The Why of Go v2

Brave New World Edition

GOTO Copenhagen 2018

Carmen Andoh

@carmatrocity

Bryan Cantrill
@bcantrill

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How about a conference called "In Retrospect" in which presenters revisit talks they've given years prior -- and describe how their thinking has evolved since?

10:01 PM - 28 Jun 2018

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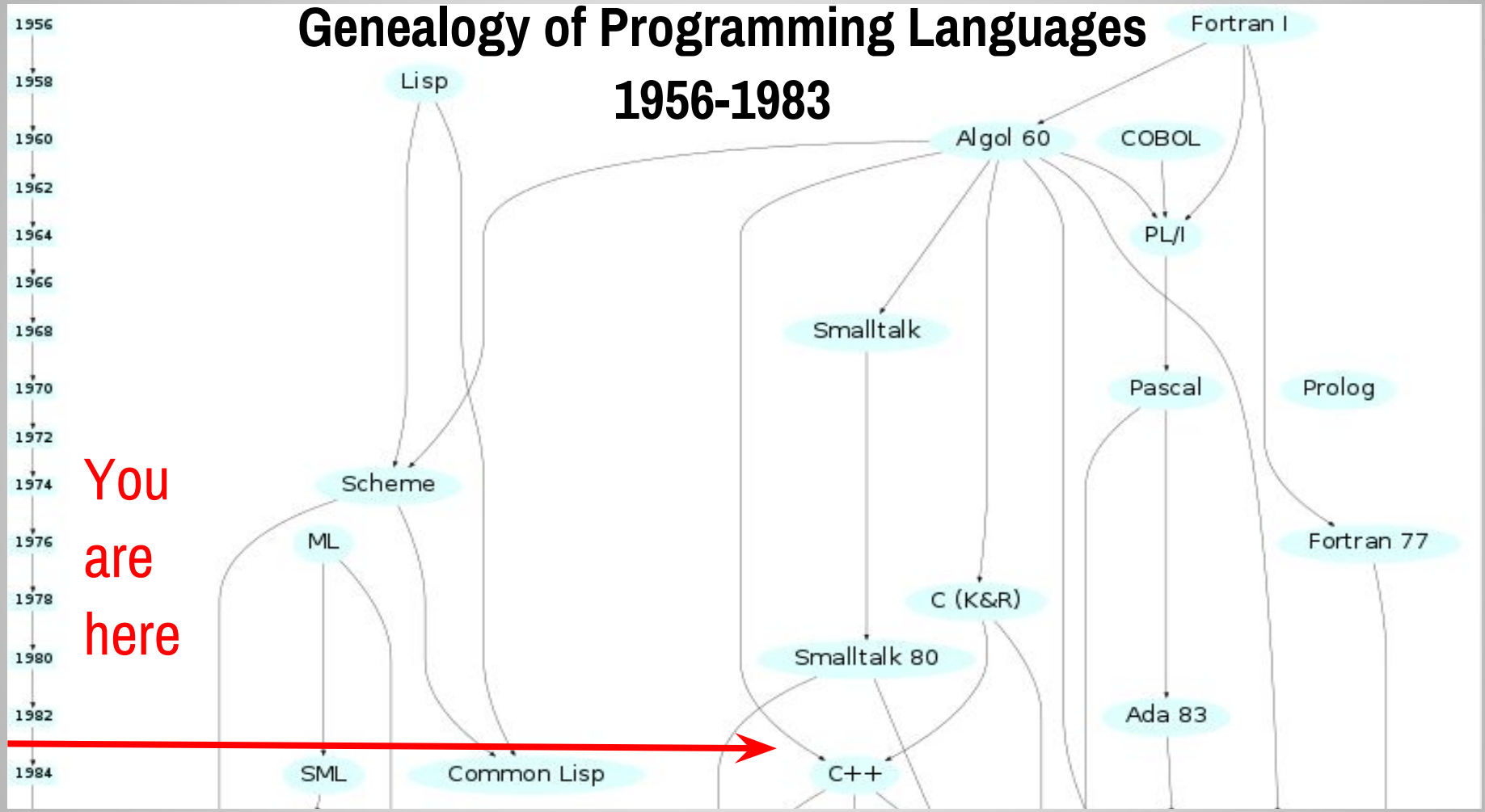
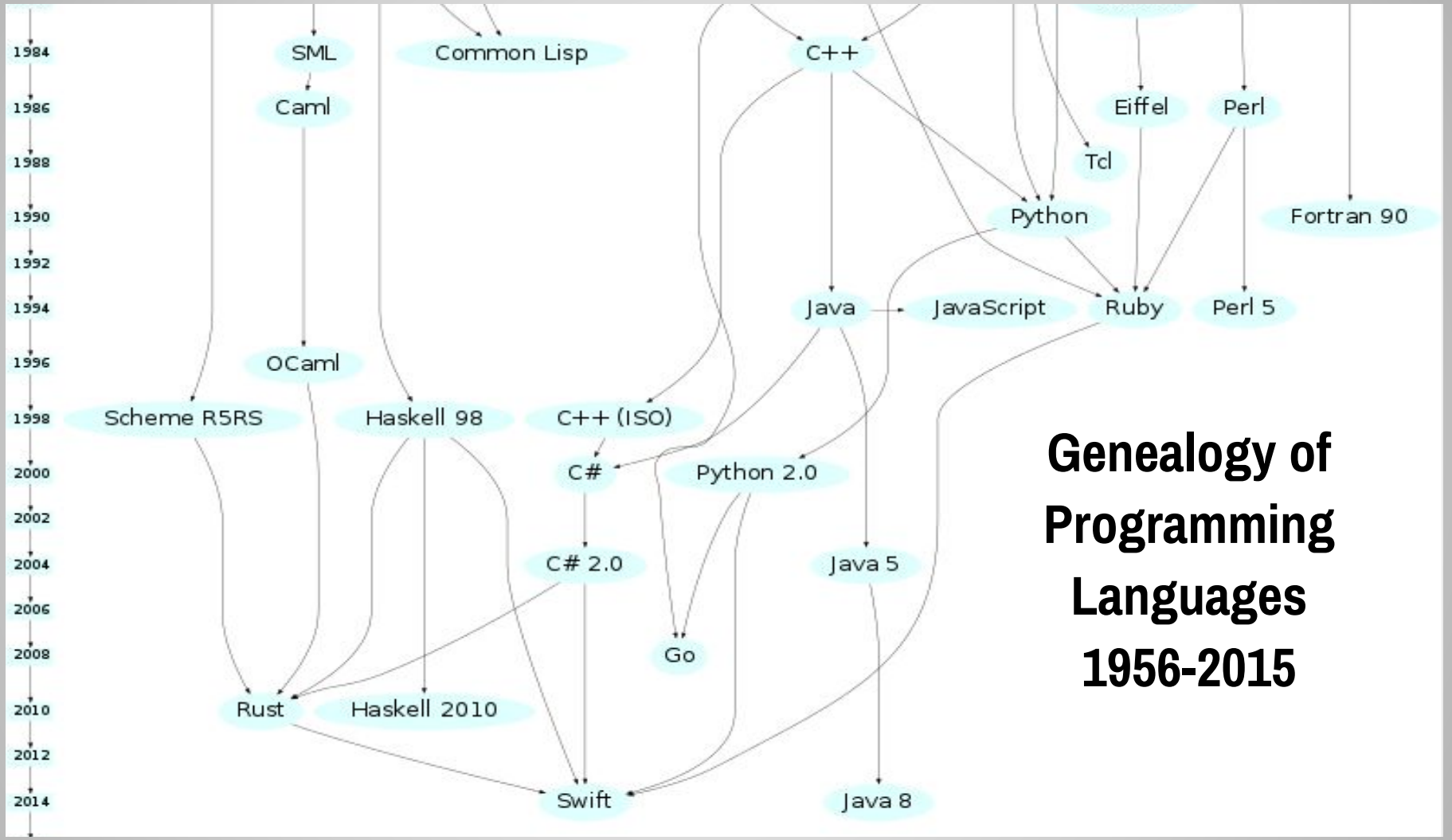
145 1.0K 5.7K

“Imagine you are a software engineer from the year 1983 who happened upon a time machine and traveled to today.”

(80s Dolorian time machines are the raddest time machines)

Genealogy of Programming Languages 1956-1983

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Python
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Java
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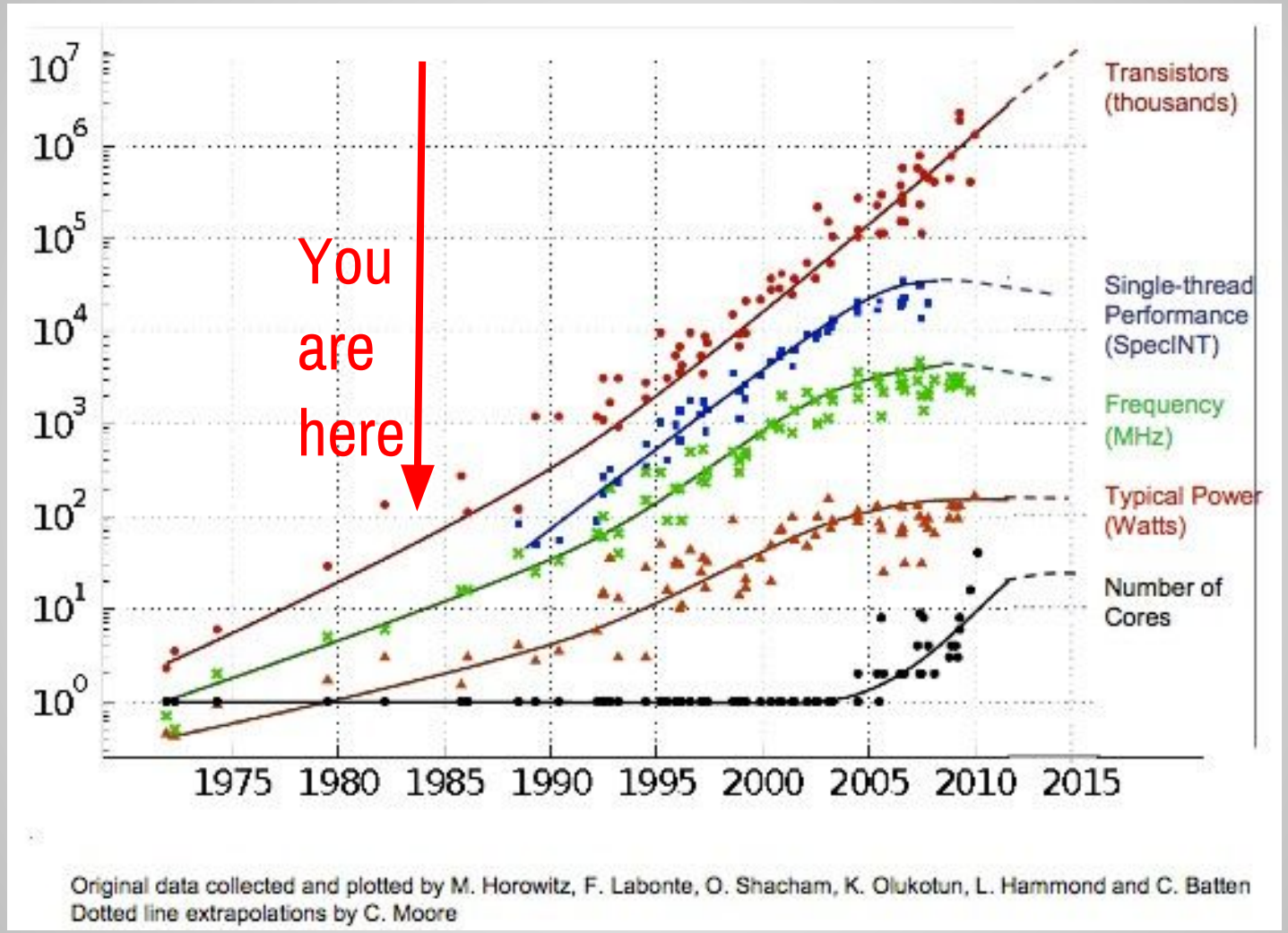
Ruby
Perl 5
OCaml
Scheme R5RS
Haskell 98
C++ (ISO)
C#
Python 2.0
C# 2.0
Java 5
Go
Rust
Haskell 2010
Swift
Java 8
Genealogy of Programming Languages 1956-2015


You are here
Transistors (thousands)
Single-thread Performance (SpecINT)
Frequency (MHz)
Typical Power (Watts)
Number of Cores
10^7
10^6
10^5
10^4
10^3
10^2
10^1
10^0
1975 1980 1985 1990 1995 2000 2005 2010 2015
Original data collected and plotted by M. Horowitz, F. Labonte, O. Shacham, K. Olukotun, L. Hammond and C. Batten
Dotted line extrapolations by C. Moore

Unix®

Operating System

Programming Techniques

S. L. Graham, R. L. Rivest Editors

Communicating Sequential Processes

C.A.R. Hoare
The Queen's University
Belfast, Northern Ireland

This paper suggests that input and output are basic primitives of programming and that parallel composition of communicating sequential processes is a fundamental program structuring method. When combined with a development of Dijkstra's guarded command, these concepts are surprisingly versatile. Their use is illustrated by sample solutions of a variety of familiar programming exercises.

Key Words and Phrases: programming, programming languages, programming primitives, program structures, parallel programming, concurrency, input, output, guarded commands, nondeterminacy, coroutines, procedures, multiple entries, multiple exits, classes, data representations, recursion, conditional critical regions, monitors, iterative arrays

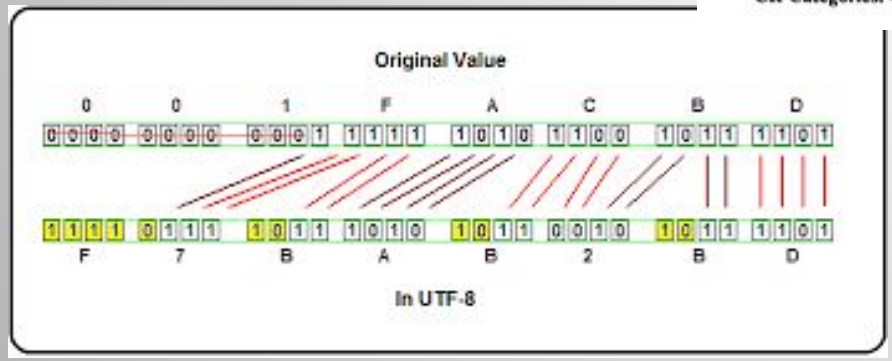
CR Categories: 4.20, 4.22, 4.32

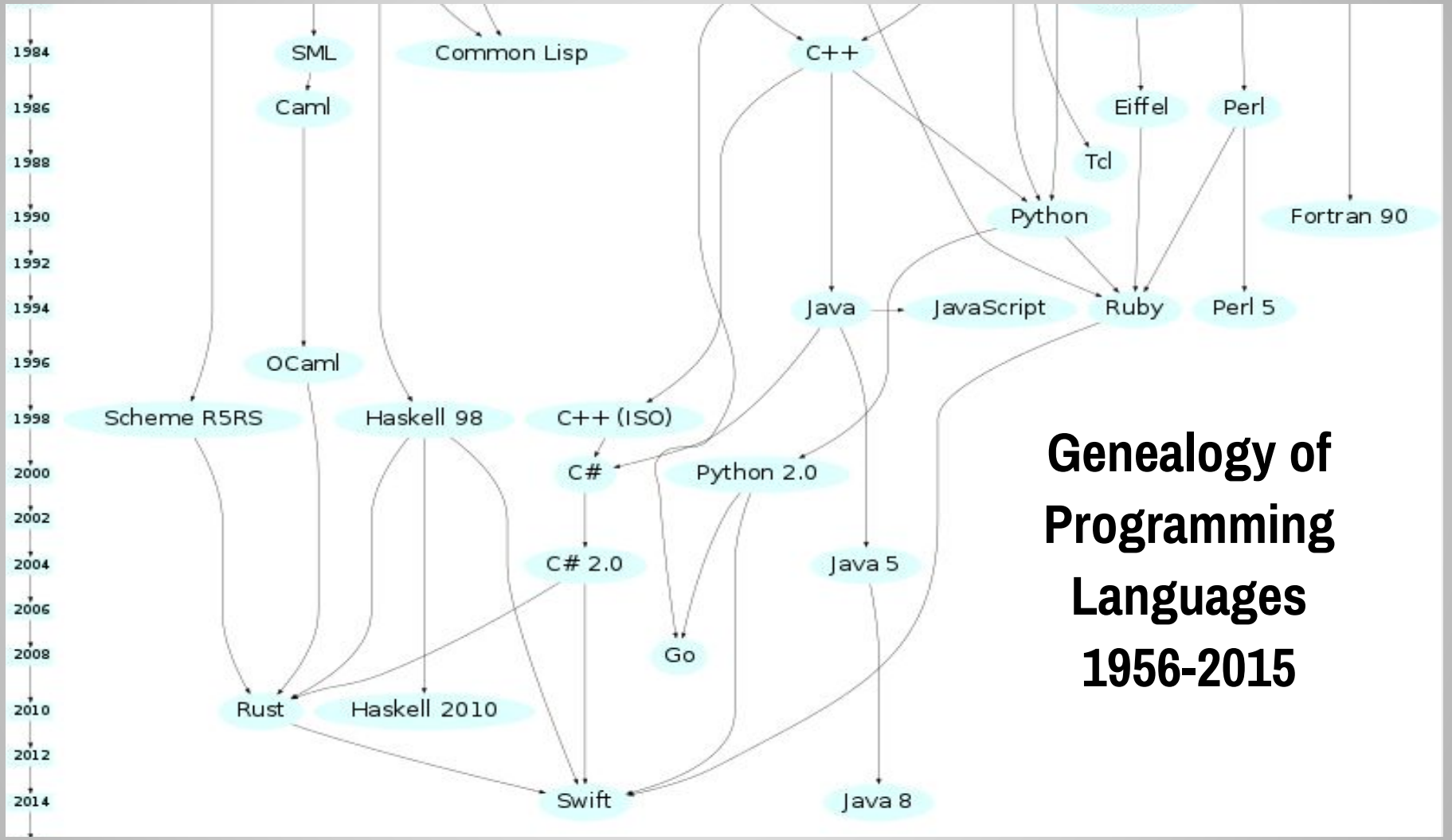
SECOND EDITION

THE C ANSI C PROGRAMMING LANGUAGE

BRIAN W. KERNIGHAN
DENNIS M. RITCHIE

PRENTICE HALL SOFTWARE SERIES

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Python
Fortran 90
Java
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Ruby
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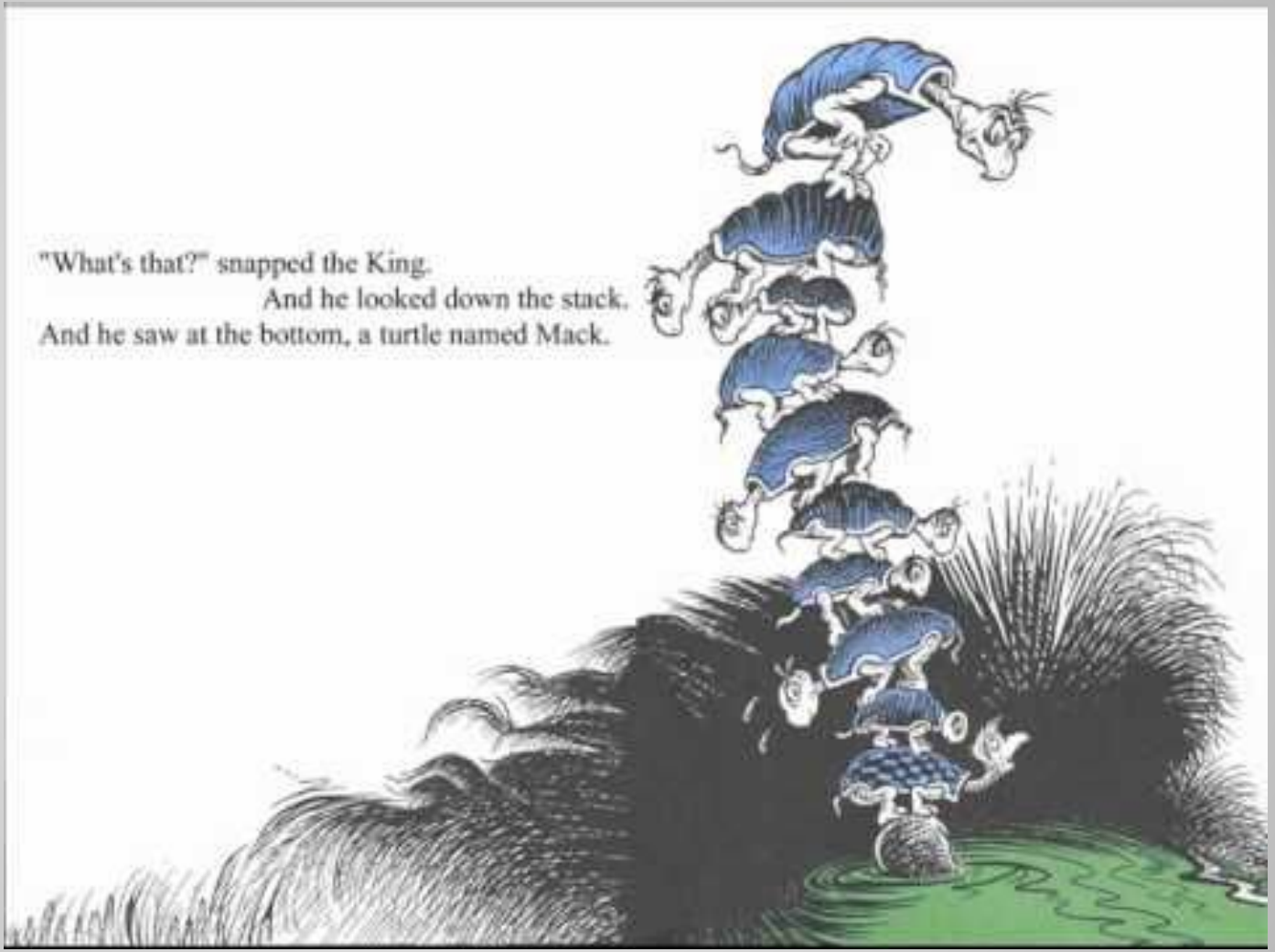
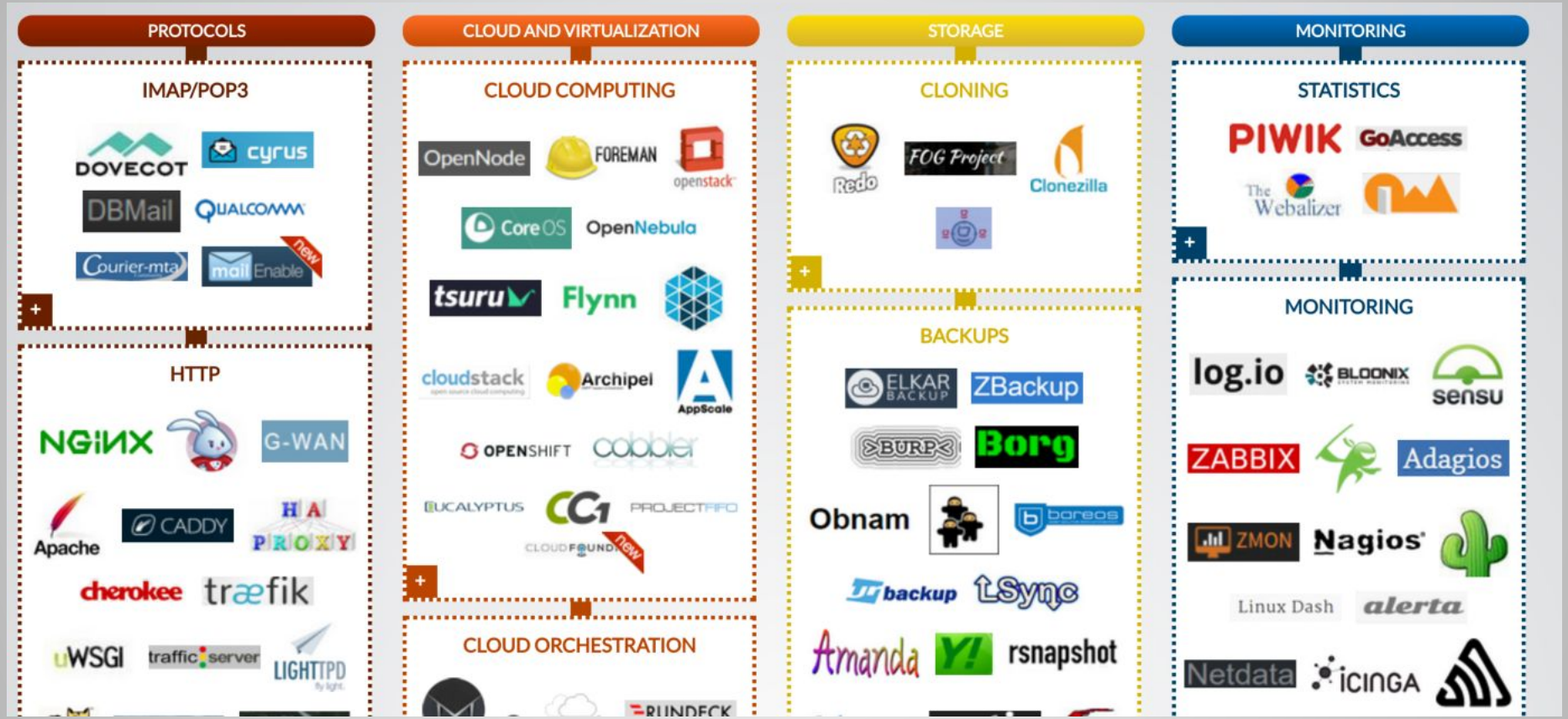
Scheme R5RS
Haskell 98
C++ (ISO)
C#
Python 2.0
C# 2.0
Java 5
Go
Rust
Haskell 2010
Swift
Java 8
Genealogy of Programming Languages 1956-2015

"What's that?" snapped the King.
And he looked down the stack.
And he saw at the bottom, a turtle named Mack.

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G-WAN
Apache
CADDY
HAPROXY
cherokee
træfik
uWSGI
traffic server
LIGHTTPD
CLOUD AND VIRTUALIZATION
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FOREMAN
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CoreOS
OpenNebula
tsuru
Flynn
cloudstack
Archipel
AppScale
OPENSHIFT
cobbler
EUCALYPTUS
CC1
PROJECTFIFO
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CLOUD ORCHESTRATION
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FOG Project
Clonezilla
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STATISTICS
PIWIK
GoAccess
The Webalizer
+
MONITORING
log.io
BLOONIX
sensu
ZABBIX
Adagios
ZMON
Nagios
Linux Dash
alerta
Netdata
ICINGA


PROTOCOLS
IMAP/POP3
DOVECOT
cyrus
DBMail
QUALCOMM
Courier-mta
mail Enable
HTTP
NGINX
G-WAN
Apache
CADDY
HAPROXY
cherokee
træfik
uWSGI
traffic server
LIGHTTPD
Hiawatha
WildFly
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POSTFIX
Haraka
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tSync
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bup
MONITORING
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PIWIK
GoAccess
The Webalizer
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ZABBIX
Adagios
ZMON
Nagios
Linux Dash
alerta
Netdata
ICINGA
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OMD
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flapjack
NetXMS
centreon
RIEMANN
LibreNMS
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postfixadmin
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iF.SVNAdmin
WebSVN
KeyHelp
SPACEWALE
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modoboa
RAINLOOP
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CITADEL
ESSENTIALS
EDITORS
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ATOM
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NetBeans
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Emacs
GNU nano
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Dotdeb
ELRepo
software COLLECTIONS
EPEL
IUS
RepoForge
SCHMANAGER


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Dovecot
Courier
Cyrus
MDaemon
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CACKE
Varnish
Cherokee
traefik
lighttpd
Hiawatha
Resin
SMTP
Postfix
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Sendmail
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VBox.Adm
ZoneMTA
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DNS
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NSD
Knot
BIND
Unbound
Dnsmasq
djbdns
tinydns
gdnsd
LDAP
FUSION DIRECTORY
OpenLDAP
FreeIPA
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OpenDJ
OpenDS
SSH
autossh
sshmux
Mosh
DSH
Dropbear SSH
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ActiveMQ
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Apollo
Kafka
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Bacula
Bareos
Obnam
Duplicity
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SNEBU
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rsnapshot
Amanda
Borg
ZBackup
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Clonezilla
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DRBD
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Lustre
XtreemFS
MooseFS
PERMS
FreeIPA
OpenLDAP
Samba
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Redis
Riak
Cassandra
Hypertable
FlockDB
Neo4j
RethinkDB
MariaDB
MySQL
PostgreSQL
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Ganglia
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Kali Linux
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PacketFence
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fpm
Poky
TROUBLESHOOTING
ngrep
BOOKS
O'REILLY

GNU

GNU’s Not Unix Project

Started in 1983

Vague but exciting ...

CERN DD/OC

Tim Berners-Lee, CERN/DD

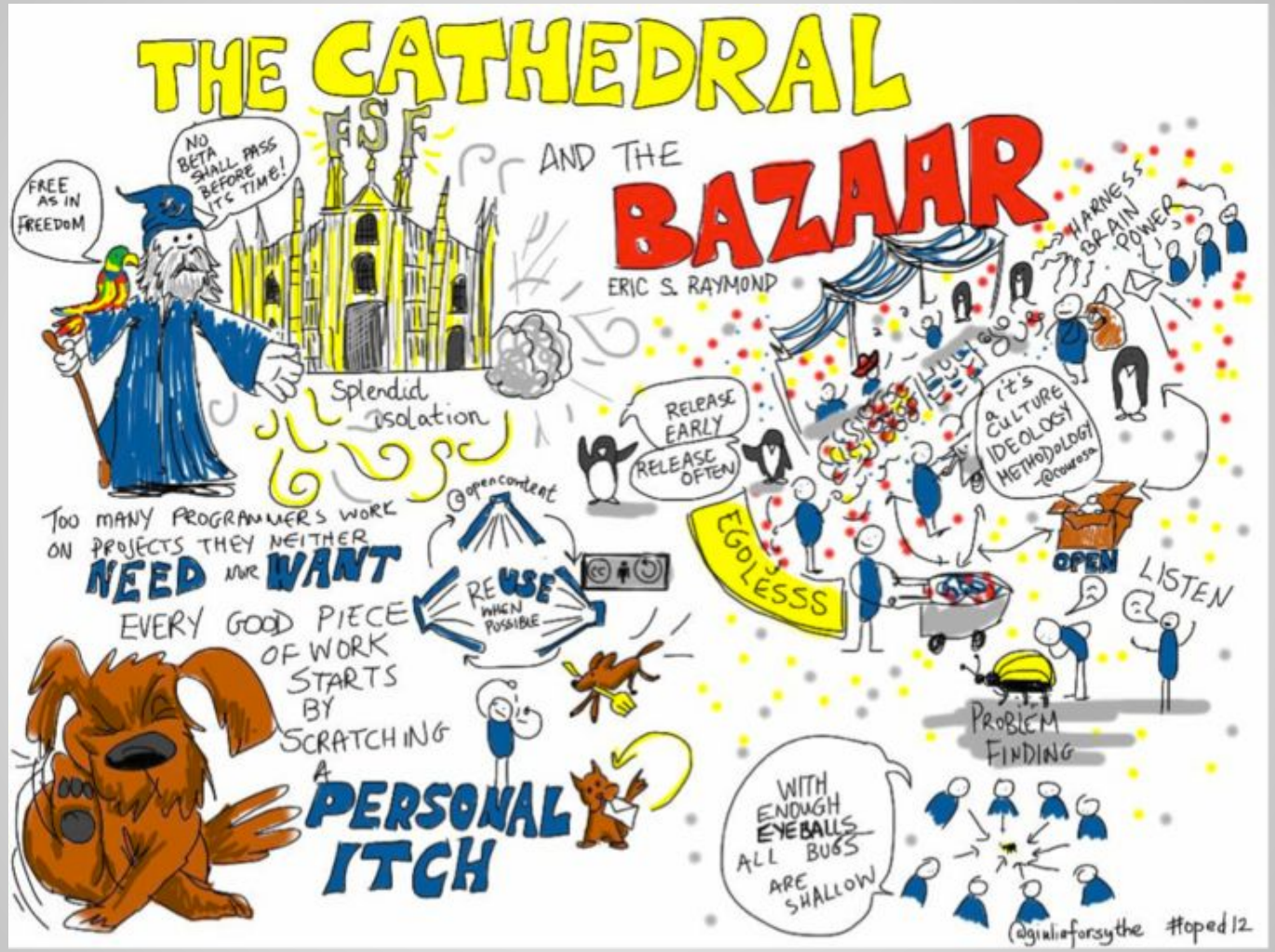
Information Management: A Proposal

March 1989

Information Management: A Proposal

Abstract

This proposal concerns the management of general information about accelerators and experiments at CERN. It discusses the problems of loss of information about complex evolving systems and derives a


THE CATHEDRAL
AND THE
BAZAAR
ERIC S. RAYMOND
FSF
FREE AS IN FREEDOM
NO BETA SHALL PASS BEFORE IT'S TIME!
Splendid isolation
HARNESS BRAIN POWER
RELEASE EARLY
RELEASE OFTEN
"IT'S A CULTURE IDEOLOGY METHODOLOGY" @cowrosa
EGOLESSS
OPEN
LISTEN
PROBLEM FINDING
TOO MANY PROGRAMMERS WORK ON PROJECTS THEY NEITHER NEED NOR WANT
@opencontent
RE USE WHEN POSSIBLE
EVERY GOOD PIECE OF WORK STARTS BY SCRATCHING A PERSONAL ITCH
WITH ENOUGH EYEBALLS ALL BUGS ARE SHALLOW
@gialiaforsythe #oped12

Bell Labs: A Hive of Invention

A selection of its most important innovations in the decades leading up to the breakup of its parent company, AT&T, in 1984, and how they helped lead to some of the latest technologies.

