KOÇ UNIVERSITY

COMP304
Operating Systems (OS)

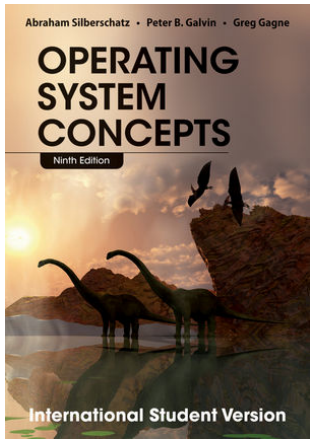
Introduction

Didem Unat

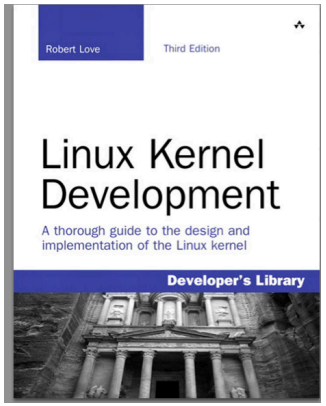
Lecture 1

Course Basics

- Website
  - Blackboard : https://ku.blackboard.com/
  - All course materials will be posted
- *Main Book*
  - *Operating System and Concepts (10th edition)*
    - *By Silberschatz, Galvin and Gagne*



- *Additional Book*
  - *Linux Kernel Development (3rd Edition)*
    - *By Robert Love*
    - *http://it-ebooks.info/book/819/*



Linux Operating System

- In assignments and projects, we will be using Linux environment. You have two options:

BACK UP YOUR DATA

1) Install a Linux OS environment (recommended)

   Installation package (latest distributions of Ubuntu or Fedora)

   Install as dual boot on your own computer

2) Install Linux Virtual Machine on your computer

Have it ready by next week for the PS, consult your TAs or peers if you have any problems

Linux Tutorial

- Learning Unix commands
  - http://www.ee.surrey.ac.uk/Teaching/Unix/
  - Study the intro and first 2 sections by next PS hour
    - Experiment with these basic commands
    - First PS will go over the commands
  - First assignment will require you to have a running Linux environment and basic Unix command knowledge

Grading

- Grading
  - %10 Written/Coding Assignments (5+3+2 of them)
  - %38 Projects (14+14+10 of them)
  - %20 Midterm
  - %30 Final
  - %02 Attendance

Final makeup exam and remedial exam will take place on the same day at the same time. A student can take either of them but not both.

Midterm makeup exam is on the last week of the instructions at the PS hour. Midterm makeups are not cumulative.

TAs and PS Hours

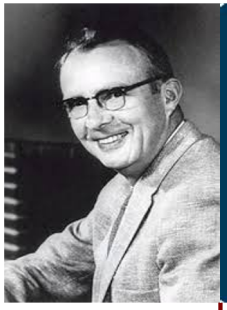
- PS is on Thursdays at 5.30 pm
  - Not every week.
  - We will annouce it when it is happening.
- TA Office Hour in-person (ENG 230)
  - 5.30-7 pm Tuesdays, Wednesdays
- My Office Hour
  - Tuesdays cefore the class
- TAs
  - Ilyas Turimbetov (ENG 230)
  - Kefah Issa (ENG 230)
  - Ismayil Ismayilsoy (ENG 230)

About me

2006
Graduated from
Boğaziçi University

2012
PhD at
University of California,
San Diego

About me



BERKELEY LAB
Lawrence Berkeley National Laboratory

MARIE CURIE ACTIONS

BİLİM AKADEMİSİ

2012-2014
Luis Alvarez Postdoctoral Fellowship

Lawrence Berkeley National Laboratory

2014 -
Koç University

KOÇ UNIVERSITY
PARALLEL AND MULTICORE COMPUTING LABORATORY

THE ROYAL SOCIETY

About me

SPAR CITY

beyond moore

2.6M Euro

6 European partners

1.5M Euro

First in Turkey
in Computer Eng.

EuroHPC
Joint Undertaking

erc
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ACM CAREERS

Didem Unat Named SIGHPC Emerging Woman Leader in Technical Computing

September 8, 2021
Comments

VIEW AS: SHARE:

Didem Unat is an assistant professor of computer engineering at Ko University in Istanbul, Turkey.

