

## Graduate Operating Systems (COP 6611) Spring 2009

### **General Information**

Class meetings: TR 11:00-12:15 in ENC 1002

Professor: Adriana (Anda) Iamnitchi ([anda@cse.usf.edu](mailto:anda@cse.usf.edu))

Office hours: Wednesdays 10am-12pm in ENB 334 and other times by appointment

Course web page: <http://www.cse.usf.edu/~anda/cop6611/>

Teaching Assistant: Mayur Palankar ([mpalanka@cse.usf.edu](mailto:mpalanka@cse.usf.edu))

Office: ENB 325

Office hours: Monday/Tuesdays 9-11 am

**Textbook:** *Operating Systems Concepts, Silberschatz, Galvin & Gagne, 8<sup>th</sup> Edition*

## 1. Course Overview

This course will cover an exciting range of materials from the broad field of operating systems, including basic operating system structure, memory management, file systems and storage, distributed systems, virtual machines, and security. We will examine influential historical systems and important current efforts, extracting lessons both on how to build systems as well as how to evaluate them.

The textbook material will be supplemented with research papers that are made available on the class web page.

## 2. Course Requirements

The work of this course consists of:

- Reading, analyzing, summarizing, and discussing in class the research papers assigned.
- Four small programming projects.
- Almost weekly problem assignments.
- A midterm and a final exam.
- ~~Final project.~~

Class attendance is expected.

### 2.1. Paper Summaries and Reading Questions (20%)

In addition to the material covered in the textbook, we will read and discuss 11 research papers. Some of these papers form the basis of the current state-of-art in operating system, while others are hot topics or current trends. These papers will provide both depth and breadth in the subject and will be a gentle introduction in systems research.

You are expected to submit concise paper summaries (less or about 1/2 page) and precise answers to questions on the paper by midnight before the Thursday of the corresponding week. The summaries and answers are to be submitted via H2O (an Internet project which lets you submit ideas and conduct discussions with ease – you will be asked to join as a member). Each paper will have a deadline by which the summaries and answers have to be posted. You can review what other people have answered after the deadline is finished. The summaries should touch the following and should provide you with nice notes for when studying for exams.

1. **Summary:** 1-2 sentences that give the essence of the paper. Please focus on the solution proposed rather than only on the problem. For example, “This paper describes the design of an

operating system” should rather be “This paper describes a multiprogramming operating system with a layered design, where layers are responsible for disjoint sets of functionalities”.

2. **Problem:** a description of the problem the paper attempts to solve. Make sure you identify the assumptions stated in the problem description.
3. **Contributions:** the main ideas of the solution proposed.
4. **Discussion:** any points you may want to raise, or questions you might want to ask the authors or see discussed in class.

The questions for each paper will be posted at least one week before the due date.

## 2.2. Small Programming Assignments (25%)

There will be 4 small programming assignments related to the textbook material (each worth 5%):

1. Working with Pthreads. On Linux. [due end of 2nd week]
2. A synchronization problem. [due end of 4th week]
3. File system performance measurement. [due end of 7th week]
4. Socket programming. [due end of 13th week]

All assignments are individual. All assignments should be submitted via the blackboard in a zip file. The code has to be documented. A readme file containing instructions on executing the program should also be provided.

## 2.3. Homework Assignments (20%)

Problem assignments will be assigned almost weekly from the textbook material. Assignments can be submitted via email to [mpalanka@cse.usf.edu](mailto:mpalanka@cse.usf.edu) or turned in as hardcopy in class. The assignment is due before the beginning of the class.

## 2.4. Final project (20%)

~~The final project will require you to design, carry out and communicate the results on an operating systems project. The final projects are intended to lead to publication quality results.~~

~~Projects are carried out in teams of two or three people. I will suggest a set of topics, but you will be required to develop your own proposal either from the topics listed or from your own ideas.~~

~~There are two grade components for the project: a status report (5%) and a final report (15%). The project proposals (due in the 3<sup>rd</sup> week) will not be graded. Project groups will meet with me after project proposals and status reports to discuss future directions.~~

## 2.5. Exams (35%)

Two in-class exams will make the rest of the grade: 15% for midterm and 20% for final (comprehensive). The exams will test understanding of the class material (covered in textbook, reading list, and class lectures). Samples of exam questions will be provided later in the semester.

