Lec-01-1
Course Overview & Introduction to OS

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Bachelor of Information Technology
IN616 – Operating Systems Concepts
Semester 1, 2020

About Us

- **Faisal**
  - PhD in Computer Science, University of Otago, 2010
  - Associate Prof, CSE, University of Dhaka, Bangladesh
  - Lecturer, ECE, University of Illinois at Urbana-Champaign, IL, USA
  - Nestle, Ingram Micro, Internet Society
  - Systems and Security, Software Defined Networks, Internet Congestion Control

- **Hymie**
  - PhD in Computer Information Engineering, Massey University, 2010
  - WLAN, WBAN, WSN

Contacts

- **Office**
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  - Try to email if you can (for serious stuff/availability)

- **Email**
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- Teams Channel
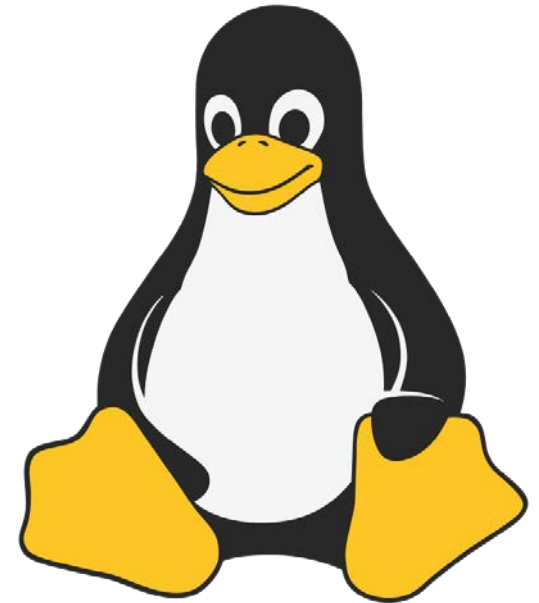
    IN616 OS Concepts

Schedule

- **Normal housekeeping**
  - Course directive
  - Detailed course overview (mainly assessments)
  - Introductions (you) and course expectations
  - Course resources

- **Content**
  - Operating Systems overview, Intro to Linux
  - Linux kernel VS. distributions
  - Lab topics:
    - Installation of Ubuntu Server (lab)

Introductions – You!

- Alphabet Linux exercise
  - Get a group (2-3 people)
  - Introduce yourself
  - Write the English alphabet on a piece of paper
  - **For each letter, think of a word related to Linux**
  - We will discuss as a group after

- Class discussion:
  - What is your name?
  - What semester/year are you in?
  - What is your one Linux word?

Course Directive

- **Mandatory read through**
  - Printed handout (please ask if you do not have one)
  - Electronic copy available:
  - `I:\COURSES\ITP\BITY2\IN616 Operating Systems Concepts\ course directive`

Course Assessments

Assessment	Content	Weight
vi Quiz	vi/vim editor quiz	10%
Skills Based Assessment	BASH commands Linux knowledge	15%
Scripting Assignment	BASH scripting	20%
Presentation	Your (Linux) topic choice	10%
Graded Labs	Networking (3/4/5 labs)	15%
Final Exam	Entire course content	30%

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Course Assessments: Term1

Assessment	Content	Weight
vi Quiz	vi/vim editor quiz	10%
Skills Based Assessment	BASH commands Linux knowledge	15%
Scripting Assignment	BASH scripting	25%
Presentation	Your topic choice (Linux)	10%
Graded Labs	Linux networking (3/4/5 labs)	15%
Final Exam	Entire course content	25%

- **SBA**
  - Week 5
  - In class assessment
  - 15%
- **vi Quiz**
  - Week 8
  - In class assessment
  - 10%
- **Scripting Assignment**
  - Given in week 5
  - Due in week 10 (after break)
  - Own time assessment
  - 20%
- **Term 1: 50% paper done**

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Course Assessments: Term2

Assessment	Content	Weight
vi Quiz	vi/vim editor quiz	10%
Skills Based Assessment	BASH commands Linux knowledge	15%
Scripting Assignment	BASH scripting	20%
Presentation	**Your topic choice (Linux)**	**10%**
Graded Labs	**Linux networking (3/4/5 labs)**	**15%**
Final Exam	**Entire course content**	**30%**

