CSc 345 - Analysis of Discrete Structures - Spring 18
2:00-3:15 pm, TuTh, Meinel 410
10-11 am, Fri, Koffler 216

Description of Course
Introduction to and analysis of algorithms and characteristics of discrete structures. Course topics include algorithm analysis techniques, recurrence relations, structural induction, hierarchical structures, graphs, hashing, and sorting.

Course Prerequisites or Co-requisites
Prerequisites:
CSc 127B or 227
CSc 245 or MATH 243

Expected Skills:
● Write programs in Java
● Design, code, and debug programs consisting of hundreds of lines of object-oriented code
● Understand and use basic common algorithms (e.g. sorting) and data structures (e.g. stacks)
● Understand and apply the basics of discrete mathematics, including the interpretation and creation of formal proofs

Instructor and Contact Information
Instructor: Russell Lewis
Russell Lewis
Office: Gould/Simpson 829
Tel: n/a
Email: russell@cs.arizona.edu

TAs:
Mallory Walsh
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Office: Gould/Simpson ???
Email: phillipgriffith@email.arizona.edu

Office Hours

Websites
Class Homepage:  https://lecturer-russ.appspot.com/classes/cs345/spring18/
Piazza:          https://piazza.com/arizona/spring2018/csc345/
D2L:            https://d2l.arizona.edu/d2l/home/646994
Recordings on Panopto: Access through “Content” tab on D2L

Course Format and Teaching Methods
We will be using an online textbook through zyBooks. Sections from the textbook will be
assigned each week; you will need to read them before class on the first lecture day. (We will be
checking, and giving you a grade for completion.)

Course Objectives and Expected Learning Outcomes
Course Goal
Introduction to and analysis of algorithms and characteristics of discrete structures. Course topics
include algorithm analysis techniques, recurrence relations, structural induction, hierarchical
structures, graphs, hashing, and sorting.

Topic Outline
The following is a rough outline of major topics. It does not list every topic to be covered in class.

- Algorithm Analysis
- Sorting
- Hashing
- Search Trees
- Heaps
- Graphs
- Algorithm Families
- Finite State Machines & Regular Expressions
- $P$, $NP$, and Undecidability

Topics may be added, removed, or reordered as time and circumstances dictate.

Outcomes
At the end of the semester, students will:

- Be able to asymptotically analyze iterative and recursive algorithms
- Have an in-depth knowledge of hierarchical structures and graphs
- Will understand searching and sorting techniques

In addition, students will have been introduced to algorithm design and theoretical Computer
Science.

Absence and Class Participation Policy
The UA’s policy concerning Class Attendance, Participation, and Administrative Drops is available
at http://catalog.arizona.edu/policy/class-attendance-participation-and-administrative-drop

The UA policy regarding absences for any sincerely held religious belief, observance or practice
will be accommodated where reasonable:
http://policy.arizona.edu/human-resources/religious-accommodation-policy.

Absences preapproved by the UA Dean of Students (or dean’s designee) will be honored. See
https://deanofstudents.arizona.edu/absences

Participating in the course and attending lectures and other course events are vital to the
learning process. As such, attendance is required at all lectures and discussion section meetings. Students who miss class due to illness or emergency are required to bring documentation from their health-care provider or other relevant, professional third parties. Failure to submit third-party documentation will result in unexcused absences.

**Makeup Policy for Students Who Register Late**
Students who register for class late will be allowed to make up missed assignments; all missed assignments will be due at the same time as the third homework/project. Students will not be allowed to register for the class more than two weeks after it begins, save in truly exceptional circumstances.

**Course Communications**
The primary path for outside-lecture communications will be Piazza. If a student has an issue which cannot reasonably be resolved through Piazza (inappropriate to discuss publicly, private issue, etc.), then the student may email the staff alias, or the instructor.

**Required Texts or Readings**
[Required] Online textbook through learn.zybooks.com. Details will be provided during the first week of class.

