MODULE: OPERATING SYSTEMS 1 (2ND YEAR LICENSE– TERM 4)

Course logistics

- 13 weeks on campus class
- Classroom: Amphitheatre A1
- Class meeting: Saturday 08h30 – 10 AM
- Teacher: Dr L. Saadi
- Reception hours: After class or by appointment

About the course:

This course is designed for the second-year students in the fourth term, it's a new course titled "operating systems 1", it is among the basics of computer science because without an operating system there is no functional machine.

After studied algorithms, architectures of computers and the basic of computer language and structures, in this term the students go far in their formation to study the concepts of an operating system; where they need to know the meaning of an OS and its objectives.

Aims and objectives:

The aim of this module is to bring the student closer to the operation of a machine through a set of programs making up the operating system.

Study the principles, algorithms and organization of operating system functionalities. The aim is to identify the common concepts underlying modern systems, such as time-sharing, scheduling, memory and disk management.

Practice all this studies on tow operating systems: **Windows** and **Unix** (Ubuntu).

The students are expected to:

1/ know the position of an operating system in computer science.

2/ know how to create and develop a program from A to Z, and learn what means a process.

3/ study how the process and OS manage the interrupts.

4/ learn how the OS manages the main memory and master the functionalities of the part that responsible of this task.

5/ master the way that the OS schedule the processes.

6/ know how the OS manage the input/output operations.

7/ learn what means file system and management.

8/ *after all that, the students are expected to have a power to analyse and comment what happen in their machines.*

Further Long -term objectives include

1/ The students must be capable to manage their machine and know the origin of all operation and they can explain what happen in the background of the hardware and software they have.

2/ prepare the students to learn more functionalities of the OS like parallelism and distributed OS.

Prerequisites for the course:

The students are required to:

1/ study the concepts of algorithms.

2/ have knowledges in computer architecture.

3/ master the binary language.

4/ program with the C language

Course elements: The course has

1/ one lecture in the week

2/ one tutorial class in the week

3/ and one practical class in the week using the Unix OS Ubuntu.

Attendance policy:

The attendance is important in the lecture class because the information will be very important to follow the tutorial and practical classes with the reason that the handout of the course doesn't contain all details and explanations. Also, there will be some examples and problems done in the lecture class.

Communication protocol:

Students can contact the teacher by her email l.saadi@univ-batna2.dz

Grading and evaluation policy:

This course will be based on the following weightings:

1/ Continuous assessment calculated by formula: **mark of tutorial class /20 + mark of practical class/20**

Mark of tutorial class:

- Application exercises and assignments: 02/ 20
- Classroom presentations: 08/ 20
- Term exam : 10 / 20

Mark of practical class:

- Application exercises and assignments: 02/ 20
- Classroom presentations: 08/ 20
- Term exam : 10 / 20

2/ the final exam /20

Syllabus of the course:

Chapter 1: Introduction to operating systems (definition, features, history, examples)

Chapter 2: Program development (program editing, translation, link editing, loading, ...)

Chapter 3: Additional information on basic mechanisms (units in the processor, registers, addressing modes, interrupts, etc.)

Chapter 4: Central memory management (objectives, different sharing modes, virtual memory, paging, segmentation, etc.)

Chapter 5: Process and processor management (process states, dispatcher, scheduler, scheduling mechanisms, etc.)

Chapter 6: Input/Output management (I/O types, peripheral controllers, I/O control modes, etc.)

Chapter 7: File management system (definition, FMS functions, file management, directory management, etc.)

WEEK	CHAPTER	LESSON	TUTORIAL AND PRACTICAL CLASS
1	Chapter 1 Introduction to operating systems	Introduction; definitions; evolution, …	/
2	Chapter 2: Program development	Editing a program, Translate a program into machine language	/
3	Chapter 2: Program development	Editing links of a program, charging in memory and process concept	Tutorial Serie 1: Exercise 1, 2 Practical class
4	Chapter 3: Additional information on basic mechanisms	Components of the process, Van Neumann architecture, executing instruction, addressing modes	Tutorial Serie 1: Exercise 3, 4 Practical class
5	Chapter 3: Additional information on basic mechanisms	The interrupts → definition, types, concepts, …	Tutorial Serie 1: Exercise 5 Practical class
6	Chapter 4: Central memory management	Memories, definition and objectives of memory management system; different sharing modes	Tutorial Serie 2: Exercise 1 Practical class
7	Chapter 4: Central memory management	Main memory paging	Tutorial Serie 2: Exercise 2, 3

