## Course Description

Topologies are used to define continuous functions. This notion of continuity is quite general and extends the concept of continuity you have seen before for metric spaces. Although the definition of a topology is very simple, the framework it provides is surprisingly powerful. In particular, a topology describes a set's "shape", both locally and in terms of its global structure.

There are two distinct branches of topology: point-set topology and algebraic topology. This course will contain elements of both branches (with my bias as a differential geometer influencing the material). We will start with basic concepts from point-set topology and spend some time with example topological spaces. The point-set portion of the class will culminate in two deep theorems: Urysohn's Metrization Theorem which gives sufficient conditions for a topology to be derived from a metric, and Tychonoff's Theorem concerning the compactness of product spaces. As time permits, the last third of the class will be devoted to elementary algebraic topology, a fascinating field that studies the relations between topological spaces and natural algebraic objects associated them. In this part of the class we will study homotopy theory, the fundamental group, covering spaces and the classification theorem of covering spaces.

## Essential Information

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|---|---|
| Professor: | David Maxwell |
| Office: | Chapman 308C |
| Phone: | 474-1196 |
| Email: | `damaxwell@alaska.edu` |
| Web: | `http://www.math.uaf.edu/~maxwell` |
| Required Text: | **Topology: a first course**, *James R. Munkres*, Prentice Hall |
| Recommended Text: | **Introduction to Topological Manifolds**, *John M. Lee*, Springer-Verlag |

## Prerequisites

MATH F401 (Advanced Calculus) **or** MATH F404 (Topology) **or** permission of instructor. It will be helpful if you have seen a bit of group theory before, but I will give a handout summarizing the basic group theoretic concepts and theorems.

## Class Time

There will be three hours of class lecture each week. We will also have a one hour problem session on Tuesdays at a time yet to be determined. The problem sessions will be an opportunity for you to discuss with each other (with occasional guidance from me) the homework problems due that week.

Lecture Times
MWF 9:15–10:15 Greuning 308

## Office Hours

I will schedule 2 hours a week of formal office hours on consultation with this class and will post the times on my website and outside my office door. I have an open door policy; if I'm in my office and my door is open, please feel free to drop by with questions. You are also

welcome to schedule a meeting outside of my formal office hours by sending me an email.

## Homework

There will be a homework assignment due roughly every week, usually on Wednesdays. Each week's assignment and due date will be announced in class and will be posted on my web page. I will also post solutions after each homework has been handed in.

Regarding late homework, I will accept from each student a single late homework with no questions asked. You must notify no later than the time the homework is due that you intend to take advantage of this opportunity, and you must hand in the homework no later than one week after it was due. Subsequent late homeworks will be accepted only under extenuating circumstances to be determined at my discretion.

## Homework Solutions

In an exercise in collaborative mathematics, the class will contribute solutions for each week's homework. The hope here is that the process of creating the solutions will make the solutions themselves more valuable. Here are the ground rules:

1. Students can expect to contribute a solution at a rate of one to two a week. I'll write solutions to the remainder of the problems (and often the hard ones).
2. The solutions must be written in LaTeX.
3. I will assign problems to students in a pseudo-random fashion. That is, I'll try to assign them randomly, but I'll also keep an eye out to ensure that you don't get a hard problem twice in a row.
4. Submit your solutions (by email) to me by 2:00 the day before the assignment is due. I'll review your work and ask for changes if need be.
5. At least once during the semester you should include a (non-handwritten) figure in your solution.
6. Participation in this exercise is included in your homework grade (and is equivalent to another homework assignment).

I reserve the right to adjust these guidelines if I find this exercise can be improved.

## Midterms

There will be one in-class midterm exam. It is tentatively scheduled to be held on Friday, March 11. Associated with this midterm, there will also be a take-home midterm to be handed out on Friday, March 4.

## Final Exam

There will be a two-hour final exam on Wednesday, May 11. It will be held from 8:00am to 10:00am at a location to be announced later. There will also be a take-home portion of the final exam to be handed out in the last week of class and due at 8:00am on May 11. Details on the take-home exam will be announced closer to the end of the semester.

