# Rhodes College

| Advanced Algorithms | Syllabus |
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| COMP 355 – CRN 20515 | Fall 2019 |

**Basic Info:**
- MWF 2:00 – 2:50pm
- Briggs 119
- Course Webpage: http://cs.rhodes.edu/welshc/CS355/F19/
- Prerequisites: COMP 172 and COMP 241 or permission of the instructor

**Instructor**:
- Catie Welsh
  - Office: Briggs 208
  - Email: welshc@rhodes.edu (please include "CS 355" in the subject)
  - Office Hours: Tues/Thurs 10-11:30am or by appointment

**Book**:
- Algorithm Design, by Jon Kleinberg and Eva Tardos, Addison-Wesley, 2005.
- (optional) Introduction to Algorithms, 3rd Edition by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, 2009.

**Course Description:**
This course is an in-depth study of the design and analysis of advanced algorithms, including the performance tradeoffs and resources required by various algorithmic implementations. Major classes of computational problems will be identified and explored. Advanced data structures and approximation heuristics are introduced as required for solution design. Topics will include the Master Theorem, dynamic programming, divide-and-conquer and greedy algorithms.

**Course Objectives:** At the end of this course, you should be able to:
- Analyze the space and time complexity of algorithms.
- Demonstrate a familiarity with major algorithms and knowledge of algorithm design strategies.
- Decide on the suitability of a specific algorithm design technique for a given problem.
- Apply important algorithmic design techniques to solve problems.

**Course Topics:**
The following list of topics is very tentative. Depending on time, some topics may be added or dropped, and the order of topics may change.
- **Algorithm analysis:**
  - Review of algorithm analysis (and summations and recurrences), review of basic graph theory and graph representations
- **Greedy Algorithms:**
  - Interval scheduling, scheduling to minimize lateness, greedy graph algorithms
- **Divide and Conquer:**
  - Mergesort and inversion counting, closest pair
- **Dynamic Programming:**
  - Weighted interval scheduling, longest common subsequences, shortest paths in graphs (Bellman-Ford)
- **Network Flow:**
  - Network flows (Ford-Fulkerson), bipartite matching, edge-disjoint paths, circulations

- **NP and Computational Intractability:**
  - Polynomial-time reductions, the definition of NP, NP-complete problems
- **Approximation Algorithms:**
  - Greedy algorithms and bounds on the optimum. Examples of approximation algorithms (vertex cover, travelling salesman, set cover)

**Workload**:
It is important to stay current with the material. You should be prepared to devote regular weekly hours to this course. Do not wait until the last minute to start your assignments.

**Coursework**:
- Coursework will consist of weekly assignments involving both programming and written components. Programming will be in Python. You should be prepared to do regular work each week to keep up with the material and the assignments.
- Assignments should be submitted at the **beginning of class** on the day that they are due.
- You are allowed to use the course textbook and the course notes for these programs. **The use of any other material to solve the problem sets is forbidden.**
- You are expected to work **individually** on assigned problems. However, you are allowed to *discuss* class material, homework problems, and general solution strategies with your classmates. If group work is allowed, it will be mentioned explicitly in the assignment.

**Collaboration:**
Students should talk to each other about the subject matter of this class and help each other. It is fine to discuss the readings, lectures, and problems and ask questions about them. I encourage such questions in class as well as elsewhere. However, there is a line past which you must not go, e.g., copying a solution from a fellow student, book, website, etc. will cause you to fail the course, or worse. If a significant part of one of your solutions is due to someone else, or something you've read, then you must acknowledge your source. Failure to do so is a serious academic violation. Of course, even after you acknowledge your source you must still understand your solution and write it in your own words. Copying a solution from the web, a book, or classmate will result in failure even if you acknowledge your source, unless you put it in quotation marks and say something like, "Here is Amy's solution, but I don't understand it enough to absorb it and write it in my own words." However, this won't get you much — if any — credit.

A good rule of thumb to follow is to not write up any solutions to homework assignments or programming projects in a group. Feel free to discuss things with your classmates, but the solution should be written alone.

