CSCI 330: Introduction to Computer Systems

Course Information and Syllabus
Semester I, 2019–2020

Lectures	G hour: 2:00–2:50 on Mondays, Wednesdays, and Fridays
Room	Salomon 101
Lecture Notes	http://www.cs.brown.edu/courses/cs033/lectures.html A recording of each lecture will be available soon after it is given.
Text	Computer Systems: A Programmer's Perspective, 3rd Edition, Bryant and O'Hallaron, Prentice Hall 2015 (prices range from $21.00 to $155.47)
Prerequisite	CSCI 150, 180, or 190. In particular, you should be a competent Java programmer (though we won't be using Java)
Instructor	Tom Doeppner (twd@cs.brown.edu)
Office	CIT 405, x3-7633
Professor's Office Hours	Mondays and Wednesdays 3-4, Fridays 4-5, by appointment, or just stop by.
Head TAs	Ilan Bigio (ibigio), Peter Cho (bcho1), Kielan Donahue (kdonahu2), Lisa Phinisee (lphinise)
UTAs	William Adriance (wadrianc), Nazem Aldroubi (naldroub), Mohammad Amoush (mamoush), Chris Avalos (cavalos1), Ariana Barzinpour (abarzinp), Zsozso Biegl (zbiegl), Grace Bramley-Simmons (gbramley), Gus Cantieni (gcantien), David Charatan (dcharata), Prithu Dasgupta (pdasgup1), Rahul Dey (rdey2), Jason Fischman (jfischma), Delmy Garcia (dgarci14), Symone Houston (khousto1), Jarrett Huddleston (jhuddle1), Shelley Jain (sjain16), William Jurayj (wjurayj), Garret Kern (gkern1), Katherine Kwan (kkwan), George Lee (glee43), Daphne Li-Chen (dlichen), Jason Ludmir (jludmir), Moustafa Makhlouf (mmakhlou), Isa Milefchik (imilefch), Casey Nelson (cnelso13), Raghu Nimmagadda (knimmaga), Daniel Park (dpark20), Tim Park (tpark10), David Promisel (dpromise), Ethan Sattler (esattler), Rudra Srivastava (rsrivas2), Star Su (ssu6), Evan Velasquez (evelasq2), Christine Wang (cwang85), Rachel Wang (rwang48), Conrad Zborowski (czborows)
TA Office Hours	See http://cs.brown.edu/courses/csci0330/hours.html
Time Requirements	In addition to three hours per week in class, you will spend two hours per week in labs and 10-18 hours per week on projects. The project times will vary — less time will be required for earlier assignments than for later ones.

Goals	The primary goal is for you to understand how a modern computer system works, to the extent that you can utilize this knowledge to construct better programs. We teach you the C language and use it in most assignments because it exposes many aspects of a computer system, such as storage allocation, that are hidden when you use higher-level languages. This helps you understand what these other languages are doing for you. We teach you assembler language and high-level computer architecture so that you can appreciate what the computer is actually doing when it runs your programs, and what you might do to write more efficient programs. We teach you the use of debugging tools, in particular gdb, not only to help you debug your code, but also to help you understand what your programs are doing. The course projects are designed to help you understand concepts such as memory allocation and concurrency in sufficient detail that you can make intelligent decisions involving these concepts in projects you pursue after the course. The lab sessions (2 hours per week) are designed to give you hands-on practice with concepts covered in class, so that you're ready to use them in the projects. Labs are done in pairs, i.e., you should have a partner for each lab. You may either choose your own partner, or we will help you find one. The projects are time-consuming. They're intended to pull together the many concepts covered in the class and force you to think through them. Your programs will have rather subtle bugs for which you'll have to use gdb to see what they're doing. You won't simply be applying what you learned in class; you will understand the intricacies of how everything works.
Diversity: 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 not been treated in a professional manner by any of the course staff, please contact either Prof. Doeppner (the instructor), Prof. Hughes (the department chair), or Laura Dobler (the department's coordinator for diversity and inclusion initiatives). We take all complaints about unprofessional behavior seriously.
TopHat	The course will make use of TopHat: at each class meeting there will be one or more questions to which you must respond using your smartphone or laptop. You must be in class to answer the questions. Please visit https://ithelp.brown.edu/kb/articles/top-hat-student-guide for instructions on how to set this up.

Homeworks and Grad Students	The graduate school requires graduate students taking an undergraduate course to do extra work to get credit for the course. Thus we have weekly homework assignments that are *optional for undergraduates* but *required for graduate students*. They go out Friday of each week (other than Thanksgiving week) and are due the following Friday. Each should take about an hour to complete. Collectively they account for 10% of grad student grades. What's described below under "Grading" will be scaled to account for 90% of grad student grades. While undergraduates are encouraged to do the homeworks, they will not be graded and thus won't count towards your grades.
Grading	Class participation via TopHat is worth 9.9% of the course grade. You will get an A for answering a question correctly, a B for answering incorrectly, and no credit for not answering. Projects are given letter grades; "curving" is done on a per-project basis. The curves will be released when the projects are given back. There is no *a priori* notion of how many students get A's. If everyone does well on an assignment, we're happy to give everyone A's. Labs are given A's if done on time, C's if no more than a week late, and NC's if beyond a week late. The final course grade is the weighted average of the TopHat, lab, and project grades. Each of the projects except for the last two (malloc and database) is worth 7.1% of your final grade; malloc and database are each 14.2% of your grade. Each lab is 1% of your final 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. For determining your final 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. In addition, you must pass (i.e., get a grade of C- or higher) all projects to get an A for the course; you must pass all but one 7.1% project to get a B for the course; you must pass (C- or higher) all but two 7.27% projects or one 14.2% project to get a C (or S) for the course. While your course grade will adhere to Brown's standard grading system (A, B, C, NC, or S/NC), projects are assigned grades ranging from A+ down to a D. The latter is worth 1 point on the 4-point scale. 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 finishing the course on time. 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 in the upcoming year.

