Speaker: Hannah PINSON

Title: **New perspectives on convolutions and depth in neural networks**

Abstract: Neural networks are powerful models, but we still lack a deep understanding of how, what, and when they learn. In this talk, I will shortly discuss two recent research projects on two fundamental aspects of neural networks [1, 2]: how the use of convolutions influences how, what, and when a network learns, and how the effective complexity of networks develops over depth and time. The first part consists of an overview of the learning dynamics of simplified, linear CNNs as compared to fully connected neural networks. This mathematical analysis reveals which features are learned by (simple) CNNs, and how this relates to the implicit bias of gradient descent and the structure of the dataset. In the second part, I briefly present experimental results showing that layers in deep, non-linear neural networks can operate in both linear-like and truly non-linear regimes, and that the regime they are in often changes during training. The complexity and effective non-linearity of deep neural networks are thus not fixed properties, but these properties evolve over depth and time.

[1] Pinson, H., Lenaerts, J., & Ginis, V. (2023). Linear CNNs Discover the Statistical Structure of the Dataset Using Only the Most Dominant Frequencies. International Conference on Machine Learning, ICML 2023, 202, 27876–27906.

[2] Pinson, H., Boland, A., Ginis, V., Pechenizkiy, M., under review.