

Course Description

Instructor. Prof. Richard Chang <chang@umbc.edu>

Office Hours (ITE 326): Tu & Th 3pm - 4:30pm, Wed 2:00pm - 3:00pm

Teaching Assistant. TBA

Course Web Page. <http://umbc.edu/~chang/cs641>

Time & Place. Tue & Thu 10:00am – 11:15am, Sondheim 112

Textbook. *Introduction to Algorithms*, fourth edition, Cormen, Leiserson, Rivest and Stein.
MIT Press (ISBN: 978-0262046305).

References.

- *Algorithm Design*, Kleinberg and Tardos. Addison Wesley, 2006.
ISBN: 0-321-29535-8.
- *Algorithms*, Dasgupta, Papadimitriou and Vazirani. McGraw-Hill, 2006.
ISBN: 978-007352340-8.

Prerequisites. An undergraduate course on algorithms is a prerequisite for this class. At UMBC, the undergraduate algorithms course (CMSC 441) uses the same textbook and typically covers Chapters 1-4, Appendix A (Big-O notation, recurrences and summations), Chapters 6–9 (Heapsort, Quicksort, “linear-time” sorts and linear-time median algorithms), Chapter 15 (dynamic programming), Chapter 16 (greedy algorithms) and Chapters 22–25 (graph search algorithms, minimum spanning trees and shortest path algorithms). In addition, hash tables and balanced binary trees are covered in CMSC 341 Data Structures. There will be minimal overlap in the material covered in the CMSC 441 and CMSC 641. If you are not familiar with some of these topics, you must have enough preparation to review the material on your own.

Objectives. The objective of this course is to prepare you to learn new algorithms — either from the literature or by designing your own new algorithms. Thus, this class will have you:

1. master advanced algorithm analysis techniques;
2. practice designing "new" algorithms;
3. accumulate the background knowledge needed to read and understand algorithms published in research journals; and
4. develop the writing skills for clear and logical presentation of algorithms..

A secondary goal of this course is to familiarize students with a range of fundamental algorithms.

Grading. Grades will be based upon the following distribution

Homework	39%
Test 0	6%
Tests 1-5	55%

The planned schedule has 13 homework assignments and 6 test topics. However, if a homework assignment or test is canceled and not made up — e.g., UMBC is closed for an extended period — homework will still be worth 39% and tests 61%.

The final letter grade is based on the standard formula:

$$0 \leq F < 60, \quad 60 \leq D < 70, \quad 70 \leq C < 80, \quad 80 \leq B < 90, \quad 90 \leq A \leq 100$$

Grades will not be "curved" — that is, the percentages of A's, B's and C's are not fixed.

Lectures & Reading. Lectures provide a unique opportunity for students to ask questions while we are all physically gathered in one location at the same time. The purpose of the lectures is to explain the parts of the reading that are difficult to understand. *Lectures do not replace reading.* The ability to read and understand the formal language in an algorithms textbook is a skill that you develop by practice.

Tests. There are six test topics:

0. greedy algorithms
1. dynamic programming
2. amortized analysis
3. network flow
4. NP-completeness
5. approximation algorithms.

Each test will consist of one question (possibly with multiple parts) on that topic. Test questions will require students to solve new problems (i.e., not simply regurgitate facts). The tests are *in-person*, closed-book and closed-notes.

Makeup Tests. There are two opportunities to improve your scores on the tests: Tuesday April 2 and Tuesday May 21. Note that May 21 is the final exam period for this class. There will not be an option to do the second makeup tests earlier than May 21, so make your travel plans accordingly.

Makeup tests are optional. On April 2, you may choose to make up **two** of Tests 0, 1 or 2. On May 21, you may make up any of Tests 3, 4 or 5.

If you take the makeup for a test, then your final score for that test will be a **weighted average** of your score on the original test and your score on the makeup test. The original score has a 25% weight and the ~~final~~ ^{makeup} exam score for that topic has a 75% weight.

For example, if you score 80% on the Test 1 on dynamic programming and 95% on the dynamic programming question on the makeup, then your final score for Test 1 would be:

$$25\% \times 80\% + 75\% \times 95\% = 20.00\% + 71.25\% = 91.25\%$$

Note that if you do worse on the makeup test than the original test, then your final score will **decrease**. If you **opt out** of a makeup test, then your score on the original test will be your final score for that test.

Homework Submission. Homework will be submitted online in PDF. You have several options for preparing your responses. You can write on paper and convert to PDF using a smartphone app. This is the recommended method. **Please do not just use your phone's camera app** and take a picture of your work. Use one of many free scanner apps and adjust the settings so that your submission is legible.