Due Dates	Projects and homeworks must be handed in by 11:59 pm on their due dates. Labs are due during the last lab hours before the next lab is released (NOT at 11:59pm!).
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 five 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 (A work goes down to a B, B work goes down to a C, C work goes down to a D, and D work goes down to an NC) for each day it is late. Note that if an assignment is handed in more than six days late (accounting for three free late days and being marked down for further late days), it will be assigned an NC and not given any feedback by TAs. The last project (database) must be turned in by 11:59pm, Dec. 13, regardless of how many late days you have. Your TopHat scores will be based on 32 out of the 37 lectures in which TopHat is used (TopHat is not employed in the first lecture). Thus we will drop the five lectures on which you did most poorly in terms of your TopHat responses (for example, because you were not present). No late days are allowed for labs, other than what is mentioned in the grading policy. 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 class or a project deadline because of a religious holiday, you may also get an extension without using late days, please contact Prof. Doeppner.
Re-Handing in Projects	It might well happen that you've handed in a project, then it occurs to you that you did a portion of it wrong and you want to hand it in again, perhaps taking advantage of a late day. This is fine for all except for the TA who's already graded your first hand-in and now has to grade your second. If you are going to re-hand in a project, we ask either that you do so before the TAs begin grading (noon on the Saturday after it is due) or that you notify us before then that you intend to hand it in again. We will provide information in the assignment handouts on how you do this. Note that while we will grade such re-handins, they won't necessarily be graded right away.
More Information	For more in-depth information about the course, refer to the course website http://cs.brown.edu/courses/csci0330).

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.
Coping with Unforeseen or Difficult Circumstances	If there are events that are upsetting to you, whether political, family-related, weather-related, etc., that affect your ability to do well in class, we are happy to take them into account with respect to our late and incomplete policies. Please feel free to talk to Prof. Doeppner about this. Additionally, Student Support Services Deans (https://www.brown.edu/offices/student-support/student-support-services) can be a helpful resource for discussing current concerns and academic and personal plans. They are available for both same-day consults and scheduled appointments.

Lectures and Due Dates

Date	Topic	Readings	Out	Due
Sept 4	1. Intro to CSCI 330; Intro to C			
Sept 6	2. Intro to C		Lab01 – Life; Maze; HW 1 (grad students only)	
Sept 9	3. Intro to C			
Sept 11	4. Intro to C			
Sept 13	5. Intro to C		HW2	HW1
Sept 16	6. Intro to C		Lab02 – Tools	
Sept 18	7. Data Representation	Chapter 2	Data	Maze
Sept 20	8. Data Representation	Chapter 2	HW3	HW2
Sept 23	9. Data Representation	Chapter 2	Lab03 – x86 Part 1	

Sept 25	10. x86 Assembler Language	Sections 3.1, 3.2	Traps	Data
Sept 27	11. x86 Assembler Language	Sections 3.4, 3.5	HW4	HW3
Sept 30	12. x86 Assembler Language	Section 3.6	Lab04 – x86 Part 2	
Oct 2	13. x86 Assembler Language	Section 3.7	Buffer	Traps
Oct 4	14. x86 Assembler Language	Section 3.10	HW5	HW4
Oct 7	15. Processor Arch. and Performance	Sections 5.1-5.6	Lab05 – Profiling	
Oct 9	16. Memory Hierarchy I	Sections 5.7-5.12	Performance + Strings	Buffer
Oct 11	17. Caching	Section 6.1-6.2	HW6	HW5
Oct 14	Holiday!			
Oct 16	18. Architecture and OS	Sections 8.1-8.4		
Oct 18	19. Shells and Files	Section 10.1	Lab06 – Makefiles; Shell Part 1, HW7	Performance + Strings, HW6
Oct 21	20. Files	Sections 10.2-10.11		
Oct 23	21. Signals	Sections 8.5 – 8.6		
Oct 25	22. Signals		Lab07 – Signals, HW8	HW7
Oct 28	23. Memory Hierarchy II	Sections 6.4, 6.5	Shell Part 2	Shell Part 1
Oct 30	24. Linking and Loading	Sections 6.3		
Nov 1	25. Memory Management	Sections 7.1-7.9	HW9	HW8
Nov 4	26. Memory Management	Section 9.9	Lab08 – Alloc	
Nov 6	27. Virtual Memory	Section 9.9	Malloc	Shell Part 2

Nov 8	28. Virtual Memory	Sections 9.1, 9.2, 9.6, 9.8	HW10	HW9
Nov 11	29. Libraries	Sections 7.10-7.13	Lab09 – VM	
Nov 13	30. Network Programming	Sections 11.1-11.4		
Nov 15	31. Network Programming		HW11	HW10
Nov 18	32. Concurrent Programming	Chapter 12	Lab10 – Network	
Nov 20	33. Concurrent Programming			
Nov 22	34. Concurrent Programming			
Nov 25	35. Concurrent Programming		Lab 11 – Concurrency I; Database	Malloc
Nov 27	Holiday!			
Nov 29	Holiday!			HW11
Dec 2	36. Concurrent Programming		Lab 12 – Concurrency II	
Dec 4	37. Concurrent Programming			
Dec 6	38: Conclusion			
Dec 13				Database