System Virtualization

DS 255 Jan 2020

3:1

Course Information

- **DS 255 (JAN) 3:1 System Virtualization**
- **Course Introduction:**
  - **Virtualization is the key mechanism on Cloud systems.**
  - **Course aims to expose the students to the current architectures and mechanisms used for virtualizing systems.**
    - **have deeper insight into these systems and thus enable to use such setups better.**
    - **potentially lead one to innovate on systems architectures with better resource utilization and safer environments fulfilling basic goals of the Cloud paradigm.**
- **Course web page:**

http://www.serc.iisc.ac.in/faculty/jlakshmi/system-virtualization/

What you get to learn

- Virtualization as a construct for resource sharing;
- System abstraction layers and modes of virtualization;
- Mechanisms for system virtualization – binary translation, emulation, paravirtualization and hardware virtualization;
- Virtualization using HAL layer – Exposing physical hardware through HAL (example of x86 architecture) from an OS perspective;
- Virtual Machine Monitor; Processor virtualization; Memory Virtualization; NIC virtualization; Disk virtualization; Graphics card virtualization;
- OS-level virtualization or Process VMs and the container model;
- OS resource abstractions and virtualization constructs(Linux Dockers example) ;
- Virtualization using APIs or HLL VMs – JVM example.

Course Outcomes

- Contemporary Cloud data centers are complex distributed system setups involving many technologies to deliver the common goals of cloud computing paradigm.
- As a result of this course you get to understand the conceptual constructs of system virtualization that is extensively used as a building block in many of the cloud datacenters.
- This course prepares you to conceptually understand, architect, use and innovate the distributed systems architectures in such setups.

Prerequisites

- Basic course on operating systems (undergrad-level) and consent of the instructor.
- A good refresher is available at this link: http://pages.cs.wisc.edu/~remzi/OSTEP/

Course References

- **J. Smith, R. Nair, Virtual Machines: Versatile Platforms for Systems and Processess, Morgan Kaufman, 2005.**
- D. Bovet, M. Casti, Understanding the Linux Kernel, Third Edition, O'Reilly, 2005.
- Wolfgang Mauerer, Linux Kernel Architecture, Wiley India, 2012.
- D. Chisnall, The Definitive Guide to the Xen Hypervisor, Prentice Hall, 2007
- R. Bryant, D. O'Hallaron, Computer Systems: A Programmer's Perspective (2nd Edition), Addison Wesley, 2010
- Current literature

Evaluation

- The course evaluation will be based on assignments(40%), case-study seminars/system architecture evaluation projects (20%) and exams(40%).
- As part of this course, students will need to successfully complete 5-6 assignments that will be mostly based on the material covered in the lectures. Each assignment will have 6-7 questions that will make the student use the conceptual understanding of the topics to answer ranging from simple to varying degree of complexity.
- For each assignment 1-2 questions will be open ended and thought provoking to elicit deeper exploration and application of the concepts to an interesting contemporary problem or use-case.

Academic Integrity

All students are expected to understand and abide by the IISc's Academic Integrity Guidelines. Students must maintain the classroom decorum and participate to enable a healthy learning atmosphere. While discussions are encouraged, absenteeism, abusive behaviour, cheating, copying or plagiarism of any manner will not be tolerated and may lead to reduced grades or expulsion.

Course Schedule

- DS 255: Tuesday and Thursday 3.30 – 5.00 pm
- Venue: CDS – 202
- All lectures will be posted on the course page after discussion in the class.
- Assignments will be emailed and responses maybe submitted through reply email. Ensuring that the responses reach within the assignment submission deadline is student's responsibility. Late submission within one working week (5 days) after the deadline is permitted but will incur 2% reduction of marks on 12hr basis. After the week of overdue, assignment submission will not be accepted and treated as non submission.
- Case-study of existing virtualization architectures will be taken up for seminar/project presentations. Each student or group of students (to be decided later) will be given one specific virtualization architecture for exploring and discussion. This will be based purely on current literature survey from recent research publications.
- Tentative Exams schedule:
  - 1st Mid-term Exam - Feb 20, 2020
  - 2nd Mid-term Exam – Mar 26, 2019
  - Seminars/Project presentations – 7, 9 Apr, 2019 (Tentative)
  - Final Exam – to be announced

Any questions?

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