Working Group:
Topological Data Analysis

MA 10

Wednesday, July 16

14h15	*Introduction to persistent homology*	Kay Werndli
15h45	*A categorical approach to persistence*	Martina Rovelli

Tuesday, July 22

14h15	*Generalizations I: Zigzag persistence*	Dimitri Zaganidis
15h45	*Applications I: Cancer biology*	Rachel Jeitziner

Wednesday, July 23

14h15	*Generalizations II: Multidimensional persistence*	Jérôme Scherer
15h45	*Applications II: Neuroscience*	Varvara Karpova

Thursday, July 24

14h15	*Recent theoretical developments I*	Justin Young
15h45	*Recent theoretical developments II*	Peter Jossen
16h30	*Discussion and brainstorming*	Kathryn Hess

Abstracts

Introduction to persistent homology

This talk will consist of an introduction to the theory of persistent homology, as it applies to topological data analysis. The four principal types of simplical complexes associated to point cloud data–the Čech, Vietoris-Rips, witness and alpha complexes–will be described and their advantages and disadvantages discussed.

Suggested references: [11] (not the multidimensional part), [12], [18], [30], [47].

A categorical approach to persistence

Bubenik, Scott, and de Silva have developed a more categorical approach to defining and studying the properties of persistent homology, which will be the subject of this talk.

Suggested references: [20], [34]

Generalizations I: zigzag persistence

Some data sets do not admit neat filtrations, but instead organize into a sort of zigzag diagram. In this talk we will see how to adapt the methods of standard persistent homology to fit this more general framework.

Suggested references: [37], [39], [40]

Applications I: cancer biology

In this talk we will see how to apply the tools of TDA to study data coming from experiments in cancer biology. In particular the methods of Progression Analysis of Disease (PAD) and Disease-Specific Genomic Analysis (DSGA) will be introduced and various concrete applications with significant consequences will be described.

Suggested references: [8], [9], [13], [14], [15], [48], [49], [50], [51]

Generalizations II: multidimensional persistence

As real data sets sometimes admit filtrations along many variables, a multidimensional theory of persistence is necessary. The theory and its pitfalls will be explained in this talk.

Suggested references: [11] (the multidimensional part), [17], [22], [41], [42]

Applications II: neuroscience

It is becoming increasingly clear that TDA can be a useful tool in neuroscience as well. Indeed, TDA has been integrated into the Medical Informatics pillar of the Human Brain Project. In this talk we will see a few interesting applications of TDA in this direction.

Suggested references: [52], [53], [55]

Recent theoretical developments I

Mainstream homotopy theorists are starting to work seriously on persistent homology, leading to development of a more powerful and precise theory. In this talk we will consider recent contributions of Blumberg and Mandell to this domain.

Suggested references: [33], [45]

Recent theoretical developments II

Continuing our investigation of recent contributions by homotopy theorists to TDA, we will see in this talk the refinement of homological persistence due to Belchi and Murillo.

After this talk, which will be somewhat shorter than the others, we will have an open brainstorming session.

Suggested references: [32]