- **Presentation**
  - Weeks 11-14
  - In class presentation
  - 10%
  - Choose a topic
- **Graded labs**
  - Weeks 11-14
  - In class practical labs
  - Linux networking
  - 15%
- **Final exam**
  - Week 16
  - All course topics
  - Closed book
  - 30%
- **Term 2: 50% paper done**

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Course Assessments

Course Expectations (1)

- **Skill focused**
  - We focus on use of Linux in a real-world context
  - You should become comfortable navigating and operating Linux

- **Interactive course**
  - You will learn more from discussions/self-directed research than from me

- **Documentation is essential**
  - System operations rely on proper documentation
  - The assessments rely on proper documentation (extra marks, makes life easier)

- **Opportunities**
  - I welcome suggestions for course content
  - Presentation in the later part of course give opportunity to select topic

Course Expectations (2)

- **Work outside class is assumed**
  - 64 hours of class time
  - 86 hours of self-directed reading, preparation, assessments etc.
  - You will be pointed to material not specifically covered in class
  - Computers do not always work as expected – time and perseverance!
  - Labs may (will) be longer than class time allows

- **Motivation**
  - Turn up to all classes
  - Do all assessments
  - Every student that has failed this class missed out on at least one assignment
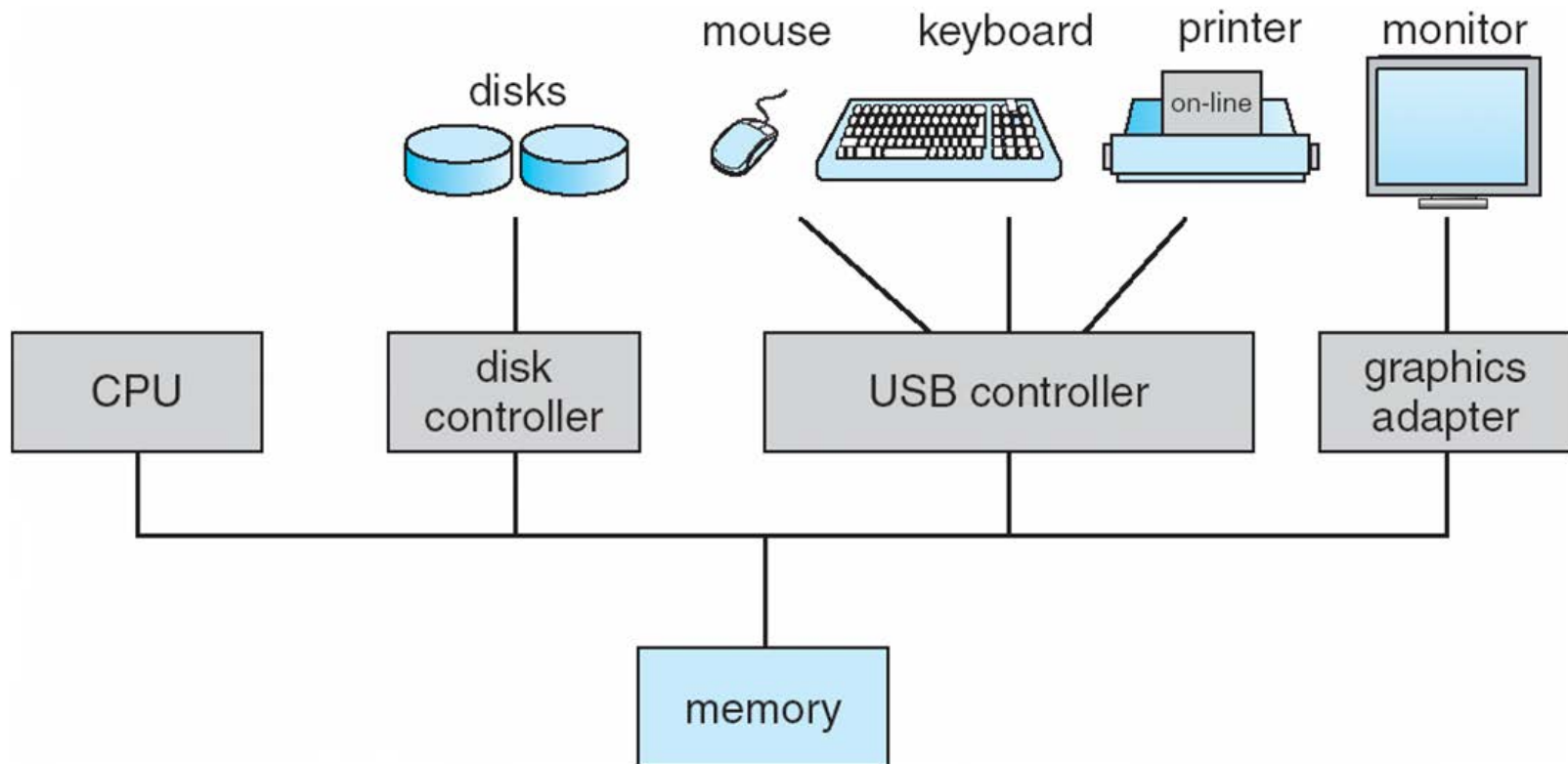   - Frantz, 2016

