Computational Geometric and Algebraic Topology

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Computational topology is a young, emerging field of mathematics that seeks out practical algorithmic methods for solving complex and fundamental problems in geometry and topology. It draws on a wide variety of techniques from across pure mathematics (including topology, differential geometry, combinatorics, algebra, and discrete geometry), as well as applied mathematics and theoretical computer science. In turn, solutions to these problems have a wide-ranging impact: already they have enabled significant progress in the core area of geometric topology, introduced new methods in applied mathematics, and yielded new insights into the role that topology has to play in fundamental problems surrounding computational complexity. At least three significant branches have emerged in computational topology:

- *algorithmic 3-manifold and knot theory*, which seeks practical solutions to the core algorithmic problems that have driven low-dimensional topology, such as testing whether two 3-manifolds are homeomorphic, or whether two knots in $\mathbb{R}^3$ are isotopic;
- *persistent homology*, which developed into a key theory, extending traditional homology to facilitate effective topological data analysis to extract structure from noisy, incomplete, or sampled data;
- *surfaces and graph embeddings*, which have been a fertile breeding ground both for powerful algorithmic tools to attack natural topological problems in several different areas of computing, and for deep structural theorems about minor-closed families of graphs.

These branches have emerged largely independently. However, it is clear that they have much to offer each other. This workshop will be the first significant step to bring these three areas together, to share ideas in depth, and to pool our expertise in approaching some of the major open problems in the field.