Operating Systems: Introduction CS400

Week 1: 16th Jan

Spring 2020

Oliver BONHAM-CARTER

Consider this…

Group Discussion

- Go online to find a small software that is an OS, or fulfills a role as one. Discuss as a group. You could even choose one from these slides.
  - What are the main differences between this OS and other popular OS's? (i.e., MacOS, Windows, Linux)
  - Why was your OS developed?
  - What does the media report about the OS?
  - What sorts of functions does this OS provide?

Please write down your discussion points to help you introduce your OS to the class.

ClassDocs: All Class Materials

- We will be using GitHub to manage all class material. Clone your repository using the following:

- ssh
  - `git@github.com:Allegheny-Computer-Science-400-S2020/classDocs.git`
- https
  - `https://github.com/Allegheny-Computer-Science-400-S2020/classDocs.git`

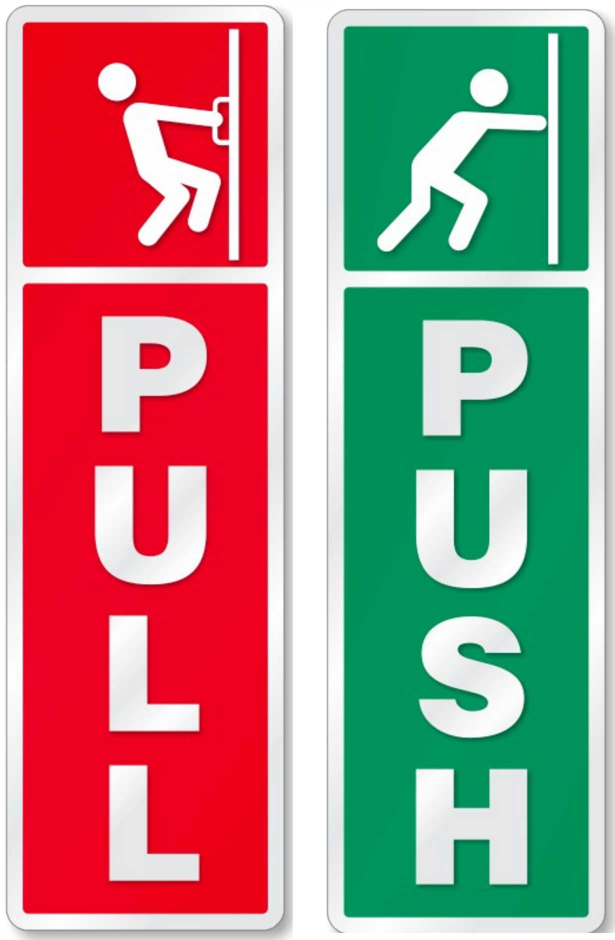
Class Repositories

- PULL your classDocs before class.

```
git pull
```

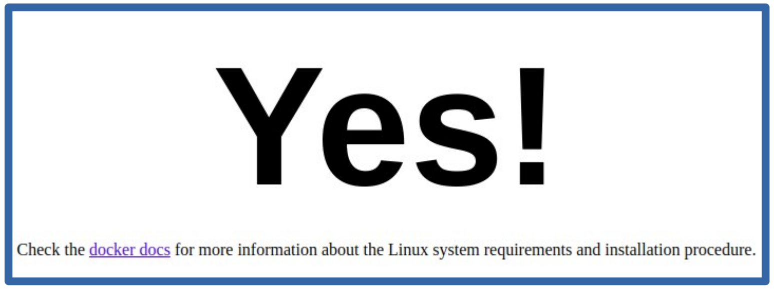
- PUSH assignment repos to submit homework

```
git add -A
git commit -m "My mesg"
git push
```



Docker for Running Software

- We will be using Docker in lab and class
- Please be sure that you machine will work with the regular Docker, **not** Docker ToolBox.
- Verify: www.cs.allegheny.edu/canirundocker



Yes!

Check the docker docs for more information about the Linux system requirements and installation procedure.

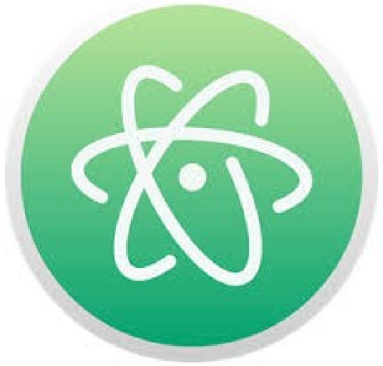
All Set!

No / Maybe

- Windows: Purchase a Windows Enterprise activation key
- Dual boot: Linux and Windows
- Use another computer

Atom: Suggested for Programming

- We will be programming and Atom facilitates this task
- If you do not already have it, please download it from: https://atom.io/