1940s

) First long-distance computing Remote eration of a computer, Bell Labs in New York, by a teletypewriter in New Hampshire.

46 First commercial obile phone service most, three subscrib- s per city could make lls at one time; each er's phone apparatus weighed almost 80 pounds.

1947 Cellular elephone technology l Labs paper was the propose a network of interlocking cell sites g users as they move, g their calls from one te to another without opping the connection.

1950s

1947 The transistor A landmark invention. Replaced vacuum tubes and mechanical relays; transformed electronics.

1948 Information theory Calculates maximum capacity for any communications system and shows how to send digital messages essentially error-free. Enabled data compression and cryptography.

1951 Direct-distance dialing No operator necessary for long-distance calls.

1954 Solar cells First use of the sun's energy to create a practical level of electricity.

1956 First transatlantic telephone cable Designed and implemented by Bell Labs; could carry up to 36 simultaneous calls.

1957 Digitized music First demonstrations of digitized and computer-synthesized music.

1958 The laser "Light Amplification by Stimulated Emission of Radiation" was described in a Bell Labs paper. It is crucial for communications, surgical and DVD technologies.

The Murray Hill, N.J., buildings opened in 1941.

1960s

1962 Digital transmission, switching First digital transmission of multiple voice signals.

1960-62 First communications satellites Echo is first to reflect a voice signal from coast to coast; Telstar I shows an orbiting relay can amplify and resend multiple phone and TV transmissions.

1962 Paging system Bellboy pager is introduced at the Seattle World's Fair.

1963 Touch-tone telephone Enables voice mail and call centers.

1965 Evidence of the Big Bang Discovery of cosmic background radiation from beyond the Milky Way.

1969 Charge-coupled device A solid-state chip that transforms patterns of light into information. Vital to digital cameras, high-definition television, medical endoscopes and video conferencing.

Bell Labs opened in Holmdel, N.J., in 1962. It was vacated in 2007.

1970s and '80s

1969-72 UNIX operating system and C programming language Makes large-scale networking of varied computing systems, and the Internet, practical.

1976 Fiber-optic network The first test of Bell Labs' experimental lightwave communication system begins in Atlanta. Information is carried by pulses of light.

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1979 Digital signal processor An essential component of cellphones, modems, PCs and video game systems.

1980 Digital cellular phone Better sound quality, greater channel capacity, lower cost.

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LEFT AND CENTER PHOTOS COURTESY OF ALCATEL-LUCENT USA INC. AND THE AT&T ARCHIVES AN

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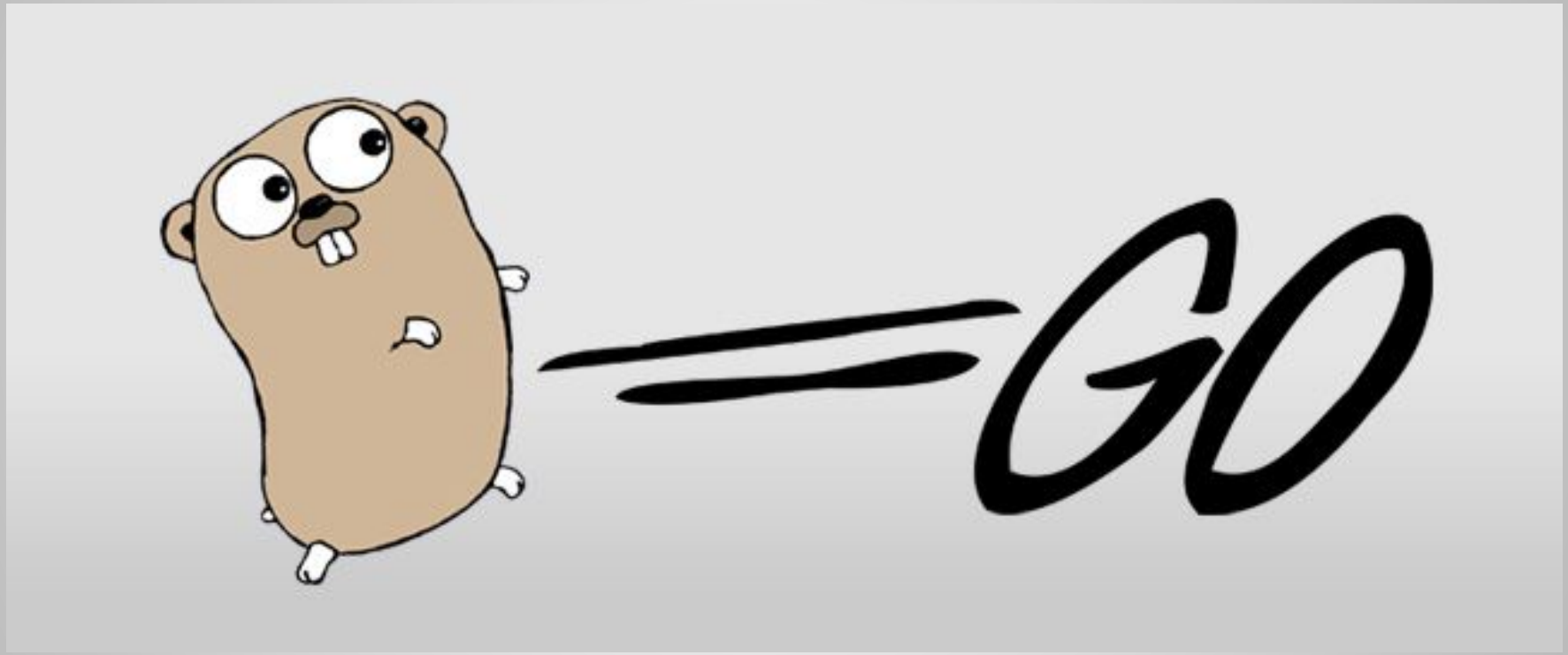
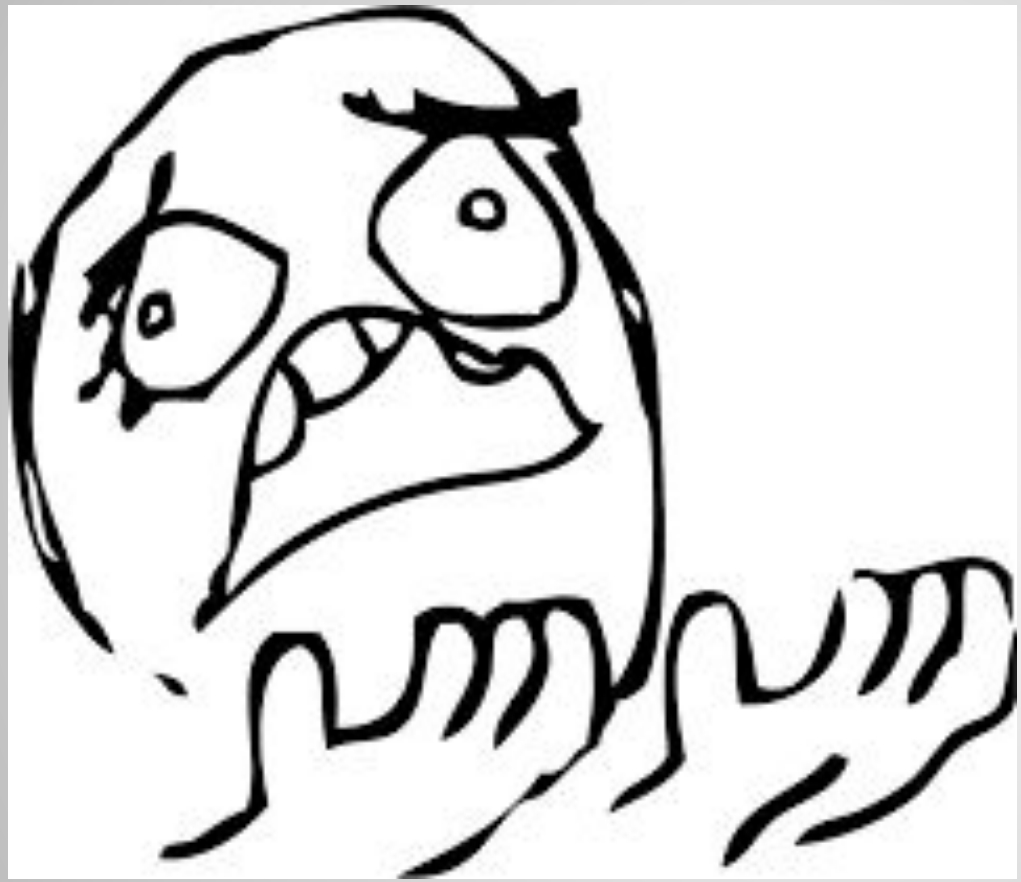

GO

Criticisms of Go

- too simple / lack of syntactic sugar
- no generics
- bad dependency management
- stuck in 70/80's
- error handling
- no unused imports
- too opinionated
- too verbose
- no ternary operator
- no macros or templates

https://github.com/ksimka/go-is-not-good




WHERE WE'RE GOING, WE DON'T NEED ROADS

“Go programming language was conceived as an answer to some of the problems we were seeing developing software infrastructure at Google. The computing landscape today is almost unrelated to the environment in which the languages being used, mostly C++, Java, and Python, had been created. The problems introduced by **multicore processors**, **networked systems**, **massive computation clusters**, and the **web programming model** were being worked around rather than addressed head-on.

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Moreover, the scale has changed: today's server programs comprise tens of millions of lines of code, are worked on by hundreds or even thousands of programmers, and are updated literally every day. To make matters worse, build time have stretched to many minutes, even hours, even languages,on large compilation clusters,"

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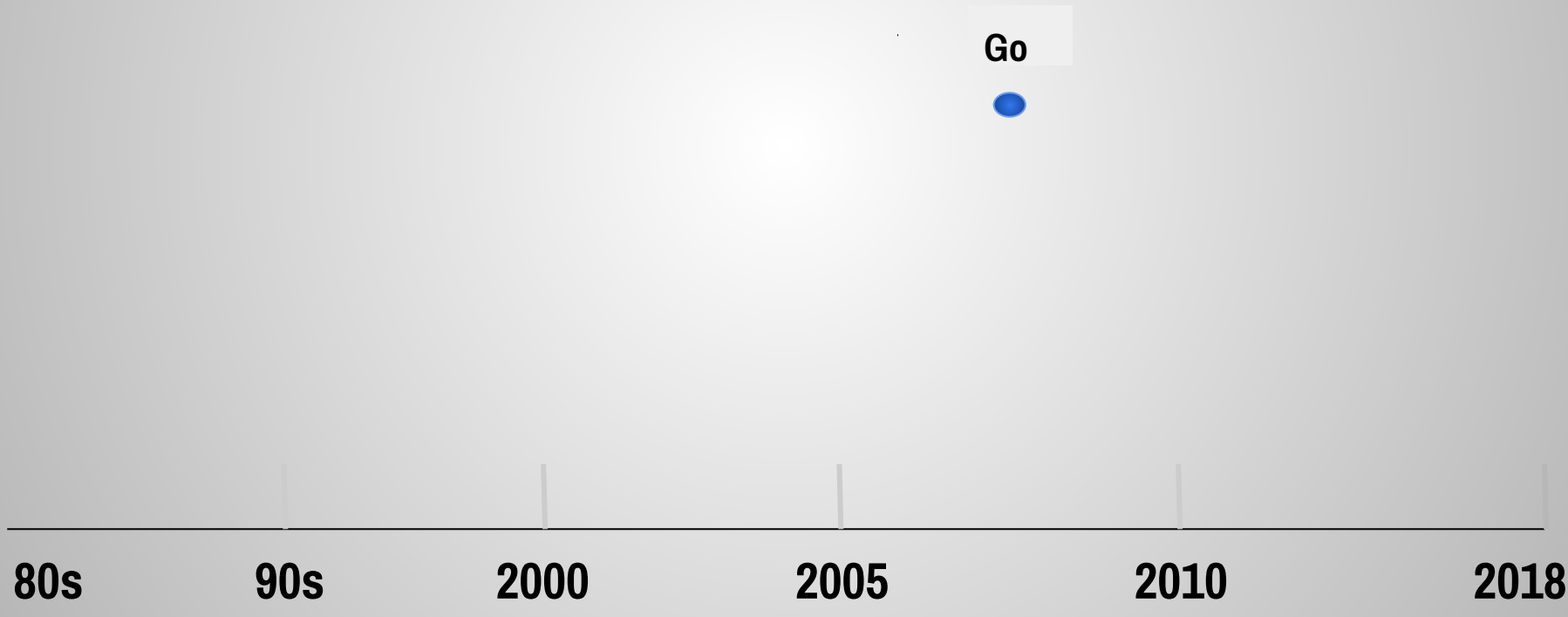
- multicore processors
- networked systems
- massive computation clusters
- web programming model

- hundreds or even thousands of programmers
- large compilation clusters


Go
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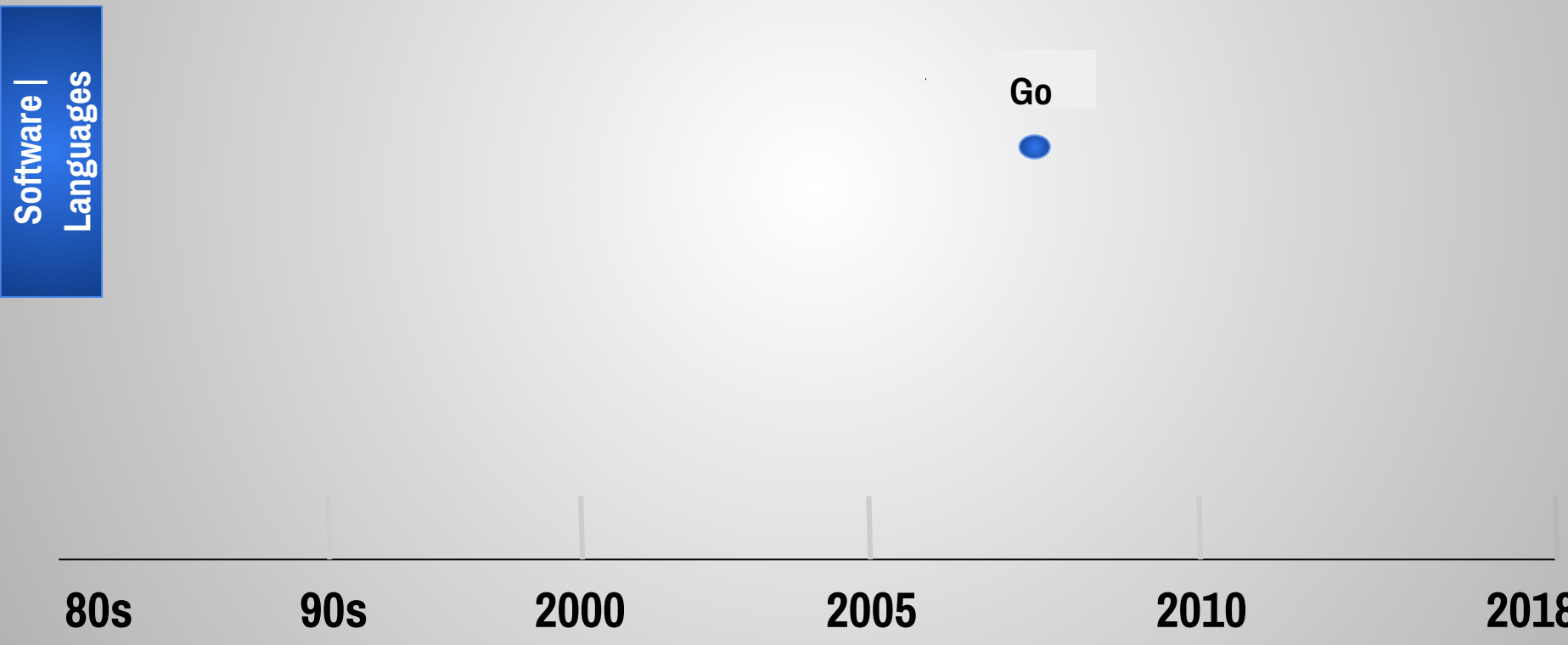
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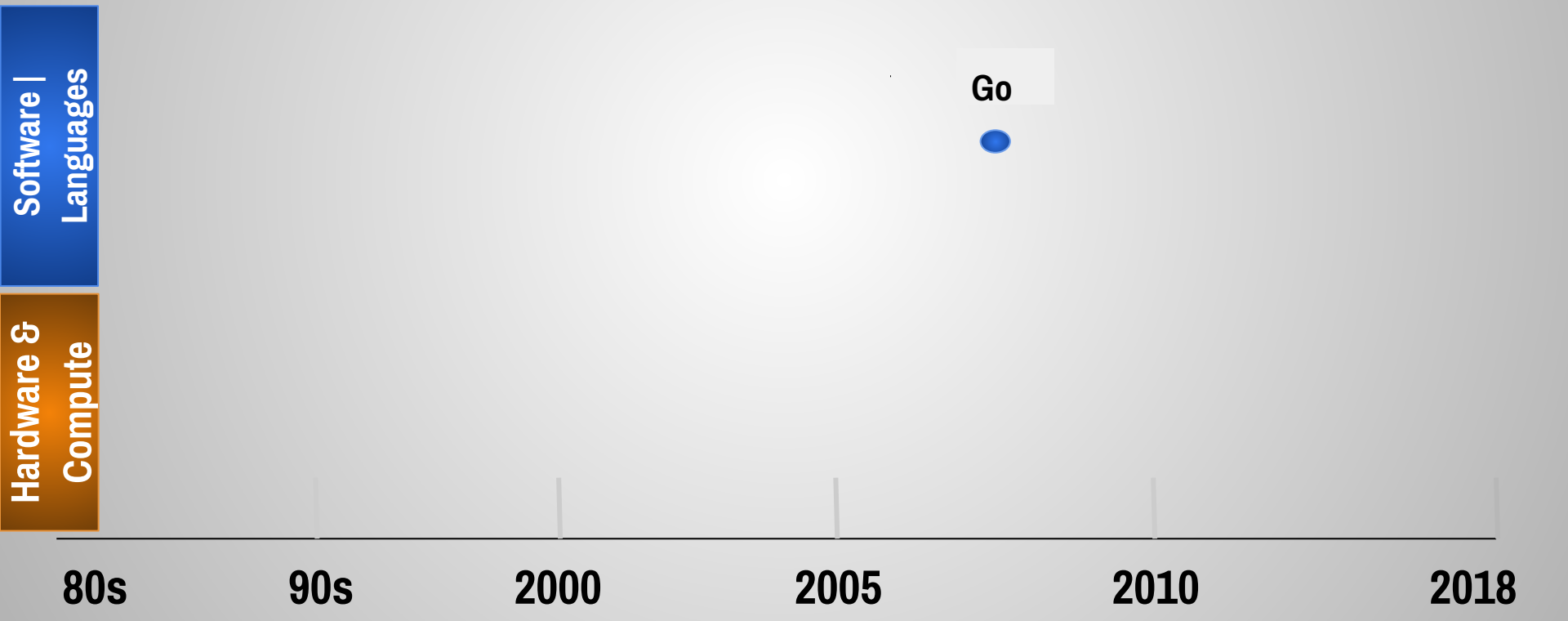
Software | Languages
Hardware & Compute
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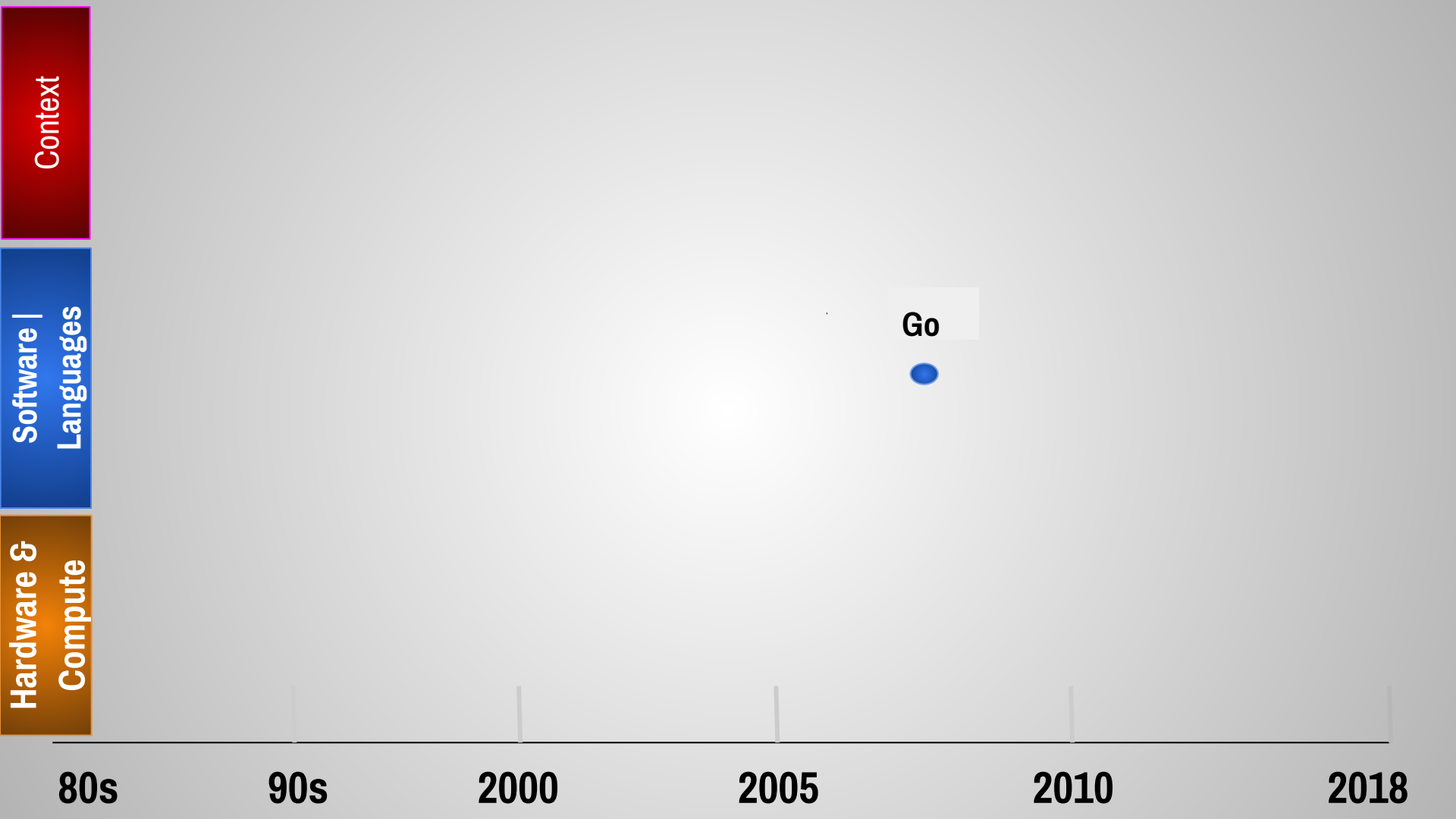

Context
Software | Languages
Hardware & Compute
Go
80s
90s
2000
2005
2010
2018

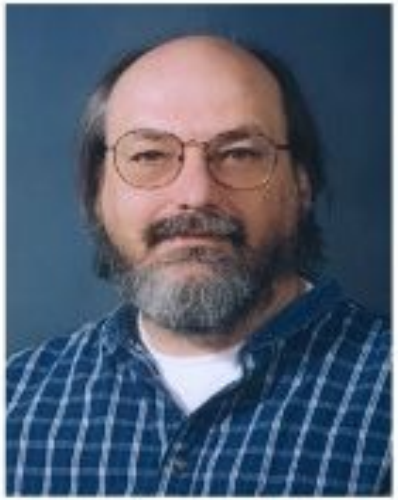
Designers

Robert Griesemer

V8 JavaScript engine, Java HotSpot VM

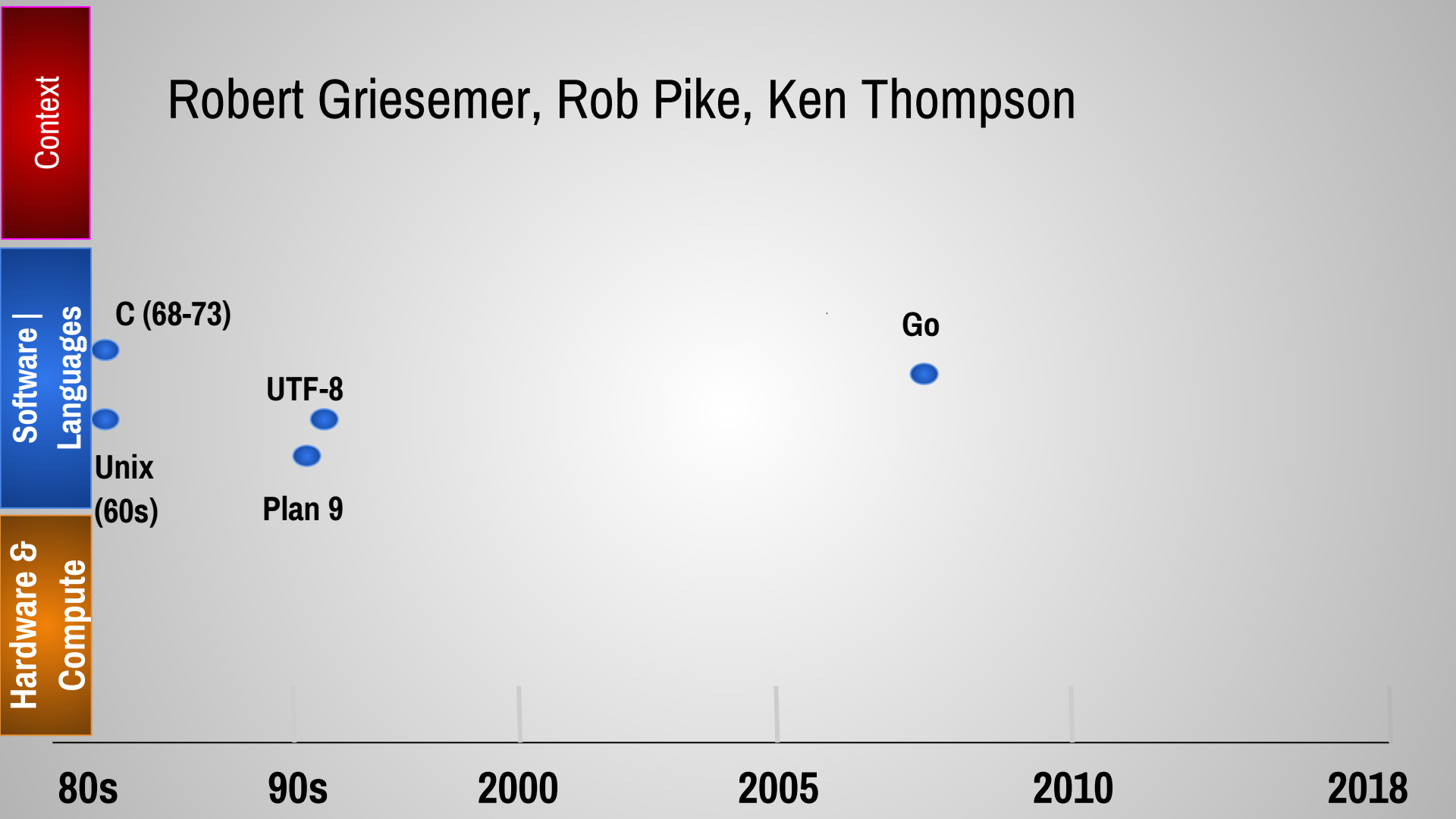
Rob Pike

UNIX, Plan 9, UTF-8



Ken Thompson

UNIX, Plan 9, B language, UTF-8


Context
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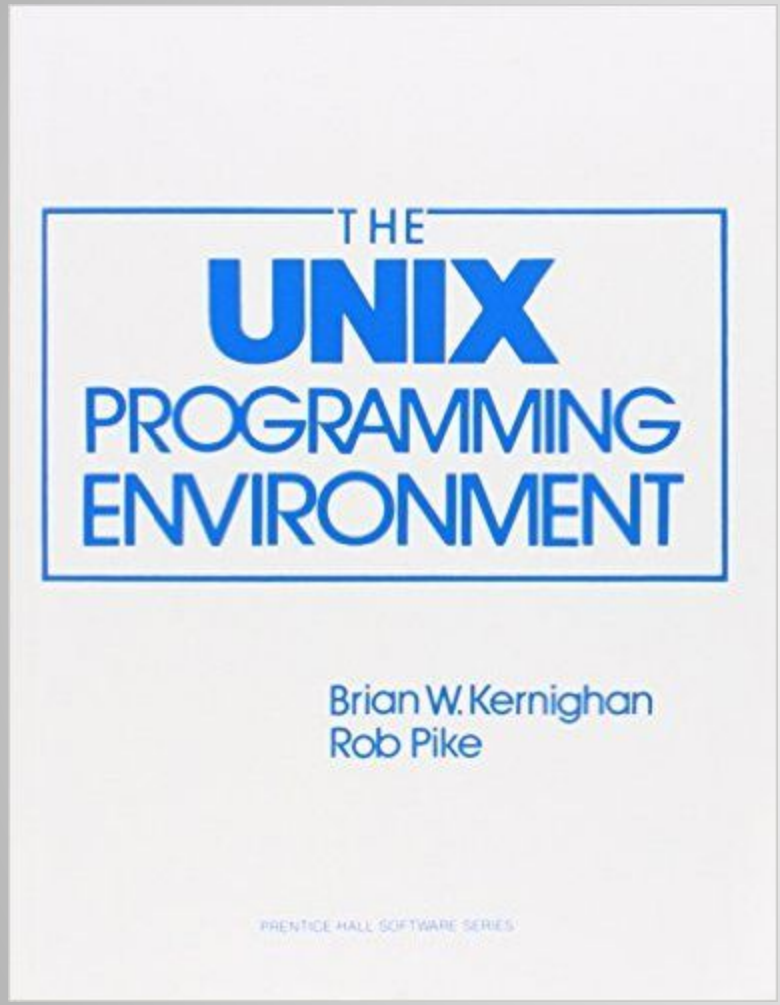
THE
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Brian W. Kernighan
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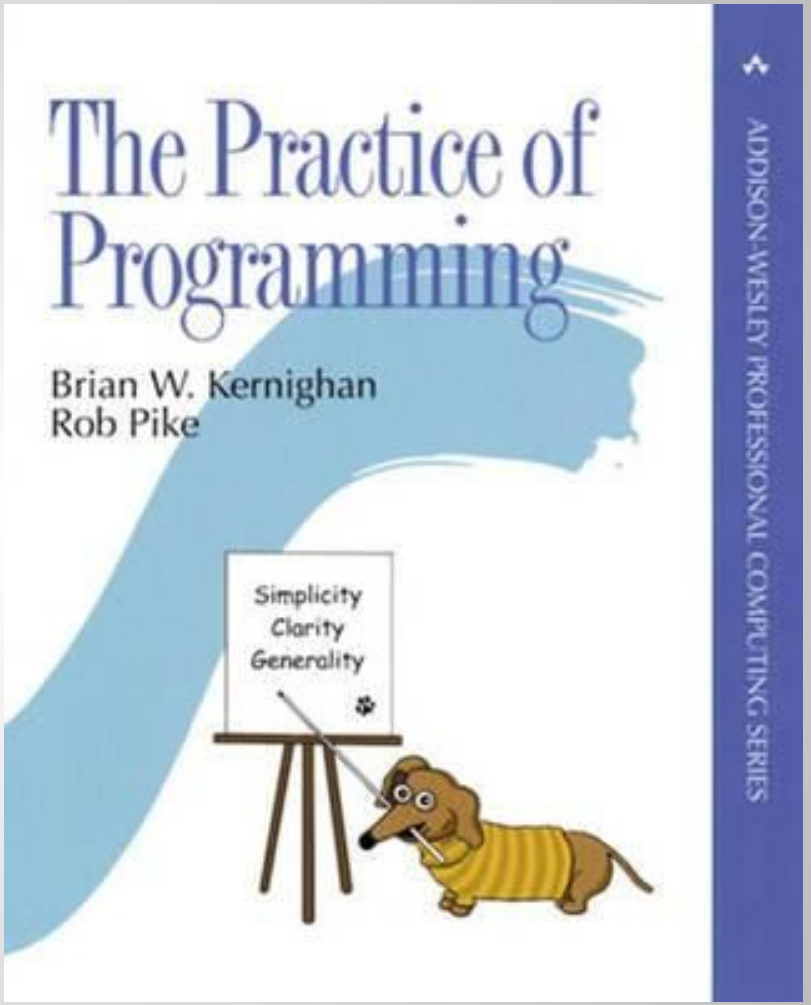
PRENTICE HALL SOFTWARE SERIES