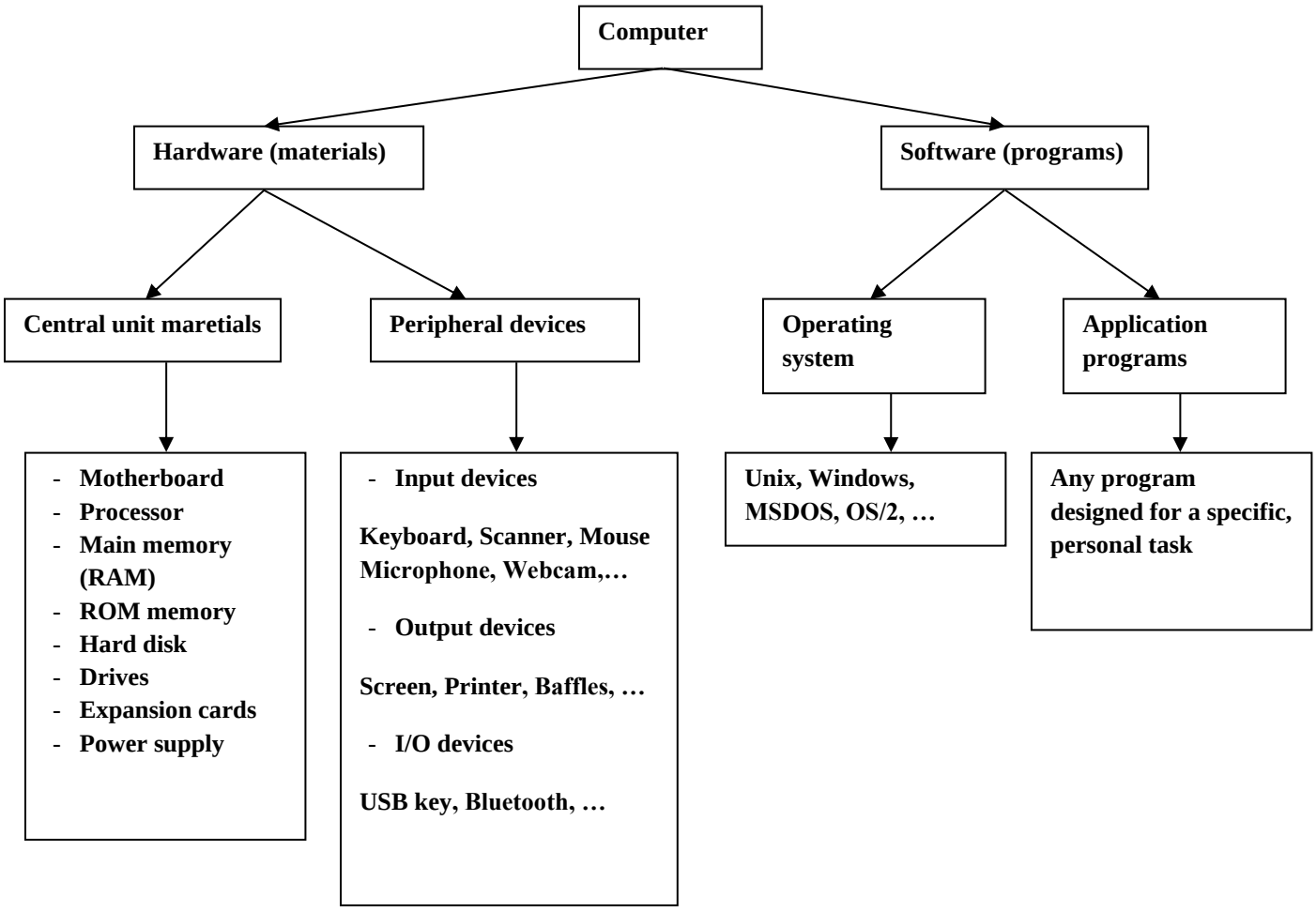
			Practical class
9	Chapter 4: Central memory management	Main memory segmentation, protection in main memory	Tutorial Serie 2: Exercise 4 Practical class
10	Chapter 5: Process and processor management	process states, dispatcher, scheduler, scheduling mechanisms, etc.	Tutorial Serie 2: Exercise 4, 5 Practical class
11	Chapter 6: Input/Output management	I/O types, peripheral controllers, I/O control modes, …	Tutorial Serie 2: Exercise 6 Tutorial Serie 3: Exercise 1, 2 Practical class
12	Chapter 7: File management system	definition, FMS functions, file management, directory management, …	Tutorial Serie 3: Exercise 3 Practical class
13	Summary and answers of questions	//	Tutorial Serie 3: if there is what to add Practical class

CHAPTER I: OPERATING SYSTEMS INTRODUCTION

I/ Introduction:

The designers' aim in creating the first computer was to make human life easier by automating all kinds of tasks. In the 40s, only one group of people designed, built, programmed and used the machine, because of its complexity (in other words, the use of computers was limited to this group). Over the following years, this complexity was gradually reduced, until the 80s, when the computer evolved to become within everyone's reach, while using an intermediary element to perform all tasks. This intermediary between the user and the computer is called the "operating system".

