

TOPICS FOR PROSEMINAR ON ALGEBRAIC TOPOLOGY AND CATEGORY THEORY

BASIC ALGEBRAIC TOPOLOGY

- Review of spectral sequences.
(Bockstein)
(Serre)
(Milnor-ROthenberg-Steenrod)
(Eilenberg-Moore)
- Cohomology operations, the cohomology of Eilenberg-MacLane spaces, and the Adams spectral sequence.
- Characteristic classes and calculations of the cohomology of classifying spaces.
- Introduction to topological K -theory.
(Bott periodicity)
(The Atiyah-Segal completion theorem)
(Equivariant K -theory)
- Introduction to cobordism.
(Thom cobordism theorem)
(Calculation in the real and complex cases)
(Detection by characteristic numbers)
(Brown-Peterson spectra)
(Formal groups)
- Introduction to algebraic K -theory.
(Low dimensions)
(The plus construction)
(The Q construction, $+$ = Q)
(Waldhausen K -theory)
- Introduction to iterated loop spaces, with calculations.
- Equivariant homotopy theory, unstable and stable.
($RO(G)$ -graded cohomology, the Connor conjecture)
- The Sullivan and Segal conjectures and some applications. Maps between classifying spaces, unstable and stable.
- The nilpotency theorem and related topics.
- The Adams-Novikov spectral sequence and chromatic theory.
- Computational brave new algebra.
(Hochschild and cyclic homology for background)

(THH , TR , TC ; relationship with algebraic K -theory)
 (Some calculations)

- HKR theory

FOUNDATIONAL TOPICS

- Localization and completion, from an elementary viewpoint.
- Model categories: philosophy, theory, and examples.
- Localization and completion, from a model category perspective.
- Stable model categories, derived categories, and triangulated categories.
- Structured stable homotopy theory and brave new algebra.
 (The various modern model categories of spectra)
 (E_∞ -ring spaces and E_∞ -ring spectra)
 (Permutative and bipermutative categories; multicategories)
- Applications: Orientation theory in theory and practice. Algebraic and topological K -theory intertwined.
 (Brauer lift and Quillen's calculations)
 (The Adams conjecture and J -theory)

CATEGORY THEORY

- Enriched category theory.
 (weighted limits)
 (enriched Kan extensions)
- Enriched model category theory.
- Bicategories and their applications.
- Model categories and 2-categories.
- Homotopy theory of higher and wider categories.
- Quasicategories and other $(\infty, 1)$ -categories.
- Categorification philosophy and examples, Khovanov homology.
- Higher category theory.
 (Strict n -categories)
 (The homotopy hypothesis)
 (Operadic approaches)
 (Segalic approaches)
 (Opetopic approaches)
 (Presheaves and Joyal's approach)
 (Comparisons)
- Day tensor product.
- Factorization systems and weak factorization systems.
- Transfinite constructions.
 (Kelly's paper)
- Fibrations and topological functors.

- Universal algebra.
(theories, operads, monads, pseudo algebras, and so on)
- Monadicity Theorem, Adjoint Functor Theorem
- *Ind* and *Pro* objects.
- Nerve Theorem of Leinster and Weber
- Joyal's Θ .
- Cisinski Theory.
- Generalized Reedy categories of Berger–Moerdijk with example of Segal's category Γ and Conne's cyclic category Λ .