**Required or Special Materials (if any)**
None

**Required Extracurricular Activities (if any)**
None

**Assignments and Examinations: Schedule/Due Dates**

**Projects and Homeworks**
This class will have programming projects or homework assignments, due most weeks. The following schedule gives approximate due dates for each one. The schedule below is approximate; as I assign the projects and homeworks, it may occasionally be necessary to adjust due dates. Likewise, the topics mentioned are my current plans, and are subject to change. It is possible that I might assign fewer projects than listed below; however, I will not assign more.

Projects will be due at 5pm, and will be turned in through D2L. Homeworks will be on paper, and will be due at the beginning of lecture on the assigned day.

<table>
<thead>
<tr>
<th>Project</th>
<th>Due Date</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Tue, 30 Jan</td>
<td>Various sort algorithms</td>
</tr>
<tr>
<td>2</td>
<td>Tue, 6 Feb</td>
<td>Sets, Quantifiers, Induction</td>
</tr>
<tr>
<td>3</td>
<td>Tue, 13 Feb</td>
<td>Other sort algorithms</td>
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<tr>
<td></td>
<td>Feb 20</td>
<td>No Project Due 20 Feb (while I’m at SIGCSE)</td>
</tr>
<tr>
<td>4</td>
<td>Tue, 27 Feb</td>
<td>Other mathematical tools</td>
</tr>
<tr>
<td>5</td>
<td>Mar 13</td>
<td>BSTs</td>
</tr>
<tr>
<td>6</td>
<td>Mar 20</td>
<td>AVL Trees</td>
</tr>
<tr>
<td>7</td>
<td>Mar 27</td>
<td>Hash Tables</td>
</tr>
<tr>
<td>8</td>
<td>Apr 3</td>
<td>2-3-4 Trees</td>
</tr>
<tr>
<td>9</td>
<td>Apr 10</td>
<td>Red-black Trees</td>
</tr>
<tr>
<td>10</td>
<td>Apr 17</td>
<td>Graphs</td>
</tr>
</tbody>
</table>
Late Days

Each student will be allocated 2 “Late Days,” which may be used through the semester. No individual assignment may be more than 24 hours late. Projects turned in more than 24 hours late - or additional late assignments after the first three - will not be accepted. The last assignment will not be eligible for any late days; additionally, I reserve the right to forbid late days on other assignments.

Additionally, this course does not allow re-submission of work after the due date (or Late Day) has passed.

Late Days may be used for Projects only. They can not be used for any other grade item.

Tests

This class will have 2 midterm exams. Each will be given during lecture, and take 60 minutes.

Tests will be given on the following days:

Midterm 1    Thu, 22 Feb
Midterm 2    Thu, 5 Apr

zyBook Readings and Quizzes

Most weeks, a few sections from the zyBook textbook will be assigned. The website automatically checks completion of these sections; the sections must all be completed by the beginning of the first lecture that week. We will collect completion information from the website, and will give points based on that information.

Final

The final exam will be at:

    Mon, 7 May, 3:30-5:30 pm

Final Examination or Project

A final exam will be given (see times listed above); the times are set by the University. The Final will be given in the normal classroom.

University Policies and Schedule


Grading Scale and Policies

Grading Scale

I will use a simple grade cutoff scheme. This means that if you earn the number of points listed for a given grade, you are guaranteed that grade. At the end of the semester, I reserve the right to lower these cutoffs, meaning that it might be easier to earn a good grade (but it is unusual for me to do so). However, I guarantee that I will not raise these cutoffs (making it harder to earn a good grade).

- 90%    A
- 80%    B
- 70%    C
- 60%    D

Point Distribution
Points will be distributed as follows:

- 5%  zyBooks Readings
- 30%  Projects
- 15%  Homeworks
- 5% Quizzes
- 30% Midterms
- 15%  Final Exam

Within each category, points are distributed evenly; that is, every Test is worth the same as every other (except the Final), every Assembly Project is worth the same as every other, and every Simulation Project is worth the same as every other. Thus, the exact value of each item will depend on the number of each item that is assigned.