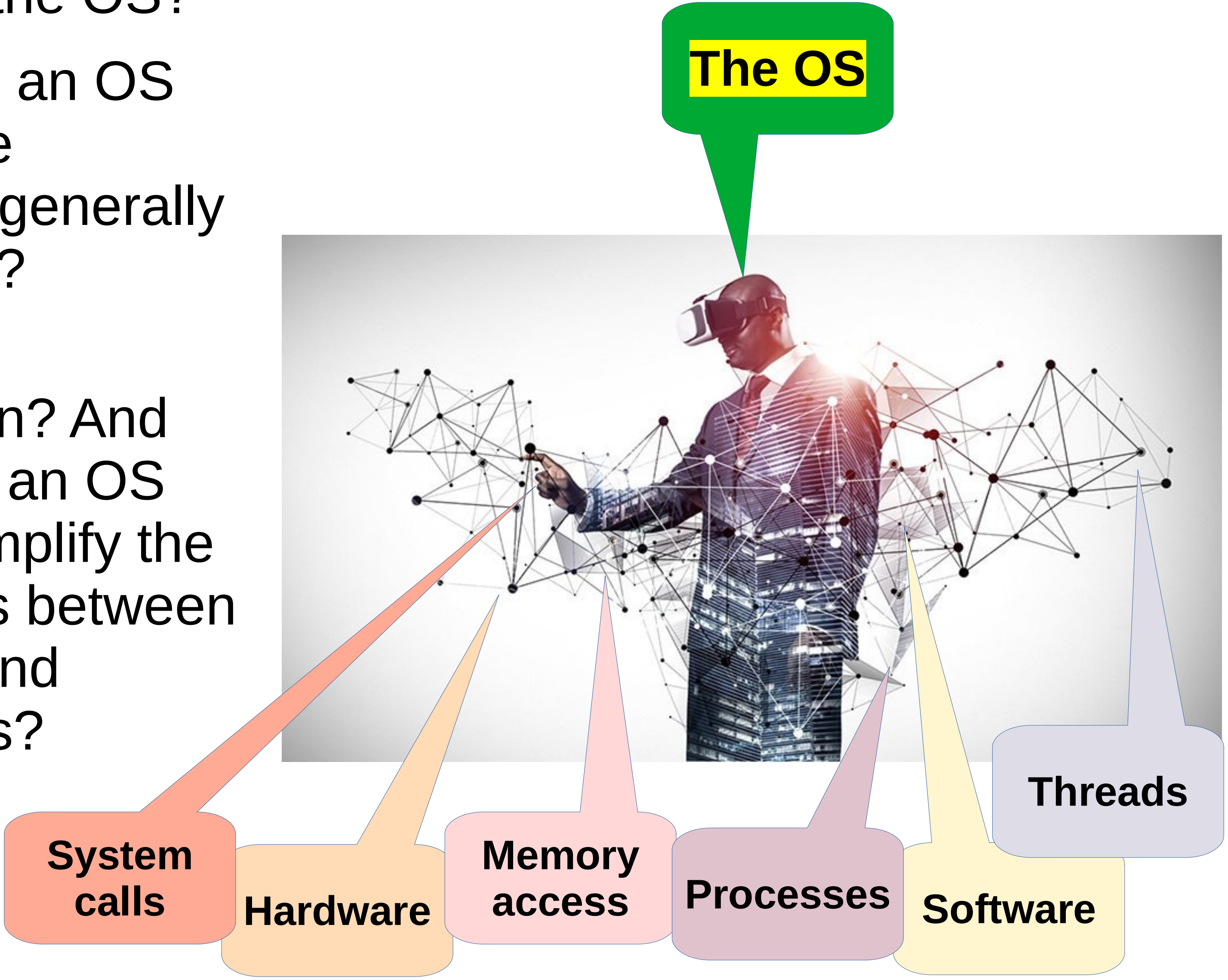


Please Install
Your Software

- We will be using Git and GitHub. Please setup your account **by next class** at https://github.com/ and also download a Git client software from https://git-scm.com/downloads
- We will also be using the Atom editor to write code. Please download and install your editor from https://atom.io/
- For most labs, we will be using Docker. Please download and install your Docker Desktop installation (note: not the Docker ToolBox) from https://www.docker.com/. Help: https://hub.docker.com/
- If necessary, please help each other to install this software. Or see the department’s Technical Leaders with questions.

To Consider Today ...

- Where is the OS?
- How does an OS control the machine (generally speaking)?
- What is abstraction? And how does an OS help to simplify the interations between humans and computers?

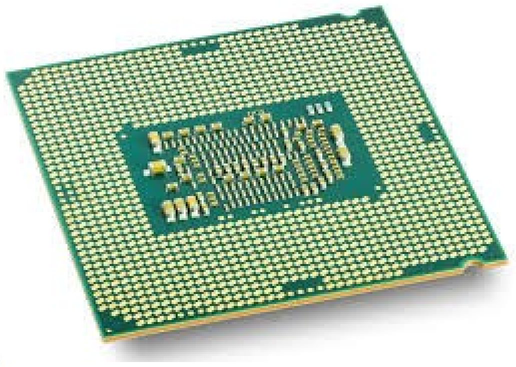
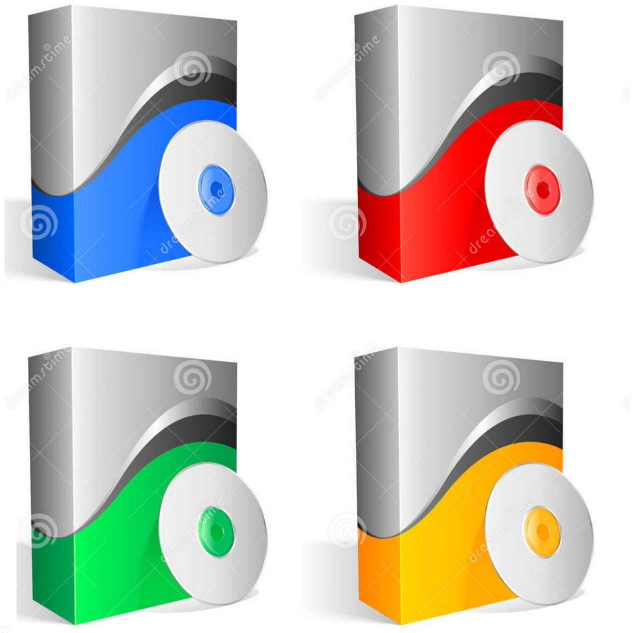


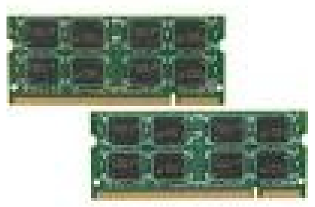
Chapter 1, Tanenbaum

- Chapter 1 topics:
  - (1.1) What are operating systems (OSs)?
  - (1.3) Computer Hardware
  - (1.4) The Operating System Zoo
  - (1.5) Operating System Concepts
  - (1.6) System Calls
  - (1.7) Operating System Structure
- And more

First: What is an OS???

- *Management in computing*



First: What is an OS???

- *We talked about this already, but briefly.*
  - *Let’s be brief again!*
- Your computer is made out of *stuff*
  - *One or more processors*
  - Memory: RAM, ROM (perhaps other types)
  - Storage: Hard drives, SATAs, SSDs, Flash, USB-C types of storage (Apple), etc.
  - Printing: paper-based, 3D
  - Types of input and output devices

First: What is an OS???

