Computer Networks Architecture and Operating Systems

Course Syllabus

Ver. 03.09.2024

ISMA University
Riga, Latvia

2024

Contact Information

Instructor: Assoc.Prof. Yuriy Shamshin

Communication e-mail: Yuriy.Shamshin@isma.lv

Course duration, hours: 2h x 30 = 60h, 4 points

Course additional websites https://sys.academy.lv/ and https://net.academy.lv/ contains:

- LS - lecture slides,
- LV - lesson videos,
- PW - trainings and practice work assignments,
- LW - lab work assignments,
- SW - online tools and software,
- BK – reading books, links to the frequently websites,
- QZ - tests and quizzes.

Objectives

The objectives of this course are to introduce the fundamental concepts, structure and components of the:

- modern operating systems (UNIX, Linux, MacOS, Android, iOS, Windows), to give your competency as a beginning user of Unix/Linux not only Windows;
- computer networking, to overview selected protocols associated with the Application, Transport, Network, Link, and Physical Layers of the OSI Reference Model and to show how these protocols are organized to produce computer networks;

After completing the course, you will be able to use remote terminals to perform routine administrative tasks to automate monitoring and management of various network devices and information systems running on Linux and Windows OS.

Prerequisites and Required Skills

The course does not assume prior knowledge of networking. However, the course will move relatively fast.

Expected Skills: The course is not suited for students without basic mathematic & computing skills.

Teachings Philosophy

- Emphasis on building stuff that works: Practical skills.
- Lateness policy is designed to encourage success rather than timeliness, but we have to find a balance.
- Grading is mostly on functionality, though there is a role for clarity, modularity, efficiency and style.
- Readings are important to make our class time more effective and to gain confidence about learning from tutorials, references and so forth.
- Classwork gives you a chance to make mistakes with support
- LW & PW Assignments integrate several skills and go beyond Classwork

Reading supports Classwork which supports PW Assignments which supports the LW Assignments.

Honor Code

Unless otherwise instructed, feel free to discuss problem sets with other students and exchange ideas about how to solve them. However, there is a thin line between collaboration and plagiarizing the work of others. Therefore, I *require that you must compose your own solution* to each assignment. In particular, while you may discuss problems with your classmates, *you must always write up your own solutions from scratch*.

Reading Books

Operating Systems: Principles and Practice by Thomas Anderson and Michael Dahlin (2014).
Computer Networks by Andrew S. Tanenbaum and David J. Wetherall (2016).

Optional Books

SYS
BK-01EN. W. Stollings. Computer Organization and Architecture, 10th Edition. 2016 [PDF].
BK-02EN. A. Silberschatz, P. Galvin, G. Gagne. Operating System Concepts, 9th.ed. 2012 [PDF].
BK-03EN. Modern Operating Systems, 4th.ed. 2015, A. Tanenbaum, H. Bos [PDF].
BK-04ENa. Windows Internals. Part I, 7th.ed. 2017, M. Russinovich, D. Solomon, A. Ionescu [PDF].
BK-04ENb. Windows Internals. Part II, 6th.ed. 2015, M. Russinovich, D. Solomon, A. Ionescu [PDF].
BK-05EN. Linux Fundamentals. A Training Manual 2003 - Philip Carinhas [PDF].
BK-06EN. GeeksforGeeks. Operating System Tutorial [Online].

NET
BK-01EN. IBM RedBooks. TCP/IP Tutorial and Technical Overview. 2006 [PDF], [Online], [EPUB], [Google Books].
BK-02EN. Forouzan. Data Communication and Networking, 5th.ed. 2012 [PDF], [Online].
BK-03EN. Tanenbaum. Computer Networks 5th.ed. 2011 [PDF], [Online].
BK-04EN. GeeksforGeeks. Computer Network Tutorial. [Online].

Road Map

* - optional elements

SYS Lectures, Lab Works Schedule and Reading Topics

Weeks	Chapters	Slides	Topics	Reading	Labs (*Optional)
01	I. OS Overview	LS-00 LS-01	Course Introduction. OS Evolution, Definition, Types.	 BK-01, Ch.01	
02		LS-02	OS Concepts, Architectures, Structures.	BK-01, Ch.02	LW-01. Computing Basis's.
03	II. Storage Management	LS-03 LS-04	OS Booting. Mass-Storage Structure. File System Interface.	BK-01, Ch.10	*LW-02. Installing Virtual Machines for Oracle VirtualBox. *LW-03. Using ssh/rdp for remote Linux / Mac / Windows servers management.
04		LS-05 LS-06	File System Implementation. File Systems Examples.	BK-01, Ch.11 BK-01, Ch.12	LW-04. Linux/UNIX Command Line Basics.
05	III. Security Management	LS-07 LS-08	OS Protection Models. Managing User Accounts on Linux.	BK-01, Ch.14	*LW-05. Linux/UNIX Shell Environment Variables.
06		LS-09	OS Permissions. SUID/SGID/Sticky. Extended Attributes.	BK-01, Ch.15	LW-07. Linux/UNIX Permissions. SUID/SGID/Sticky Bits.
07	IV. Process Management	LS-10	Processes & Threads. OS Examples. CPU Scheduling.	BK-01, Ch.03 BK-01, Ch.06	LW-06. Linux/UNIX Shell. Files Globbing & Streams Redirection.
08	V. Distributed & Embedded Systems	LS-11	Distributed File Systems. Embedded Operating Systems	BK-01, Ch.17	LW-08. Linux/UNIX Regular Expressions and Filters. *LW-09. Shell scripting.

