

Approval: 9th Senate Meeting

Course Name: Systems Practicum
Course Number: CS307
Credits: 0-0-3-2
Prerequisites: IC150 Computation for Engineers , CS207 Applied Databases Practicum
Intended for: UG
Distribution: Compulsory for CSE; CS elective for EE and ME
Semester: 5th

Preamble:

The new curriculum calls for a sequence of 3 Practicum courses for CSE, viz. CS207 Applied Databases Practicum, CS307 Systems Practicum and CS308 Large Applications Practicum. The erstwhile CS211 Networks and Database Practicum included both networks and databases tools and programming. Now, the networks material is shifted to CS307 and CS207 focusses only on database applications.

Tentative sequencing:

Semester 3 – CS207 Applied DB Practicum, followed by CS204 Introduction to Databases

Semester 5 – CS307 Systems Practicum, followed by CS3xx Introduction to Distributed Communicating Processes, and electives in networks and OS

Semester 6 – CS308 Large Applications Practicum, in conjunction with electives on software engineering, compiler construction, etc.

Course Outline:

Understanding of architecture and working of networks and OS through use of system calls, monitoring tools (ps, vmstat, netstat, tcpdump, ping, traceroute, ...), simple socket programming in C. Building multi-process, distributed applications using scripting or other languages. Setting up and configuring various network and OS services such as web, DNS, email, LDAP, etc. Installing Linux – master boot record, boot loader, disk partitioning, virtualisation (VirtualBox). OS and network security. Techniques for performance measurement, data analysis and presentation.

Modules:

A few introductory lab lectures (6-8 hours spread over the semester):

1. Architecture and functions of an OS, layered network architecture

2. Processes and threads
3. Concept of name, address, location – IP addresses and DNS; well-known services
4. Inter-process communication: files, shared memory, pipes, sockets
Synchronisation: lock files, semaphores
5. Packet-switching: packet formats, hop-by-hop routing, routing tables
6. Files, devices, filesystems
7. Installation and boot procedures of an OS; virtualisation

Lab assignments (9-10 weekly assignments – 3 hours in the lab, preceded by at least 3 hours at home – plus a mini-project for 4 weeks). Assignment problems are designed to expose the students to the following sequence of concepts, skills and tools:

1. Create and synchronise processes and threads. Utilities: ps, vmstat, /proc
2. Bulk data transfer using various forms of IPC.
3. Use of networking utilities: ping, traceroute, netstat, tcpdump, /proc
4. Socket programming in C: applications such as file transfer, simple chat, ping, etc using UDP or TCP. Use of socket options.
5. Socket programming in C (continued)
6. Program access to i-nodes and directory nodes; Use of rsync.
7. Virtualisation using eg. VirtualBox; installation of at least 2 different OS'es on virtual machines. Network connections between these OS'es.
8. Configuration of DNS, NAT, NFS, syslogd.
9. I/O to serial or parallel port. Use of ioctl().

Measurement of performance integral to most of the lab exercises: design of experiments, measurement techniques, confidence intervals, analysis of results, presentation in graphs and tables.

Mini-projects involving one or more of the following (4 weeks): Email, RMI, PKI, DNS, LDAP/single-sign on, configuring IP routing, Iptables, backup/restore of filesystems, Apache, Squid, Linux user administration, system logging using syslog, NFS, automounting, etc.

Textbooks:

1. Wikipedia, man pages and online documentation on assorted utilities, tools, components and platforms
2. Batts, Dawson & Purdy, *Linux Network Administrator's Guide*, 3rd ed., O'Reilly, 2005
3. Adelstein & Lubanovic, *Linux System Administration*, O'Reilly, 2007

References:

1. A.S. Tanenbaum, *Modern Operating Systems*, 3rd ed., Pearson Ed. Inc., 2008
2. B. Davie & L. Peterson, *Computer networks*, Morgan and Kauffman, 4th ed., 2011.
3. R. Jain, *The Art of Computer Systems Performance Evaluation*, Wiley, 2008.
4. R.L. Schwartz, T. Phoenix & b.d. foy, *Learning Perl*, 5th ed., O'Reilly, 2008.
5. L. Wall, T. Christiansen & J. Orwant, *Programming Perl*, 3rd ed., O'Reilly, 2000