We will drop the following items from the grade calculation:

- One Project
- One Quiz

We will not drop any items from the following categories:

- zyBooks readings
- Homeworks
- Any tests

**Grading Schedule**

Projects will be graded, typically, within 6 days of the due date. If exceptions have to be made occasionally, staff will inform the students about the delay and the reason for it.

Tests will be graded within 10 days.

**University Policies**

University policy regarding grades and grading systems is available at [http://catalog.arizona.edu/policy/grades-and-grading-system](http://catalog.arizona.edu/policy/grades-and-grading-system)

**Requests for incomplete (I) or withdrawal (W)** must be made in accordance with University policies, which are available at [http://catalog.arizona.edu/policy/grades-and-grading-system#incomplete](http://catalog.arizona.edu/policy/grades-and-grading-system#incomplete) and [http://catalog.arizona.edu/policy/grades-and-grading-system#Withdrawal](http://catalog.arizona.edu/policy/grades-and-grading-system#Withdrawal), respectively.

**Dispute of Grade Policy**

If you have an issue with how a quiz, project, or exam was graded, you must submit a request for a regrade (through email) to within 7 days of when the item was returned to you.

**Honors Credit**

Unfortunately, I am not able to offer Honors Credit for this course this semester.

**Scheduled Topics/Activities**

For a list of assignment and test dates, please see the “Assignments and Examinations: Schedule/Due Dates” section above.

The lectures will cover the following material. Note that this schedule is approximate, and may need to be modified slightly during the semester.

Students are responsible for all material covered in lecture (as well as the required reading), even if the actual lectures deviate from this overview.

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Topic</th>
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<tbody>
<tr>
<td>1</td>
<td>11 Jan</td>
<td>Class intro; intro to sorting</td>
</tr>
<tr>
<td>2</td>
<td>16 Jan, 18 Jan</td>
<td>n^2 sorting algorithms; Merge Sort</td>
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<tr>
<td>3</td>
<td>23 Jan - 25 Jan</td>
<td>Quicksort; math review</td>
</tr>
<tr>
<td>Week</td>
<td>Dates</td>
<td>Topics</td>
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<td>------</td>
<td>---------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>4</td>
<td>30 Jan - 1 Feb</td>
<td>Induction; Heaps</td>
</tr>
<tr>
<td>5</td>
<td>6 Feb - 8 Feb</td>
<td>Linear sorts; step counting</td>
</tr>
<tr>
<td>6</td>
<td>13 Feb - 15 Feb</td>
<td>Asymptotic analysis; master method</td>
</tr>
<tr>
<td>7</td>
<td>20 Feb - 22 Feb</td>
<td>--- Russ: at SIGCSE Thurs --- BST review</td>
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<td></td>
<td></td>
<td>--- Midterm 1 ---</td>
</tr>
<tr>
<td>8</td>
<td>27 Feb - 1 Mar</td>
<td>Rotations in BSTs; splay trees and amortized analysis</td>
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<tr>
<td></td>
<td></td>
<td>--- Spring Break ---</td>
</tr>
<tr>
<td>9</td>
<td>13 Mar - 15 Mar</td>
<td>AVL Trees</td>
</tr>
<tr>
<td>10</td>
<td>20 Mar - 22 Mar</td>
<td>Hash Tables</td>
</tr>
<tr>
<td>11</td>
<td>27 Mar - 29 Mar</td>
<td>B-Trees; 2-3-4 Trees; Red-black trees</td>
</tr>
<tr>
<td>12</td>
<td>3 Apr - 5 Apr</td>
<td>Intro to graphs</td>
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<tr>
<td></td>
<td></td>
<td>--- Midterm 2 ---</td>
</tr>
<tr>
<td>13</td>
<td>10 Apr - 12 Apr</td>
<td>Graphs (implementation); Prim’s Algorithm</td>
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<tr>
<td>14</td>
<td>17 Apr - 19 Apr</td>
<td>Dijkstra’s algorithm; algorithm patterns</td>
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<tr>
<td>15</td>
<td>24 Apr - 26 Apr</td>
<td>Algorithm patterns; Theory of computation</td>
</tr>
<tr>
<td>16</td>
<td>1 May</td>
<td>Theory of computation</td>
</tr>
</tbody>
</table>

