MATH 322, Spring 2017
Real Analysis

Professor: Carl Toews
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Office Hours: TBD (check my webpage)

Class Website: math.pugetsound.edu/~ctoews/teaching/spring17/analysis/

Schedule: MWF 3:00-3:50, T 3:30-4:20, Thompson 399 (reserve T 4:20-4:50 for exams)

Introduction:

This course is the second half of a year-long rigorous introduction to real analysis. The purpose of the course is to leave you well prepared to pursue graduate level studies in this subject.

Because this is an advanced course, one of my goals is to help you start working like a real mathematician. There are three basic skills you need to prosper in this (and many other) fields: one, the capacity to learn information independently from written sources, two, the capacity to express yourself clearly both orally and in writing, and three, the capacity to solve hard technical problems. This course will be writing intensive, with a dual focus on both proof and expository writing. You will be held to very high standards for written work, but given multiple opportunities for revision. Finally, you will be expected to participate actively in class discussion and present solutions to homework exercises to your classmates. In other words, in this class you will work like a real mathematician!

Real analysis is a beautiful, rich, and exciting subject. This course will involve a lot of work, both on your end and on mine, but it will be an exciting journey, and one well worth the effort!

Course Catalog Description:

This course provides a rigorous study of calculus. The course begins with a study of the real numbers and then moves on to the core topics of limits, continuity, differentiation, integration, and series. In the first semester, the focus is on functions of one variable; in the second semester, the focus is on scalar- and vector-valued functions of several variables. Additional topics may include differential geometry of curves and surfaces or vector calculus.

Specific Learning Goals:

After successfully completing this course, you should be able to:

1. Write beautiful proofs.
2. Construct insightful peer reviews of your classmates’ work.
3. Use Latex effectively and comfortably.
4. Communicate mathematics effectively in both written and oral form.
5. Produce well-crafted expository articles on various mathematical themes.

Required Text:

The course will cover Chapter 5-9 of the text.

**Course Structure:**

The structure of this course will be somewhat different from the structure we used in the fall semester. I still intend to use a roughly “flipped” structure in the sense that you will be responsible for reading the text outside of class, and should come to class prepared to discuss concepts, ask questions, and work problems rather than listen to lecture. But based on our experience in the fall, I anticipate incorporating some lecture into the classroom. Another significant difference is that this semester I intend to give exams.

- **Homework:** for each chapter, there will be one problem set. For each problem set, you will make the following submissions:
  - A first shot at all the problems. This should be a good first draft… I expect you to shoot for neat, correct, articulate solutions to all of the problems. I will grade each problem on 0-3 point scale.
  - A typeset solution to one or two problems that have been allocated to you, turned in on the same day you turn in the draft of all the problems. I will grade each typeset problem on 0-3 point scale.
  - A revised version of the typeset problem, revised according to my feedback on the problem. I will grade the revision on a 0-10 point scale.
  - A final version of any problems for which you need to make corrections. I will grade these revised problems on 0-3 point scale, and average your scores with those of your draft versions.

The three point scale should be interpreted as follows:

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
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<tbody>
<tr>
<td>3</td>
<td>Work is correct, free of typographical and grammatical errors, and adheres to principles of effective mathematical communication</td>
</tr>
<tr>
<td>2</td>
<td>Work is mostly correct, maybe with a couple of typographical and grammatical errors; a little weaker in terms of expressive content.</td>
</tr>
<tr>
<td>1</td>
<td>Work is grossly deficient.</td>
</tr>
<tr>
<td>0</td>
<td>Not submitted.</td>
</tr>
</tbody>
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We’ll use Dropbox for most of our submissions, and I will pay strict attention to timestamps. Please make sure things are turned in on time. The various elements of each homework submission will receive the following weights:

<table>
<thead>
<tr>
<th>Element</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full set</td>
<td>60</td>
</tr>
<tr>
<td>Typed draft</td>
<td>20</td>
</tr>
<tr>
<td>Typed revision</td>
<td>20</td>
</tr>
</tbody>
</table>

These weights are subject to revision.

- **Papers:** there will be one substantive expository paper that you need to write over the course of the semester. The paper is to be typeset in Latex, and will involve drafts, revisions, and peer reviews.

- **Exams:** there will be a mid-term exam and a final exam.