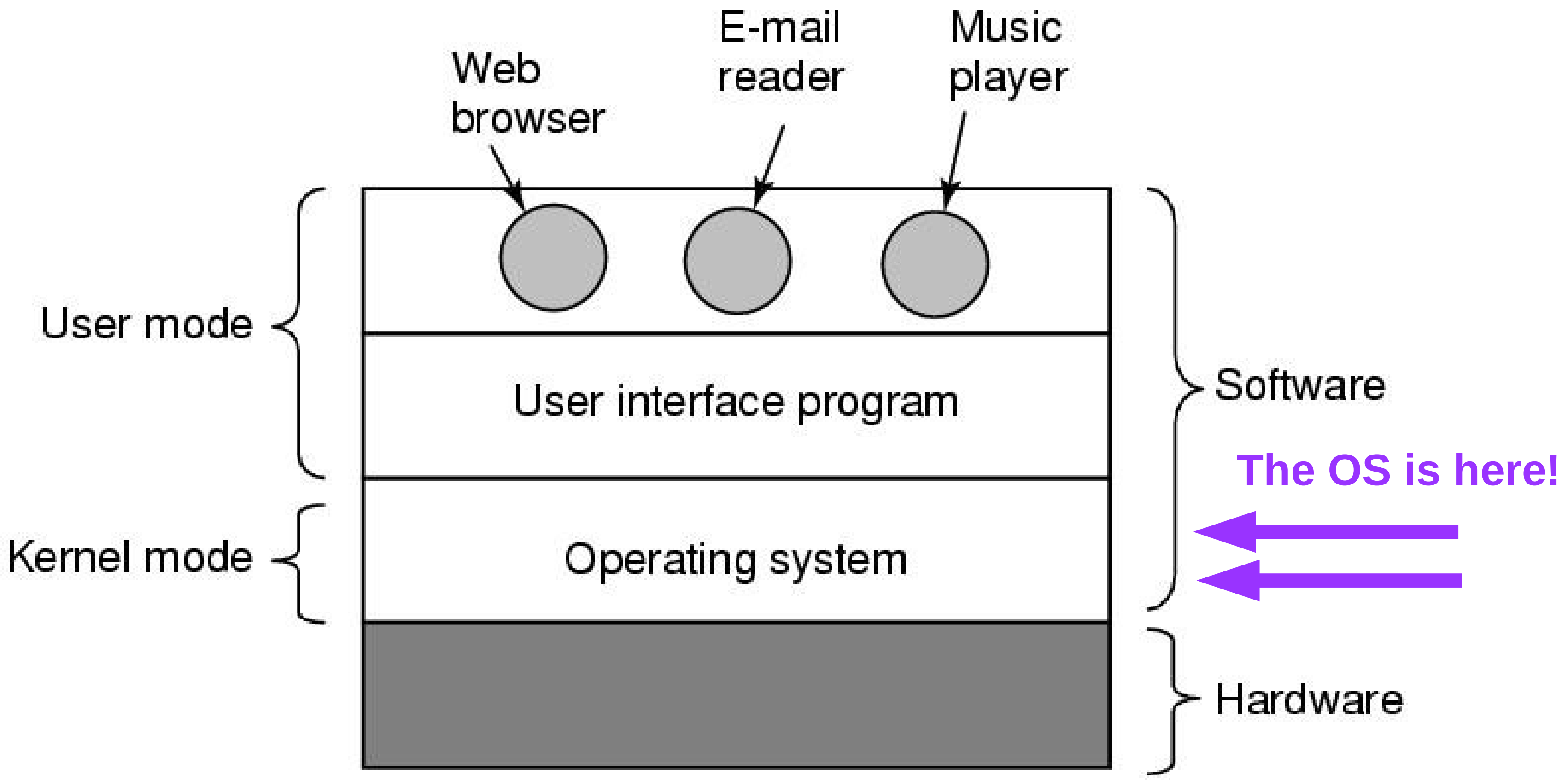
- *All these parts must work together!*

Managing all these components requires a layer of software – the **operating system**

What is the software?

- *Allowing software to work together with hardware on system*

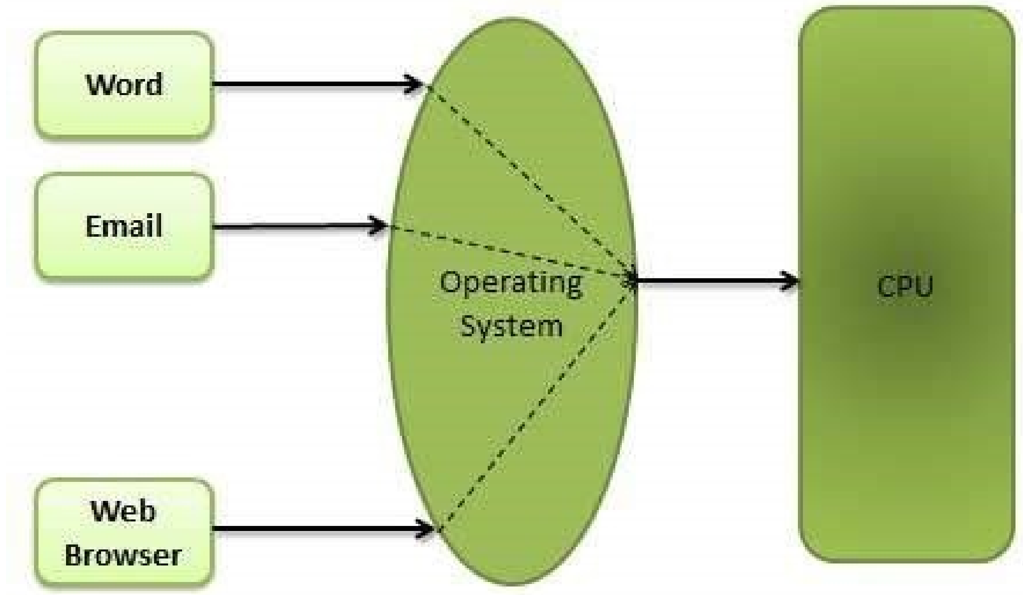
Where is the OS in the software?



