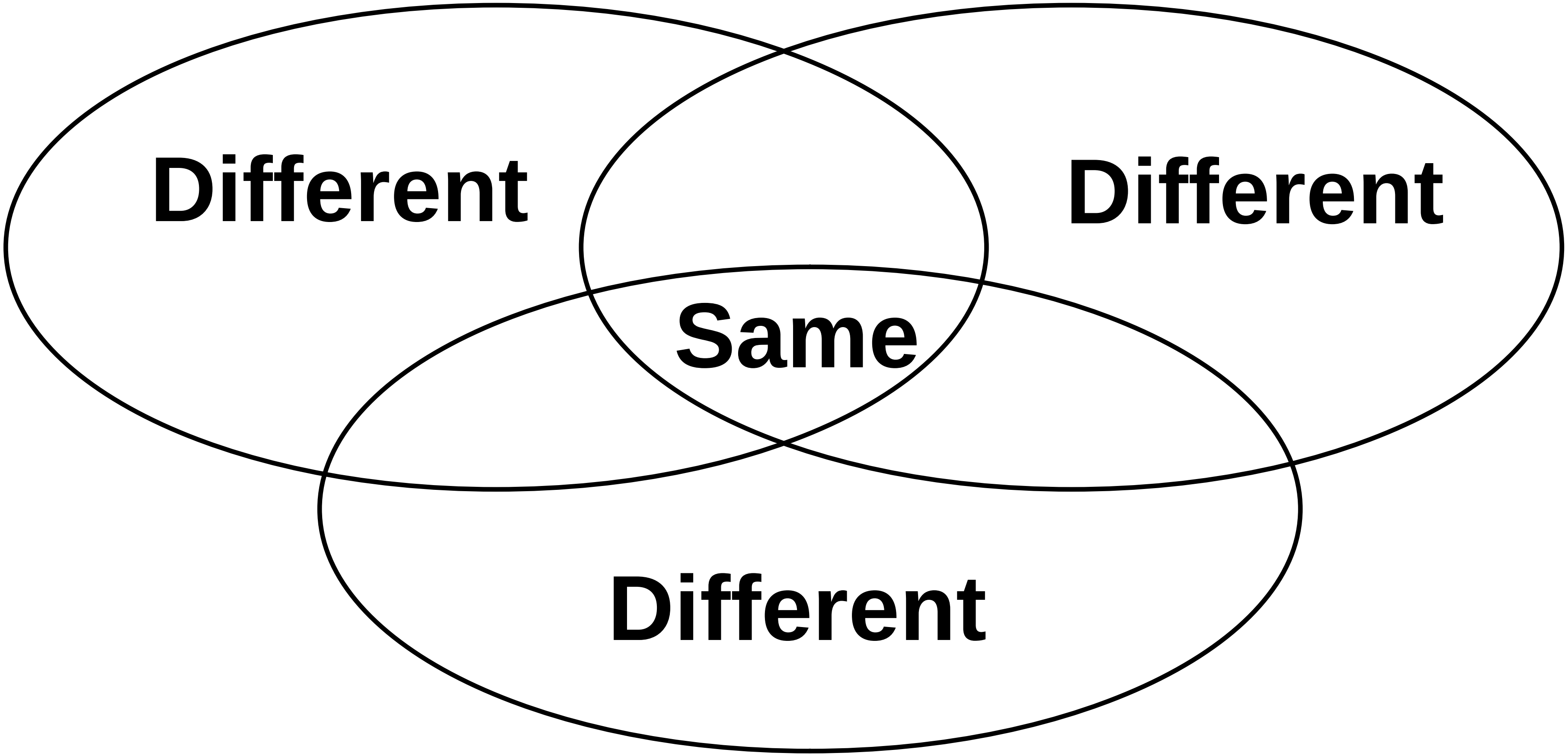
The value of pure Functions

...which are often just transforms

...it’s all about the data structures

Modelling

Design Paradigms



Different

Different

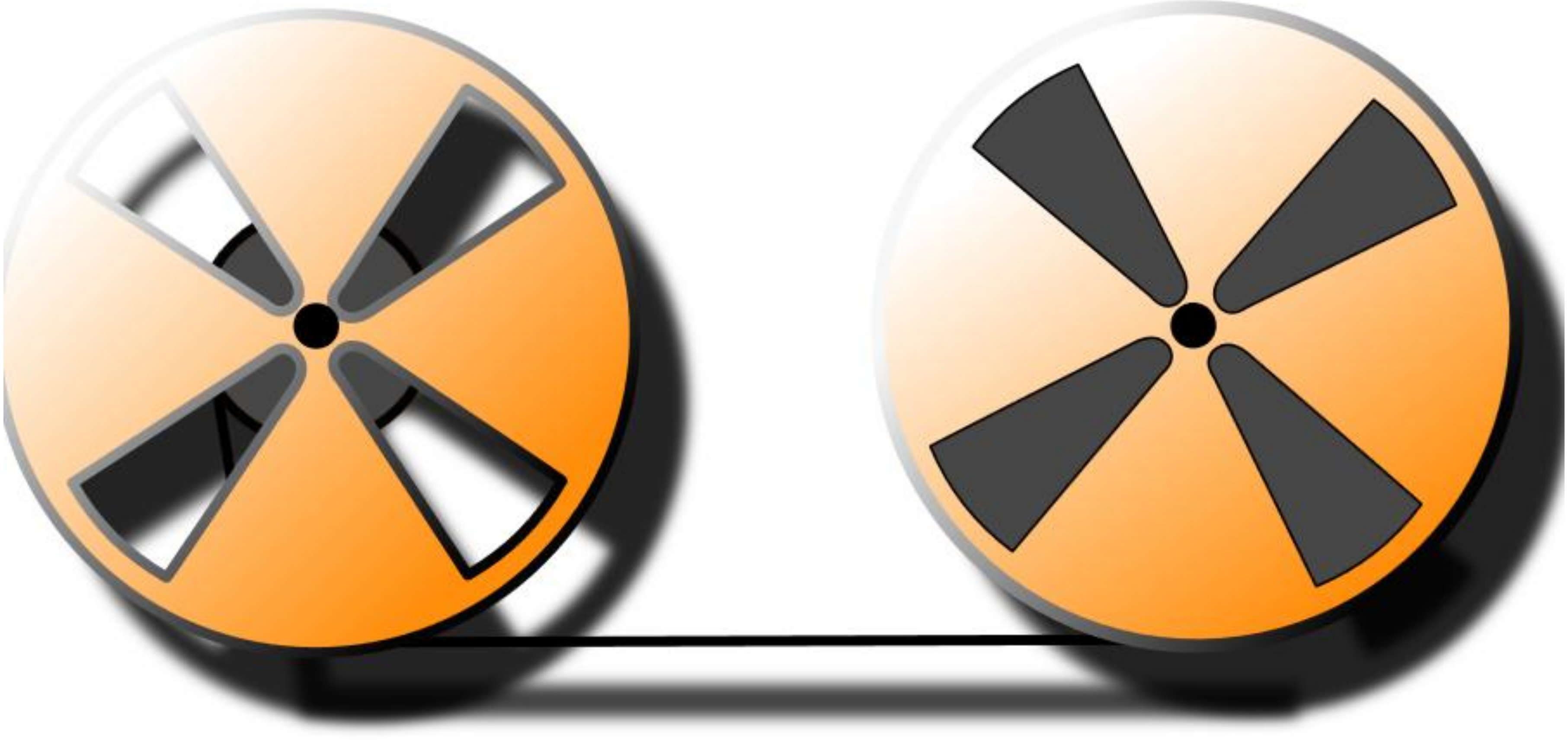
Same

Different

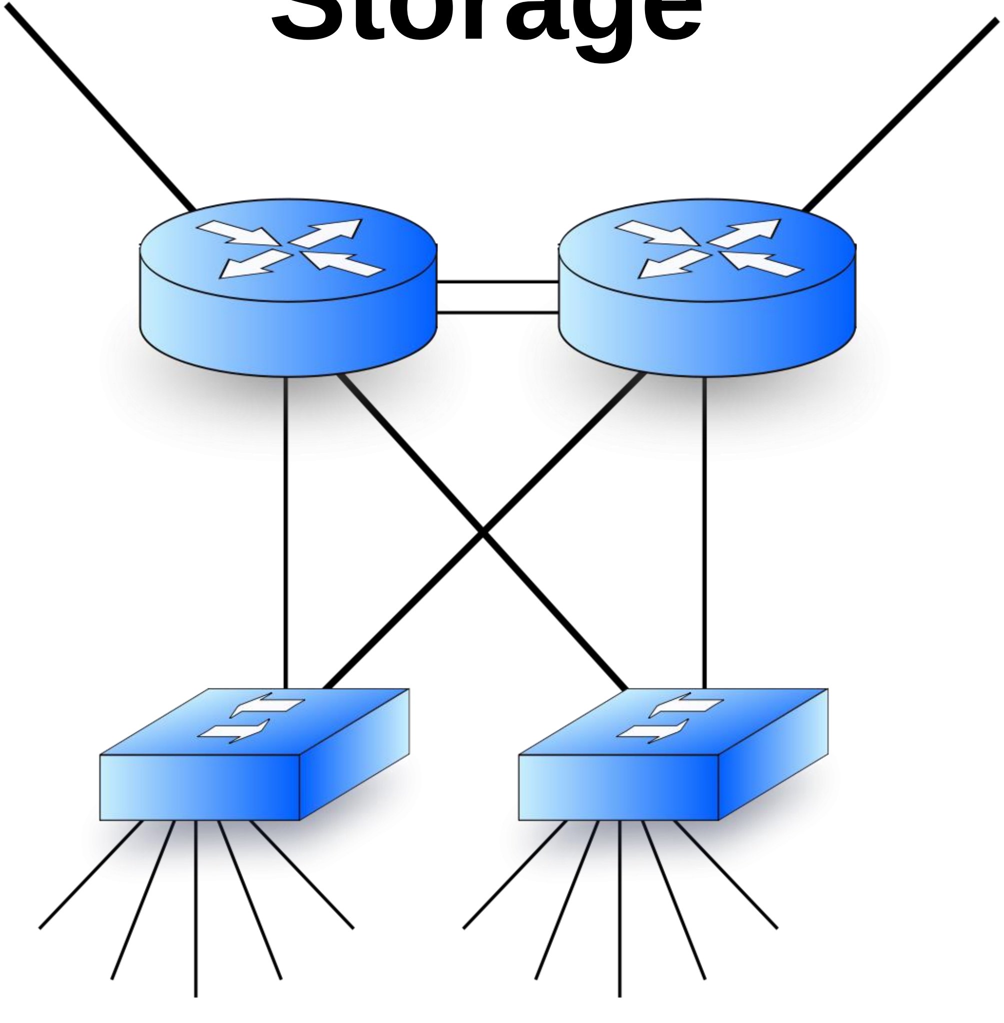
3.
Evolving Hardware Platform

