UNIVERSITY OF SASKATCHEWAN

Department of Computer Science
176 Thorvaldson Building
110 Science Place, Saskatoon, SK, S7N 5C9, Canada
Telephone: (306) 966-4886, Facsimile: (306) 966-4884

CMPT 432/832-02
Winter 2016-2017

Course Syllabus
CMPT 432/832: Advanced Operating Systems Principles

Catalogue Description

An advanced look at the principles of modern operating systems. The process and the kernel, communication between processes, interrupt handling in the kernel. Message passing and synchronization primitives and their implementation. Implementation of Virtual memory and file systems. Device drivers and I/O.

Prerequisite(s):	CMPT 332
Class Time and Location:	TTh 2:30 P.M. Thorvaldson S342 (and S386)
Website:	bblearn.usask.ca

Instructor Information

Instructor	Dwight Makaroff
Contact:	Email: makaroff@cs.usask.ca, Phone: 966-8656
Office Hours:	Location: Thorvaldson 218.3,
	Hours: By appointment

Course Objectives

After completing this course, students should be able to do the following tasks:

- Implement system calls in the Linux operating system.

- Explain design principles influencing the structure of different OS paradigms.

- Design the components of a simple, but complete operating system.

- Design and implement an API for user processes to access OS facilities.

- Implement, integrate and document operating system components in a small- team environment.

- Integrate device drivers and bootloaders into the operating system for communication with peripheral devices.

- Compare and evaluate design alternatives for processes/threads, schedulers and/or memory management.

- Evaluate research literature in operating systems design and implementation and explain open issues and potential solutions.

Student Evaluation

Grading Scheme

Requirements: For CMPT 432, there will be 1 or 2 equally-weighted assignments (in teams of two students for CMPT 432 and individually for CMPT 832), two course projects (one implementation project in groups of 4-6 students, and one research project in teams of two students for CMPT 432 and individually for CMPT832), a mid-term exam (held in-class), and a final examination during the regular examination period. Additional requirements beyond the above for CMPT 832 are the presentation of a research paper to the rest of the class and increased weighting on the research project. The role of CMPT 832 students will be more in a design/managerial role for implementation projects.

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Exact dates will be announced as the course progresses. The approximate weightings for the assignments and examinations are as follows:

Component	CMPT 432	CMPT 832
Assignments	5%	5%
Midterm Exam	15%	10%
Implementation Project	35%	35%
Research Project	15%	20%
Paper Presentation		5%
Final Exam	30%	25%
Total	100%	100%

Criteria That Must Be Met To Pass

All components of the course must be complete in order to achieve a passing grade in the course. This includes exams, projects and assignments. Failure to do so will result in an automatic failure of the course. Submission of assignments must be a credible attempt to solve the problems in the assignment in the judgment of the marker.

Final Exam Scheduling

The Registrar schedules all final examinations, including deferred and supplemental examinations. Students are advised not to make travel arrangements for the exam period until the official exam schedule has been posted.

Note: All students must be properly registered in order to attend lectures and receive credit for this course.

Textbook Information

Required Text

- Title: Modern Operating Systems

- Author: Andrew S. Tanenbaum and Herbert Bos

- Edition/Year/ISBN: 4th Edition/2014/978-0133591620

- Additional information: We will examine a few things on more detail than was possible in CMPT 332, with additional emphasis on case studies and File Systems.

Recommended Texts

- Additional resources: optional, reference book that each team should have access to for completing the assignments and project.

  - Title: Advanced Programming in the UNIX Environment
  - Author: W. Richard Stevens, Stephen A. Rago
  - Publisher: Addison Wesley
  - Edition/Year/ISBN: 3rd Edition/ 2013/978-0-321-63773-4

- Kernel Programming Internals.

- – Title: Linux Kernel Development
- – Author: Robert Love
- – Publisher: Addison Wesley
- – Edition/Year/ISBN: 3rd Edition/2010/978-0-6723-2946-3 (available as a free download).

- Essential for everyone to have for their career. Many should already have this.

  - – Title: The C Programming Language
  - – Author: Brian Kernighan and Dennis Ritchie
  - – Publisher: Prentice Hall
  - – Edition/Year/ISBN: 2nd/1988/0-13-110362-8

Lecture Schedule

Topic	Topic/Subtopics
Introduction	Overview, review of CMPT 332. Readings: Tanenbaum 1-4, mostly
Process Description and Control	process design, context switching, stack manipulation Duration: 1.5 weeks.
Booting and Boot Loaders	Examining source code of the bootloader for real operating systems to review and understand the architecture and memory structure of the Intel Processor. Possible discussion of ARM assembly language and process for booting on ARM processors. Duration: 1.5 weeks Readings: on-line web pages
Interrupts/Traps	Low level handling of external events Duration: 1.5 weeks Readings: Tanenbaum (Chapter 5)
I/O and File Systems	File organization; secondary storage management; examples. Duration: 2 weeks Readings: Tanenbaum (Chapter 4 and 5)
IPC and friends	Communicating between processes, shared memory, etc. Duration: 1.5 weeks Readings: Stevens (10, 15, 16, 17)
Memory Management	Support for virtual memory and other memory management strategies. Duration: 1.5 weeks Readings: Tanenbaum (Chapter 3)
Naming/SecurityPerformance /Other Issues	Whatever is left in design issues for Operating Systems

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Class Presentations	Implementation and Research Projects
	Duration: 1 week

Course Procedures

- Facilities. Students will be using the computers in the Spinks Lab to do most of their work, and are expected to be familiar with the use of these facilities. We will be experimenting with Raspberry Pi computers for the implementation project. Several of these will be available in the lab for each team.

- This course will be administered with BlackBoard. The Discussion Forum will be used to disseminate answers to questions regarding assignments, lecture material, etc. **Many important things may happen there that will not be repeated in class, so daily reading of the bulletin board is required.**

- The course will make regular use of Internet facilities. Page Locations will be given during lectures and on BlackBoard.

- Assignment descriptions will be made available in electronic form only. Submissions will be in electronic form only.

- Assignments are to be done in groups of **at most** two students.

- Version control using SVN at svn.cs.usask.ca is required for every assignment/project and will be verified by submitting meaningful SVN logs.

Policies

In general, the U of S Course Policy Document (Arts and Science version - under Links&Resources - Academic Resources) applies. Further repetitions and/or details are in this section.

Late Assignments

In general, late assignments are not accepted. If there are extenuating circumstances whereby it is impossible to hand in an assignment on time, please see the instructor for special accommodations. This policy may change for different assignments.

Missed Assignments

If an assignment is missed, it is not possible to receive a passing grade in the course.

Missed Examinations

1. "Students who have missed an exam or assignment must contact their instructor as soon as possible. Arrangements to make up the exam may be arranged with the instructor. Missed exams throughout the year are left up to the discretion of the instructor if a student may make up the exam or write at a different time. If a student knows prior to the exam that she/he will not be able to attend, they should let the instructor know before the exam."

2. "Final exams - a student who is absent from a final examination through no fault of his or her own, for medical or other valid reasons, may apply to the College of Arts and Science Dean's office. The application must be made within three days of the missed examination along with supporting documentary evidence. Deferred exams are written during the February mid-term break for Term 1 courses and in early June for Term 2 and full year courses."

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Incomplete Course Work and Final Grades

When a student has not completed the required course work, which includes any assignment or examination including the final examination, by the time of submission of the final grades, they may be granted an extension to permit completion of an assignment, or granted a deferred examination in the case of absence from a final examination. Extensions for the completion of assignments must be approved by the Department Head, or Dean in non-departmentalized Colleges, and may exceed thirty days only in unusual circumstances. The student must apply to the instructor for such an extension and furnish satisfactory reasons for the deficiency. Deferred final examinations are granted as per College policy.

In the interim, the instructor will submit a computed percentage grade for the course which factors in the incomplete course work as a zero, along with a grade comment of INF (Incomplete Failure) if a failing grade. In the case where the instructor has indicated in the course outline that failure to complete the required course work will result in failure in the course, and the student has a computed passing percentage grade, a final grade of 49% will be submitted along with a grade comment of INF (Incomplete Failure).

If an extension is granted and the required assignment is submitted within the allotted time, or if a deferred examination is granted and written in the case of absence from the final examination, the instructor will submit a revised computed final percentage grade. The grade change will replace the previous grade and any grade comment of INF (Incomplete Failure) will be removed. For provisions governing examinations and grading, students are referred to the University Council Regulations on Examinations subsection of the Calendar.

Academic Honesty

The University of Saskatchewan is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the Student Conduct & Appeals subsection of the University Secretary Website and avoid any behaviour that could potentially result in suspicions of cheating, plagiarism, misrepresentation of facts and/or participation in an offence. Academic dishonesty is a serious offence and can result in suspension or expulsion from the University.

All students should read and be familiar with the Regulations on Academic Student Misconduct,
http://www.usask.ca/university_secretary/honesty/StudentAcademicMisconduct.pdf,
as well as the Standard of Student Conduct in Non-Academic Matters and Procedures for Resolution of Complaints and Appeals,
http://www.usask.ca/university_secretary/honesty/StudentNon-AcademicMisconduct.pdf.

For more information on what academic integrity means for students see the Student Conduct & Appeals subsection of the University Secretary Website at:
http://www.usask.ca/university_secretary/pdf/dishonesty_info_sheet.pdf

Examinations with Disability Services for Students (DSS)

Students who have disabilities (learning, medical, physical, or mental health) are strongly encouraged to register with Disability Services for Students (DSS) if they have not already done so. Students who suspect they may have disabilities should contact DSS for advice and referrals. In order to access DSS programs and supports, students must follow DSS policy and procedures. For more information, check http://www.students.usask.ca/disability/, or contact DSS at 966-7273 or dss@usask.ca.

Students registered with DSS may request alternative arrangements for mid-term and final examinations. Students must arrange such accommodations through DSS by the stated deadlines. Instructors shall provide the examinations for students who are being accommodated by the deadlines established by DSS.