Computer Software

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School of Business Administration
Portland State University

- Computer Software
  - Introduction
  - Operating Systems
  - Application Software
  - Unix Command Line (on a Mac)

Introduction
Two Categories of Software

- **Software**: Stored instructions that specify the tasks and behavior of the hardware
  - **Operating System**: Master control program of the entire computer
  - **Application software**: A specific application that runs in a specific operating system to accomplish a specific task

Operating Systems

- A comprehensive OS is the most complex software that exists, containing tens of millions of lines of code
- An OS provides at least 4 different types of functions
  - Resource Management: Interface with the hardware, e.g., virtual memory
  - User Interface
  - Application Management, e.g., multi-tasking
  - File Management
Open vs. Closed Source

- Two general classes of operating systems left for most computers: Windows and Unix family
- Examples of Unix, generically defined:
  - Macintosh
  - Linux
- Open Source Software: Computer software for which the original source code is available for everyone and can be modified as long as the modifications are available to everyone
- Anyone can charge money for open source software, and in one business model companies that do so also provide support
- Windows is completely closed, Macintosh is in-between being built on an open-source version of Unix called BSD, and Linux is completely open

Copyleft vs. Copyright

- Traditional licensing of intellectual property is with copyright, which protects the owner/creator of the work from having the work copied and used by others without permission and/or licensing
  - owner/creator gets exclusive rights of distribution of the work
  - owner can charge money for the work
- Copyleft is a form of copyright that provides a different kind of intellectual protection to the owner
  - anyone can access the work
  - anyone can change the work, but any changes are available to all
  - anyone can charge money for the work, but anyone else can take the same work and provide for free
- Open source software is based on the copyleft model

OS Versions for Windows and Mac

- Windows 10
  - Unified OS to run across a variety of devices from traditional computers, to laptops, to tablets to phones, including touch-based devices
  - Adapts to either a touch-based or classic desktop environment, with seamless switching between the two by changing aspects of the user interface
  - Software updates are incremental, so there may not be a Windows 11
  - Can also run multiple virtual desktops
  - Also monitor users more than any other version of Windows
Windows in the World

- Part of the consideration for Microsoft is to provide cheaper versions for people in countries with less money
- However, in many places around the world, no one would ever dream of paying for any Windows version
- Windows also runs without a software key
- Instructor’s Conjecture: MS lets users use Windows without a software key probably because they do not want more people to start using Linux

Linux is Born

Open source operating systems

- In the late 1980’s a graduate computer science student in Finland, Linus Torvalds, decided to develop his own OS
- At that time there was a new development that became available to technologically oriented academics: the Internet
- Torvalds asked for help over this new medium and to his surprise soon he had hundreds then thousands of volunteers
- Linux grew until today it is a major operating system supported by major technology companies
  - Corporate development by IBM, which has spent billions helping to develop Linux, and others
  - The OS foundation for Amazon, Google and Facebook
- Today the most famous person in the world of open source, Linux Torvalds, lives in Portland, one of the open-source centers of the world

Linux

- The open-source world offers many choices
- Even if focusing just on Linux, there are many variants, called distributions
  - Third most widely installed OS world-wide is the Linux distribution call Ubuntu, ubuntu.com, but does not include proprietary software such as Flash and multi-media co-decs needed to do basic things such as view youtube videos
  - Recommended (by your instructor) is an Ubuntu based Linux distribution called Mint, linuxmint.com, almost as popular as Ubuntu and ready to go right from the initial installation
  - For an enterprise server SUSE, is often highly recommended, as is Red Hat
Linux Mint Screenshot

- If you can run Mac or Windows, you can run Linux Mint, which can be installed next to or in place of Windows

![Linux Mint with a Customized Background](image)

Figure: Linux Mint with a Customized Background

Source Code

- **Source Code**: A language that resembles, to some extent, ordinary English, more than the raw machine code that actually runs on the computer, and is used by programmers to write computer programs, including the operating system
- Examples include C, C++, objective C, Java, Fortran and Visual Basic
- **Compiler**: A program that translates source code into machine language
- Linux is a giant C program, and the thousands of lines of Linux C are available to anyone from kernel.org
- **Kernel**: Basic core of an OS, of which other services such as the filesystem and user interface are added to form the complete OS

