# Santa Clara University

Department of Computer Engineering

## SYLLABUS

## Course Syllabus

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|---|---|
| **Course Title:** | **Advanced Operating Systems** |
| **Instructor:** | **Professor Ahmed Ezzat, Ph.D.** **e-Mail: AKEzzat@scu.edu** |
| **Date:** | **Fall, 2019 (Section 92125)** |
| **Course Number:** | **COEN 383-01** |
| **Office hours:** | **1-2 hrs/week (by advanced reservations only)** |
| **Credit Hours:** | **4 Credit Hours** |
| **Classroom:** | **Room: Kenna Hall 111** |
| **Schedule:** | **Monday and Wednesday: 7:10am – 9:00am** |
| **Grader:** | Shivangi Vyas **Email**: svyas@scu.edu |
| **Text Book:** | - "Operating Systems: Three Easy Pieces,"by Remzi H. Arpaci-Dusseau and Andrea C. Arpaci-Dusseau. http://pages.cs.wisc.edu/~remzi/OSTEP/<br>- Additional readings to be provided by the instructor |
| **Course Description:** | The course covers advanced topics in Operating System including CPU virtualization, memory virtualization, concurrency and deadlock, persistence, Security. In addition, the course covers current active research topics in distributed Operating System. Substantial programming projects are required **Prerequisite:** COEN-283 or equivalent. |
| **Prerequisite:** | *COEN 283 or to demonstrate to the instructor that you have the equivalent of COEN283.* A familiarity with C programming and the use of Linux system will be needed. |
| **Course Objectives:** | The purpose of this course is to offer a graduate level coverage to operating systems and systems software principles. The course assumes a prior knowledge of the basic concepts of operating systems, common to most computer systems, and offers a more detailed coverage of key ideas as well as more advanced concepts such as NUMA and RDMA. The successful student should be able to explain basic components of a computer operating system, as well as more advanced concepts of general systems software. |

## Course Projects Assignment

The course include group-based project assignments and related documents must be handed in the classroom on due date (one copy per group). Familiarity with C language and Linux are expected for these projects.

- Project-1 (5 pts): Assignment is on Sept 30, 2019, and is due back on Oct 7, 2019.
- Project-2 (6 pts): Assignment is on Oct 7, 2019, and is due back on Oct 16, 2019.
- Project-3 (6 pts): Assignment is on Oct 16, 2019, and is due back on Oct 23, 2019.
- Project-4 (6 pts): Assignment is on Oct 23, 2019, and is due back on Nov 4, 2019.
- Project-5 (6 pts): Assignment is on Nov 4, 2019 and is due back on Nov 11, 2019.
- Project-6 (6 pts): Assignment is on Nov 11, 2019, and is due back on Aug 20, 2019.

## Due Dates and Lateness

Group members will lose 10% of the project grade for each day delay, and after 5 days, projects will not be accepted. Project descriptions are available on the Design Center Servers.

## Course Outline

| Week | Topic |
|---|---|
| 1. Sept 23: | Introduction to Operating Systems |
| 2. Sept 25: | CPU Virtualization: Process model, scheduling, and VM models |
| 3. Sept 30: | CPU Virtualization (Contd.) + Project-1 Preview |
| 4. Oct 2: | CPU Virtualization (Contd.) |
| 5. Oct 7: | Memory Management (memory abstraction, and free space management + Project-2 Preview + return of Project-1 |
| 6. Oct 9: | Memory Virtualization (Contd.) |
| 7. Oct 14: | Memory Virtualization (Contd.) |
| 8. Oct 16: | Concurrency and Deadlock + Project-3 Preview + return of Project-2 |
| 9. Oct 21: | Concurrency and Deadlock (Contd.) + Midterm Preview |
| 10. Oct 23: | Concurrency and Deadlock (Contd.) + Project-4 Preview + return of Project-3 |
| 11. Oct 28: | Midterm (closed Book) |
| 12. Oct 30: | Persistence (File System, High Availability, Storage Hierarchy) |
| 13. Nov 4: | Persistence (Contd.) + Project-5 Preview + return of Project-4 |
| 14. Nov 6: | Persistence (Contd.) |
| 15. Nov 11: | Distributed Operating Systems + return of Project-5 |
| 16. Nov 13: | Security + Project-6 Preview |
| 17. Nov 18: | Case Study: Hadoop HDFS + MapReduce |
| 18. Nov 20: | Case Study: Hadoop HDFS + MapReduce (Contd.) + return of Project-6 |
| 19. Nov 25: | Case Study: NUMA and RDMA + Final Preview |
| 20. Nov 27: | Holliday |
| 21. Dec 2: | Case Study: Data Center OS |
| 22. Dec 4: | Case Study: Data Center OS (Contd.) |
| 23. Dec 9: | Review |
| 24. Dec 11: | Final |

## Additional Readings

Additional readings may be assigned by the instructor for advanced and contemporary topics under the topics covered in the course outline.

**Grading:** **Projects: 30%**
**Quizzes and Class Participation: 10%**
**Midterm: 30%**
**Final: 30%**

**Grading System:** Grading follow the standard distribution as shown below:

| Score Range | Grade | GPA |
|---|---|---|
| 92 – 100.00 | A | 4.0 |
| 90 - 91.9 | A- | 3.7 |
| 88 - 89.9 | B+ | 3.3 |
| 82 - 87.9 | B | 3.0 |
| 80 - 81.9 | B- | 2.7 |
| 78 - 79.9 | C+ | 2.3 |
| 72 - 77.9 | C | 2.0 |
| 70 - 71.9 | C- | 1.7 |
| 68 - 69.9 | D+ | 1.3 |
| 62 - 67.9 | D | 1.0 |
| 60 -61.9 | D- | 0.7 |
| Below 59.9 | F | 0.0 |

**Expected Learning Outcomes:** Upon successful course completion, students would achieve the following:

- Describe basic OS functionality and components: CPU scheduling, process management, main memory management, secondary storage management, I/O devices, file management, security.
- Ability to explain various scheduling algorithms and their relative merits and problems, including multi-processor scheduling challenges.
- Demonstrate an understanding of the tradeoffs involved in resource management.
- Demonstrate an understanding of memory management algorithms, including those applied to basic caching and buffering, as well as memory management in the context of varying memory technologies.
- Apply the concepts in file management, such as directory structure, layout management, buffering, and data space management in both uni-processor and distributed contexts.
- Understand performance measurements and the importance of performance evaluation in operating system design.

**Honor Code:** All students taking courses in the School of Engineering agree, individually and collectively, that they will not give or receive unpermitted aid in examinations or other course work that is to be used by the instructor as the basis of grading.

**Attendance:** Required. All students are expected to attend all classes and the final at the official time. No make-up exams will be given unless there is official valid documentation – please plan accordingly.

**Make-up Work:** No. Presentations and papers are expected the same day as designated. All team members need to be present; no exceptions are allowed.

**Resources:** All students are encouraged to read more relevant articles published in conference or Journals.

**Revision Date:** 8/24/2019