Course Outline	
COMP6153 Operating System (2/2)	**Study Program** Computer Science
Effective Date 01 September 2018	**Revision** 3

1. Course Description

This course explains the basic concepts of the Operating System taking examples from the two most commonly used Operating Systems, UNIX and Windows, and discusses the fundamentals of Operating System design in each of the main components of the Operating Systems, i.e. Process Management, Memory Management, I/O Management and File Management. It is recommended for students to have knowledge on C programming language

2. Graduate Competency

Each course in the study program contributes to the graduate competencies that are divided into employability and entrepreneurial skills and study program specific outcomes, in which students need to have demonstrated by the time they complete their course.

BINUS University employability and entrepreneurial skills consist of planning and organizing, problem solving and decision making, self management, team work, communication, and initiative and enterprise.

Employability and Entrepreneurial Skills

Aspect	Key Behaviour

Study Program Specific Outcomes

Study Program Specific Outcomes

3. Topics

- Linux Shell Commands
- FIle Permissions,Redirection and pipes
- Process Management
- Java Programming 1
- Java Programming 2
- Quiz
- Introduction to Nachos
- Nachos Machine
- Process and thread Sheduling
- User Level Process
- Nachos Memory Management
- Final Quiz
- Operating Systems Overview
- Process
- Multiprocessor and Embedded System
- Threads
- Scheduling
- Concurrency
- Deadlock
- File Management
- I/O Management

- Memory Management
- Virtual Memory
- Security
- Study Case

4. Learning Outcomes

On successful completion of this course, student will be able to:

- LO 1: Describe each of the components of the Operating Systems and their interrelationship
- LO 2: Demonstrate different techniques of the design of the Operating System
- LO 3: Relate the fundamental design to the current development of Operating System
- LO 4: Demonstrate the skills in programming to write user programs to interact with the operating system

5. Teaching And Learning Strategies

In this course, the lecturers might deploy several teaching learning strategis, including Lecture, Class discussion, Question and Answer, Demonstrate methods or procedures, Demonstrate problem-solving through scenarios, Hands-on Practice, Discussing the cases, Exercise and solve problem with students, Laboratory Experiments, Problem Solving, Case Study.

6. Textbooks and Other Resources

Textbooks

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne . (2012). ***Operating System Concepts .*** 9. Wiley & Sons. USA. ISBN: 978-1118063330 .
2. Andrew S. Tanenbaum and Herbert Bos. (2015). ***Modern Operating System.*** 4. Pearson Education. New Jersey. ISBN: 978-0-13-35916 .
3. William Stallings . (2015). ***Operating systems : internals design principles .*** 08. Pearson Education Limited . England . ISBN: 9781292061351 .

The book in the first list is a must to have for each student.

Other Resources

1. null
2. Case Study
3. Clock Algorithm
4. Concurrency
5. Deadlock
6. File Management
7. http://sce.uhcl.edu/helm/rationalunifiedprocess/process/workflow/ana_desi/co_cncry.htm
8. http://www.cs.ucsb.edu/~rich/class/cs170/notes/Security/
9. http://www.cse.unsw.edu.au/~cs9242/12/lectures/10-multiproc-4up.pdf
10. http://www.itrelease.com/2017/11/deadlock-avoidance-operating-system/
11. https://study.com/academy/lesson/threads-in-an-operating-systems-definition-examples.html
12. https://web.cs.wpi.edu/~cs3013/c07/lectures/Section01-Overview.pdf
13. https://www.androidauthority.com/reduce-ram-usage-android-869298/
14. https://www.cs.uic.edu/~jbell/CourseNotes/OperatingSystems/3_Processes.html
15. https://www.includehelp.com/operating-systems/file-management-in-operating-system.aspx
16. https://www.includehelp.com/operating-systems/process-scheduling-in-operating-system.aspx
17. https://www.tutorialspoint.com/operating_system/os_io_software.htm
18. https://www.tutorialspoint.com/operating_system/os_memory_management.htm

19. https://www.tutorialspoint.com/operating_system/os_virtual_memory.htm
20. I/O Management
21. Memory Management
22. Multi Processor
23. Operating systems : internals design principles
24. Overview
25. Process
26. Round Robin Scheduling
27. Scheduling
28. Security
29. Threads
30. Virtual Memory

