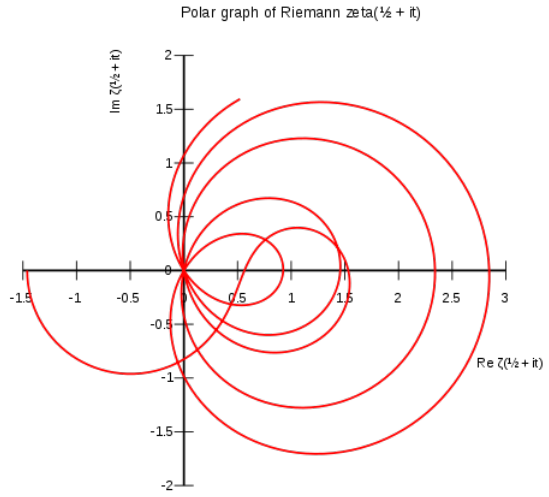
Complex Analysis

Most culture's mathematics begins with the introduction of the counting numbers and their structure under addition, with multiplication following soon thereafter. In western mathematics these two operations (together with the usual comparisons) were the language in which mathematics was written for thousands of years. The inverses of these operations were also considered, though "improper fractions" were socially accepted long before negative numbers were thought to have real meaning. Though one might expect the acceptance of negative numbers to far predate that for complex numbers, the two were finally considered "natural" around the same time when it was discovered that there are integer-coefficient cubic equations with real (positive) roots that nonetheless require square roots of negative numbers to be formulated (you might look up *casus irreducibilis* if you want to find out more about this). This was the first in a long line of discoveries that pointed to the fact that the nature of the complex numbers is important to understand, even if you think you only care about real phenomena.



The goal of this class is to learn what we can about functions of a single complex variable. In many ways this will mean attempting to translate familiar notions from calculus into the complex setting, and we'll see that there are certain surprises in the study of complex functions which one might not have predicted from studying real calculus. A constant theme in the course will be connecting the geometric understanding of the complex numbers with the algebraic operations we perform on them. By the end of the course we will understand the classical results on derivatives and path integrals for complex functions, and we will (hopefully) discuss one of the most important complex functions in all of mathematics: the Riemann zeta function.

1. Course Details

1.1. **Professor.** The professor for this class is Andy Schultz. His office is on the third floor of the Science Center, room S352. His office hours are: Monday from 1:15 to 2:15, Tuesday from 3 to 4, Wednesday from 11 to noon, Thursday from 9 to 10, and Friday from 1 to 2. You are highly encouraged to attend office hours, and you never need an appointment to do so. If these office hours don't fit with your schedule, contact the instructor so that he can either adjust when "official" office hours are held or set up an appointment to help you outside of office hours.

You can contact the instructor at `andrew.c.schultz@gmail.com`. Though he is always happy to receive emails from you with questions or concerns about the course, he can't guarantee that he'll be able to promptly reply to emails late at night or over the weekend. If you do contact the professor by email, please be sure to follow standard email etiquette. In particular, please make sure you include a greeting and signature and avoid abbreviations. If you're contacting him to ask about a problem, please be sure to specify what the problem asks (as opposed to asking something like "I can't get problem 2 and need your help").

1.2. **Text.** The course is centered around Conway's *Functions of One Complex Variable*, 2nd edition. Students will be expected to read from the book in preparation for class each day, and they should treat the book as a helpful reference when attempting to digest lectures.

1.3. **Online resources.** You'll be able to access homework assignments, lecture summaries and copies of quizzes online through the course webpage at `http://palmer.wellesley.edu/~aschultz/f11/math310`. The Sakai site for this class has a forum feature that you can use to ask questions of both the professor and your colleagues. This can be a good way to ask questions to that the whole community can benefit from, so please take advantage of it. The instructor will be checking the forum regularly to answer questions posted there, but you should also feel free to respond to other students' inquiries. If you do respond to another student's question, please be sure to use common courtesy and proper grammar, punctuation and spelling.

