Virtual Computers
EEL 6892

Class Periods: MWF Period 5
Location: CSE-E107
Academic Term: Spring 2020

Instructor:
- Name: Renato J. Figueiredo
- Email Address: renato@acis.ufl.edu
- Office Phone Number: 352-392-6430
- Office Hours: Available on calendar: https://calendar.google.com/calendar/embed?src=rjofig@gmail.com

Teaching Assistants:
Please contact through the Canvas website

Course Description
Virtualization technologies allow the decoupling of the user-perceived behavior of hardware/software systems from their physical implementation. Techniques to virtualize the basic functionality of today’s typical computing systems – processing, networking, and data storage – are becoming pervasive in industry and form a foundation for the Infrastructure-as-a-Service (IaaS) cloud computing model. The combination of virtualization technologies and ubiquitous network connectivity allows for the creation of virtual computers where processing, data and communication are distributed and decoupled from physical resources. This class will cover the basic mechanisms and techniques involved in resource virtualization, from individual machines to virtualized networked infrastructures.

Course Pre-Requisites / Co-Requisites
Principles of Computer Systems Design (EEL 5737), or instructor approval

Course Objectives
Students will learn techniques that are used in modern computer systems to enable virtualization of major subsystems (CPU, networking, and storage), which are becoming pervasive in industry and form a foundation for the Infrastructure-as-a-Service (IaaS) cloud computing model.

Materials and Supply Fees
N/A

Required Textbooks and Software
- Title: “Virtual Machines”
- Author: James E. Smith and Ravi Nair
- ISBN number: 1558609105
- Software: Desktop virtualization software (VMware or VirtualBox)

The course will also cover several technical papers in the literature – a tentative reading list is provided at the end of the syllabus.

Recommended Materials
- Title:
- Author:
- Publication date, edition, and publisher:
- ISBN number:

Course Schedule
Week 1: Introduction to virtualization and review of computer system fundamentals
Week 2: Introduction to virtual machine monitors (VMMs) (Goldberg paper)
Week 3: Formal requirements for CPU virtualization (Popek and Goldberg paper)
Week 4: Memory virtualization
Week 5: I/O virtualization and the hosted I/O model (Sugerman et al. paper)
Week 6: Para-virtualization and Xen (Barham et al. paper)
Week 7: x86 virtualization challenges and binary-translation in VMMs (Robin and Irvine paper) and hardware extensions for virtualization (Neiger et al. paper)
Week 8: Memory virtualization in consolidated servers (Waldsurger paper)
Week 9: Virtual machine migration (Sapuntzakis et al. paper, and Clark et. al paper)
Week 10: High-availability in VMMs (Cully et al. paper) and O/S containers (Banga et al.)
Week 11: System call-based virtualization (Dike paper) and VM introspection (Garfinkel and Rosenblum paper)
Week 12: Multiprocessor virtualization
Week 13-14: Virtual networks, VNET (Sundararaj and Dinda paper) and IPOP (St. Juste et. al paper)
Week 15-16: Storage virtualization, VMFS (Vaghani paper) and UFO

Attendance Policy, Class Expectations, and Make-Up Policy
Excused absences are consistent with university policies in the undergraduate catalog (https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx) and require appropriate documentation.

Evaluation of Grades

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Percentage of Final Grade</th>
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<tbody>
<tr>
<td>Homework Sets (3)</td>
<td>10%</td>
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<tr>
<td>Quizzes (around 16)</td>
<td>0%</td>
</tr>
<tr>
<td>Midterm Exams (2)</td>
<td>40%</td>
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<tr>
<td>Final Exam</td>
<td>30%</td>
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<tr>
<td>Final project</td>
<td>20%</td>
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<tr>
<td>TOTAL</td>
<td>100%</td>
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Grading Policy

Final letter grades will be assigned based on the distribution of the final grades above by students in class.

In order to graduate, graduate students must have an overall GPA and a major GPA of 3.0 or better (B or better). Note: A “B-” average is equivalent to a GPA of 2.67, and therefore, it does not satisfy this graduation requirement.

More information on UF grading policy may be found at: http://gradcatalog.ufl.edu/content.php?catoid=10&navoid=2020

Students Requiring Accommodations
Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, https://www.dso.ufl.edu/drc) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

Course Evaluation
Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at [https://gatorevals.aa.ufl.edu/students/](https://gatorevals.aa.ufl.edu/students/). Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via [https://ufl.blueracom/ufl/](https://ufl.blueracom/ufl/). Summaries of course evaluation results are available to students at [https://gatorevals.aa.ufl.edu/public-results/](https://gatorevals.aa.ufl.edu/public-results/).

**University Honesty Policy**

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code ([https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/](https://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/)) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

**Software Use**

All faculty, staff and student of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

**Campus Resources:**

**Health and Wellness**

<table>
<thead>
<tr>
<th>U Matter, We Care:</th>
<th>If you or a friend is in distress, please contact <a href="mailto:umatter@ufl.edu">umatter@ufl.edu</a> or 352-392-1575 so that a team member can reach out to the student.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Counseling and Wellness Center:</strong></td>
<td><a href="http://www.counseling.ufl.edu/cwc">http://www.counseling.ufl.edu/cwc</a>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.</td>
</tr>
<tr>
<td><strong>Sexual Assault Recovery Services (SARS)</strong></td>
<td>Student Health Care Center, 392-1161.</td>
</tr>
<tr>
<td><strong>University Police Department</strong></td>
<td>at 392-1111 (or 9-1-1 for emergencies), or <a href="http://www.police.ufl.edu/">http://www.police.ufl.edu/</a>.</td>
</tr>
</tbody>
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**Academic Resources**

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<tr>
<th><strong>E-learning technical support:</strong></th>
<th>352-392-4357 (select option 2) or e-mail to <a href="mailto:Learning-support@ufl.edu">Learning-support@ufl.edu</a>. <a href="https://lss.at.ufl.edu/help.shtml">https://lss.at.ufl.edu/help.shtml</a>.</th>
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</thead>
<tbody>
<tr>
<td><strong>Career Resource Center,</strong></td>
<td>Reitz Union, 392-1601. Career assistance and counseling. <a href="https://www.crc.ufl.edu/">https://www.crc.ufl.edu/</a>.</td>
</tr>
<tr>
<td><strong>Library Support,</strong></td>
<td><a href="http://cms.uflib.ufl.edu/ask">http://cms.uflib.ufl.edu/ask</a>. Various ways to receive assistance with respect to using the libraries or finding resources.</td>
</tr>
<tr>
<td><strong>Teaching Center,</strong></td>
<td>Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. <a href="https://teachingcenter.ufl.edu/">https://teachingcenter.ufl.edu/</a>.</td>
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</tbody>
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Virtual Computers, EEL-6892  
Renato Figueiredo, Fall 2019

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers.  
https://writing.ufl.edu/writing-studio/.

Tentative reading list


“Xen and the Art of Virtualization”, Paul Barham, Boris Dragovic, Keir Fraser, Steven Hand, Tim Harris, Alex Ho, Rolf Neugebauer, Ian Pratt and Andrew Warfield, Proceedings of the ACM Symposium on Operating Systems Principles (SOSP), October 2003


Xuxian Jiang, Dongyan Xu, "VIOLIN: Virtual Internetworking on OverLay INfrastructure", Department of Computer Sciences Technical Report CSD TR 03-027, Purdue University, July 2003