Didem Unat of Koç University has been named the winner of the 2021 ACM SIGHPC Emerging Woman Leader in Technical Computing award. Unat was recognized for innovations in the field of programming models for data locality in high performance and scientific computing and for her leadership role in the international high performance computing community.

Unat's work on simplifying software development for current and future supercomputing architectures resulted in architecture-independent abstractions. These allow for the development of scientific software that maps to complex memory hierarchies and accelerator structures, with high-performance results.

"Unat's rigorous technical work has directly impacted the productivity of application scientists," says award committee chair Cristina Beldica of Intel. " This is critical not only for high performance computing, but science in general."

From *HPCwire*
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Motivation

- Operating Systems: Major field of Computer Science and Engineering
  - One of the MOST important and enjoyable course

- Around 20% of questions in GRE Computer Science subject test are from the OS concepts

- Forms a good knowledge base for other subject areas
- Provides a complete understanding of software/hardware infrastructure

Elements

- Good knowledge in
  - C programming
  - Data structures
  - Computer Systems
    - CPU and Memory Subsystem
  - Algorithms

What is an Operating System?

- A program that acts as an intermediary (supervisor) between a user of a computer and the computer resources

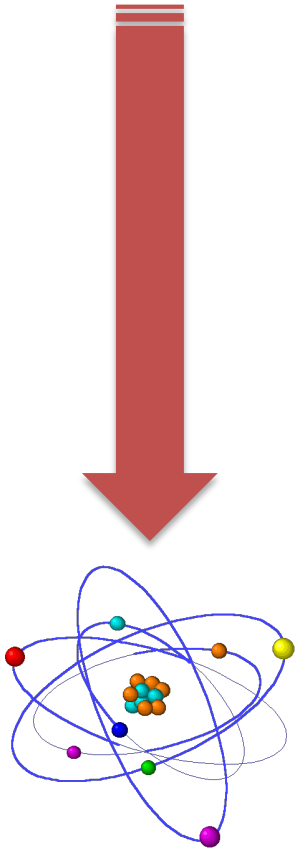
- Duties of an OS
  1) Provide resource abstraction
  2) Manage and coordinate resources
  3) Provide *security and protection*
  4) Provide *fairness* among users (or programs)

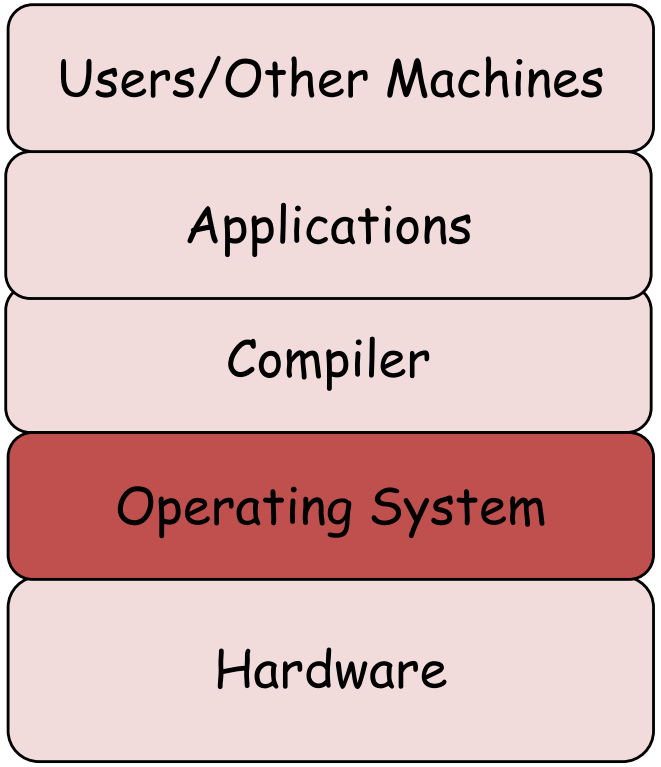
Computer Startup

- **Bootstrap program** is loaded at power-up or reboot
  - Typically stored in ROM, generally known as **firmware**
  - Initializes all aspects of a system
  - Loads operating system **kernel** into main memory and starts execution
    - The first system process is '**init**' in Linux
  - When the system is fully booted, it waits for some event to occur
- Kernel
  - The ``one" program running at all times (the core of OS)
    - Everything else is an application program
- Process
  - An executing program (active program)

