List of Suggested Topics for the Graduate Seminar - Winter 2020 Edition

If you are a Master's student and would like to give an expository talk in the Grad Seminar, here are some ideas for topics you could talk about. Don't feel like you have to restrict yourself to this list, though – if you have a different topic that you'd like to talk about, feel free to email one of the organizers and suggest it!

1   Algebra

- Artin-Wedderburn theorem
- Groupoid theory
- Group extensions
- Group cohomology
- Transcendental field extensions

2   Algebraic Geometry

- Riemann-Roch theorem
- Algebraic curves/ divisors
- Intersection numbers

3   Algebraic Number Theory

- p-adic numbers
- Zeta functions
- Diophantine equations
- Galois groups
- Elliptic curves
- Cryptography

4 Analysis

- Distributions and Schwartz space of rapidly decreasing functions
- Von Neumann algebras
- C^*-algebras
- Sobolev spaces
- Payley-Wiener theorem

5 Combinatorics

- Zaslavsky's theorem
- Stanley-Reisner Ring
- Toric Varieties

6 Computer Science

- Automata theory
- Complexity theory
- Data Analysis (clustering)
- Machine Learning

7 Graph Theory

- Graph representations
- Expander graphs and applications
- Cayley graphs
- Random walks on graphs

8 Geometry and Topology

- de Rham's Theorem
- Poincaré-Hopf
- Fundamental theorem of Morse theory
- Brown representability
- Basic knot theory
- K-theory and Hopf invariant
- Characteristic classes

- Cech cohomology (sheaf)
- Simplectic geometry
- Gauss-Bonnet theorem
- Atiyah-Singer index theorem

9 Probability theory

- Laws of large numbers
- Stochastic processes
- Random walks