## 3. Grading Scheme

A: 90-100%

B: 80-90%

C: 70-80%

D: 60-70%

F: below 60%

I may decide not to use grade curving.

## 4. Lecture Schedule

Week	Topics	Reading
1, 2	Overview. OS Structures	Ch. 1, 2, 23, [1,2,3]
3	Process Management. Threads. Scheduling	Ch. 3, 4, 5, [4]
4	Process Synchronization. Deadlocks	Ch. 6, 7
5	Memory Management	Ch. 8, 9, [5]
6	File Systems	Ch. 10, 11, [6]
7	Distributed File Systems	Ch. 16, 17, [7]
8	Google File System. Midterm exam (Thursday, 2/26)	[8]
9	Mass Storage Structures. Network-attached Storage.	Ch. 12, [9]
10	Distributed Storage	TBD
11	Protection and Security	Ch. 14, 15
12	Distributed Systems. Distributed Coordination	Ch. 18, [10]
13	More on Distributed Systems.	[11]
14	TBD	
15	Final project discussions	

### Reading List:

1. D. Engler, F. Kaashoek and J. O'Toole, "Exokernel: An Operating System Architecture for Application-Level Resource Management ", Proceedings of the 15th ACM Symposium on Operating System Principles, ACM, December 1995.
2. J. Liedtke, " On Micro-Kernel Construction ", Proceedings of the 15th ACM Symposium on Operating System Principles, ACM, December 1995.
3. P. Barham, B. Dragovic, et al. Xen and the Art of Virtualization. In the Proceedings of the ACM Symposium on Operating Systems Principles (SOSP), 2003
4. C. Waldspurger and W. Weihl. Lottery Scheduling: Flexible Proportional-Share Resource Management in Proceedings of 1st USENIX Symposium on Operating System Design and Implementation, 1994.
5. C. Waldspurger. Memory Resource Management in VMware ESX Server in Proceedings of the 5th Symposium on Operating Systems Design and Implementation, 2002
6. M. Rosenblum and J. K. Ousterhout. The Design and Implementation of a Log-Structured File System. ACM Trans. on Computer Systems 10(1), 1992, pp. 26-52.
7. J. Howard et. al. Scale and Performance in a Distributed File System, ACM Transactions on Computer Systems, 6(1) , 1988.
8. S. Ghemawat, H. Gobioff and S-T Leung. The Google File System, in Proceedings of the 19th ACM Symposium on Operating Systems Principles, 2003
9. D. A. Patterson, G. Gibson, and R. H. Katz. A Case for Redundant Arrays of Inexpensive Disks (RAID) Proceedings of the 1988 ACM SIGMOD Conference on Management of
10. L. Lamport, Time, Clocks, and the Ordering of Events in a Distributed System, *Communications of the ACM*, July 1978, pages 558-564.
11. K. M. Chandy and L. Lamport, Distributed Snapshots: Determining Global States of Distributed Systems, *ACM Transactions on Computer Systems*, February 1985, pages 63-75.

## 5. Deadlines and Late Work

Answers to reading questions must be submitted by midnight before the Thursday class in the weeks they are due. No late submissions will be accepted.

Problem assignments are due on paper at the beginning of class on the day they are due.

All programming assignments ~~and project components~~ deadlines are 11:59pm on the day they are due. Late assignment submission is not accepted (will result in a 0). Late project submissions will incur a 10% penalty per late day (weekend days count as “days”).

## **6. Collaboration and Cheating**

Collaboration is strongly encouraged on reading. You may want to form a reading group to better understand the research papers. In this case, you still have to submit your own paper summaries and answers; in addition, please acknowledge the colleagues in your reading group.

Collaboration outside your reading group on all class components must be acknowledged. If you use any published or unpublished work in your own work, you must give full citation.

Acts of cheating and plagiarism will be reported to the appropriate administrative bodies. You are responsible for knowing and will be held to the Honor Code of the University.

*Every part of this syllabus is subject to adjustment as the semester progresses. Please contact me as soon as possible if you are dissatisfied with the course policies, lectures, assignments, grading, etc.; I will be happy to accommodate reasonable requests for modifications.*