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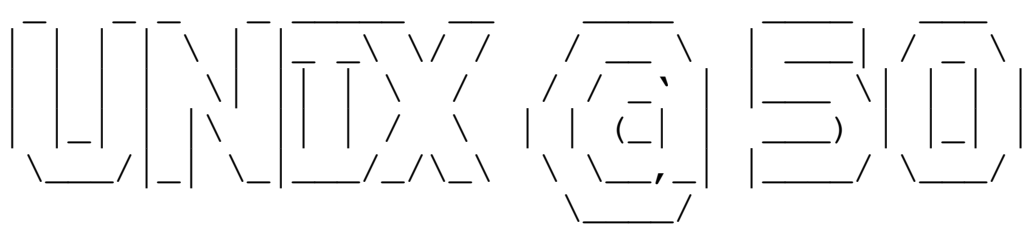

50 years of the Unix Operating System
Myths, Legends, and quirky stories

Vincenzo "KatolaZ" Nicosia
Freaknet -- QMUL

Lovelace Mondays
Mon 2nd Dec 2019

Dipartimento di Matematica e Informatica
Universita’ della Calabria

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Krogg

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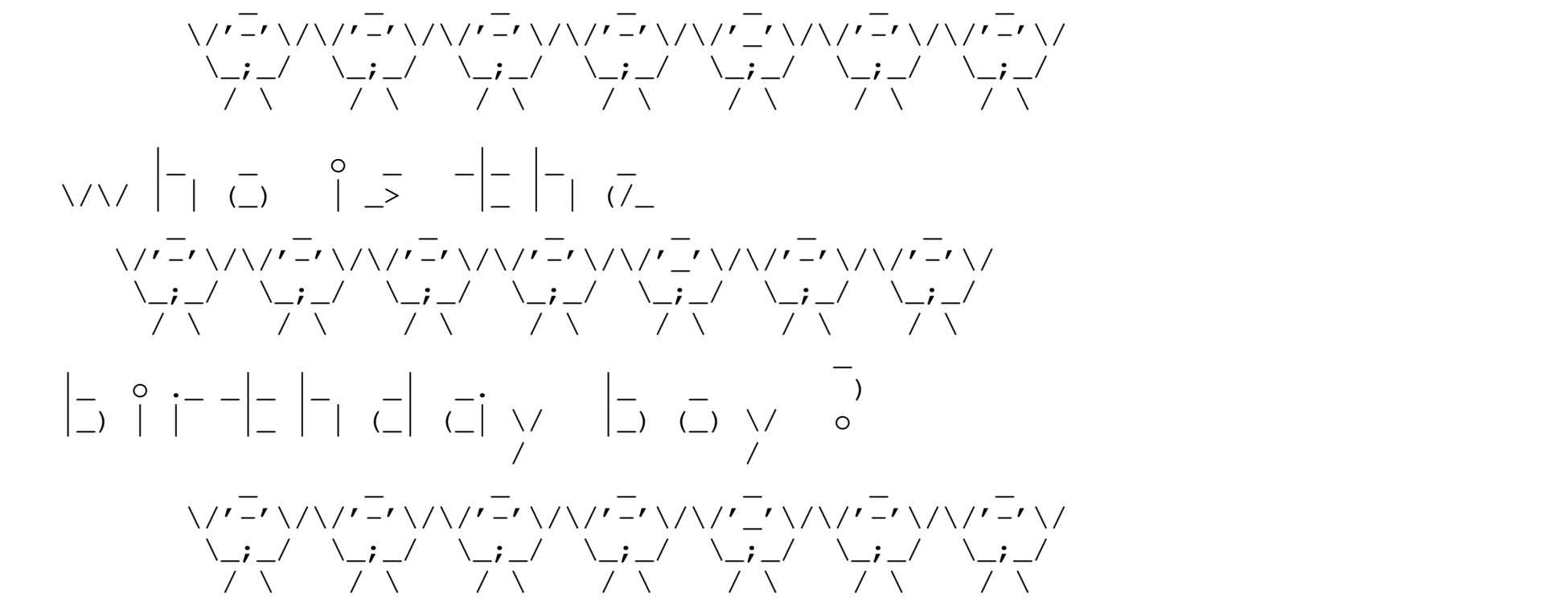

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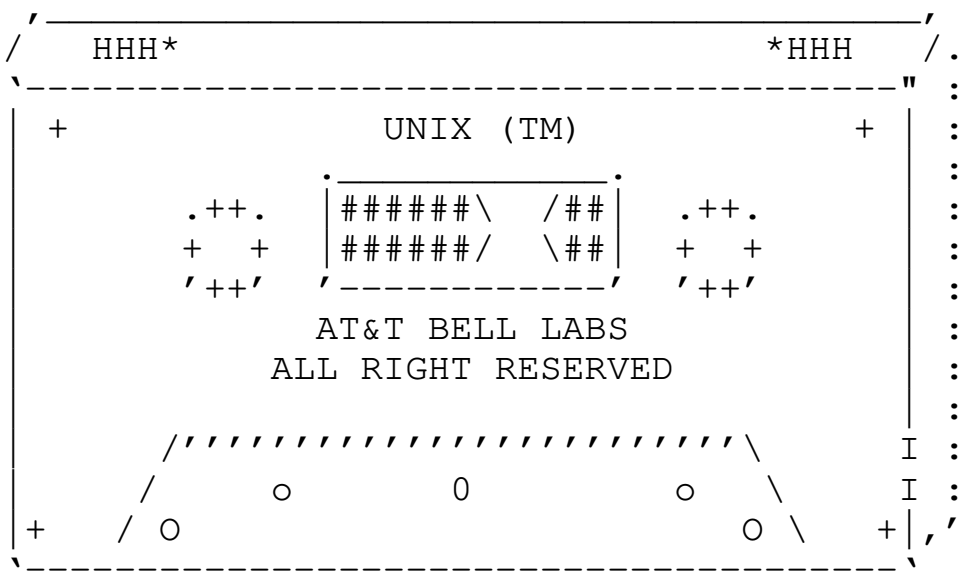
UNIX: The operating system
==========================



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UNIX: The operating system

- Operating system for mini and micro computers

- Developed at AT&T Bell Laboratories (1969 - 1992)

- Initially working on DEC PDP-11

- Then ported on Interdata, VAX, m68k, Sparc, Alpha, i386, RISC, PPC, ...

- Licensed to universities and resellers

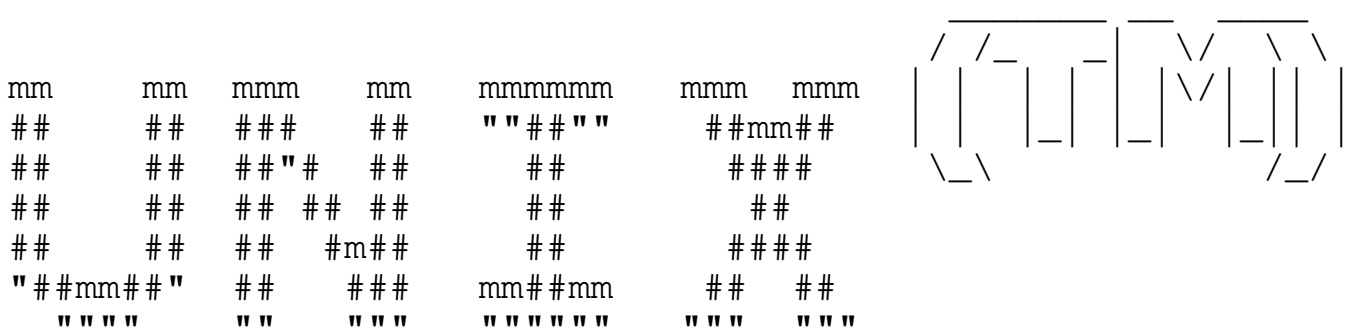
...but...

- Ceased its existence around 1992 (SysV R4.2)

- Most of the architectures where it worked are extinct

=

UNIX: The Trademark



=

UNIX: The Trademark

- UNIX is a Trademark registered by AT&T

- when AT&T dismantled the UNIX business the trademark was sold and passed to

  ...Novell first...
  ...X/Open next...
  ...and finally to The Open Group

- The Open Group certifies UNIX(tm)-compliant systems, and licenses the usage of the UNIX(tm) trademark (after you have paid $$$)

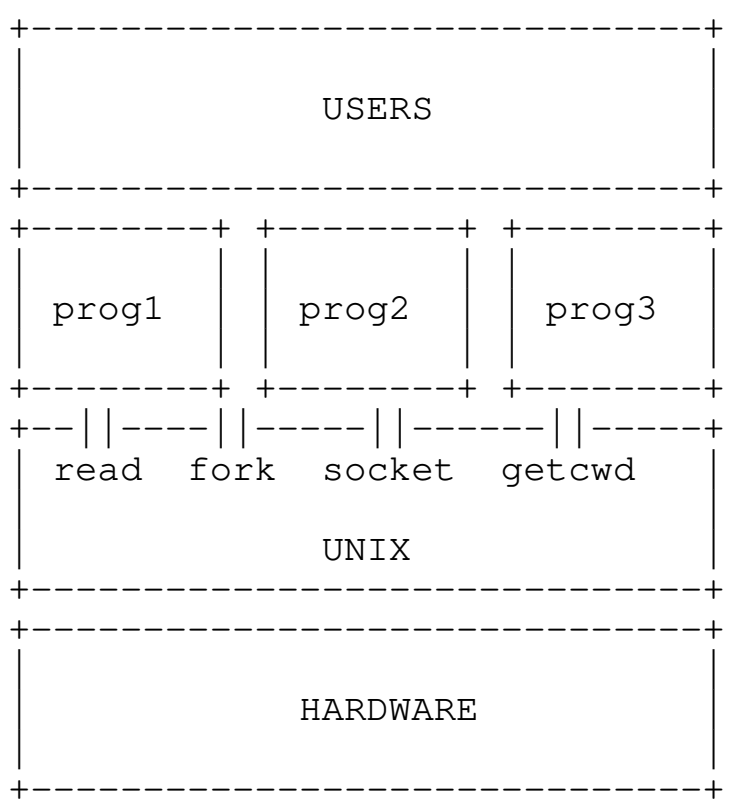
- Current Licensees include: AIX (IBM), HP-UK (HP), Solaris (Oracle), Tru64 (DEC), macOS (Apple) and z/OS (IBM)

...but...

- UNIX is not just about MONEY...

=

UNIX: The kernel interface
==========================



==

UNIX: The kernel interface

- A (more or less) defined set of "standard" system calls
  (read, open, creat, fork, ...)

- A common interface between user programs and hardware
  resources (memory, disks, network, etc.)

- Common access to data (everything is a file)

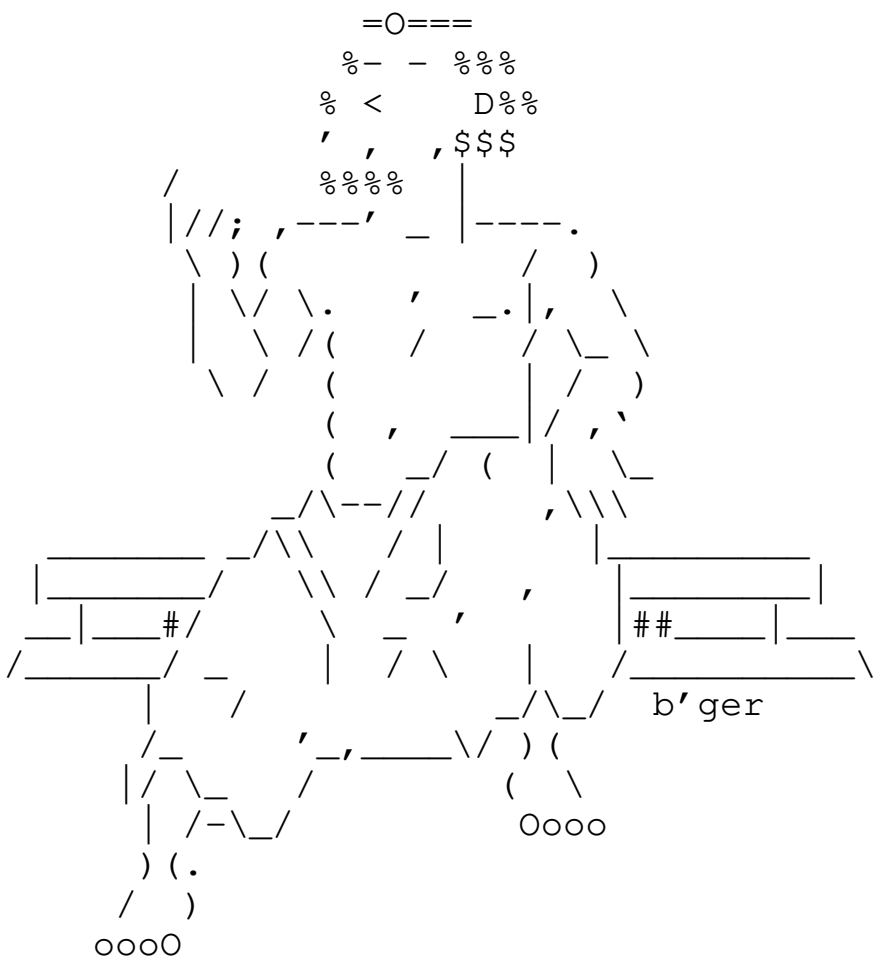
...but...