The Practice of Programming
Brian W. Kernighan
Rob Pike
Simplicity
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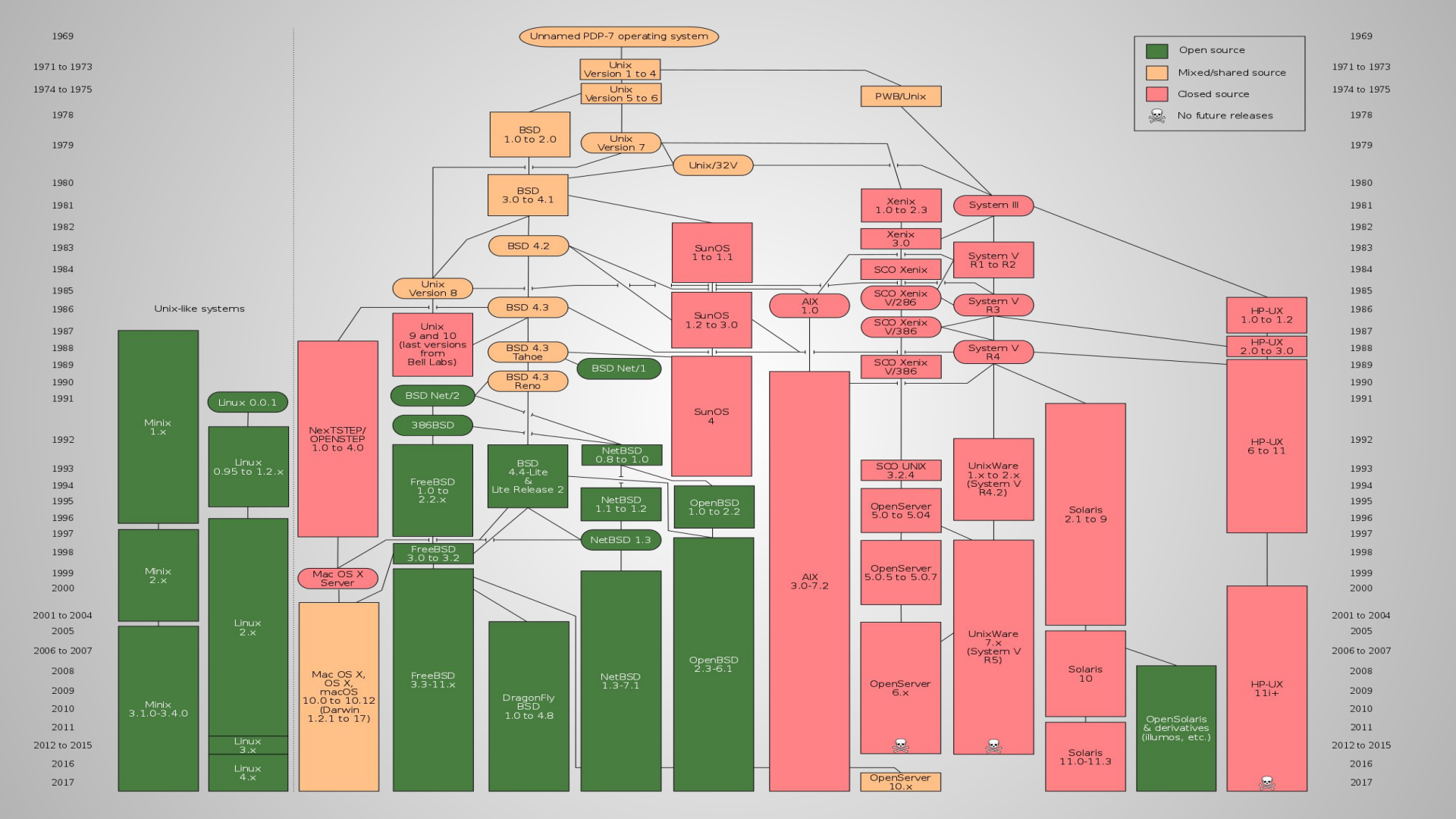
Generality
ADDISON-WESLEY PROFESSIONAL COMPUTING SERIES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Unix-like systems
Minix 1.x
Minix 2.x
Minix 3.1.0-3.4.0
Linux 0.0.1
Linux 0.95 to 1.2.x
Linux 2.x
Linux 3.x
Linux 4.x
NexTSTEP/ OPENSTEP 1.0 to 4.0
Mac OS X Server
Mac OS X, OS X, macOS 10.0 to 10.12 (Darwin 1.2.1 to 17)
Unnamed PDP-7 operating system
Unix Version 1 to 4
Unix Version 5 to 6
Unix Version 7
Unix Version 8
Unix 9 and 10 (last versions from Bell Labs)
BSD 1.0 to 2.0
BSD 3.0 to 4.1
BSD 4.2
BSD 4.3
BSD 4.3 Tahoe
BSD 4.3 Reno
BSD Net/1
BSD Net/2
386BSD
FreeBSD 1.0 to 2.2.x
FreeBSD 3.0 to 3.2
FreeBSD 3.3-11.x
BSD 4.4-Lite & Lite Release 2
DragonFly BSD 1.0 to 4.8
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NetBSD 1.3
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OpenBSD 2.3-6.1
PWB/Unix
AIX 1.0
AIX 3.0-7.2
Xenix 1.0 to 2.3
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SCO Xenix
SCO Xenix V/286
SCO Xenix V/386
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OpenServer 5.0 to 5.04
OpenServer 5.0.5 to 5.0.7
OpenServer 6.x
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System III
System V R1 to R2
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Solaris 2.1 to 9
Solaris 10
Solaris 11.0-11.3
OpenSolaris & derivatives (illumos, etc.)
HP-UX 1.0 to 1.2
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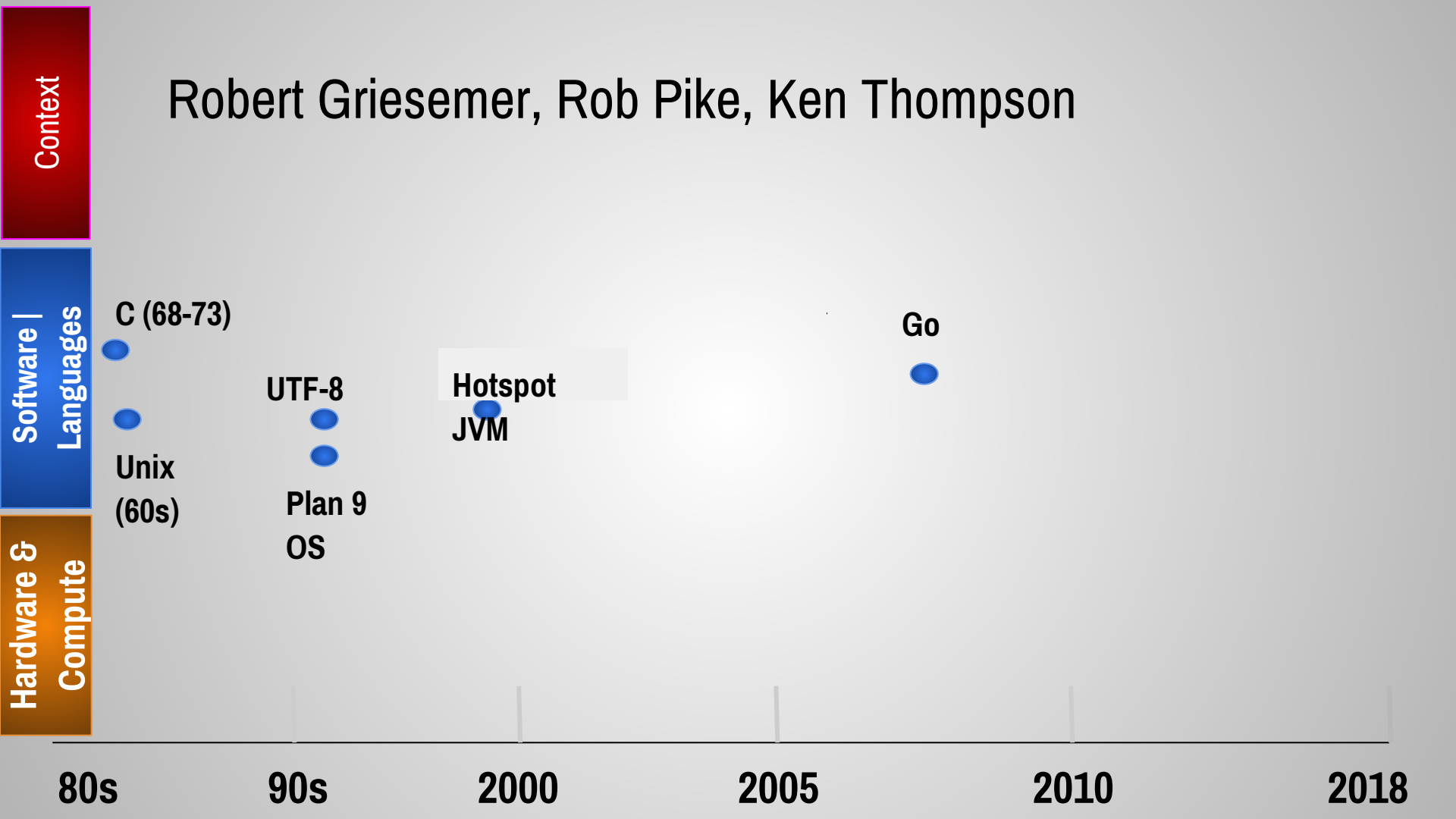
HP-UX 11i+
Open source
Mixed/shared source
Closed source
No future releases


Context
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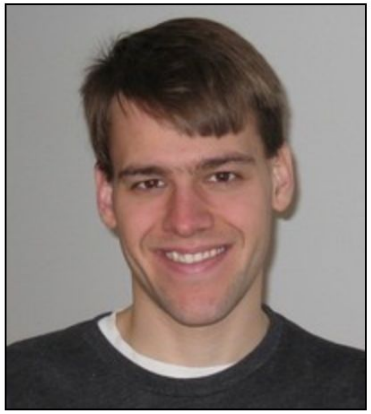


Russ Cox

rsc@swtch.com

c/o Google
5 Cambridge Center
Cambridge, MA 02142

A C, an E-flat, and a G walk into a bar.
The bartender says, "Sorry, but we don't serve minors."

What's grey? A melted penguin.

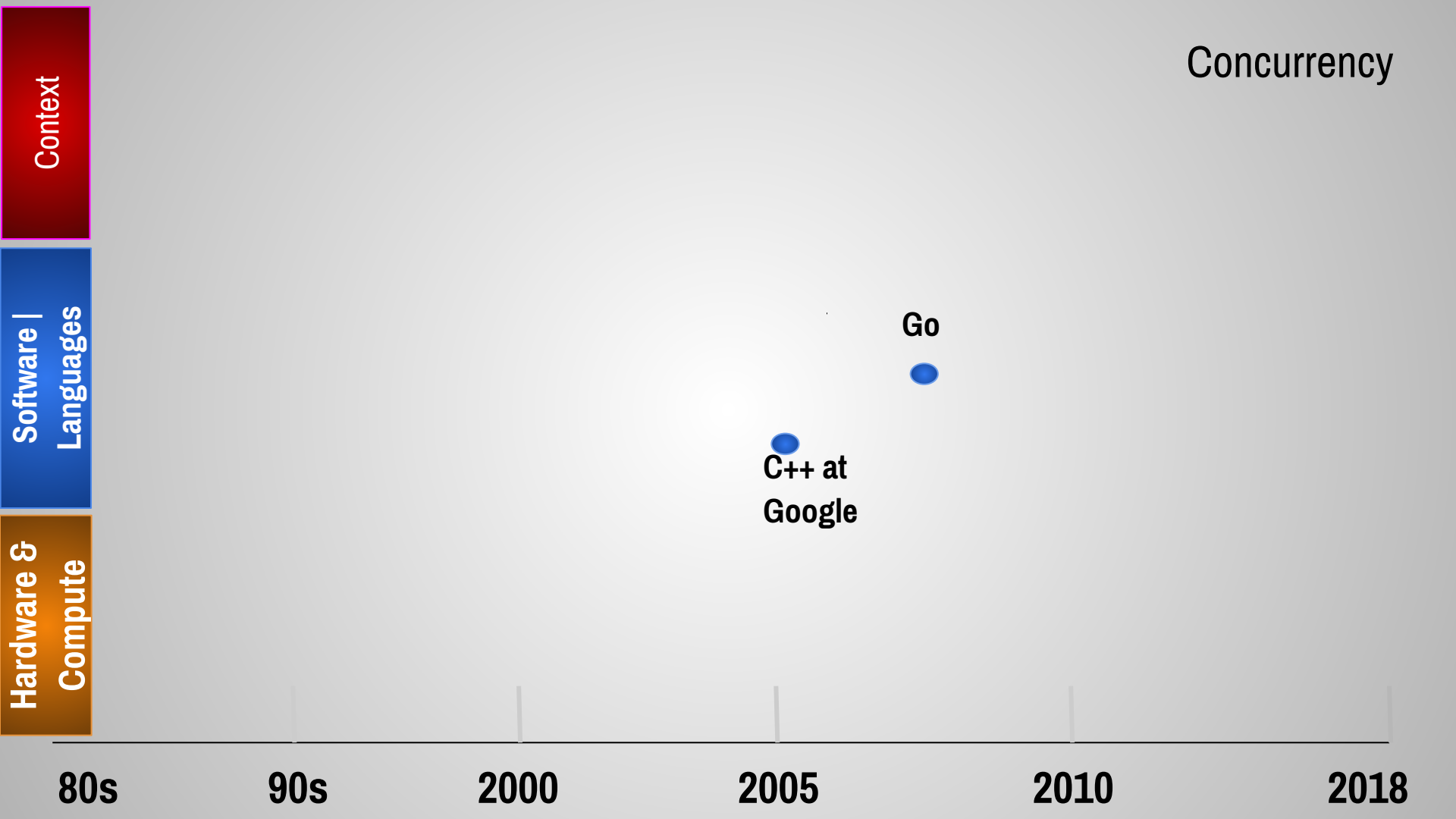
Go's 21st Century "5th Gen" Characteristics

- Concurrency
- Distributed Systems
- Garbage Collection
- Memory and Data Locality
- Readability
- Simplicity

Concurrency

Why Massive Concurrency?

Why goroutines (green threads) ?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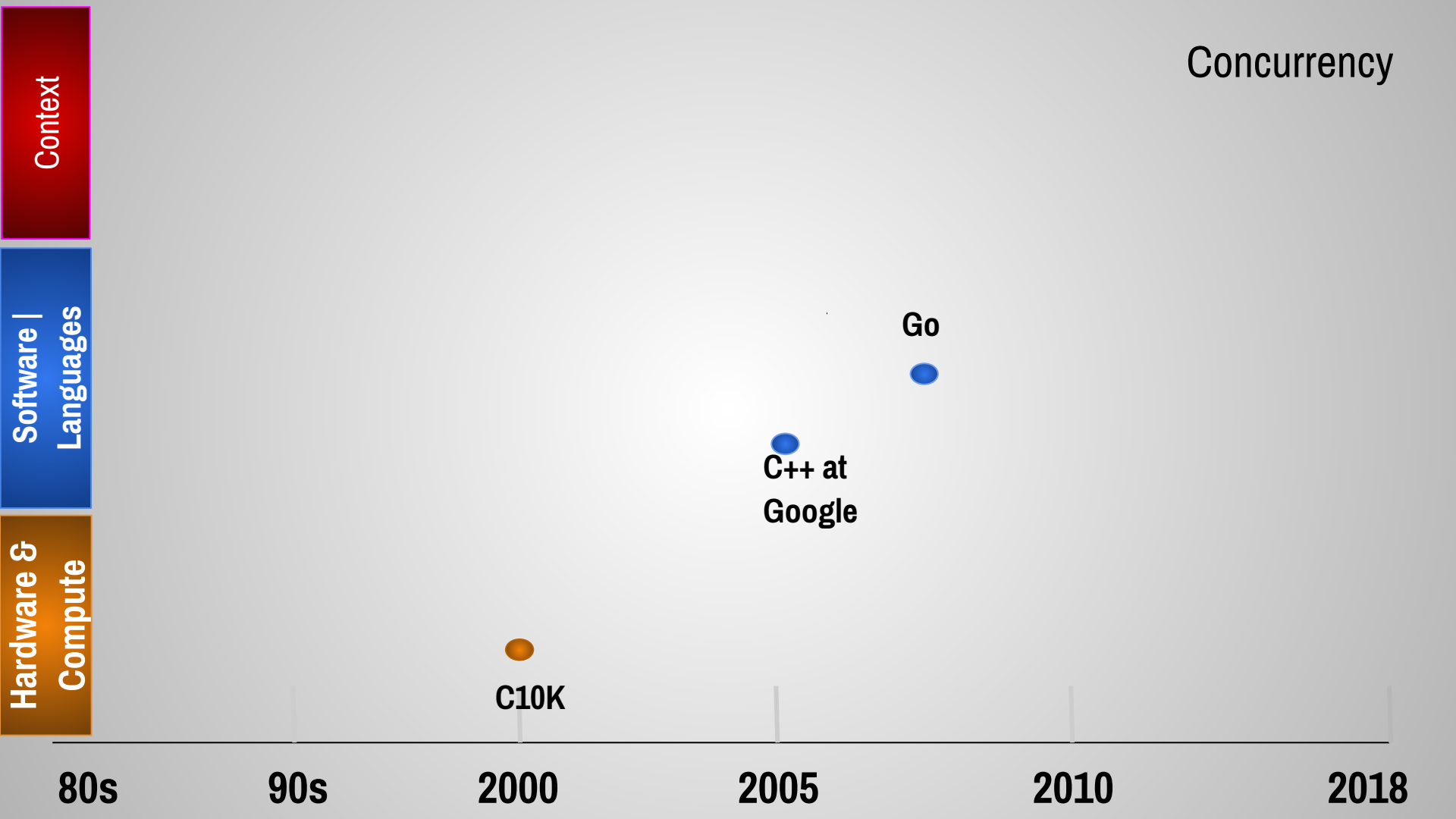
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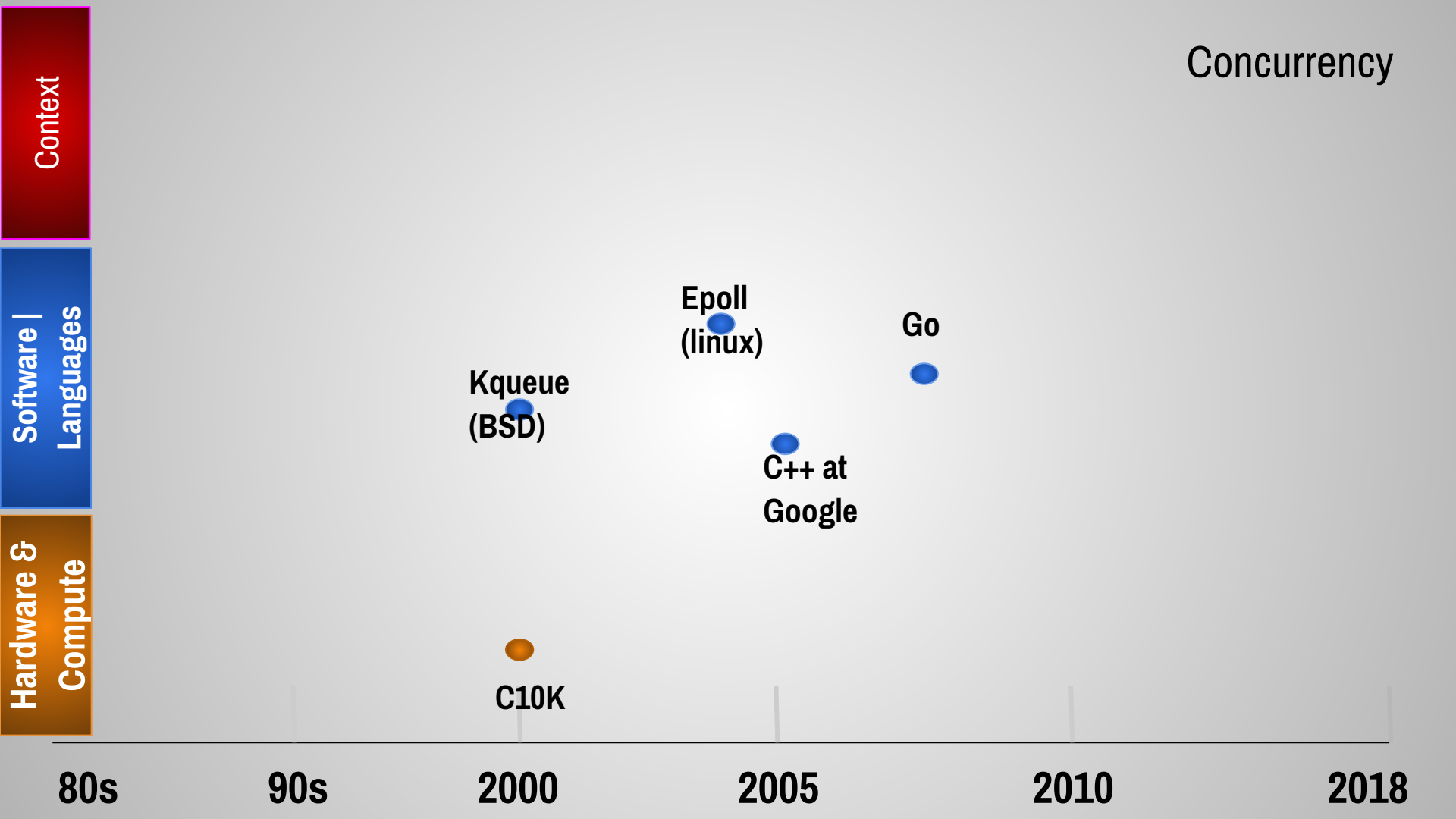
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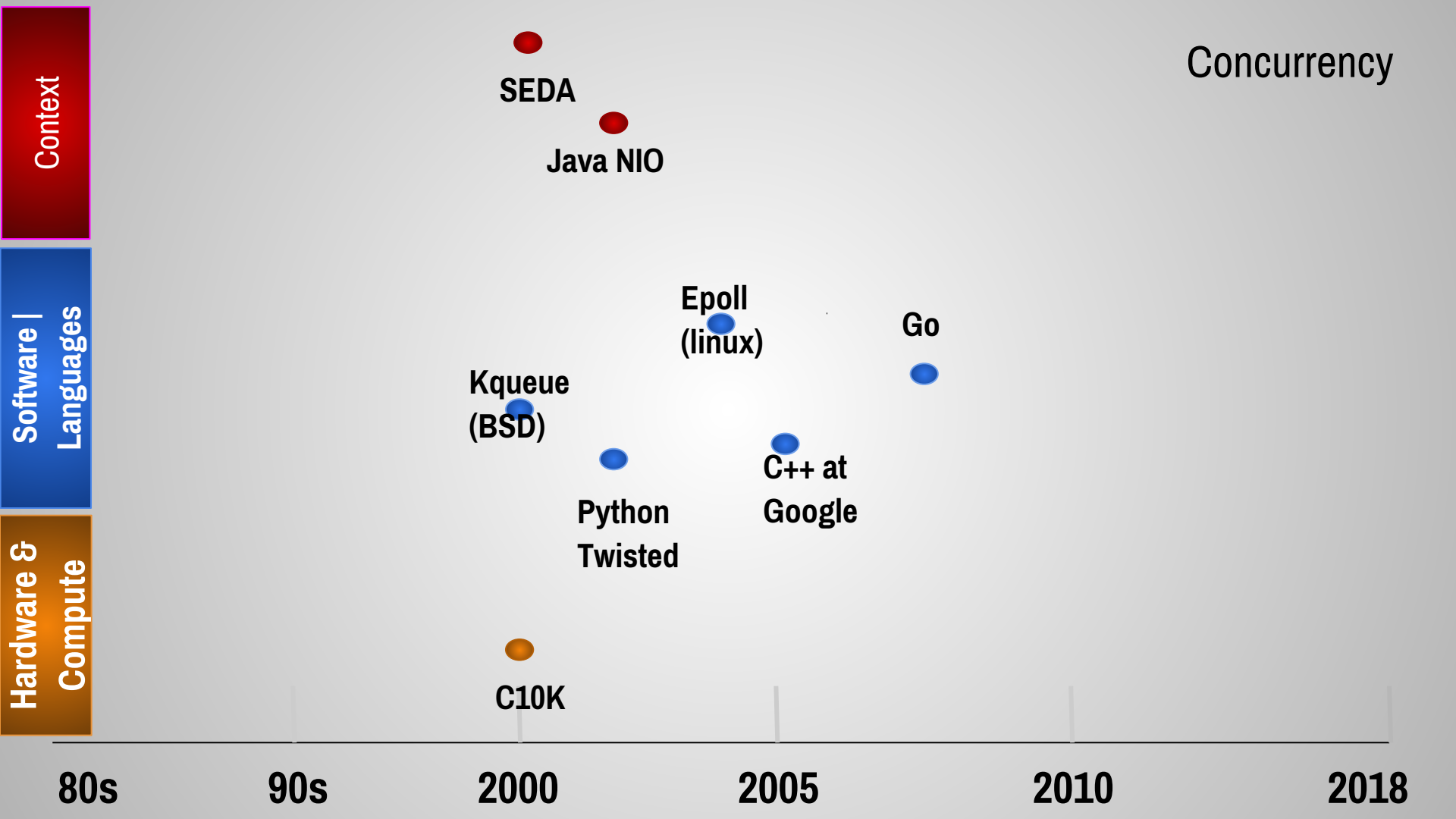
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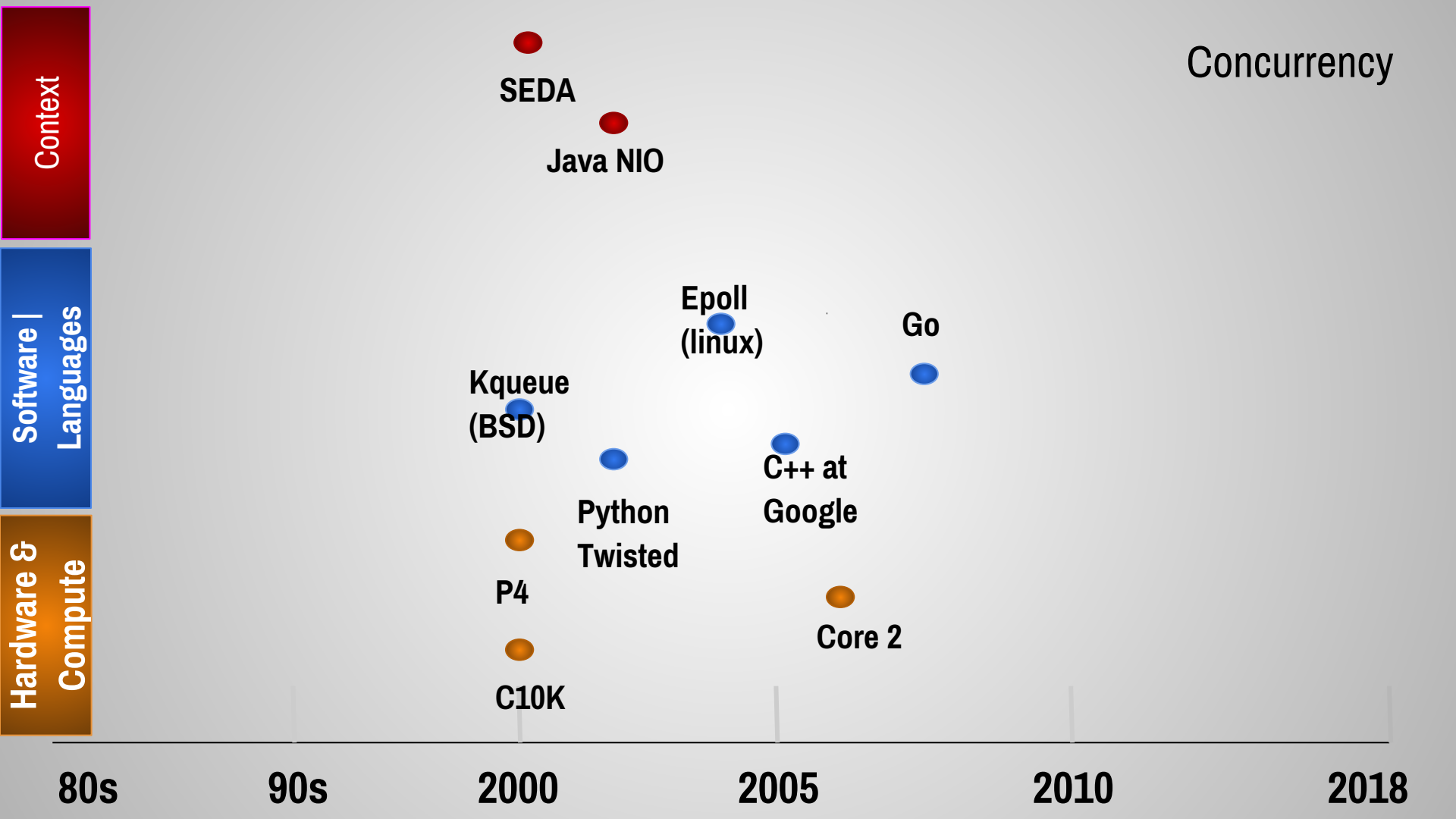
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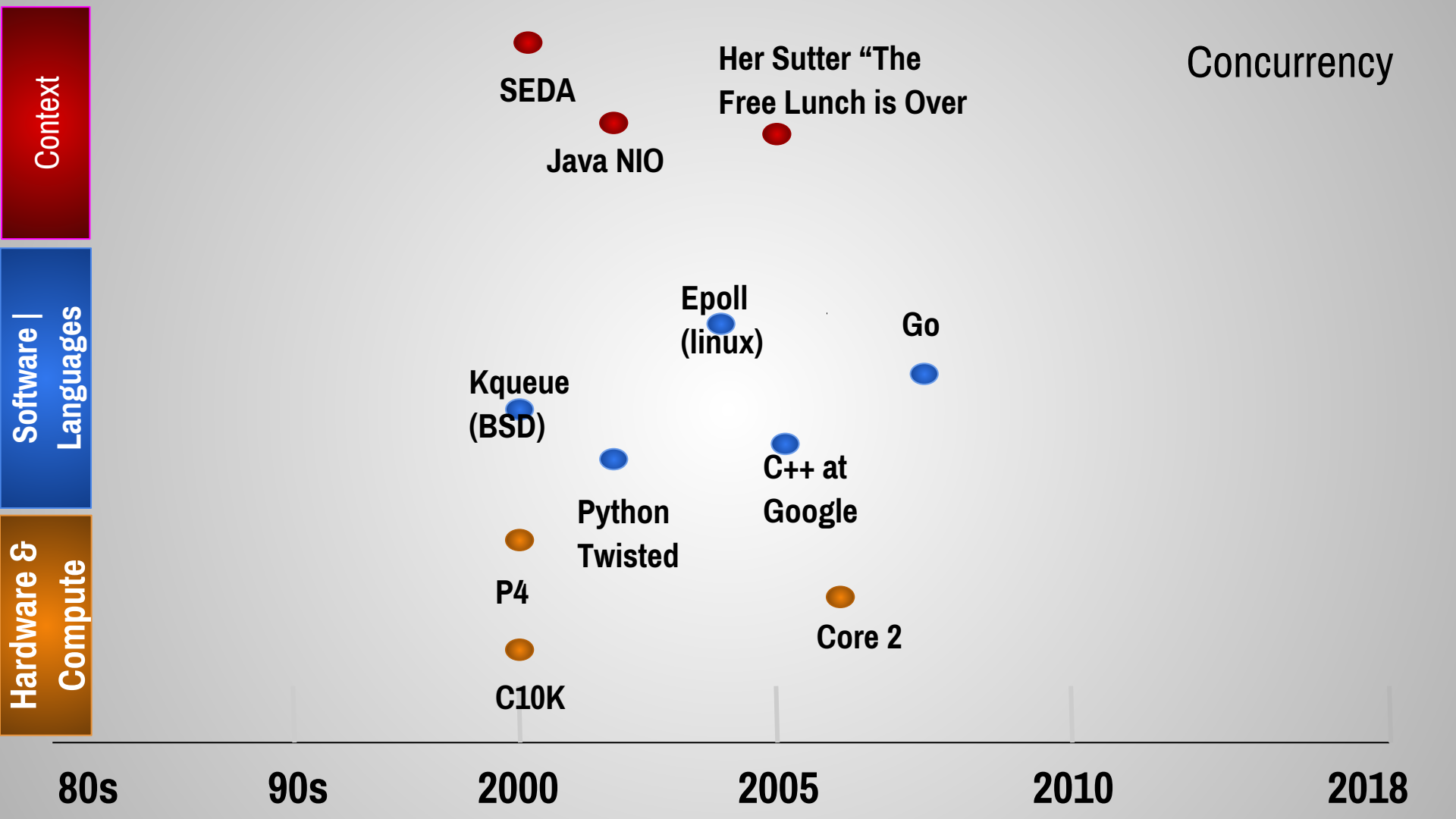
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The Concurrency Revolution

By Herb Sutter, February 01, 2005

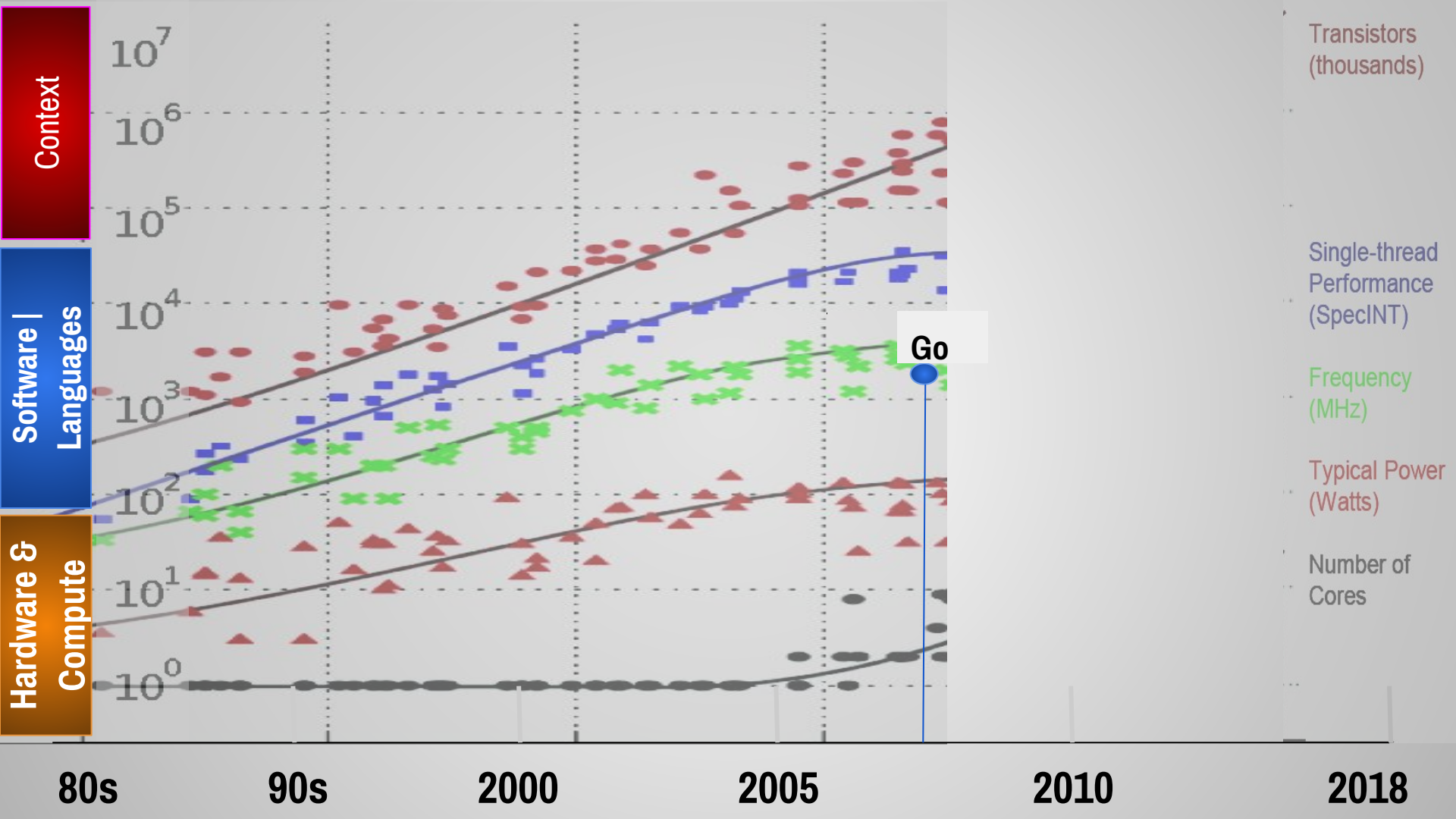
Post a Comment

Will concurrency be the next revolution in software development?

