

MATT DAMON
**THE
BOURNE ULTIMATUM**

A deep-field astronomical image showing a vast field of galaxies in various colors (blue, orange, white) against a black background. The galaxies are of different shapes and sizes, some appearing as bright, diffuse clouds and others as more compact, point-like sources. A thin red horizontal line is visible across the middle of the image.


LAB03

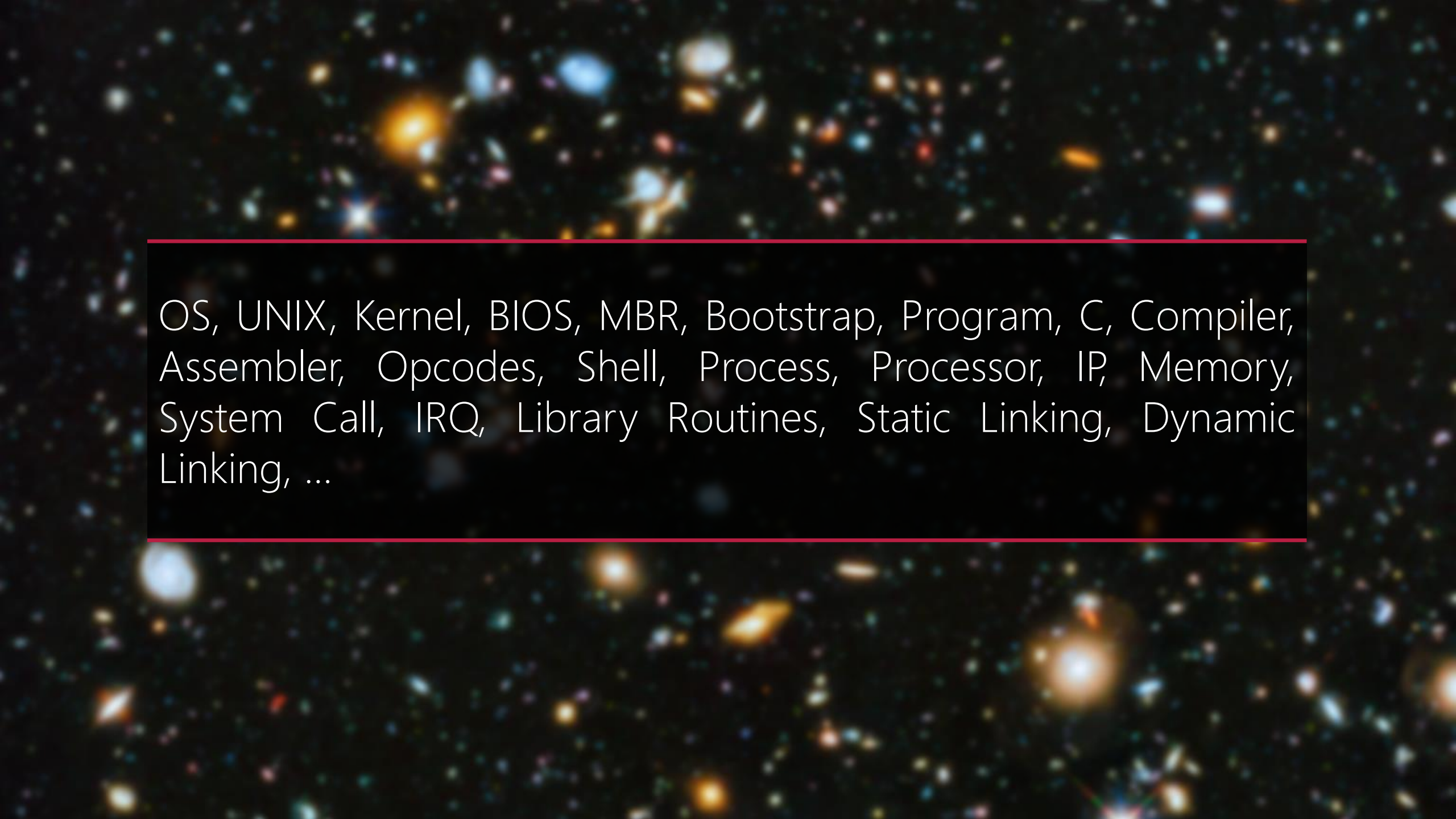
Labs > Lab03: C and Assembly > Lab03

A deep-field astronomical image showing a vast field of galaxies in various colors (blue, orange, white) against a black background. The galaxies are of different shapes and sizes, some appearing as bright, fuzzy blobs and others as more distinct, elongated structures. A thin red horizontal line is positioned above the title.

LEC03

Lectures > Lec03: Shell > Lec03

A deep-field astronomical image showing a vast field of galaxies in various colors (blue, orange, white) against a black background. The galaxies are of different shapes and sizes, some appearing as bright, fuzzy blobs and others as more distinct, elongated structures. A thin red horizontal line is positioned below the navigation text.

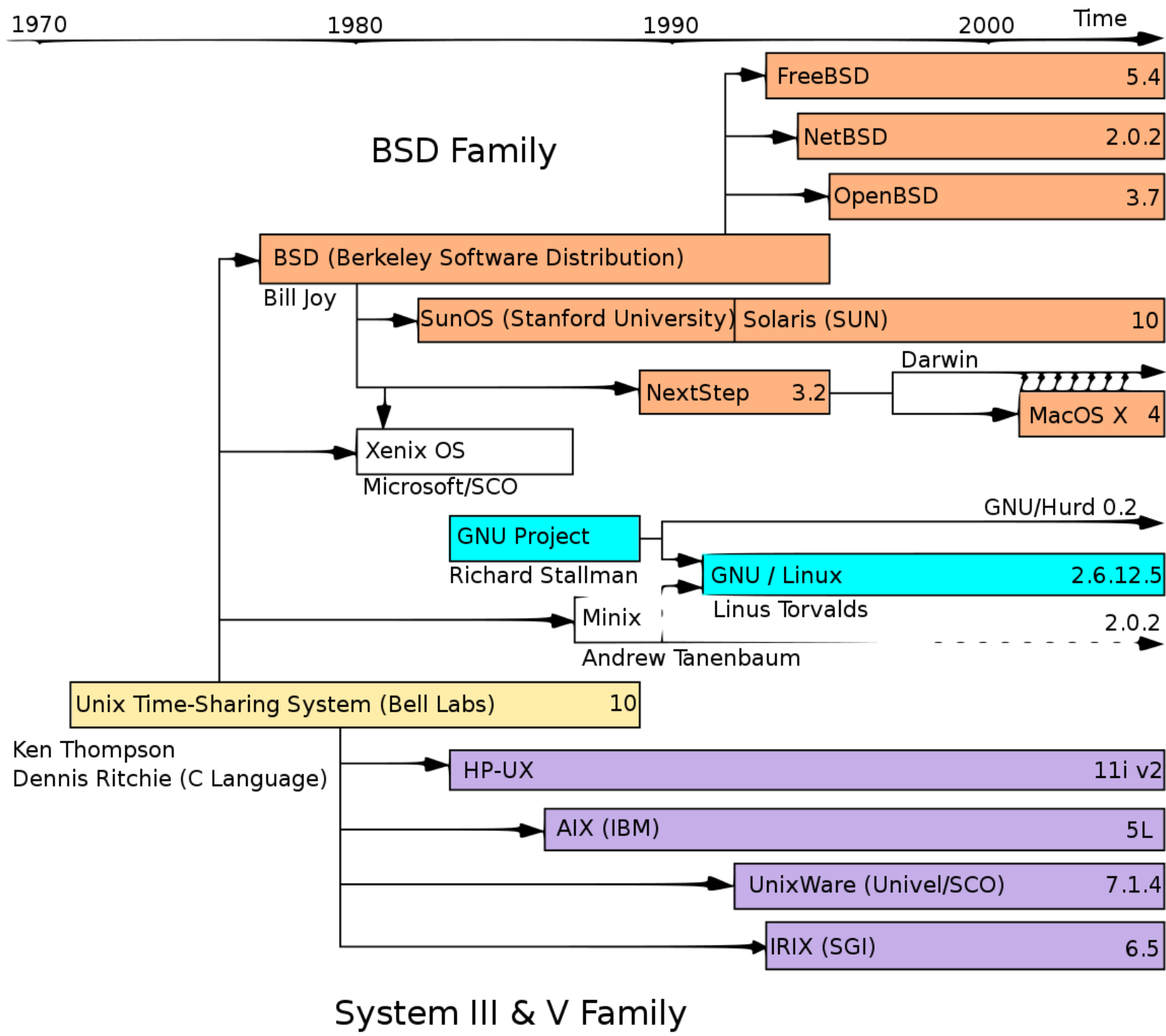


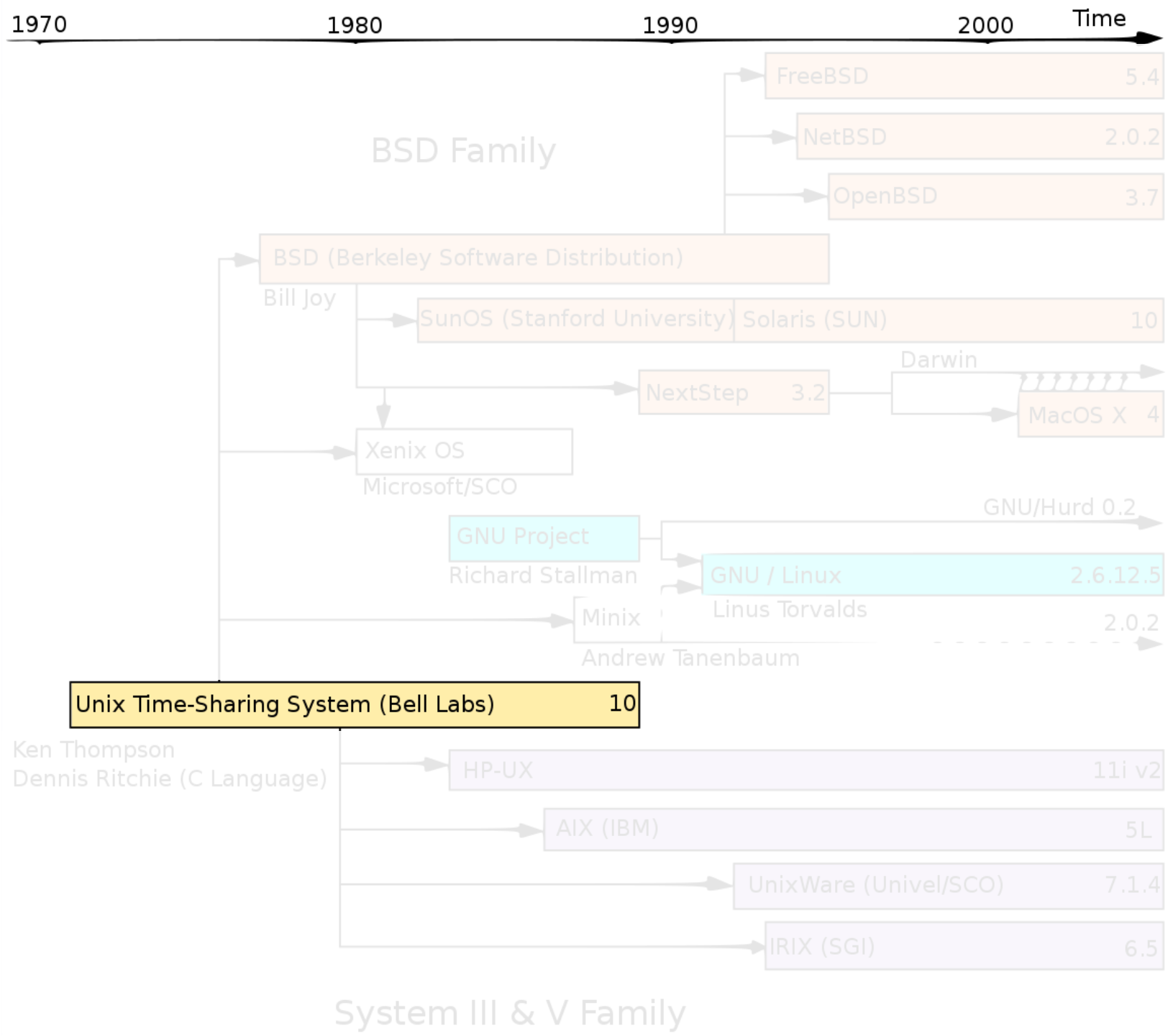
OS, UNIX, Kernel, BIOS, MBR, Bootstrap, Program, C, Compiler,
Assembler, Opcodes, Shell, Process, Processor, IP, Memory,
System Call, IRQ, Library Routines, Static Linking, Dynamic
Linking, ...