7. Schedule

Laboratory

Session/Mode	Related LO	Topics	References
1 F2F	LO 1 LO 4	Linux Shell Commands − Computer Overview − Folders on Linux − Grep and Find	− Operating systems : internals design principles
2 F2F	LO 4	FIle Permissions,Redirection and pipes − Operating System Overview − Pipes and Redirection	− Operating systems : internals design principles
3 F2F	LO 4	Process Management − Background and Foreground Process − Parent and Child Process − Process Management	− Operating systems : internals design principles
4 F2F	LO 4	Java Programming 1 − Java Part 1	null
5 F2F	LO 4	Java Programming 2 − Java Part 2	null
6 F2F	LO 1 LO 4	Quiz − Quiz 1	null
7 F2F	LO 2 LO 4	Introduction to Nachos − Cross compiler Installation − Nachos Installation − Nachos Source Packages − Using Eclipse with Nachos	null

8 F2F	LO 2 LO 4	Nachos Machine − Boot Process − Interrupt Manageent − Network Link − Processor − Serial Console	null
9 F2F	LO 2 LO 3 LO 4	Process and thread Sheduling − KThread and Nachos Thread Life cycle − Scheduler	null
10 F2F	LO 2 LO 4	User Level Process − Developing and compilingUser programs − Loading COFF Binaries − System Calls and Exception Handling − Timer − User threads	null
11 F2F	LO 2 LO 3 LO 4	Nachos Memory Management − Address translation − Memory Allocation − Review	null
12 F2F	LO 1 LO 2 LO 3 LO 4	Final Quiz − All topic	null

Lecture

Session/Mode	Related LO	Topics	References
1 F2F	LO 1 LO 2	Operating Systems Overview − Advances in Modern O/S − Evolution of O/S − Hardware Review − O/S Objecties − System Calls	− Overview − Operating systems : internals design principles − Clock Algorithm − Round Robin Scheduling
2 F2F	LO 2 LO 4	Process − Creation and Termincation of Process − PCB − Process Management System Calls − Process State	− Process − Operating systems : internals design principles
3 F2F	LO 1 LO 2 LO 3	Multiprocessor and Embedded System − Characteristic of Embedded System − Introduction − Purpose of Embedded System − Synchronization	− Multi Processor − Operating systems : internals design principles

4 F2F	LO 2 LO 3 LO 4	Threads − Benefits of threads − Thread Basics − Thread Implementation − Thread Model − Thread Programming	− Threads − Operating systems : internals design principles
5 F2F	LO 2 LO 3	Scheduling − Goals of Scheduling − Process Behavior − Scheduling Algorithm − Threa Scheduling	− Scheduling − Operating systems : internals design principles
6 F2F	LO 2 LO 3	− Concurrency − Mutual Exclusion − Problems in Concurrency − Semaphores	null
7 F2F	LO 1 LO 2 LO 3 LO 4	− Deadlock − Banker's Algorithm − Conditions to Deadlock − Introduction − Strategies Handling Deadlock	− Deadlock − Operating systems : internals design principles
8 F2F	LO 1 LO 2 LO 3	File Management − Directories − FIle Allocation Method − File Concepts − FIle MAnagement System − File Structure	− File Management − Operating systems : internals design principles
9 GSLC	LO 2 LO 3	I/O Management − Design Issues − Disk Arm Scheduling − Disk Management − I/O Device − RAID Configuration	− I/O Management − Operating systems : internals design principles
10 F2F	LO 2 LO 3	Memory Management − Addressing − Memory Allocation Algorithm − Memory Management Implementation − Memory Management Requirements	− Memory Management − Operating systems : internals design − principles
11 F2F	LO 1 LO 2 LO 3	Virtual Memory − Paging − Segmentation	− Virtual Memory − Operating systems : internals design principles
12 F2F	LO 1 LO 2 LO 3	Security − Access Control − Authentication	− Security − Operating systems : internals design

	LO 4	− Intruders − Malicious Programs − System Access Threads	− principles
13 F2F	LO 2 LO 3	Study Case − Architecture − Concurrency Mechanism − File System − Memory Mnaagement − Process and Threads − Scheduling	− Case Study − Operating systems : internals design principles

