

CS 518

Unix: Simplicity and Elegance

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The “Third System”

- Multics, the “second system effect”
 - Visionary
 - Ungainly
- Unix
 - “Elegance, taste, craftsmanship”
 - Minimum functionality and implementation, yet...
 - Power, and...
 - The pieces fit together seamlessly
 - How many times can one say: “this is just totally obvious...”?
 -
 - “Obvious”
 - “Understandable”
 - longevity

The File System

- Hierarchical name space
- Directories like files
- Byte-oriented I/O
- Device-independent I/O
- Set-user ID
- Mounting mechanism

Process Management

- fork and exec
 - question: why don't we replace them by a single operation?
- Standard I/O
- Redirection
- Pipes and filters

The genesis of pipes

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Summary--what's most important.
To put my strongest concerns in a nutshell:

1. 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.
2. Our loader should be able to do link-loading and controlled establishment.
3. Our library filing scheme should allow for rather general indexing, responsibility, generations, data path switching.
4. It should be possible to get private system components (all routines are system components) for buggering around with.

M. D. McIlroy
Oct. 11, 1964

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Pipes and pipelines

- connect output of one program to input of another
 - who | grep joe | wc
- Ken's idea, with Doug's prodding?
 - Ken's notation?
- frenzy of invention
 - reformulating programs to work in pipelines
 - e.g., sort, and why it can't be in a pipeline
- spell program
 - cat files | tr ... | sort | uniq | comm -1 - dict
- modularization of programs
 - grap | pic | tbl | eqn | troff

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grep: the quintessential tool

- "Reach out and grep someone"
- genesis from ed editor
- programmer's tool
- building block in scripts
- dictionary searches


```
grep '^[behilos]*$' /usr/dict/web2
```

```
b      bilsh  bosc  hellish  ibisbil  liss  ohelo  shies  slish
be     bios  bosh  hello   ie       lo    oho    shih  slob
bebless  biose  boss  heloe   ihl     lob   oii    shill  sloe
beboss  biosis  e     helosis  ill     lobish  oil    shilloo  sloo
bee     bis    ebb   hi       illless  lobe  oilhole  shish  sloosh
beeish  bleb  eboe  hie     illish  lobeles  oilless  sho  slosh
beelol  blee  eel   hill    ic       lobo  oleo   shoe  so
bees   blec  eelbob  his    is       lobose  oleose  shoebil  sob
bel     bless  eh    hish    isle    loess  olio   shoeles  soboles
belee  blibe  el    hiss    isleles  loll  os     shole  soe
belibel  bliss  elb   ho      iso     loc    ose    shoo  sch
belie  blissle  ell  hob     isoheh  loose  osse  shooi  soho
bell   blo   elle  hobbl  issei   loosish  s     shool  soil
belle  blob  els   hobble  l       lose   se     si     soilles
bes    bo   else  hobo   lee     losel  see    sib    sol
besee  bob  es    hoe    lees   losh  seel   sie    sole
beshell  bobbish  ess  hoi    lei     loss  seesse  sil    soleil
besoil  bobble  h     hoise  less   lossles  seise  sile  soleles
bib     bobo  he    hole   lessee  o     sele  sill  soles
bibb   boho  heel  holeles  li     obe   sell  silo  soli
bibble  boil  heelles  holl  libel  obese  sellie  siol  solio
bibi   bole  hei   hollo  libelee  obi   sess  sis   solo
bibless  bolis  heii  hoose  lie    oboe  sessile  sise  sool
bilbie  boll  helbeh  hoosh  liesh  obol  sh     sisel  sooloo
bilbo  bolo  hele  hose  lile  obole  she    sish  soch
bile   boe  helio  hoseh  lill  obesss  shee  sisi  soso
bilio  boob  heliosi  hoseles  lis  oe    shell  siss  sosoish
bill   boohoo  hell  i     lish  oes   shi    sissoo  soss
bilo   bool  hellhol  ibis  lisle  oh    shiel  slee  sossle
bilobe  boose
```

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Undercurrent

- Consider the example of stdio, redirections, pipes, filters, shells
- Provide mechanisms (glue), not solutions
 - a success story of “component programming”
- Structure the system in such a way to keep the kernel at a minimum size
 - “micro-kernel” without going “micro-kernel”
 - e.g.: the shell

Some Quotables

- It is hoped, however, the users of UNIX will find that the most important characteristics of the system are its simplicity, elegance and ease of use.
- Perhaps paradoxically, the success of UNIX is largely due to the fact that it was not designed to meet any predefined objectives.
- [S]ince we are programmers, we naturally designed the system to make it easy to write, test, and run programs.
- [T]he size constraint has encouraged not only economy but a certain elegance of design.
- If designers of a system are forced to use that system..., [they] are strongly motivated to correct [problems] before it is too late.
- The success of UNIX lies not so much in new inventions but rather in the full exploitation of a carefully selected set of fertile ideas.