Linux Source Code Snippet

```c
static struct request *get_request(struct request_queue *q, int rw_flags,
     struct bdev *bdev, GFP_T GFP_MASK)
{
    struct request *req = NULL;
    struct request_list *rl = q-&gt;q;
    struct io_context *ioctl = NULL;
    const bool is_sync = rw_sync(rw_flags) &gt; 0;
    int may_queue, prlv;

    may_queue = elv_may_queue(q, rw_flags);
    if (may_queue == ELV_MUTEX_RW)
        goto req_starved;

    if (rl-&gt;count(is_sync) &gt;= &gt;queue_congestion_on_threshold(q)) {
        if (rl-&gt;count(is_sync) &gt; q-&gt;nr_requests) {
            lock = current_dio_context(GFP_ATOMIC, q-&gt;node);
            if (!blk_queue_full(q, is_sync)) {
                lock_set_blocking(q, loc);
                blk_swap_queue_full(q, is_sync);
            } else {
                if (may_queue &gt; ELV_MUTEX_MUTEX
                    &amp;&amp; !lock_catching(q, loc)) {
                    goto out;
                }
            }
        }
    }
    blk_set_queue_congested(q, is_sync);
    ... continued
```
Application Software

Accomplish the tasks that make the computer useful

- Consumption
  - Word processing, e.g., MS Word, LibreOffice, LaTeX
  - Spreadsheets
  - Slide presentation
  - E-mail, calendar, contacts
  - File uploads
  - Web browser

- Production
  - Database
  - Drawing, e.g., Adobe Illustrator
  - Photographic editing e.g., Adobe Photoshop
  - Web site authoring, e.g., Adobe DreamWeaver
  - Video production, e.g., Adobe Premier

Unix Command Line (on a Mac)
Type Primary Classes of Computer Interfaces

▶ GUI: Graphical user interface, such as the default interface of the Macintosh, Windows, and Linux Ubuntu
▶ Historically the first elements of the GUI were developed at Xerox/Parc in the late 1970’s, and then refined and commercialized on the Macintosh, which debuted in January of 1984
▶ The inventor of the computer mouse in 1967, Douglas Engelbart, just recently passed away, July 2013
▶ CLI: Command line interface, such as found in the Macintosh Terminal application, the Windows Run command, or the Linux Ubuntu Terminal application
▶ The CLI is the first computer interface, and still the source of most power and speed for those who are able to take advantage of the often rather arcane commands

Example of a (Unix) CLI: Mac Terminal App

Or, go the Utility folder in the Applications folder, and run the Terminal.app

A Unix Prompt

Ready to enter a Unix command
List Files: Input

```
DG-31:~ David$ ls -l
```

The `ls -l` command produces a vertical list of the contents of the current directory, which is represented as a Folder in a GUI.

List Files: Output

```
DG-31:~ David$ ls -l
total 0
drwx-----  21 David  staff  714 Jul 21 18:13 Desktop
drwx-----  15 David  staff  510 Jul 19 22:29 Documents
drwx-----  10 David  staff  340 Jul 21 17:27 Downloads
drwxrwxr-x  12 David  staff  408 Jul 21 22:33 Dropbox
drwxrwxrw-x 17 David  staff  578 Jul 9 11:38 INGRID
drwx------  53 David  staff  1802 May 19 11:44 Library
drwx------  12 David  staff  136 Apr 6 22:05 Movies
drwx------  17 David  staff  204 Feb 23 10:27 Music
drwxrwxr-x  16 David  staff  1904 Apr 6 21:57 Pictures
drwxrwxr-x  17 David  staff  170 Apr 3 2008 Public
drwxrwxr-x  16 David  staff  136 Mar 8 2009 Sites
```

The contents of the directory David, here a list only of directories, as indicated by the `d` at the beginning of each line of output.

Change Directory

```
DG-31:~ David$ cd Dropbox
```

The `cd` command is for change directory, here to the directory Dropbox.
List Files: Input

The list of files in the Dropbox directory

The End