Herb Sutter (http://www.gotw.ca/) chairs the ISO C++ Standards committee and is an architect in Microsoft's Developer Division. His most recent books are Exceptional C++ Style *and* C++ Coding Standards *(Addison-Wesley).*

We appear to be at a major turning point in the way we develop software.

The major processor architectures, from Intel and AMD to Sparc and PowerPC, have run out of room with most of their traditional approaches to boosting CPU performance. Instead of driving clock speeds and straight-line instruction throughput ever higher, they are turning *en masse* to hyperthreading and multicore architectures. That puts us at a fundamental turning point in software development because for years, we've enjoyed a free lunch as faster computers directly made our applications faster too, and that will largely not be true any more. Most of the coming gains won't be picked up directly by the majority of today's applications.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Transistors (thousands)
Single-thread Performance (SpecINT)
Frequency (MHz)
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Number of Cores
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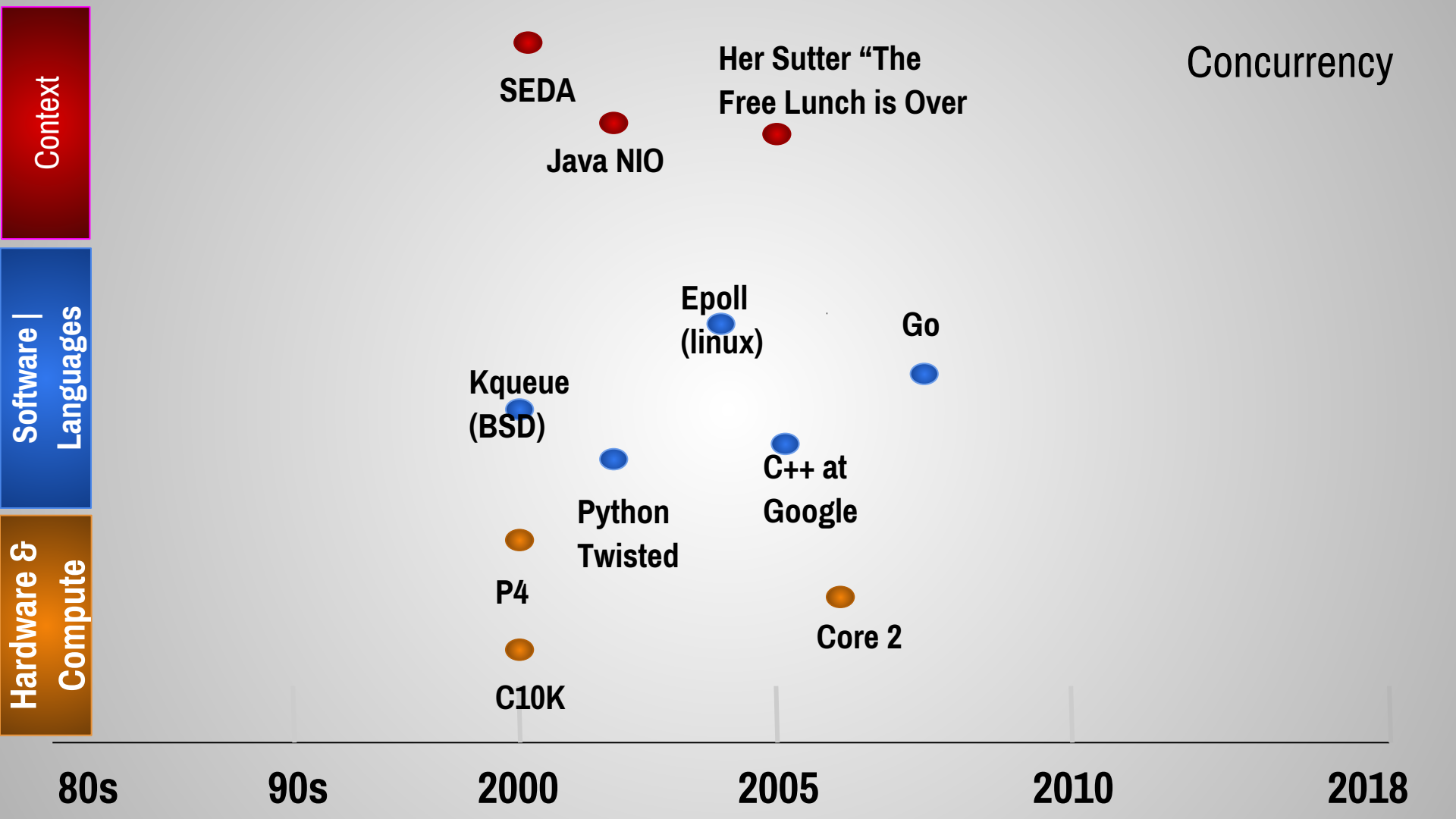
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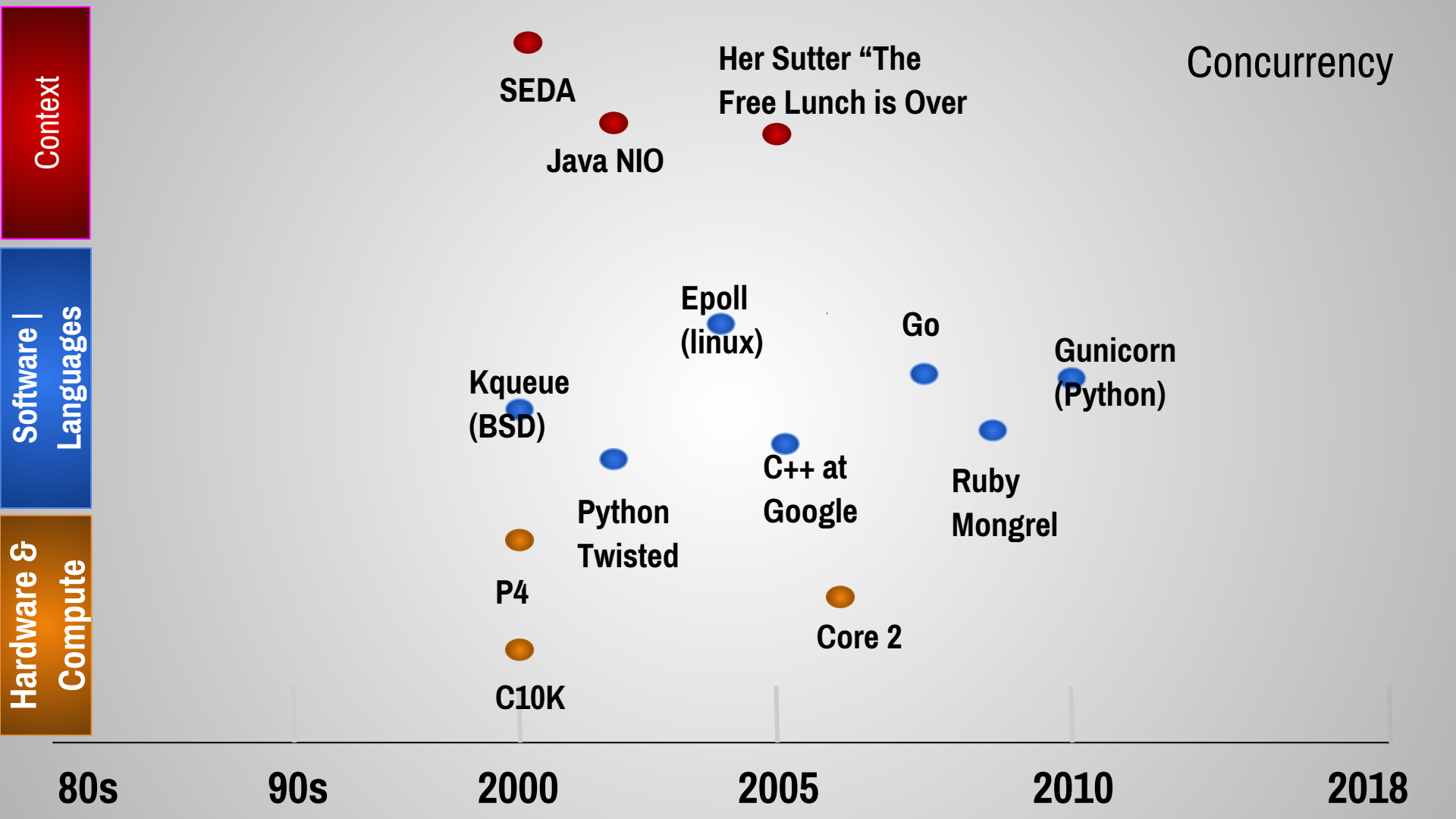
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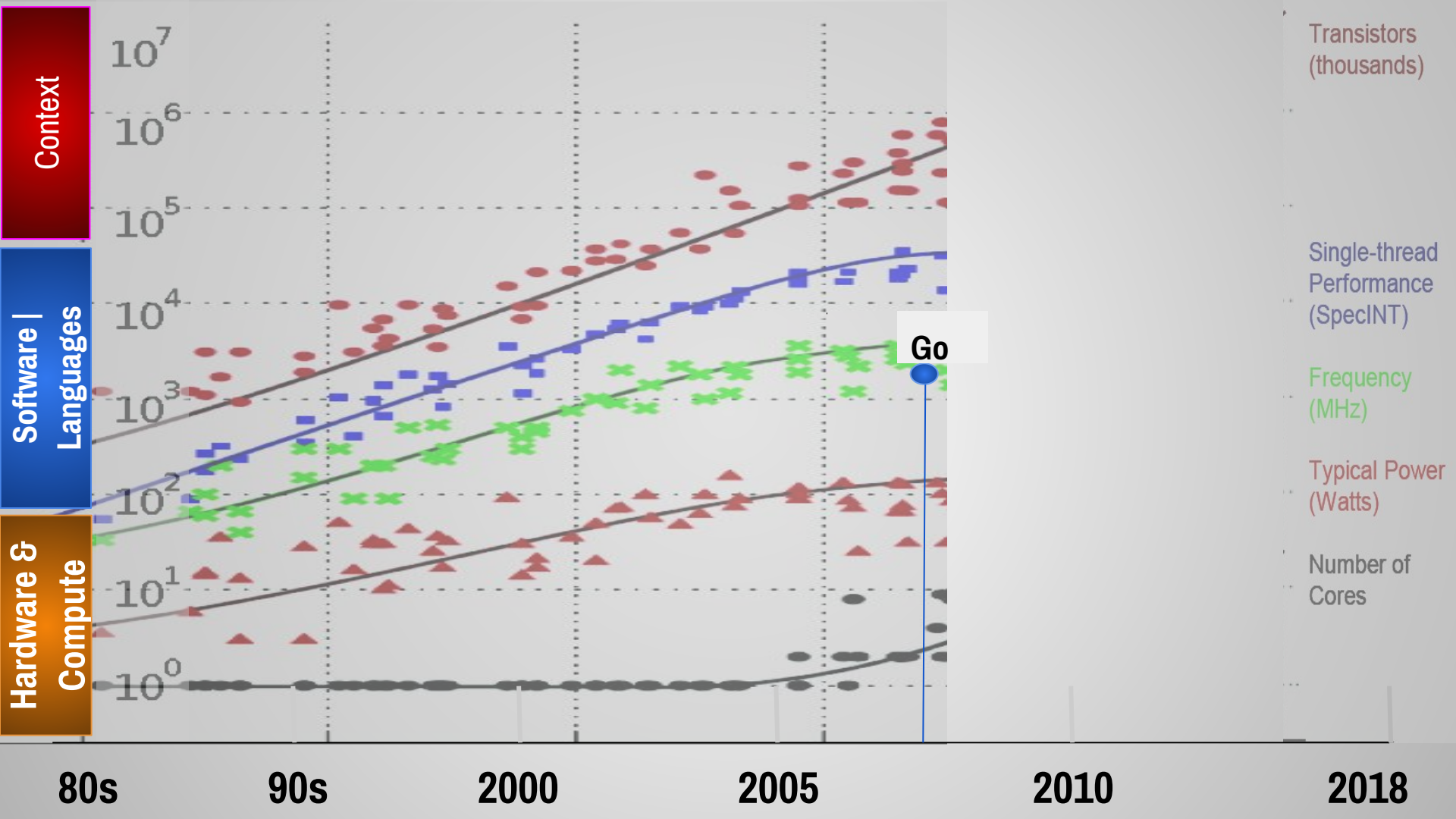
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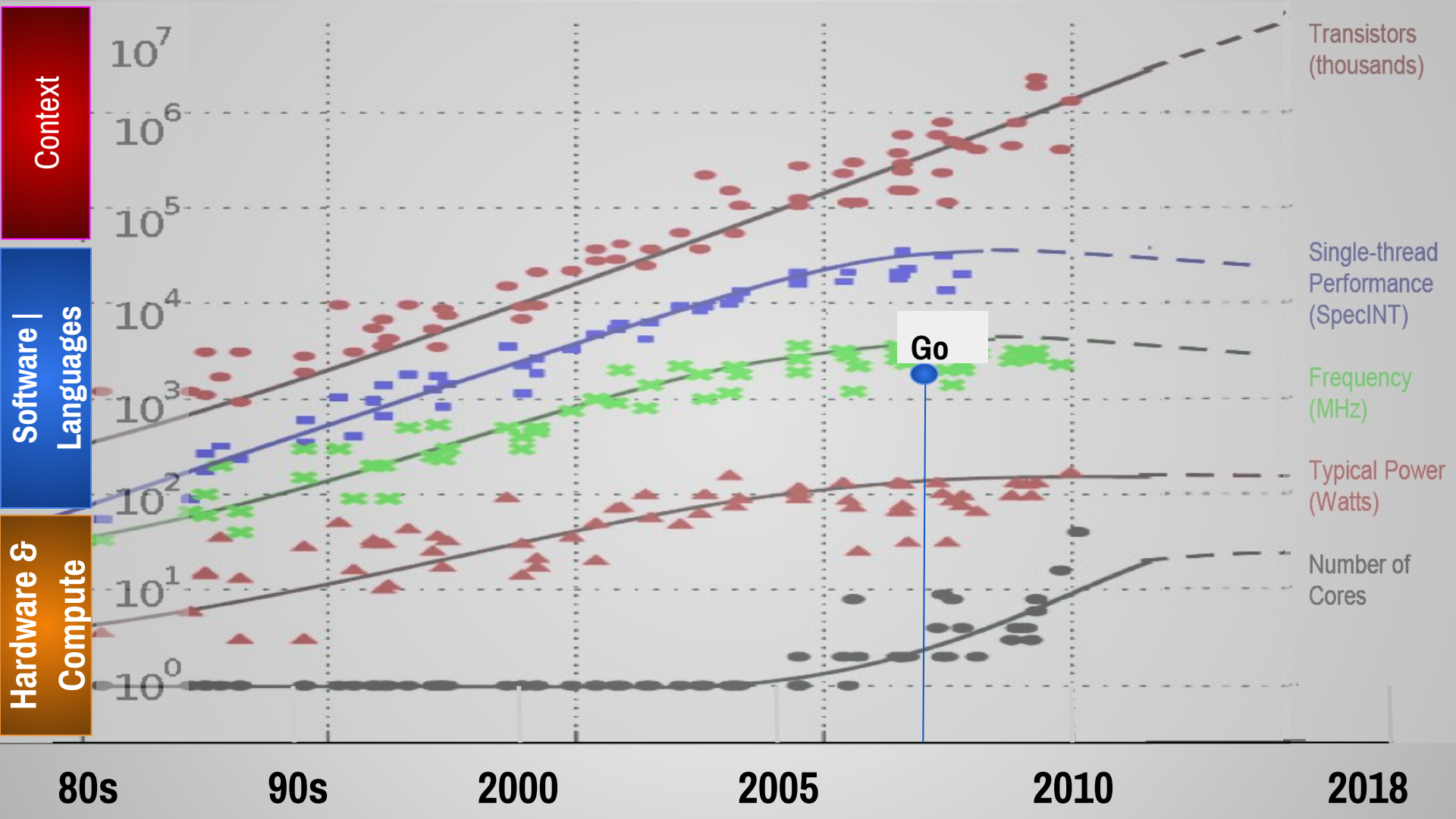
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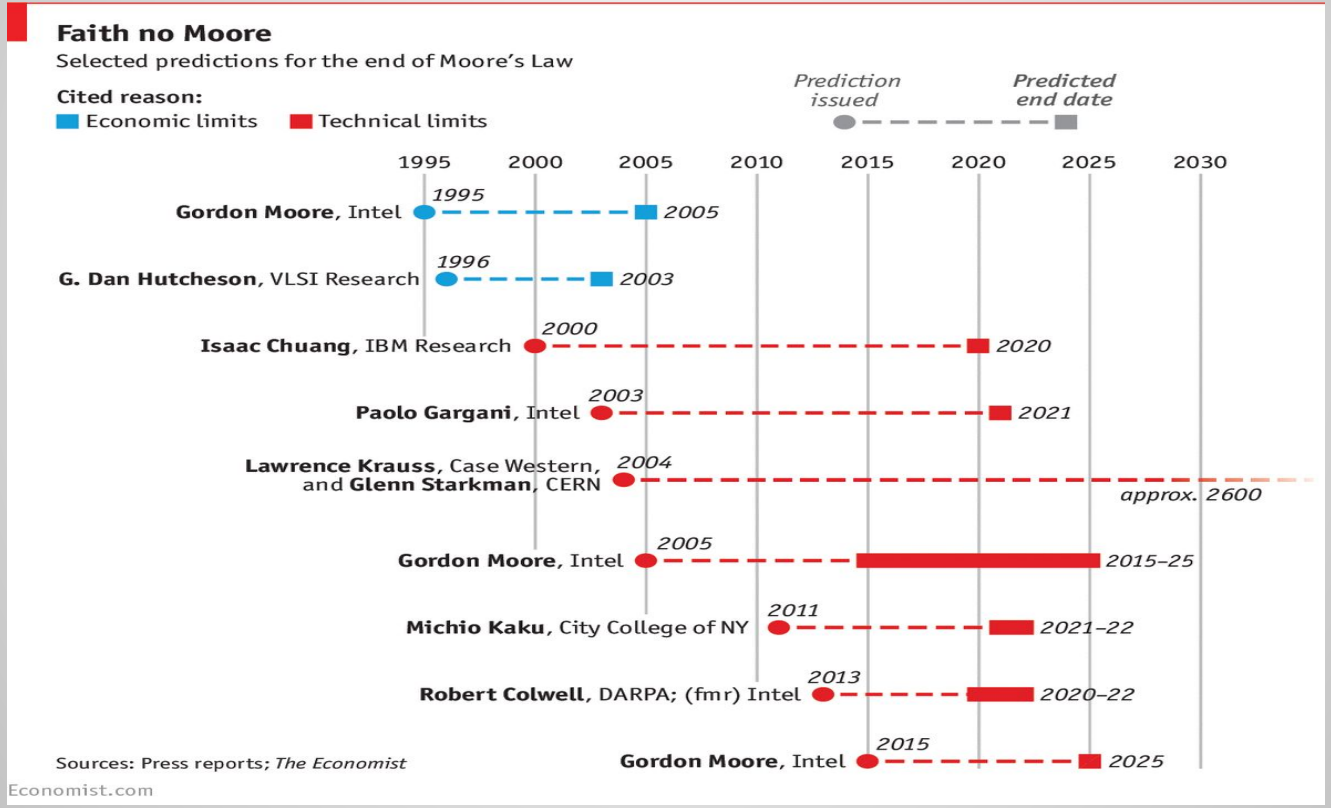
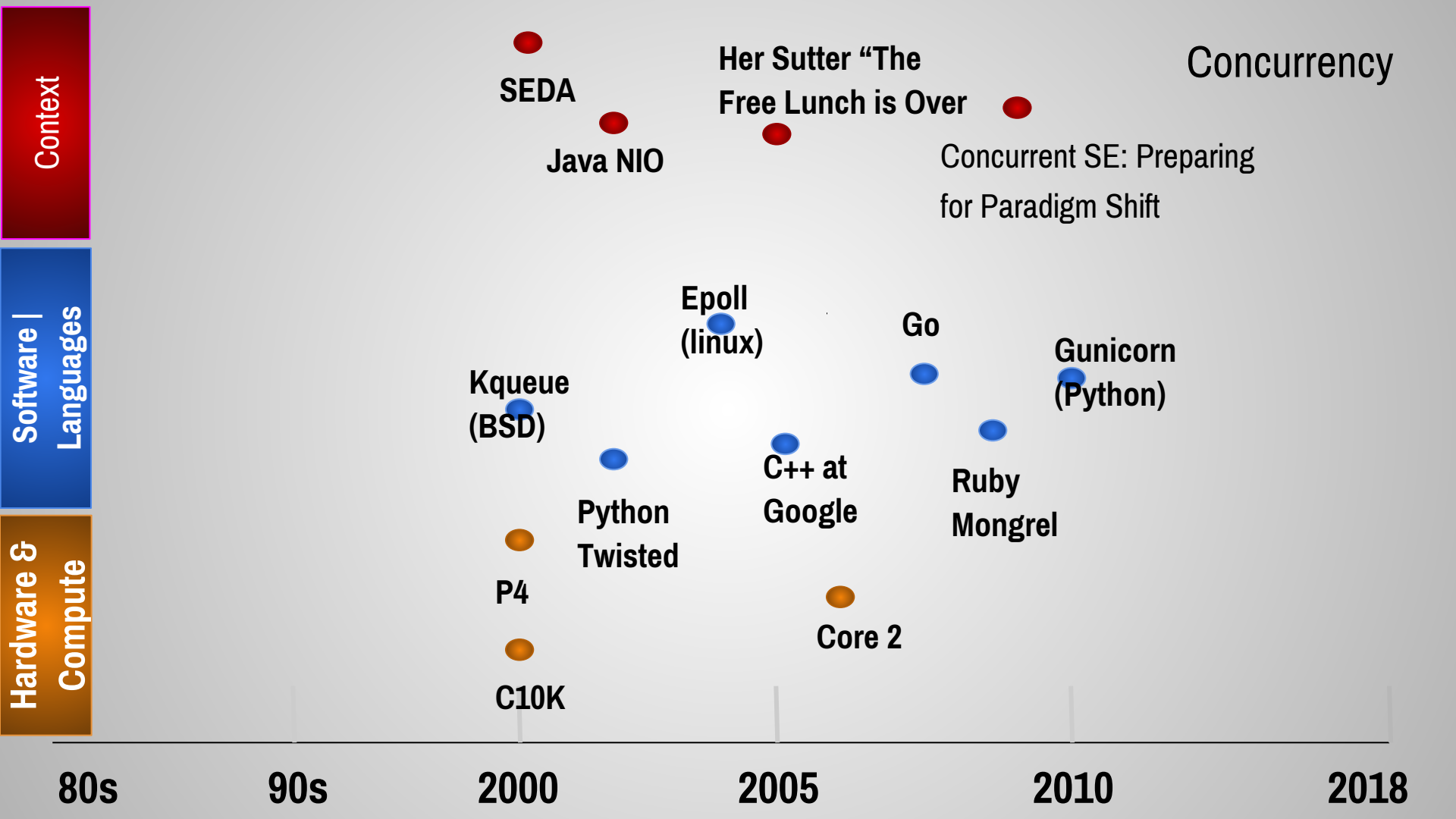
Predictions for the end of Moore's Law

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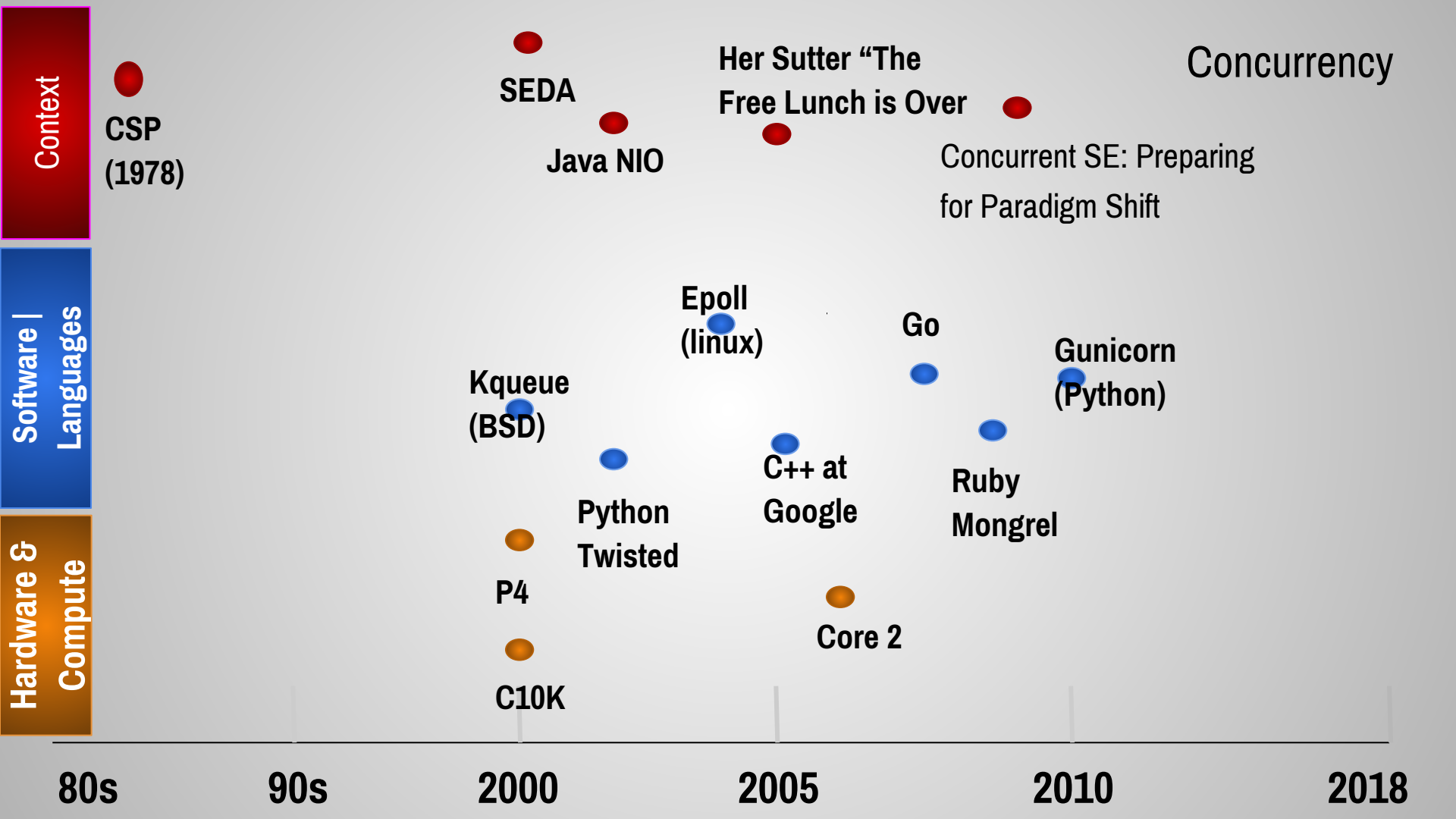
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Programming Techniques

S. L. Graham, R. L. Rivest Editors

Communicating Sequential Processes

C.A.R. Hoare
The Queen's University
Belfast, Northern Ireland

This paper suggests that input and output are basic primitives of programming and that parallel composition of communicating sequential processes is a fundamental program structuring method. When combined with a development of Dijkstra's guarded command, these concepts are surprisingly versatile. Their use is illustrated by sample solutions of a variety of familiar programming exercises.

Key Words and Phrases: programming, programming languages, programming primitives, program structures, parallel programming, concurrency, input, output, guarded commands, nondeterminacy, coroutines, procedures, multiple entries, multiple exits, classes, data representations, recursion, conditional critical regions, monitors, iterative arrays
CR Categories: 4.20, 4.22, 4.32

1. Introduction

Among the primitive concepts of computer programming, and of the high level languages in which programs are expressed, the action of assignment is familiar and well understood. In fact, any change of the internal state of a machine executing a program can be modeled as an assignment of a new value to some variable part of that machine. However, the operations of input and output, which affect the external environment of a machine, are not nearly so well understood. They are often added to a programming language only as an afterthought.

Among the structuring methods for computer programs, three basic constructs have received widespread recognition and use: A repetitive construct (e.g. the **while** loop), an alternative construct (e.g. the conditional **if..then..else**), and normal sequential program composition (often denoted by a semicolon). Less agreement has been reached about the design of other important program structures, and many suggestions have been made: Subroutines (Fortran), procedures (Algol 60 [15]), entries (PL/I), coroutines (UNIX [17]), classes (SIMULA 67 [5]), processes and monitors (Concurrent Pascal [2]), clusters (CLU [13]), forms (ALPHARD [19]), actors (Hewitt [1]).

The traditional stored program digital computer has been designed primarily for deterministic execution of a single sequential program. Where the desire for greater speed has led to the introduction of parallelism, every attempt has been made to disguise this fact from the programmer, either by hardware itself (as in the multiple function units of the CDC 6600) or by the software (as in an I/O control package, or a multiprogrammed operating system). However, developments of processor technology suggest that a multiprocessor machine, constructed from a number of similar self-contained processors (each with its own store), may become more powerful, capacious, reliable, and economical than a machine which is disguised as a monoprocessor.

In order to use such a machine effectively on a single task, the component processors must be able to communicate and to synchronize with each other. Many methods of achieving this have been proposed. A widely adopted method of communication is by inspection and updating of a common store (as in Algol 68 [18], PL/I, and many machine codes). However, this can create severe problems in the construction of correct programs and it may lead to expense (e.g. crossbar switches) and unreliability (e.g. glitches) in some technologies of hardware implementation. A greater variety of methods has been proposed for synchronization: semaphores [6], events (PL/I), conditional critical regions [10], monitors and queues (Concurrent Pascal [2]), and path expressions [3]. Most of these are demonstrably adequate for their purpose, but there is no widely recognized criterion for choosing between them.