Mechanical Sympathy

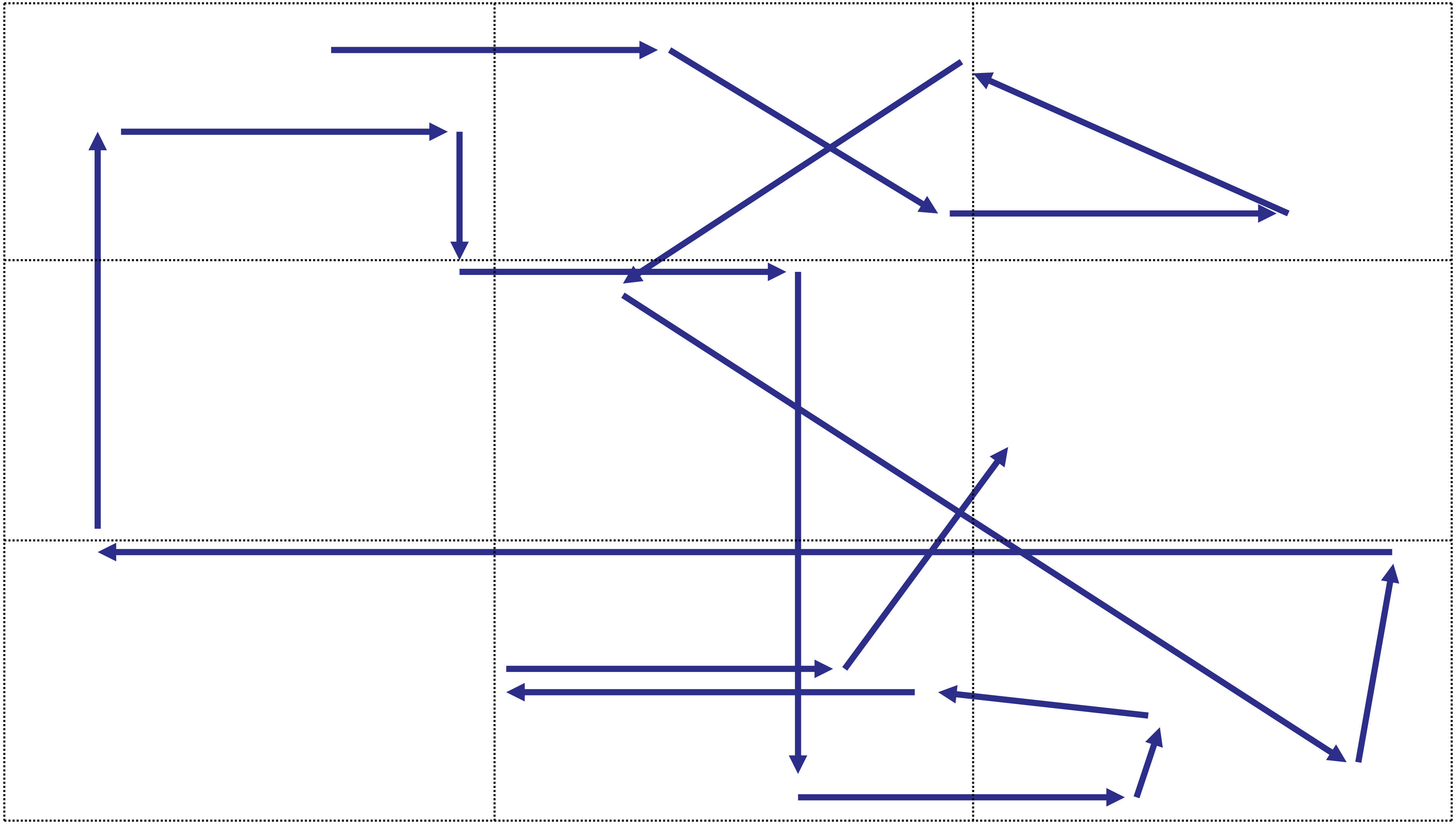
All Storage is Tape



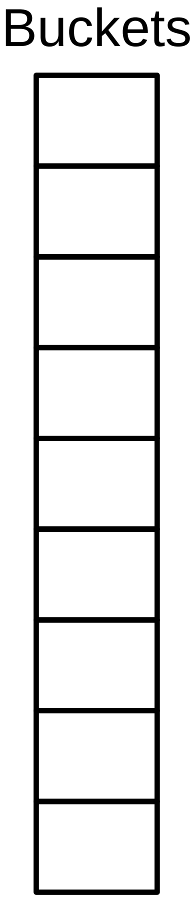
Networks are faster than Storage

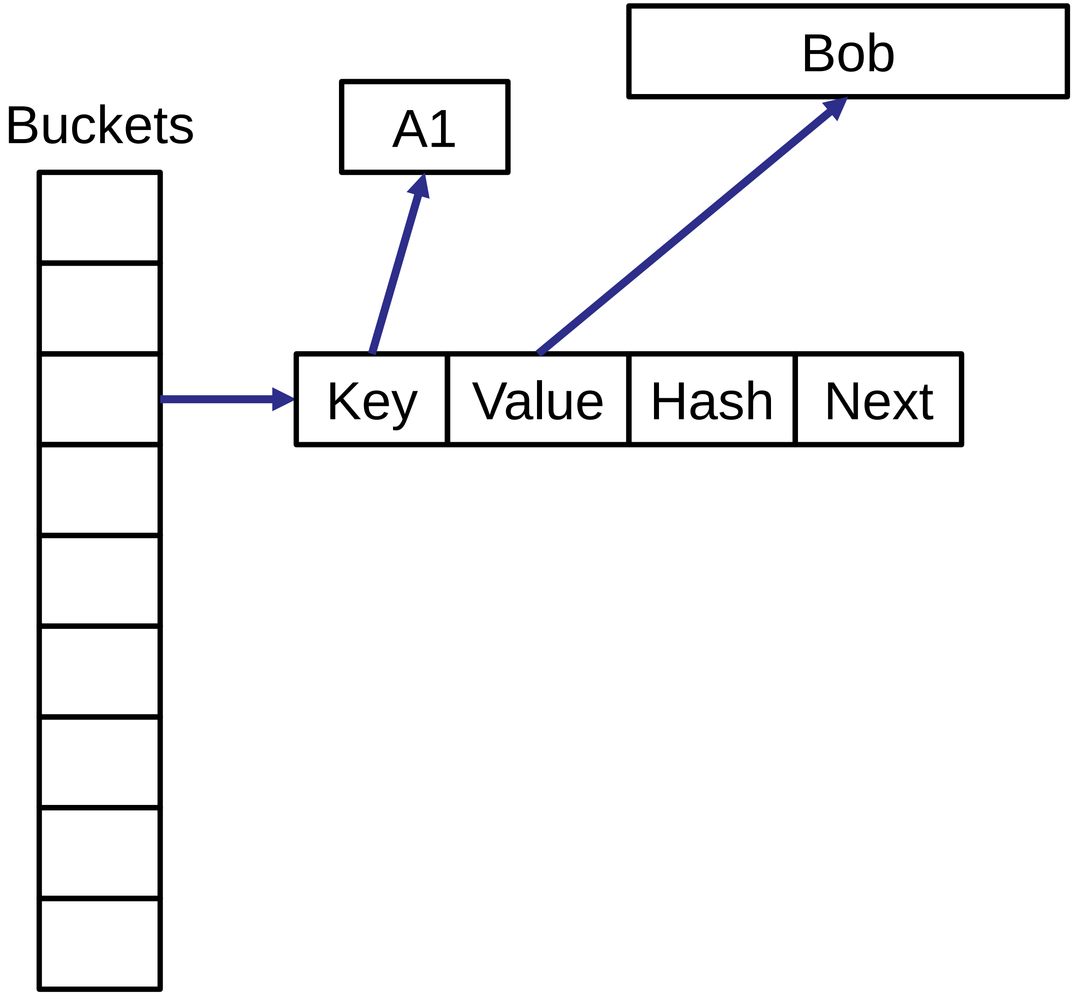


Memory Access Patterns Matter



What if you could build a HashMap with reified generics and arrays of structures?


