Western-Trained Topologists Serving China: Laurent Lafforgue

Second article in this series

French Topologist Recruited by Huawei

This article is the second in a series of exploring Western trained topologies who work for Chinese companies or who have returned to China to continue their research in Chinese universities. Mathematical topology is increasingly finding applications within Artificial Intelligence (AI), particularly in fields like machine learning. Topology offers a framework for understanding the shape and connectivity of data, which is crucial for analyzing complex datasets and developing robust AI models. This is discussed in detail in the first article in this series.

The first article in this series detailed the professional life of MA Xiaonan who returned to Nankai University in China in November of 2024 after more than 18 years at the University of Paris. He is an expert in differential geometry and topology and the winner of several awards.

This article investigates award-winning French mathematician Laurent Lafforgue who worked for over twenty years at France's Institut des Hautes Études Scientifiques (IHES) before stepping down to join Huawei Technologies in 2021. In his last five years at IHES, he held a university position that was funded by Huawei. Laurent Lafforgue joined Huawei Technologies France to foster a closer collaboration with company's research teams he worked with while at IHES.

Laurent Lafforgue is a mathematician focused new algebraic functorial geometry. In summary, functorial geometry and topology offer a powerful and flexible framework for studying geometric and topological structures. It allows for a more abstract and general understanding of these concepts, opening new avenues for research and applications in various fields.

Further investigation finds that Lafforgue and several other French mathematicians, many of whom have won the prestigious Fields Medal, are part of a Huawei network in France. This network includes Huawei-funded laboratories at French universities, Huawei-funded post-docs at IHES, a Huawei-funded chair position at IHES, a Huawei-funded talent recruitment program at IHES, and French academic collaboration with Huawei affiliated organizations as well as Chinese universities. The scientists involved are affiliated with many French universities including IHES, Paris Diderot University, and Université de Paris-Sud.

Laurent Lafforgue is known for his essential contributions in the fields of number theory and analysis, which earned him the Fields Medal in 2002. His work on topos theory led him to collaborate with the research teams of Huawei Technologies France. Topos theory is a generalization of topology, offering a broader framework for studying spaces and structures, while topology focuses on properties of spaces under continuous deformation.

Discussions between Laurent Lafforgue and Huawei researchers, which began in 2017, first led to a two-year project focused on topos theory and funded by Huawei. In 2019, this relationship led to the creation of the Huawei Chair in algebraic geometry at IHES, of which Professor Lafforgue was the first holder.

IHES' affiliation with Huawei Technologies France will continue to develop, particularly within the framework of the **Huawei Young Talents program**, launched in the fall of 2020. Every year, this Chinese talent recruitment program funds about 7 postdoctoral fellowships.

Lafforgue is also a member the Lagrange Center for Mathematical Computation, established by Huawei in France in 2020. In addition to Laforgue, there are currently three Fields Medal winners working at the Lagrange Center for Mathematical Computation alone. Since 2013, Huawei has established six research and development centers in France.

Lafforgue's Research

Lafforgue began to delve into the field of topos theory as part of the Langlands Project. The Langlands Project was proposed by Canadian mathematician Robert Langlands in a letter to French mathematician André Weil in 1967. He predicted that there was a unified connection between all major mathematical fields.

Just as physicists pursue the grand unification of physics, the Langlands Program believes that there is also such a connection between different branches of mathematics (such as number theory, algebraic geometry, and reduced group representation theory). As such, mathematicians can turn to another field to find answers to problems that cannot be solved in the primary field. But Langlands did not give relevant proofs.

Lafforgue made a breakthrough and proved that Langlands' conjecture is valid in the field of algebraic curve functions, thus establishing a new connection between the two major fields of number theory and analysis, discovering a new geometric construction that may be proved.

In 2017, Lafforgue was invited to give a lecture on his topology research at a mathematics application conference. The development prospects of topology and AI caught the attention of academia and industry. At this conference Lafforgue first came into contact with the Huawei scientific team. Most of his publications after that meeting show him affiliated with the Huawei Research Center, Huawei Fundamental Research Center, and the Huawei Paris Research Center all in Boulogne-Billancourt, France (and presumably all referring to the same organization).

In 2023, Lafforgue traveled to China to give a lecture at the Chinese government supported Beijing Institute of Mathematical Sciences and Applications (BIMSA, 北京雁栖湖应用数学研究院) on the topic of Grothendieck topology, characterized as mathematics for future AI. In essence, Grothendieck topology provides a framework for generalizing the concept of open covers in topology to arbitrary categories, allowing for the definition of sheaves and the study of local properties in a more general setting.

Grothendieck is characterized as a scientist as integral to mathematics as Einstein was to physics. The premise is that topos can become the future mathematics of AI by giving more emphasis to geometric forms. The existing approach favors numbers through statistical procedures.