

# Theoretical Analysis of Hyperbolic-space-based Machine Learning Models



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Time : 2:00 p.m. - 3:00 p.m.

## ► Abstract

Hyperbolic space has been attracting much attention since it has been experimentally shown that we can obtain much lower-dimensional representations of hierarchical data in hyperbolic space than in Euclidean space. The capability of hyperbolic space to represent hierarchical data effectively is thanks to its property that the circumference in hyperbolic space grows exponentially with respect to its radius. However, the exponential growth speed property implies that hyperbolic-space-based machine learning models could be more complex and thus more likely to suffer from overfitting than Euclidean-space-based ones. Nevertheless, no one had theoretically quantified the overfitting effect (generalization error). We quantitatively analyzed the generalization error of hyperbolic-space-based models for the first time. Our results allow us to clarify the specific condition where a hyperbolic-space-based model outperforms a Euclidean-space-based one and vice versa. In this seminar, I first review the basics of hyperbolic-space-based machine learning and learning theory. Based on the review, I explain our theoretical upper bounds of their generalization errors and their interpretations.

## ► About the Speaker

Atsushi Suzuki is a Lecturer with the School of Computing and Mathematical Sciences, Faculty of Liberal Arts and Sciences, University of Greenwich, London, United Kingdom. Atsushi's research interests include learning theory and optimization, their relation to information theory and geometry, and their application to machine learning. Atsushi received the degree of Doctor of Philosophy in the field of Information Science and Technology from the University of Tokyo, Tokyo, Japan, in 2020. Prior to this, Atsushi received the degrees of Master of Information Science and Technology and Bachelor of Engineering and from the University of Tokyo, in 2017 and 2015, respectively. Atsushi was awarded Research Fellowships for Young Scientists from Japan Society for the Promotion of Sciences from 2018 to 2020. Atsushi has published papers in top-leading academic journals and international conferences, including IEEE Trans. Inf. Theory, ICML, NeurIPS, ISIT, AAI, IJCAI, and ICDM.

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