Math 266x: Categorical Homotopy Theory[1]

Emily Riehl

General information

Lectures.
TTh 10-11:30 am in Science Center 113

Course website.
http://www.math.harvard.edu/~eriehl/266x

Contact.
Email: eriehl@math.harvard.edu
Office: Science Center 320

Office hours.
M 1-2, W 11-12, or by appointment

Lectures notes.
Lecture notes will be made available on the course website, which will also include suggestions for supplementary reading.

Course content

Overview. We intend to largely follow the original course description:

> A survey of categorical tools for homotopy theory emphasizing the formal relationships among the following topics: weak factorization systems, model categories; enriched categories; Kan extensions, derived functors; homotopy colimits, the bar construction; ∞-categories.

though we won't present the topics in quite this order.

Schedule. The following schedule is subject to revision based the interests and background of those attending the course[2]. In particular, I may change my mind about what we do after spring break. Anyone with a strong opinion about this is encouraged to speak up during the first few weeks of the term.

1/24	Kan extensions
1/26	derived functors via deformations
1/31	basic enriched category theory
2/2	the (co)bar construction
2/7-2/9	homotopy colimits, the theory and the practice
2/14-2/16	weighted limits and colimits
2/21-2/23	enriched homotopy theory
2/28-3/1	weak factorization systems and model categories
3/6	formal properties of simplicial sets
3/8	homotopy coherence and simplicial categories
3/20-4/24	∞-categories emphasizing homotopy coherence and homotopy (co)limits

[1] Spring 2012.

[2] It is also conceivable that I have been characteristically over-ambitious in my expectations about what might reasonably be covered in an hour and a half.

Assessments

Overview. Official enrollees will be expected to complete

- written assignments due in class on alternate Tuesdays
- oral assignments due on alternate Fridays
- a final exam, to be completed during the week of April 23-27th.

Anyone who intends to take this course for credit is requested to come and see me sometime before Friday, January 27th to introduce themselves and discuss their mathematical background.

Written assignments. Problem sets will be due in class on February 7th, February 21st, March 6th, March 20th, April 3rd, and April 17th. No late homework will be accepted. Each biweekly problem set will be approximately the length of an ordinary weekly problem set and composed of exercises appearing in the lecture notes.

Oral assignments. Students are also required to give short oral presentations at the board[3] in my office on a previously specified topic related to the lecture material. Presentations are due by 5pm on February 3rd, February 17th, March 2nd, March 30th, and April 13th. Each individual is expected to schedule his or her own meetings at some point during that week. **February 3rd's assignment is to state and prove the Yoneda lemma.**

The purpose of these exercises is pedagogical: insuring that enrollees stay reasonably up to date with the course material and allowing me to address gaps in background knowledge. The discussion topics are chosen to emphasize the ideas of greatest importance inside and outside of this course.

The grading scheme will be pass (full credit) or fail (no credit), where passing signifies that the student has succeeded in communicating a reasonable understanding of the assigned material.

Final. An oral final exam will be held by appointment anytime during the week of April 23-27. I will provide a list of questions by April 19th at the latest and will ask a subset thereof during the exam. The format will be similar to the oral assignments though will take somewhat longer.

The purpose of this exam, which will be reflected in its grading scheme, is motivational. The intent is not to differentiate between students, but rather to encourage everyone to take the time to revisit and synthesize the main ideas covered in this course. The experience should be no more (and no less) scary than an ordinary final. I am happy to discuss questions or concerns should they arise.

Course grades. A numerical grade will be assigned based on the following formula: 40% written homework, 40% oral homework, 20% final. The lowest score on either a problem set or an oral assignment will be automatically dropped; the relevant 40% will be computed using the remaining $n - 1$ assignments. At minimum, letter grades will be the standard conversion (e.g. A^- for 90%) from the numerical score computed by this formula, though I reserve the right to make upwards adjustments on a case-by-case basis.

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[3] In part to facilitate a somewhat nefarious indoctrinatory objective, by providing me with an opportunity to suggest my preferred notation for certain categorical gadgets.