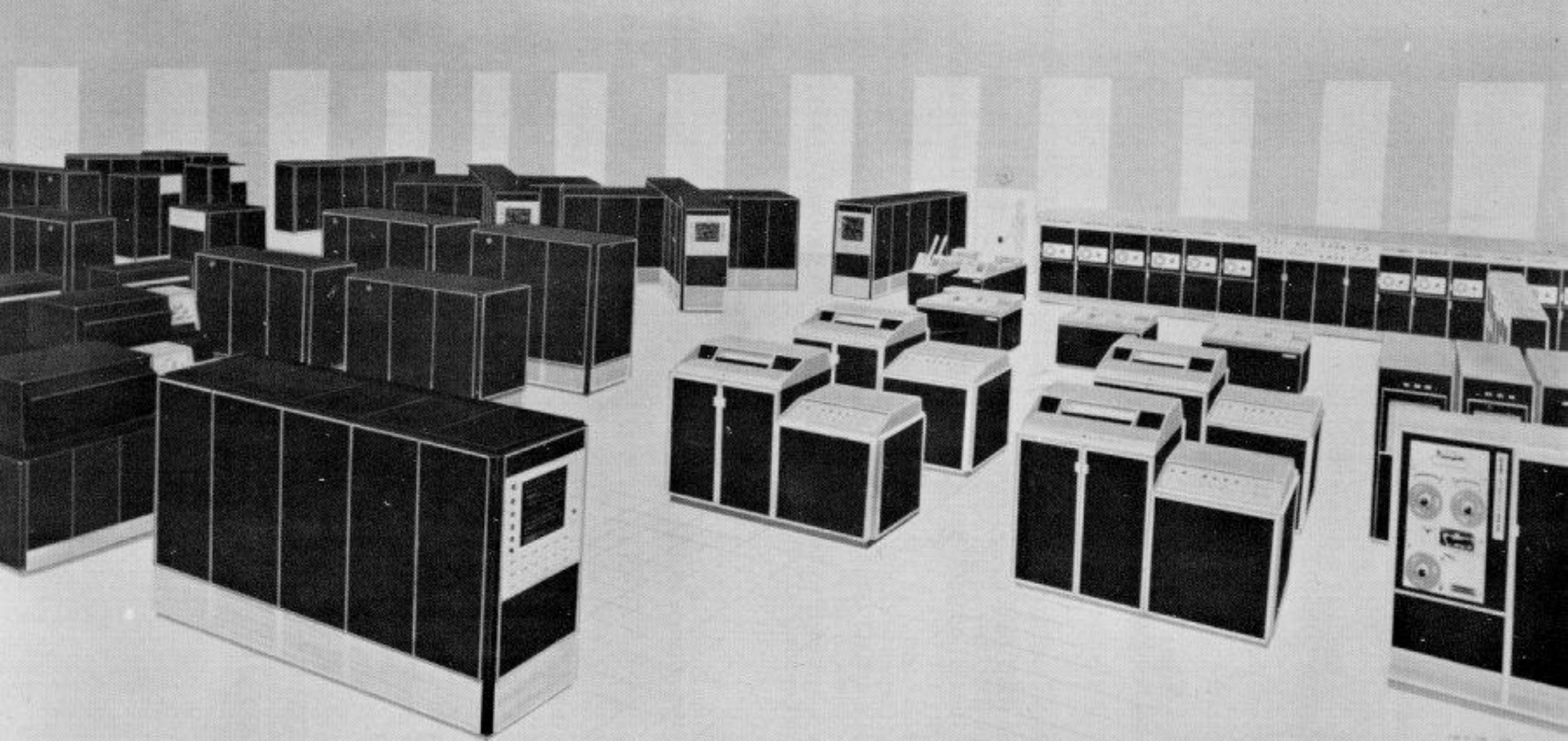
A deep-field astronomical image showing a vast field of galaxies in various colors (blue, orange, white) against a black background. Two horizontal blue lines frame the central text.

HISTORY

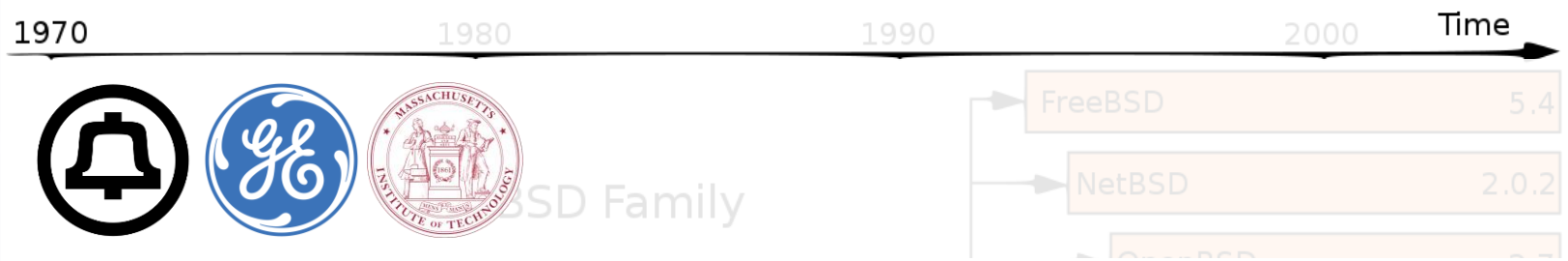








GE-645 mainframe

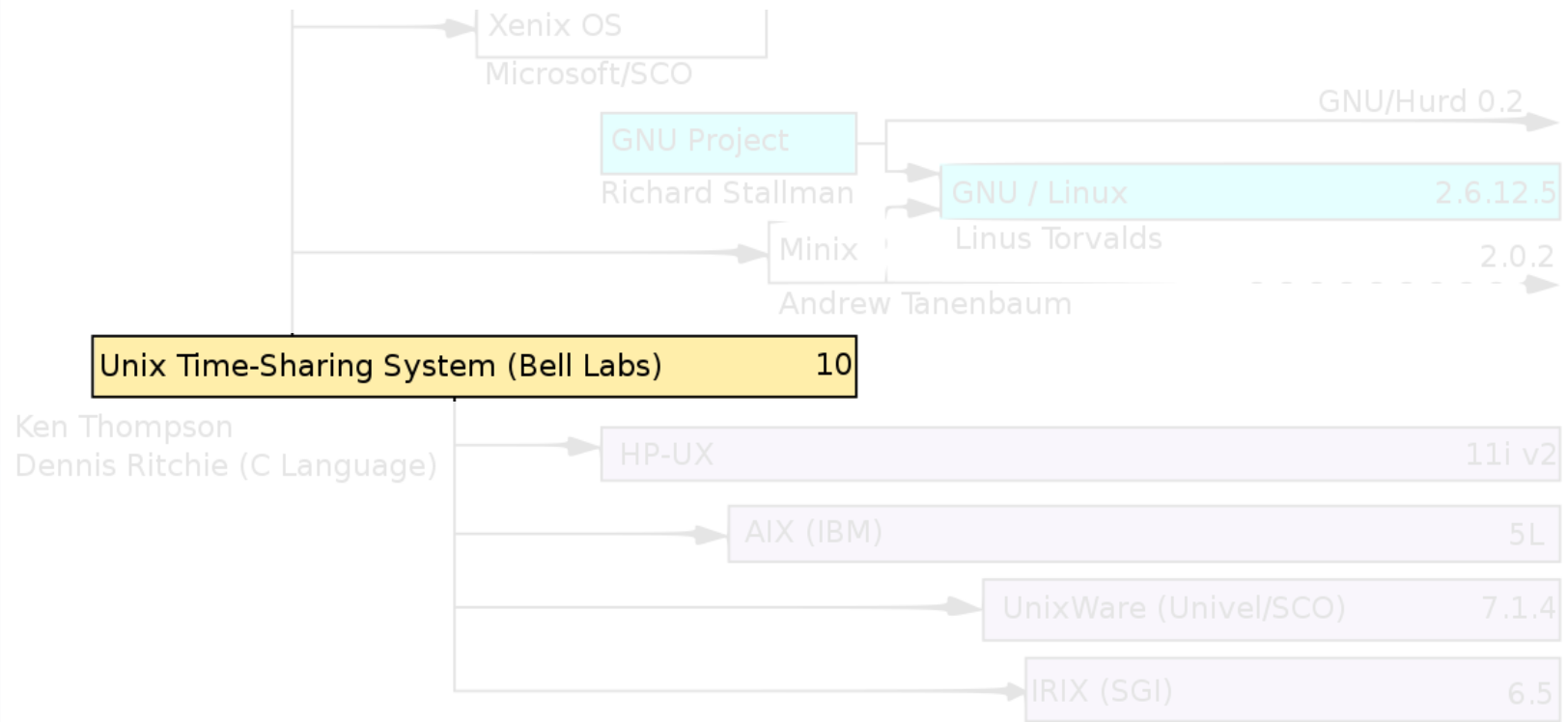


1969, Bell Labs, MIT, General Electric

Develop a *time-sharing* system

Multiplexed Information and Computing Service (Multics)

Allows multiple users to access a mainframe simultaneously



System III & V Family



PDP-7 minicomputer

1970

1980

1990

2000

Time



BSD Family

FreeBSD

5.4

NetBSD

2.0.2

1969, Bell Labs

Ken Thompson & Denise Ritchie

Rewrite Multics but simpler

Uniplexed Information and Computing Service (Unics) , as "eunuchs"

UNIX

+ an assembler, editor, shell

Andrew Tanenbaum

Unix Time-Sharing System (Bell Labs)

10

Ken Thompson

Den

PDP-7 minicomputer

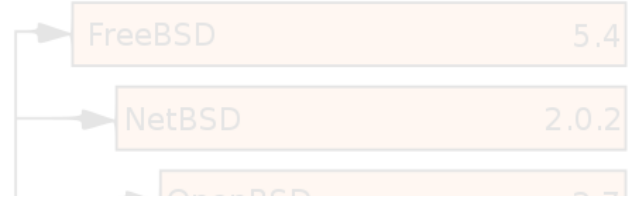
AIX (IBM)

System III &



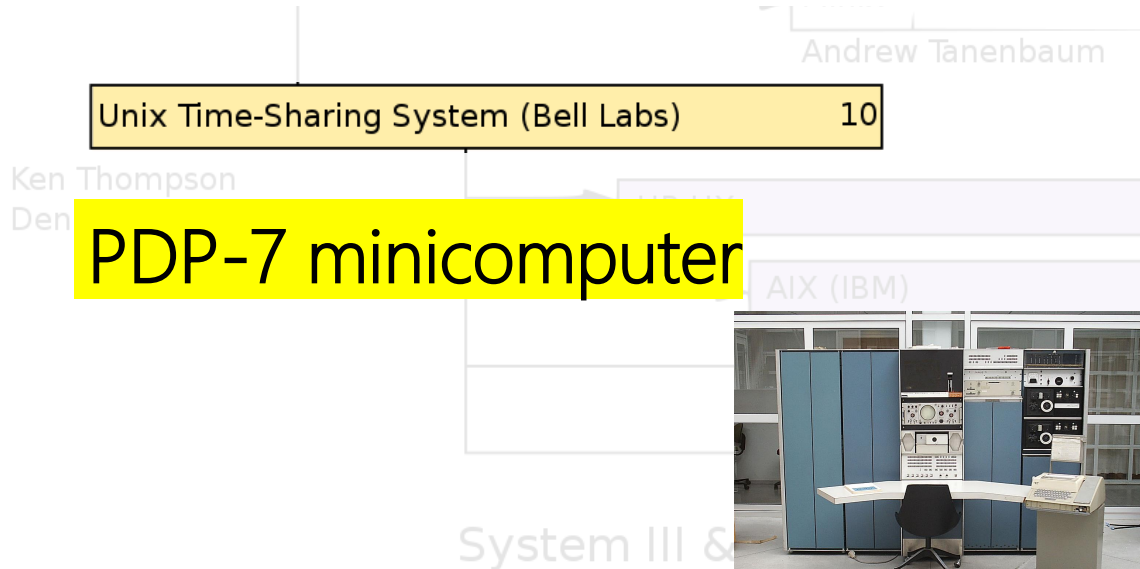


BSD Family



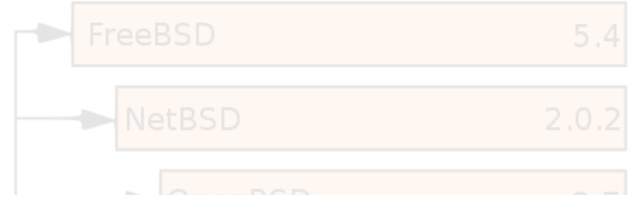
1973, Bell Labs
Ken Thompson & Denise Ritchie
Rewrite UNIX but not in assembly
High-Level Programming Language
C Programming Language

