

# CMSC 401

## Algorithm Analysis with Advanced Data Structures

### Syllabus

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<b>Catalog listing:</b>	CMSC 401
<b>Course Level:</b>	Undergraduate
<b>Prerequisites:</b>	CMSC 256 and CMSC 302
<b>Instructor:</b>	Tom Arodz
<b>Office:</b>	E4252
<b>Phone:</b>	804-827-3989
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<b>email:</b>	<a href="mailto:tarodz@vcu.edu">tarodz@vcu.edu</a> (start subject line with CMSC401)
<b>Classroom:</b>	Engineering East E2214, TR 9:30am-10:45am
<b>Class website:</b>	Canvas
<b>Office Hours:</b>	TR 11am-noon
<b>TA:</b>	Md Touhiduzzaman

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#### 1.0 – Overview (Catalog Course Description):

Semester course; 3 lecture hours. 3 credits. Prerequisites: CMSC 256 with a grade of C or better and CMSC 302 with a grade of C or better. Topics covered include foundations of algorithm and complexity analysis, advanced data structures including multiple linked lists, balanced trees, and B-trees, hashing and graph representation; incorporating data structures into object-oriented design, analysis of various searching and sorting algorithms. Algorithm design topics include divide-and-conquer, dynamic programming and greedy methods.

#### 2.0 – Course Structure:

Lecture hours/week –	3
Lab hours/week –	0

#### 3.0 – Course Goals

Upon successful completion of this course, the student will be able to:

- Apply mathematical knowledge to analyze algorithm's computational complexity
- Use knowledge of computing to prove correctness of algorithms

- Make correct design choices on the type of data structures and the type of the algorithms to use to solve given problems

#### **4.0 – ABET Criteria Addressed:**

1. Analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions.
2. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.
6. Apply computer science theory and software development fundamentals to produce computing-based solutions.

Other Criteria Addressed:

- Substantial coverage of algorithms and complexity, computer science theory, concepts of programming languages, and software development.

#### **5.0 – Major Topics Covered:**

Week 0 (Jan 18/20): Syllabus review, Algorithm Correctness

Week 1 (Jan 25/27): Algorithm Efficiency, Asymptotic notation

Week 2 (Feb 1/3): Sorting Recap, Solving recurrences

Week 3 (Feb 8/10): Quicksort, Randomized Quicksort - Decision Tree Model

Week 4 (Feb 15/17): Heapsort, Priority Queues, Disjoint Sets

*Test 1 (Feb 24, 9:30-10:45), Study problems discussion: Feb 22*

Week 5 (Mar 1/3): Graphs: Search and Single-Source Shortest Paths

Week 6 (Mar 15/17): Spanning Trees, All-pairs shortest paths

Week 7 (Mar 22/24): Maximum flow, Matchings

Week 8 (Mar 29/31): Hash Tables, Search Trees

Week 9 (Apr 5): B-Trees

*Test 2 (Apr 12, 9:30-10:45), Study problems discussion: Apr 7*

Week 10 (Apr 14): Greedy algorithms

Week 11 (Apr 19/21): Dynamic programming

Week 12 (Apr 26/28): Dynamic programming (cont'd), Optimization, P vs NP

*Test 3 (TBD - on the VCU assigned date/time), Study problems discussion: May 3*

All dates are tentative.

#### **6.0 – Textbook(s):**

Recommended textbook:

Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein,  
"Introduction to Algorithms, Third Edition"

The book is available online at VCU library

- <https://proxy.library.vcu.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&scope=site&db=nlebk&db=nlabk&AN=343613>

## 7.0 – Class Schedule:

- Lecture: TR 9:30 AM – 10:45 PM in E2214 (in-person)
- Lab: None

## 8.0 – Evaluation:

### General Instructions:

**Tests:** There will be 3 tests. Before each test, study problems will be posted and discussed in class.

### Course assignments:

- 1 introductory programming assignment
- 4 programming assignments
- 2 theory assignments

**Late submissions:** 1 day: 20% penalty, 2 days 40% penalty, after 2 days not accepted.

### Grading:

Category	% weight
Introductory Programming Assignment	5%
Programming Assignments	40% (10% each)
Theory Assignments	10% (5% each)
Tests	45% (15% each)

Final grade:

- A (85% - 100%),
- B (70% - 84.99%),
- C (60% - 69.99%),
- D (50%-59.99%),
- F (0%-49.99%)

## 9.0 – Resources needed:

- Java compiler - required
- Canvas - required

Standard computing resources (computer, operating system, editor, PDF viewer, email client, web browser, etc.) - required

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## Technology Support

### Engineering & VCU Resources:

- **Personal Computer Requirement:** For our current system requirements and recommendations, see: <https://egr.vcu.edu/admissions/accepted/computer-recommendations/>
  - **Remote Access to Public Lab computers:** To provide remote access, we use the Citrix App2Go environment to provide full and exclusive control over "the next available" computer in the lab. See this link for more details: <https://wiki.vcu.edu/x/Oa0tBg>
  - **VCU provides a lot of software available for students to download to their personal computers.** For a list of software and the specifics for each, see: <https://ts.vcu.edu/software-center/>. In particular, [Microsoft Office](#) is available free to students.
  - **VCU is transitioning to Canvas.** See the Canvas Student Guide at this link: <https://community.canvaslms.com/t5/Student-Guide/tkb-p/student>
  - **For IT help in the College of Engineering,** see our Wikipedia for "student" help at: <https://wiki.vcu.edu/display/EGRITHELP>
  - **VCU's Technology Services (TS) provides support for "central IT" services.** If you have a technical issue with any of the following services, please submit a ticket with VCU Technology Services at <https://itsupport.vcu.edu/> or call (804) 828-2227. VCU TS maintains and supports these services and will be able to provide assistance to you.
    - VCU Cisco VPN
    - 2Factor or Dual Authentication (DUO)
    - Blackboard/Canvas
    - Gmail or other Google Apps
    - Zoom videoconferencing
    - VCU App2Go (Application server)
    - Resetting VCU password
  - **For IT issues related to College of Engineering teaching and research, email [egrfixit@vcu.edu](mailto:egrfixit@vcu.edu)**  
**For loaner Chromebooks for emergency purposes:** See this link for more details: <https://vcutsmpc.getconnect2.com/>
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Students should also visit <http://go.vcu.edu/syllabus> and review all syllabus statement information. The full university syllabus statement includes information on safety, registration, the VCU Honor Code, student conduct, withdrawal and more.