## Evaluation

Course grades will be determined as follows:

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|---|---|
| Homework | 40% |
| Midterm | 30% |
| Final | 30% |

Letter grades will be assigned according to the following scale. This scale is a guarantee; I also reserve the right to lower the thresholds.

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|---|---|---|---|---|---|
| A+ | 97–100% | C+ | 77–79% | F | $\leq 59$ |
| A | 93–96% | C | 73–76% | | |
| A- | 90–92% | C- | 70–72% | | |
| B+ | 87–89% | D+ | 67–69% | | |
| B | 80–86% | D | 63–66% | | |
| B- | Not given. | D- | 60–62% | | |

## Tentative Schedule

| Week | Topics and Events |
|---|---|
| 1/21 | Review of Metric Spaces; Topologies (Section 12) |
| 1/24 – 1/28 | Bases, example topological spaces, closed sets (Sections 12, 13, 14, 16) |
| 1/31 – 2/4 | Convergence, continuity, manifolds (Sections 14, 17, 18) |
| 2/7 – 2/11 | New topological spaces from old. Quotient Spaces (Sections 19, 22) |
| 2/14 – 2/18 | Connectedness and compactness (Sections 23–26) |
| 2/21 – 2/25 | More on compactness, nets (Sections 26–27) |
| 2/28 – 3/4 | More nets, Countability and separation axioms (Sections 30, 31) |
| 3/7 – 3/11 | Normal spaces, Urysohn Lemma (Sections 32, 33)<br>Friday: Midterm |
| 3/14 – 3/18 | Spring Break (no classes). |
| 3/21 – 3/25 | Tietze Extension Theorem, Urysohn Metrization Theorem (Sections 33, 35)<br>Friday: Last day to withdraw with a 'W' |
| 3/28 – 4/1 | Axiom of Choice, Zorn's Lemma, Tychonoff Theorem (Sections 32, 33, 35 ) |
| 4/4 – 4/8 | Homotopy, fundamental group, homotopy equivalence (Sections 51, 52, 58) |
| 4/11 – 4/15 | More on homotopy, retractions (Sections 58, 55) |
| 4/18 – 4/22 | Fundamental group of the circle and some other spaces (Sections 54, 53) |
| 4/25 – 4/29 | Universal covering spaces and the classification theorem (Sections 79, 81, 82)<br>Friday: SpringFest (no classes) |
| 5/2 – 5/6 | Classification theorem continued<br>Friday: Last day of class |
| 5/9 – 5/13 | Exam week<br>Wednesday: Final Exam: 8:00-10:00 |

## Rules and Policies

### Collaboration

You are encouraged to work together in solving homework problems. But each student must

write up his or her own solutions independently. If you receive significant help solving a problem, it is customary to make a note in your homework to give the person who helped you credit.

**Makeup Exams**
You can make up an exam if certain extenuating circumstances prevent you from taking it and if you inform me in advance. Contact me as soon as possible if you are going to miss an exam.

**Attendance**
Attendance is not included directly as part of your grade.

**Cell Phones**
Turn off your cell phone before you come to class. Refrain from texting.

**Disabilities Services**
I will work with the Office of Disabilities Services (203 Whitaker, 474-7043) to provide reasonable accommodation to students with disabilities.

**Incomplete Grade**
Incomplete (I) will only be given in Computer Science, Mathematics or Statistics courses in cases where the student has completed the majority (normally all but the last three weeks) of a course with a grade of C or better, but for personal reasons beyond his/her control has been unable to complete the course during the regular term. Negligence or indifference are not acceptable reasons for the granting of an incomplete grade. (Note: this is essentially the old University policy.)

**Late Withdrawals**
A withdrawal after the university deadline from a Department of Mathematical Sciences course will normally be granted only in cases where the student is performing satisfactorily (i.e., C or better) in a course, but has exceptional reasons, beyond his/her control, for being unable to complete the course. These exceptional reasons should be detailed in writing to the instructor, department head and dean.

**Academic Dishonesty**
Academic dishonesty, including cheating and plagiarism, will not be tolerated. It is a violation of the Student Code of Conduct and will be punished according to UAF procedures.