- the set of system calls is not standard

  - 35 in the original UNIX - About 350 in modern Linux
    more than 400 in FreeBSD

=

UNIX: The Philosophy
====================



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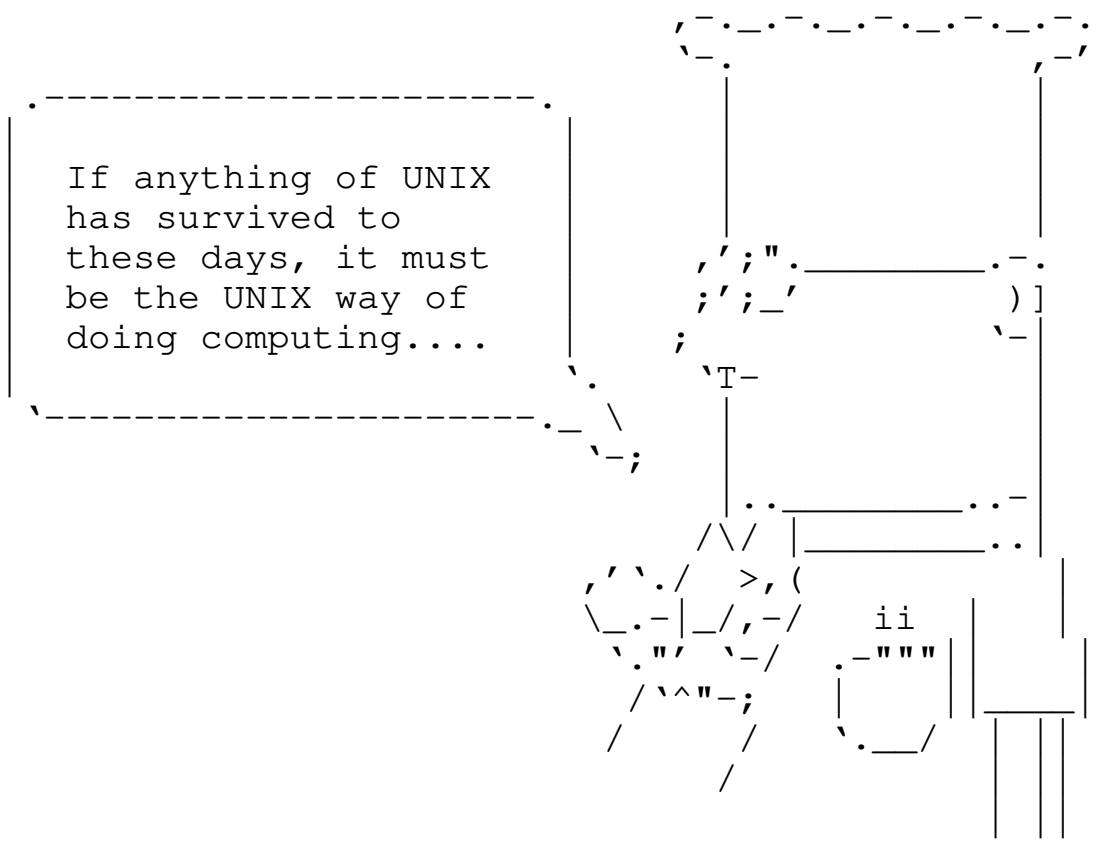
UNIX: The Philosophy

- KISS: Keep It Simple, Stupid!
- Do one thing, and do it well
- Prefer small programs
- Make programs interact easily (filters and pipes)
- Use text input/output
- Prefer portability over efficiency
- Prototype before polishing
- If unsure, just shut up

=


If anything of UNIX
has survived to
these days, it must
be the UNIX way of
doing computing....

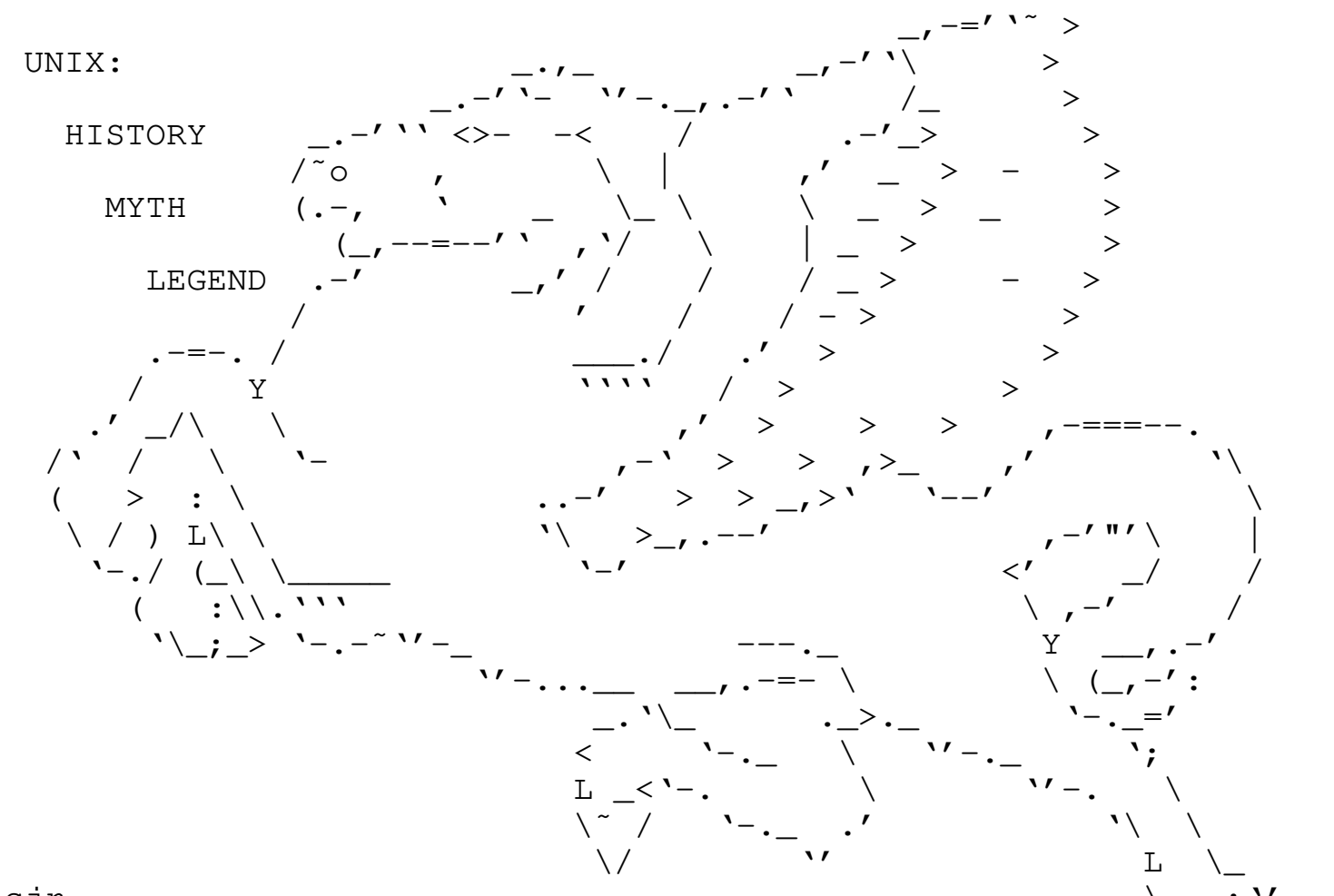
=

UNIX:

HISTORY

MYTH

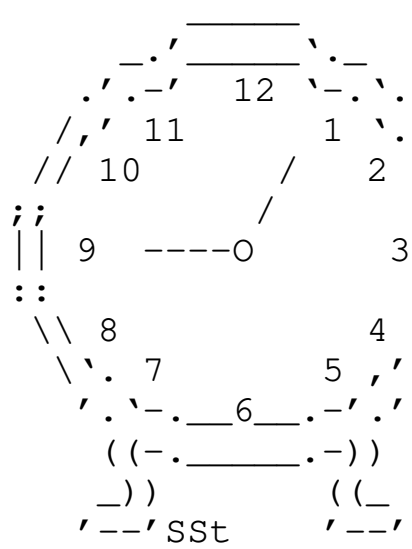
LEGEND



cjr
14jul00

===

The Unix epoch



NUMBER OF SECONDS

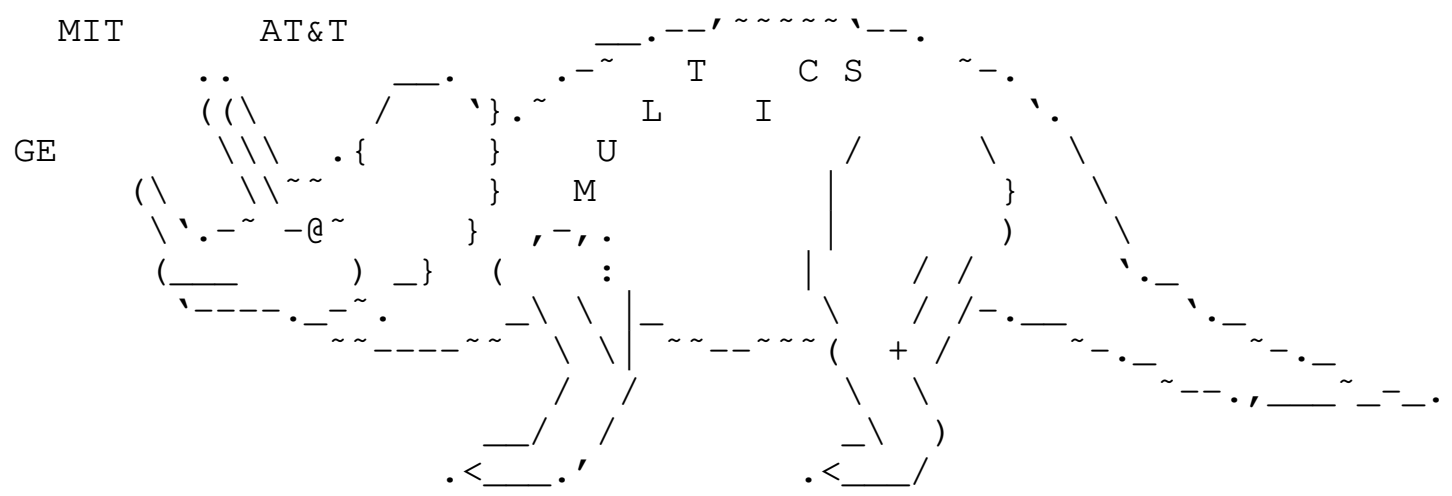
SINCE 1st JANUARY 1970

AT MIDNIGHT

==

~100,000,000 BUE (1967) -- Multics
==========

MULTIPLEXED INFORMATION AND COMPUTING SERVICE



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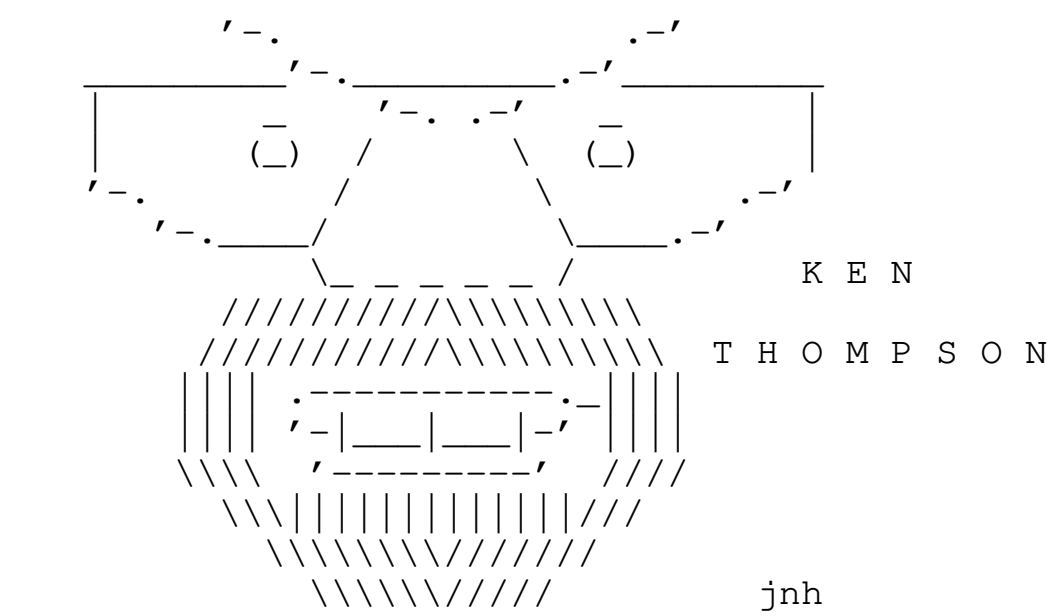
~ 13,219,200 BUE (July 1969) -- The origin
==========