(1) OS creates resource abstractions

```
foo(int x) {…}
```

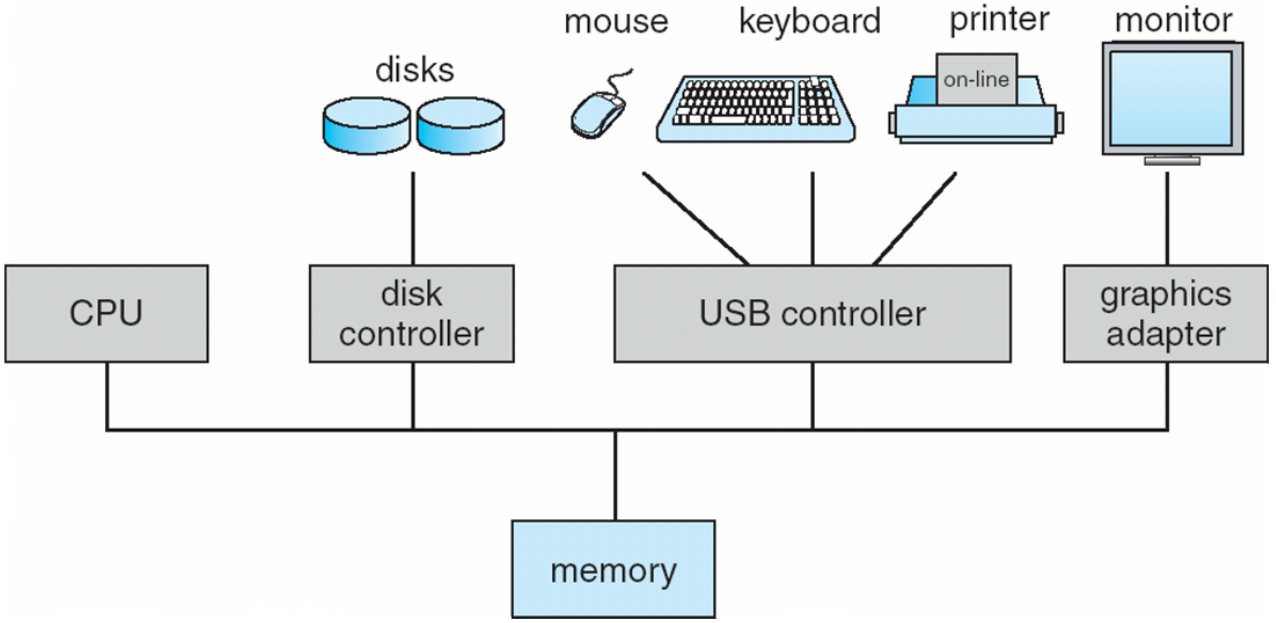




There are other layers in software stack such as runtime, libraries etc. Operating System and Compilers are essentials.

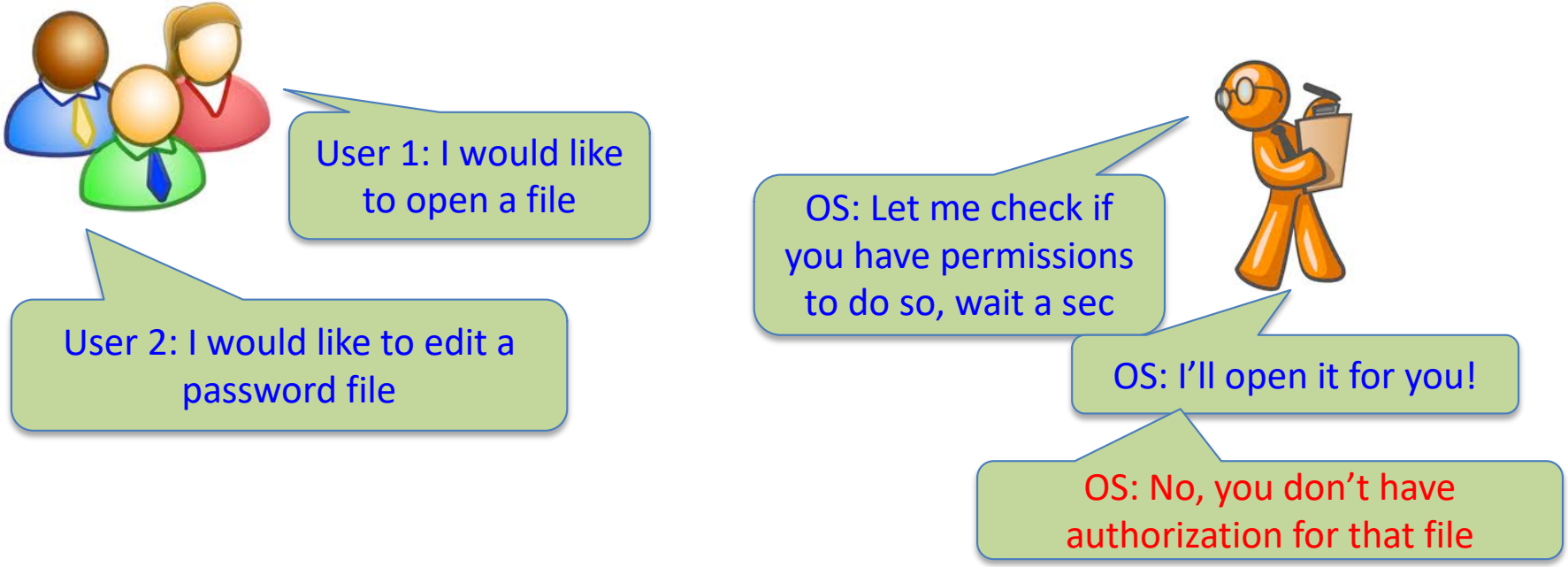
(2) OS manages resources

- OS is a **resource allocator**
  - Manages all resources for processes
  - Decides between conflicting requests for efficient and fair resource use



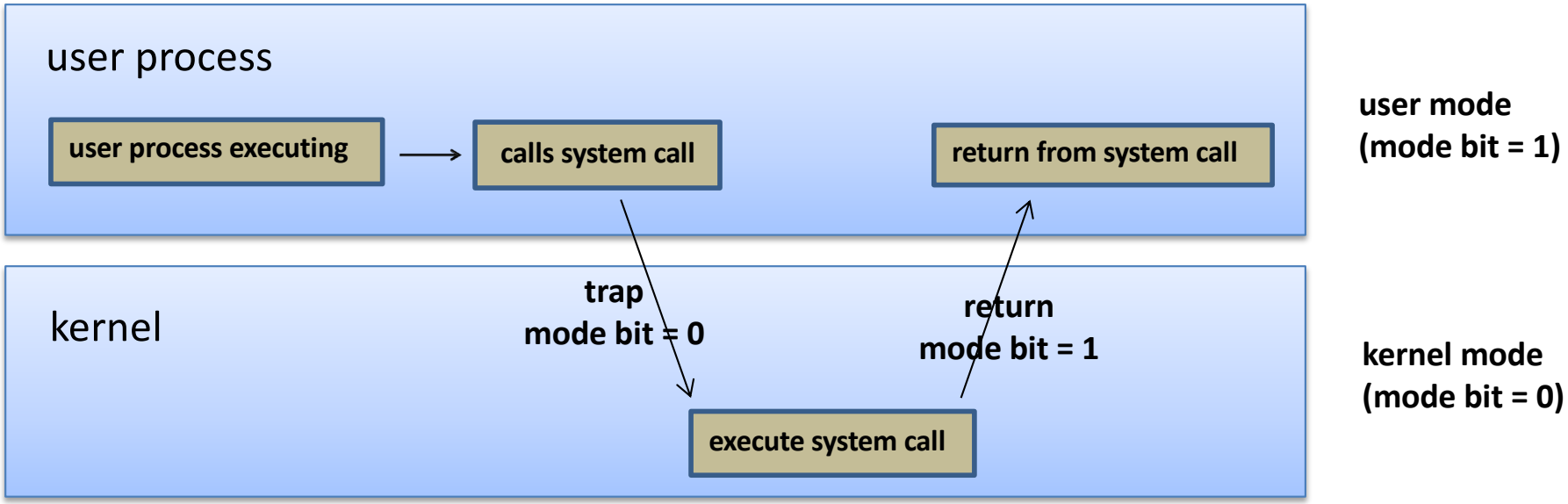
(3) OS provides protection and security

- OS is a **control program**
  - Controls execution of programs to prevent errors and improper/malicious use of the computer
  - Dual mode and Multimode OS
    - User mode and Kernel mode



(3) OS provides protection and security

- **System Call**
  - How a program requests a service from an OS
  - Results in a transition from user to kernel mode
  - Return from call resets it to user mode
- Software error or request creates exception or trap

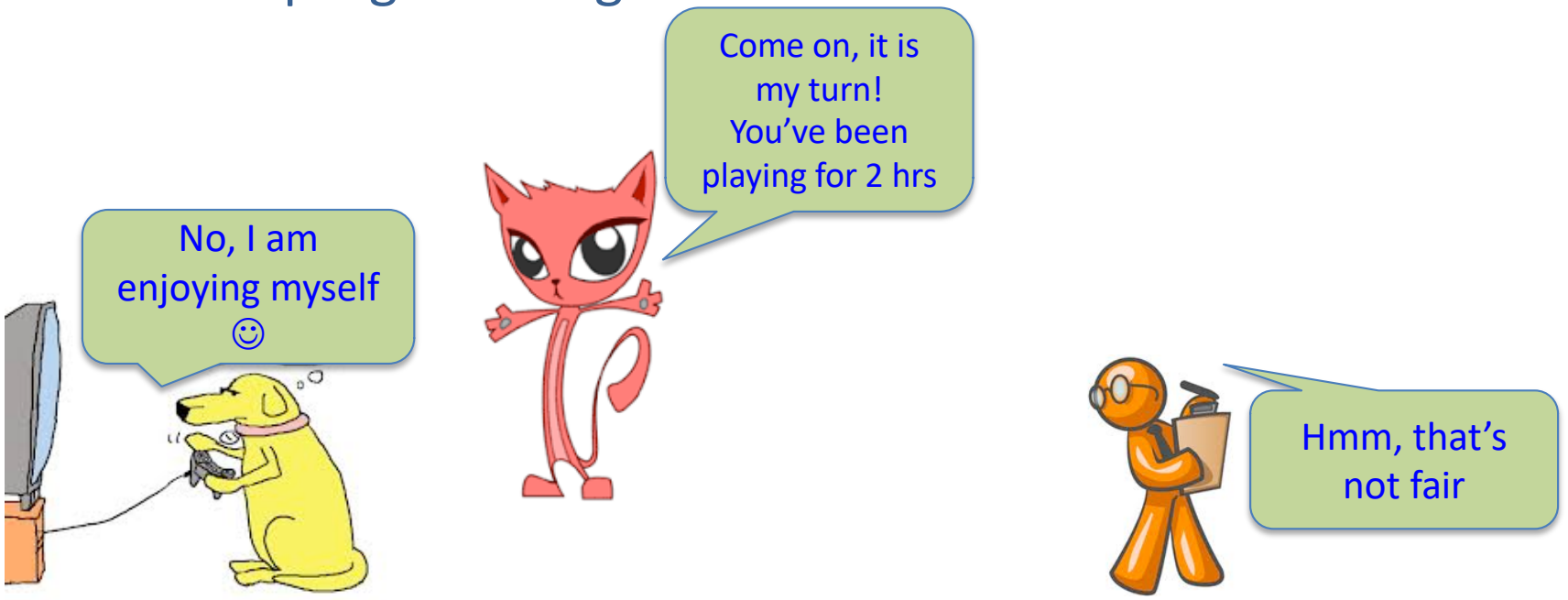


Interrupts

- An operating system is **interrupt driven**
  - It sits and waits for an event to occur
- Device or hardware interrupts
  - I/O device is done or
  - Hardware throws an exception (e.g. overflow)
- Software interrupts
  - A **trap** or **exception** is a software-generated interrupt caused either by an error or a user request (system call)
- OS has an **interrupt vector**, which contains the addresses of all the service routines for interrupt handling