Buckets



Buckets

A1

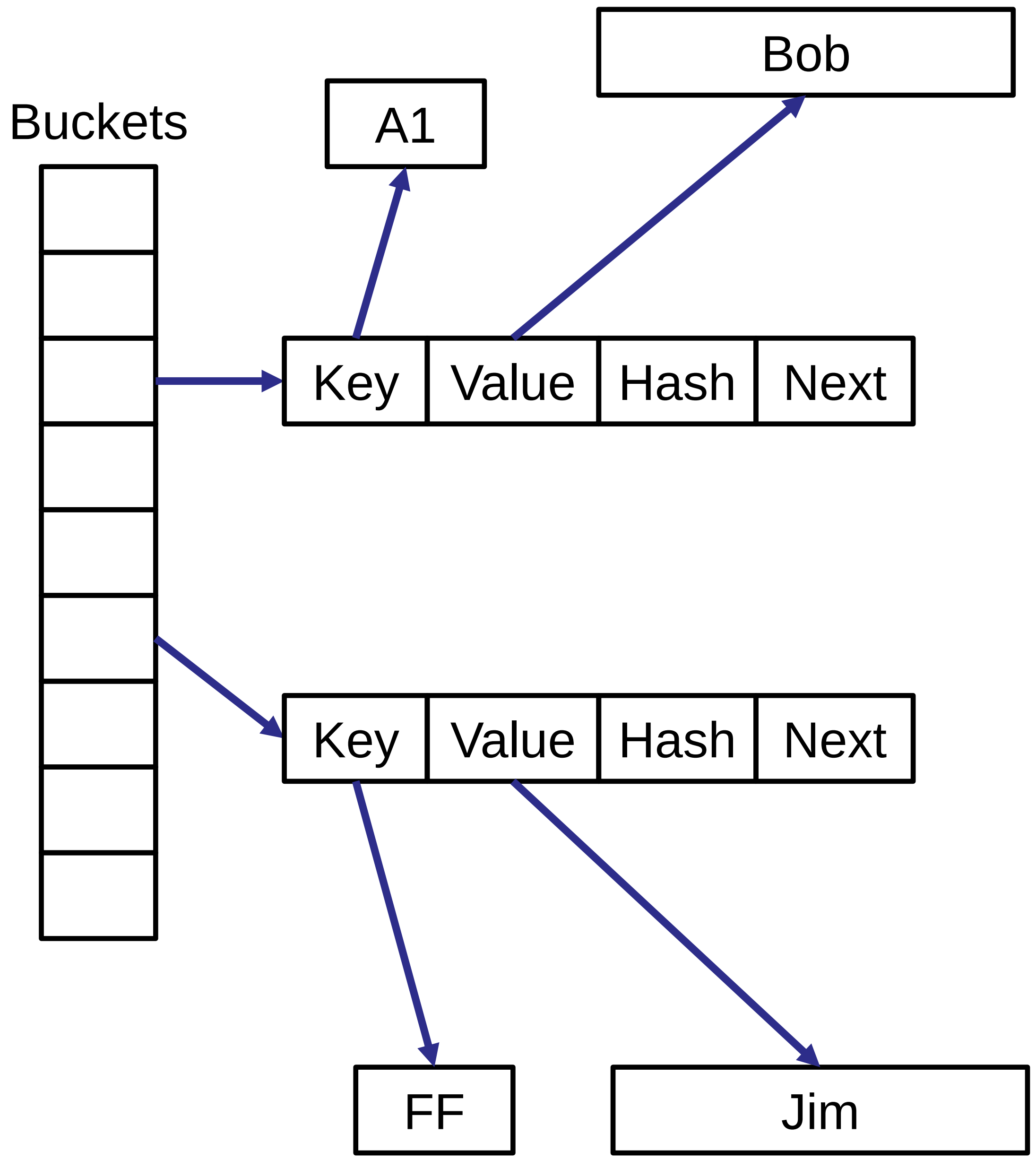
Bob

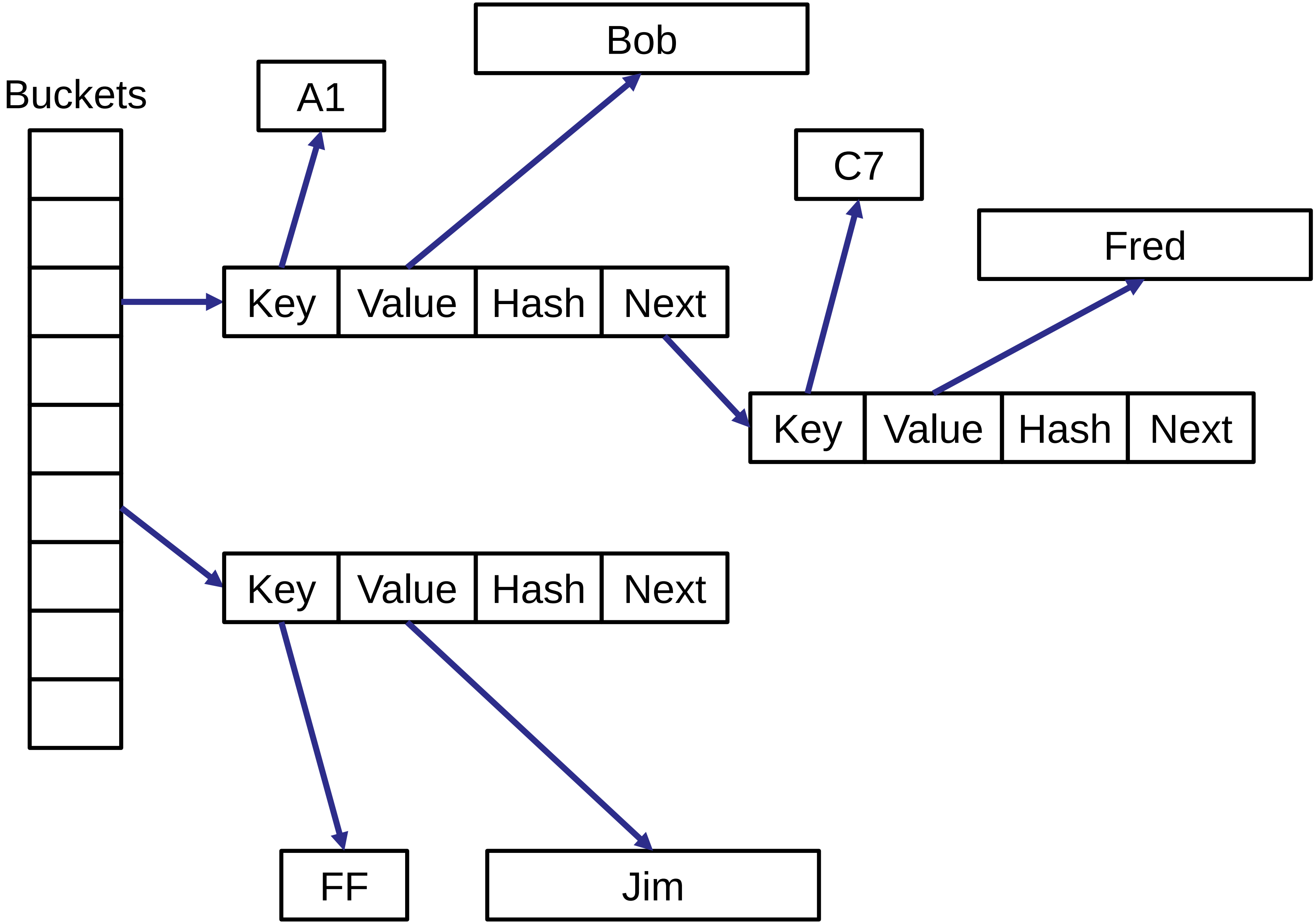
Key

Value

Hash

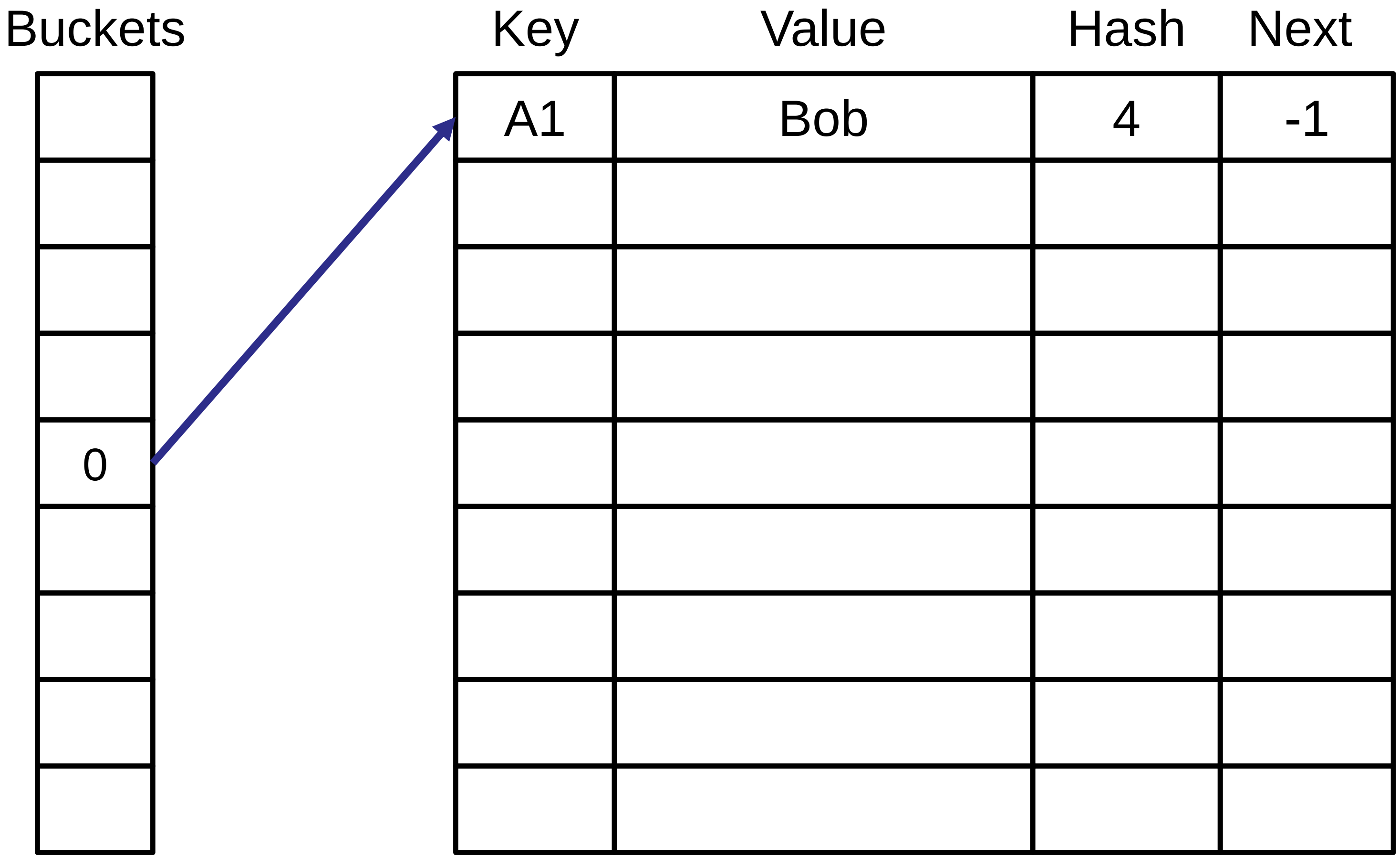
Next

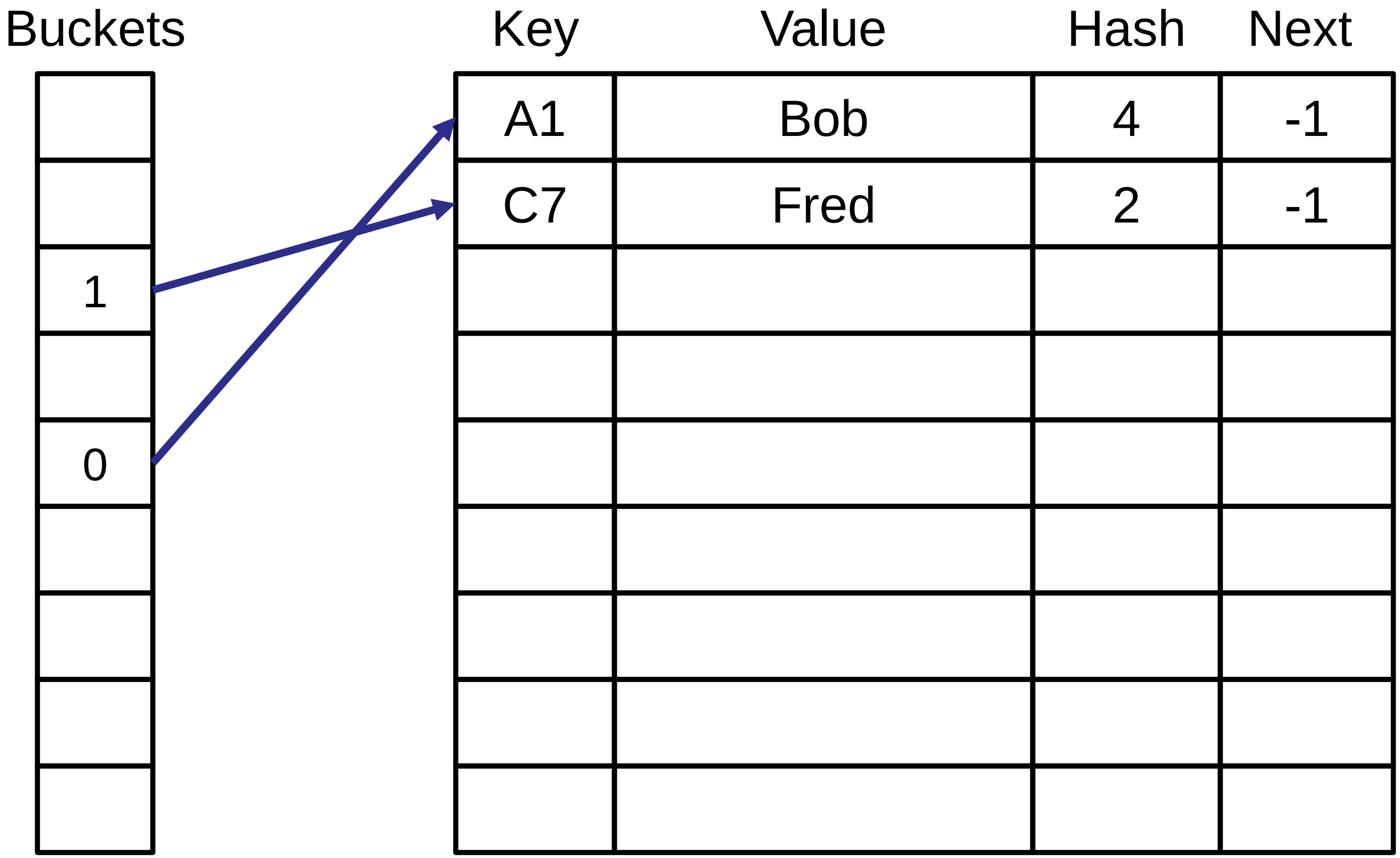

Bob
A1
Buckets
Key
Value
Hash
Next
Key
Value
Hash
Next
FF
Jim


Buckets
A1
Bob
C7
Fred
Key
Value
Hash
Next
Key
Value
Hash
Next
Key
Value
Hash
Next
FF
Jim

Buckets

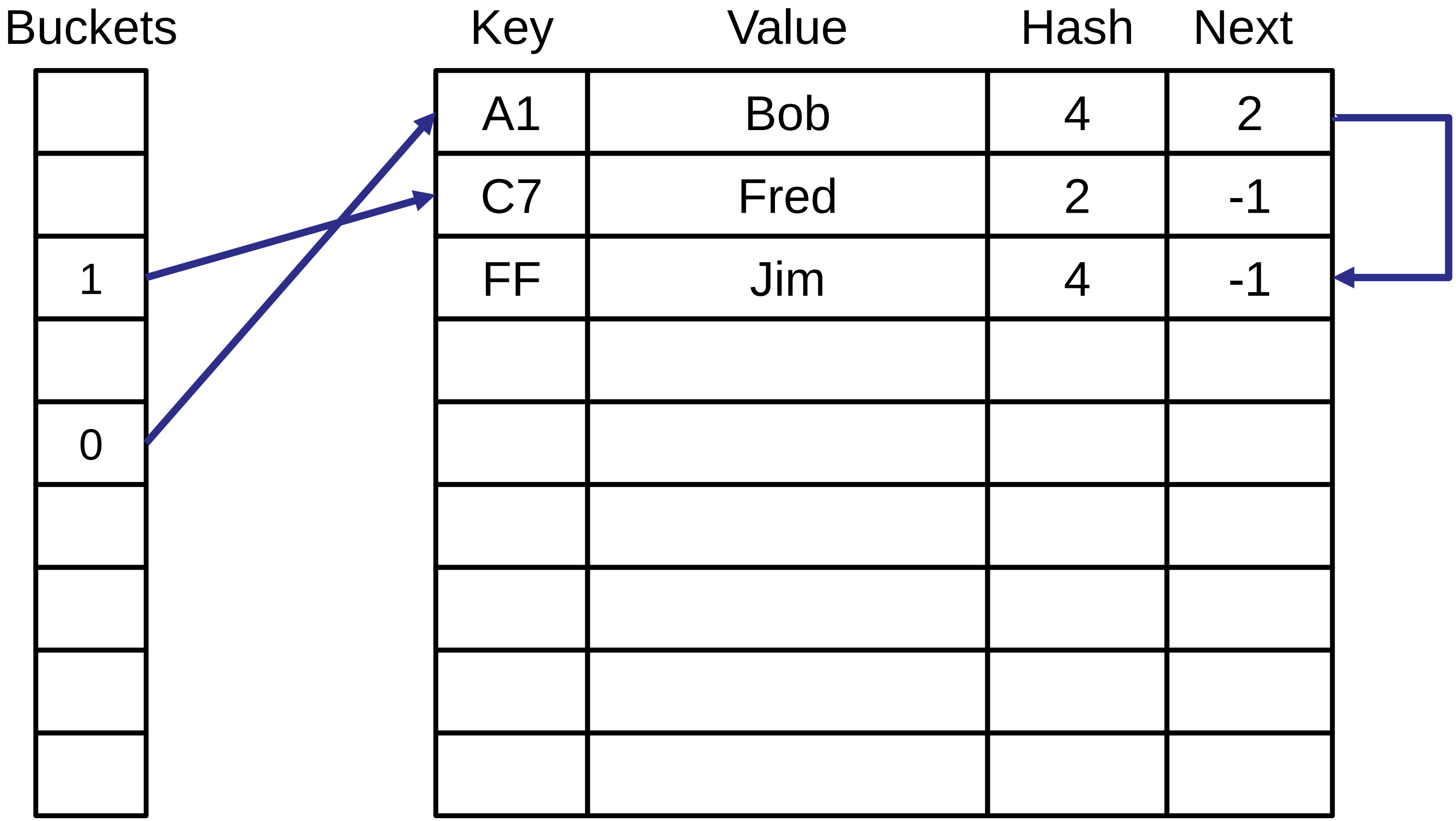
Key	Value	Hash	Next


Buckets
0
Key
Value
Hash
Next
A1
Bob
4
-1



Buckets
1
0

Key	Value	Hash	Next
A1	Bob	4	-1
C7	Fred	2	-1



Key	Value	Hash	Next
A1	Bob	4	2
C7	Fred	2	-1
FF	Jim	4	-1

.NET Dictionary is 10X faster than HashMap for 2GB of data

Value Types (Arrays 2.0^{64})

ObjectLayout

PackedObjects

Amdahl’s Law

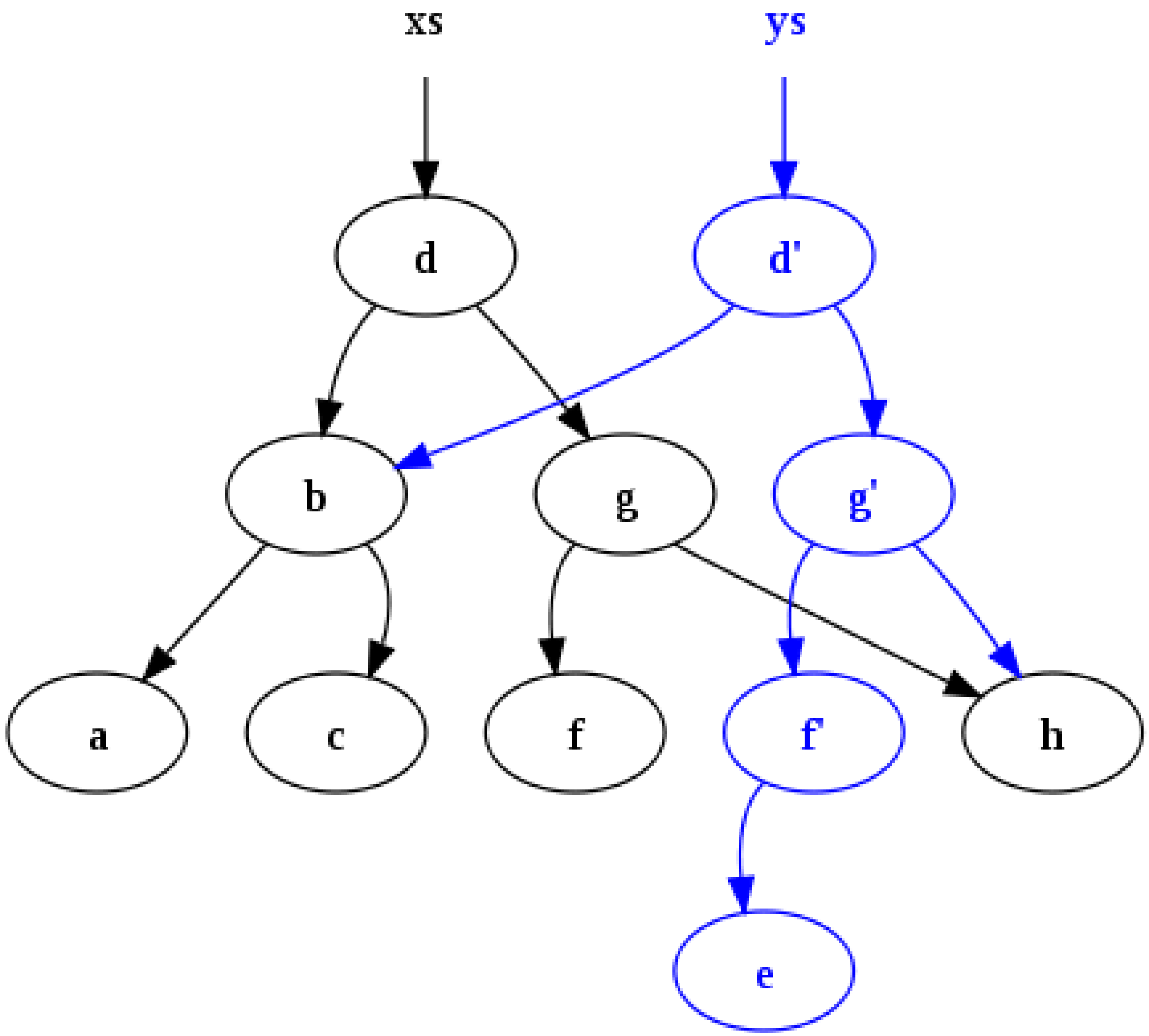
© http://mofarahrunningawayfromthings.tumblr.com

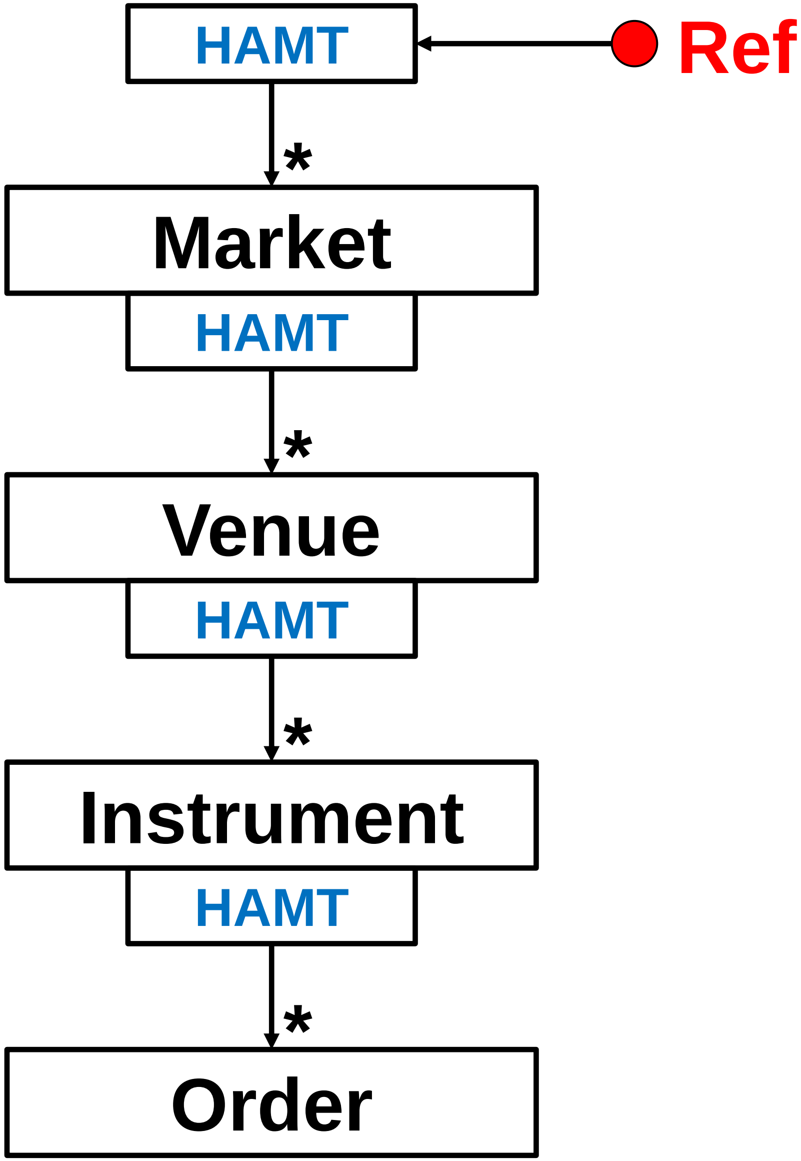
Concurrent Garbage?

Stop The World GC

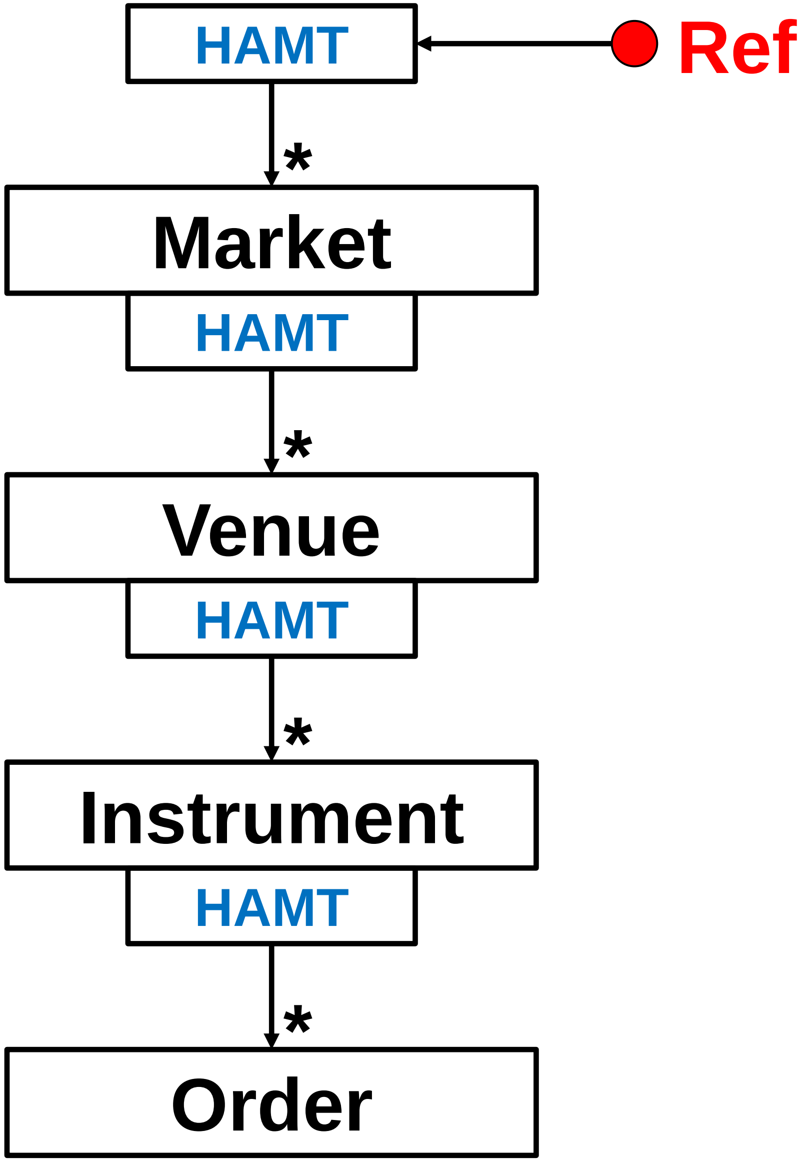
Safepoints!!!

Persistent Data Structures




HAMT
Ref
*
Market
HAMT
*
Venue
HAMT
*
Instrument
HAMT
*
Order

<< CAS Failure? >>



Ref

HAMT

*

Market

HAMT

*

Venue

HAMT

*

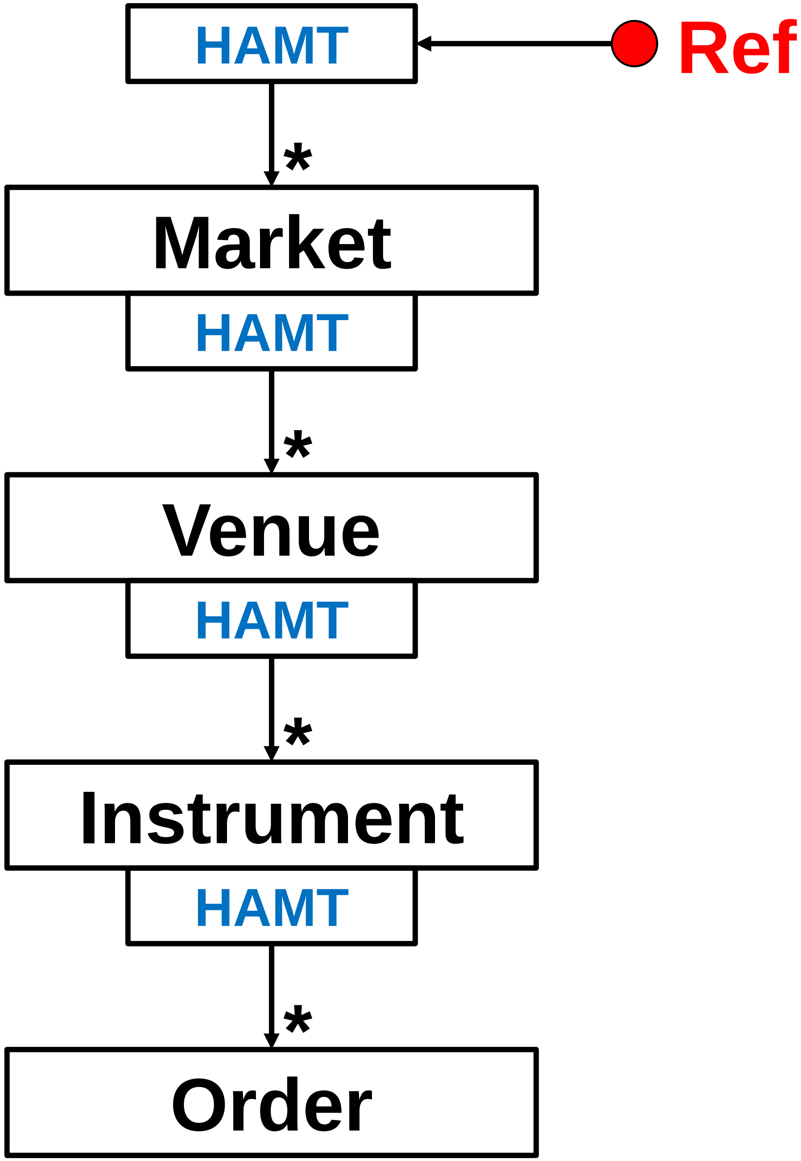
Instrument

HAMT

*

Order

<< CAS Failure? >>



HAMT

Ref

*

Market

HAMT

*

Venue

HAMT

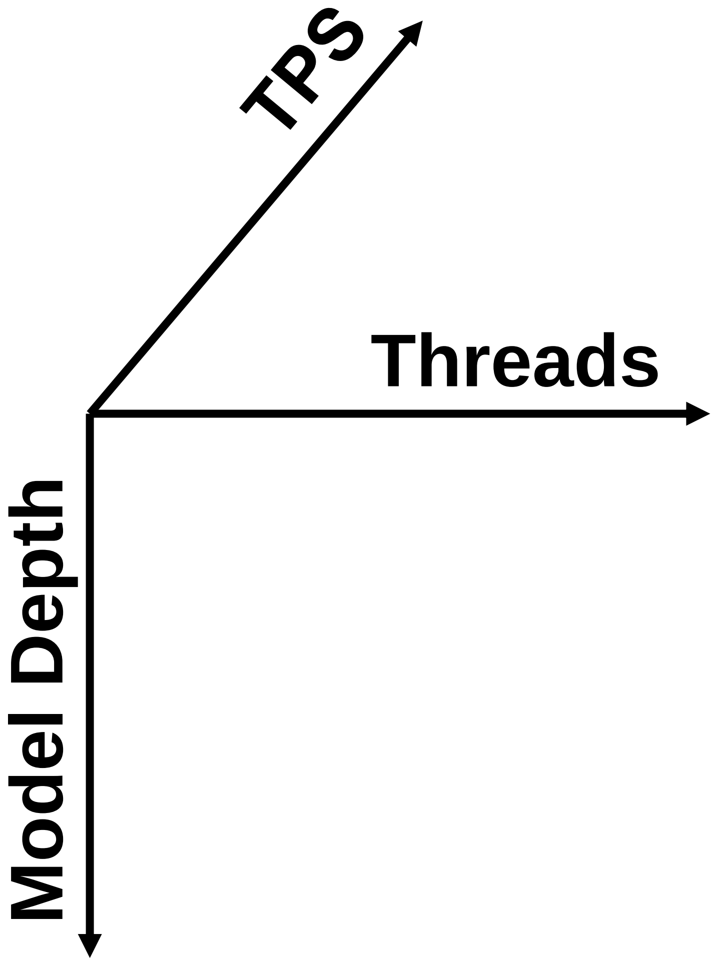
*

Instrument

HAMT

*

Order

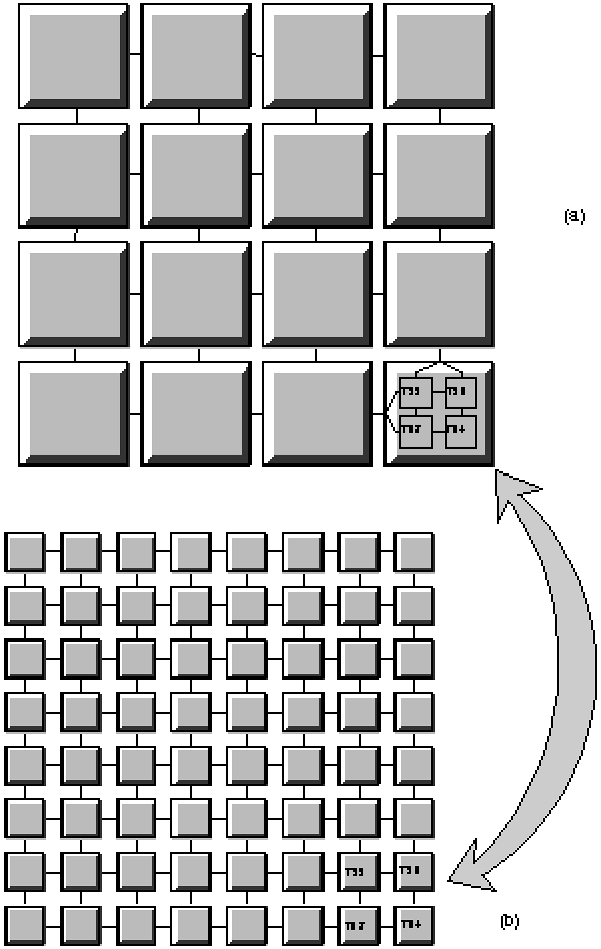


TPS

Threads

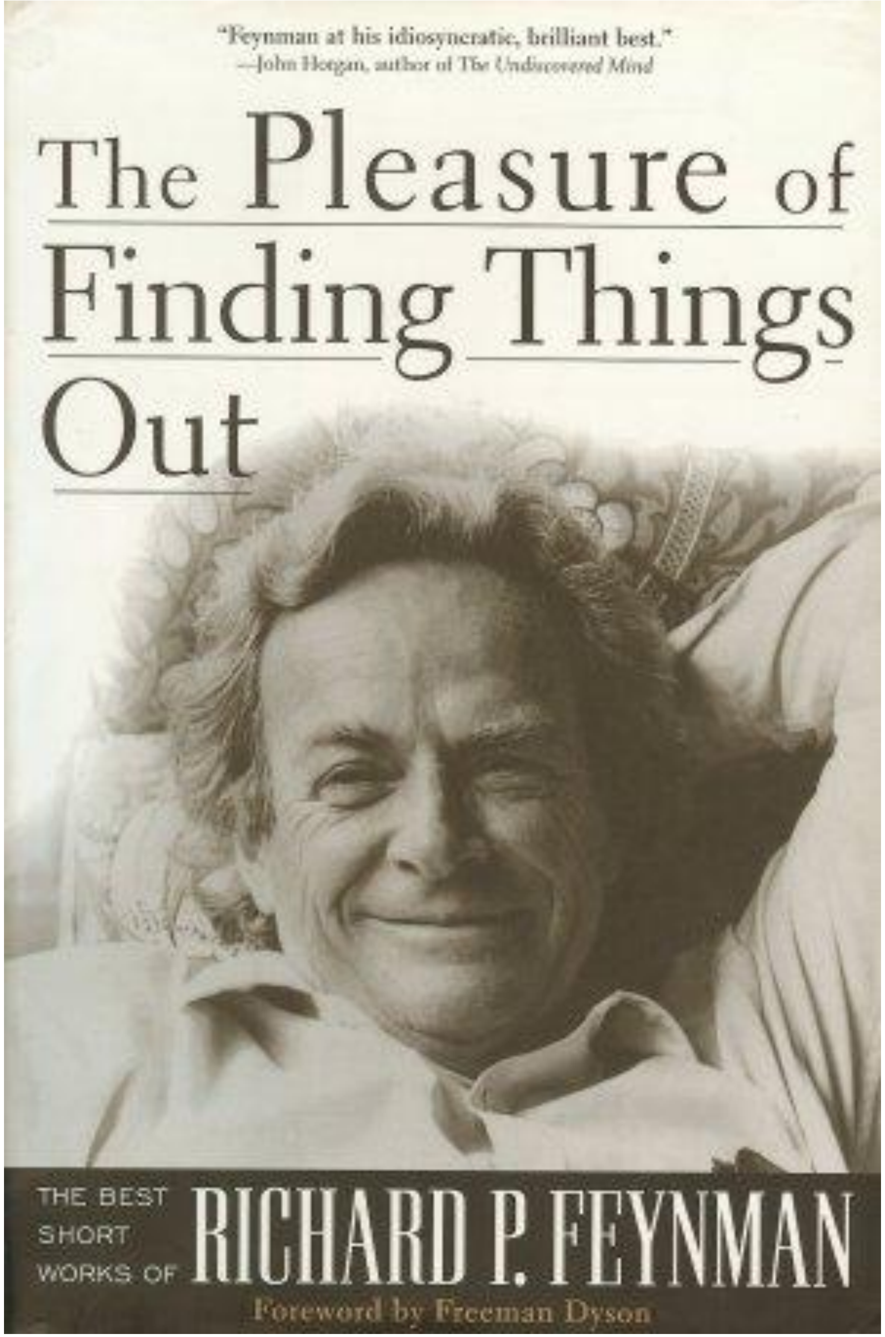
Model Depth

Shared Nothing to Scale



Think Transputers but with message passing via SHM

4.
Changes in Culture



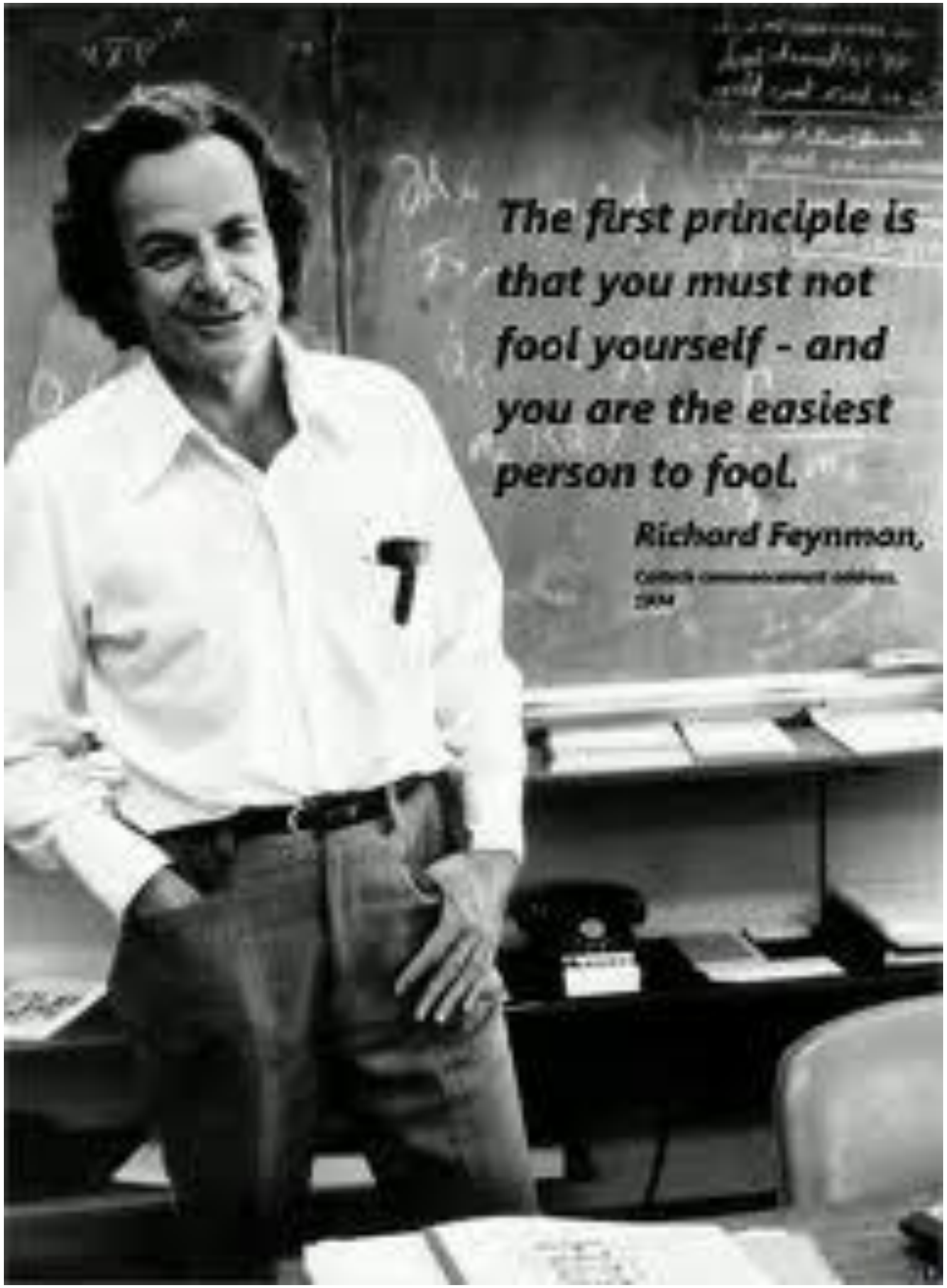
"Feynman at his idiosyncratic, brilliant best."
—John Horgan, author of *The Undiscovered Mind*

The Pleasure of Finding Things Out

THE BEST SHORT WORKS OF RICHARD P. FEYNMAN

Foreword by Freeman Dyson

Measure Everything


The first principle is that you must not fool yourself - and you are the easiest person to fool.
Richard Feynman,
Caltech commencement address, 1974

Continuous Profiling

What have I learned that is really important?

Research

Experiment

Collaborate

Questions?

Blog: http://mechanical-sympathy.blogspot.com/

Twitter: @mjpt777

***"It does not matter how intelligent you are,
if you guess and that guess cannot be backed
up by experimental evidence -
then it is still a guess."***

- Richard Feynman