LEHIGH UNIVERSITY

Department of Mathematics
A. Everett Pitcher Lecture Series

presents

GUNNAR CARLSSON

Ann and Bill Swindells Professor of Mathematics, Stanford University

THE SHAPE OF DATA

GUNNAR CARLSSON is the Ann and Bill Swindells Professor of Mathematics at Stanford University. He was born in Sweden, and received a B.S. from Harvard University and a Ph.D. from Stanford. Prior to joining Stanford's faculty in 1991, he taught at University of Chicago, University of California San Diego,and Princeton University.

He gave a plenary lecture at the annual meeting of the American Math Society in 1984, and an invited talk at the International Congress of Mathematicians in 1986 on his proof of the Segal Conjecture, which was a major outstanding problem in algebraic topology at the time.

For most of the 21st century, his work has been focused on applications of algebraic topology to data analysis, and he is the cofounder in 2008 of Aysadi Inc., which applies topological methods to help organizations discover insights in data.

In recent years, it has become possible to collect very large amount of data of extremely varied types. Analyzing these data sets is a problem which is now recognized as one of the fundamental intellectual problems facing the scientific and mathematical communities. Topology can be characterized as the study of shape, and most data sets are equipped with a notion of shape, via a metric which captures the notion of similarity of data points. From this observation, one can attempt to adapt topological methods to studying these data. In these talks, we will present a number of methods based on topological methods and ways of thinking, with examples.

Monday, March 18, 2013

MEASURING THE SHAPE OF DATA I: PERSISTENT HOMOLOGY

Lewis Lab 270 - 7:30pm
Lobby reception at 6:45pm

Homology in standard topology is a methodology for "measuring" shape, in terms of invariants which count occurrences of certain kinds of features or patterns in topological spaces. It can be adapted to finite metric spaces via a construction called the Vietoris-Rips complex, which builds an increasing family of complexes parametrized by the positive real line. One can then evaluate homology groups on these complexes, and obtain a diagram of vector spaces with shape the real line. We will describe this construction, together with the associated diagrams of homology groups, and discuss some applications.

Tuesday, March 19, 2013

MEASURING THE SHAPE OF DATA II: EXAMPLES AND GENERALIZED PERSISTENCE

Christmas-Saucon Hall, Room 107 - 3:30pm - coffee and light refreshments preceding the talk

Sinclair Auditorium - 4:10pm

Persistent homology represents homology of finite metric spaces by diagrams of a particular shape. Diagrams of other shapes are also useful for other data analysis questions. We will discuss some of these methods, including multidimensional analogues of persistence, as well as zig-zag persistence, another extension.

Wednesday, March 20, 2013

MAPPING BIG DATA

Christmas-Saucon Hall, Room 107 - 3:30pm - coffee and light refreshments preceding the talk

Sinclair Auditorium - 4:10pm

Another direction in topology is the combinatorial representation of shapes, exemplified by triangulation theorems for manifolds of various kinds. One can do similar things for point cloud data. We will describe such methods, with numerous examples.

The lectures are held in honor of A. Everett Pitcher, who was secretary of the AMS from 1967 until 1988. Pitcher served in the mathematics department at Lehigh from 1938 until 1978, when he retired as Distinguished Professor of Mathematics. He died on December 4, 2006, at the age of 94.

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