(4) OS provides *fair* execution

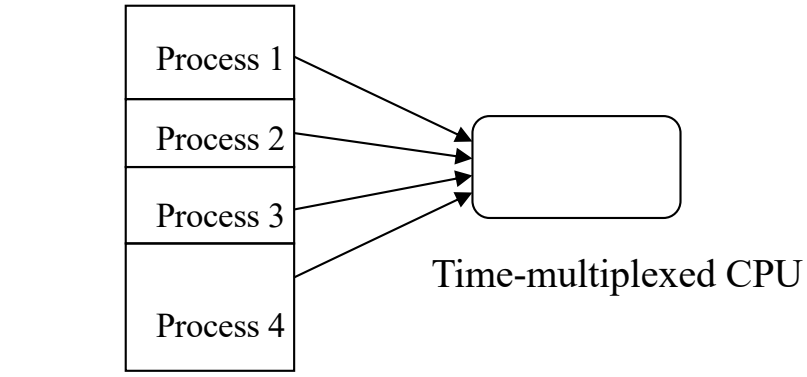
- OS provides fair execution and resource sharing between users and programs
  - via multiprogramming



How Multiprogramming Works

- **Multiprogramming** needed for efficiency
  - Single user or program cannot keep CPU and I/O devices busy at all times
  - Organize processes so that CPU always has one process to execute
  - A subset of total jobs is kept in main memory

- One job selected and run via **CPU scheduling**
  - When it has to wait (for I/O for example), OS switches to another job



Brief History of OS

- No operating system 1940s
  - Computers are exotic
  - Program in machine language
  - Programs manually loaded
  - No concurrency: no multiple jobs, no multiple users
- 1950s
  - First compiler is developed
  - OS uses batch scheduling
    - No human-computer interaction
    - Still used in servers, clusters and data centers today

Brief History of OS

- 1960s
  - Multics – one of the most important real OS
    - Hierarchical file system (directory structure)
    - Access control list and protection
    - https://multicians.org/
- 1970s
  - Computers became affordable
  - UNIX is born at Bell Labs by Ken Thompson and Dennis Ritchie
    - Written in C, allows people to experiment

Brief History of OS

- 1980s
  - MS-DOS
    - IBM needed software for their personal computers
    - Approached Bill Gates (Microsoft) and he created MS-DOS
  - BSD Unix
    - University of California developed BSD Unix
    - Became open source later
  - Mach
    - Carnegie Mellon Univ. developed Mach to replace Unix
    - Apple chose BSD/Mach as the foundation for MacOS X
- 1983
  - Richard Stallman started the GNU project
    - Advocates free, open-source UNIX compatible operating system
    - GNU General Public License (GPL) is now a common license under which free software is released

Brief History of OS

- 1990s
  - Linux
    - Developed by a student (Linus Torvalds) in Finland
    - Unix-based
    - Several distributions: SUSE, Fedora, Ubuntu, Redhat ….
    - Open-source operating system under GNU General Public License
  - Windows 95 and MacOS X became mature and complex
- 2000s
  - Mobile devices: Android (based on Linux)
  - Trend is to have a smaller OS (network storage)
  - Virtualization has become common (Vmware Player, VirtualBox etc.)

Reading

- From text book
  - Read 1.1, 1.4-1.10 (OS Structure – Kernel Data Structures)
  - Read 1.12 (Open-Source OS)
  - Read 1.2-1.3 if you want to refresh your Computer Architecture knowledge
- Install the Linux Distribution or Virtual Machine by next PS
- Subscribe to Blackboard Discussion Forum

Acknowledgments

- These slides are adapted from
  - Öznur Özkasap (Koç University)
  - Operating System and Concepts (9th edition) Wiley