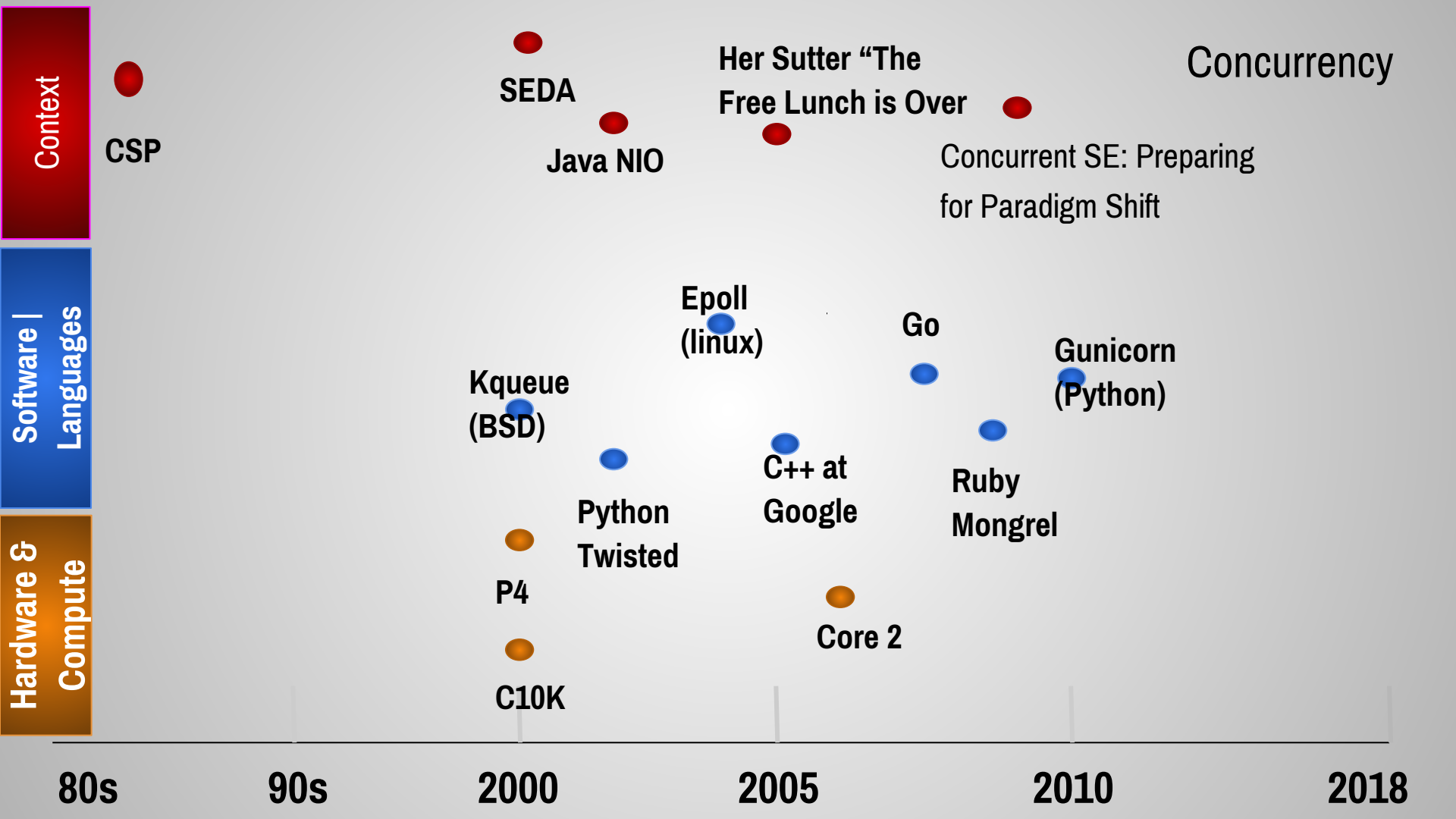
This paper makes an ambitious attempt to find a single simple solution to all these problems. The essential proposals are:
(1) Dijkstra's guarded commands [8] are adopted (with a slight change of notation) as sequential control structures, and as the sole means of introducing and controlling nondeterminism.
(2) A parallel command, based on Dijkstra's *parbegin* [6], specifies concurrent execution of its constituent sequential commands (processes). All the processes start simultaneously, and the parallel command ends only when they are all finished. They may not communicate with each other by updating global variables.
(3) Simple forms of input and output command are introduced. They are used for communication between concurrent processes.

This research was supported by a Senior Fellowship of the Science Research Council.

Author's present address: Programming Research Group, 45, Banbury Road, Oxford, England.

Why build concurrency on the ideas of CSP?

Concurrency and multi-threaded programming have over time developed a reputation for difficulty. [...]One of the most successful models for providing high-level linguistic support for concurrency comes from Hoare's Communicating Sequential Processes, or CSP. ***Occam and Erlang are two well known languages that stem from CSP.*** Go's concurrency primitives derive from a different part of the family tree whose main contribution is the powerful notion of channels as first class objects. Experience with several earlier languages has shown that the CSP model fits well into a procedural language framework.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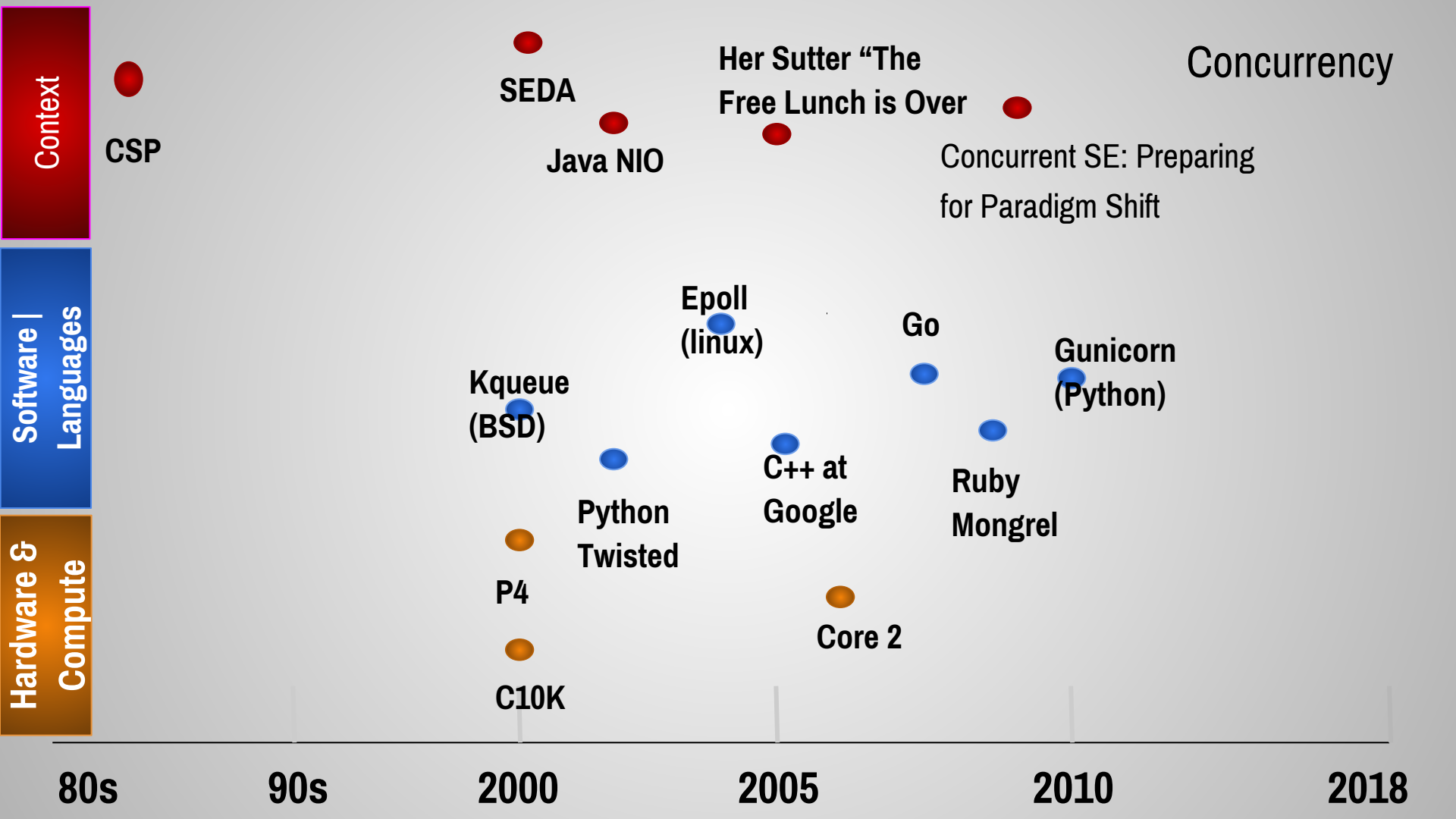
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Events, Threads and Goroutines

Nginx - event loop plus state machine model

Events, Threads and Goroutines

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Events, Threads and Goroutines

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Events, Threads and Goroutines

Nginx - event loop plus state machine model

App

Events, Threads and Goroutines

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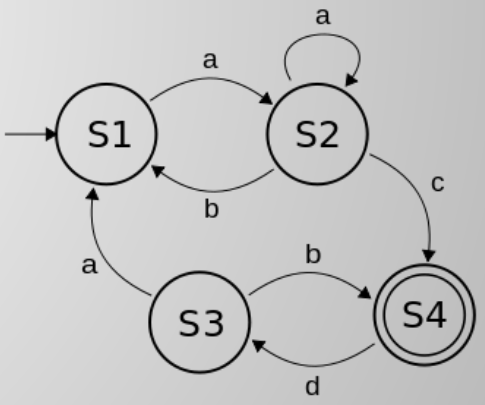

Events, Threads and Goroutines

Nginx - event loop plus state machine model

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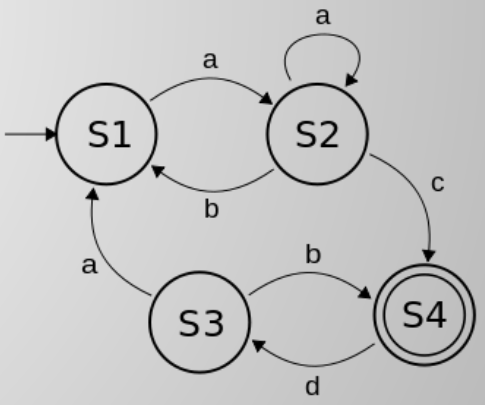

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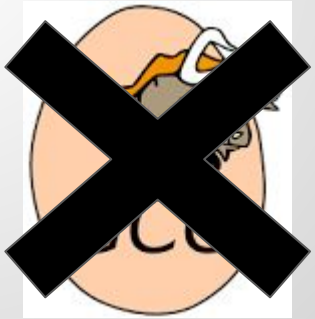

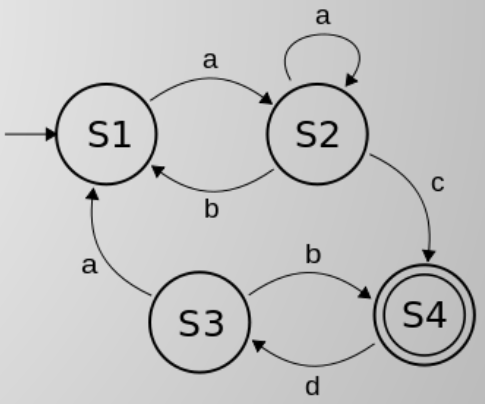

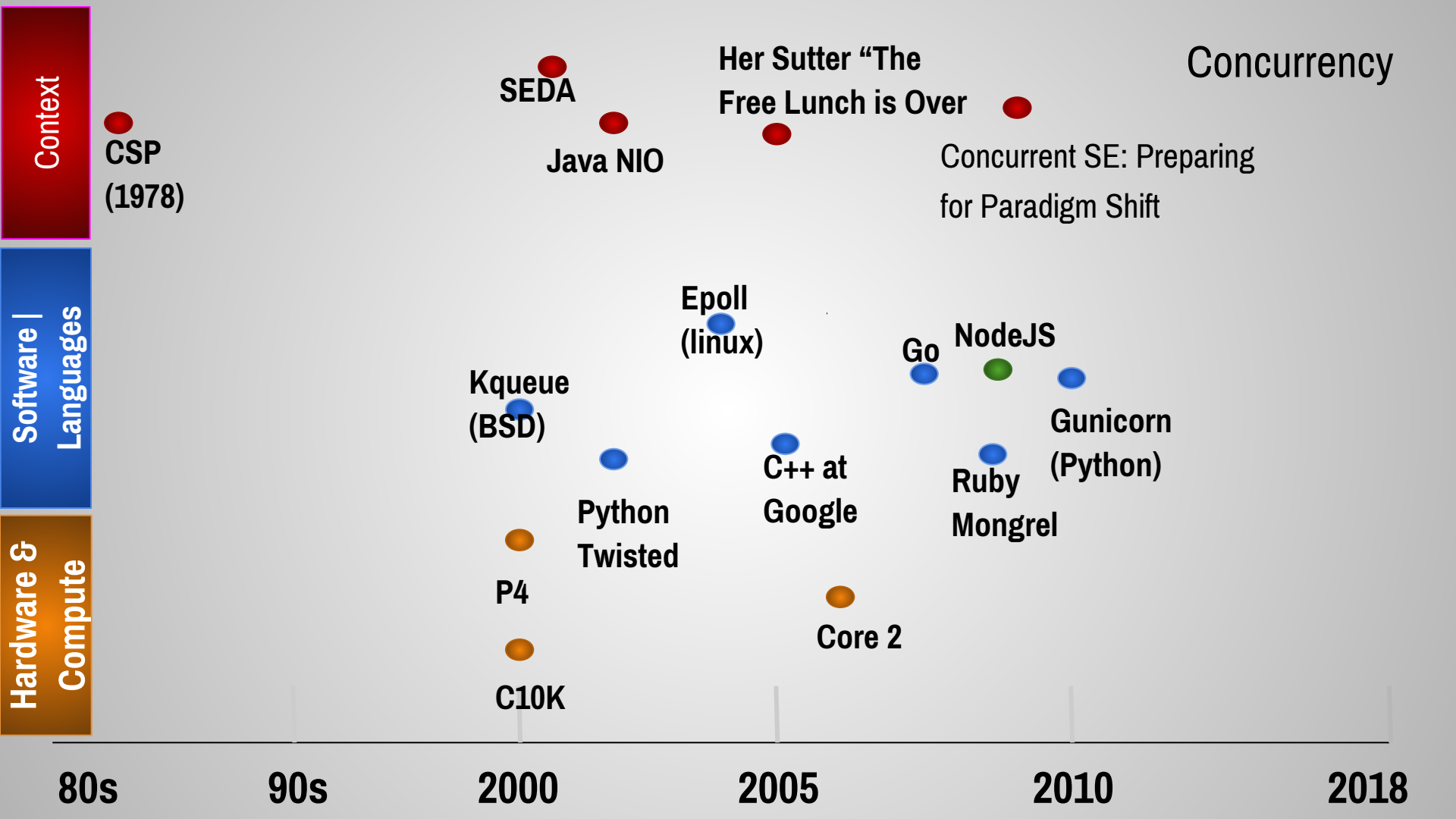
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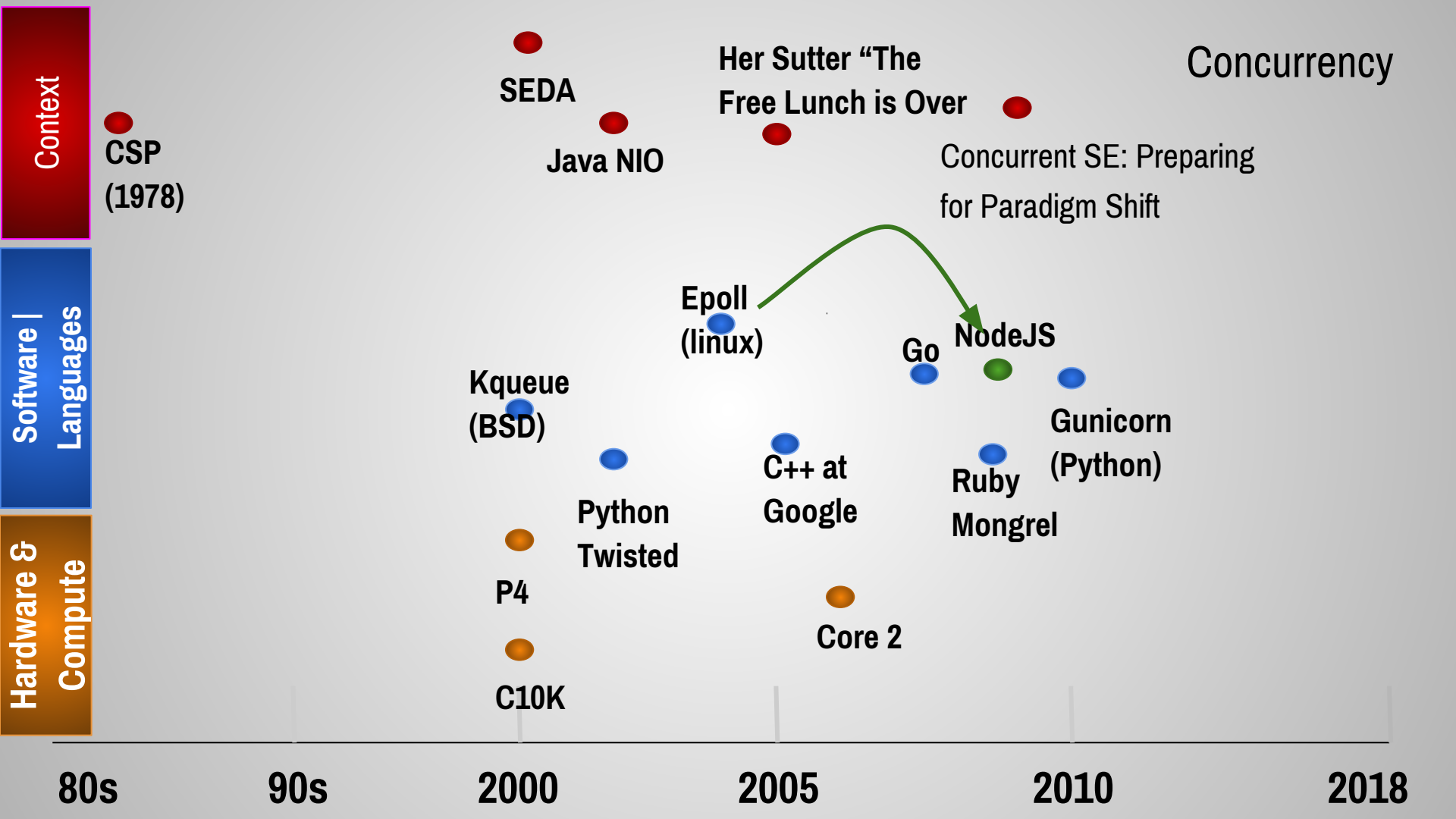
Context
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CSP
(1978)
SEDA
Java NIO
Her Sutter "The
Free Lunch is Over
Concurrent SE: Preparing
for Paradigm Shift
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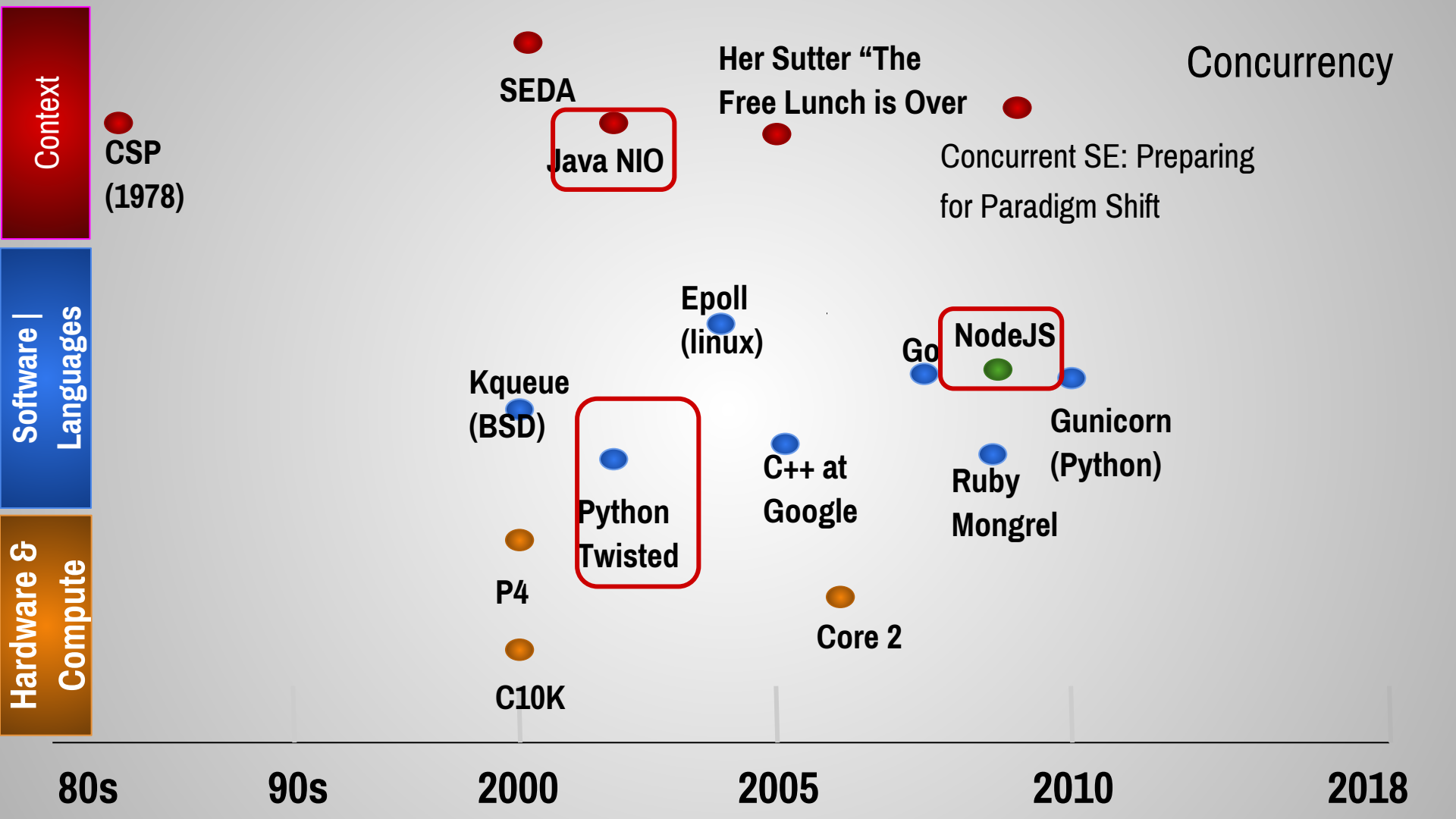
(linux)
Kqueue
(BSD)
Python
Twisted
P4
C10K
C++ at
Google
Core 2
Go
NodeJS
Ruby
Mongrel
Gunicorn
(Python)
80s
90s
2000
2005
2010
2018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Ruby Mongrel
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90s
2000
2005
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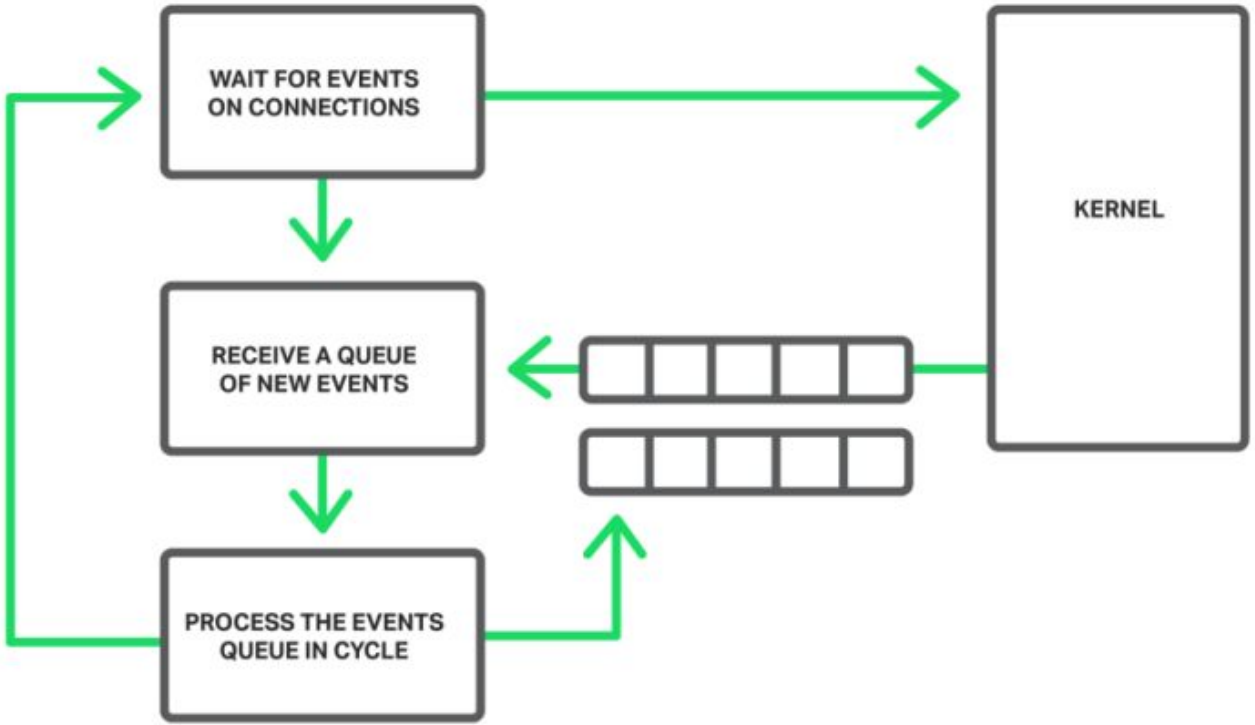
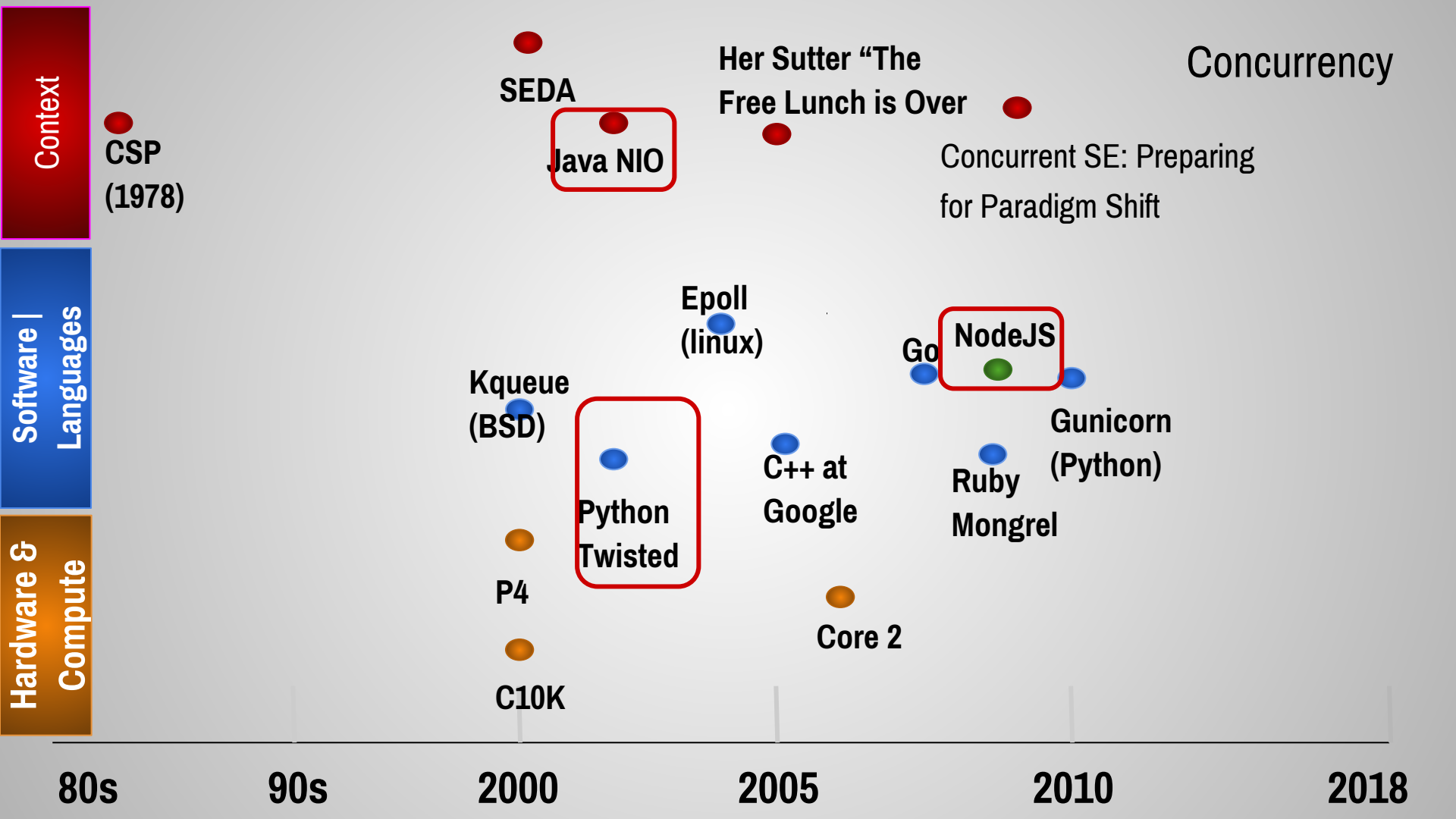
2018