Course Resources

- **Lecture and lab material**
  - Usually a lecture (PowerPoint) and lab (worksheet) each week

- **Online resources**
  - There are many, provided in lectures and labs

- **vRealize**
  - A cloud computing virtualization platform
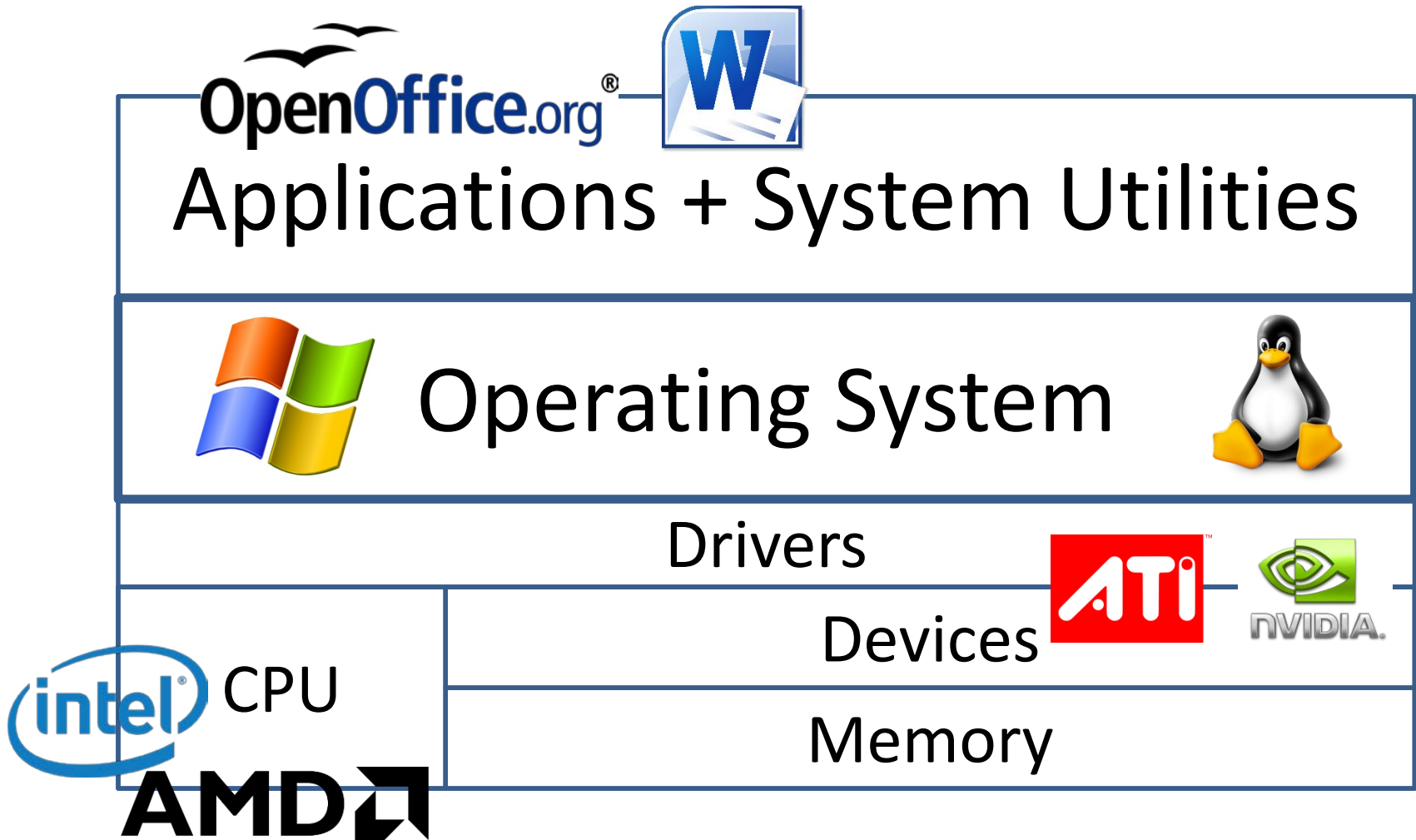 - We will use this platform heavily in this paper

