

## Review

- What are software tools? What are the goals of software tools?
- What are your favorite buzzwords and what do they mean?

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1

1

## HOW TO BE A WIZARD

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2

## Discussion

- How do we become wizards?
- What new buzzwords/lingo were featured in the zine?
- What are your biggest takeaways from the zine?

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3

# UNIX

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4

## Our Heroes: UNIX Developers



Ken  
Thompson

Dennis  
Ritchie

Started: 1969 at Bell Labs

Log into the lab machines

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5

## UNIX Philosophy

- Doug McIlroy, inventor of Unix *pipes*, a founder of Unix tradition:

*This is the Unix philosophy:*

*Write programs that do one thing and do it well.*

*Write programs to work together.*

*Write programs to handle text streams, because that is a universal interface*

- This is usually severely abridged to “do one thing and do it well”

Remind you of any software principles?

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6

6

## UNIX Philosophy

- Make each program do one thing well
- Consequences of philosophy:
  - More complex functionality by combining programs
  - Make every program a filter
  - More efficient
  - Better for reuse

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7

7

## The UNIX Philosophy

- Scripting increases leverage and portability

Goal: List the usernames of a system's current users:

```
who | awk '{print $1}' | sort | uniq
```

We'll talk more about piping later

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8

## The UNIX Philosophy

- Avoid captive interfaces
  - The user of a program isn't always human
  - Look nice, but code is big and ugly
  - Problems with scale
- Silence is golden
  - Only report if something is wrong
- Think hierarchically
  - We can apply attributes in a hierarchical way

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9

9

## UNIX Highlights / Contributions

- Portability
  - Because implemented in C rather than assembly language (specific to machine), ran on variety of machines
- Multitasking and multiuser capability for minicomputer
- TCP/IP implementation -- 1984
  - Communicate between different machines from different vendors

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10

10

## UNIX Highlights / Contributions

- Hierarchical file system
- The file abstraction
  - A file is a sequence of bytes
    - No random access, no going back
    - No distinction in files – file extension in name is how to distinguish files
  - Everything is a file
    - Don't necessarily have names or persistent storage, e.g., interprocess communication



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11

11

## UNIX Highlights / Contributions

- Inter-process communication
  - Pipes: output of one program fed into input of another
- Software tools
- Development tools
- Scripting languages

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12

12

## Quotes

- “Unix is simple. It just takes a genius to understand its simplicity.”  
– Dennis Ritchie
- “UNIX was not designed to stop its users from doing stupid things, as that would also stop them from doing clever things.”  
– Doug Gwyn
- “Unix never says 'please'.” – Rob Pike
- “Unix is user-friendly. It just isn't promiscuous about which users it's friendly with.” – Steven King
- “Those who don't understand UNIX are condemned to reinvent it, poorly.” – Henry Spencer

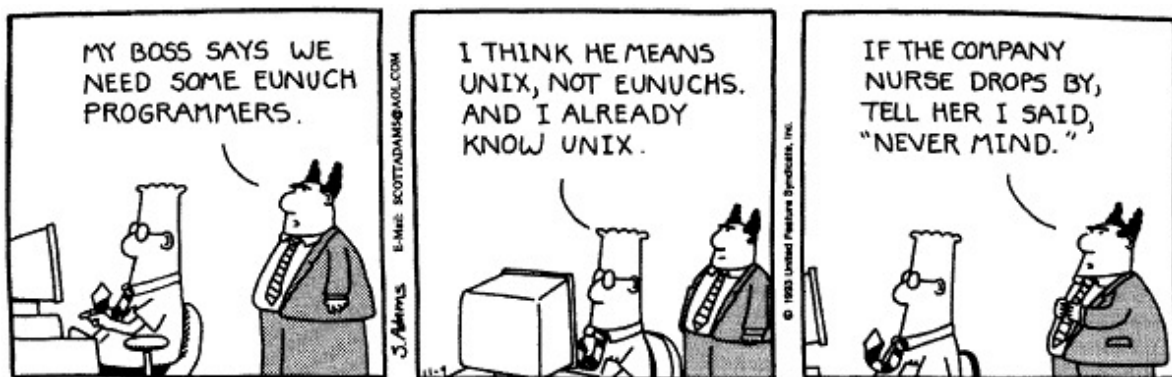
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13

13

## Popular Success



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14

14

# UNIX STRUCTURE

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15

## The Operating System

- The government of your computer
- Kernel: Performs critical system functions and interacts with the hardware
  - Loaded into memory during the boot process and always stays in physical memory
  - Responsible for managing CPU and memory for processes, managing file systems, and interacting with devices
- Systems utilities: Programs and libraries that provide various functions through system calls to the kernel