NGINX EVENT LOOP

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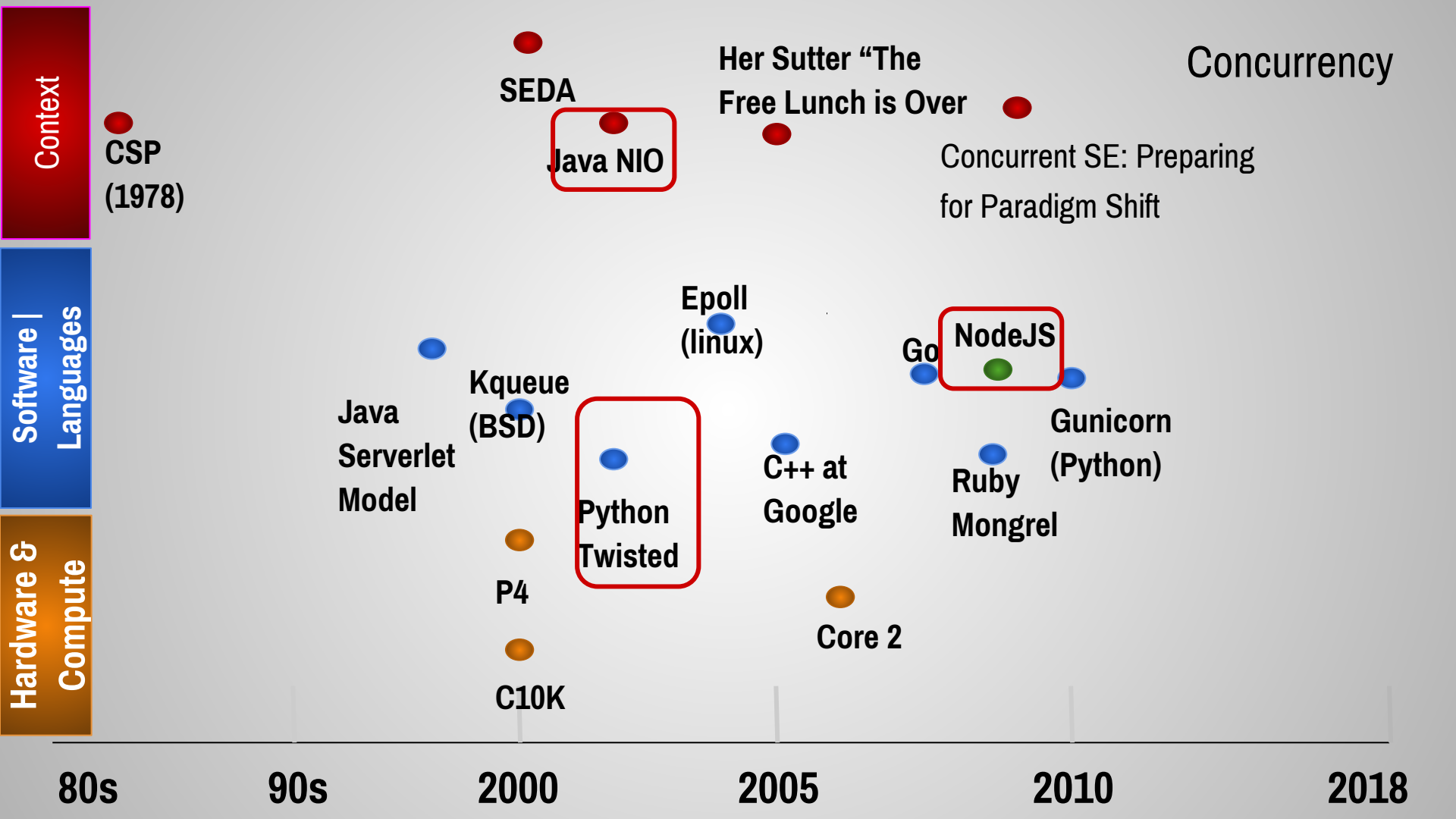
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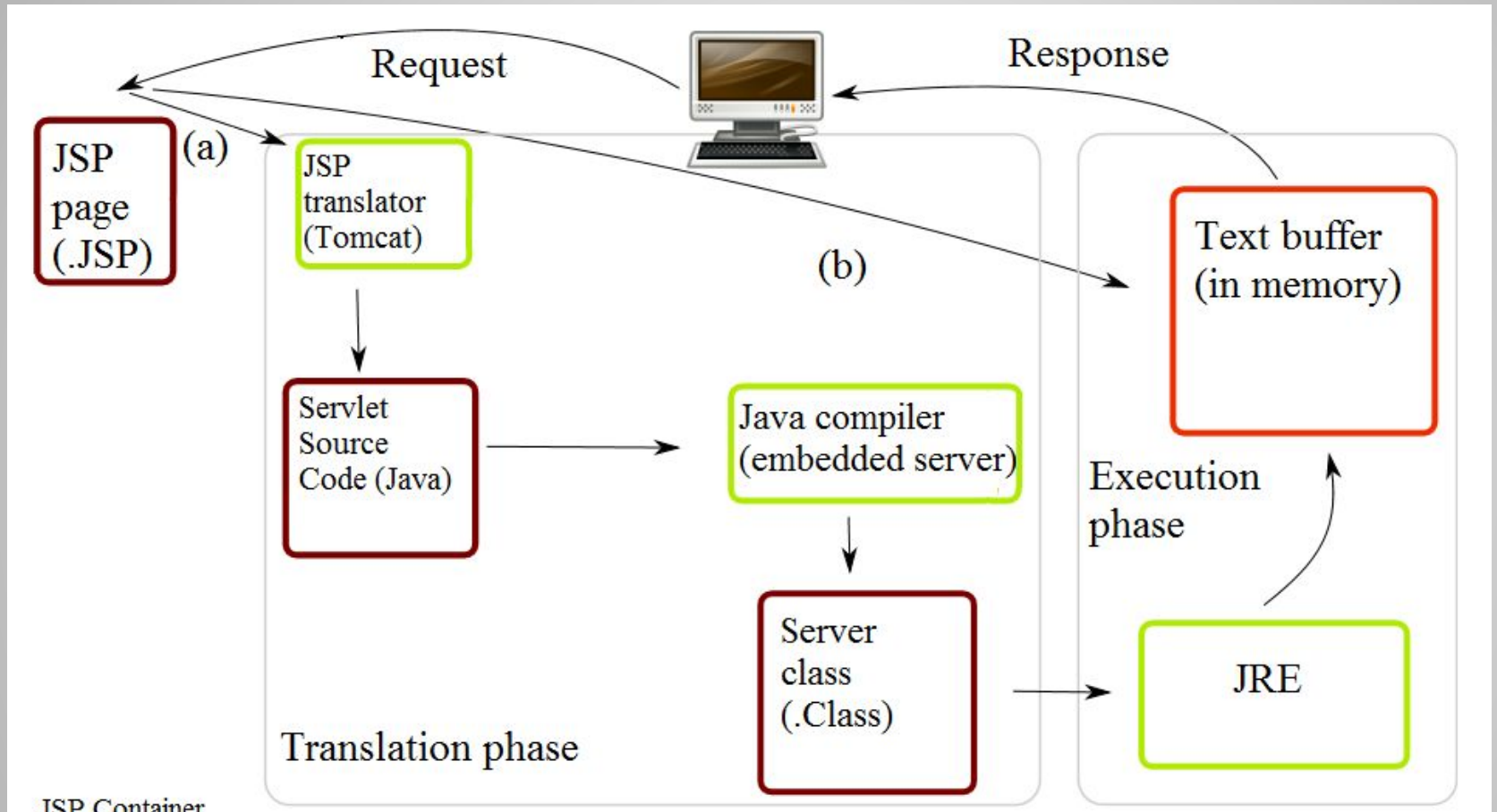
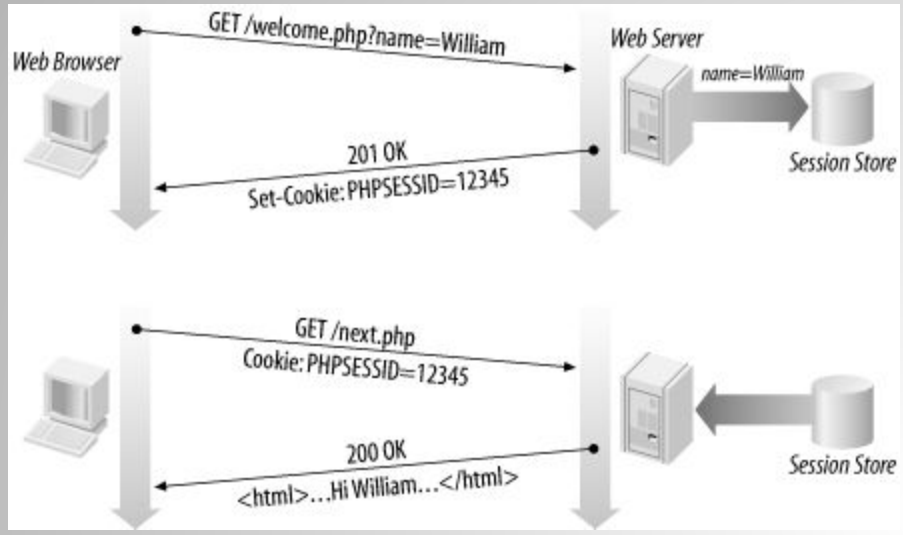
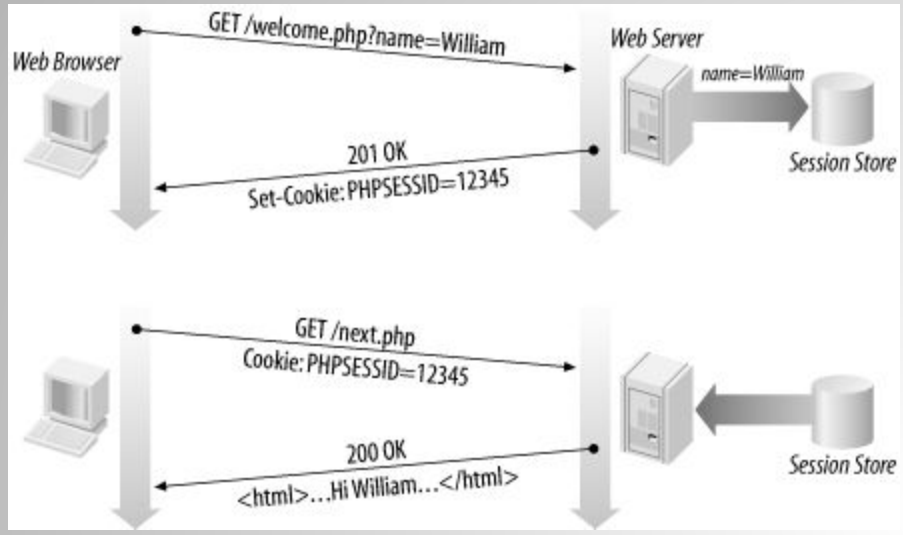


JSP Container
(a) Translation occurs at this point, if JSP has been changed or is new.
(b) If not, translation is skipped.


GET /welcome.php?name=William
Web Browser
Web Server
name=William
Session Store
201 OK
Set-Cookie: PHPSESSID=12345
GET /next.php
Cookie: PHPSESSID=12345
Session Store
200 OK
<html>…Hi William…</html>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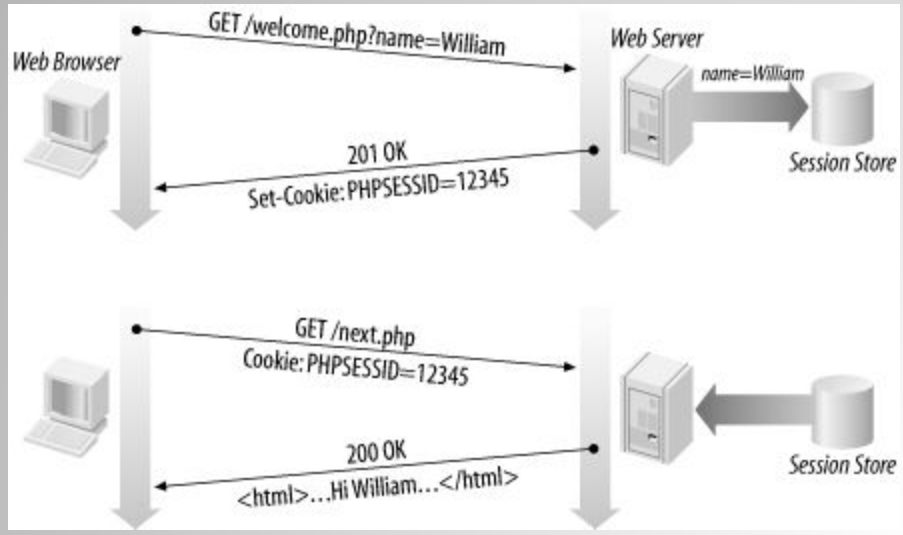
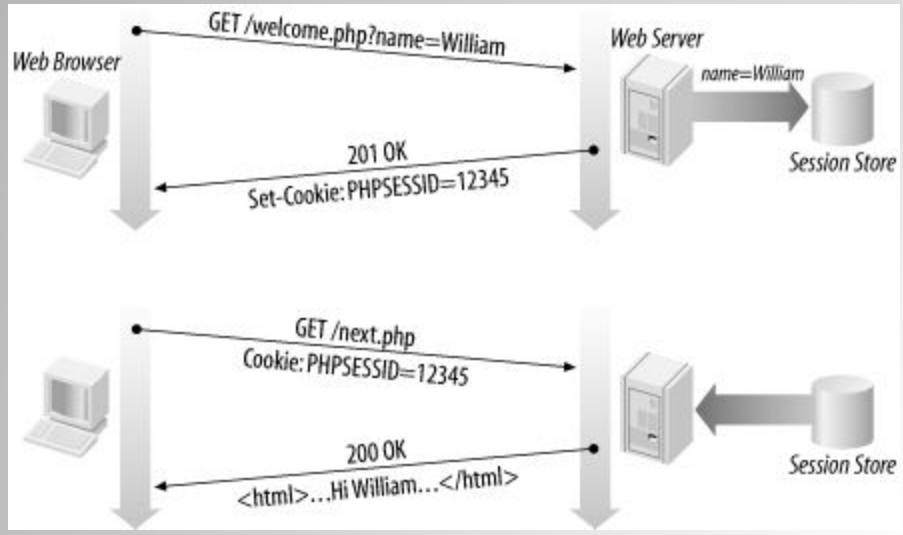
GET /welcome.php?name=William
Web Server
name=William
Session Store
201 OK
Set-Cookie: PHPSESSID=12345
GET /next.php
Cookie: PHPSESSID=12345
200 OK
<html>…Hi William…</html>
Session Store


WWW.


Web Browser
GET /welcome.php?name=William
Web Server
name=William
Session Store
201 OK
Set-Cookie: PHPSESSID=12345
GET /next.php
Cookie: PHPSESSID=12345
200 OK
<html>…Hi William…</html>
Session Store


WWW.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Web Browser
Web Server
name=William
Session Store
201 OK
Set-Cookie: PHPSESSID=12345
GET /next.php
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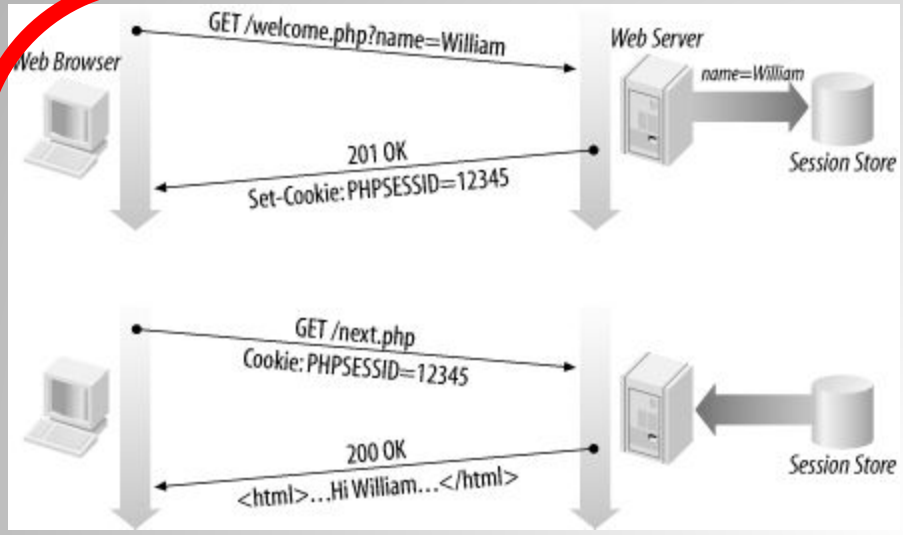
200 OK
<html>…Hi William…</html>
Session Store


WWW.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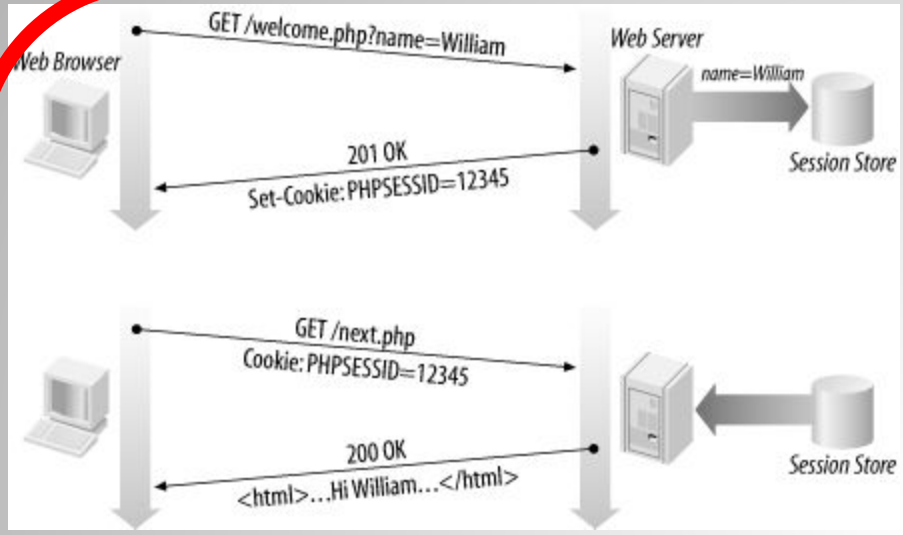
Web Browser
Web Server
name=William
Session Store
201 OK
Set-Cookie: PHPSESSID=12345
GET /next.php
Cookie: PHPSESSID=12345
200 OK
<html>…Hi William…</html>
Session Store


WWW.

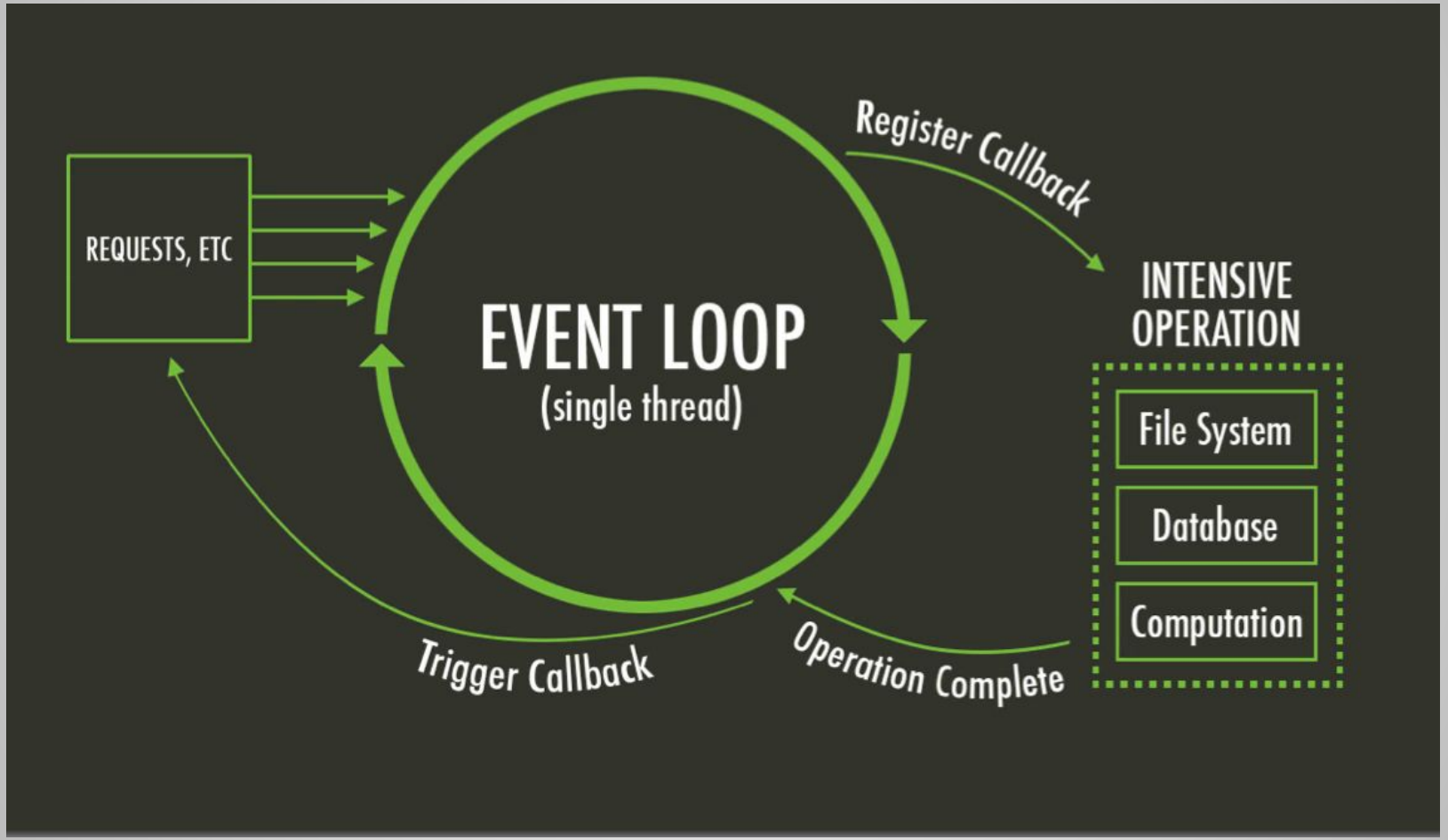
App

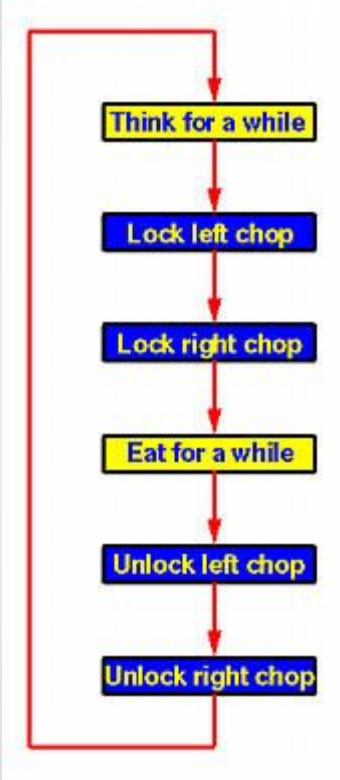

GET /welcome.php?name=William
Web Browser
Web Server
name=William
Session Store
201 OK
Set-Cookie: PHPSESSID=12345
GET /next.php
Cookie: PHPSESSID=12345
200 OK
<html>…Hi William…</html>
Session Store

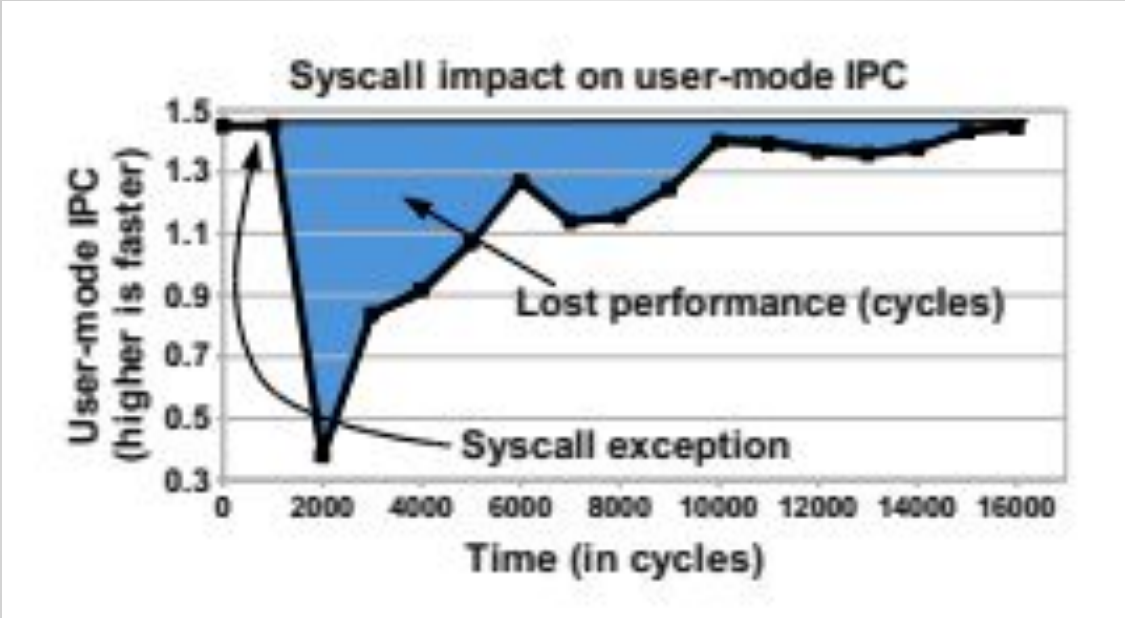

WWW.

= Threads

App


REQUESTS, ETC
EVENT LOOP
(single thread)
Register Callback
INTENSIVE OPERATION
File System
Database
Computation
Trigger Callback
Operation Complete

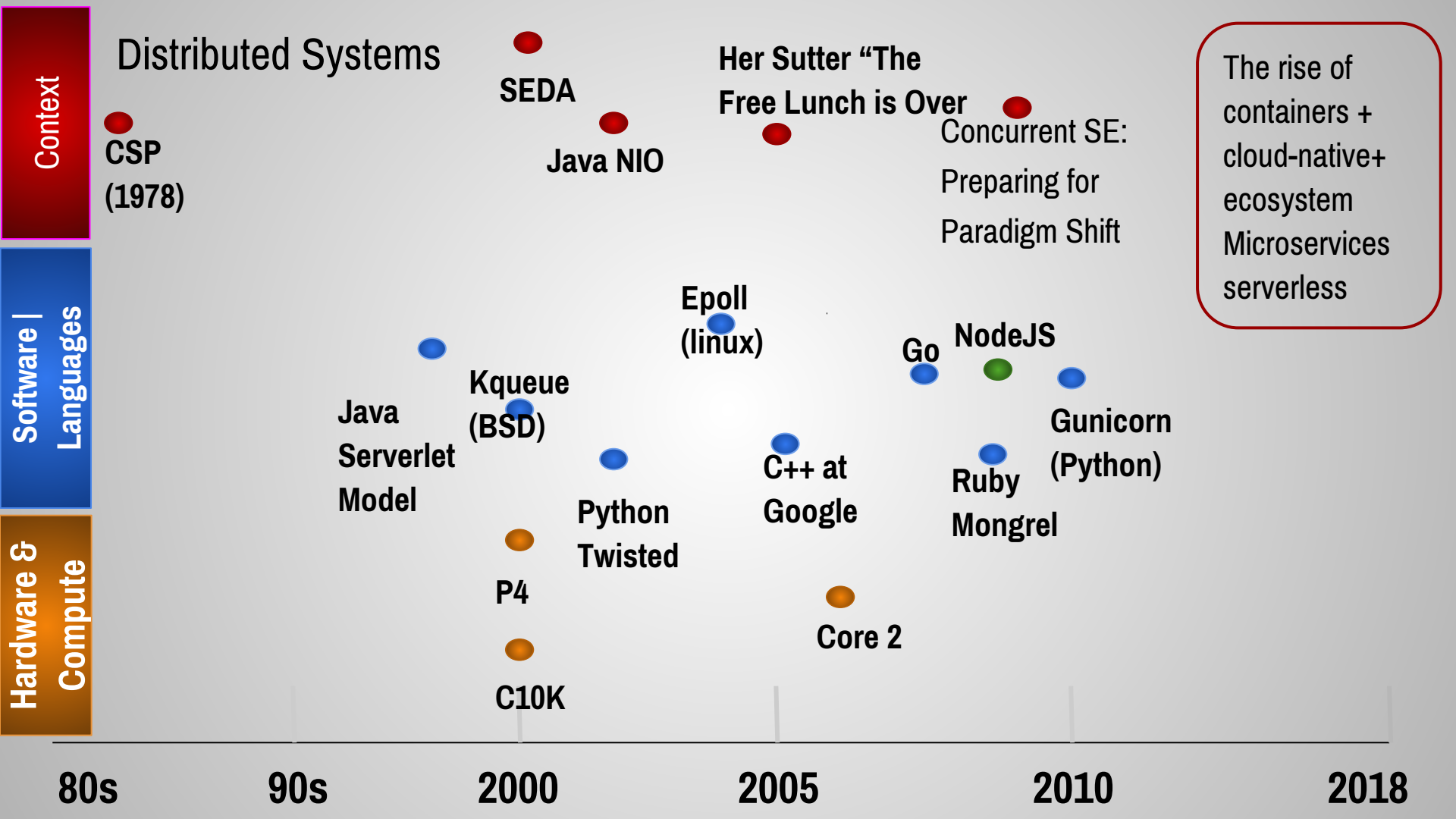

Think for a while
Lock left chop
Lock right chop
Eat for a while
Unlock left chop
Unlock right chop


Syscall impact on user-mode IPC
User-mode IPC
(higher is faster)
1.5
1.3
1.1
0.9
0.7
0.5
0.3
0
2000
4000
6000
8000
10000
12000
14000
16000
Time (in cycles)
Lost performance (cycles)
Syscall exception

CONCURRENCY - Conclusions

- goroutines are a success: give you the same expressiveness of a traditional imperative programming language while hiding the event driven nature of their interactions with the outside world from the programmer.

- when goroutines do need to coordinate, they do so in user space, rather than being forced to use expensive kernel interactions.


Context
Software | Languages
Hardware & Compute
Distributed Systems
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2010
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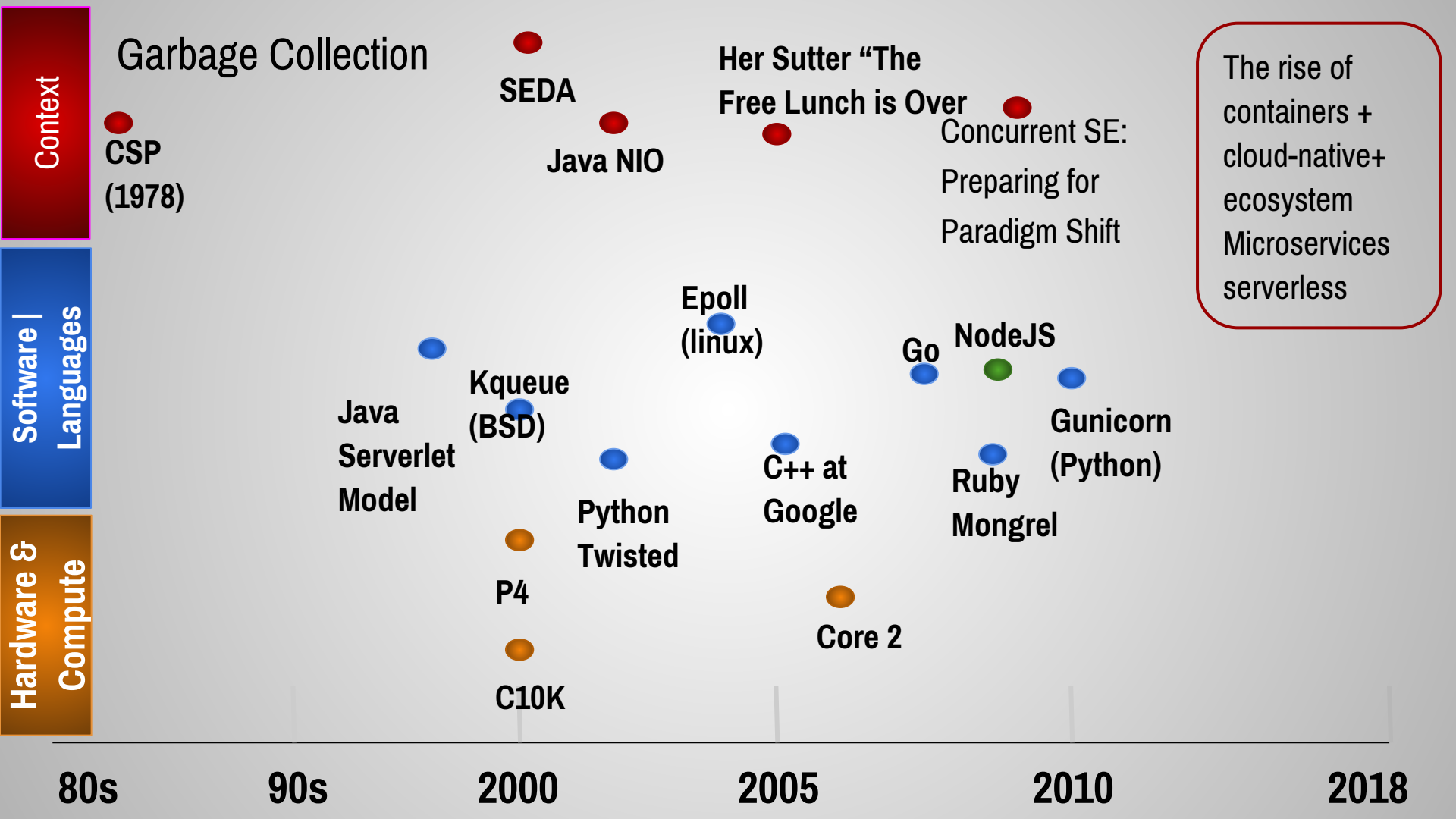
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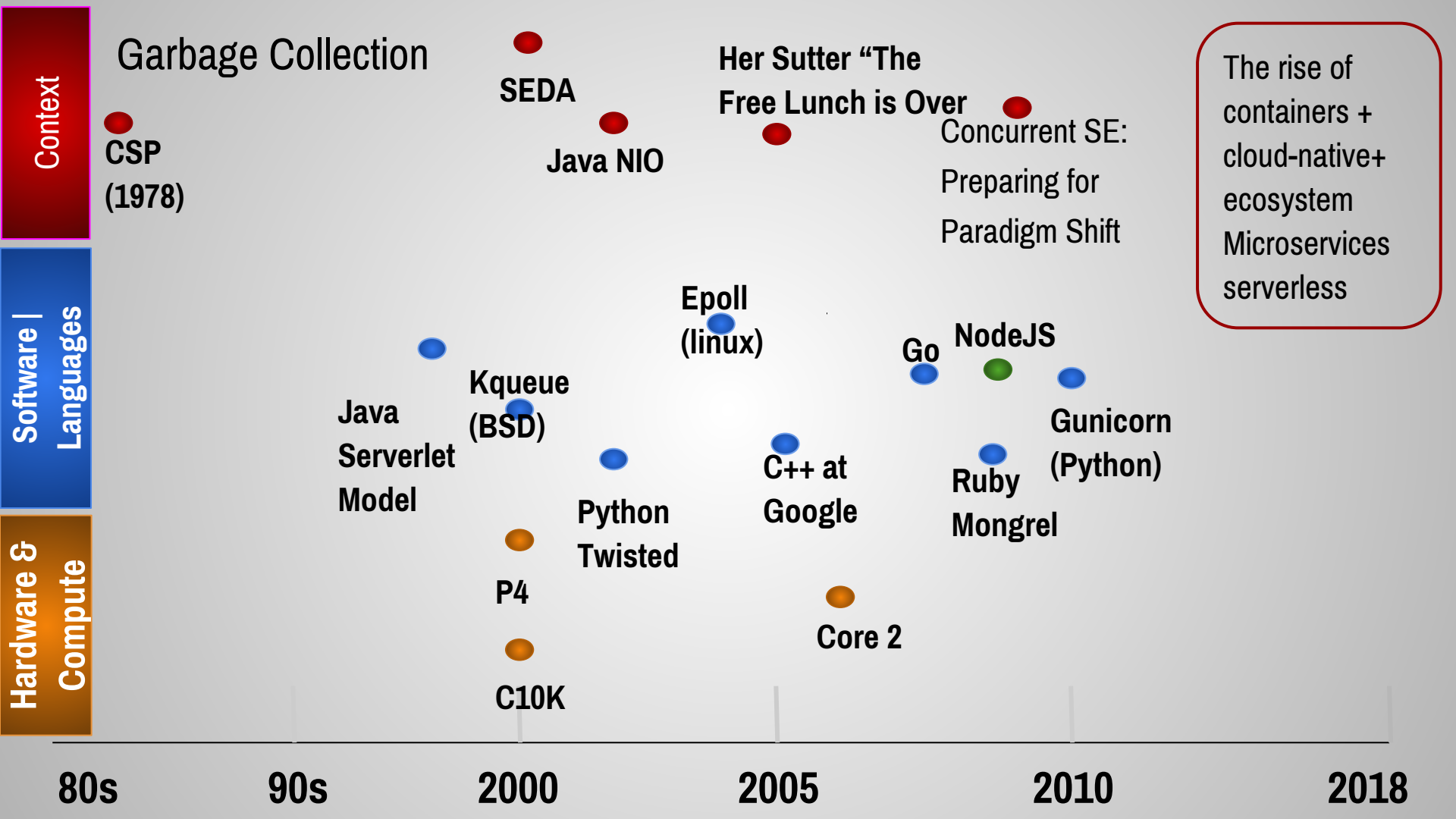
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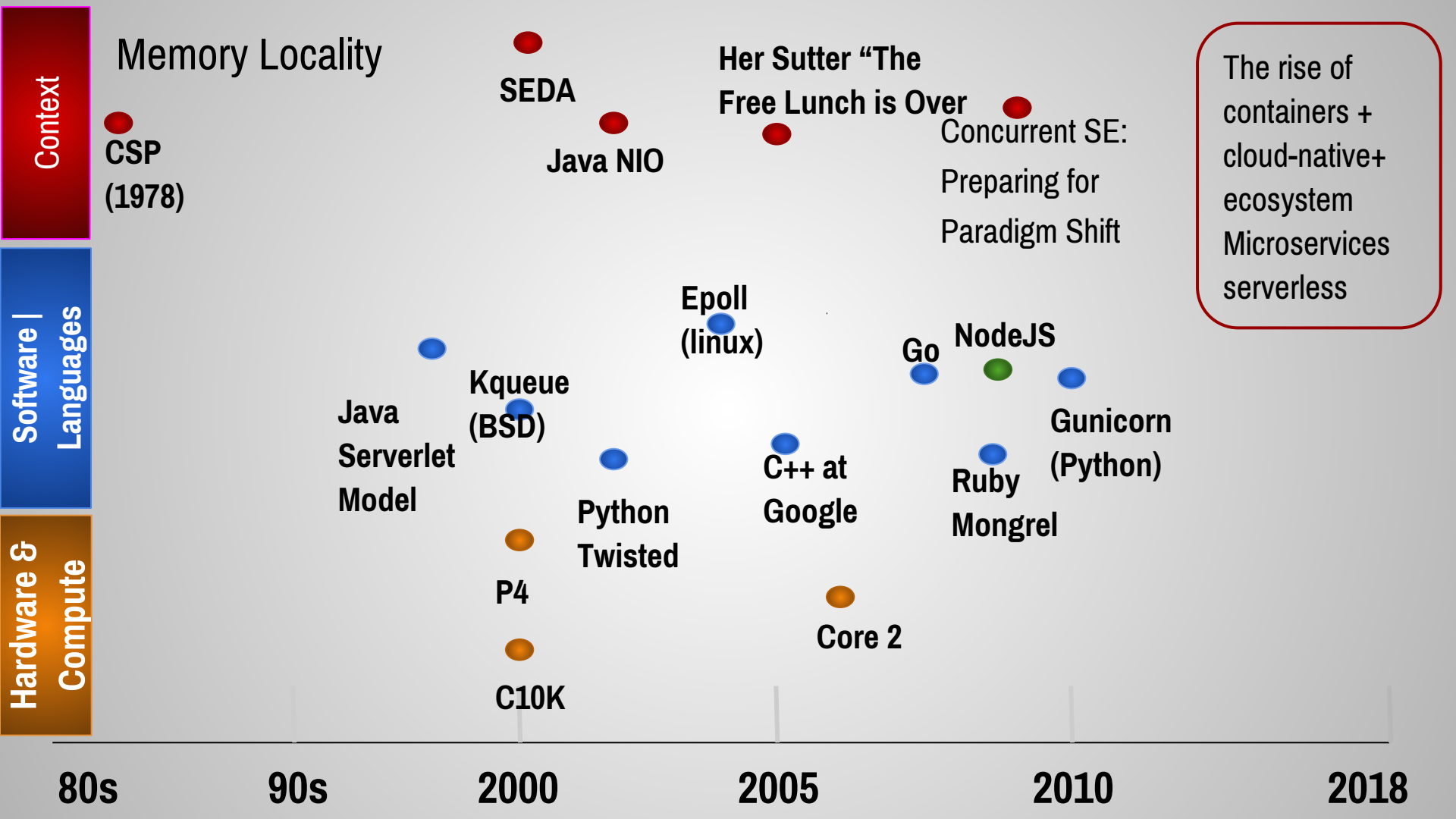
Context
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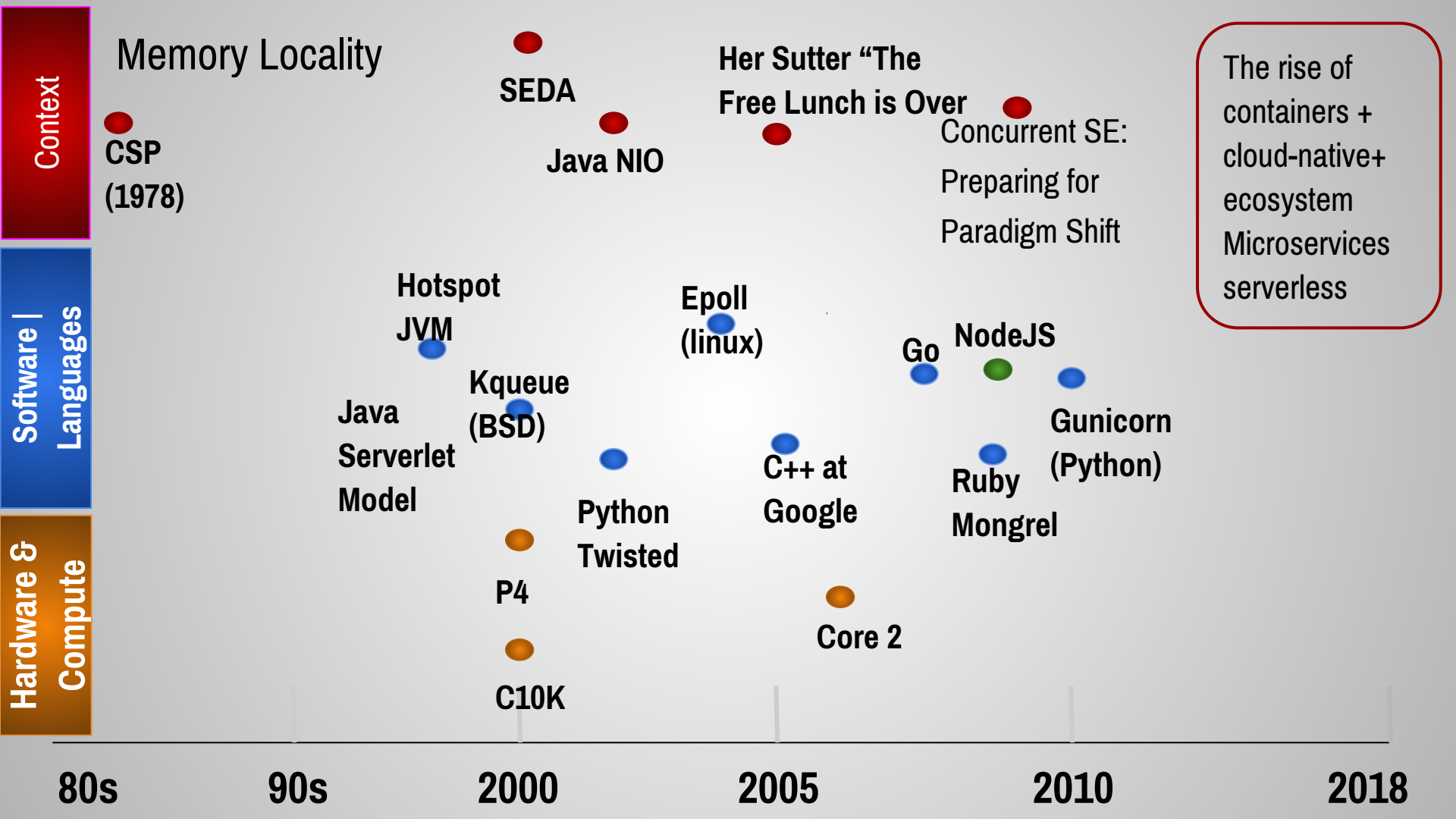
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90s
2000
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2010
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Memory & Data Locality

Python

```
% python
>>> from sys import getsizeof
>>> gocon = 2014
>>> getsizeof(gocon)
24
```

Memory & Data Locality

Java

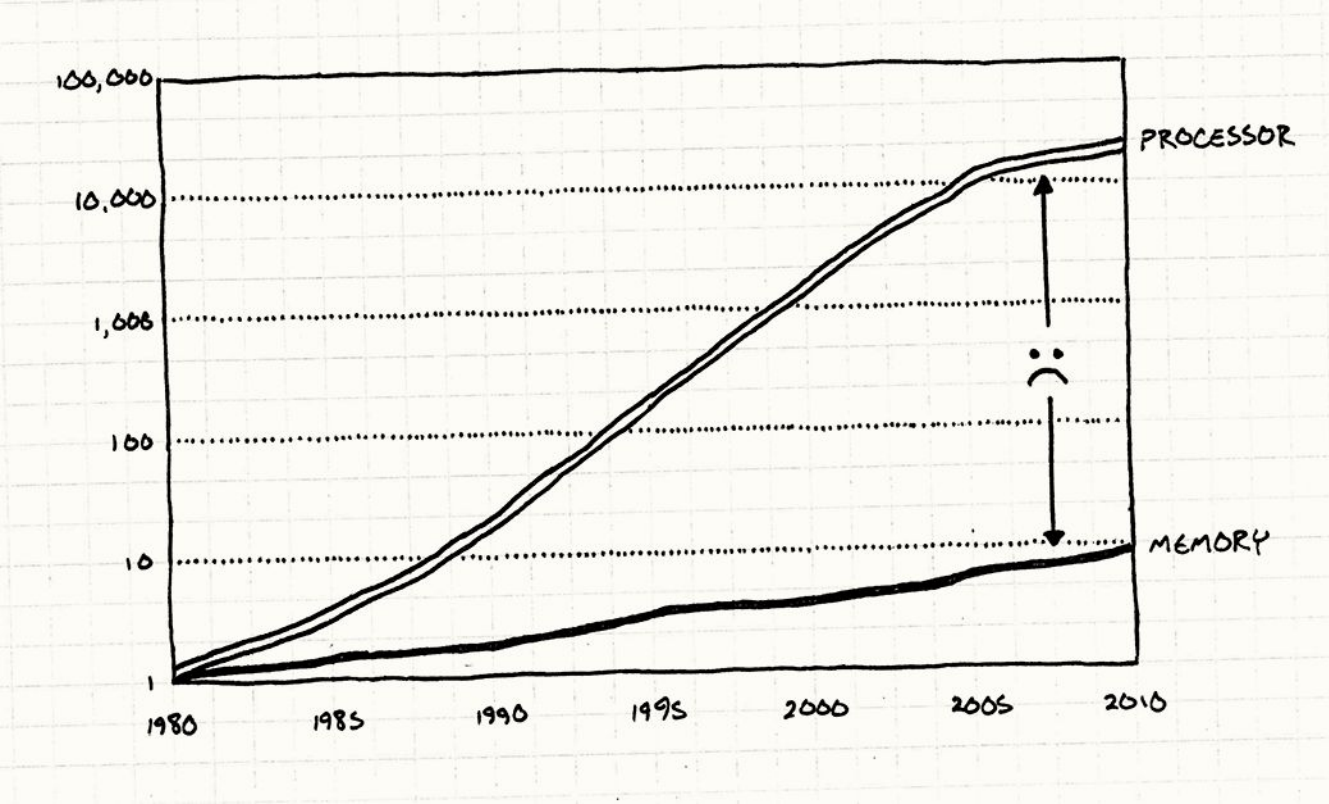
```
int gocon = 2014;
```

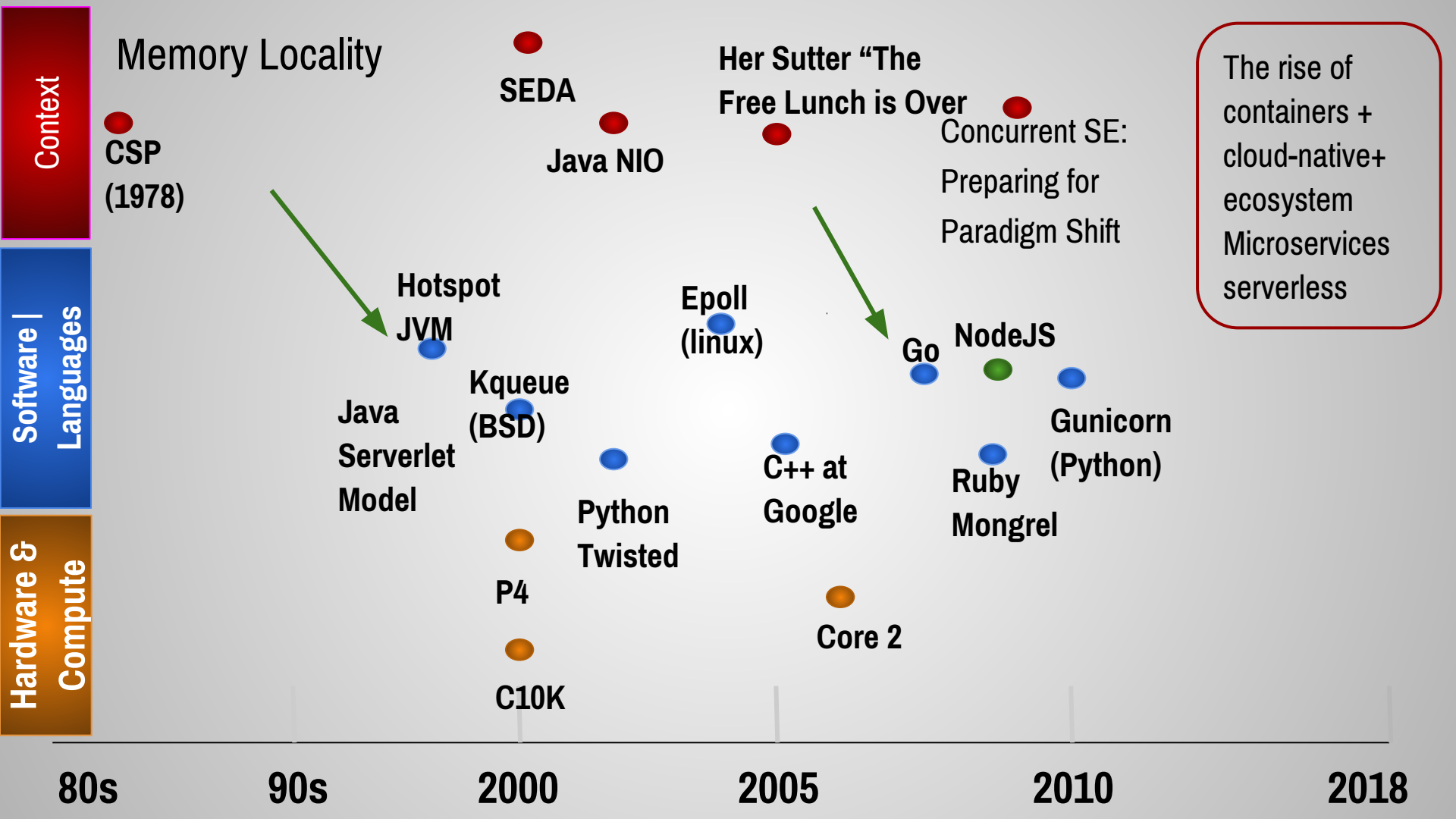
Memory & Data Locality

Java

```
// 16 bytes on 32 bit JVM
// 24 bytes on 64 bit JVM
Integer gocon = new Integer(2014);
```

Memory & Data Locality

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Memory Locality

Java

Memory Locality

Java

No value types

Everything Allocated

Memory Locality

Java

No value types

Everything Allocated

Go

Memory Locality

Java

No value types

Everything Allocated

Go

Structs

True Value types

Memory Locality

Java

No value types

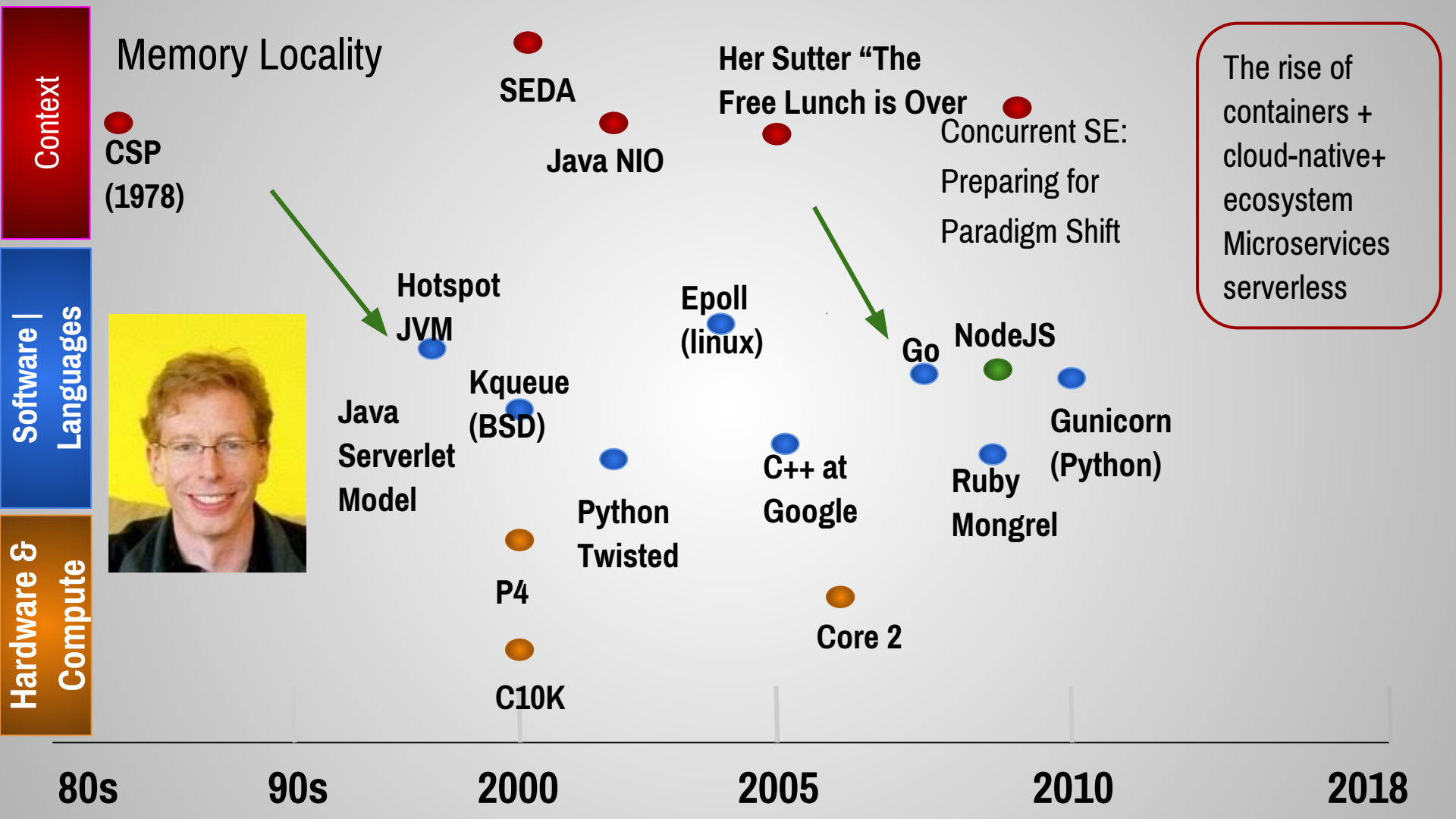
Everything Allocated

Can’t return multiple values (until 2018)

Go

Structs

True Value types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90s
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When the three of us [Ken Thompson, Rob Pike, and Robert Griesemer] got started, it was pure research. The three of us got together and decided that we hated C++. [laughter] ... [Returning to Go,] we started off with the idea that all three of us had to be talked into every feature in the language, so there was no extraneous garbage put into the language for any reason.

Memory Locality

Java

No value types

Everything Allocated

Can’t return multiple values

Go

Structs

True Value types

Memory Locality

Java	Go
No value types	Structs
Everything Allocated	True Value types
Can’t return multiple values	compact object layout
	No object headers

Memory Locality

Java	Go
No value types	Structs
Everything Allocated	True Value types
Can’t return multiple values	compact object layout
	No object headers

Memory Locality

Java **UTF-16**

No value types

Everything Allocated

Can’t return multiple values

Go **UTF-8**

Structs
True Value types
Compact object layout
No object headers
Lazy initialization of collections

Memory and Data Locality (conclusion)

Memory Locality (conclusion)

- Go gives programmers the tools to talk about memory efficiently ***if they need it.***

Memory Locality (conclusion)

- Go gives programmers the tools to talk about memory efficiently ***if they need it.***
- Flexible

Memory Locality (conclusion)

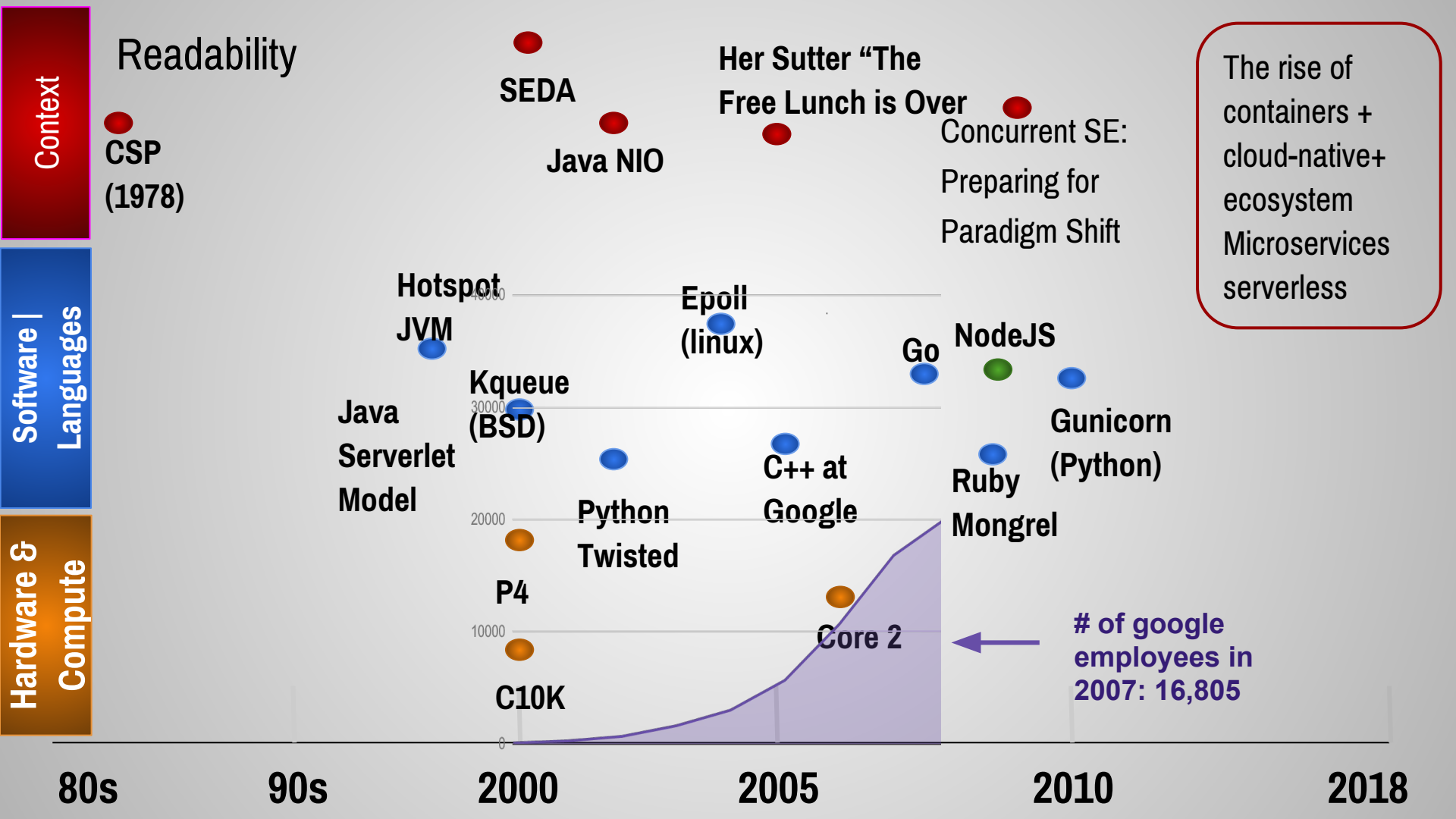
- Go gives programmers the tools to talk about memory efficiently ***if they need it.***
- Flexible
- Memory management (not an all-or-nothing like in C++ or Rust)

Readability

Readability is paramount—Rob Pike

Readability

> *“ Debugging is twice as hard as writing the code in the first place. Therefore, if you write the code as cleverly as possible, you are, by definition, not smart enough to debug it. ”*—Brian Kernighan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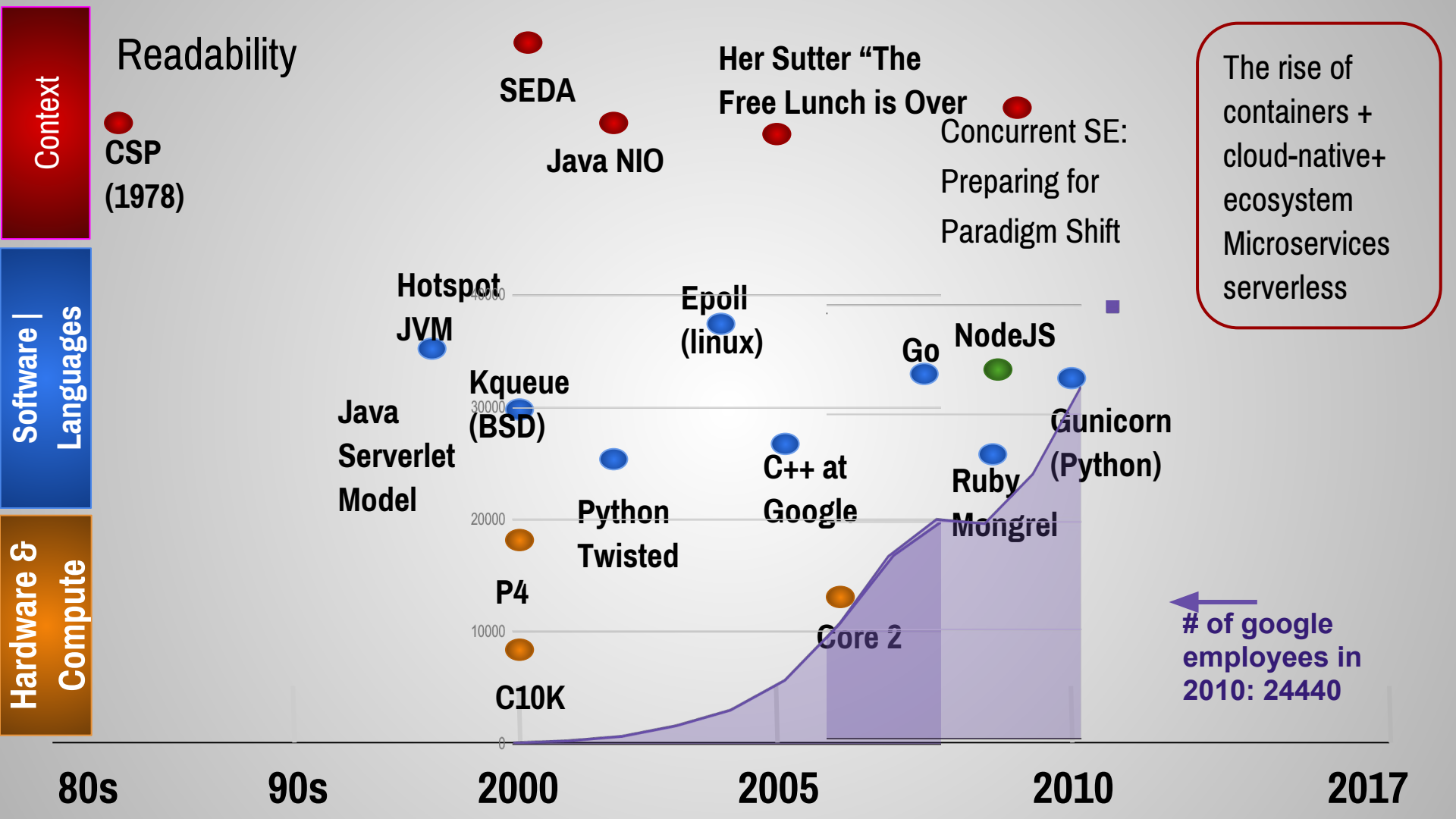
C10K
Core 2
# of google employees in 2007: 16,805
40000
30000
20000
10000
0
80s
90s
2000
2005
2010
2018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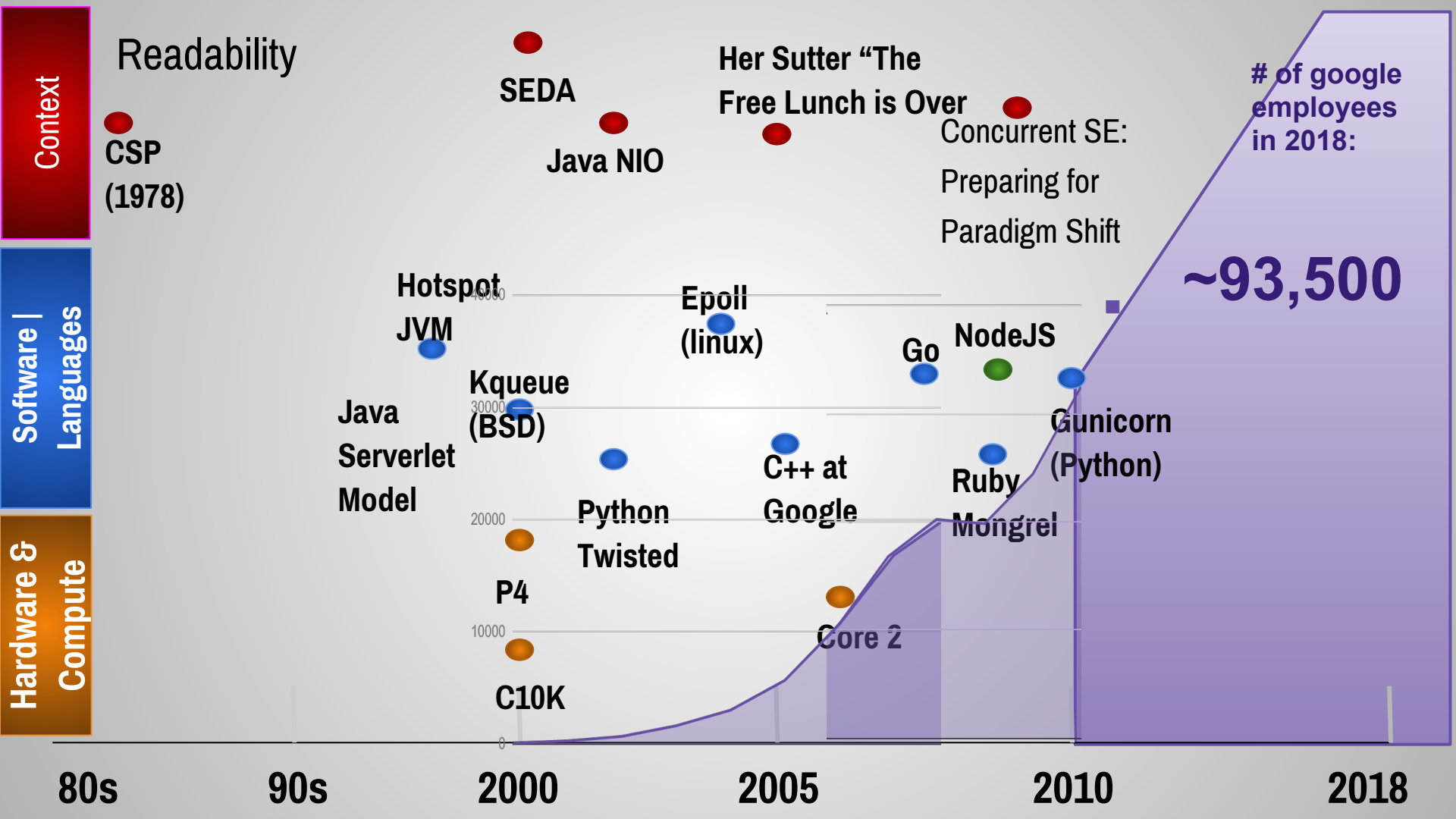
C10K
40000
30000
20000
10000
0
# of google employees in 2010: 24440
80s
90s
2000
2005
2010
2017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~93,500
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2018

Readability

simplicity

Readability

simplicity

“simple is better”

Readability

simplicity

“simple is better”

“this is an insult to intelligent programmers”

Readability

simplicity

“simple is better”

“you’re trying to commodify programming and create a situation where our bosses can replace us at will”

“You’re not paid to program, you’re not even paid to maintain someone else’s program, you’re paid to deliver solutions to the business.”