- The OS is the lowest level of software before we transition to the hardware level of computer management

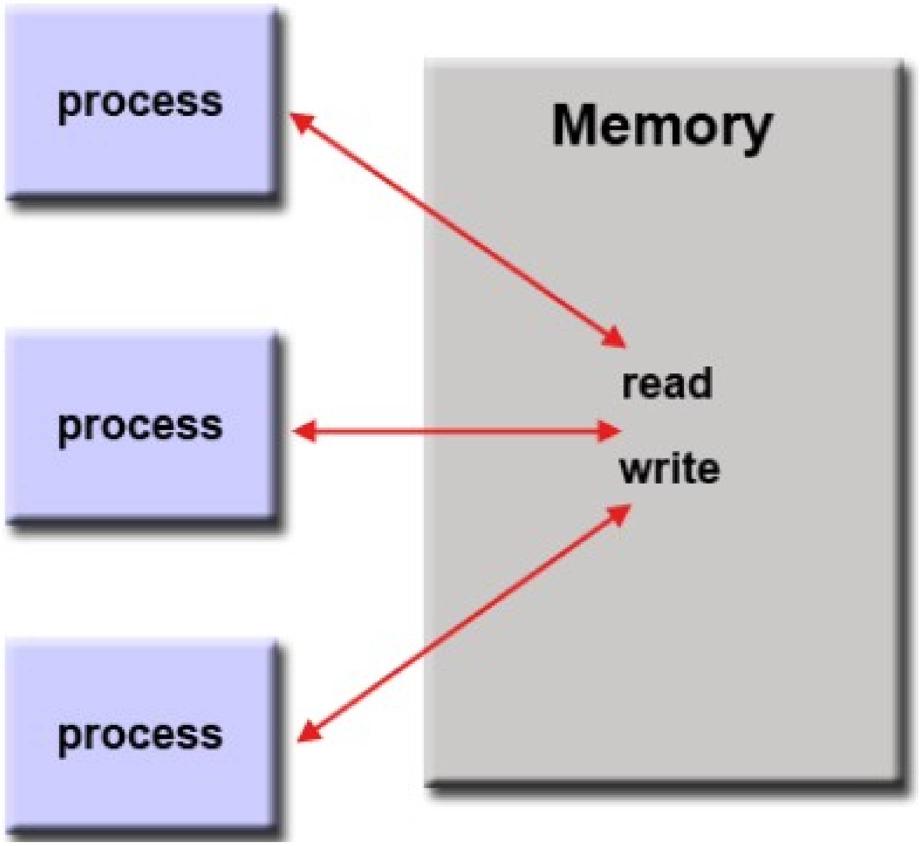
The OS as a Resource Manager

- Allow multiple programs to run at the same time
- Multiplexing (sharing) resources
  - By *Time*: When a resource is time multiplexed, different programs or users take turns using it. Ex: One CPU must be shared across several different tasks according to *time-sharing*



The OS as a Resource Manager

- Multiplexing (sharing) resources, continued
- By *Space*: Instead of taking turns, resources get a (small) part of a resource to use.
- Ex: Memory is used by several tasks simultaneously.



ALLEGHENY COLLEGE

Modes of Use

- Two modes of operation in Computing
  - **Kernel** mode (supervisor mode)
  - **User** mode
- Access
  - The **kernel** mode has complete access to all parts of the machine (software, hardware, internal clocks, memory blocks, storage blocks, etc.) and can execute any instruction the machine is capable of executing.
  - The **user** mode is given *very slight* privileges which allow for basic application launching and some other *high-level* software activity.

Let us consider the "kernel" to be the "brain" behind the OS.

Permissions: Levels of Access

Kernel Space

- Regulates
  - Manage hardware resources,
  - Determine app printer privileges,
  - Maintain the memory pages,
  - Handle hardware restrictions,
  - Display graphics from graphics chips,
  - Allocate time to the CPU for multitasking
  - Access, reallocate app memory
  - Control the computer cooling system
  - Write/read to disk
  - Interface with drivers ...