UNIX v.4.0





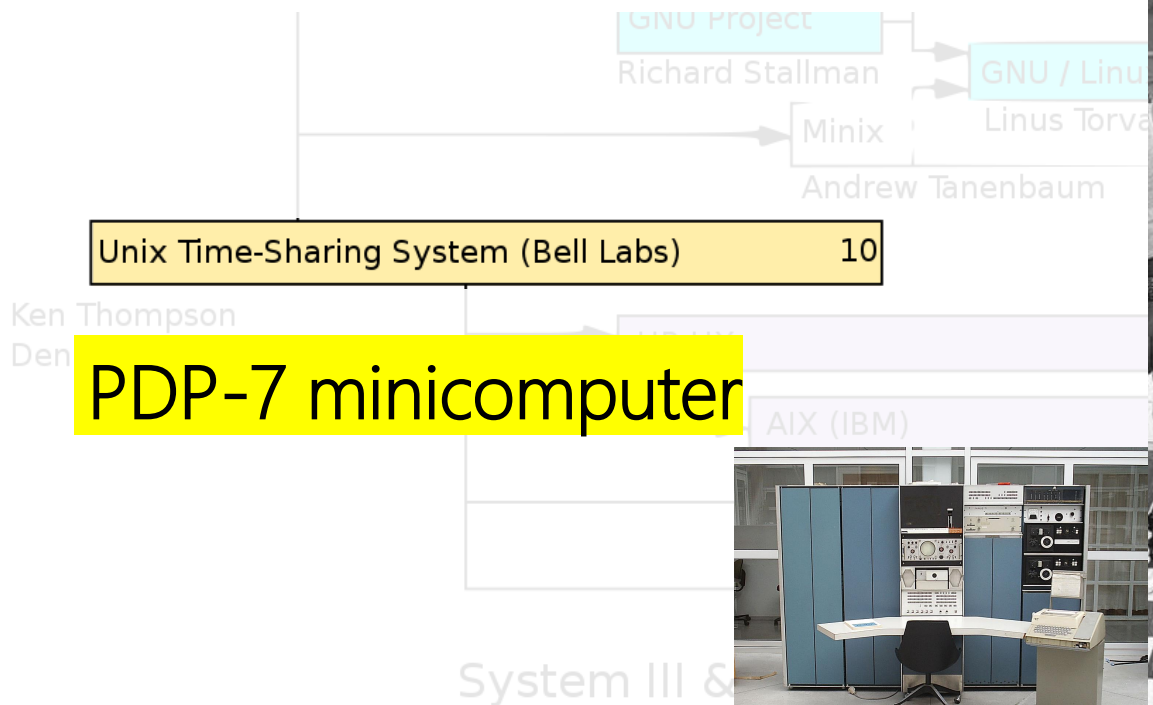
BSD Family

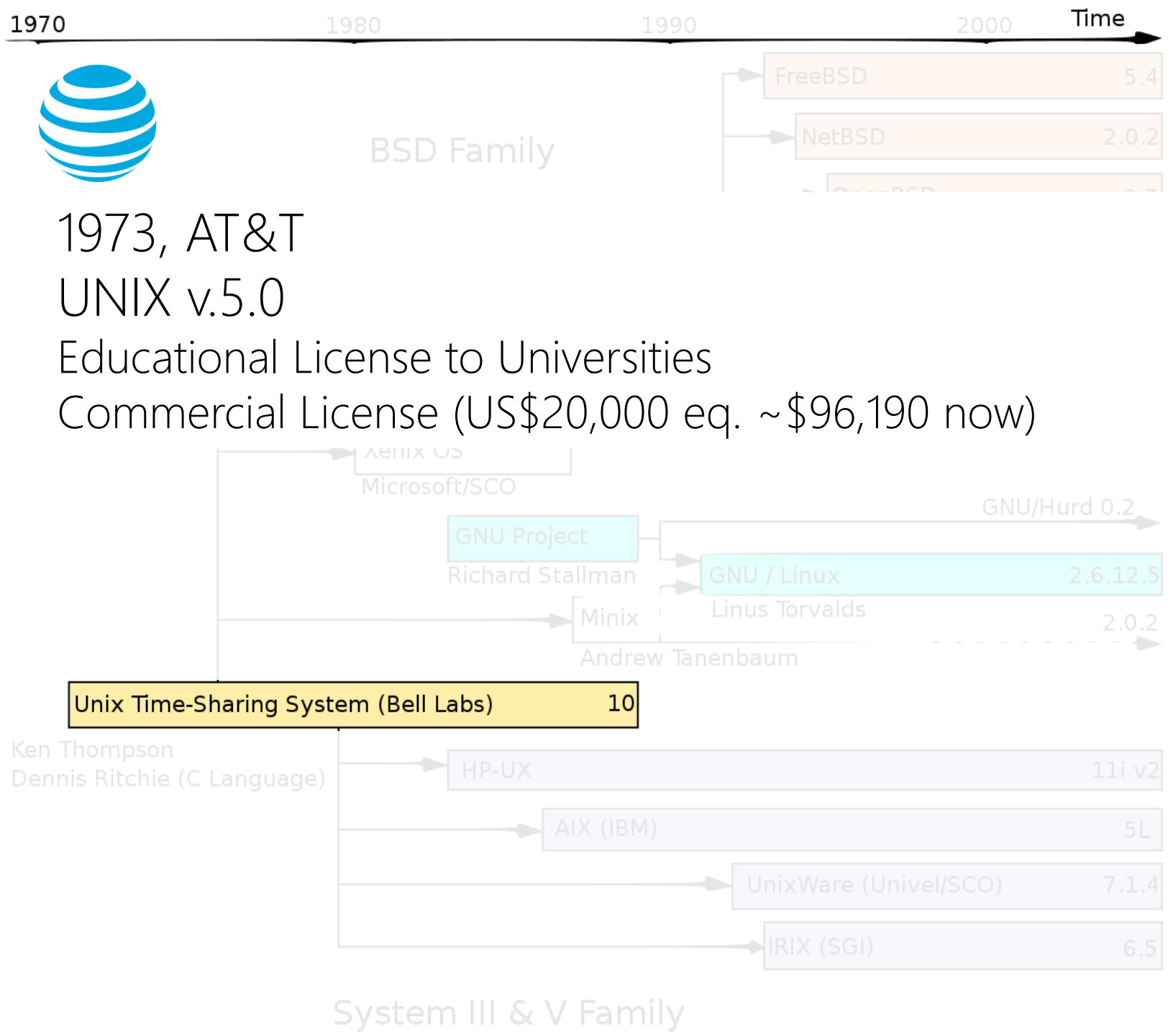


1978, Bell Labs

Bell was not able to make UNIX as product. Why?

Thompson quietly began shipping out tapes and disks, signed, *"Love, Ken"*







USENIX: UNIX Users, New York, 1974

A cosmic background image featuring a dense field of galaxies in various colors (blue, orange, white) against a dark space. Two horizontal blue lines are positioned above and below the text.

ONE UNIX DIFFERENT TYPES OF COMPUTERS

C

UNIX Source Code

Compiler

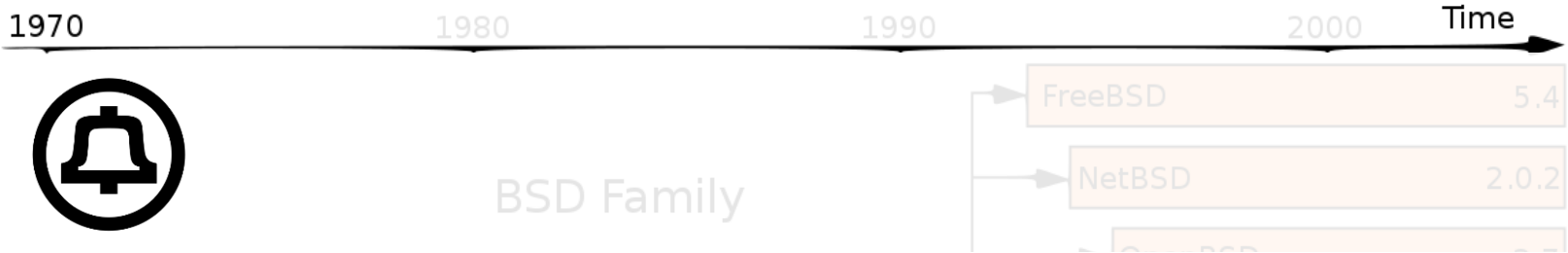
Assembly

Assembler

```
<printf@plt>:  
jmpq    *0x3002(%rip)  
pushq   $0x0  
jmpq    401000 <.plt>  
<main>:  
push    %rbp  
mov     %rsp,%rbp  
lea     0xfd5(%rip),%rdi  
mov     $0x0,%eax  
callq   401010 <printf@plt>  
nop  
pop     %rbp  
retq
```

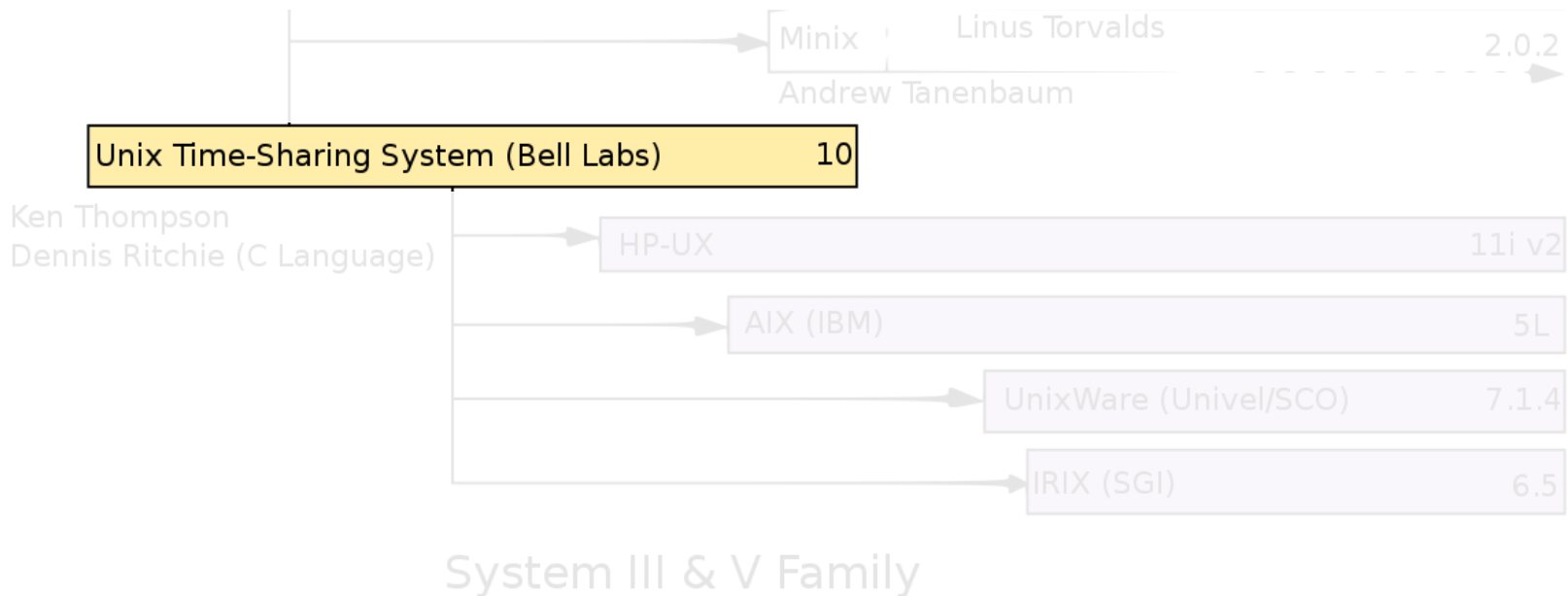
OP Code

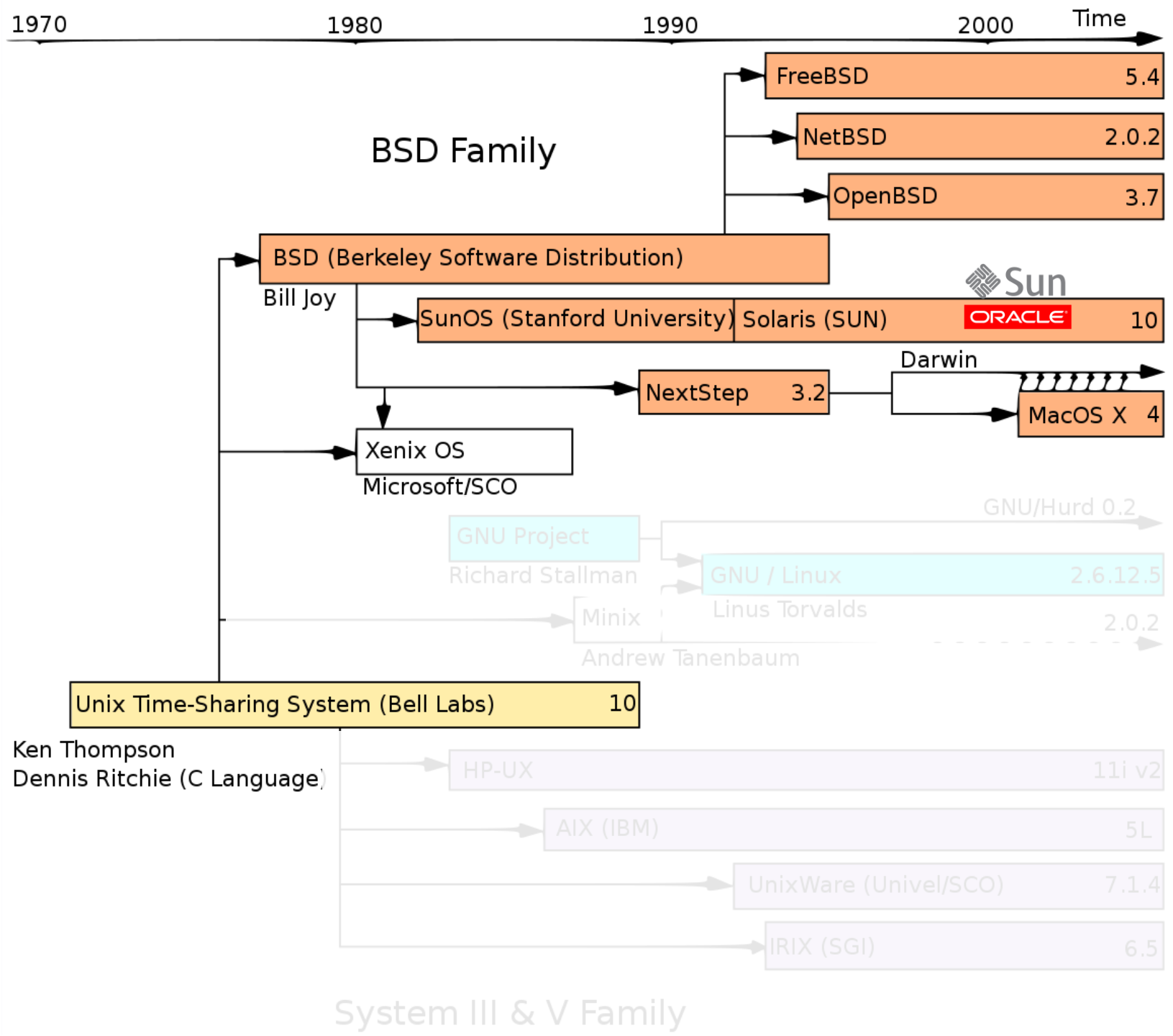
```
0001 0000 0000 0000 0000 0000 0000 0000  
0011 0000 0003 0000 0000 0000 0000 0000  
0000 0000 0000 0000 3309 0000 0000 0000  
0096 0000 0000 0000 0000 0000 0000 0000  
0001 0000 0000 0000 0000 0000 0000 0000
```

