

Operating Systems and Networks

| | Prerequisites: | Familiarity with the use of a computer, basic notions of programming in a C-like language (can be learnt in parallel during the first weeks of the semester) | | | |
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| | Learning outcomes: | Students know and understand the purpose and the architecture of an operating system, and in particular memory and tasks management; they are able to install an OS; they know, can apply and program shell commands for Linux and Windows OS ; they understand multitasking and concurrent programming and can analyze and write small concurrent programs in C or Java. As a result of discipline studying students should to know: the basic concepts and definitions of the theory of networks; bases of construction LAN and WAN networks; descriptions of routing protocols. Students should to be able: to make diagnostics of network malfunctions; to carry out a choice of the necessary equipment for networks; to have an idea: about methods of network design; about existing protocols and their features; about optimization ways of networks. | | | |
| № | Lecture | Hours | Laboratory works | | Ref |
| | | | Content | Hours | |
| 1. | Introduction to Operating systems, general architecture and organization | | | | |
| | Definitions, main functions, role of the OS, types and characteristics of an OS, general organization (software layers), command language; organization of a mono-user OS and of a multi-user OS. | 2 h | | | [2] |
| 2. | The Windows Operating System | | | | |
| | Short history of Windows, general architecture, software configuration, registry, main administration tools; the boot process, the Windows file system: directories hierarchy, files, pathnames, home directory, basic shell commands. | 2 h | Familiarization with Windows OS: configuration files, registry, administrations tools (computer manager, users' manager, events observer, etc.), file system: basic commands. | 2 h | [1] |
| 3. | The Windows command language and scripts programming | | | | |
| | The Windows command language: files and directory manipulation advanced, pipes and input/output redirection, OS variables, disks manipulation, system commands, command files, the scripting language, examples of command files. | 2 h | Familiarization with the Windows command language, simple and more advanced command files (programming exercises). | 2 h | [1] |
| 4. | The Linux Operating System | | | | |
| | General Linux architecture and characteristics, the Linux file system, pathnames, home directory, configuration files and configuration principles, shells, basic shell commands, rights ; processes: task definition, the Linux boot process, process creation, commands for process creation and management. | 2 h | Installation and configuration of a Linux Workstation, familiarization with the basic shell commands. | 2 h | [3] |
| 5. | The Linux command language (shell) and scripts programming | | | | |
| | Shell, environment variables, compound commands, the scripting language, conditional and iterative instructions, functions and procedures, useful commands for programming. | 2 h | Linux shell commands and Shell files programming. | 2 h | [2] [3] |

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| 6. | Execution Mechanisms - Introduction to resources management | | | | |
| | Process memory organization, procedure call mechanisms (stack, coroutines), asynchronous activity (interruptions, rerouting, supervisor call), context commutation, multi-task mechanisms, dynamic task creation (fork, exec), | 2 h | Process management by Linux shell commands, process management by programming: study of examples of small programs using fork. | 2 h | [2] |
| 7. | Execution Mechanisms - Introduction to resources management | | | | |
| | Processor management strategies (scheduler) - Resource notion, resource share, mutual exclusion, active waiting. | 2 h | Programming similar applications, programming applications using fork and exec. | 2 h | [2] |
| 8. | Mutual Exclusion - Tasks Synchronization | | | | |
| | Programming tools for mutual exclusion : locks, semaphores, deadlock - Synchronization : general principle, synchronization by events, monitors, the producer/consumer example, the dining philosophers problem, tubes communication. | 2 h | Study and writing small applications doing synchronization between tasks (Unix) - Tubes programming in C language (small programs), Unix. | 2 h | [2] |
| | Total hours for Operating Systems : 30 h | 16 h | | 14 h | |