**Class Conduct:**
- I encourage everyone to participate in class. Raise your hand if you have a question or comment. Please don't be shy about this; if you are confused about something, it is likely that someone else is confused as well. Teaching and learning is a partnership between the instructor and the students, and asking questions will not only help you understand the material, it also helps me know what I'm doing right or wrong.
- Do not use your cell phone for calls or texting while in class and silence their ringers.
- If you cannot make it to class for whatever reason, make sure that you know what happened during the lecture that you missed. It is your responsibility, and nobody else's, to do so. The best way to do this is to ask a classmate.
- If you need to leave a class early, inform the instructor in advance. It is rude to walk out in the middle of a lecture.

**Attendance**:

Attendance is expected for each class as material that is not covered in the book may appear in class. If your attendance deteriorates, you will be referred to the dean and asked to drop the course. Attendance and participation may also be considered when assigning a final grade.

**Exams**:

- There will be two midterms and one final exam:
    - **Midterm 1:  Wednesday, September 25, 2019, in class**
    - **Midterm 2:  Wednesday, October 30, 2019, in class**
    - **Final Exam:  Tuesday, December 10, 2019, 5:30-8pm**

**Grade Breakdown:**

- 50% Assignments
- 15% Midterm 1
- 15% Midterm 2
- 20% Final

**Grade Assignments:**

- Grading is based on the below scale:
    - A :    [93%, 100%]
    - A-:    [90%, 93%)
    - B+:    [87%, 90%)
    - B:    [83%, 87%)
    - B-:    [80%, 83%)
    - C+:    [77%, 80%)
    - C:    [73%, 77%)
    - C-:    [70%, 73%)
    - D:    [65%, 70%)
    - D-:    [60%, 65%)
    - F:    [0%, 60%)
- For borderline cases, I may take into account participation, and/or attendance, and improvement during the semester.

**Special Accommodations:**

If you are in need of special accommodations, please register with Student Accessibility Services as soon as possible so that all necessary arrangements can be made.

**Academic Integrity:**

Plagiarism, cheating, and similar anti-intellectual behavior are serious violations of academic ethics and will be correspondingly penalized. If you are concerned about a possible violation of this kind, please talk with me. I understand that being a student at Rhodes can be stressful sometimes and you will have many demands on your time. However, I would much rather have you turn in a partially-completed assignment or do poorly on a test than have you violate the Rhodes Honor Code. I can — and very much want to — help you if you don't understand the material, but violations of academic integrity will be dealt with harshly.

Unless otherwise specified, everything you submit in this course must be your own work and represent your individual effort. These are all included in the definition of reportable Honor Code violations for this course: copying all or part of a solution to a problem, downloading a solution from the internet and submitting it as your own, having someone else provide the solution for you, or allowing someone else to copy from you. If you have any doubt about what type of behavior is acceptable, please talk with me.

**Diversity:**

A diverse learning community is a necessary element of a liberal arts education, for self-understanding is dependent upon the understanding of others. We are committed to fostering a community in which diversity is valued and welcomed. To that end any discrimination or harassment on the basis of race, gender, color, age, religion, disability, sexual orientation, gender identity or expression, genetic information, and national or ethnic origin, will not be tolerated in the classroom.

We are committed to providing an open learning environment. Freedom of thought, a civil exchange of ideas, and an appreciation of diverse perspectives are fundamental characteristics of a community that is committed to critical inquiry. To promote such an academic and social environment we expect integrity and honesty in our relationships with each other and openness to learning about and experiencing cultural diversity. We believe that these qualities are crucial to fostering social and intellectual maturity and personal growth.

Intellectual maturity also requires individual struggle with unfamiliar ideas. We recognize that our views and convictions will be challenged, and we expect this challenge to take place in a climate of open-mindedness and mutual respect.

**Sexual Misconduct Disclosure:**

I will do my best to help any student who comes to me with non-course-related concerns. Please keep in mind, however, that all faculty members are mandated to report any incidents of sexual misconduct that comes to their attention. That means that I cannot keep information about sexual misconduct confidential from the college if you share that information with me, but the college has specific confidentiality and antiretaliation protections in place. The Rhodes Counseling Center or the Student Health Services staff can advise you confidentially. Also, the Title IX Coordinator can help you access other resources on campus and in the local community.

*I reserve the right to alter this syllabus as necessary.*