Introduction to Operating Systems

Why do we need an OS?

Where is the OS?

Applications + System Utilities

Operating System

Drivers

Devices

CPU

Memory

Essential purpose of any OS

- **Abstraction and Arbitration**

- **Abstraction**
  - Separating lower layers from upper layers
  - An example:
    - Writing files is the same whether you write to hard drives, USB sticks or the cloud
  - Making life simpler for the user/developer

- **Arbitration**
  - Separating programs that run in parallel
  - An example:
    - Running your browser should not affect your word processors or IDE
    - None should freeze or affect other applications when it crashes
  - Ensuring robust and reliable systems

(Some) Functions of an OS

- **Management**
  - Device Management
  - User Management
  - Memory Management

- **Operation**
  - Handling user interactions
  - Scheduling of tasks/processes
  - Error Handling

What is Linux

- **An operating system developed by Linus Torvalds**
  - Released in 1991
  - That means it is more than 25 years old!

- **Derived from UNIX**
  - Proprietary (Bell Labs / AT & T)
- **Inspired by MINIX**
  - UNIX-like
  - Open source

- **Linus's reason for Linux**
  - No suitable operating systems available
  - UNIX was too expensive
 - MINIX did not allow modification and redistribution

Linus Torvalds

If Microsoft ever does applications for Linux... it means I've won.
- Linus Torvalds

LOOKS LIKE HE WON!

Is Linux an operating system?

- **What is an operating system?**
  - Ever general purpose computer needs one
  - Allows other programs/applications to run
  - Low-level software to support a computer's basic functions
  - For example: Controlling hardware
  - For example: Scheduling tasks