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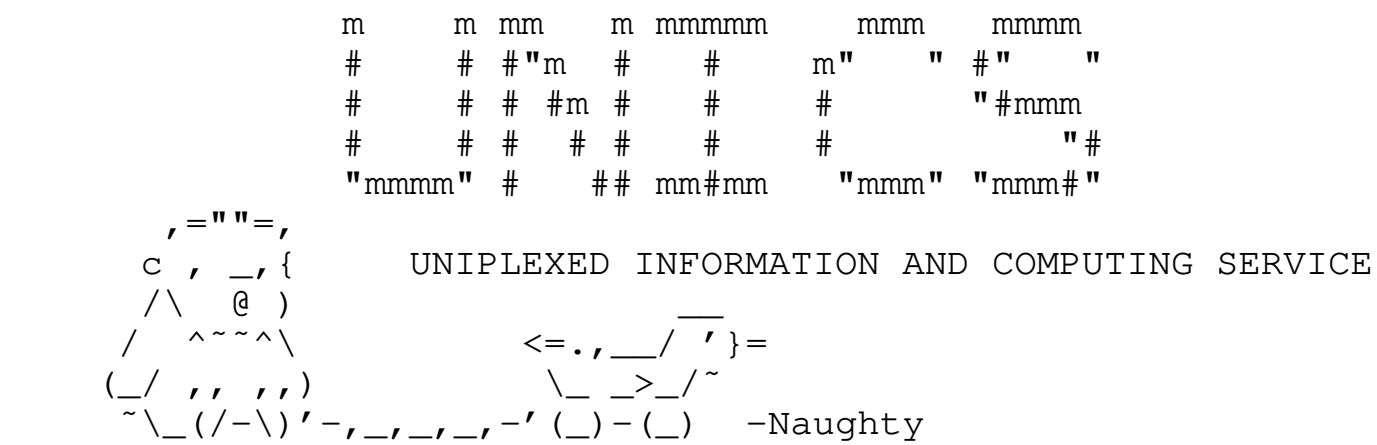
The Mythical Man-Month

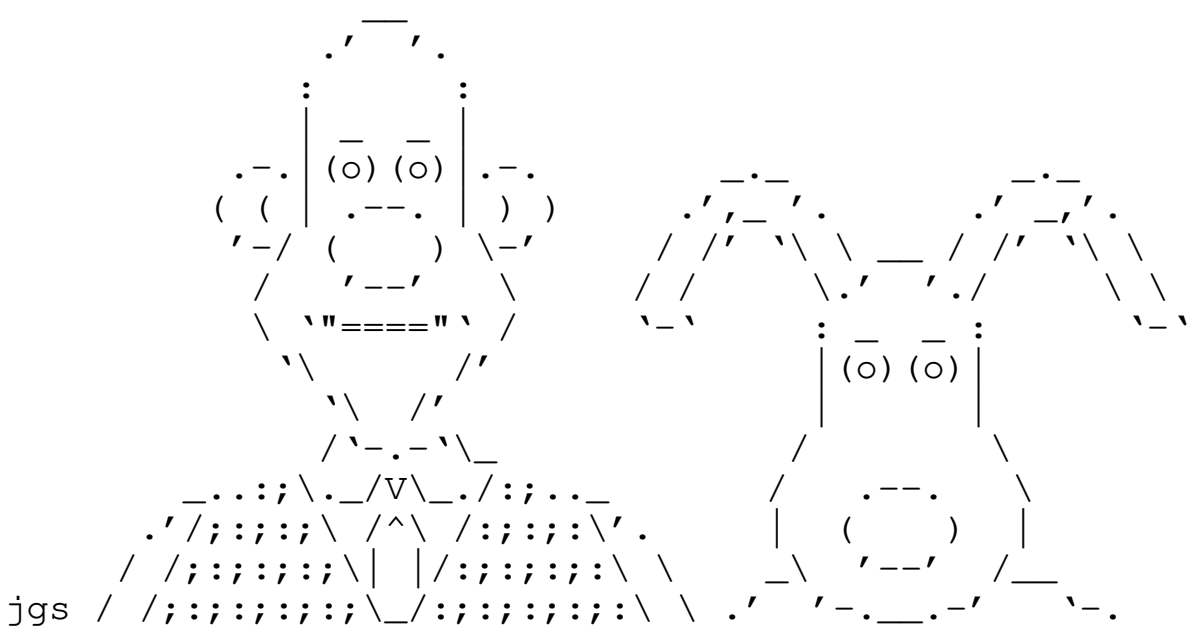
- Ken Thompson, Dennis Ritchie, and Rudd Canaday in the same room
- they discuss a prototype of a hierarchical filesystem
- Ken implemented the filesystem on a "poorly-used" PDP-7
- "At a certain point I realised I was three weeks away from a complete system", Ken
- Ken’s wife goes on vacation to the West Coast
  - One week for the assembler
  - One week for the editor (ed!)
  - One week for the shell (and an exec loop)

=


m m mm m mmmmm mmm mmmm
#"m # # m" " #" "
#m # # # "#mmm
"#
"mmmm" # ## mm#mm "mmm" "mmm#"
UNIPLEXED INFORMATION AND COMPUTING SERVICE
-Naughty

==

0 UE - 157,680,000 UE (1970 - 1974)
==========



K E N
T H O M P S O N

D E N N I S
R I T C H I E

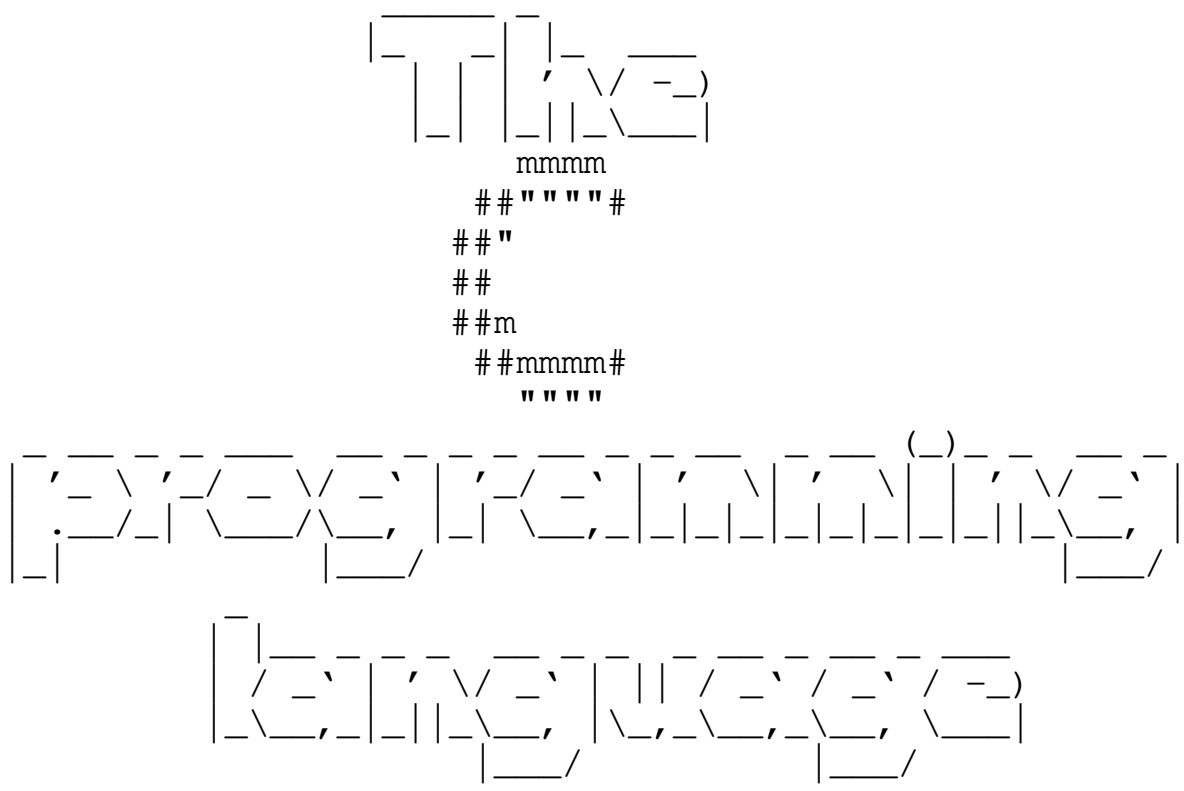
==

1970: "No operating systems research!"

- the PDP-7 was already obsolete in 1969
- The new PDP-11/20 from DEC was just perfect for UNICS
- AT&T did not want to spend ANY MONEY AT ALL on Operating Systems
- They got a PDP-11/20 to produce a text-processing system!
- UNIX was immediately ported on the PDP-11/20

=

1972: "C is not a very high-level language"
==========



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QUIZ: What is the most powerful ASCII character?
==========

or: How to totally break Unix with the minimal
possible effort?

=

QUIZ: What is the most powerful ASCII character?
==========

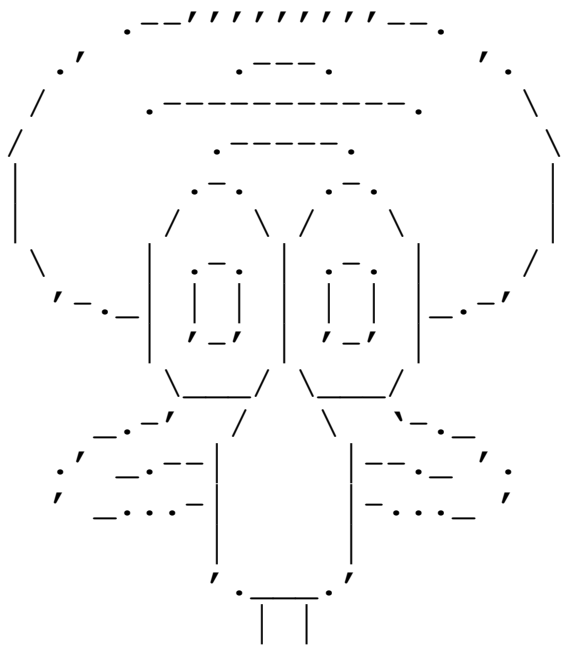
The winner is: pipe!

(0174 / 124 / 0x7C)

=

"We should have some ways
of coupling programs like
garden hose --screw in another
segment when it becomes
necessary to massage data
in another way. This is the
way of IO also."

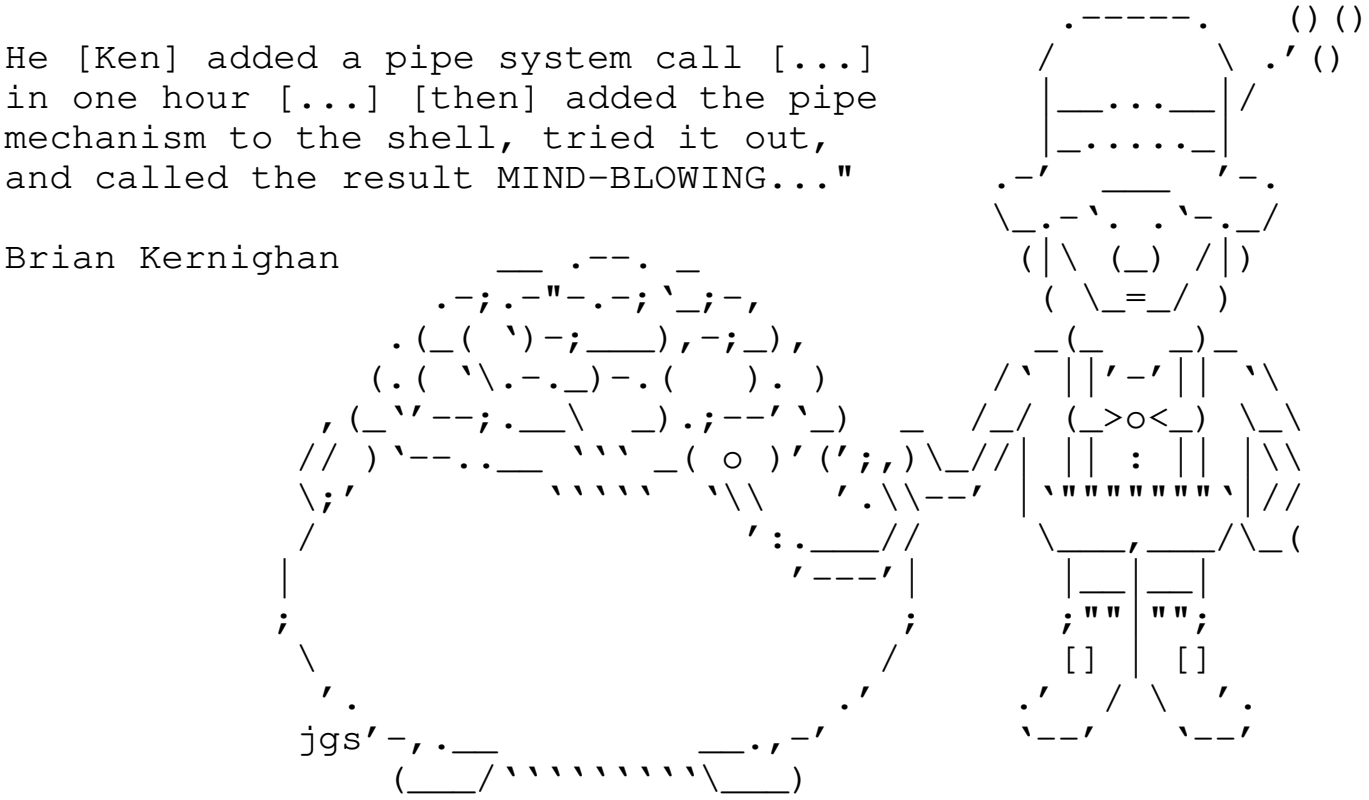
Doug McIlroy, 1964



=

"He [Ken] added a pipe system call [...]
in one hour [...] [then] added the pipe
mechanism to the shell, tried it out,
and called the result MIND-BLOWING..."

Brian Kernighan



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Communications of the ACM, 17(7), 1974
==========

The UNIX Time-Sharing System

Dennis M. Ritchie and Ken Thompson
Bell Laboratories

UNIX is a general-purpose, multi-user, interactive operating system for the Digital Equipment Corporations PDP-11/40 and 11/45 computers. It offers a number of features seldom found even in larger operating systems, including:....