**Grade Distribution:**

Points will be assigned for these elements according to the following scheme:
Homework 30%
Exams 30%
Paper 30%
Participation 10%

The final grading scale is as follows:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>&gt; 93.3</td>
<td>73.3 – 76.6</td>
</tr>
<tr>
<td>A-</td>
<td>90.0 - 93.3</td>
<td>70.0 – 73.3</td>
</tr>
<tr>
<td>B+</td>
<td>86.6 - 89.9</td>
<td>66.6 – 69.9</td>
</tr>
<tr>
<td>B</td>
<td>83.3 - 86.6</td>
<td>63.3 – 66.6</td>
</tr>
<tr>
<td>B-</td>
<td>80.0 - 83.3</td>
<td>60.0 – 63.3</td>
</tr>
<tr>
<td>C+</td>
<td>76.6 - 79.9</td>
<td>&lt; 59.9</td>
</tr>
</tbody>
</table>

**Class Expectations:**

*Productive failure* is an idea that lies at the root of my philosophy to teaching (and life in general.) When you’re trying to learn something, never making a mistake is generally a sign that you’re not pushing yourself hard enough. This class should be a safe and supportive space in which to get things wrong. When talking or presenting, you are challenged to work slightly outside of your comfort zone, to volunteer answers when you have a pretty good idea but aren’t 100% certain, to risk a conjecture that might turn out to be off the mark. And when you are listening to fellow students talk, you are challenged to pay strict attention, to flag small errors of language or comprehension, and to politely and respectfully help guide one another towards a clearer and truer picture of the matter at hand. Failure is part of the design spec for this class, and it can be hard, but you will not be struggling alone.

Although the spirit of what I’m shooting for is probably clear, here is a minimalist list of concrete expectations:

- attend class daily
- do all assigned homework by the deadline
- do all assigned reading, in a timely fashion
- participate actively in class discussions and class group work activities
- volunteer to present solutions on the board
- volunteer answers to questions I pose, and to ask your own questions when you are confused, uncertain, or simply thinking outside the box
- be courteous and supportive of your fellow learners
- help create a classroom that is a supportive, energetic, respectful place to learn.

More broadly, my basic hope and expectation is that you will engage this class with enthusiasm, openness, and joy (it *is* fun), and help make this class a fun and supportive place in which to learn.

**Policies:**

*Attendance:*

I expect you to be in class, barring major emergencies. Please be present.

*Late work:*

At this level you should be able to figure out a way to get things in on time. I will not accept late work without some very compelling excuses.

*Planned absences:*

If you need to be absent for some planned family or medical reason, you should contact me in advance. If an emergency arises, contact me as soon as possible after the emergency has passed. Student athletes who need to miss class for games should let me know of this as early as possible.
Classroom policies:
You are welcome to bring a cup of coffee or a bottle of water to class, but please eat your meals outside of class. Please turn off your phones and keep your laptops closed, unless we happen to be doing a computer exercise. You can take a bathroom break if necessary, but please make this the exception, not the rule—in general, I don’t want people entering and leaving the room during class.

Academic integrity:
It is your responsibility to understand the academic integrity policy of the university. You can find this policy in the Academic Handbook, and it is also available online at:
Not citing other people’s work, turning in the same work to satisfy two different classes, citing false information, or plagiarism are all violations of the academic integrity policy. Such violations are taken very seriously, and will be reported if discovered.

Disabilities:
If you have a physical, psychological, medical or learning disability that may impact your course work, please contact Peggy Perno, Director of Student Accessibility and Accommodation, 105 Howarth Hall, 253-879-3395. She will determine with you what accommodations are necessary and appropriate. All information and documentation is confidential.

Classroom Emergency Response Guidance
Please review university emergency preparedness and response procedures posted at www.pugetsound.edu/emergency/. There is a link on the university home page. Familiarize yourself with hall exit doors and the designated gathering area for your class and laboratory buildings.

If building evacuation becomes necessary (e.g. earthquake), meet your instructor at the designated gathering area so she/he can account for your presence. Then wait for further instructions. Do not return to the building or classroom until advised by a university emergency response representative.

If confronted by an act of violence, be prepared to make quick decisions to protect your safety. Flee the area by running away from the source of danger if you can safely do so. If this is not possible, shelter in place by securing classroom or lab doors and windows, closing blinds, and turning off room lights. Lie on the floor out of sight and away from windows and doors. Place cell phones or pagers on vibrate so that you can receive messages quietly. Wait for further instructions.