ALLEGHENY COLLEGE

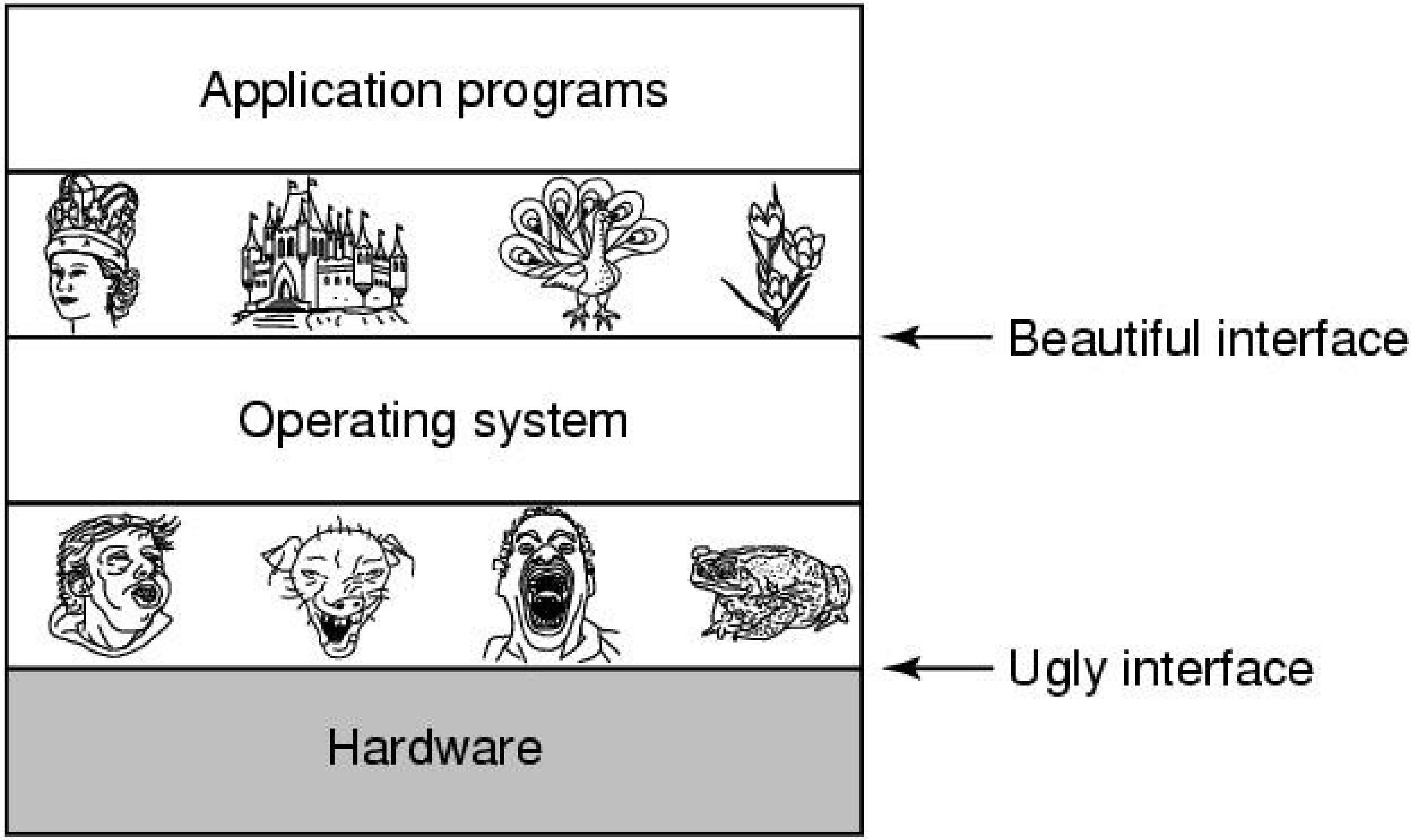
Permissions: Levels of Access

User Space

- Regulates
  - Update software,
  - Use of email client,
  - Install and use a new browser,
  - Choose any video player,
  - Play a video game,
  - Use a word processor,
  - Online banking applications,
  - Run a spreadsheet,
  - Code software
  - Run a program...

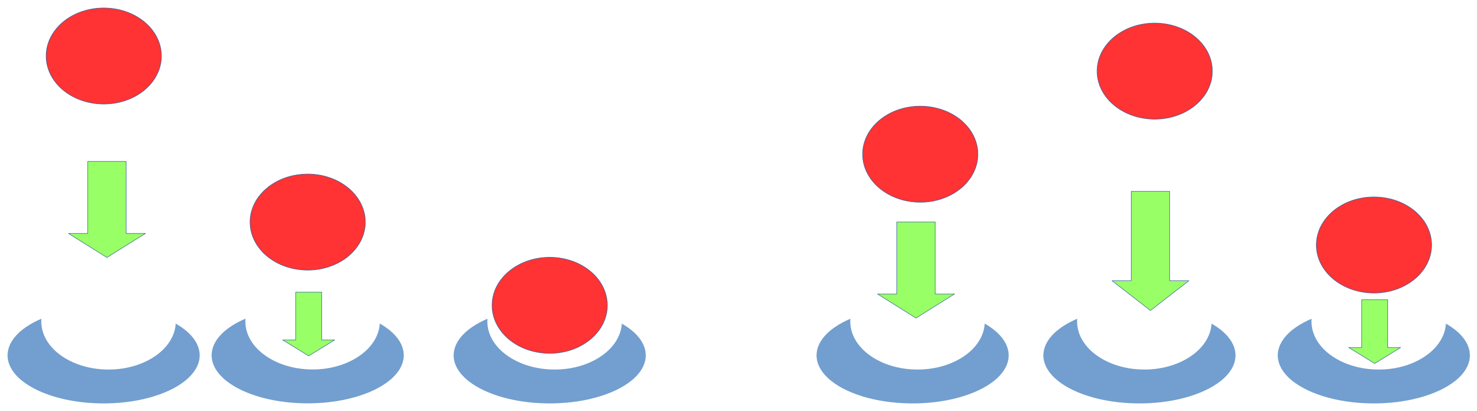
The Hard/ Software Connection

- The OS as an Extended Machine



The Hard/ Software Connection

- It is EXTREMELY difficult to work directly with hardware.
- Many types (kinds) of connections from software to make with hardware.