II/ Recall: the computer components



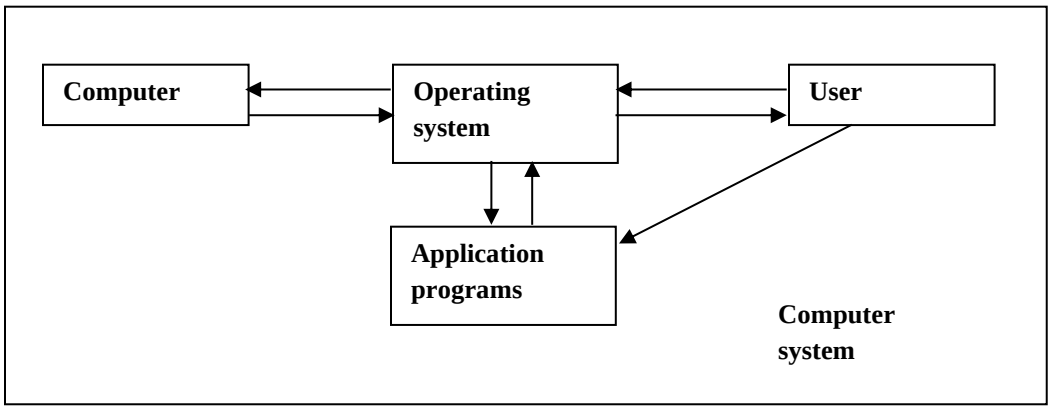
III/ Definition:

We can consider the definitions:

Definition 1: an operating system is the intermediary between the computer and the user.

Definition 2: An operating system is a set of essential programs that manage, control and operate the computer's resources.

Definition 3: an operating system acts as an intermediary between application programs and machine hardware.



Note: a computer system consists of hardware, OS, application programs and users

IV/ Resources managed by the OS:

The operating system manages two categories of resources:

a. Hardware resources: it manages the processor, the memories and I/O devices
b. Software resources: it manages:
   - Application programs
   - Users' data

V/ Operating system functions:

The OS can provide several tasks to ensure user convenience and execution efficiency:

a/ Program execution control:

The system takes charge of controlling the program execution stages (program on disk → loading into main memory → execution on the processor).

This task becomes more difficult when you are in a multitasking environment where you have to decide:

- Which program to run first

- For how long
- Which program to prioritize

b/ Memory management:

The OS needs to share all memory space between programs and data, knowing which spaces are free and which are occupied, in order to facilitate and speed up execution.

c/ Processor management:

The operating system must control the execution of a process at processor level. It must decide on the program scheduling policy during execution, as well as the execution time of each program (especially in time-sharing systems).

It manages status and execution priorities.

d/ Input/Output operations and devices management:

The OS provides I/O request service regardless of the complexity of the device and media used.

e/ File management:

The OS must enable users to access their files via specific operations.

f/ Resource sharing between users:

The operating system allocates each resource to the required user using a predefined policy. It manages access to the resource, as well as its release and recovery.

g/ Protect users from unexpected actions by other users:

Unexpected actions are the result of :

- The use of resources by different users.
- Simultaneous execution of several programs.
- Sharing a computer by several users.
- ….

h/ Hardware/software error detection and recovery:

The OS must be able to detect anomalies, report them and correct them if possible.

i/ Machine virtualization:

The OS must offer the user a virtual (abstract) machine in place of the real (physical) machine. This virtual machine provides the user with a command language (or graphical user interface) better suited to the instructions of the physical machine.

VI/ Operating system classes:

a/ Industrial process-oriented system:

This type of system is designed to control an industrial process, and to achieve this goal, the system must be able to perform the following additional functions:

- Regulation: maintaining operating parameters (temperature, flow, pressure, etc.) at the values required for production to run smoothly.
- Recording: periodically record the values of operating parameters, in order to keep track of the history, which can be used in studies targeting production improvement.
- Safety: to avoid disasters if certain parameters exceed their correct values. The system must be equipped with a safety function capable of stopping the entire process in the event of failure.

b/ Transaction-oriented system:

This category of system is designed to store and manage large volumes of information (databases), such as Air Algérie's reservation system or the CCP. The functions performed by this system are:

- Interactive transaction execution: a set of indivisible operations executed on databases.
- Competition management: information in databases is shared between different users, who can access it simultaneously. The role of this function is to manage access conflicts between users.

c/ Program creation and execution-oriented system:

This category of system allows users to create and run their own programs.