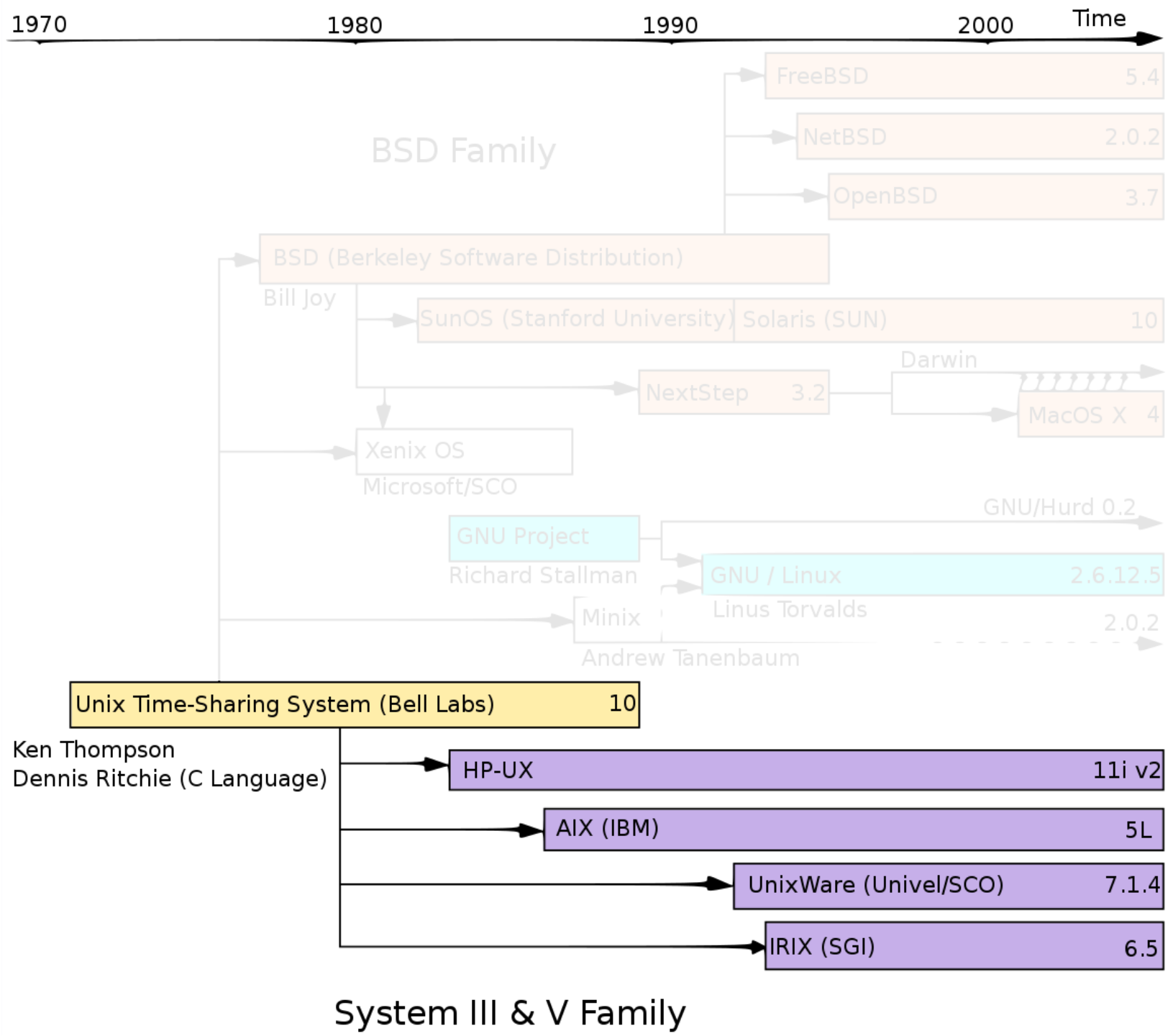



1978, Bell Labs
Thompson and Ritchie
UNIX 4.0 still had considerable PDP-dependent code

First port to other platform was for Interdata 8/32

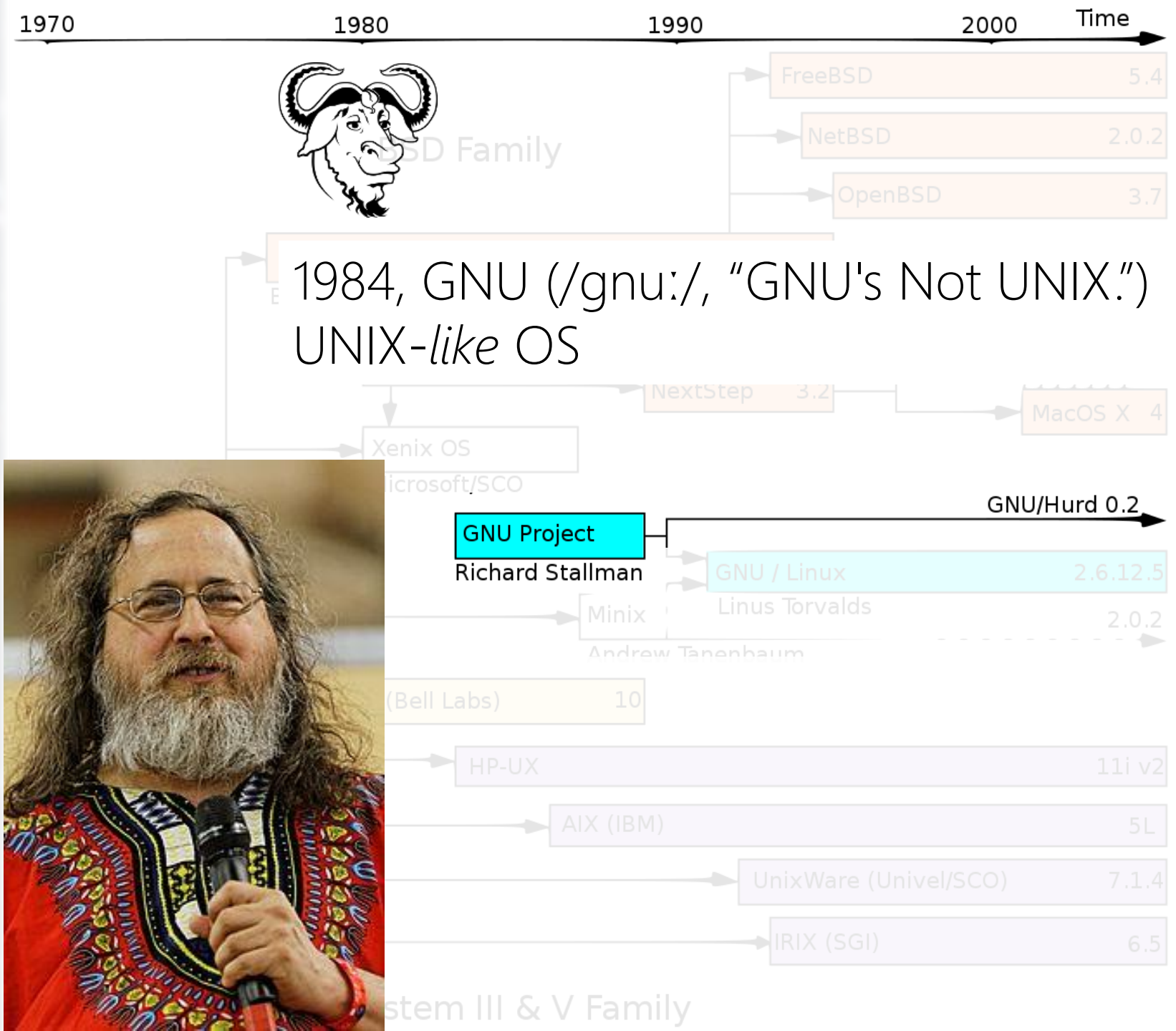






A cosmic background image featuring a dense field of galaxies and stars against a black sky. The galaxies are in various stages of evolution, with some appearing as bright, glowing clusters and others as more distant, fainter points of light. The colors range from deep blues and purples to bright yellows and oranges, suggesting different temperatures and compositions. Two thin, horizontal blue lines are positioned above and below the central text.

