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# Operating Systems

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# Content I

1. Interfaces of OS. Resources & Operations
2. Structure of OS. Kernel & Processes
3. Overall organization of OS Linux. GUI
4. CLI. Work with files
5. Processes. Conveyers and filters
6. Programming in Shell Language
7. Networking with Linux

# Content II

- 8. Compiling Linux kernel. Kernel modules
- 9. Processes control
- 10. Communication of processes
- 11. Memory control. Partitions. Caching
- 12. Virtual memory: pages & segments
- 13. Devices control. Drivers. Buffering
- 14. Information control. File system
- 15. Security of operating systems

A first pass - roughly

# Interfaces of OS. Resources & Operations

- Definition of Operating System
- Interfaces of OS and their implementation
- Graphical User Interface (GUI) and Command Line Interface (CLI)
- Interfaces with hardware: i/o ports and interrupts
- Implementation of system calls
- Resources: processor, memory, devices, information
- Operations: allocation, deallocation, tracking, scheduling (planning)
- Formula of OS: 4x4

# Structure of OS. Kernel & Processes

- Kernel and its structure
- System processes
- User processes
- Data base of OS: lists of control blocks
- Multiprogramming & time slicing
- Batch and interactive modes
- Security of OS
- Virtual resources and machines
- Overview of modern hardware platforms & OC

# Overall organization of OS Linux. GUI

- History notes: Unix & Linux
- Boot loader and booting process
- Daemons. Init
- Username and password
- Terminals & shells
- Xwindow, KDE, Gnome
- Software center
- Libre Office
- Graphics & Sound & Video
- Developer tools
- Installing Ubuntu

# CLI. Work with files

- Inittab & Runlevels
- Getty, login, and logout
- Principles of shell work
- Volumes, files, and directories
- Basic directories root file system
- Basic commands for working with files
- Protection of files: groups & access keys
- Basic commands for protection of files
- Ed and vi text editors



# Processes. Conveyers and filters

- Attributes of processes. States and priorities
- Foreground and background modes
- Commands for work with processes
- Starting processes in nohup mode and on a schedule
- Redirecting input and output
- Programming with conveyers
- Basic filters. Sort and grep

# Programming in Shell Language

- Variables and expressions
- Branching “if”
- Testing conditions
- Loops “for” and “while”
- Creating and running script files
- Passing parameters to scripts
- Variables of environment
- Configuring command line prompt

# Networking with Linux

- Configuring network interface
- Testing network connectivity
- Configuring routing
- Using Domain Name System
- Starting Internet services
- Network Address Translation
- Configuring a firewall
- Programming client-server interaction

# Processes control

- State-chart of a process
- Multiprogramming
- Time-slicing
- Static and dynamic priorities
- Process control block
- Switching processor's context
- Scheduler of processes
- Using threads and multicore structure

# Communication of processes

- Using threads and multicore structure
- Complex system as a set of communicating processes
- Flags of events
- P/V semaphores
- Messages
- Common areas
- Monitors
- Avoiding deadlocks

# Memory control. Partitions. Cashing

- Consecutive and scattered memory allocation
- Loading entire process or its part
- Memory control in a single program mode
- Static partitions
- Dynamic partitions
- Fragmentation and reallocation
- Overlays
- Swapping of processes
- Hierarchy of memory. Cashing

# Virtual memory: pages & segments

- Virtual and physical pages
- Mapping of pages
- Tracing free and busy pages
- Pumping and swapping of pages
- Last Recently Used strategy
- Fast mapping: associative registers
- Segments and page-segment memory structure
- Dynamic linking libraries

# Devices control. Drivers. Buffering

- Byte oriented and block oriented devices
- Shared and assigned devices
- Controllers and channels
- Representation of a device in computer architecture: i/o ports and interrupts.
- Device (controller) control block
- Typical device driver – waiting for readiness
- Typical device driver – work on interrupts
- Buffering to smooth input/output time



# Information control. File system

- File structure and file system
- Attributes of a volume/directory/file
- Mapping file space into device space
- Tracking free/allocated space
- File control block
- Basic file operations
- Implementation of a file system as a system process

# Security of operating systems

- Hardware support of security
- Authentication of users
- Access rights
- Protection of hardware
- Protection of information
- Data encryption
- Networking security: firewalls

# Literature

- Tanenbaum A.S. Modern Operating Systems. Pearson, 2008, 1104 p.
- Smith R.W. Linux essentials. John Willey&Sons, 2012, 344 p.
- McHoers A.M., Flynn I.M. Understanding operating systems. Course Technology, 2011, 568 p.
- Holcombe J., Holcombe C. Survey of operating systems. McGraw Hill, 2012, 432 p.
- Zaitsev D.A., Doroshuk A.V. Summary of lectures on course Networking Operating Systems. Odessa: ONAT, 2007. - 68 p.
- Voronoy S.M., Zaitsev D.A., Shmeleva T.R. Tracing networking operating systems processes: textbook for laboratory training. Donetsk: IAIP, 2007. - 67 p.

A second pass – thoroughly  
by lectures

Extra lectures

# Linux system calls

# Compiling Linux kernel. Kernel modules

- Structure of kernel sources
- Configuring kernel
- Making kernel
- Loading a new kernel
- Libc and implementation of systems calls
- Basic modules of kernel
- Building kernel loadable modules
- Kernel modules for networking protocols
- Device drivers