NET Lectures, Lab Works Schedule and Reading Topics

Week	Chapters	Slides	Topics	Reading	Labs, Practices, Quizzes (*Optional)
9	I. Overview OSI/RM & TCP/IP	LS-01 LS-02	Networking Standards and the OSI Model. Review of Important Networking Concepts.	IBM Redbook, Chapter 1	*LW-11. Wireshark. Introduction.
10	II. Physical Layer and Media	LS-03 LS-04a LS-04b	Network Classification. Topology, Hardware, Transmission Media. Data Communications. Line Coding. Block Coding. Scrambling.	IBM Redbook, Chapter 2.1	LW-13. Line & Block Coding Schemes.
11	III. Data Link Layer	LS-05 LS-06	Introduction and Services. Error Detection & Correction. Multiple Access.	IBM Redbook, Chapter 2.4	
12		LS-07	EUI/MAC, ARP, Ethernet, VLANs.		
13	IV. Network Layer I	LS-08 LS-09	IP - Internet Protocol. IP Addressing. Subnetting, Supernetting. IPv6 Addressing.	IBM Redbook, Chapter 3.1,3.4	LW-15. IPv4 Sub/Super-netting (Classes, CIDR, VLSM).
14		LS-10	ICMP - Internet Control Message Protocol.	IBM Redbook, Chapter 3.2	
15	V. Transport Layer	LS-11	TCP and UDP.	IBM Redbook, Chapters5.1,5.2	*LW-16. Wireshark. Network Traffic Capture and Analyse.
16	VI. Network Layer II	LS-12 LS-13	IP Forwarding. AS. Static Routing. Dynamic Routing DVA. RIP.	IBM Redbook, Chapters4.1,4.3	
17		LS-14	Dynamic Routing LSA. OSPF, AS, BGP.	IBM Redbook, Chapter 4.4	LW-19. Dynamic Routing LSA.
18		LS-15	IP Multicasting. IGMP, PIM.		
19	VII. *Application Layer	LS-16 LS-18	DNS. SMTP, POP, IMAP.		
20	VIII. *Networks Administration & Security	LS-19 LS-20 LS-21	Monitoring & Diagnostic. SNMP, MIB, OIDs. Spam and Phishing. TCP/IP Security		*LW-20. Mail Spam: telnet-smtp.
21	IX. *Modern Networks Solutions	LS-22	Internet of Things.		
	Final Subject Grade	All bellow	Exam	All below Chapter	All below assignments Reports

Course Grading Policy

Course activity:	Cost, %
Interactive participation in Classroom or via BBB	5%
SYS Lab Works Reports	25%
LW01 5%, LW04 5%, LW06 5%, LW07 5%, LW08 5%.	
NET Lab Works Reports	30%
LW-13 10%, LW-15 10%, LW-19 10%.	
____ * Optional LW	
Final Exam	40%
SYS Test=10%, SYS Task=10%, NET Test=10%, NET Task=10%,	
==========	
Final Grade SUM	100%

Your Skills after Course

SYS

1. Introduction to Linux/UNIX Philosophy
2. Positional Number Systems & Binary Operations Understanding
3. Getting Access to a Remote Linux/UNIX/Mac/Windows Systems
4. Installing VirtualBox on Windows and Mac
5. Installing Linux/Windows Virtual Machine on VirtualBox
6. Learn Linux/UNIX Directory Structure
7. Basic Shell and Linux/UNIX Commands
8. Linux Package Management
9. Working with Directories and Files
10. OS File and Directory Permissions Understanding
11. Finding Files and Directories, Wildcards, Files Globing
12. Understanding Basic & Extended Regular Expressions
13. Working with Linux/UNIX Filters utilities
14. Stream redirection
15. User and Group Management Conception (DAC, MAC, RBAC, ABAC Access Models)
16. File and Directory Extended Attributes Understanding (xattr)
17. Managing Linux/UNIX Processes and Jobs
18. At and Cron Scheduling of Tasks
19. *Shell Scripting to Automate of System Tasks

NET

Concept of Layering

- Basics of Computer Networks,
- Concept of Layering

Flow & Error Control

- Flow and error control techniques,
- Switching

LAN

- LAN technologies,
- Ethernet, WiFi

IP

- Classful and Classless IP Addressing,
- Subnetting, Supernetting,
- IPv4 and IPv6
- ICMP

TCP and UDP

- TCP, UDP and sockets, congestion control

Routing Algorithms

- IP Forwarding. AS. Static Routing,
- Routers and routing algorithms (distance vector, link state)
- RIP, OSPF, BGP,
- Multicasting

Application Layer Protocols*

- Application layer protocols (DNS, SMTP, POP, FTP, HTTP)

Network Security*

- authentication,
- basics of public key and private key cryptography,
- firewalls.

Network Administration*

- Diagnostic & Monitoring (SNMP, MIB, OIDs)

After this Course You can complete Basic exam preparation for:

RedHat Certified System Administrator / Engineer (RHCSA/RHCE),
Linux Foundation Certified System Administrator / Engineer (LFCS/LFCE),
Linux Professional Institute Certified Linux Administrator / Engineer / Enterprise (LPIC-1/LPIC-2/LPIC-3),
CompTIA Network+ Certification (https://www.comptia.org/certifications/network).