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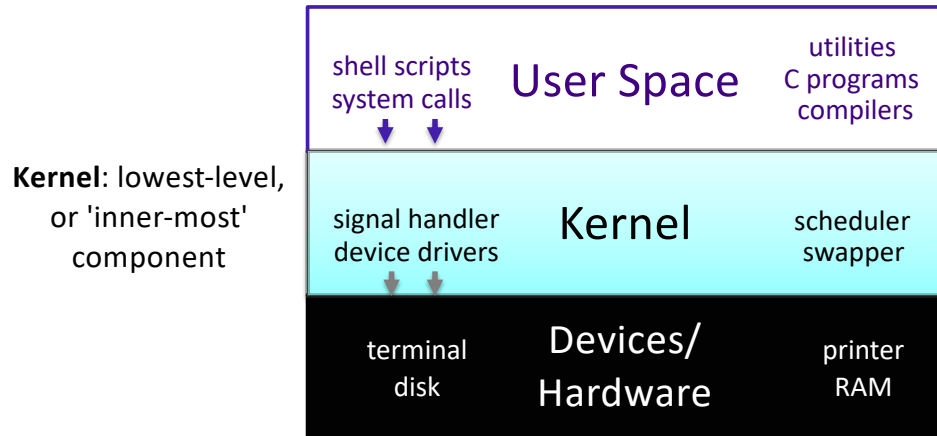
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16

16



# UNIX Structural Layout



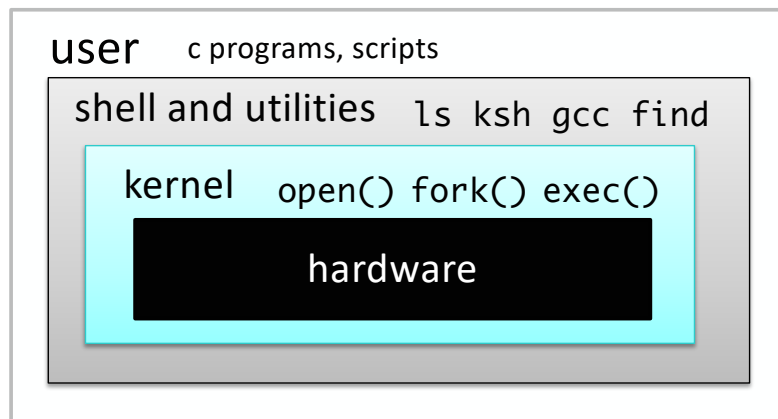
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17

# UNIX System Structure



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18

## What is a Shell?

- User interface to the operating system
- A program like any other
- Command-line interpreter
- Functionality:
  - Execute other programs
  - Manage files
  - Manage processes
- Basic form of shell:
  - `while <read command>:`  
     `parse command`  
     `execute command`



hides details of underlying  
operating system

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19

## Most Commonly Used Shells

- `/bin/sh`     The Bourne Shell / POSIX shell
- `/bin/csh`    C shell
- `/bin/tcsh`   Enhanced C Shell
- `/bin/ksh`    Korn shell
- `/bin/bash`   Free bash: Bourne again shell
- `/bin/zsh`    Z shell, extended Bourne shell

Which shell is the default used in the lab?

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20

20

## Shell: Interactive Use

- When you open a terminal, you interactively use the shell:
  - Command history
  - Command line editing
  - File expansion (tab completion)
  - Command expansion
  - Key bindings
  - Job control

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21

21

## Simple Commands

- Sequence of non-blank arguments separated by blanks or tabs
- 1st argument (numbered 0) usually specifies the name of the command to be executed
- Any remaining arguments:
  - Are passed as arguments to that command
  - Depending on command, arguments may be filenames, pathnames, directories or special options
  - Special characters are interpreted by shell

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22

22

## Example of Simple Command

prompt      command      arguments

```
$ ls -l /bin
lrwxrwxrwx 1 root root 7 Aug 24 08:47 /bin -> usr/bin
$
```

- Execute a basic command
- Parsing into command and arguments is called *splitting*

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23

## Types of Arguments

```
$ tar -c -v -f archive.tar main.c main.h
```

- Options/Flags
  - Convention: *-X* or *--longname*
- Parameters
  - May be files, may be strings
  - Depends on command

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24

## Getting Help on UNIX

- **man**: display entries from UNIX online documentation
- Manual entries organization:
  - 1. Commands
  - 2. System calls [https://en.wikipedia.org/wiki/Man\\_page](https://en.wikipedia.org/wiki/Man_page)
  - 3. Subroutines
  - 4. Special files
  - 5. File format and conventions
  - 6. Games
  - 7. Miscellanea
  - 8. System administration commands and daemons
- **whatis** <command> : one-line description of command
- **apropos** <keyword> : search man pages

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## Useful Shortcuts

- Up arrow
- **!**
  - != bang
  - Repeat last command
- **!command-prefix**
  - Repeat most recent command that begins with prefix

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26

## Useful Commands

- Control-C
  - Kill the current process
- Control-A
  - Go to the beginning of the line
- Control-Z
  - Suspend the current process
- Control-E
  - Go to the end of the line

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27

27

## Assignment for Friday

- Set up your machine to be able to work remotely with the lab machines
- Software:
  - [http://cswiki.wlu.edu/dokuwiki/doku.php/labs/remote\\_access](http://cswiki.wlu.edu/dokuwiki/doku.php/labs/remote_access)
- VPN for off-campus access (if necessary)  
<https://wlu.box.com/v/NewCompSciLabs>

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28

28