- **So is Linux an operating system?**
- **Yes!**

User

Application

Operating System
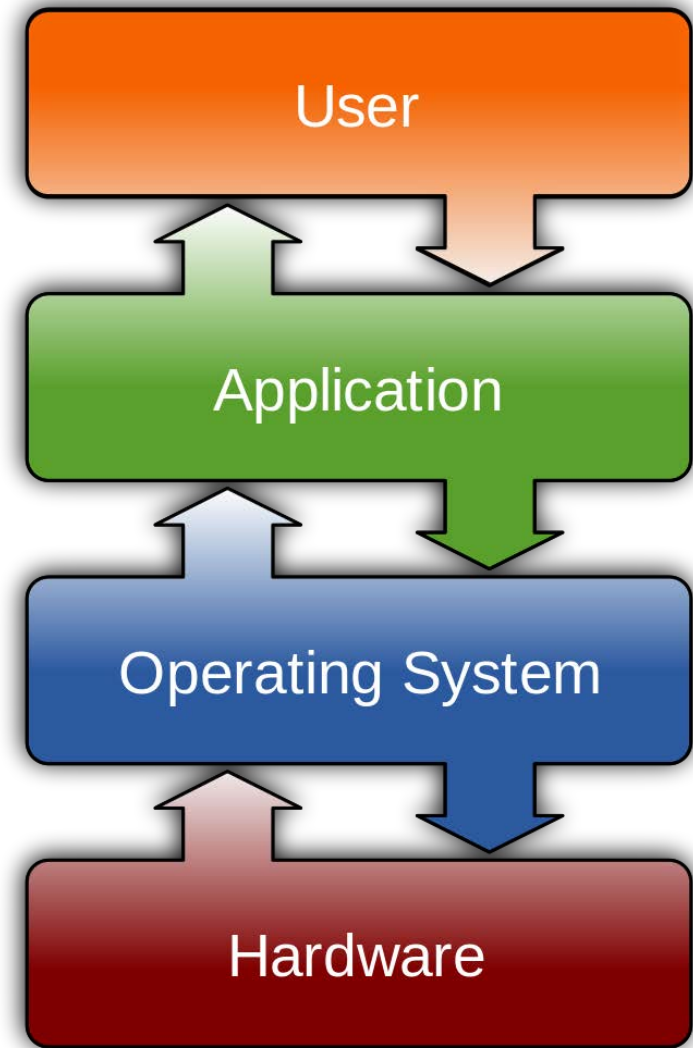
Hardware

Linux: The kernel (1)

- **What is a kernel?**

- It is not just a Linux thing
- Every operating system has a kernel
- Most fundamental part of an OS

- Provides core functionality
  - Booting
  - Memory management
  - User management
- The kernel talks to hardware/software
- The kernel manages resources
- The only program that runs all the time
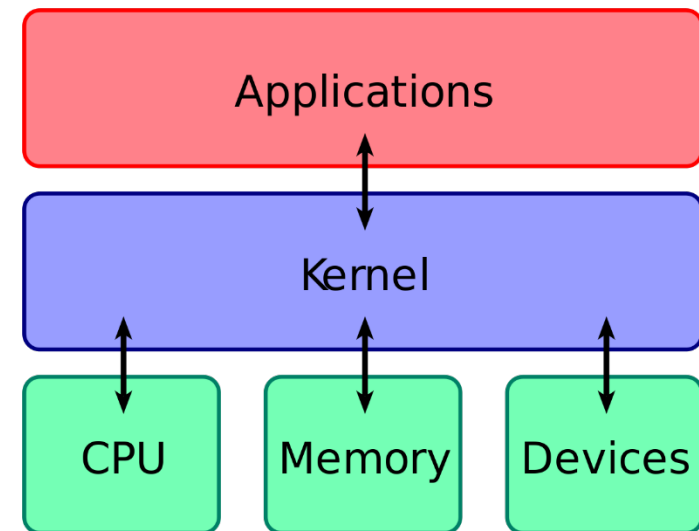
Linux: The kernel (2)

- **The kernel is the core**
- **But has no useful functionality by itself**

- **For example, Android contains:**
  - Linux Kernel +
  - User Interface +
  - Applications =
  - A smartphone that is useful !!

- **The Linux kernel is freely available**
  - www.kernel.org
 - Good introduction: www.kernelnewbies.org

Linux: Market Share

- **Mobile:**
  - Android with 71%
  - iOS is 26%

- **Desktop:**
  - Linux with 1.6%
  - Windows is 89% and Mac is 9.5%
  - www.netmarketshare.com

- **Web servers**
  - Linus accounts for 36% of all webservers
  - http://stackoverflow.com/research/developer-survey-2016#technology-desktop-operating-system
  - All UNIX-like account for 67% of all webservers
  - http://w3techs.com/technologies/overview/operating_system/all

- **Supercomputers:**
  - Linux with 99.4%
  - http://www.top500.org/statistics/overtime