PLATFORM-FREE UNIX





1970

1980

1990

2000

Time



Open Source Community

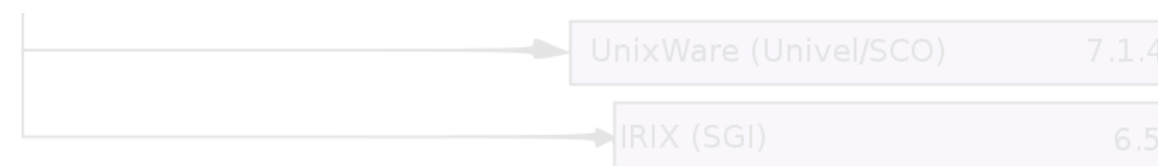
gratis vs. libre

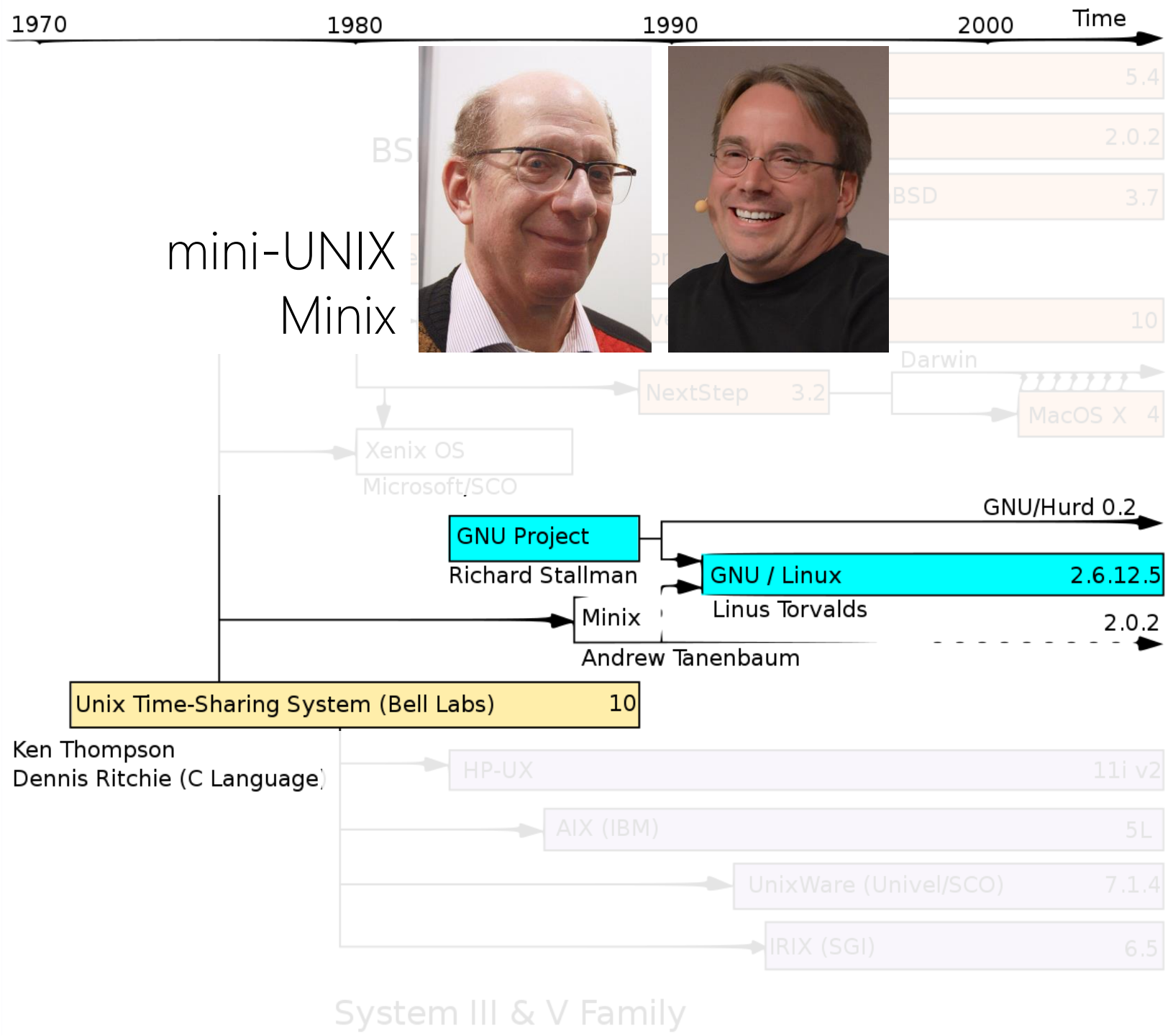
Free Software vs. Libre Software

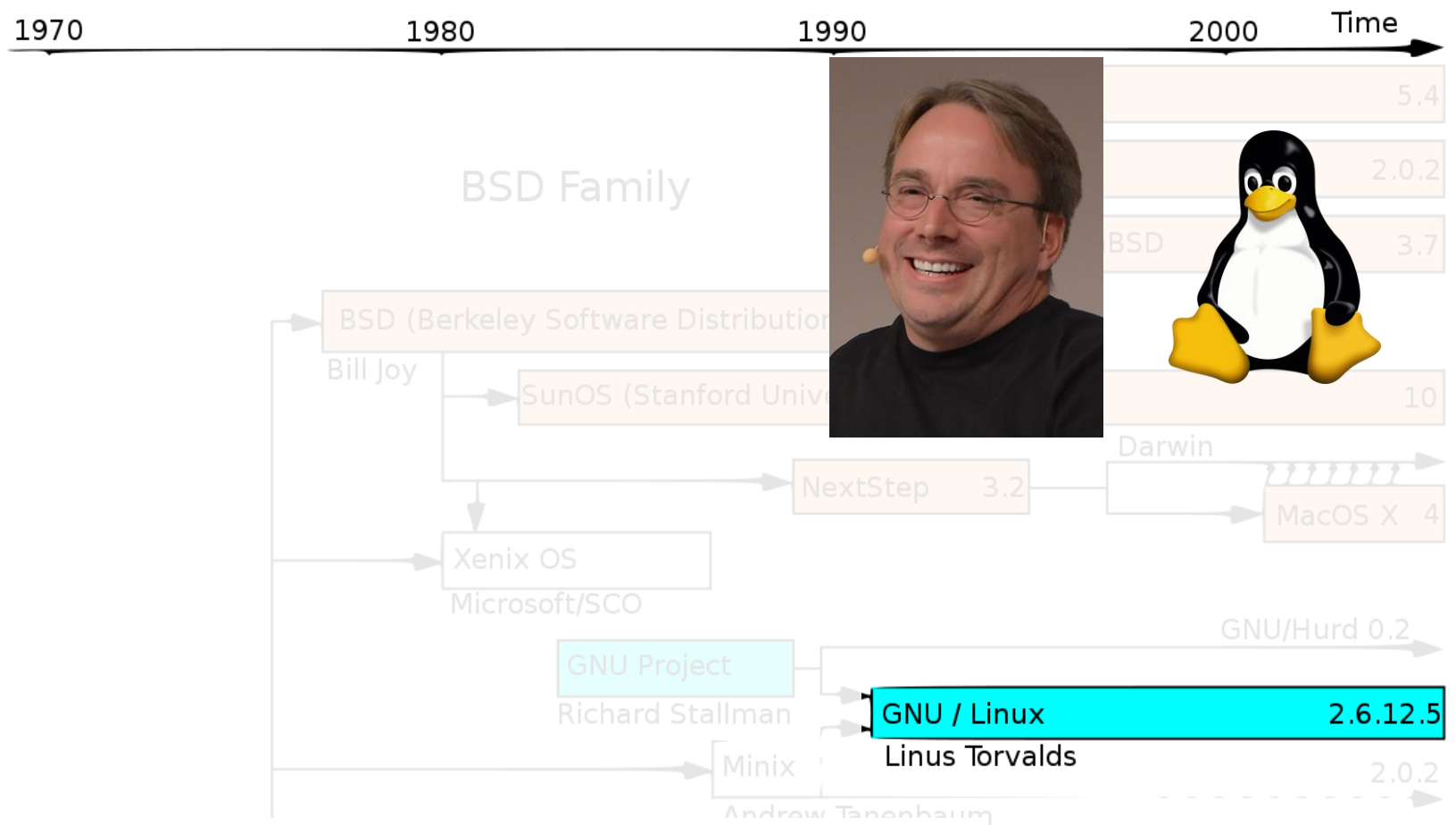


"Think free as in free speech, not free beer"

"Free as in freedom, not free as in free beer"







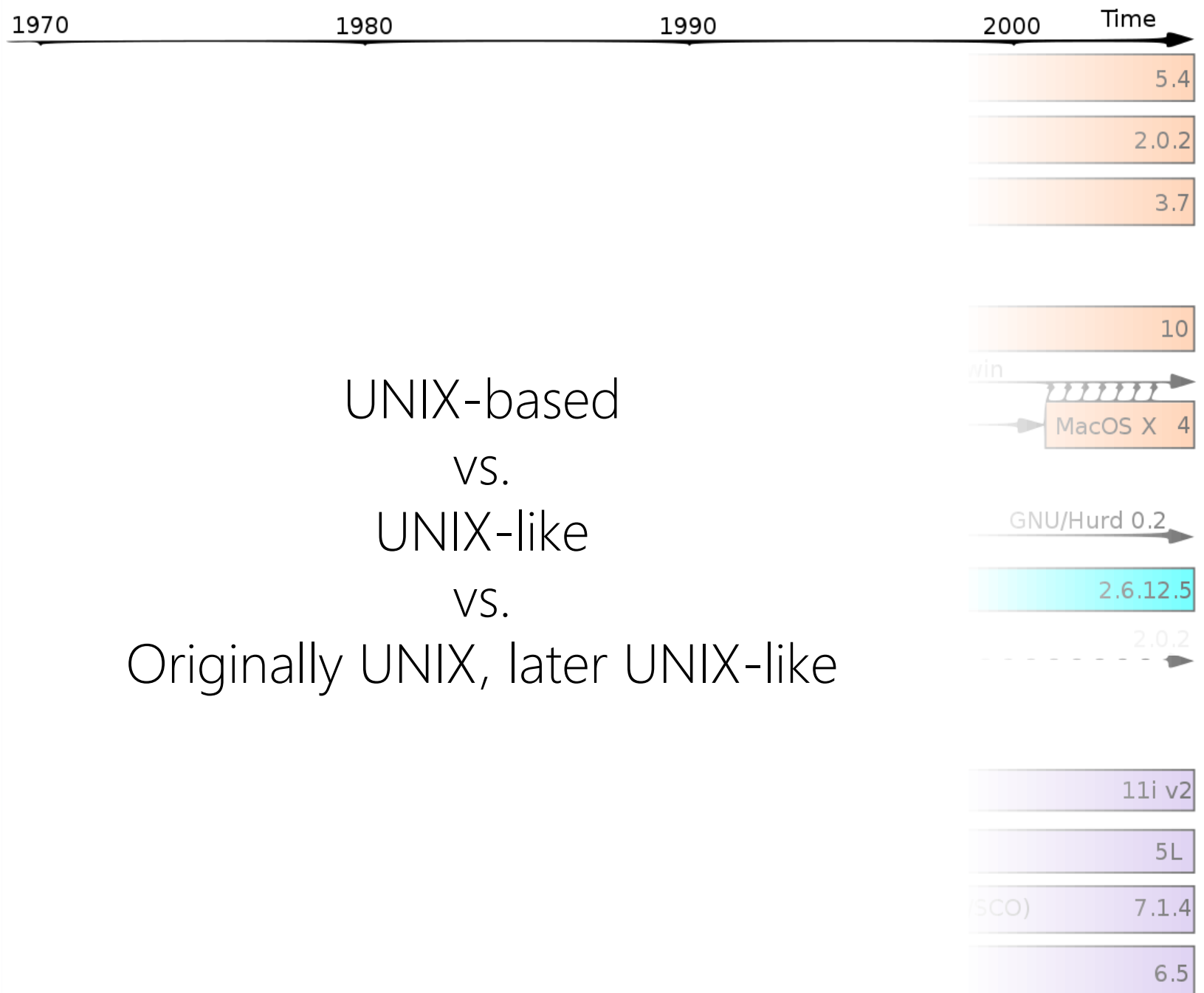
Free (libre) Linux Distributions:

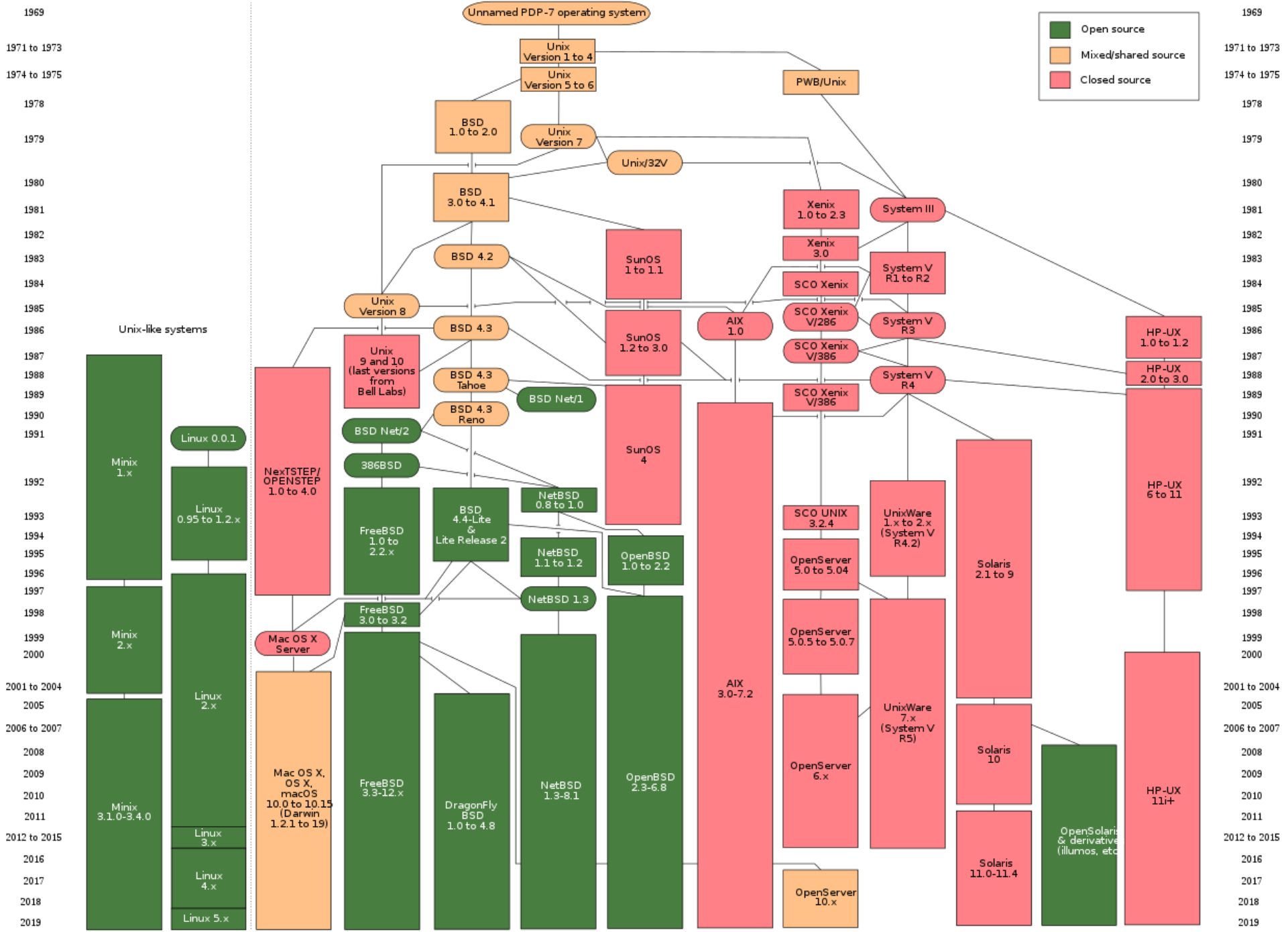
- Debian
- Fedora
- Ubuntu

Commercial Distributions:

- Red Hat Enterprise Linux
- SUSE Linux Enterprise Server.

	11i v2
	5L
Ware (Univel/SCO)	7.1.4
X (SGI)	6.5





A cosmic background image featuring a dense field of galaxies in various colors (blue, orange, white) against a dark space. Two horizontal blue lines are positioned above and below the text.

MANY UNIXs
DIFFERENT TYPES OF COMPUTERS



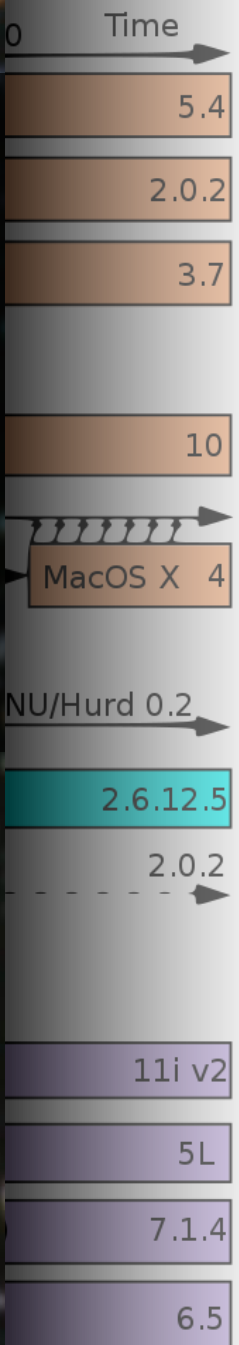
STANDARD

UNIX wars

e.g., ask kernel to allocate memory (System Call)

UNIX:	xxxx(10 byte)
Linux-Debian	yyyy(10 byte)
Linux-Ubuntu	Not Available
MacOS	aaaa(10 byte)
OpenBSD	Not Available

....



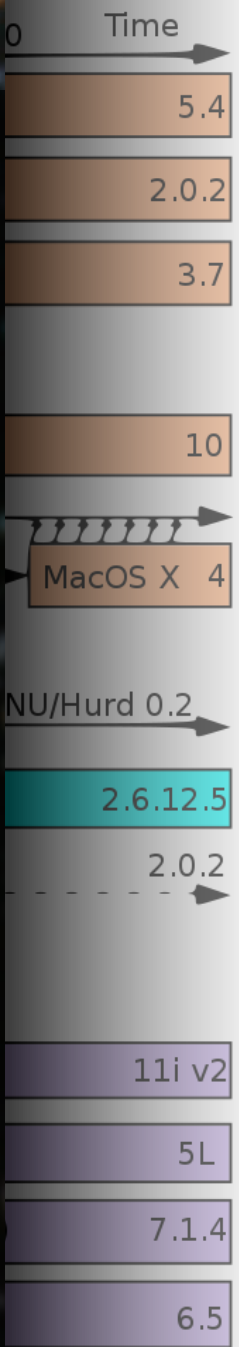
e.g., ask kernel to allocate memory (System Call)

UNIX:	xxxx (10 byte)
Linux-Debian	xxxx (10 byte)
Linux-Ubuntu	xxxx (10 byte)
MacOS	xxxx (10 byte)
OpenBSD	xxxx (10 byte)
....	

A min common-denominator ~~system~~ interface

Same Set of System Calls
Each System Call

- Same input, same result. How is not important!
- 10 byte = 5 byte + 5 byte = 1 byte + 9 byte = 10 byte



A deep space image showing a vast field of galaxies and stars against a black background. The galaxies are in various orientations and colors, including blue, orange, and white.

THE *Open* GROUP

The Open Group owns the UNIX trademark and uses the Single UNIX Specification to define the interfaces an implementation must support to call itself a UNIX system. Vendors must file conformance statements, pass test suites to verify conformance, and license the right to use the UNIX trademark.



POSIX

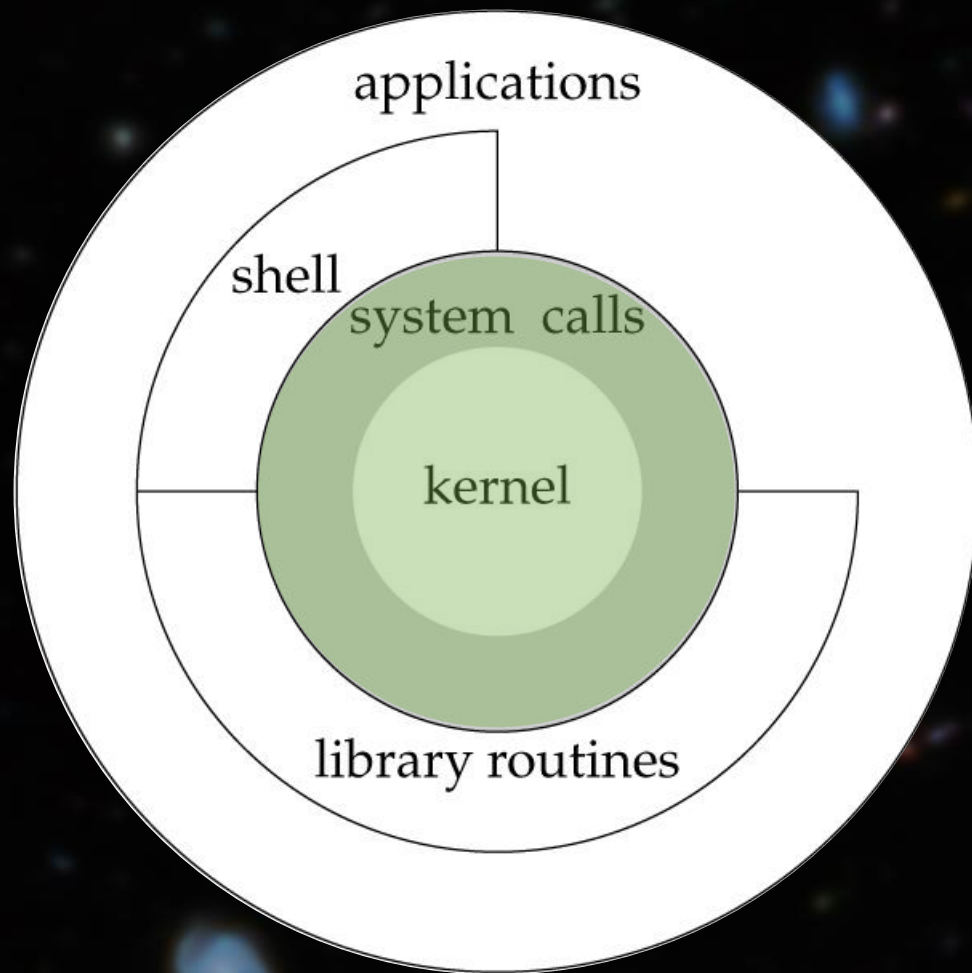
Portable Operating System Interface

a family of standards by the IEEE Computer Society for maintaining compatibility between operating systems



POSIX

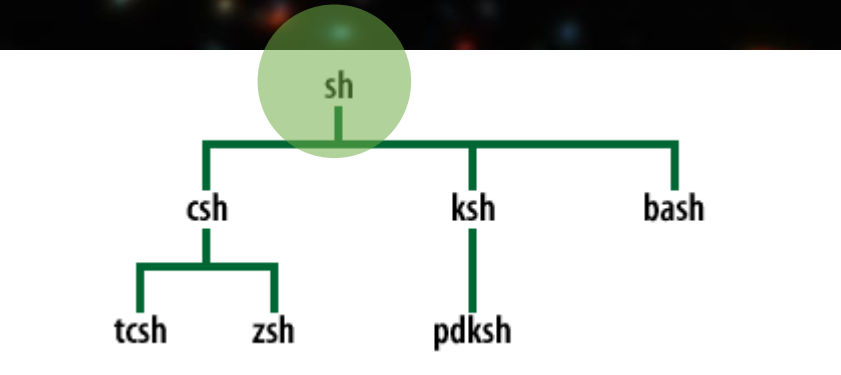
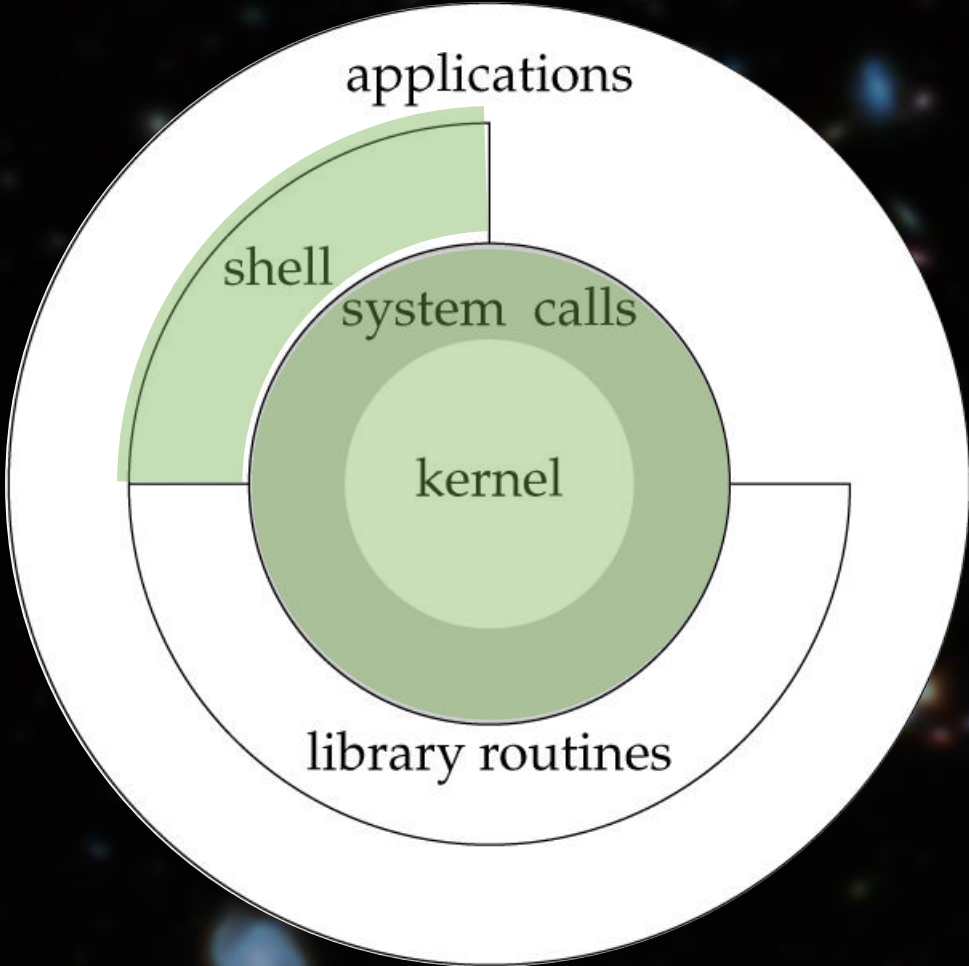
POSIX-compliant != UNIX



Header	FreeBSD 8.0	Linux 3.2.0	Mac OS X 10.6.8	Solaris 10	Description
<mqueue.h>	•	•		•	message queues
<spawn.h>	•	•	•	•	real-time spawn interface

Figure 2.4 Optional headers defined by the POSIX standard

Header	FreeBSD 8.0	Linux 3.2.0	Mac OS X 10.6.8	Solaris 10	Description
<aio.h>	•	•	•	•	asynchronous I/O
<cpio.h>	•	•	•	•	cpio archive values
<dirent.h>	•	•	•	•	directory entries (Section 4.22)
<dlfcn.h>	•	•	•	•	dynamic linking
<fcntl.h>	•	•	•	•	file control (Section 3.14)
<fnmatch.h>	•	•	•	•	filename-matching types
<glob.h>	•	•	•	•	pathname pattern-matching and generation
<grp.h>	•	•	•	•	group file (Section 6.4)
<iconv.h>	•	•	•	•	codeset conversion utility
<langinfo.h>	•	•	•	•	language information constants
<monetary.h>	•	•	•	•	monetary types and functions
<netdb.h>	•	•	•	•	network database operations
<nl_types.h>	•	•	•	•	message catalogs
<poll.h>	•	•	•	•	poll function (Section 14.4.2)
<pthread.h>	•	•	•	•	threads (Chapters 11 and 12)
<pwd.h>	•	•	•	•	password file (Section 6.2)
<regex.h>	•	•	•	•	regular expressions
<sched.h>	•	•	•	•	execution scheduling
<semaphore.h>	•	•	•	•	semaphores
<strings.h>	•	•	•	•	string operations
<tar.h>	•	•	•	•	tar archive values
<termios.h>	•	•	•	•	terminal I/O (Chapter 18)
<unistd.h>	•	•	•	•	symbolic constants
<wordexp.h>	•	•	•	•	word-expansion definitions
<arpa/inet.h>	•	•	•	•	Internet definitions (Chapter 16)
<net/if.h>	•	•	•	•	socket local interfaces (Chapter 16)
<netinet/in.h>	•	•	•	•	Internet address family (Section 16.3)
<netinet/tcp.h>	•	•	•	•	Transmission Control Protocol definitions
<sys/mman.h>	•	•	•	•	memory management declarations
<sys/select.h>	•	•	•	•	select function (Section 14.4.1)
<sys/socket.h>	•	•	•	•	sockets interface (Chapter 16)
<sys/stat.h>	•	•	•	•	file status (Chapter 4)
<sys/statvfs.h>	•	•	•	•	file system information
<sys/times.h>	•	•	•	•	process times (Section 8.17)
<sys/types.h>	•	•	•	•	primitive system data types (Section 2.8)
<sys/un.h>	•	•	•	•	UNIX domain socket definitions (Section 17.2)
<sys/utsname.h>	•	•	•	•	system name (Section 6.9)
<sys/wait.h>	•	•	•	•	process control (Section 8.6)



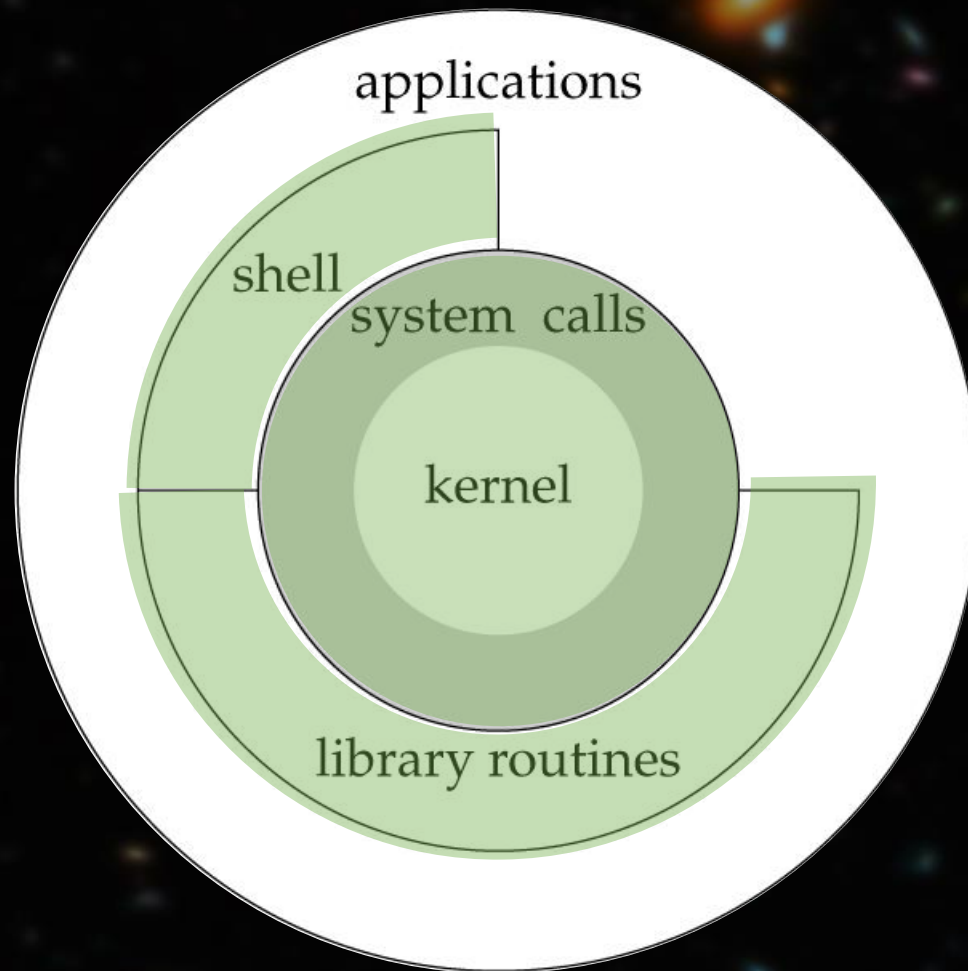
Name	Path	FreeBSD 8.0	Linux 3.2.0	Mac OS X 10.6.8	Solaris 10
Bourne shell	/bin/sh	•	•	copy of bash	•
Bourne-again shell	/bin/bash	optional	•	•	•
C shell	/bin/csh	link to tcsh	optional	link to tcsh	•
Korn shell	/bin/ksh	optional	optional	•	•
TENEX C shell	/bin/tcsh	•	optional	•	•

ls

From Wikipedia, the free encyclopedia

For other uses, see [LS \(disambiguation\)](#).

