Homotopical algebra
Autumn 2020

Detailed syllabus

1. Category-theoretic foundations

    (a) Categories, functors, and natural transformations

    (b) Adjunctions

    (c) Limits and colimits

    (d) Simplicial sets and geometric realization

2. Model categories and their homotopy categories

    (a) Definitions, examples, and elementary properties

    (b) The homotopy relation in a model category

    (c) The homotopy category of a model category

    (d) Derived functors, Quillen pairs, and Quillen equivalences

    (e) Creation of model structures

3. An introduction to ∞-categories

Evaluation

Each week you will receive a set of exercises, of which you will have to hand in one to be graded. The average exercise grade will count for 30% of the final course grade.

The final exam will be a three-hour written test.

Bibliography

1. Bayeh, M.; Hess, K.; Karpova, V.; Kedziorek, M.; Riehl, E.; and Shipley, B., *Left-induced model category structures and diagram categories*, Contemporary Mathematics **641** (2015) 49-81.

2. Dwyer, W. G. and Spaliński, J., *Homotopy theories and model categories.* Handbook of algebraic topology, 73-126, North-Holland, Amsterdam, 1995.

3. Hess, K.; Kędziorek, M.; Riehl, E.; and Shipley, B., *A necessary and sufficient condition for induced model structures.* J. Topol. 10 (2017), no. 2, 324-369.

4. Hirschhorn, P., *Model categories and their localizations.* Mathematical Surveys and Monographs, 99. American Mathematical Society, Providence, RI, 2003. xvi+457 pp.

5. Hovey, M., *Model categories.* Mathematical Surveys and Monographs, 63. American Mathematical Society, Providence, RI, 1999. xii+209 pp.

6. May, J. P. and Ponto, K., *More concise algebraic topology: Localization, completion, and model categories.* Chicago Lectures in Mathematics. University of Chicago Press, Chicago, IL, 2012. xxviii+514 pp.

7. Riehl, E., *Categorical homotopy theory.* New Mathematical Monographs, 24. Cambridge University Press, Cambridge, 2014. xviii+352 pp.