You could also use LaTeX (or equivalent) to prepare a document. (Although drawing diagrams could be quite challenging.) If you have a tablet or a 2-in-1 laptop *and* you have some skill with a stylus, you can use one of those. Microsoft Word and Powerpoint are not recommended since they are terrible with math notation.

In any case, *please* use letter size paper (8.5x11 inches) and leave a good margin.

Late Homework. **Homework 0** must be turned in on time, by 11:59pm Tuesday February 8.

Homework 1-12 are due on Thursdays by 11:59pm. If you submit late homework, a deduction will be taken:

1 day late (by Friday 11:59pm)	-5%
2 days late (by Saturday 11:59pm)	-10%
3 days late (by Sunday 11:59pm)	-20%
4 days late (by Monday 11:59pm)	-40%
before next class (by Tuesday 10am)	-100%

Late homework will not be accepted after the start of the next lecture (Tuesday). This allows for timely grading and discussion.

Three times during the semester, you will be allowed to submit a late homework assignment without excuse and without penalty one lecture late (e.g., homework due on Thursday may be submitted on Tuesday by 10am without penalty). One full-credit unexcused late assignment will be accepted for Homework 1-4, one for Homework 5-8 and another for Homework 9-12. You do not accrue any credit for submitting homework assignments on time. For example, if you submitted all of Homework 1-8 on time, you can still only turn in one of Homework 9-12 late for full credit.

Homework Policy. You are allowed to, and even encouraged to, collaborate on homework problems. Collaborators and reference materials must be acknowledged at the top of each homework assignment. However, homework solutions must be written up *independently*. A student who is looking at someone else's solution or notes, whether in print or in electronic form, while writing up his or her own solution is considered to be cheating. **All cases of cheating will be reported to the university, this is standard practice.**

Finally, looking up the solutions to homework problems completely defeats the purpose of homework assignments, which is to train a student's mind to think. Students who bypass this training will do poorly on the test. The primary purpose of doing homework **is not** to obtain the correct solution — it is to practice thinking.

The UMBC Graduate School's academic integrity policy is available from the [Graduate Catalog](#).

University Policies & Resources

Food Insecurity

[Retriever Essentials](#) is a faculty, staff, and student-led partnership that addresses food insecurity in the UMBC community. They offer free groceries, toiletries, baby items, and meal swipes, and have opportunities to engage and volunteer. Pick up items from their pantry, [The Essential Space](#), located in RAC 235 or get a pre-assembled bag of non-perishable food items and personal care products at one of their [Food Zones](#). Email retrieveressentials@umbc.edu about their meal swipe program or to find out how to [volunteer](#) with them.

Accessibility and Disability Accommodations, Guidance and Resources:

Accommodations for students with disabilities are provided for all students with a qualified disability under the Americans with Disabilities Act (ADA & ADAAA) and Section 504 of the Rehabilitation Act who request and are eligible for accommodations. The Office of Student Disability Services (SDS) is the UMBC department designated to coordinate accommodations that creates equal access for students when barriers to participation exist in University courses, programs, or activities.

If you have a documented disability and need to request academic accommodations in your courses, please refer to the SDS website at sds.umbc.edu for registration information and office procedures.

SDS email: disAbility@umbc.edu

SDS phone: 410-455-2459

If you will be using SDS approved accommodations in this class, please contact the instructor to discuss implementation of the accommodations. During remote instruction requirements due to COVID, communication and flexibility will be essential for success.

Sexual Assault, Sexual Harassment, and Gender Based Violence and Discrimination:

[UMBC Policy](#) in addition to federal and state law (to include Title IX) prohibits discrimination and harassment on the basis of sex, sexual orientation, and gender identity in University programs and activities. Any student who is impacted by sexual harassment, sexual assault, domestic violence, dating violence, stalking, sexual exploitation, gender discrimination, pregnancy discrimination, gender-based harassment, or related retaliation should contact the University's Title IX Coordinator to make a report and/or access support and resources. The Title IX Coordinator can be reached at titleixcoordinator@umbc.edu or 410-455-1717.

You can access support and resources even if you do not want to take any further action. You will not be forced to file a formal complaint or police report. Please be aware that the University may take action on its own if essential to protect the safety of the community.

If you are interested in making a report, please use the [Online Reporting/Referral Form](#). Please note that, if you report anonymously, the University's ability to respond will be limited.

