All talks will take place in KELLER 302.

Schedule

Monday, Wednesday, Friday:
Isaac Goldbring 9AM-9:50AM.
Marissa Loving 10:30AM-11:20AM
Lunch break
Dmytro Savchuk 1:30PM-2:20PM.

Tuesday, Thursday
Bin Sun 9AM-10:20AM
Sahana Balasubramanya 11AM-12:20PM
Lunch break
Catherine Pfaff 2:30PM-3:50PM

Titles and abstracts:

1) **Marissa Kawehi Loving**

An intro to mapping class groups

Abstract: The mapping class group of a connected, oriented, finite-type surface S, denoted Mod(S), is the group of homotopy classes of orientation-preserving homeomorphisms of S. In this mini-course, we will cover some of the basics of Mod(S) such as finite generation, actions of Mod(S) on various metric spaces (the curve complex, Teichmuller space, etc.), as well as (coarse) models for Mod(S).

Time allowing, in the final lecture, we will explore "big" mapping class groups of infinite-type surfaces, which is an area of increasing interest and is full of open questions and directions.

2) Dmytro Savchuk

Title: Self-similar groups and their applications

Abstract: The main purpose of the minicourse is to introduce the class of self-similar groups (or groups generated by automata) and to survey their applications. These groups were formally introduced in the beginning of 1960's, but it took a while to realize their importance, utility, and, at the same time, complexity. The first understanding of importance of this class came in the 1980's with the discovery of the Grigorchuk group, that served as the simplest example of a Burnside group (infinite finitely generated periodic group) and as the first example of a group of intermediate growth. Many other examples followed soon after providing counterexamples to several other long-standing conjectures. Later, it became clear that this class of groups had connections to other areas of mathematics, such as holomorphic dynamics, combinatorics, analysis on graphs, computer science, cryptography, p-adic analysis and dynamics, and other fields.

The first lecture will be devoted to a gentle introduction of the main notions and terminology with some basic examples of computations. The class of self-similar groups is particularly interesting from computational point of view as many algorithmic problems, while lacking general solutions, do allow many partial algorithms that work in various situations. The second lecture will be devoted to the discussion of contraction property that is an important feature of many of the important examples that is responsible, for example, for the torsion and intermediate properties of the Grigorchuk group and has deep roots in holomorphic dynamics via the construction of iterated monodromy groups proposed and developed by Nekrashevych. In the third lecture we will discuss some applications of self-similar groups to combinatorics and group-based cryptography.

3) Sahana Balasubramanya

   Title: Acylindrically hyperbolic groups - an overview

   Abstract: In this mini-course, I will start by defining acylindrical actions and the class of acylindrically hyperbolic groups, which is a generalization of non-elementary cyclic hyperbolic groups. We shall see that this is a very large class of groups, and discuss properties and results about them. I will then talk about hyperbolically embedded subgroups, and how these generalize the notion of peripheral subgroups of relatively hyperbolic groups. In particular, this will allow us to build many examples of acylindrically hyperbolic groups with vastly varied behavior. Lastly, I will talk about some recent work extending the study of acylindrical actions to products of hyperbolic spaces, and associated results.

4) Isaac Goldbring

Title: Applications of existentially closed operator algebras
Abstract: The notion of an existentially closed structure is the model-theoretic generalization of an algebraically closed field. Existentially closed groups were intensely studied in the 1970s and progress on them often proceeded with an interesting blend of logic and combinatorial group theory. In this mini course, we present two recent applications of the notion of existentially closed structures to operator algebras. After gathering the necessary background material on operator algebras in the first talk, in the second talk we will give a striking application to C*-algebra theory, by discussing the recent result of Amrutam, Gao, Kunnawalkam Elayavalli, and Patchell, proving that the reduced group C*-algebra of a finitely generated free group has the strict comparison property, answering a prominent open question in the subject. (This proof also uses some interesting group theory.). In the third talk, I will present a result of mine from 2020 which gave the first progress on a conjecture of Popa about embeddings of property T tracial von Neumann algebras into ultrapowers with factorial relative commutant. The talks will assume no prior background knowledge in logic or operator algebras.

5) Catherine Pfaff
Title: The parameter space of metric graphs: Culler-Vogtmann Outer Space

Abstract: Culler-Vogtmann Outer Space was constructed by Culler and Vogtmann in 1986 to study the outer automorphism group of the free group. It has continued to be used in the study of these outer automorphism groups, but has also been shown to relate to tropical geometry objects and the space of phylogenetic trees. There are also other versions constructed to study other groups. We will focus on the original version of Culler-Vogtmann Outer Space.

6) Bin Sun

Introduction to hyperbolic groups

Hyperbolic groups are generalizations of free groups and fundamental groups of hyperbolic manifolds. They play major roles in resolving several important problems, such as the Burnside Problem, the Day–von Neumann Problem, and the Virtual Haken Conjecture.
This is a two-part minicourse on the basic theory of hyperbolic groups. In the

first lecture, I will define the notion of hyperbolic groups, provide examples, and discuss the fundamental properties of such groups. In the second lecture, I will talk about Dehn filling and small cancellation–these are methods to construct new hyperbolic groups from old ones. As an application, I will show how to use these methods to construct a finitely generated infinite group in which every element has finite order.