8. Evaluation

Laboratory

Assessment Activity	LO			
	1	2	3	4
ASSIGNMENT	✓	✓	✓	✓
FINAL EXAM	✓	✓	✓	✓
MID EXAM	✓	✓	✓	✓

Lecture

Assessment Activity	LO			
	1	2	3	4
ASSIGNMENT	✓	✓	✓	✓
FINAL EXAM	✓	✓	✓	✓
MID EXAM	✓	✓	✓	✓

Final Evaluation Score

Aspects	Weight
Practicum	30%
Theory	70%

9. Assessment Rubric (Study Program Specific Outcomes)

LO	Indicators	Proficiency Level			
		Excellent (85 - 100)	**Good (75 - 84)**	**Average (65 - 74)**	**Poor (<= 64)**
LO 1	1.1. Ability to identify and describe the basic elements of a computer system	At least 90% of the basic elements in a computer system is identified and described correctly.	At least 75% of the basic elements in a computer system is identified and described correctly.	At least 60% of the basic elements in a computer system is identified and described correctly.	Less than 60% of the basic elements in a computer system is identified and described correctly.
	1.2. Ability to describe the interrelationships of the components in a computer system	The interrelationship of all the components in a computer system is described with at least 90% correct.	The interrelationship of all the components in a computer system is described with at least 75% correct.	The interrelationship of all the components in a computer system is described with at least 60% correct.	The interrelationship of all the components in a computer system is described less than 60% correct.
LO 2	2.1. Ability to explain different operating systems design strategies	At least 90% of the operating systems design strategies is explained	At least 75% of the operating systems design strategies is explained	At least 60% of the operating systems design strategies is explained	Less than 60% of the operating systems design strategies is explained
	2.2. Ability to apply the design strategy of the operating system that is used to measure the performance of the operating system	Ability apply the design strategy of the operating system that is used to measure the performance of the operating system and fully analyse and compare the different strategies	Ability apply the design strategy of the operating system that is used to measure the performance of the operating system and compare the different strategies	Ability apply the design strategy of the operating system that is used to measure the performance of the operating system however no capability to analyse and compare	Ability to only describe the design strategy of the operating system that is used to measure the performance of the operating system.
LO 3	3.1. Ability to relate the fundamental design of the operating system to the current development of Operating System	Ability to relate the fundamental design of the operating system to all of the current development of different operating system	Ability to relate the fundamental design of the operating system to in some of the current development of operating system	Ability to explain the fundamental design of the operating system and the current development of different operating system	Ability to describe the fundamental design of the operating system to the current development of different operating system

	3.2. Ability to analyze the application of the fundamental design of the operating system in the current development of Operating System	Ability to analyze at least 90% of the application of the fundamental design of the operating system to all of the current development of different operating system	Ability to analyze at least 75% of the application of the fundamental design of the operating system to all of the current development of different operating system	Ability to analyze at least 60% of the application of the fundamental design of the operating system to all of the current development of different operating system	Ability to analyze less than 60% of the application of the fundamental design of the operating system to all of the current development of different operating system
LO 4	4.1. Ability to write programs programming language using low- level system calls	Correct and appropriate use of all system calls related to computer and the interaction with the user	Correct and appropriate use of several system calls related to computer and the interaction with the user	Incorrect use of several system calls related to computer and the interaction with the user	Inability to write program using the system calls related to computer and the interaction with the user
	4.2. Ability to solve practical operating systems related problems using any programming language	Correct application of the system calls and effectively solving at least 90% of the problems related to operating systems	Correct application of the system calls and solving at least 75% of the problem related to operating systems	Correct application of the system calls and solving at least 60% of the problem related to operating systems	Incorrect application of the system calls and less than 60% capability of solving problems related to operating system

Prepared by	Checked by
D2632 - Zulfany Erlisa Rasjid, B.Sc., MMSI.	**D2632 - Zulfany Erlisa Rasjid, B.Sc., MMSI.** **Subject Content Specialist**
Approved by	Acknowledged by
D5068 - Azani Cempaka Sari, S.Kom., M.T.I. **Subject Content Coordinator**	**D3690 - Derwin Suhartono, S.Kom., M.T.I.** **Head of Program – Computer Science**