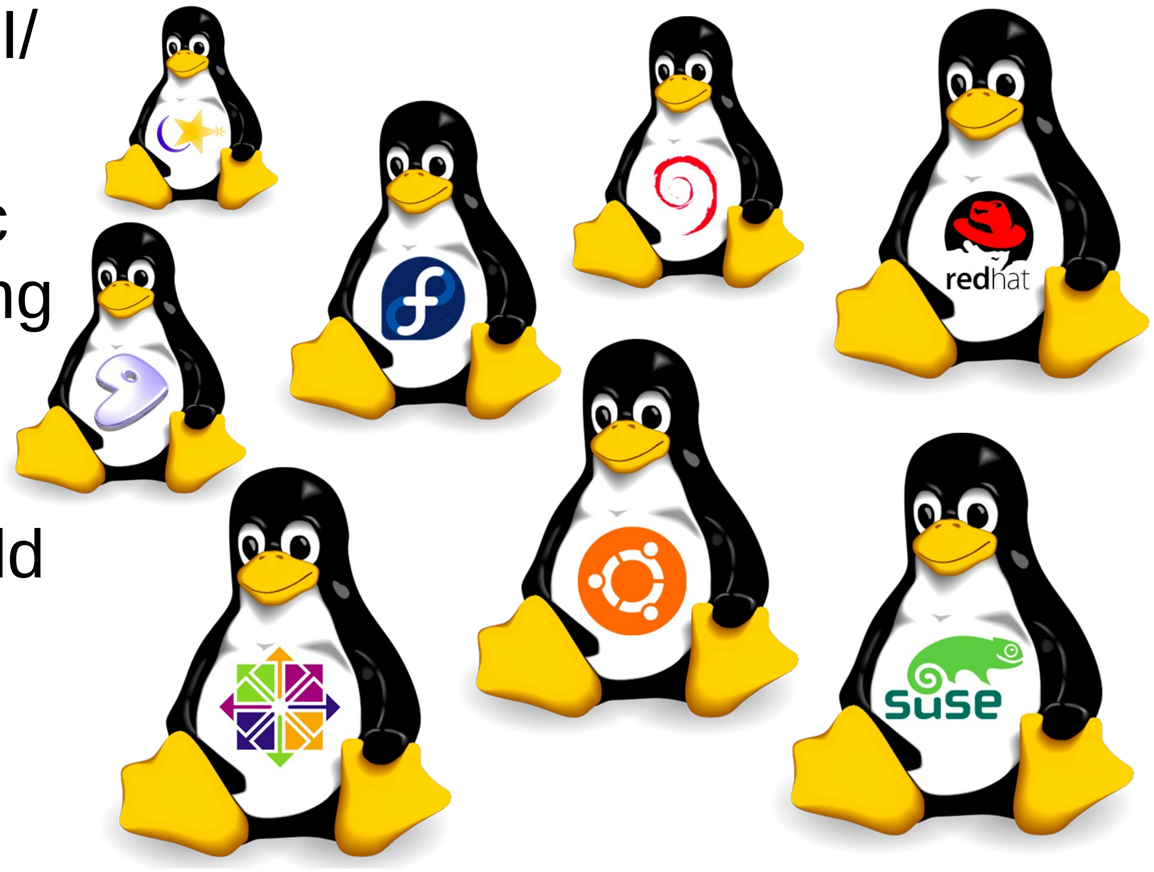
Hardware Connections to Software

Abstraction: Dealing with the Complexity Using Simplicity

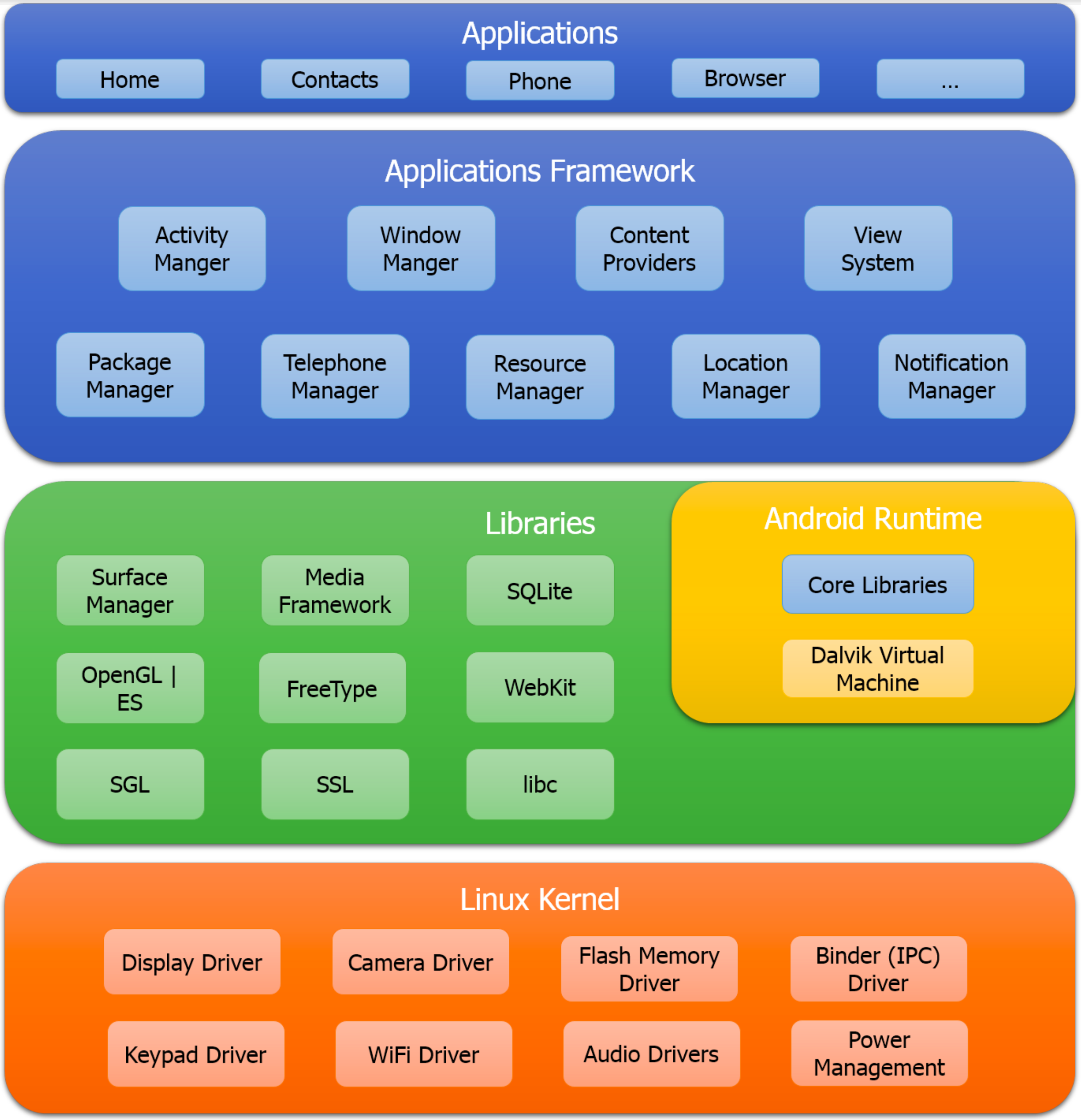
- Directly interacting with the hardware is complicated.
- Software-is created to handle this interaction once.
- Other software interacts with this software to form shortcuts for using hardware resources