VII/ History and evolution of OS:

a/ Fully sequential systems (1950-1960):

Operating systems during this period were based on the working principle of running a single program at a time:

- Stand-alone programs: Initially, computer peripherals consisted of a card reader, a card punch and a printer. From the user's point of view, operation was fairly straightforward, since program execution involved placing a packet containing the "binary" form of the program, followed by the data, into the card reader. Once the program had been read, the computer would execute it, with the results in the form of a packet of punched cards, or printed lines.
- The job sequence monitor (1955): the user prepares a deck of cards representing his job, consisting of one or more steps. Each step corresponds to a program whose execution is requested by the user on a particular data set. This program may be one of the utilities stored on tape, such as a compiler, or the result of a previous step temporarily stored on tape.

b/ Systems introducing parallelism (1960-1965):

The most popular systems at the time were multi-programming systems, whose principle was to keep several jobs ready to run in memory and share resources between them. The processor is initially allocated to one job and the rest are in memory; as soon as the job performs an I/O, the processor is allocated to the next job.

c/ Time sharing systems (1965):

The processor in these systems is switched to the next process each time a Q (Quantum Time) delay expires.

c/ Real time systems:

These are specialized systems dedicated to specific applications, in particular control systems. They are used when there are response time requirements.

d/ Parallel systems:

These are highly coupled systems with more than one processor sharing the clock and memory.

e/ Distributed systems:

They are systems that use several processors, not necessarily identical, each with its own memory.

f/ Embedded systems:

Are systems for mobile terminals.

VIII/ Examples of OS:

Several operating system variants have appeared since the 50s, the most famous of which are:

1/ MS-DOS: Microsoft Disk Operating system

It's a single-user system, known since the early '80s, designed for microcomputers (the first IBM-PC 8088), conceived by Bill Gates and now associated with Windows.

2/ Windows Operating system

A system designed by Microsoft with a graphical interface, its name refers to the use of a window for each execution. It is designed for several architectures (PC, workstation, laptop, client/server network, etc.).

It has gone through several versions, as for PC: 1.0, 2.0, 3.10, 3.11, 9x, 2000, Me, XP, Vista, Seven, 10, 11, also: Windows Server, NT for multi-user and client/server architecture.

3/ UNIX Operating system: Uniplexed Information and Computer Service

A family of time-sharing systems proposed for most architectures, used in certain industrial and research environments.

4/ Android operating system:

The Android operating system is a mobile operating system that was developed by Google (GOOGL) to be primarily used for touchscreen devices, cell phones, and tablets. Its design lets users manipulate the mobile devices intuitively, with finger movements that mirror common motions, such as pinching, swiping, and tapping. Google also employs Android software in televisions, cars, …

5/ IOS operating system:

IOS stands for iPhone operating system. It is a proprietary mobile operating system of Apple for its handheld. It supports Objective-C, C, C++, and Swift programming languages. It is based on the Macintosh OS X. After Android, it is the world's second most popular mobile operating system. Many of Apple's mobile devices, including the iPhone, iPad, and iPod, run on this operating system. To control the device, iOS employs a multi-touch interface, such as sliding your finger across the screen to advance to the next page or pinching your fingers to zoom in or out of the screen.

APPENDIX:

1/ Central unit:

Motherboard: This is an electronic board that connects all the PC's components and enables the flow of information.

Processor: This is the brain of the machine, executing all the operations requested and providing the expected responses.

Random Access Memory RAM: This is the processor's working area, where the information needed for processing is stored. It's a volatile memory that's erased whenever there's a power cut.

Hard disk: This is where information is stored; it's a permanent memory.

CD/DVD and floppy disk drives: These drives provide access to external disks (floppy disk, DVD and CD-ROM).

Expansion cards: These are cards that are added to the motherboard to provide other functions not available on the motherboard (e.g. network card, sound card, graphics card, etc.).

2/ Peripheral devices:

Input devices:

These are the elements of the PC, such as: keyboard, mouse, scanner, modem...etc. used to enter data.

Output devices:

These are the elements of the PC that allow information to be output, such as: screen, printer, speakers...

Input/output devices:

These are the elements of the PC that enable information to be input and output, such as USB keys, digital cameras and scanner printers,