CS 695

Topics in virtualization and cloud computing

Course Overview

Spring 2024-25

Instructor

- **Puru**
  - ~~(Purushottam Kulkarni), Sir Puru, Puru Sir, Sir, *Sir*, …~~
  - puru@cse.iitb.ac.in
  - http://www.cse.iitb.ac.in/~puru

- Office hours
  - Knock-on-door policy
  - Wed: 11:30 AM to 1PM
  - KR-304 or SynerG Lab

About CS695

- https://www.cse.iitb.ac.in/~puru/courses/spring2024-25/

- Meeting times
  - **Slot 5 Wed. & Fri : 9.30 am or 11 am**
  - **Venue: CC103**
  -
- Mailing list, announcements, submissions
  - Moodle

- TAs
  - Khushboo, Debojeet, Asish, …

Pre-requisites

- CSE UG/DD students
  - CS219/CS347, CS236/CS333 (CS348, CS378)
- CSE PG students
  - CS744, undergraduate courses in OS and Computer Networks
- Access to a Linux machine (with root access)
- If do you not meet above criteria but still want to take/audit course
  Meet me!

Course goals

- Develop an understanding of *Systems issues/under-the-hood* topics
- Topics list (incomplete)

  Virtual machine basics and techniques to design VMMs
  CPU, memory, I/O virtualization (for VMs)
  VM-enabled mechanisms —
  ballooning, live migration, snapshots, record-replay, resource management
  Containers from the ground-up
  Serverless computing basics and frameworks
  Networking techniques for the modern-era
  Acceleration-as-a-service models
  Classic/latest research papers in above topics

- Hands-on experience
- Familiarity with how to read/interpret/use research papers
- Identify new/open research/problem directions

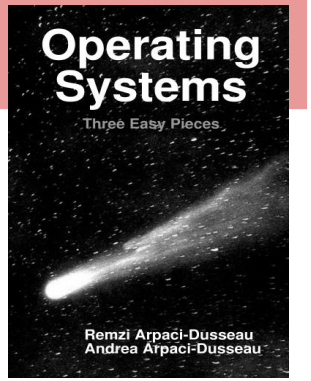
Course components

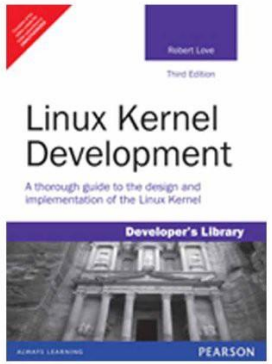
- In-class teaching
  - Textbook, papers, online notes
  - Paper discussions
- Programming assignments/project (4+1)
- Paper reviews
- Guest lectures
- Exams

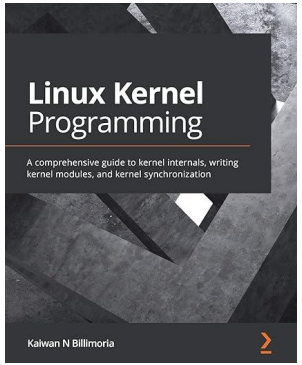
Course content

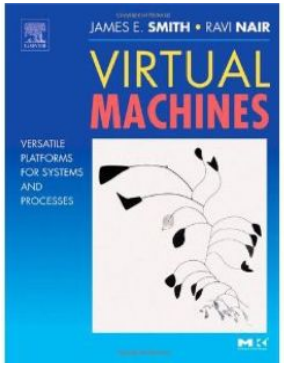
1. virtualization
2. cgroups and containerization
3. topics/problems from research papers
4. cloud systems/infrastructure
    a. ebpf, …

Course material









No single textbook

- OS Three Easy Pieces
- xv6 book
- Linux Kernel Development, Linux Device Drivers
- Virtual Machines: Versatile Platforms for Systems and Processes
- The Definitive Guide to the Xen Hypervisor

Research papers

- ~10 papers over the semester

Online material

- https://linux-kernel-labs.github.io/refs/heads/master/index.html
- https://0xax.gitbooks.io/linux-insides/content/
- https://www.kernel.org/doc/html/latest/
- https://sysprog21.github.io/lkmpg/

Assignments and Projects

- Default: No group assignments or projects
- Non-trivial component of the course
  - Assignment every 2-3 weeks
  - Needs continuous and consistent effort
  - Design, system building, experimentation, demos, report, …
  - 4 assignments
- Project
  - Open-ended or could be large assignment
- 1 : x rule
  - Value of **x** in most/all cases is 3+

Evaluation

- Class participation : 100%

  answers, questions, explanations from papers, new ideas/problems …

- Components
  - Quizzes ~10%
  - Exams ~50%
  - Assignments ~40%
  - Project ~15%

CS695 allergies

- PLAGIARISM
  - **Devil's Snare***

    * A deadly plant with a tendency to use its tentacle-like tendrils to trap victims.
  - **33/99** students got a 0 on Assignment #1 and were on the DADAC watch list
  - Detective agencies on stand by
    - MOSS, Holmes, Byomkesh, …

- GenAI
  - Might as well ask Lexa/Sori to sit through CS695

Things to remember!

- An interactive/open-ended course
  - several self-learning components
- Do not cut-copy-paste anything!
- Start early
  - Paper readings, assignments, project, …
- Course philosophy (motto?)
  Systems for all, all for systems

Addendum

- ***How to read paper?***
  Srinivasan Keshav
  ACM SIGCOMM Computer Communication Review,
  Volume 37 , Issue 3, July 2007.

- **Programming assignment #1**

  Available online now!

  Linux kernel modules + ioctl