Abstraction: Dealing with the Complexity Using Simplicity

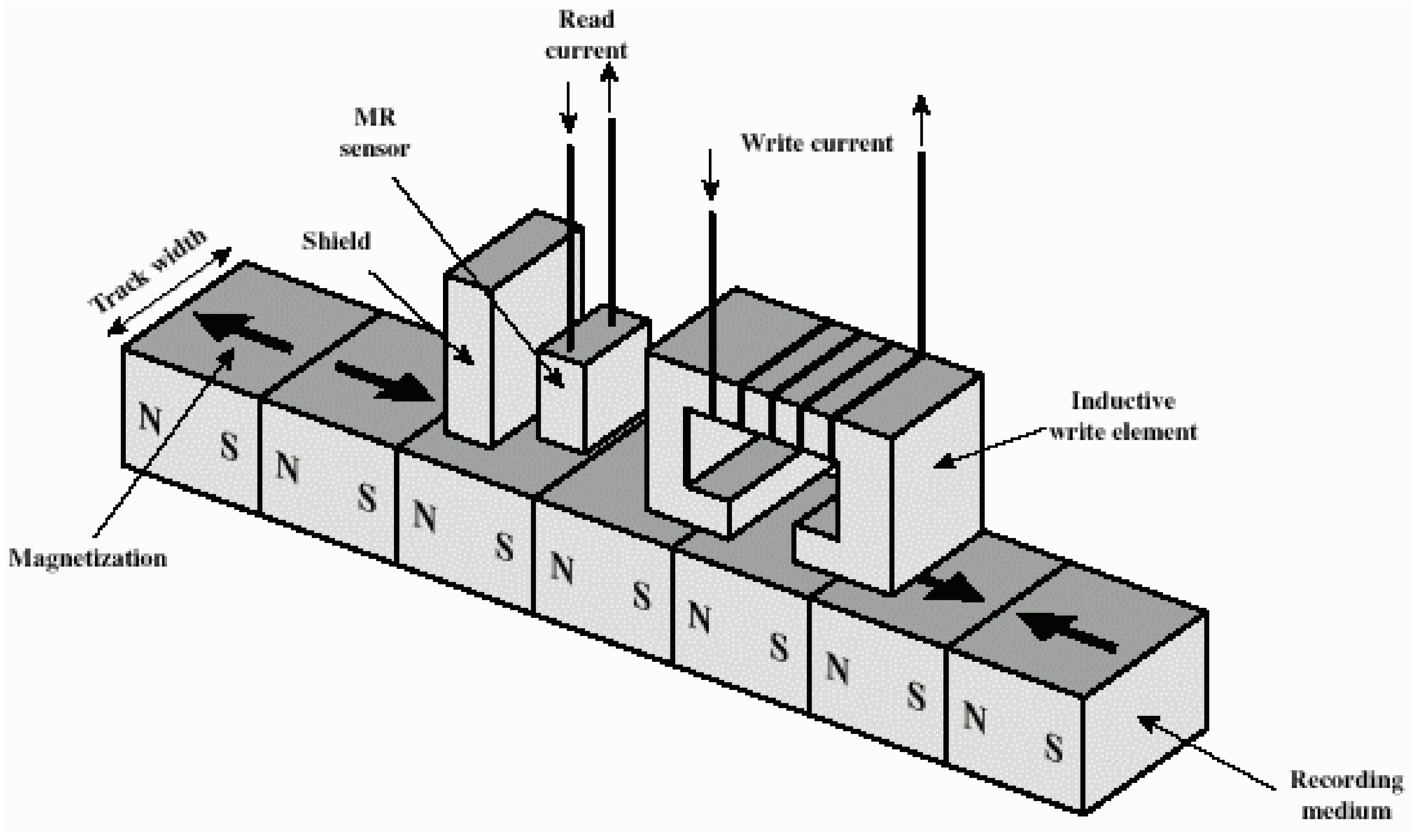
- Software drivers for I/O devices
- Drivers enable basic (simple) programming rules to perform complex work.
- Ideally, drivers should work across many different same-type systems such as similar Linux distributions.



Ex1: Some Linux Drivers

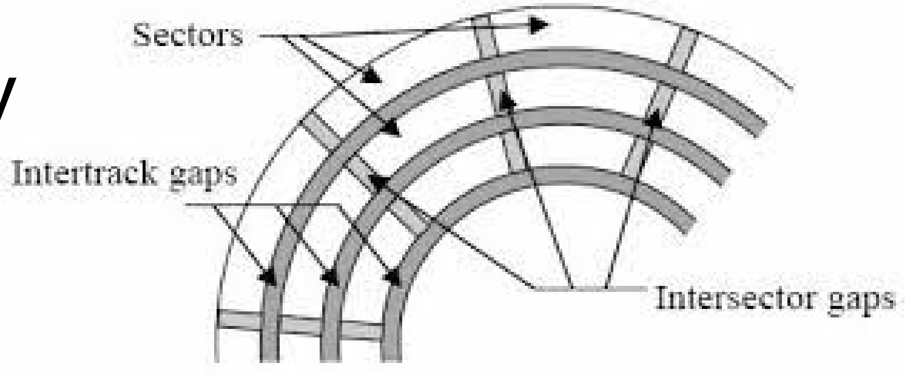


Abstraction: Complexity of Working with Storage

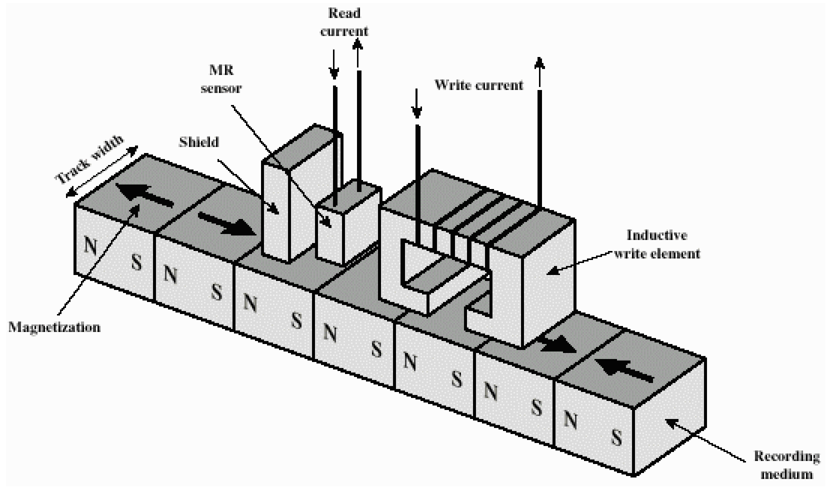


Abstraction: Dealing with the Complexity Using Simplicity

- Ex2: saving files is very complicated
  - Determine how quickly disk is turning
  - Attribute the 1’s and 0’s in correct places of disk sectors
  - Check for reading / writing errors
  - Check for bad sectors