==

"Perhaps I didn’t do a good job", Ken
==========

=


WE LOVE UNIX

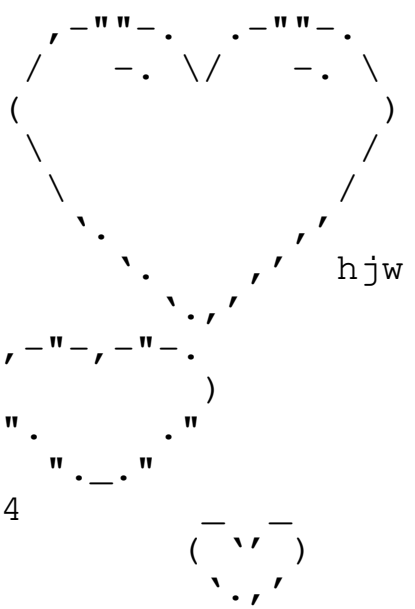
=

1974: "Love, Ken"

- UNIX is shipped to Universities for 150$
- Full sources are available for little more $$$
- You receive a 9-track tape with a message:

"Love, Ken"

- Many US universities run unix by the end of 1974
  (including UC Berkeley...)



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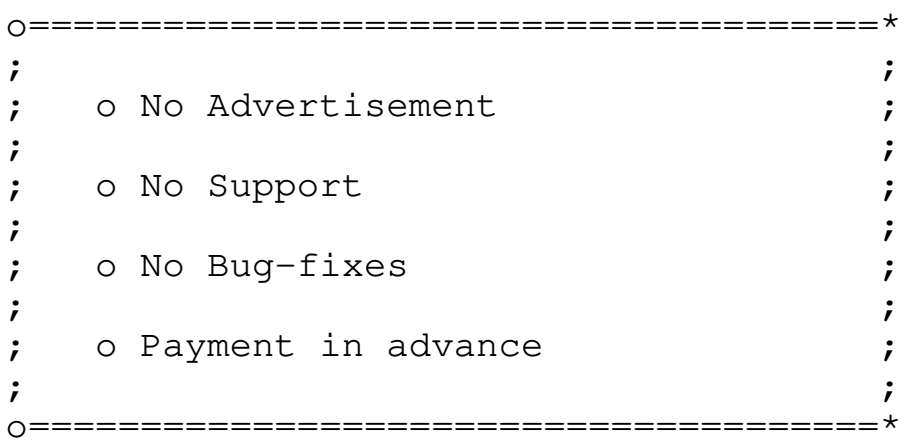
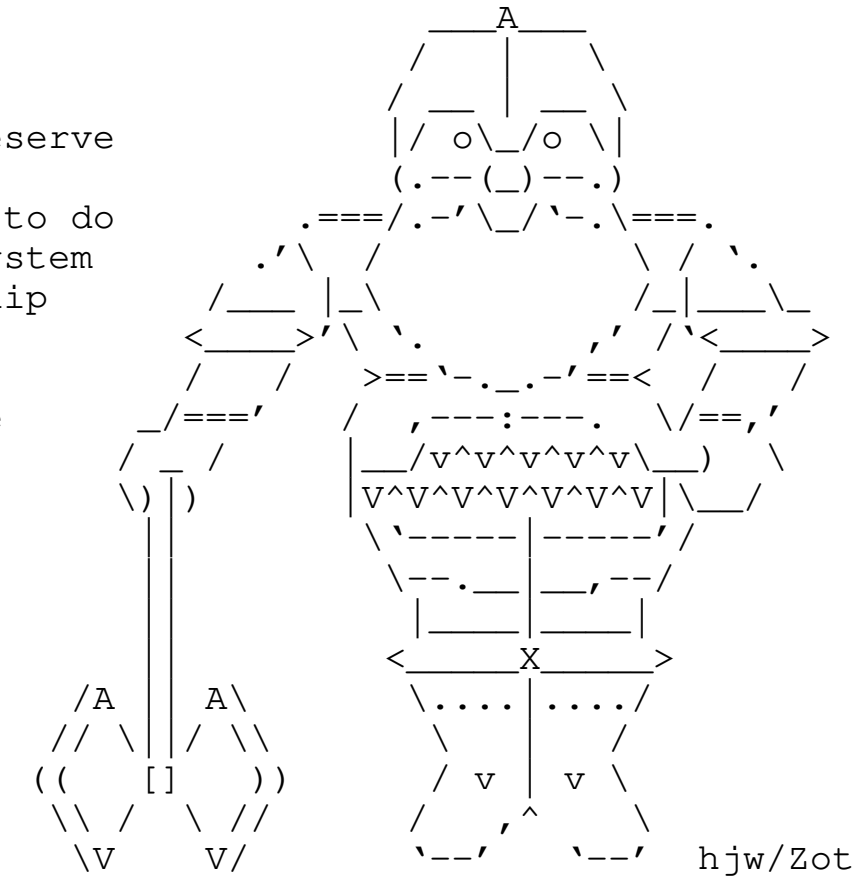
Bell Systems UNIX(tm) support policy:
=====================================



=

"What we wanted to preserve
was not just a good
environment in which to do
programming, but a system
around which fellowship
could form".

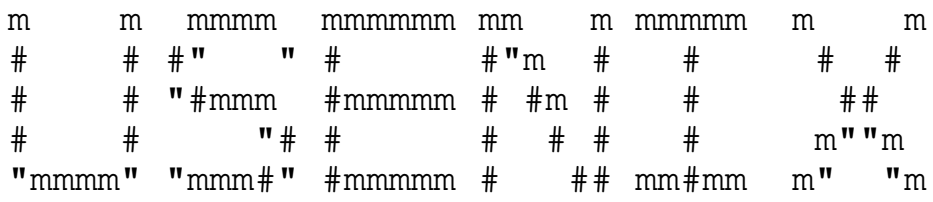
Dennis Ritchie



hjw/Zot

=

A FELLOWSHIP OF UNIX USERS



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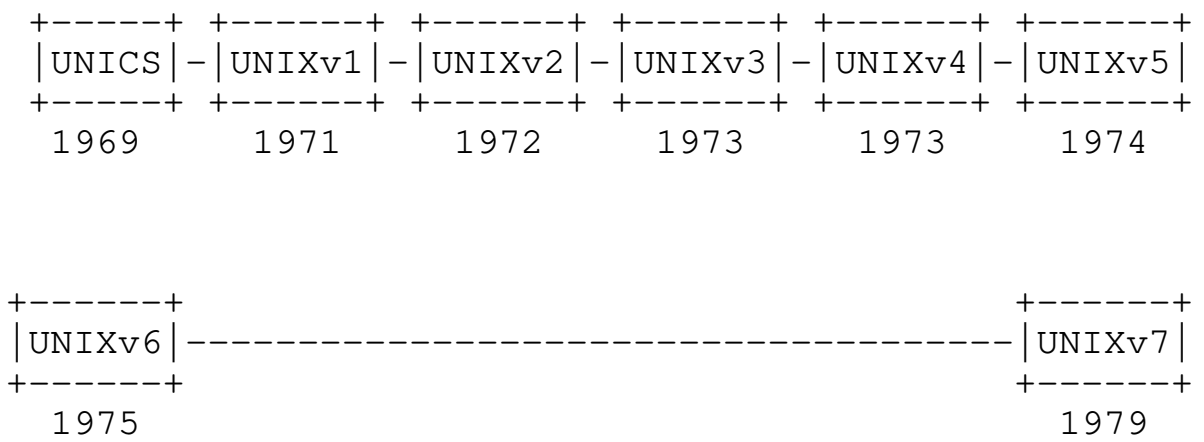
157,680,000 UE - 315,360,000 UE (1975 - 1979)



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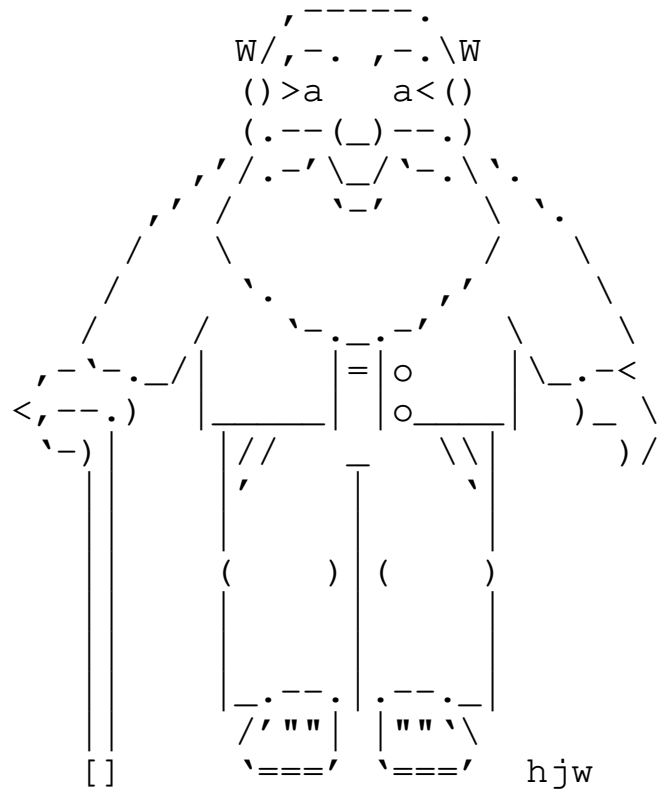
UNIX v7: The grandparent of all Unix-like systems

ar at awk basename bc cc cal cat
cd chmod chown cmp comm cp date
dd df diff du echo ed expr false
file find fgrep grep join kill
lex link ln ls mailx man mesg
mkdir mv newgrp nice nm nohup od
pr ps pwd rm rmdir sed sh slip
sort split strip stty tee test
time touch tr true tsort tty
uniq unlink uucp uux wait wc
who write



