WORKSHOP REPORT: HOMOTOPY TYPE THEORY AND UNIVALENT FOUNDATIONS

The Workshop on Homotopy Type Theory and Univalent Foundations of Mathematics took place from May 16 to 20, 2016 at the Fields Institute. With over 100 participants, it was the biggest HoTT/UF event to date.

Homotopy Type Theory is a new area of research, combining homotopy theory (a branch of topology) and type theory (a formal logical system studied in computer science and logic). It is based on the idea that the logical notion of equality can carry more information beyond its truth value and as such may resemble the notion of homotopy between continuous maps. The result is a rich theory, capable of being used in the study of a wide variety of mathematical topics, ranging from homotopy theory and higher category theory, to algebra and analysis. In addition to providing a new viewpoint on these subjects, it also provides a framework in which proofs can be formally verified by a computer.

Homotopy Type Theory has seen a surge of interest recently, with over 50,000 downloads of *The HoTT Book*, an introductory textbook on the topic, and a large number of reading seminars held around the world. However, it can be a difficult area for beginners to break into, as it requires familiarity with several areas of mathematics. For that reason, we decided to ask four leading researchers to give mini-courses on areas of active research in Homotopy Type Theory:

(1) Robert Harper, Department of Computer Science, Carnegie Mellon University, *Computational Higher Type Theory*;
(2) Daniel R. Licata, Department of Mathematics and Computer Science, Wesleyan University, *Cubical type theory*;
(3) Peter LeFanu Lumsdaine, Department of Mathematics, Stockholm University, *Homotopy-theoretic models of type theory*;
(4) Michael Shulman, Department of Mathematics and Computer Science, University of San Diego, *Synthetic homotopy theory.*

These mini-courses assumed some familiarity with the basics of Homotopy Type Theory, and surveyed the main results, techniques, and open problems in their respective topics.

In addition to the mini-courses, we had 5 invited talks and 17 contributed talks, which covered many exciting recent developments in the fields. The invited talks were Benedikt Ahrens, *Categorical structures in type theory, in type theory*; Thorsten Altenkirch, *Why does Homotopy Type Theory matter?*; Jeremy Avigad, *Homotopy Type Theory in Lean*; Emily Riehl, *Towards a synthetic theory of* $(\infty, 1)$*-categories*; and Michael Warren, *Directedness in type theory.*

Thanks in large part to the mini-courses, we saw many non-specialists participating in discussions of open problems and contributing many interesting ideas and viewpoints. Our workshop clearly marks the beginning of many new collaborations.

None of this would be possible without the generous support of our sponsors: The Fields Insitute, The National Science Foundation, The Pacific Institute for the Mathematical Sciences, The Atlantic Association for Research in the Mathematical Sciences, and The Faculty of Science at The University of Western Ontario. Their contributions made it possible for us to provide (at least partial) funding for over 50 of the participants, primarily graduate students and postdocs.

This event will surely have a lasting impact on the future development of the field, and we would like to thank The Fields Institute and its staff for making it possible.