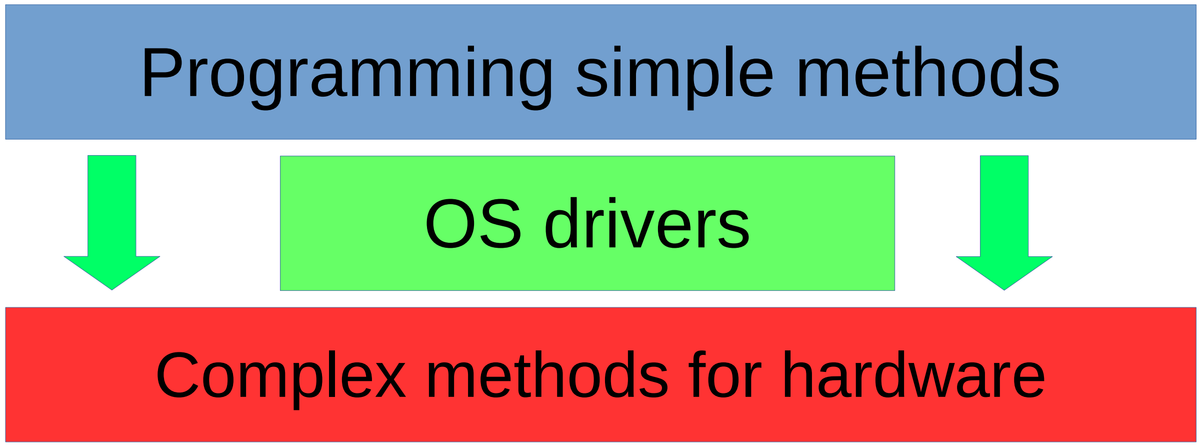


Organization of Hard Disk Platter



The OS Makes Connections

- An API (Application Programming Interface) is a set of defined functions and methods for interfacing with the underlying operating system or another program or service running on the computer.
- Connections by establishing a reference to a software library or importing functions from software such as to dynamic link libraries (dll), in case of Windows.



Abstraction:
Making a Cup of Coffee

Ground coffee

Coffee Cup

Coffee Maker

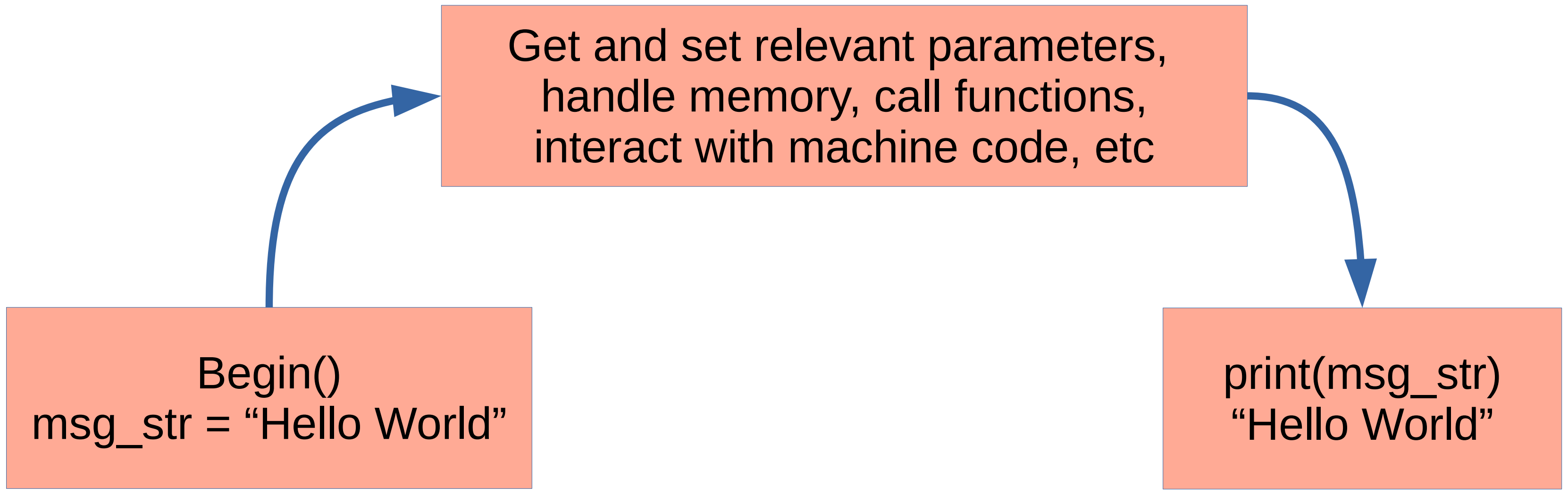
By the process of abstraction, a the coffee maker hides all but the relevant inputs to make coffee in order to reduce complexity and increase efficiency, and make a cup of joe.

Cup of Joe

Consider This

- An abstraction model in Python3 programming
- File: `abstraction.py`
- A method to handle the messy inputs which are necessary by another
- Take a moment to play with this simple, yet overly complicated, program.

Abstraction by Object Oriented Programming


Get and set relevant parameters, handle memory, call functions, interact with machine code, etc
Begin() msg_str = “Hello World”
print(msg_str) “Hello World”

The OS handles this kind of abstraction for each process to manage systems resources to work together.