Seminari Informal de Matemàtiques de Barcelona

***Speaker*:** Albert Alcalde.
University: FAU Erlangen-Nürnberg.

Date: Wednesday, May 6th, 2026.
Schedule: 12:20 talk.
Place: UB (Aula IA) and Zoom.
Language: English.

Title: Geometry and Long-Time Behavior of Attention Dynamics in Transformers.

Abstract: We present a mathematical analysis of attention mechanisms in transformers, the deep learning architecture underlying modern large language models. By viewing attention layers as discrete-time dynamical systems on high-dimensional vector configurations, and by considering suitable scaling limits, we obtain tractable descriptions of their evolution. In this setting, we prove that the dynamics drive representations toward clustered configurations organized around a small number of dominant states, reminiscent of attractors. We also identify metastable regimes in which intermediate clusters persist over long time scales before eventual collapse. Finally, we show that these updates admit an interpretation in terms of projection-free convex optimization, linking transformer dynamics to classical algorithms such as Frank-Wolfe.

About us: *SIMBa* is a mathematics seminar organized by graduate students in the Barcelona area. It is aimed towards graduate and last–year undergraduate students. Our goals are disseminating knowledge from different branches of mathematics for those interested and promoting networking between the attendants.
This seminar is backed by the Faculty of Mathematics and Computer Science at Universitat de Barcelona, Faculty of Mathematics and Statistics at Universitat Politècnica de Catalunya, the Department of Mathematics at Universitat Autònoma de Barcelona, CRM, IMUB and BGSMath.

Fore more information, visit seminari-simba.github.io/en. You may contact us by sending an email to ***seminari.simba@gmail.com***.