Networks

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|------------|--|-------------|---|-------------|---------------|
| 9. | Introduction to network concepts | | | | |
| | Definition of a communications network. Concept of a node; nodes connected by links to form networks. Types of networks : LAN, WAN, other Area Networks and Internetworks. Active and passive equipments. Common networking standards and popular networking protocols. | 2 h | | 2 h | [4], [9] |
| 10. | OSI Transport Layer. OSI Network Layer. Addressing the Network – IPv4 | | | | |
| | Roles of the Transport Layer. The TCP Protocol – Communicating with Reliability. Managing TCP Sessions. The UDP Protocol – Communicating with Low Overhead. IPv4, Networks – Dividing Hosts into Groups. Routing – How Our Data Packets are Handled. Routing Processes: How Routes are Learned. Overview of IPv6 | 2 h | IPv4 Addresses. Addresses for Different Purposes. Assigning Addresses. Calculating Addresses. Testing the Network Layer. | 2 h | [5], [6], [9] |
| 11. | Data Link Layer. OSI Physical Layer. Ethernet | | | | |
| | Data Link layer – Accessing the Media. Media Access Control Techniques. Media Access Control Addressing and Framing Data. Putting it All Together. The Physical Layer – Communication Signals. Physical Signaling and Encoding: Representing Bits. Physical Media – Connecting Communication. | 2 h | Overview of Ethernet. Ethernet – Communication through the LAN. The Ethernet Frame. Ethernet Media Access Control. Ethernet Physical Layer. Hubs and Switches. Address Resolution protocol (ARP). | 2 h | [5], [8] |
| 12. | Introduction to Routing and Packet Forwarding. Static Routing. Introduction to Dynamic Routing Protocols | | | | |
| | Inside the Router. Configuration and Addressing. Building the Routing Table. Path determination and Switching Functions. Routes and Network. Router Configuration review. Exploring Directly Connected Networks. Static Routes with “Next Hop” Addresses. Static Routes with exit Interfaces. Summary and Default Static Routes. Managing and Troubleshooting Static Routes. | 2 h | Introduction and Advantages. Classifying Dynamic Routing Protocols. Metrics. Administrative Distances. | 2 h | [7], [8] |
| 13. | Planning and Cabling Networks. Configuring and Testing the Network | | | | |
| | LANs – making the Physical Connection. Device Interconnections. Developing an Addressing Scheme. Calculating the Subnets. | 2 h | vmware/virtualPC labs on “configuring IP in Windows and/or GNU/Linux OS” (e.g. configurations with single subnet (2 virtual computers and routed subnets : 3 virtual computers one of them is router) | 2 h | [6], [8] |
| 14. | Network security basics | | | | |
| | Risk management, network security policy and security architecture. Attack and intrusion techniques. Firewall concepts, types, topology and the firewall's relationship to the TCP/IP protocol. | 2 h | Setting up a firewall NAT using IPTables. | 2 h | |
| 15. | Network security basics | | | | |
| | Introduction to network programming API with Java or C language (sockets) | 2 h | Examples of network programming. Programming a generic client. Programming un simple server (for example an echo server) | 4 h | |
| | TOTAL for Networks | 30 h | | 16 h | |

References

1. Charlie Russel and Sharon Crowford, Microsoft Windows XP Professional Resource Kit, Third Edition, 1568 pages, Microsoft Press, March 2005
2. Andrew S. Tanenbaum and Albert S. Woodhull, Operating Systems Design and Implementation (3rd Edition), 1080 pages, Prentice Hall Software series, January 2006, ISBN-13: 978-0131429383
3. Mark G. Sobell, A Practical Guide to Linux(R) Commands, Editors, and Shell Programming, 1008 pages, Prentice Hall PTR, July 2005, ISBN-13: 978-0131478237
4. Douglas Comer. Internetworking with TCP/IP Vol.1: Principles, Protocols, and Architecture (4th Edition).
5. Douglas E. Comer, Ralph E. Droms. Computer Networks and Internets, with Internet Applications (3rd Edition).
6. Behrouz A. Forouzan, Catherine Ann Coombs, Sophia Chung Fegan. Data Communications and Networking 2/e Update.
7. Andrew S. Tanenbaum. Computer Networks.
8. Wendell Odom. CCNA 640-802 Exam Certification Library, Simulator Edition. Cisco Press; 1 Pap/Cdr/ edition (January 9, 2010)
9. Todd Lammle. CCNA Portable Command Guide (2nd Edition). Sybex; 6 edition (February 3, 2009)

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