Linux: Supercomputers
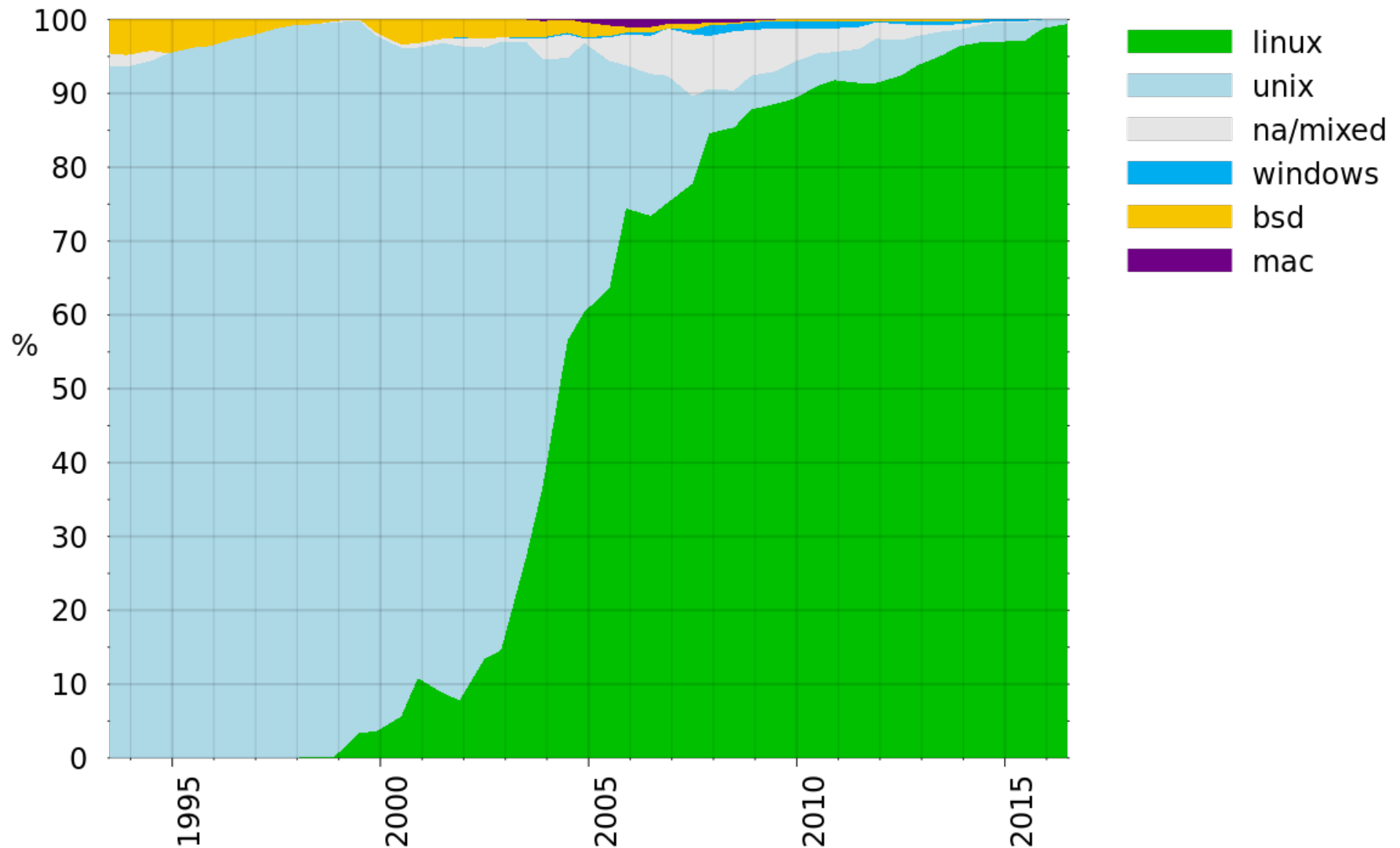
Linux is Everywhere

24 Nuclear submarines

Way back in 2004, Lockheed Martin gave the US government a nuclear submarine powered by Red Hat Linux. Linux is used to power the submarine's on-board sonar systems.

If it was running Windows I don't think I'd be able to sleep as soundly!