Notice that Faculty and Teaching Assistants are Responsible Employees with Mandatory Reporting Obligations

All faculty members and teaching assistants are considered Responsible Employees, per UMBC's [Policy on Sexual Misconduct, Sexual Harassment, and Gender Discrimination](#). Faculty and teaching assistants therefore required to report all known information regarding alleged conduct that may be a violation of the Policy to the Title IX Coordinator, even if a student discloses an experience that occurred before attending UMBC and/or an incident that only involves people not affiliated with UMBC. Reports

are required regardless of the amount of detail provided and even in instances where support has already been offered or received.

While faculty members want to encourage you to share information related to your life experiences through discussion and written work, students should understand that faculty are required to report past and present sexual harassment, sexual assault, domestic and dating violence, stalking, and gender discrimination that is shared with them to the Title IX Coordinator so that the University can inform students of their [rights, resources, and support](#). While you are encouraged to do so, you are not obligated to respond to outreach conducted as a result of a report to the Title IX Coordinator.

If you need to speak with someone in confidence, who does not have an obligation to report to the Title IX Coordinator, UMBC has a number of [Confidential Resources](#) available to support you:

- [Retriever Integrated Health](#) (Main Campus): 410-455-2472; Monday – Friday 8:30 a.m. – 5 p.m.; For After-Hours Support, Call 988.
- [Center for Counseling and Well-Being](#) (Shady Grove Campus): 301-738-6273; Monday-Thursday 10:00a.m. – 7:00 p.m. and Friday 10:00 a.m. – 2:00 p.m. (virtual) [Online Appointment Request Form](#)
- Pastoral Counseling via [The Gathering Space for Spiritual Well-Being](#): 410-455-6795; i3b@umbc.edu; Monday – Friday 8:00 a.m. – 10:00 p.m.

Other Resources

- [Women's Center](#) (open to students of all genders): 410-455-2714; womenscenter@umbc.edu; Monday – Thursday 9:30 a.m. – 5:00 p.m. and Friday 10:00 a.m. – 4 p.m.
- [Shady Grove Student Resources](#), [Maryland Resources](#), [National Resources](#).

Child Abuse and Neglect

Please note that Maryland law and [UMBC policy](#) require that faculty report all disclosures or suspicions of [child abuse or neglect](#) to the Department of Social Services and/or the police even if the person who experienced the abuse or neglect is now over 18.

Additional UMBC Policies on Pregnancy and Parenting; Religious Observances & Accommodations; and Hate, Bias Discrimination & Harassment are described at the [Office of Equity & Civil Rights website](#).

Spring 2024 CMSC 641-01 Design & Analysis of Algorithms, Class Schedule

	Lecture topics	Textbook Reading	HW Assigned	HW Due
1	Tue Jan 30	Introduction + Greedy	15.1--15.4	HW0
2	Thu Feb 01	Greedy		
3	Tue Feb 06	Dynamic Programming	14.1--14.4	HW0
4	Thu Feb 08	Test 0: Greedy	HW1	
5	Tue Feb 13	Dynamic Programming		
6	Thu Feb 15	Amortized Analysis: Intro + Leftist Heaps	16.1--16.4 + handouts	HW2
7	Tue Feb 20	Amortized Analysis: Skew Heaps		
8	Thu Feb 22	Amortized Analysis: Splay Trees	HW3	HW2
9	Tue Feb 27	Test 1: Dynamic Programming		
10	Thu Feb 29	Amortized Analysis: Fibonacci Heaps	Handout	HW4
11	Tue Mar 05	Disjoint-Set Union	19.1--19.4	
12	Thu Mar 07	Network flow	24.1--24.3	HW5
13	Tue Mar 12	Test 2: Amortized Analysis		
14	Thu Mar 14	Network flow	HW6	HW5
	Tue Mar 19	<i>Spring Break</i>		
	Thu Mar 21			
15	Tue Mar 26	Network flow		
16	Thu Mar 28	NP-completeness	34.1-34.5	HW7
17	Tue Apr 02	Makeup Tests 0, 1 & 2		
18	Thu Apr 04	NP-completeness	HW8	HW7
19	Tue Apr 09	NP-completeness		
20	Thu Apr 11	NP-completeness	HW9	HW8
21	Tue Apr 16	Test 3: Network Flow		
22	Thu Apr 18	Approximation algorithms	35.1-35.5	HW10
23	Tue Apr 23	Approximation algorithms		
24	Thu Apr 25	Approximation algorithms	HW11	HW10
25	Tue Apr 30	Test 4: NP-completeness		
26	Thu May 02	Randomized algorithms	5.1--5.3, handout	HW12
27	Tue May 07	Randomized algorithms		
28	Thu May 09	TBD		HW12
29	Tue May 14	Test 5: Approximation Algorithms		
	Tue May 21	Makeup Tests 3, 4 & 5 10:30am - 12:30pm		