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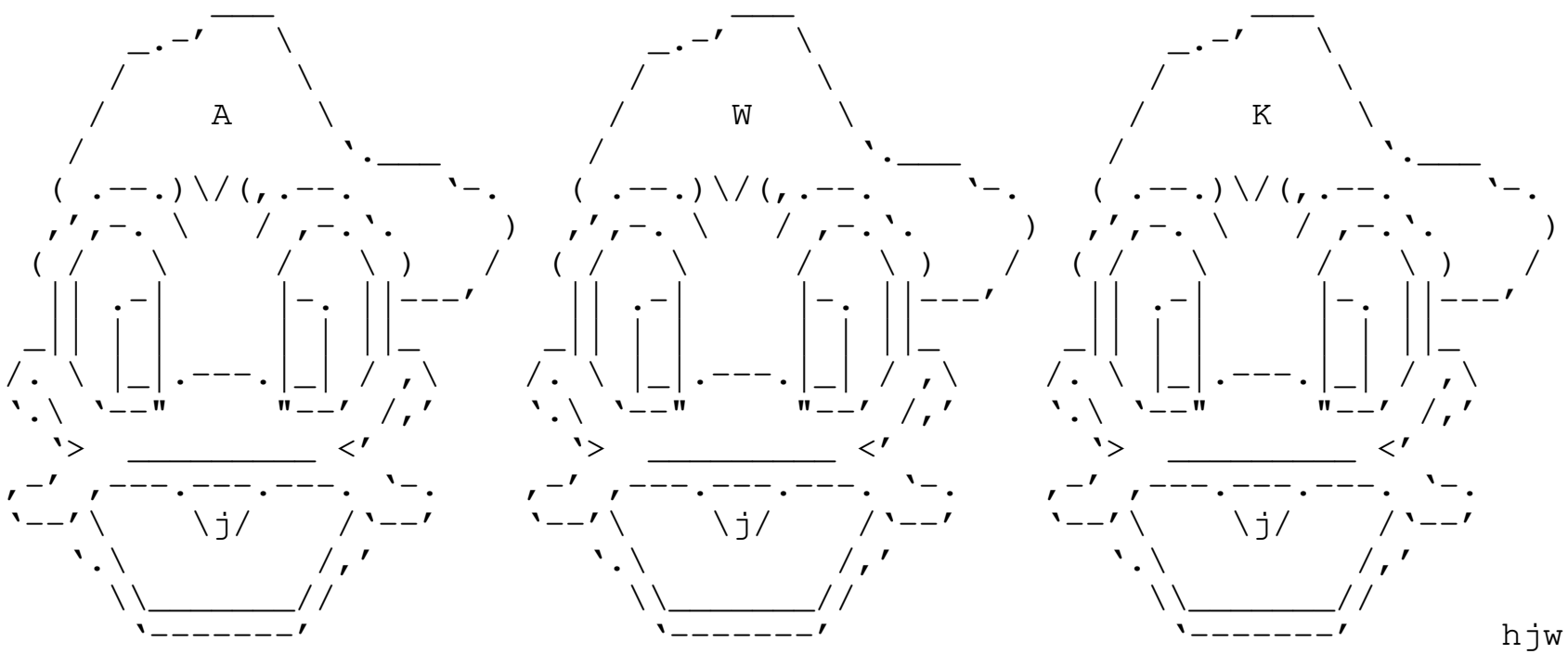
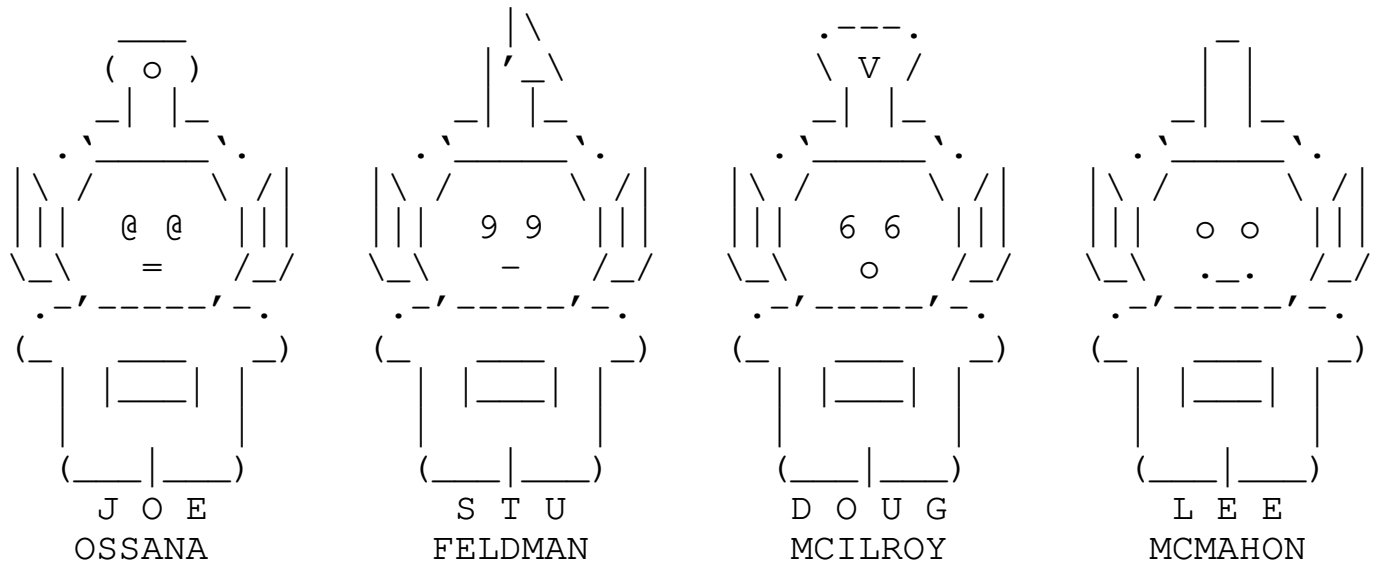
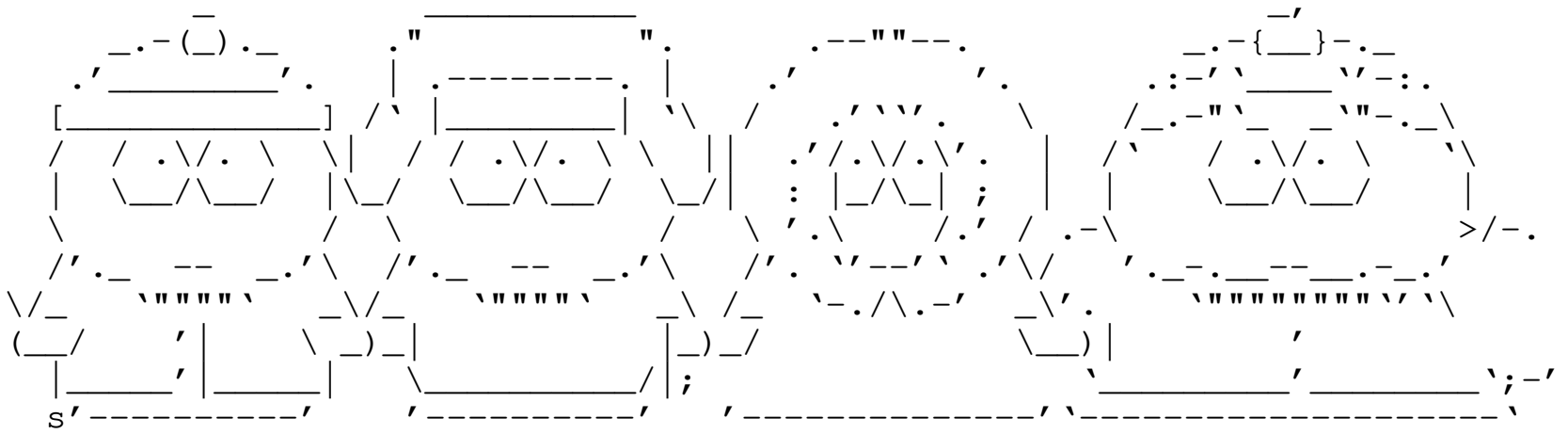

A
W
K
A L F R E D
AHO
(regexp,egrep,..)
P E T E R
WEINGERGER
(f77)
B R I A N
KERNIGHAN
(troff,eqn,m4...)
hjw

=



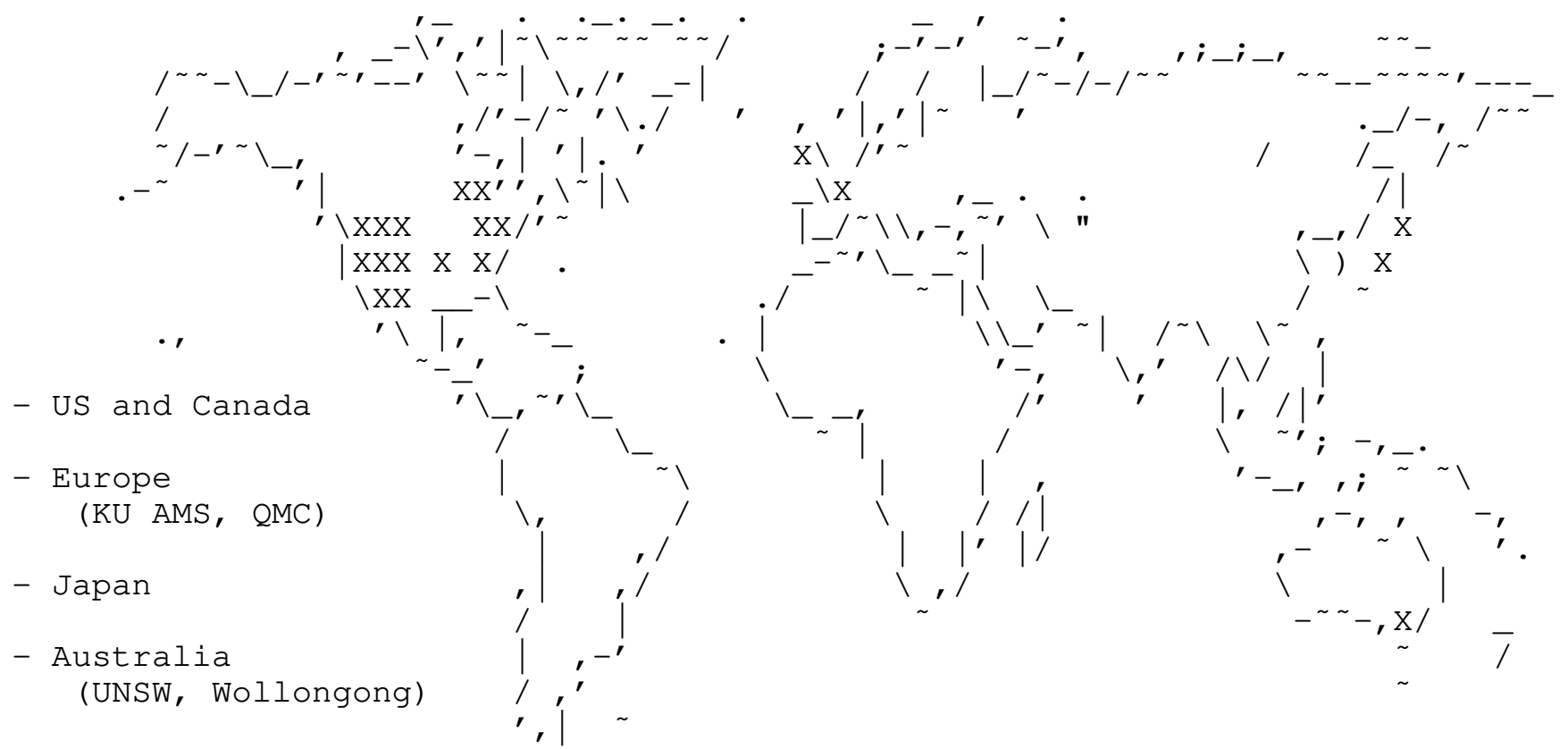
(troff) (make) (diff,join,sort) (sed)

=


S T E V E
BOURNE
S T E V E
JOHNSON
L O R I N D A
CHERRY
M I K E
LESK
(shell)
(pcc,yacc,lint)
(eqn,bc,dc)
(lex,tbl,uucp)

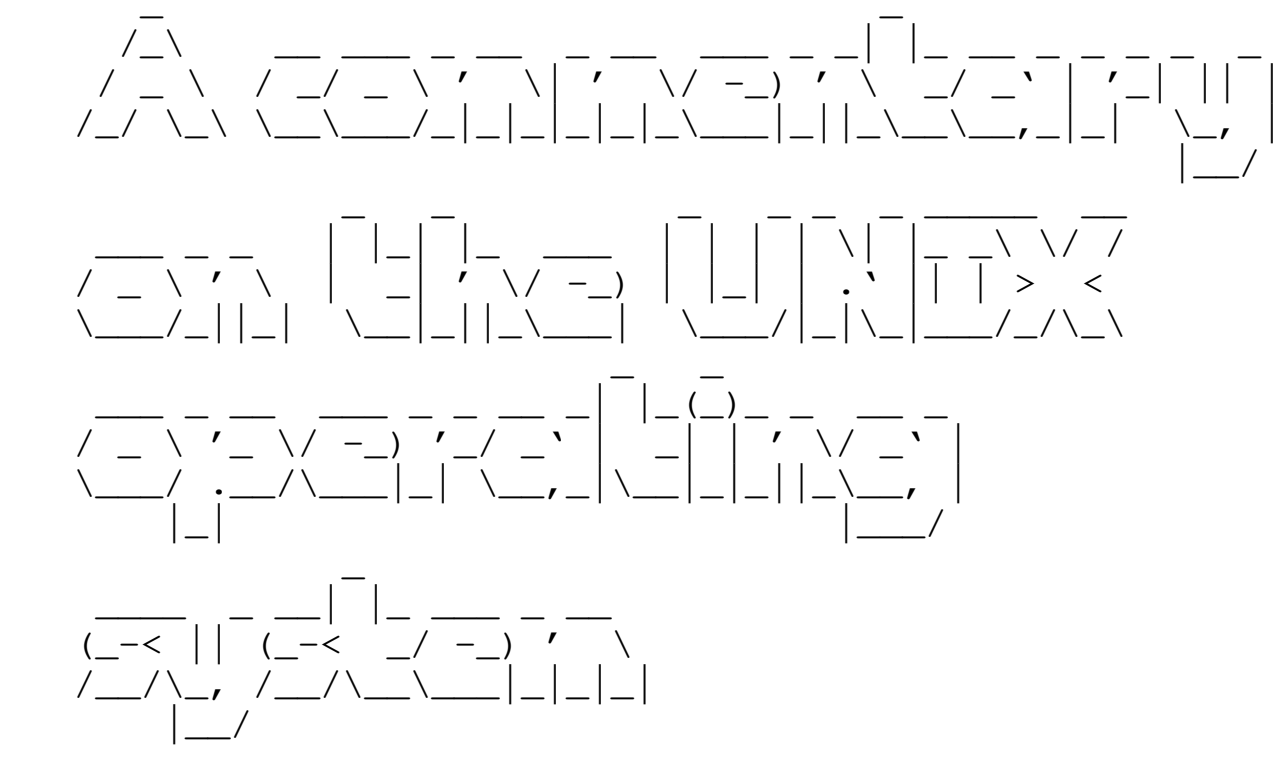
==

UNIX V6 everywhere



- US and Canada
- Europe
  (KU AMS, QMC)
- Japan
- Australia
  (UNSW, Wollongong)

==



(c) 1976 JOHN LIONS (UNSW)

=

```
         "You are not expected to understand this"
         ========================================

        /*
         o Switch to stack of the new process and set up
         o his segmentation registers.
         o/
        retu(rp->p_addr);
        sureg();
        /*
         o If the new process paused because it was
         o swapped out, set the stack level to the last call
         o to savu(u_ssav).  This means that the return
         o which is executed immediately after the call to aretu
         o actually returns from the last routine which did
         o the savu.
         o
         o You are not expected to understand this.
         o/
```

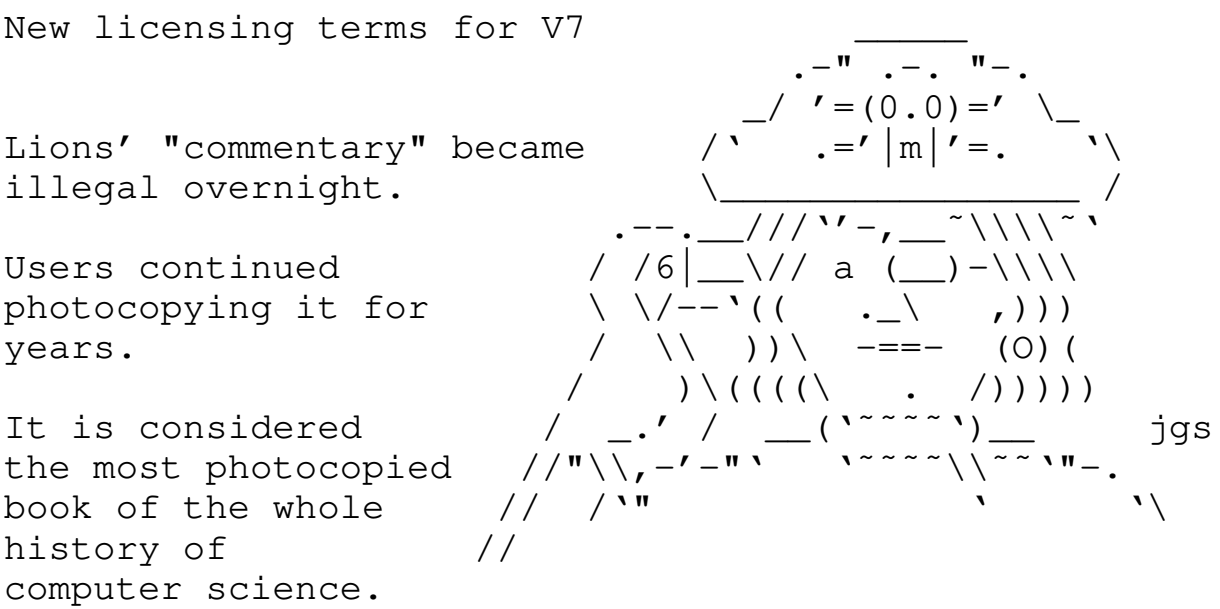
=

New licensing terms for V7

Lions' "commentary" became illegal overnight.

Users continued photocopying it for years.

It is considered the most photocopied book of the whole history of computer science.

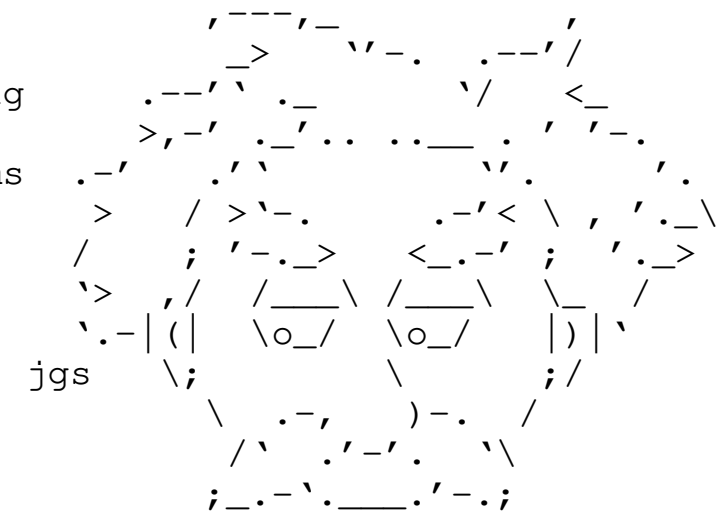


jgs

=

"This is the Unix philosophy.
Write programs that do one thing
and to it well. Write programs
to work together. Write programs
that handle text streams,
because this is a universal
interface".

Doug McIlroy



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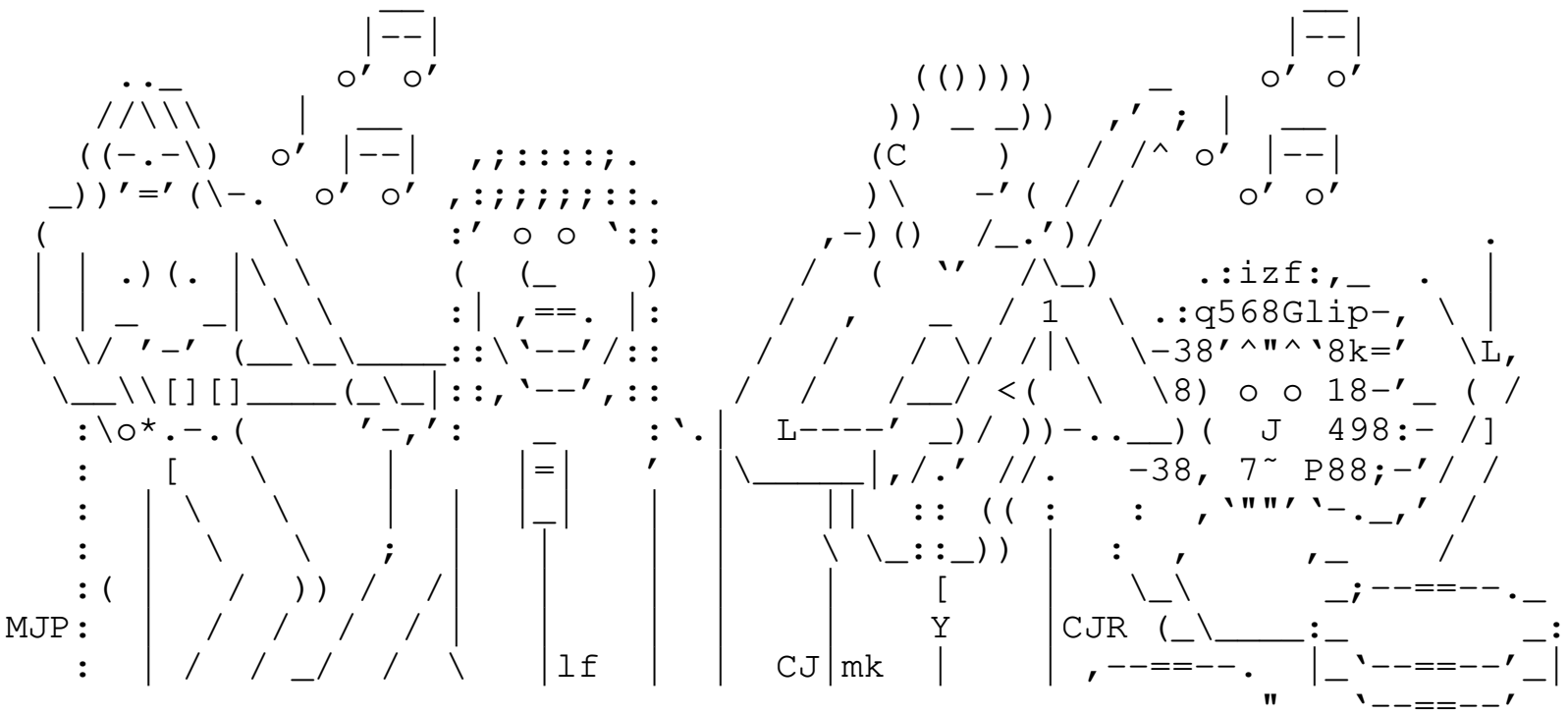
315,360,000 UE – 473,040,000 UE (1980 – 1984)
==========



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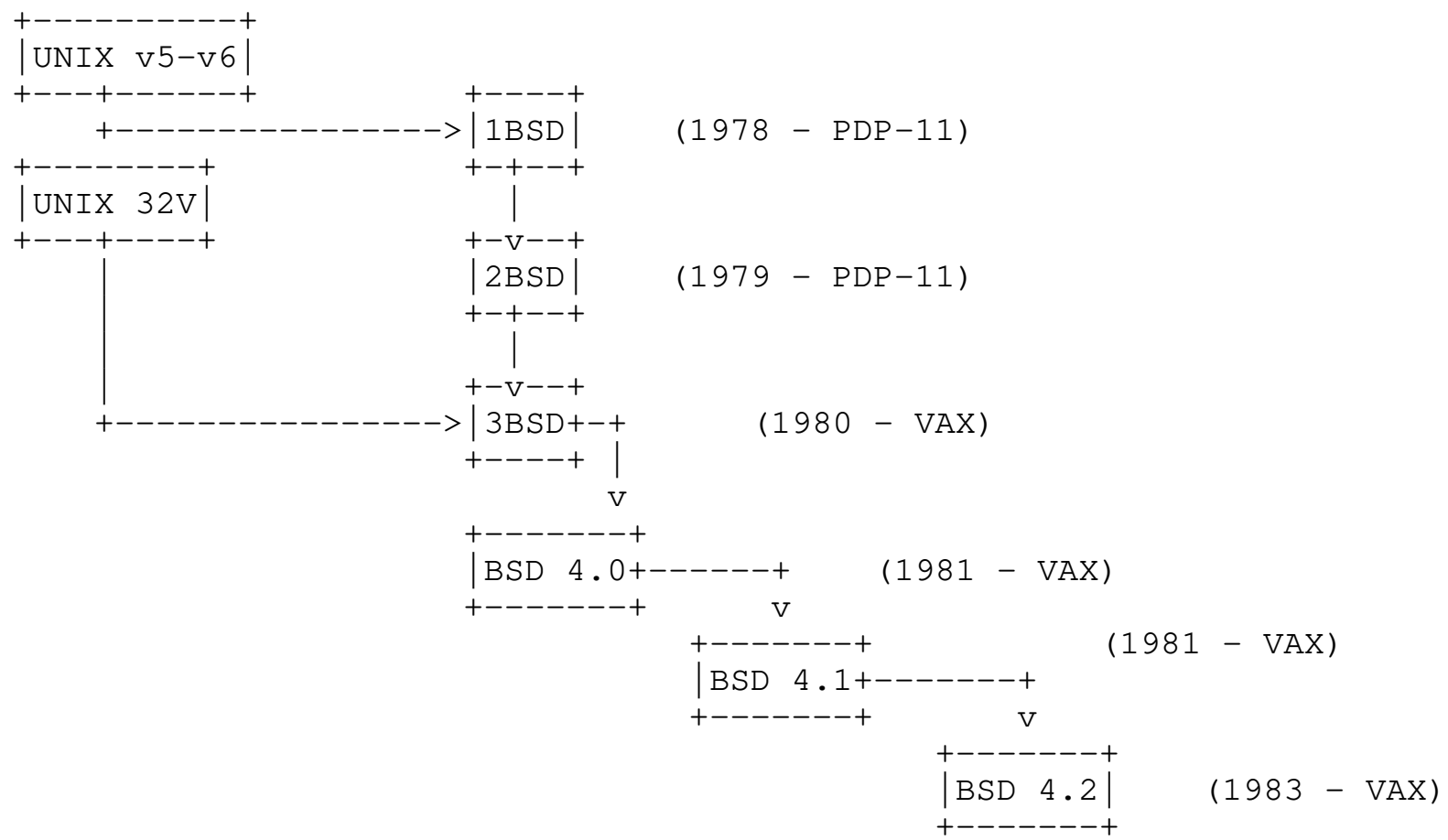
The Berkeley System Distribution

- UNIX (v4) arrived at UC Berkeley in 1974
- Grad students started "playing with it"
- Bill Joy and Chuck Haley (re)wrote a Pascal compiler
- Joy wrote the "ex" editor
- Universities wanted a Pascal compiler
- Joy put together the compiler and ex and created 1BSD (1978)

=

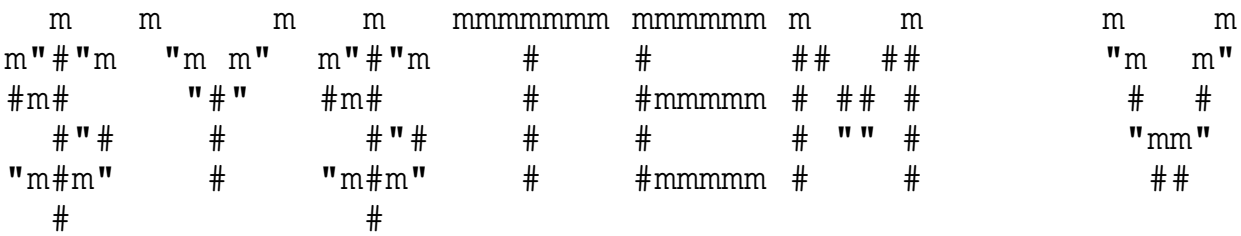

UNIX v5-v6
1BSD
(1978 - PDP-11)
UNIX 32V
2BSD
(1979 - PDP-11)
3BSD
(1980 - VAX)
BSD 4.0
(1981 - VAX)
BSD 4.1
(1981 - VAX)
BSD 4.2
(1983 - VAX)

=

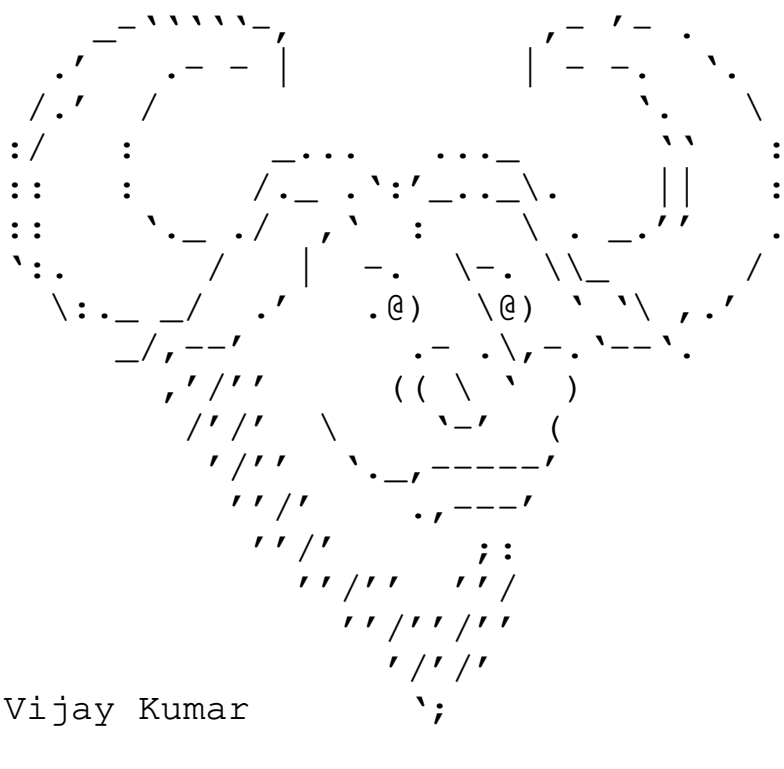

mmm
#"##
##
##
##
mmm##mmm
"""""""""
mmmm
m##""##m
##
"##mm###
"""
#mmm##
"""""
mmmm
m##""##m
##m m##
######
##" "##
"##mm##"
"""""
mmmmm
#""""##m
m##
#####
"##
#mmmm##"
"""""

=

=


m m m m mmmmmmm mmmmmm m m m m
m"#"m "m m" m"#"m # # ## ## "m m"
#m# "#" #m# # #mmmmm # ## # # #
#"# # #"# # # # "" # "mm"
"m#m" # "m#m" # #mmmmm # # ##
# #

=



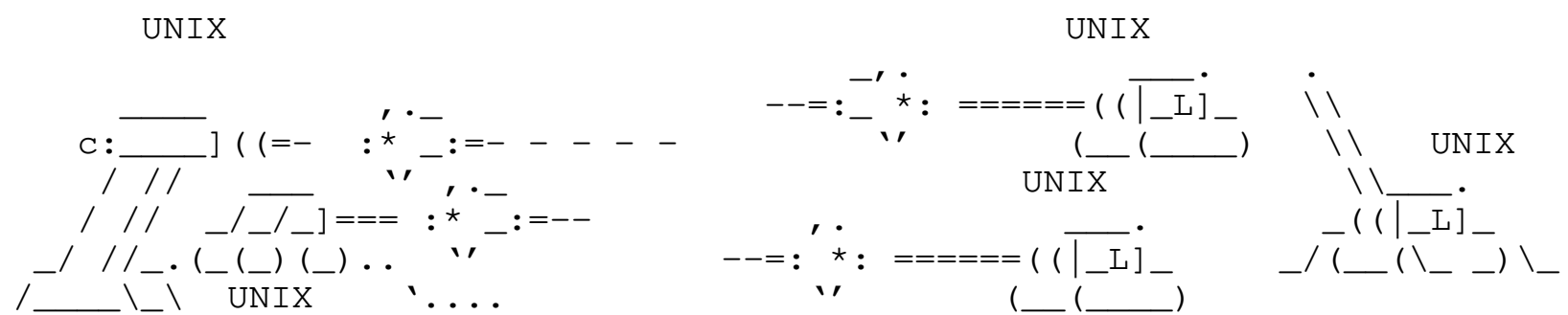
Vijay Kumar

```
GGGG  N   N  U   U      I   SSS
G     NN  N  U   U      I  SS
G  G  N N N  U   U      I    SS
GGGG  N  NN   UUU       I  SSSS

N   N   OO   TTTTT
NN  N  O  O    T
N N N  O  O    T
N  NN   OO     T


U   U  N   N   I   X  X
U   U  NN  N   I    XX
U   U  N N N   I    XX
 UUU   N  NN   I   X  X
```

==

473,040,000 UE - 670,720,000 UE (1985 - 1989)
==========

UNIX GOES TO WAR



cjr

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1BSD|2BSD|386 BSD|3BSD|4.4BSD Lite 1|4.4BSD Lite 2|4BSD|A/UX|ABCenix|ACIX|AD|AIX|AIX PS/2|AIX/370|AIX/6000|AIX/ESA|AIX/RT|AMiX|ANALIX|AOS Lite|AOS Reno|ARIX|ASV|Acorn RISC Unix|Acorn RISC iX|Altos System V|Android|AppleTV|ArchBSD|Atari Unix|AurOS|BBX|BKUNIX|BOS|BOS/X|BRL Unix|BS2000/OSD-BC|BSD Net/1|BSD Net/2|BSD/386|BSD/OS|Bitrig|C Executive|CB Unix|CLIX|COSIX|CPIX|CTIX|CX/UX|CXOs|Chorus|Chorus/MiX|Coherent|Concentrix|Consensys Unix|ConvexOS|Cromix|DC/OSx|DCC-IX|DEC OSF/1 ACP|DG/UX|DISTRIX|DNIX|DRM System|DTIX|DVIX|Darwin|Debian GNU/Hurd|Dell Unix|DesktopBSD|Digital Unix|Domain/OS|DragonFly BSD|Dynix|Dynix/ptx|EDIX|ENIX|EP/IX|Esix SVR4|Eunice|Eurix|FOR:PRO|FTX|FireFly BSD|FreeBSD|FreeDarwin|FreeMiNT|GNU|GNU-Darwin|Genix|Gnuppix GNU/Hurd-L4|HCR|HEP-UPX|HI-UX|HP-UX|HP-UX BLS|HPBSD|Helios|IBM AOS|IBM IX/370|IDRIS|INOS|IRIS GL2|IRIX|Illumos|Inferno|Interactive 386/ix|Interactive IS|Junos OS|LSX|LSX|Linux|Lites|LynxOS|MAXION/OS|MCS|MERT|MIPS OS RISC/os|MMOS|MP-RAS UNIX|MST UNIX|MVS/ESA OpenEdition|MacMach|Mach|MachTen|MicroBSD|MicroPort Unix|Micronix|Microport SVR4|MidnightBSD|Mimos|Mini Unix|Minix|Minix-VMD|MirBSD|Mk Linux|Monterey|Mulplix|Munix|NCR Unix/NS |NDIX|NUXI|NachOS|NeXTSTEP|NetBSD|News-OS|NonStop-UX|ONIX|OPENSTEP|OPUS|OS 9|OS X|OS/390 OpenEdition|OS/390 Unix|OS/MP|OSF/1|OSx|Oasis|Open Desktop|Open UNIX|OpenBSD|OpenDarwin|OpenIndiana|OpenServer|OpenSolaris|PC-BSD|PC/IX|PCUNIX|PNX|PWB|PWB/UNIX|PacBSD|Plan 9|Plurix|Punix|PureDarwin|QNIX|QNX|QNX RTOS|QNX/Neutrino|QUNIX|REAL|RISC iX|RT|RT/EMT|RTUX|Regulus|ReliantUnix|RetroBSD|Rhapsody|SCO UNIX|SCO UnixWare|SCO Xenix|SCO Xenix System V/386|SORIX|SOX|SPIX|SPP-UX|SUNIX|Security-Enhanced Linux|Silver OS|Sinix|Sinix ReliantUnix|Solaris|Sortix|Sphinx|Stellix|SunOS|Super-UX|System B|TI System V|TNIX|TOS|TS|Thix|Topix|Triance OS|Tribblix|Tropix|Tru64 Unix|Trusted IRIX/B|Trusted Solaris|Trusted Xenix|Tunis|UCLA Locus|UCLA Secure Unix|UHC Unix|UNICS|UNIX 32V|UNIX Interactive|UNIX System III|UNIX System IV|UNIX System V|UNIX System V Release 2|UNIX System V Release 3|UNIX System V Release 4|UNIX System V/286|UNIX System V/386|UNIX Time-Sharing System|UNOS|UNSW|USG|USIX|UTEK|UTS|UTX/32S|UX|UXP/DS|UZIX|Ultrix|Ultrix 32M|Ultrix-11|Umax|UniFLEX|UniSoft UniPlus|Unicos|Unicos/mk|Unicos/mp|Unicox-max|Uniq|Unisis|Unity|UnixWare|VM/IX|VOLVIX|Venix|Xenix OS|Xinu|Xoftnix|Zeus|ekkoBSD|iOS|iPhone OS|iPod OS|macOS (Mac OS X)|more/BSD|mt Xinu|xMach|z/OS Unix System Services|Ã\206rieBSD|

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Which UNIX sold the largest number of licenses?
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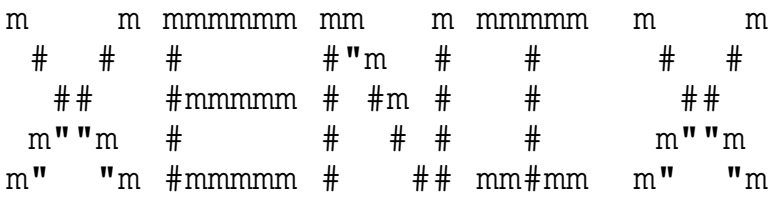
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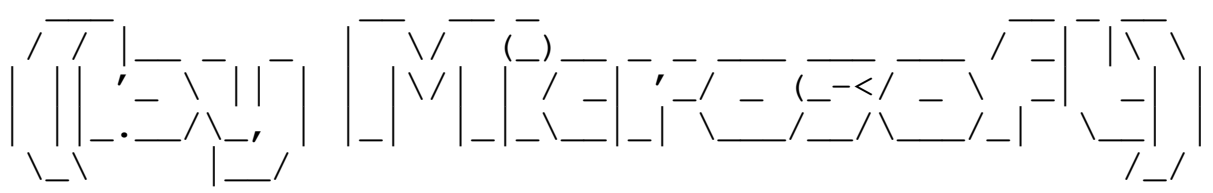
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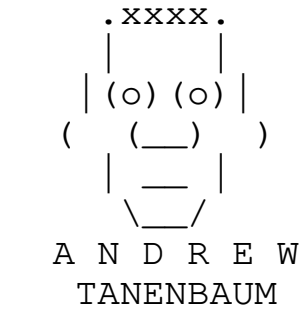


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(1987)

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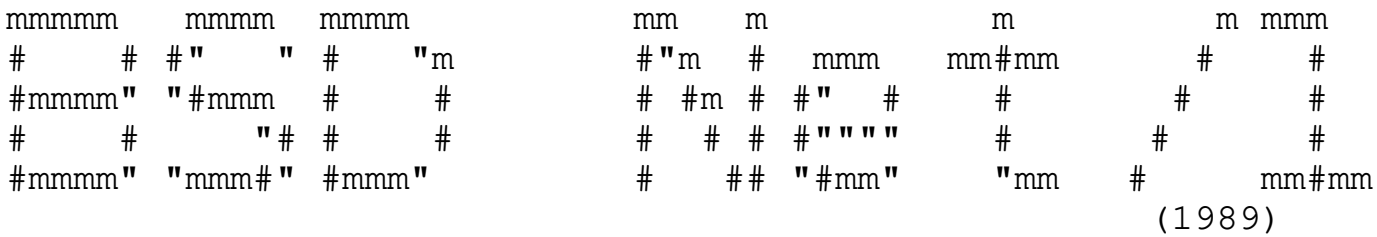
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(1989)

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670,720,000 UE - 788,400,000 UE (1990 - 1994)
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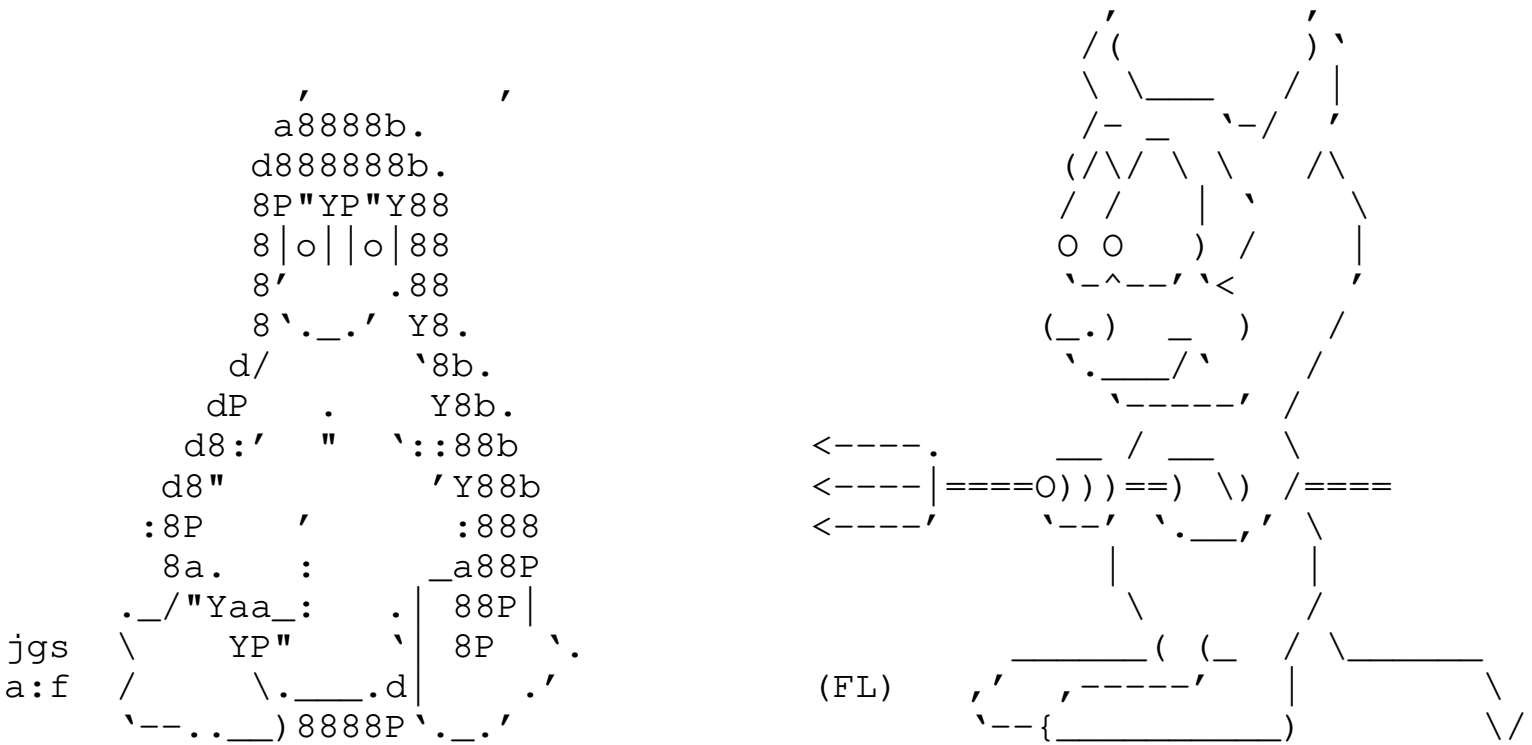

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Date: 25 Aug 91 20:57:08 GMT

Hello everybody out there using minix -

I'm doing a (free) operating system (just a hobby, won't be big and professional like gnu) for 386(486) AT clones. This has been brewing since april, and is starting to get ready. I'd like any feedback on things people like/dislike in minix, as my OS resembles it somewhat (same physical layout of the file-system (due to practical reasons) among other things).

I've currently ported bash(1.08) and gcc(1.40), and things seem to work. This implies that I'll get something practical within a few months, and I'd like to know what features most people would want. Any suggestions are welcome, but I won't promise I'll implement them :-)

Linus (torv...@kruuna.helsinki.fi)

PS. Yes - it's free of any minix code, and it has a multi-threaded fs. It is NOT protable (uses 386 task switching etc), and it probably never will support anything other than AT-harddisks, as that's all I have :-(.

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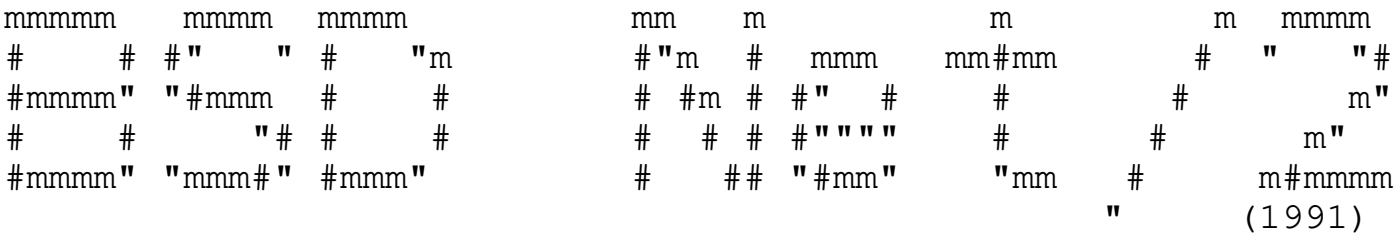
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" (1991)

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From Jolix to the modern BSD

- in 1992 Bill and Lynn Jolitz ported BSD Net/2 to 80386
- this required to modify/rewrite about 10 files
- the new OS was called 386BSD (or Jolix)
- very slow development
- a group of users/developers branched out and created FreeBSD (Jun 1993)
- another group of users/developers forked NetBSD (Apr 1993)
- in 1994 Theo de Raadt leaves NetBSD and creates OpenBSD

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788,400,000 UE - 1,575,309,000 UE (1995 - 2019)
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- Unix (in its many incarnations) has come to:
  - Smartphones/tablets (97%, Android, iOS)
  - Internet servers (98%)
  - Mainframes (90%-98%)
  - Supercomputers (100% top-500)
  - Embedded (> 35%)
  - Desktop (~12%, incl. MacOS)

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The Unixes of today

- Linux (and its many distributions)
- FreeBSD, NetBSD, OpenBSD (and clones/forks)
- AIX (IBM)
- Solaris (SUN/Oracle)
- HP-UX
- MINIX
- OpenIndiana
- GNU/Hurd
- Android
- MacOS / iOS

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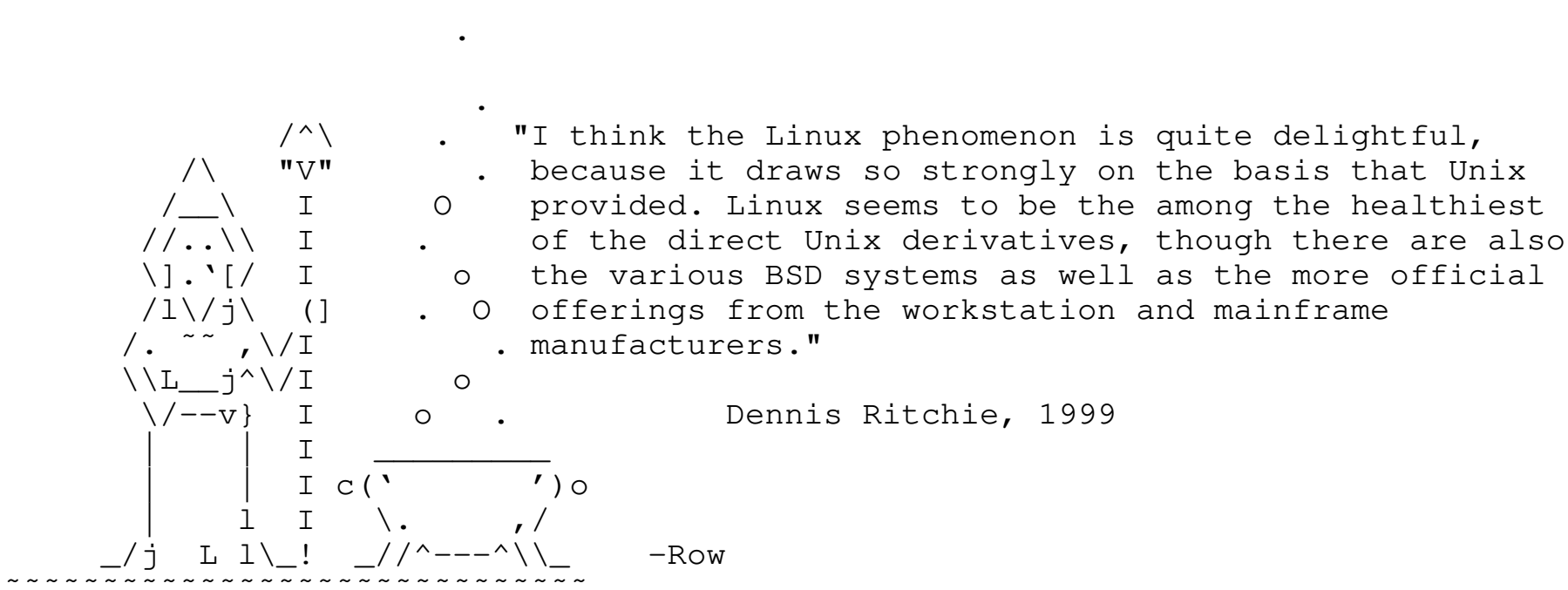
"I think the Linux phenomenon is quite delightful,
because it draws so strongly on the basis that Unix
provided. Linux seems to be the among the healthiest
of the direct Unix derivatives, though there are also
the various BSD systems as well as the more official
offerings from the workstation and mainframe
manufacturers."
Dennis Ritchie, 1999
-Row

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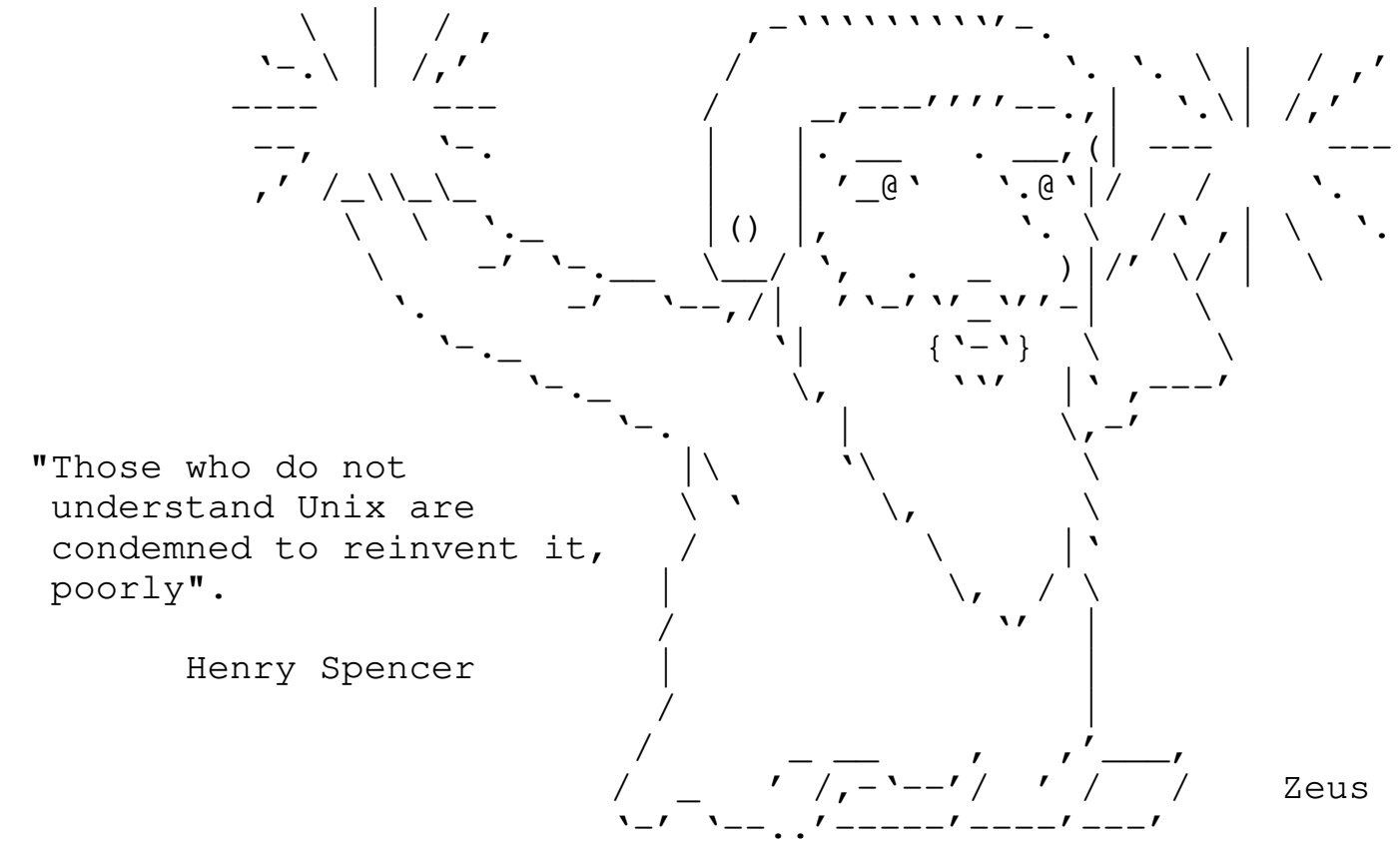

"Those who do not
understand Unix are
condemned to reinvent it,
poorly".

Henry Spencer

Zeus

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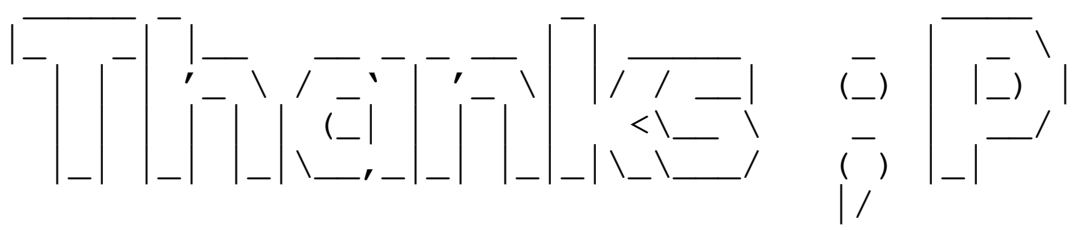

DISCLAIMER: NO ASCII CHARACTER WAS HARMED DURING THE
PREPARATION OF THIS PRESENTATION

NOTE: ASCII ARTS BELONG TO THEIR RESPECTIVE AUTHORS.
IF NO AUTHOR IS INDICATED, THE PIECE IS MINE,
AND YOU CAN DO WHATEVER YOU WANT WITH IT.

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REFERENCES

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- B. Kernighan, Unix: a history and a memoir, 2019

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- I. Darwin, G. Collyer, History of Unix before Berkeley, 1984

- S. J. Leffler, M. K. McKusick, M. J. Karels, J. S. Quarterman The design and implementation of the 4.3 BSD Unix System, 1989

- B. Kernighan, R. Pike, The Unix Programming Environment, Prentice Hall, 1984

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LINKS

- https://www.tuhs.org
  The Unix Heritage Society

- gopher://republic.circumlunar.space/0/~katolaz/phlog/20190901_unix_50.txt
  Unix gets 50 -- 50 links and pointers

- https://github.com/dspinellis/unix-history-repo
  Research Unix historic source repository

- https://github.com/robohack/ucb-csrg-bsd
  BSD historic source repository

- https://museo.freaknet.org
  Museo dell'Informatica Funzionante
  Freaknet, Palazzolo Acreide (SR)

- https://www.verdebinario.org
  Verdebinario e Museo Interattivo di Archeologia Informatica

These slides were prepared for the talk "UNIX@50: 50 years of the Unix Operating System Myths, Legends, and quirky stories", that I gave on 2nd Dec. 2019 at the Lovelace Mondays, Universita' della Calabria, Cosenza (Italy).

The slides are meant to be viewed using `catpoint`:

```
$ git clone git://r-36.net/catpoint
$ cd catpoint && make && make install
$ catpoint 0*.txt
```

The master file is in markdown format (slides.md). The single .txt files were obtained using `md2point`, available in `pointtools`:

```
$ git clone git://r-36.net/pointtools
```

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