2. Expectations

2.1. **Prerequisites.** Students are expected to have completed the first course in real analysis (Math 302) and have a rigorous understanding of the topics from that course, particularly sequences, limits, basic point-set topology, continuity, and the definitions of the derivative and integral. The first weeks of class will be spent reviewing some of these concepts, and students are encouraged to review this material on their own, as a group, or with their instructor.

2.2. **In-class expectations.** A student's engaged presence is expected in classroom lectures. While the professor is in charge of determining what content is covered during a class period, students share the responsibility of directing lectures and discussion sections so each is as clear as possible. In particular, students should feel comfortable stopping the instructor to ask him to repeat a particular exposition, to present a concrete example of an abstract concept, or to explain a confusing concept in a new way. Classroom time is there for the benefit of students, so should be treated as an interactive resource.

2.3. **Attendance.** Mathematics requires that a student understand one concept before moving on to the next, and since our course moves at a fast pace it is critical that you attend class on a regular basis. That said, the instructor won't be formally taking roll in this class. While there is no set penalty for the occasional absence, being absent on the day of an exam will result in a score of 0 on that exam. The only acceptable excuses for missing any assignment or written evaluation are conflicts due to university-related travel, serious personal illness, or family emergency. Notice in particular that minor illnesses are *not excusable.*

2.4. **Effort.** Many students have the impression that "understanding the material" means instantly knowing how to do problems assigned in the class. On the contrary, most students find they don't truly understand the course material until they have struggled through several attempts at solving problems or understanding concepts. You are expected to exert a good amount of effort in working through the course material, and you shouldn't be discouraged if a certain topic remains elusive when you first encounter it: try some suggested problems, go to office hours, and ask your instructor or friends for help when you need it. The typical student will need to put in between 8 and 10 hours per week on the assigned problem set. If you find you are consistently spending more than 12 hours on a give problem set, please discuss this with the professor so he can help you manage the time you spend on this class more effectively.

2.5. **Academic Integrity.** Students are expected to read and understand the college's Honor Code. Incidents where academic integrity have been compromised will be dealt with severely. Although most students have a good feel for what constitutes a violation of the Honor Code, for this class you will also need to be familiar with the instructor's policy on homework collaboration. Please be sure to thoroughly read and understand the section on homework below to avoid an inadvertent violation of the Honor Code.

3. Grading

Your performance in this class is graded based on your ability to perform two tasks. First, you are expected to develop an understanding of concepts covered in the course and an ability to do related computations. Second, you are expected to be able to clearly display your understanding to your instructor and your peers. Though these goals are certainly interrelated, a mastery of one skill does not imply a mastery of the other. For instance, it's possible that you have a good understanding of the course material but can't exhibit this to someone else.

3.1. **Homework.** Homework problems will be assigned each week. Students are to write their solutions neatly and submit them to the envelope on the instructor's door at the allotted time. Each student is given two late passes per semester to accommodate the occasional illness or emergency; late homeworks should be submitted within 5 working days of the original due date.

An important note about collaboration and the Honor Code. Students are more than welcome to work with the instructor or their friends when solving homework problems. In the event that you have taken notes while working with someone else, you must put these notes away and recreate the solutions on your own when you begin writing up your homework assignment. You should also never look at the written solutions of a fellow classmate. If you have any confusion about this policy, please talk to the instructor.

3.2. **Tests.** There will be 2 midterm examinations and 1 final. Both midterms are given during the regularly scheduled lecture period in the regularly scheduled classroom, so there should be no conflicts which prevent you from taking a midterm as scheduled. The first exam will be held on Wednesday, October 5, and the second will be held on Wednesday, November 16. Your final will be self-scheduled.

3.3. **Computing your grade.** Your grade is computed as follows:

- `Midterm 1 ..... 25%`
- `Midterm 2 ..... 25%`
- `Homework Average ..... 25%`
- `Final ..... 25%`