- Dave Cheney

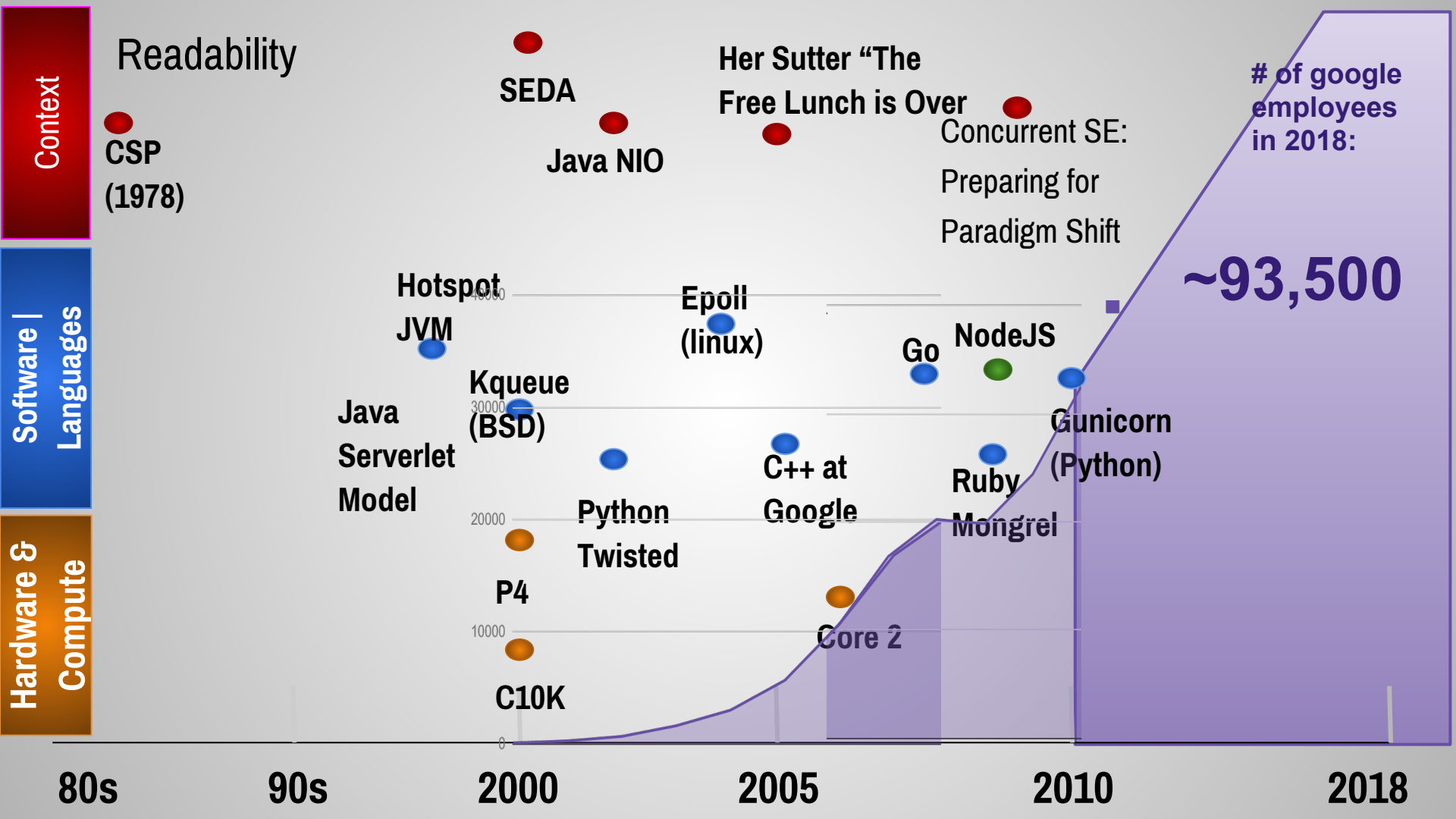
Readability

Programs which cannot be maintained will be rewritten

Readability

Programs which cannot be maintained will be rewritten

“If you can’t be replaced, you cannot be promoted”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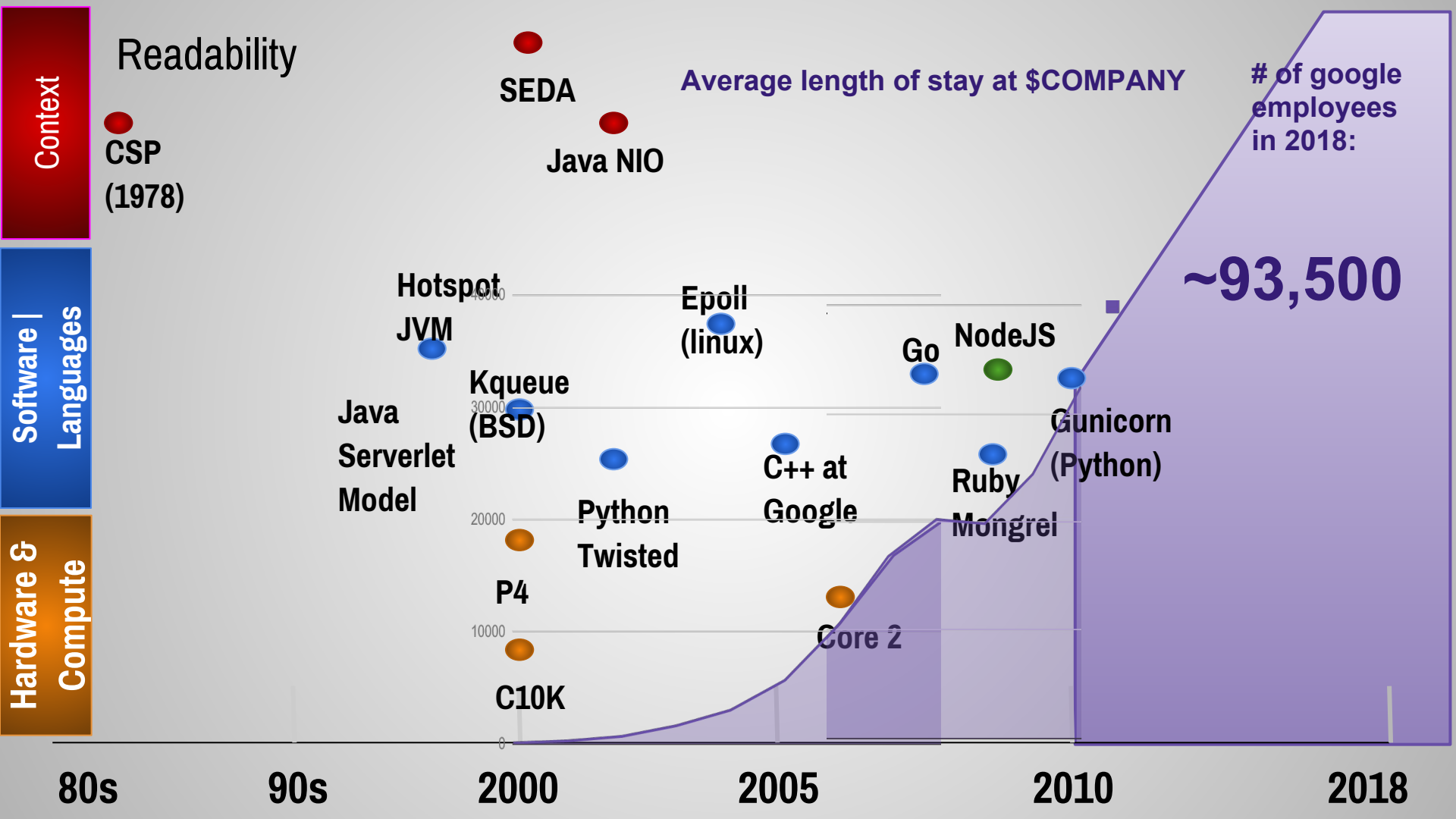
Context
Software | Languages
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Readability
CSP
(1978)
SEDA
Java NIO
Average length of stay at $COMPANY
# of google employees in 2018:
~93,500
Hotspot
JVM
Epoll
(linux)
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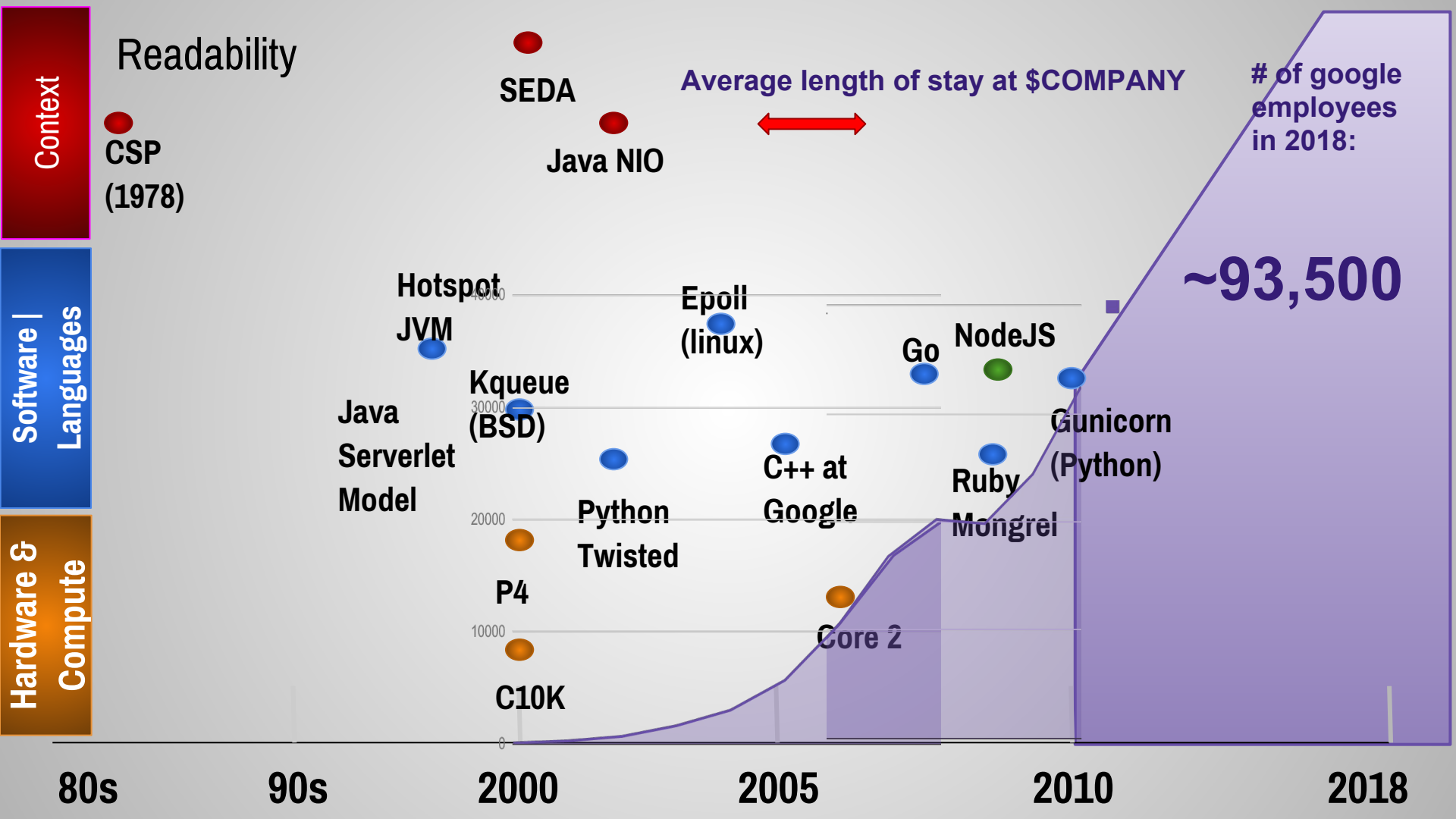
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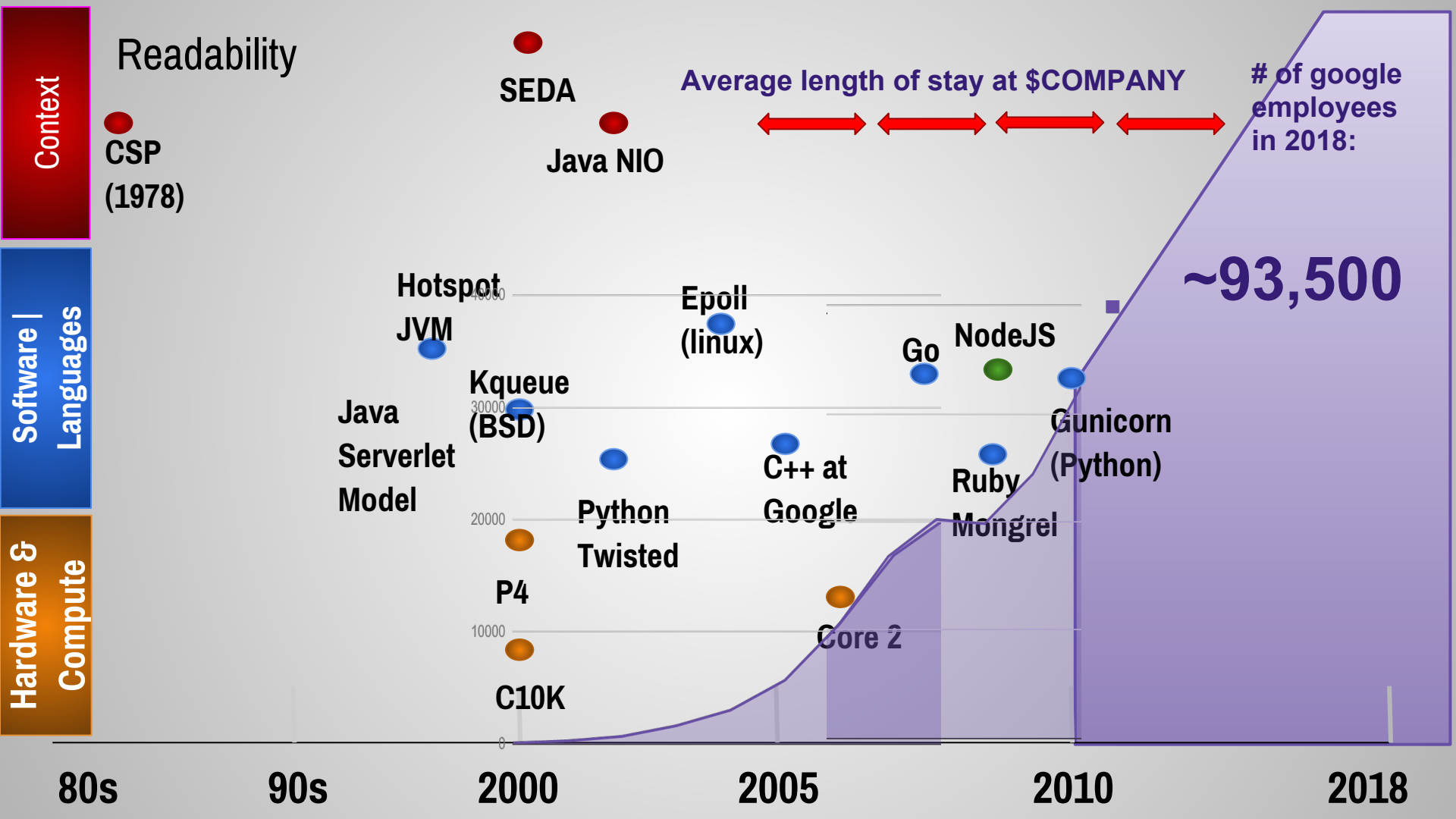
Software | Languages
Hardware & Compute
Readability
CSP
(1978)
SEDA
Java NIO
Average length of stay at $COMPANY
# of google employees in 2018:
~93,500
Hotspot
JVM
Epoll
(linux)
Go
NodeJS
Kqueue
(BSD)
Java
Serverlet
Model
Gunicorn
(Python)
C++ at
Google
Ruby
Mongrel
Python
Twisted
P4
Core 2
C10K
40000
30000
20000
10000
0
80s
90s
2000
2005
2010
2018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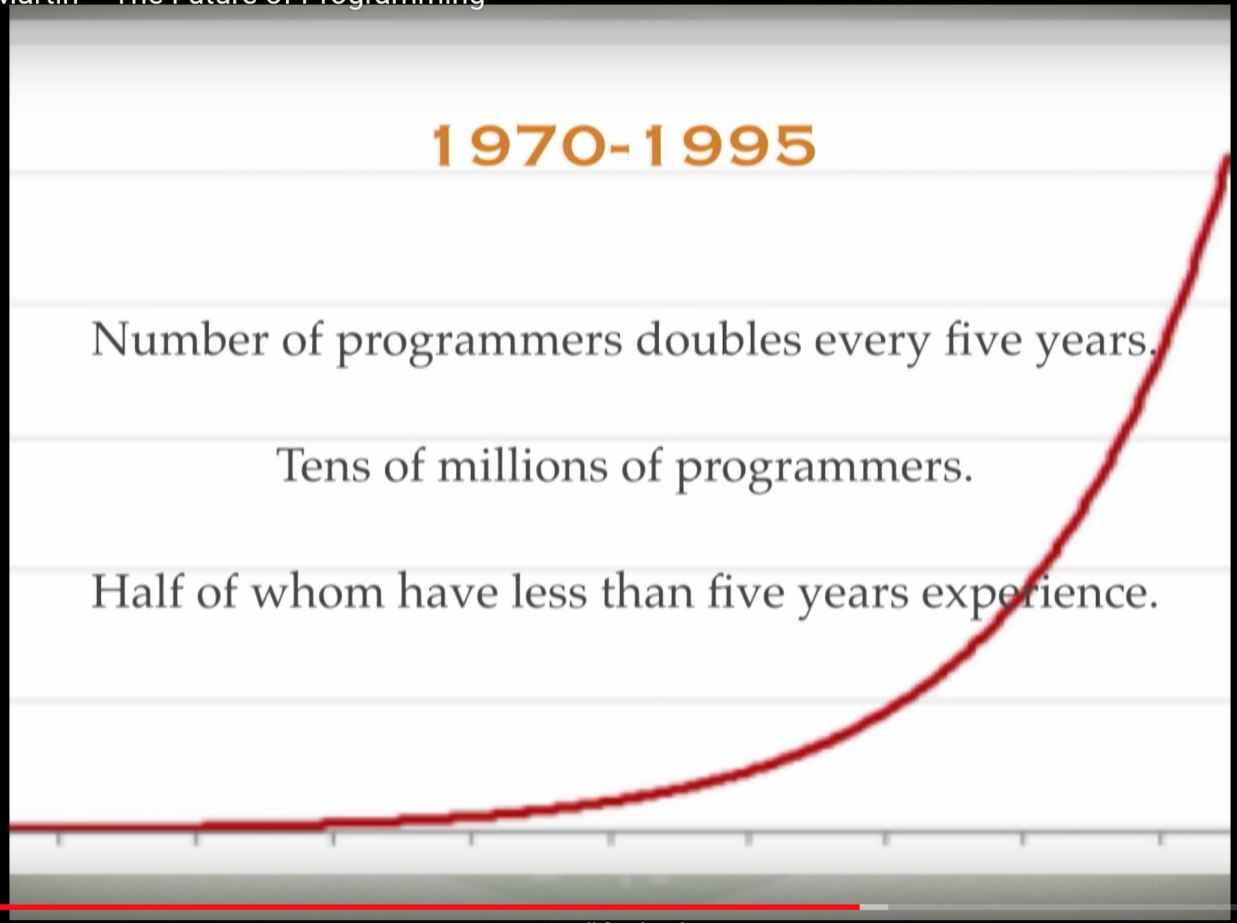
"Uncle" Bob Martin - "The Future of Programming"



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Scroll for details

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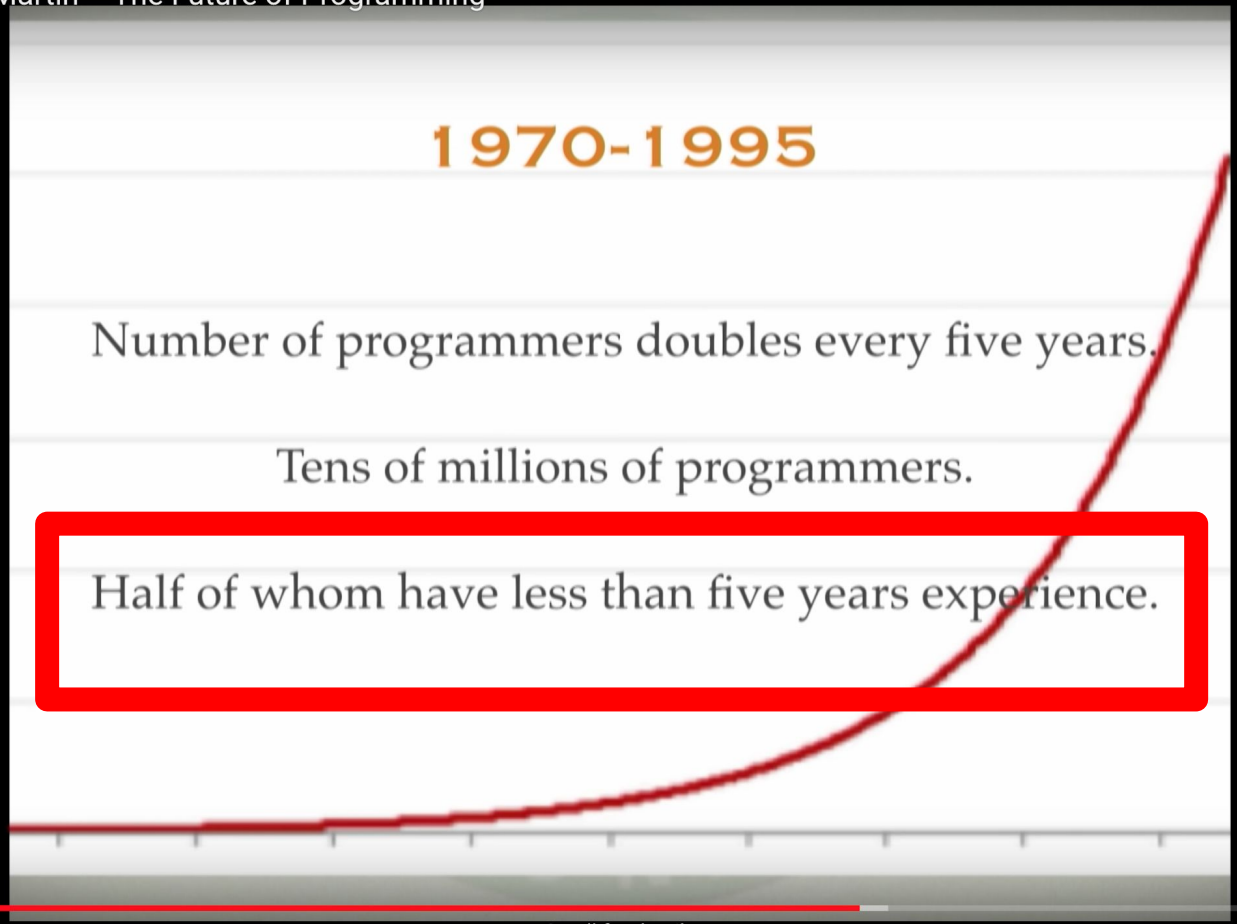

51:05 / 1:18:20

Scroll for details

Readability

N+1 different opinions on what makes readability.

Familiarity - Go’s small language footprint (25 keywords)

Readability

Familiarity - Go’s small language footprint (25 keywords)

Ingroup knowledge

Readability

Familiarity - Go’s small language footprint (25 keywords)

Ingroup knowledge

Learners perspectives - First time seeing code

No “magic” - easy vs. Simple

Readability

Familiarity - Go’s small language footprint (25 keywords)

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Learners perspectives - First time seeing code

No “magic” - easy vs. Simple

HTML w3org: 3.2. Priority of Constituencies: User > Author > Implementor

Readability

Personal Convenience.

Convention over Configuration

Readability

~~Personal Convenience.~~

Convention over Configuration

Readability

~~Personal Convenience.~~

~~Convention over Configuration~~

Simplicity

Software Engineering

Software Engineering vs Programming

Software Engineering

Software Engineering vs Programming

Software Engineering = Programming integrated over time.

Software Engineering

Software Engineering vs Programming

Software Engineering = Programming integrated over time.

Engineering is what happens when things need to live longer and influence of time starts creeping in. -Titus Winters

Software Engineering

Software Engineering vs Programming

Software Engineering = Programming integrated over time.

Engineering is what happens when things need to live longer and influence of time starts creeping in. -Titus Winters

All this complexity is fundamentally a different flavor than programming.

Software Engineering

focus on sustaining engineering (readability)

Software Engineering

TIME TRAVELING EVERYWHERE

CI

Unit Tests

Refactoring

Design Patterns

Dependency Management

Software Engineering

focus on sustaining engineering (readability)

continuance of many different engineers over a long period of time

clear module boundaries

keeping import dependencies between packages linear, thus keeping compile times down.

Simplicity and the Greater Good


STOP
Stop Sign
YIELD
RIGHT
OF
WAY
Yield Right of Way
No Left Turn
Straight Only
Turn Left
Turn Right
P
Parking Permitted
30
Speed Limit
End of Speed Limit
TAXI
Taxi Rank
Pedestrian Street
Clearway

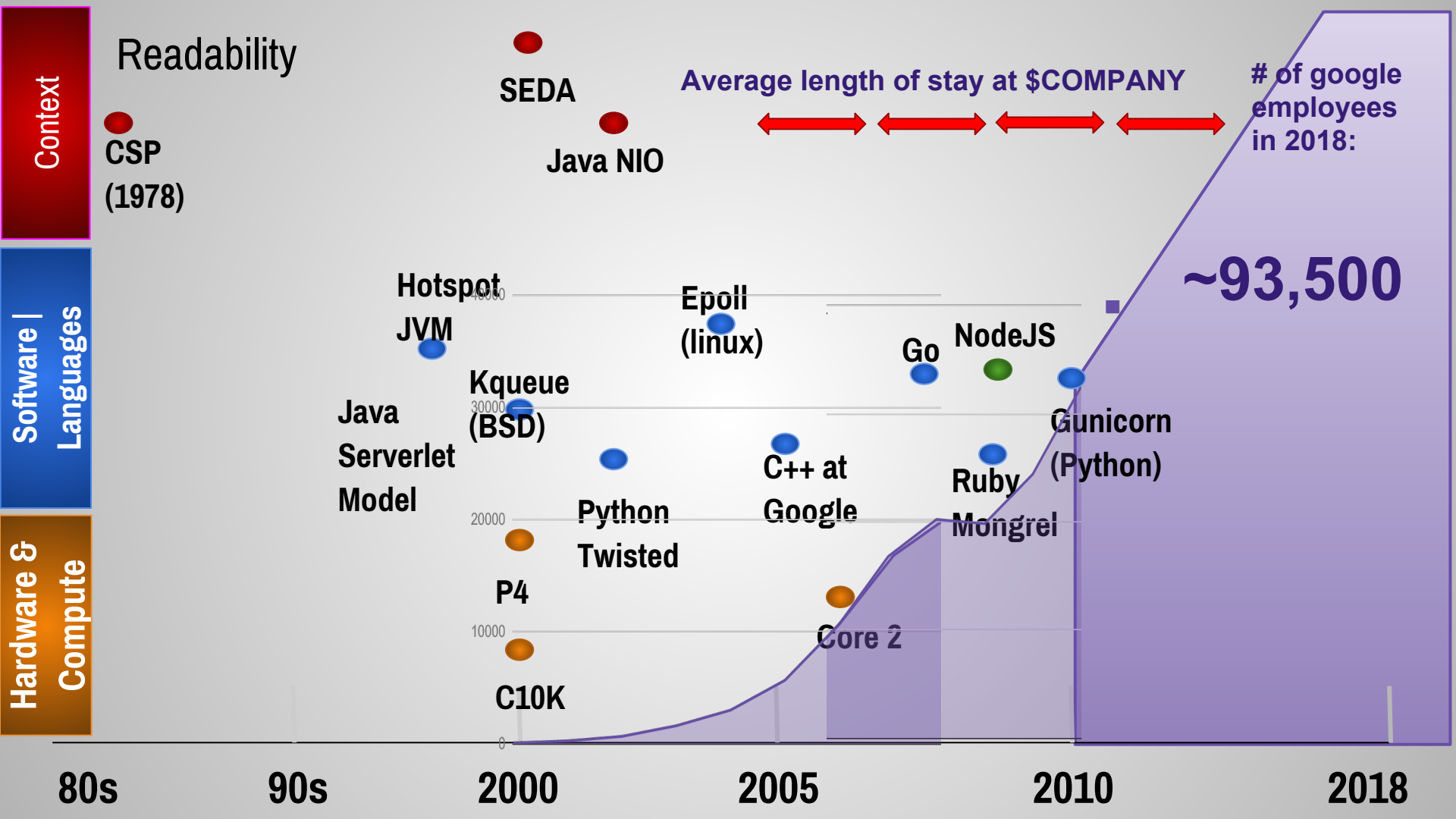

KEEP
LEFT
NO
ENTRY
NO
RIGHT
TURN


GIVE
WAY
SPEED
HUMP
STOP
GO
30
DIVERSION

“Simplicity is a great virtue but it requires hard work to achieve it and education to appreciate it. And to make matters worse: complexity sells better.”

— **Edsger W. Dijkstra**

The Future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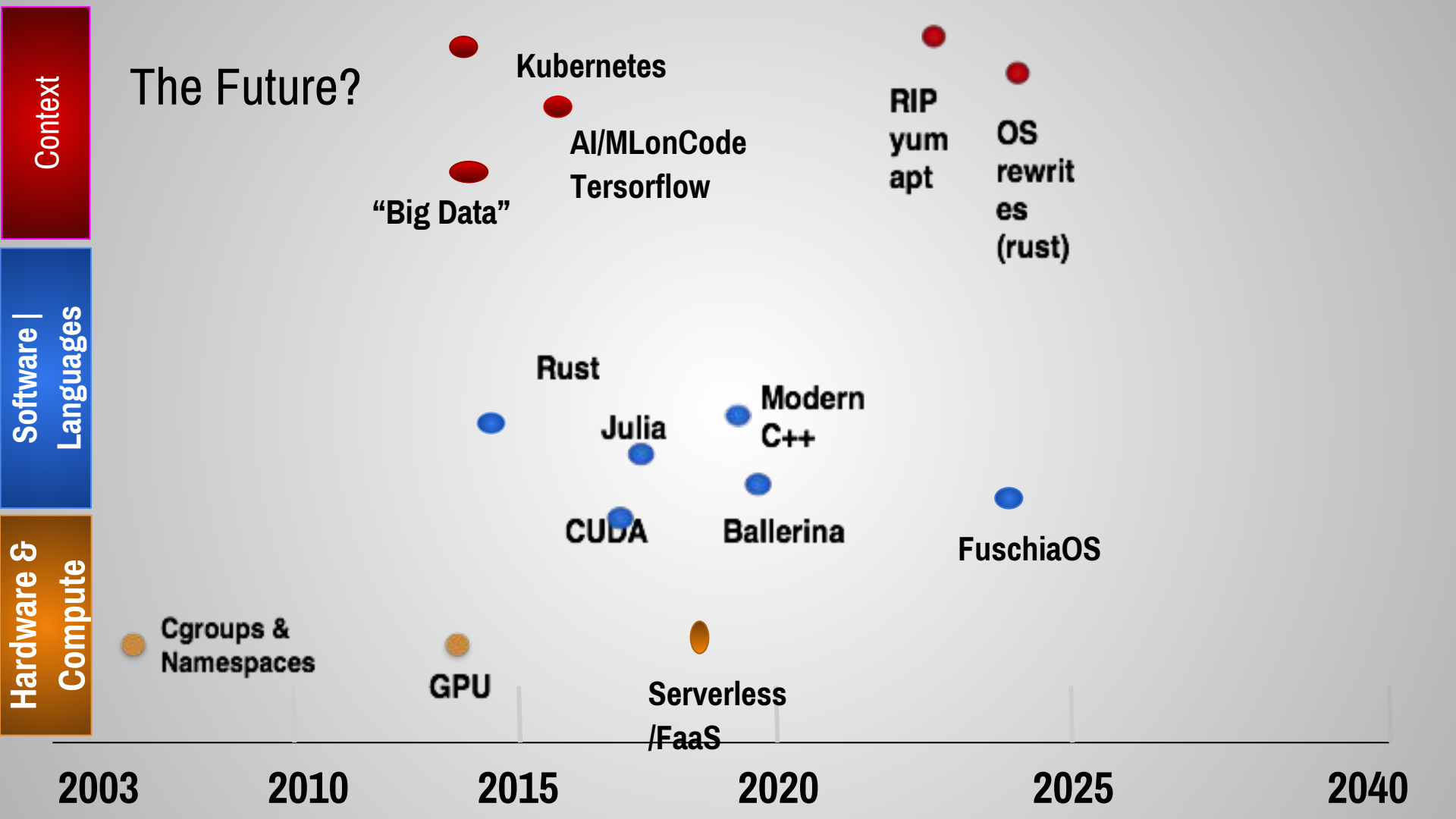
Hardware & Compute

The Future?

The problems we have today were not there 20 years ago, nor will be problems we face 20 years from now.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The Future?
Kubernetes
AI/MLonCode
Tersorflow
"Big Data"
RIP
yum
apt
OS
rewrit
es
(rust)
Rust
Julia
Modern
C++
CUDA
Ballerina
FuschiaOS
Cgroups &
Namespaces
GPU
Serverless
/FaaS
2003
2010
2015
2020
2025
2040

Context

Software | Languages

Hardware & Compute

The Future?

...hang on for the ride

2017 2020 2025 2030 2035 2040

Thank you!

Carmen Andoh
@carmatrocity
GOTO Copenhagen

November 2018