**Department of Computer Science Code of Conduct**

The Department of Computer Science is committed to providing and maintaining a supportive educational environment for all. We strive to be welcoming and inclusive, respect privacy and confidentiality, behave respectfully and courteously, and practice intellectual honesty. Disruptive behaviors (such as physical or emotional harassment, dismissive attitudes, and abuse of department resources) will not be tolerated. The complete Code of Conduct is available on our department web site. We expect that you will adhere to this code, as well as the UA Student Code of Conduct, while you are a member of this class.

**Classroom Behavior Policy**

To foster a positive learning environment, students and instructors have a shared responsibility. We want a safe, welcoming, and inclusive environment where all of us feel comfortable with each other and where we can challenge ourselves to succeed. To that end, our focus is on the tasks at hand and not on extraneous activities (e.g., texting, chatting, reading a newspaper, making phone calls, web surfing, etc.).

Students are asked to refrain from disruptive conversations with people sitting around them during lecture. Students observed engaging in disruptive activity will be asked to cease this behavior. Those who continue to disrupt the class will be asked to leave lecture or discussion and may be reported to the Dean of Students.

The use of personal electronics such as laptops, iPads, and other such mobile devices is distracting to the other students and the instructor. Their use can degrade the learning environment. Therefore, students are not permitted to use these devices during the class period, except as part of assigned group activities.

**Threatening Behavior Policy**

The UA Threatening Behavior by Students Policy prohibits threats of physical harm to any member of the University community, including to oneself. See [http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students](http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students).

**Accessibility and Accommodations**

At the University of Arizona we strive to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability or pregnancy, you are welcome to let me know so that we can discuss options. You are also encouraged to contact Disability Resources (520-621-3268) to explore reasonable accommodation.
If our class meets at a campus location: Please be aware that the accessible table and chairs in this room should remain available for students who find that standard classroom seating is not usable.

**Code of Academic Integrity**

Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog. See [http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity](http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity).

The University Libraries have some excellent tips for avoiding plagiarism, available at [http://www.library.arizona.edu/help/tutorials/plagiarism/index.html](http://www.library.arizona.edu/help/tutorials/plagiarism/index.html).

Selling class notes and/or other course materials to other students or to a third party for resale is not permitted without the instructor’s express written consent. Violations to this and other course rules are subject to the Code of Academic Integrity and may result in course sanctions. Additionally, students who use D2L or UA e-mail to sell or buy these copyrighted materials are subject to Code of Conduct Violations for misuse of student e-mail addresses. This conduct may also constitute copyright infringement.

**UA Nondiscrimination and Anti-harassment Policy**

The University is committed to creating and maintaining an environment free of discrimination; see [http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy](http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy).

Our classroom is a place where everyone is encouraged to express well-formed opinions and their reasons for those opinions. We also want to create a tolerant and open environment where such opinions can be expressed without resorting to bullying or discrimination of others.

**Additional Resources for Students**

UA Academic policies and procedures are available at [http://catalog.arizona.edu/policies](http://catalog.arizona.edu/policies).

Student Assistance and Advocacy information is available at [http://deanofstudents.arizona.edu/student-assistance/students/student-assistance](http://deanofstudents.arizona.edu/student-assistance/students/student-assistance).

**Confidentiality of Student Records**


**Subject to Change Statement**

Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor.