CS167: Operating Systems

Course Information and Syllabus
Semester II, 2016–2017

Lectures	G hour: 2:00–2:50 on Mondays, Wednesdays, and Fridays
Room	CIT 368
Help Sessions	Occasional Tuesday and Thursday evenings, 7–9pm, TBA
Lecture Notes	http://www.cs.brown.edu/courses/cs167/lectures.html A recording of each lecture will be available soon after it is given.
Text	*Operating Systems in Depth*, by Doeppner, Wiley 2011
Prerequisite	CS 33
Instructor	Tom Doeppner (twd@cs.brown.edu)
Office	CIT 405, x3-7633
Office Hours	Mondays and Wednesdays 3-4, Fridays 4 to 5, by appointment, or just stop by.
Head TA	Kyle Laracey (klaracey@cs.brown.edu)
Grad TA	Archita Agarwal (archita@cs.brown.edu)
UTAs	Ian Boros (iboros@cs.brown.edu) Isaac Davis (imdavis@cs.brown.edu) Egor Shakhnovskiy (eshakhno@cs.brown.edu) Di Yang Shi (ds65@cs.brown.edu)
Requirements	4 Programs (50%) (those taking CS169 need complete only the first two CS167 programs) (those who have not taken CS33 should do the optional program at the beginning of the course; it will not count towards the course grade) 4 Homeworks (20%) Midterm Exam (10%) Final Exam (20%)
Time Requirements	In addition to three hours per week in class, you will spend 12 to 20 hours per week on homeworks and programs.
Goals	The primary goals are that you have both a solid understanding of the principles behind the design of modern operating systems and practical experience in constructing them. The homeworks and exams help with the former; the programs help with the latter. After

	completing this course, you should be ready to work in operating-system development teams in industry and to participate in systems research projects. Both require not just a solid knowledge of the theoretical underpinnings of modern systems, but also experience in coding and debugging such systems and working with the large code bases typically involved. To gain this experience, the projects you will work on are necessarily time-consuming.
All Are Welcome	Our intent is that this course provide a welcoming environment for all students who satisfy the prerequisites. Our TAs have undergone training in diversity and inclusion; all members of the CS community, including faculty and staff, are expected to treat one another in a professional manner. If you feel you have been treated unprofessionally by any of the course staff, please contact either Prof. Doeppner (the instructor), Prof. Cetintemel (the department chair), or Laura Dobler (the department's coordinator for diversity and inclusion initiatives). We take all complaints about unprofessional behavior seriously.
Grading	Homeworks, exams, and programs are given letter grades; "curving" is done on a per-assignment basis. The final course grade is the weighted average of homework, exam, and program grades. The first program is 10% of your course grade; each of the others is 13.33% The midterm exam is is 10% of your course grade; the final exam is 20%. Each homework is 5% of your course grade. Grade averages are computed using a 4-point scale: an A+ is worth 4.3 points, an A 4 points, an A- 3.7 points, a B+ 3.3 points, etc. To determine your final course grade, a weighted course average of 3.5 and higher is an A, 2.5 and higher is a B, and 1.5 and higher is a C. Students taking CS169 are excused from the third and fourth programming assignments. Your grade in 169 will be used in place of the grades for these assignments in computing your final course grade for 167. Please note that your assignments will be graded by the TAs, most of whom are undergraduates. If you have a question about the grading of an assignment, please bring it up first with the TA who graded it. If your question is not resolved to your satisfaction, then bring it up with Prof. Doeppner.
Incomplete Policy	We expect everyone to complete the course on time. However, we certainly understand that there may be factors beyond your control, such as health problems and family crises, that prevent you from doing so. If you feel you cannot complete the course on time, please

	discuss with Prof. Doeppner the possibility of being given a grade of Incomplete for the course and setting a schedule for completing the course over the summer.
Due Dates	Assignments submitted electronically are due at 11:59pm; those submitted on paper are due at 10pm in CS167's handin bin on the second floor of the CIT.
Late Policy	The late-day policy described here applies to all late days other than those due to illness and religious holidays. Thus days missed because of job interviews are included in the late-day policy. Everyone is allowed a total of four late days on projects free of charge, but no more than three late days may be applied to any one assignment. Beyond that, you are penalized one grade level (e.g., B work goes down to a C) for each day it is late. We will apply late days to assignments in an optimal fashion (with respect to your grade). Note that late penalties are applied after grades have been curved. If you are ill, you may get an extension without using late days. Please get a note from either health services or the office of student life and contact Prof. Doeppner. If you must miss an assignment deadline because of a religious holiday, you may also get an extension without using late days; please contact Prof. Doeppner.
Accommodations	If you feel you have physical, psychological, or learning disabilities that could affect your performance in the course, we urge you to contact SEAS (https://www.brown.edu/campus-life/support/accessibility-services/). We will do whatever we can to support accommodations recommended by SEAS.
Mental Health	Being a student can be very stressful. If you feel you are under too much pressure or there are psychological issues that are keeping you from performing well at Brown, we encourage you to contact Brown's Counseling and Psychological Services (CAPS: https://www.brown.edu/campus-life/support/counseling-and-psychological-services/). They provide confidential counseling. In addition, the deans of student life as well as the deans of the college can provide notes supporting extensions on assignments for health reasons.

Lectures and Due Dates

Date	Topic	Readings	Out	Due
Jan 25	1. Intro. to CS167 and OS	Sections 1.1 and 1.2	Program 0: Shell (optional)	
Jan 26 (7pm)	*Help Session: Program 0*			
Jan 27	2. Threads Implementations		Program 1: U Threads	
Jan 30	3. Threads Implementations			
Jan 31 (7pm)	*Help Session: Program 1*			
Feb 1	4. Threads Implementations	Section 4.1		Program 0
Feb 3	5. I/O and Interrupts			
Feb 6	6. Interrupts and Booting			
Feb 8	7. Introduction to Unix™ and Weenix OS Structure		Homework 1	Program 1
Feb 10	8. Introduction to Unix™ and Weenix OS Structure			
Feb 13	9. Introduction to Unix™ and Weenix OS Structure	Section 5.1		Program 1 (for those who do Program 0)
Feb 15	10. OS Design: Virtual Machines	Section 4.2.1	Program 2: M Threads	Homework 1
Feb 16 (7pm)	*Help Session: Program 2*			
Feb 17	11. OS Design: Virtual Machines			
Feb 20	Holiday!!			
Feb 22	12. OS Design: Microkernels	Section 4.2.2		
Feb 24	13. Scheduling	Section 5.2		
Feb 27	14. Scheduling	Section 5.3		
March 1	15. Scheduling			
March 3	16. Scheduling		Homework 2	Program 2

March 6	17. File Systems			
March 8	18. File Systems	Section 6.1	Program 3: VFS	
March 9 (7pm)	*Help Session: Program 3*			
March 10	19. File Systems	Section 6.2		Homework 2
March 13	20. File Systems	Section 6.3		
March 15	21. ZFS (Guest Lecture by Matt Ahrens)			
March 17	22. Virtual Memory: Architecture	Section 6.4		
March 20	23. Virtual Memory: OS	Sections 7.1, 7.2		
March 22	*In-Class Help Session: Midterm*			
March 23	**Midterm Exam: 7pm – 9pm**			
March 24	24. Virtual Memory: OS	Section 7.3		Homework 3
March 27	Holiday!!			
March 29	Holiday!!			
March 31	Holiday!!			
April 3	25. Virtual Memory: OS			
April 5	26. Virtual Memory: OS			
April 7	27. Security			
April 10	28. Security	Section 8.1		Homework 3
April 12	29. Security	Section 8.2	Program 4: File System	Program 3
April 13 (7pm)	*Help Session: Program 4*			
April 14	30. Communication Protocols			
April 17	31. Remote Procedure Call Protocols	Section 9.1		
April 19	32. Distributed File Systems	Section 9.2		
April 21	33. Distributed File Systems	Chapter 10		
April 24	34. Avoiding Operating Systems			

April 26	35. Summing Up		Homework 4	
May 3				Homework 4
May 5				Program 4
May 10 (5pm)	*Help Session: Final Exam*			
May 12	**Final Exam: 2pm – 5pm**			