In computing, **ls** is a command to *list* computer files in Unix and Unix-like operating systems. **ls** is specified by POSIX and the Single UNIX Specification. When invoked without any arguments, ls lists the files in the current working directory. The command is also available in the EFI shell.^[1] In other environments, such as DOS, OS/2, and Microsoft Windows, similar functionality is provided by the **dir** command. The numerical computing environments MATLAB and GNU Octave include an **ls** function with similar functionality.^{[2][3]}



Header	FreeBSD 8.0	Linux 3.2.0	Mac OS X 10.6.8	Solaris 10	Description
<assert.h>	•	•	•	•	verify program assertion
<complex.h>	•	•	•	•	complex arithmetic support
<ctype.h>	•	•	•	•	character classification and mapping support
<errno.h>	•	•	•	•	error codes (Section 1.7)
<fenv.h>	•	•	•	•	floating-point environment
<float.h>	•	•	•	•	floating-point constants and characteristics
<inttypes.h>	•	•	•	•	integer type format conversion
<iso646.h>	•	•	•	•	macros for assignment, relational, and unary operators
<limits.h>	•	•	•	•	implementation constants (Section 2.5)
<locale.h>	•	•	•	•	locale categories and related definitions
<math.h>	•	•	•	•	mathematical function and type declarations and constants
<setjmp.h>	•	•	•	•	nonlocal goto (Section 7.10)
<signal.h>	•	•	•	•	signals (Chapter 10)
<stdarg.h>	•	•	•	•	variable argument lists
<stdbool.h>	•	•	•	•	Boolean type and values
<stddef.h>	•	•	•	•	standard definitions
<stdint.h>	•	•	•	•	integer types
<stdio.h>	•	•	•	•	standard I/O library (Chapter 5)
<stdlib.h>	•	•	•	•	utility functions
<string.h>	•	•	•	•	string operations
<tgmath.h>	•	•	•	•	type-generic math macros
<time.h>	•	•	•	•	time and date (Section 6.10)
<wchar.h>	•	•	•	•	extended multibyte and wide character support
<wctype.h>	•	•	•	•	wide character classification and mapping support

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Base Specifications, Issue 7, 2018 Edition

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Reference#: C181

UNIX®

Technically identical to IEEE Std 1003.1, 2017 Edition (published in 2018)

The 2018 Edition incorporates the Single UNIX Specification, Version 4 Technical Corrigendum No. 1 and Technical Corrigendum No. 2.

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POSIX-compliant printf

<https://pubs.opengroup.org/onlinepubs/9699919799/functions/fprintf.html>

```
int printf(const char *restrict format, ...);
```


University of California (BSD) printf

<https://unix.superglobalmegacorp.com/Net2/newsrsrc/stand/printf.c.html>

```
void
#if __STDC__
printf(const char *fmt, ...)
#else
printf(fmt /* , va_alist */)
        char *fmt;
#endif
```



Linus Torvalds (Linux) printf

<https://code.woboq.org/linux/linux/arch/x86/boot/printf.c.html>

```
int printf(const char *fmt, ...)
```




Is Linux POSIX-compliant?

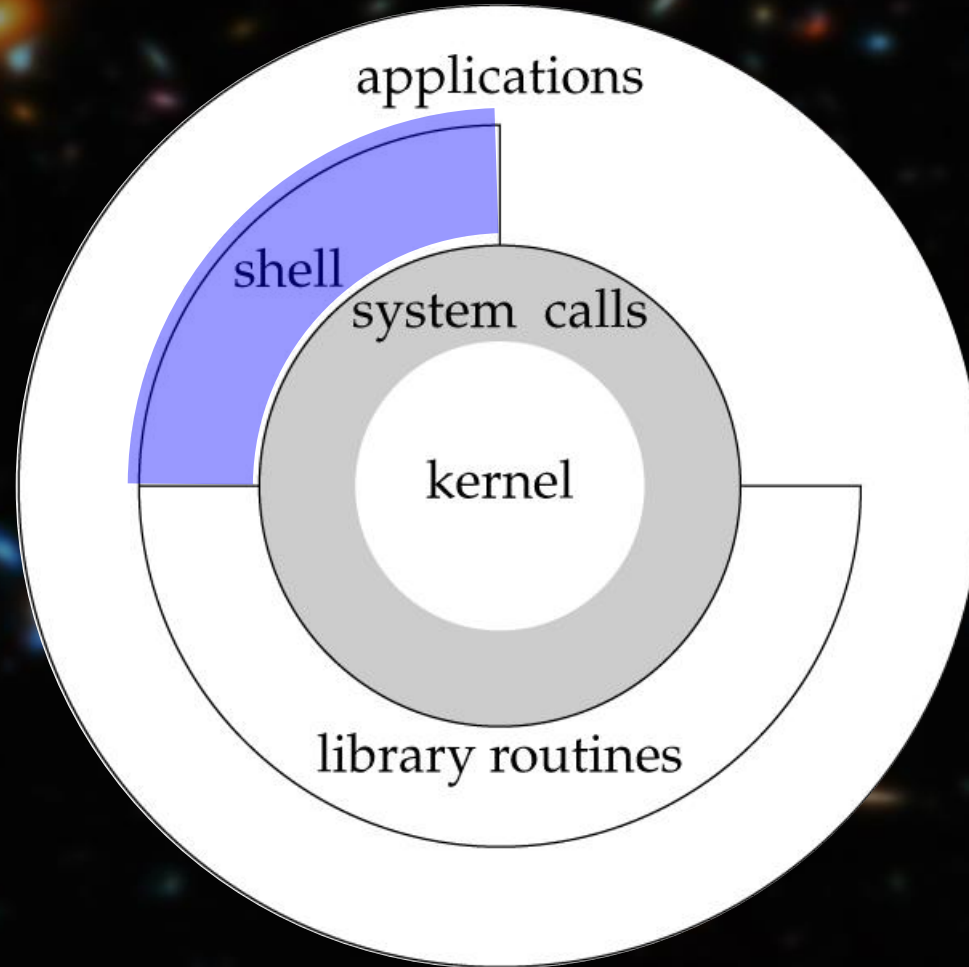
mostly!

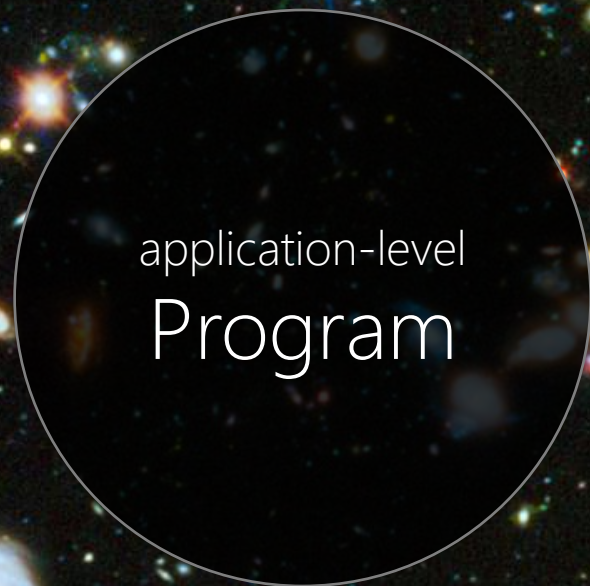
Has its own standard: Linux Standard Base (LSB) - compliant



Is MacOS POSIX-compliant?

Since 2009 (10.5 Leopard)





The background of the slide is a deep space image showing numerous galaxies in various colors (blue, orange, white) against a black sky. A solid blue horizontal bar spans the width of the slide, positioned behind the main title and the secondary question.

Know the Computer System Status

Is there any other programs?



Know the Computer System Status

Is there any other files?



Know the Computer System Status

What are the files?



Know the Computer System Status

What are the files' sizes?



Know the Computer System Status

Are there any hidden files?



Know the Computer System Status

Does memory have free space?



Know the Computer System Status

Does HDD have free space?

A cosmic background image featuring a dense field of galaxies and stars. The galaxies are in various stages of evolution, appearing as bright, colorful (yellow, orange, blue) spots and elongated structures against a dark, star-filled sky. Two horizontal blue lines are positioned above and below the main text.

Know the Computer System Status

And many other questions.



Who knows the answers?

Oracle? Programmer? Shell? Kernel? Processor?



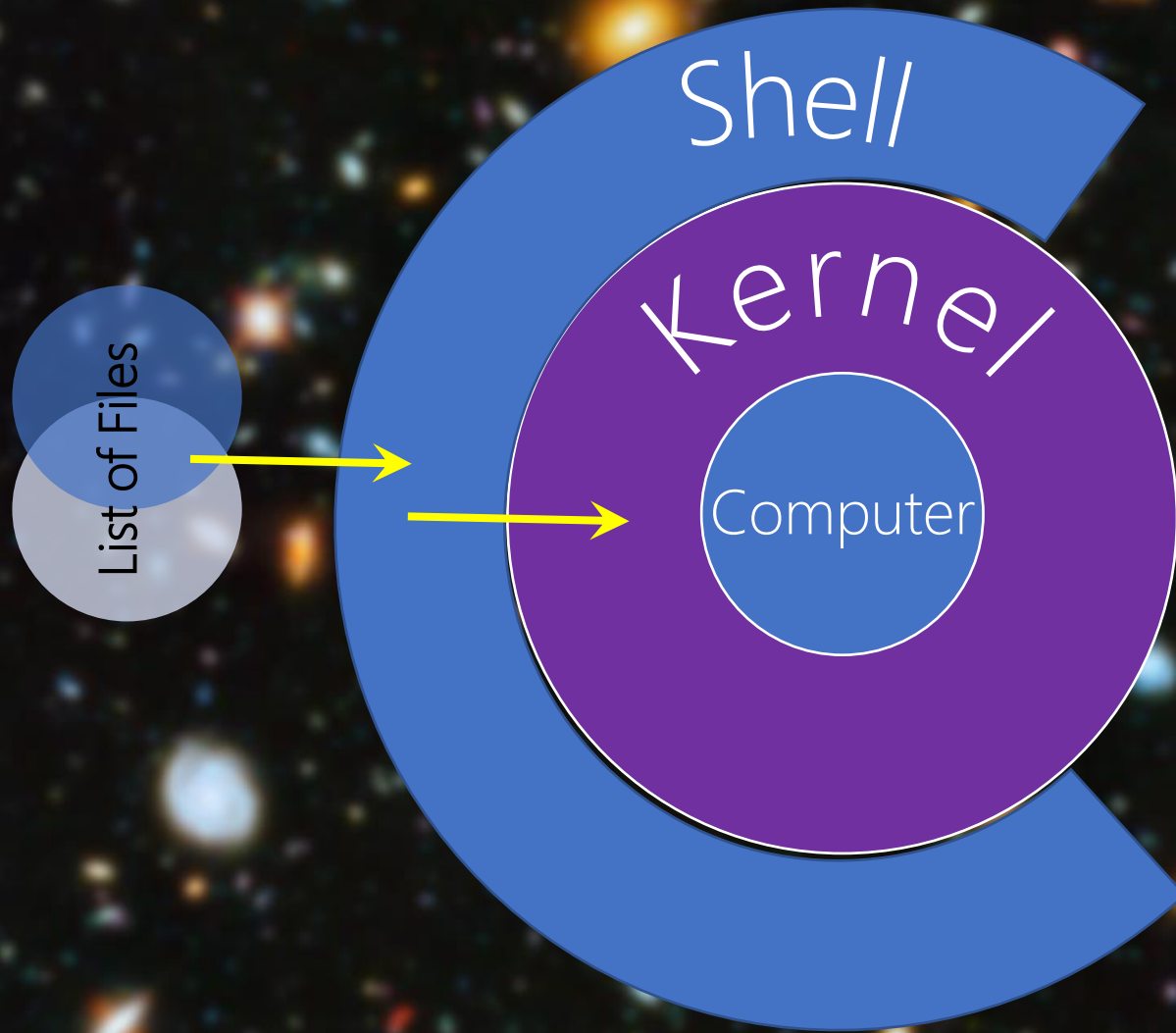
How to ask?

In English language verbally?
In written Opcodes?



How to ask?

Writing a program!



