1) *Michelle Chu and Kate Petersen*

Representations of knot groups and associated invariants

Knot complements in S^3 are a rich class of manifolds to study. By the Wallace-Lickorish theorem these are the building blocks of 3-manifolds and can be studied in many ways, from diagrammatic and combinatorial analysis (through Reidemeister moves, and skein diagrams, for example) to an algebraic approach via their fundamental groups (called knot groups). This project will study representations of knot groups and associated invariants.

2) *Anne Thomas and Tullia Dymarz*

Geometry of right angled Coxeter groups

Right-angled Coxeter groups are groups generated by order 2 elements, called reflections, where each pair of reflections either commutes or generates an infinite dihedral group. They are closely related to right-angled Artin groups, yet their large-scale geometry is much less well-understood. They have straightforward word combinatorics and they act on CAT(0) cube complexes, so can be studied using a mixture of algebraic and geometric techniques. In this project we will explore various properties of RACGs, their associated spaces, and related objects.

3) *Johanna Mangahas and Sahana Balasubramanya*

Projection complexes and coarse cubulation

In this project we will explore the role of projection complexes in ways to capture the 'cubical' and/or 'non-positively curved' nature of groups. Specifically we are interested in the settings of coarse median groups and hierarchically hyperbolic groups, which put cubical nonpositively curved groups and mapping class groups under the same umbrella. The embedding of mapping class groups (and more generally of 'colorable' hierarchically hyperbolic groups) into a finite product of quasi-trees is a starting point for this exploration of using projection complexes to clarify the nature of these general families of groups.

4) *Genevieve Walsh and Kasia Jankiewicz*

Finiteness properties of groups

We will study groups with interesting subgroups, e.g. finitely generated subgroups that are not finitely presentable, and higher dimensional analogues. We will look at examples, such as right-angled Artin and Coxeter groups using Bestvina-Brady Morse theory, products of surface groups using homological techniques, and certain hyperbolic 4-manifold groups. We plan to go over the background for understanding these wild subgroups.

5) *Catherine Pfaff and Rylee Lyman*

Stretch factors in Out(F_r) and finite state automata

Associated to a pseudo-Anosov homeomorphism of a surface is an algebraic integer greater than 1 called its stretch factor. These stretch factors (or their logarithms, which are called dilatations) have been intensely studied; a conjecture of Fried asks whether every bi-Perron unit is the stretch factor of some pseudo-Anosov homeomorphism of some finite-type surface, and many people have worked on bounding the least dilatation of pseudo-Anosov homeomorphisms of a given surface. For outer automorphisms of free groups, there is also a stretch factor associated to any train track map representing a fully irreducible outer automorphism of a free group, an Out(F_r)-analogue of a pseudo-Anosov mapping class. Thurston showed that in fact, every algebraic integer greater than 1 occurs as the stretch factor of some train track map, and Algom-Kfir--Rafi gave the first bounds on the least dilatation of Out(F_r). Pfaff and coauthors have described a method for constructing train track maps representing fully irreducible outer automorphisms using finite-state automata. In our project, we would like to investigate the stretch factors that can arise from these constructions: which algebraic integers can arise? Can we bound the least dilatation within a "stratum" of outer automorphisms? Is there a simple relationship between a loop in the automaton representing a fully irreducible outer automorphism and its stretch factor?