Source: https://www.omgubuntu.co.uk/2016/08/25-awesome-unexpected-things-powered-linux

Linux: Kernel or OS or Distribution

- **Linux**
  - Only kernel without software ecosystem

- **GNU/Linux**
  - A fully-fledged operating system
  - Linux kernel + GNU software packages

- **Distribution**
  - Specific selection of applications
  - Focuses on purpose of distribution
  - www.distrowatch.com
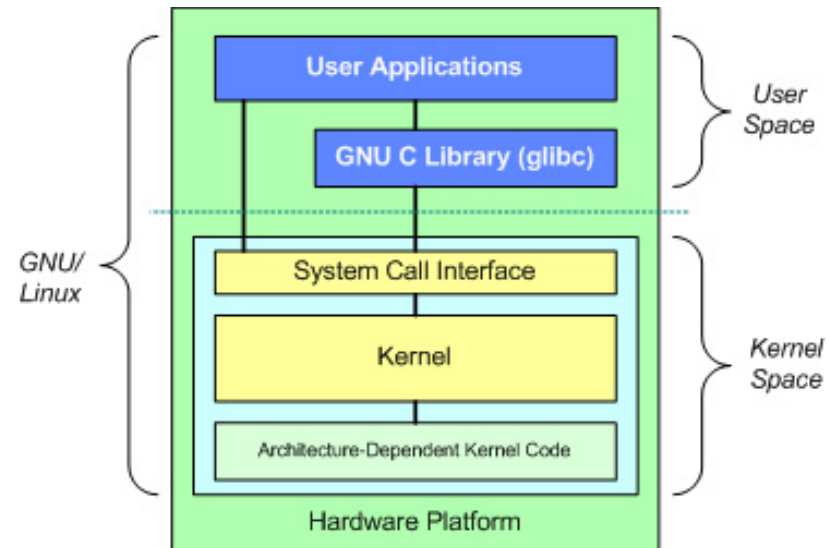
Linux: Distributions (Objectives)

- **Commercial (Red Hat) – biggest commercial contributors to Linux**
- **Technology preview for Red Hat (Fedora)**
- **Rolling releases, bleeding edge (ArchLinux)**
- **Stable (Debian) – stable, testing, experimental**
- **User-centered (Ubuntu)**
- **Mint (alternative GUI)**
- **Strongly modular (ArchLinux, Slackware)**
- **Off the shelf (Ubuntu)**
- **Security-centric (Kali Linux)**
- **Media-centric (AVLinux)**
- **Game-oriented (SteamOS)**

IN616: Our Distribution

- **Ubuntu server 16.04-4 LTS and higher**
  - LTS = Long term support (5 years)

- **Server version =**

  No Graphical User Interface (GUI)

- **Why no GUI**
  - GUIs are beautified interfaces for console commands; only commands (i.e. less powerful)
  - GUIs change, the command line doesn't (think about how Windows changed over time)
  - GUIs depend on graphic cards (which can fail)
  - GUIs require more bandwidth for remote control

Lab-01-1 – Start

- **Install Ubuntu server 18.04-4 LTS**
  - Lab worksheet on `I:\`
  - `I:\COURSES\ITP\BITY2\IN617 Operating Systems Concepts\week1`
  - This is where all material is shared

- **GOAL:**
  - Install Ubuntu server on VMWare Workstation
  - We will use this system in the next few classes!

USE LINUX AT HOME!

- Using Linux at home is a key to success!

- **Option 1: Virtualization**
  - Use a desktop virtualization product
    - VMWare Workstation (get for free from: https://secure.ict.op.ac.nz/vmware/)
    - Oracle VirtualBox (open-source… mostly!)

- **Option 2: Run Linux on a physical system**
  - You can dual boot (Windows + Linux)
  - You can use a Live Bootable USB-based OS

- You also have access to a *TrainingVM* all semester long
  - Available on-campus, and off-campus

Next Day

- **vRealize setup:** https://fthvra01.op.ac.nz/vcac/
  - Check you have access (can log in)
- Request the *TrainingVM*
  - Catalog → IN616 → IN616-TrainingVM (Request one!)