

TOPICS FOR PRO-SEMINAR 04-05

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ABSTRACT. This year, we will be experimenting with a somewhat new format for the proseminar, in which students will give lectures on a variety of classical and contemporary topics. We have formulated a (partial) list of subjects for such talks, which we are making available now in case some people would like to give some thought to their lectures over the summer.

Foundational topics:

- (1) Postnikov invariants
- (2) Spectral Sequences (References: books of Bott & Tu, Weibel, McCleary, and research articles, particularly of Serre)
- (3) Cohomology operations (the Steenrod algebra and its dual) (References: Book of Steenrod & Epstein and papers of Cartan-Serre and Milnor)
- (4) Group cohomology (books of Evens, Brown)
- (5) Characteristic classes (Ref: Milnor & Stasheff)
- (6) Cobordism (Books of Stong and Kochman, Thom's original paper, chapter in May's book)
- (7) Exotic Spheres (papers of Milnor and Kervaire-Milnor)
- (8) The finiteness obstruction (Wall's paper, survey by Mislin)
- (9) Spectra (start with chapter 3 of Adams's book?)
- (10) Model categories (Paper of Dwyer-Spalinski; book of Hovey)
- (11) Rational homotopy theory (book of Félix-Halperin-Thomas)
- (12) Simplicial Techniques and the homotopy theory of categories (books of May and Goerss-Jardine; paper of Curtis)
- (13) The Adams spectral sequence and related homological algebra (Dan Christensen's thesis published in Adv. Math.)
- (14) Topological K-theory including Bott periodicity and Hopf invariant 1 (books of Atiyah and Gitler et al.)
- (15) Hopf algebras and loop spaces (Paper of Milnor-Moore and Kane's book "Hopf Spaces")
- (16) Localization of spaces and spectra (papers of Bousfield, yellow monster of Bousfield-Kan; also a recent paper of Dwyer)
- (17) Whitehead torsion (Milnor's survey paper in Bull. AMS)
- (18) Equivariant homotopy theory and the Atiyah-Segal completion theorem (Refs: paper of Segal in Publ. IHES; May's Alaska proceedings, survey by Greenlees-May)
- (19) Infinite loop spaces; operads; recognition of n-fold loop spaces (book of Adams; books of May, inventiones paper of Segal)
- (20) Algebraic K-theory (Quillen's paper in Springer LNM 341)

More advanced topics (in somewhat arbitrary order):

- (1) Some of the foundational topics including (but not limited to): the Steenrod algebra, Adams SS, localization, infinite loop spaces, topological K-theory, and algebraic K-theory could be given a second, more advanced talk with a new goal.
- (2) Formal group laws and complex oriented cohomology theories (Chapter II of Adams's blue book)
- (3) The space $\text{Im}(J)$ (Adams: On the space $J(X)$ I-IV, (IV in particular))
- (4) The transfer map (paper of Becker-Gottlieb, more advanced treatments..)
- (5) Intersection homology (papers by Goresky-MacPherson)
- (6) Infinite loop space structure on the mapping class group (papers of Tillmann and Wahl)
- (7) Stable cohomology of the mapping class group (papers by Harer, Ivanov)
- (8) Stable cohomology of general linear group (papers by Quillen, Dwyer, Betley)
- (9) Chromatic picture of stable homotopy theory (Miller-Ravenel-Wilson), Morava K-theory (paper of Morava), etc.
- (10) Nilpotence in stable homotopy theory (Nishida's paper, Devinatz-Hopkins-Smith and Hopkins-Smith)
- (11) Unstable localization and periodicity (papers by Dror-Farjoun, Bousfield, Chachoski)
- (12) Free actions of groups on spheres (Swan's 1960 Annals paper; later work on surgery theory of Wall, Milnor, Madsen-Thomas-Wall..., work on products of spheres of Carlsson etc.)
- (13) Waldhausen theory (papers of Waldhausen)
- (14) Goodwillie Calculus (Calculus I-III by Goodwillie and survey by Kuhn)
- (15) Finite loop spaces are manifolds (Acta paper by Bauer-Kitchloo-Notbohm-Pedersen)
- (16) Maps between classifying spaces (paper of Jackowski-McClure-Oliver, etc.)
- (17) Sullivan conjecture (papers of H. Miller, J. Lannes, book of Schwartz)
- (18) Segal Conjecture (papers of Carlsson, proof via Sullivan conj?, paper by Adams-Haeberly-Jackowski-May)
- (19) generalized cohomology of classifying spaces (paper of Hopkins-Kuhn-Ravenel)
- (20) Elliptic cohomology (see Ando-Hopkins-Smith, Rezk's notes, and Hopkins's two ICM papers)
- (21) p -compact groups (paper of Dwyer-Wilkerson, ICM paper of Dwyer, bourbaki talk by Lannes, Andersen-Grodal-Moller-Viruel classification paper for p odd)
- (22) Exponent results in classical homotopy theory (paper by Cohen-Moore Neisendorfer)
- (23) Brave New Algebra of S-modules, symmetric spectra (Elmendorf-Kriz-Mandell-May and Hovey-Shipley-Smith)
- (24) Combinatorial differential manifolds (papers of MacPherson and Biss)

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