Computer

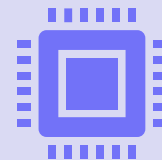
Memory

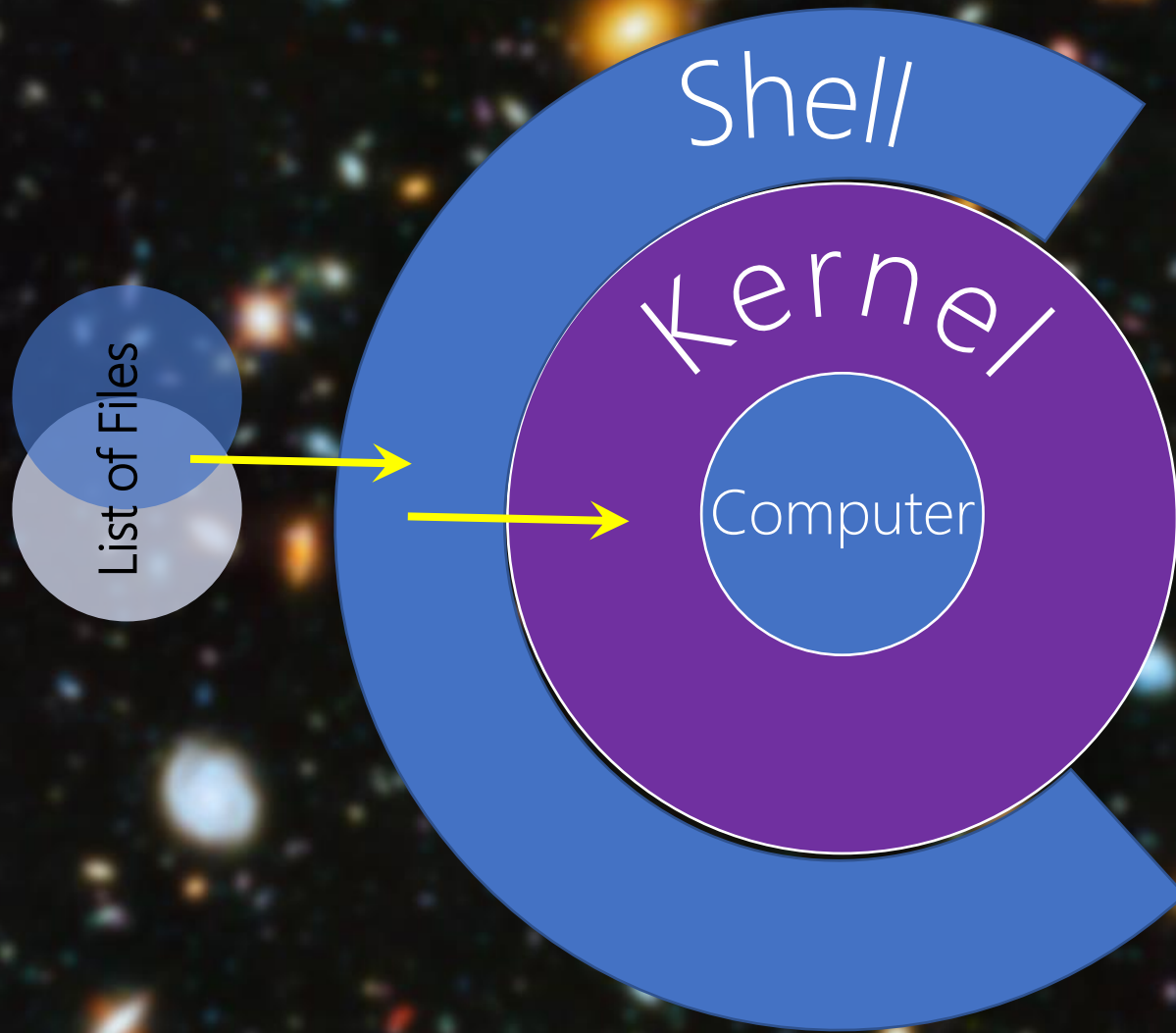
Kernel
File System

Shell

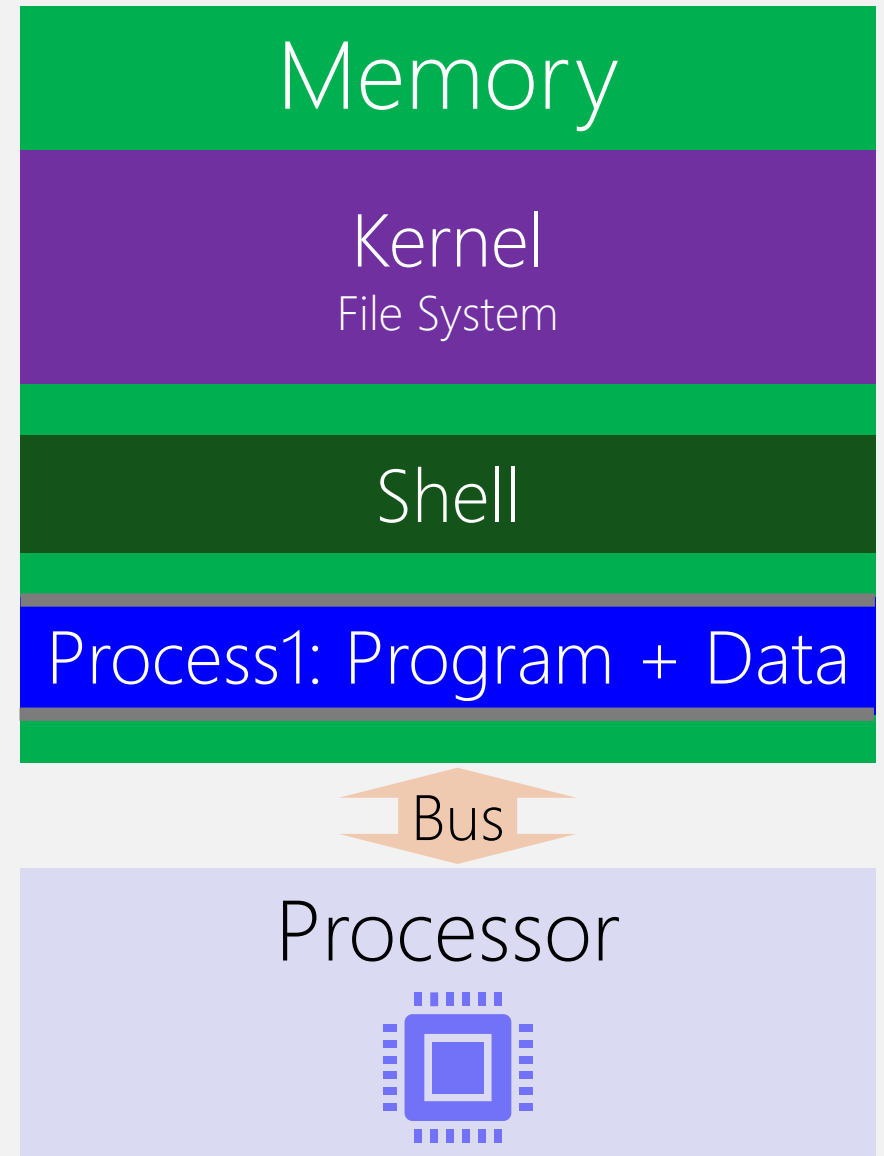
Bus

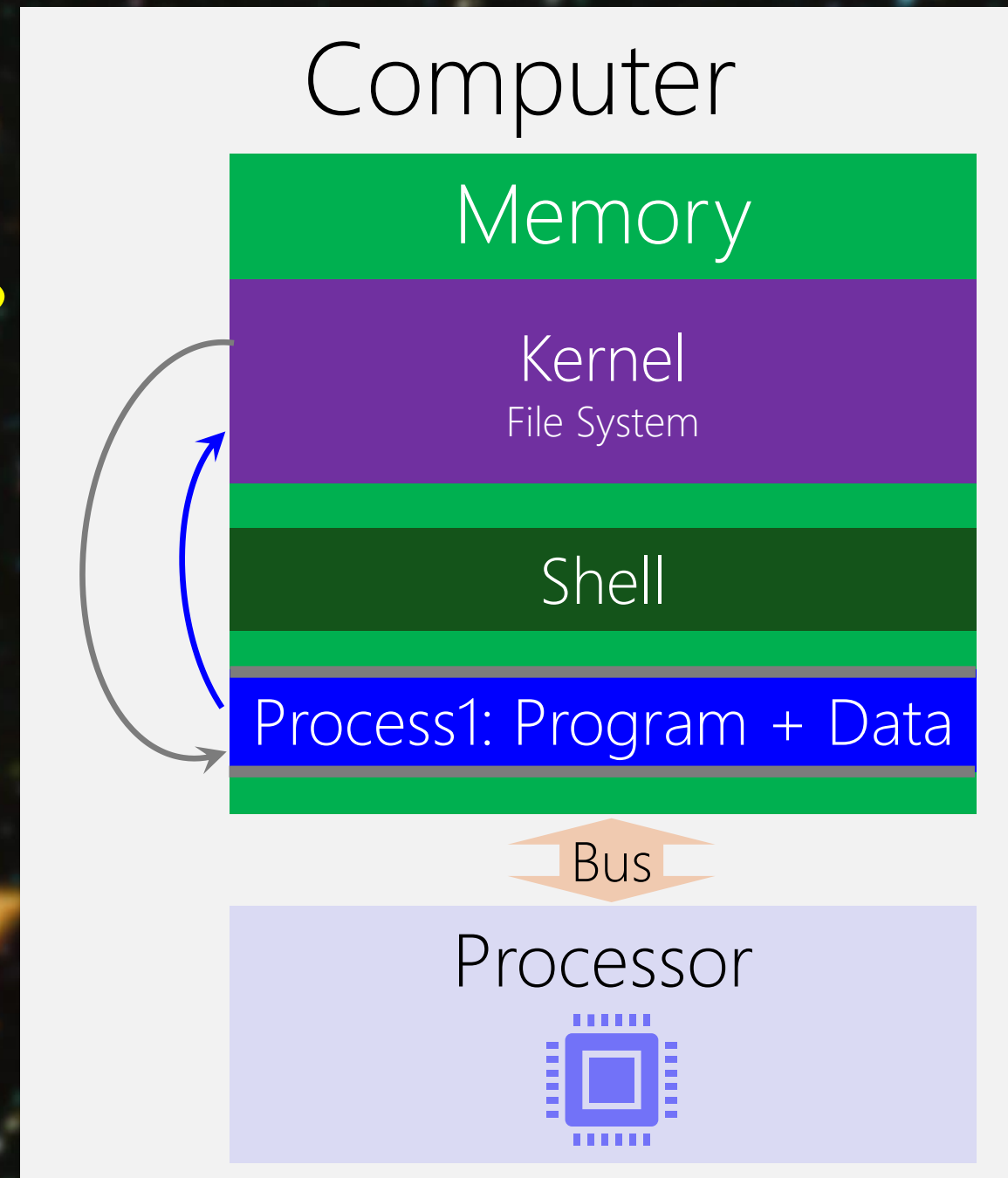
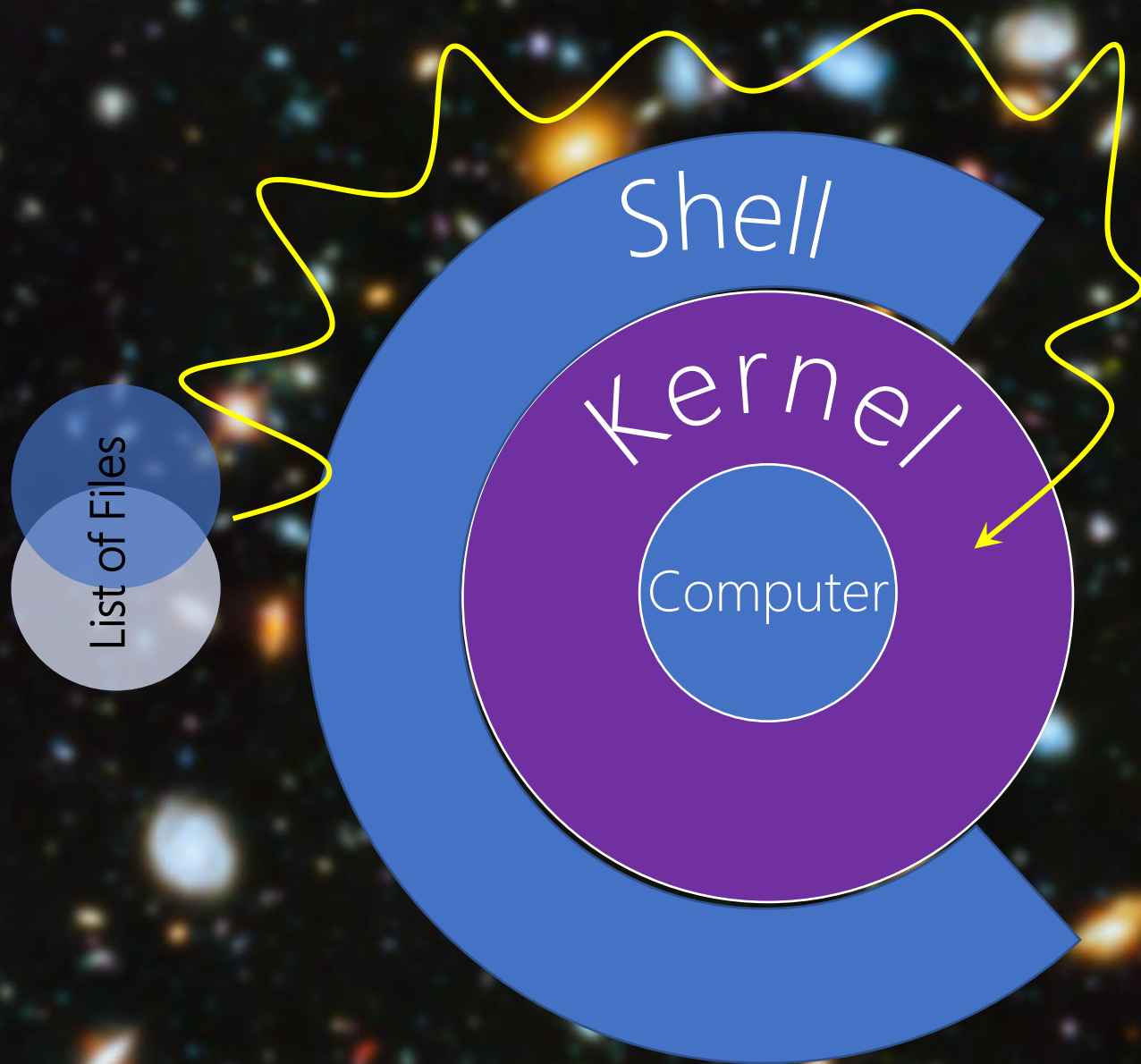
Processor





Computer





A cosmic background image featuring a dense field of galaxies and stars against a dark, black sky. The galaxies are scattered across the frame, appearing in various colors including yellow, orange, blue, and white. Some are bright and distinct, while others are faint and blurry. The stars are small, bright points of light. A thin, horizontal blue line is visible across the middle of the image, separating the top and bottom sections.

<https://github.com/wertarbyte/coreutils/blob/master/src/ls.c>

This program is free software: you can redistribute it and/or modify it under the terms of the GNU General Public License as published by the Free Software Foundation, either version 3 of the License, or (at your option) any later version.