# Inverse Approximation Theory of Recurrent Models for Learning Sequences

**Speaker:** Shida Wang (National University of Singapore)

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**Location:** Rm 1801, Guanghua East Tower

**Advisor:** Qianxiao Li (National University of Singapore)

**Abstract:** Learning long-term dependencies remains a significant challenge in sequence modelling. Despite extensive empirical evidence showing the difficulties recurrent models face in capturing such dependencies, the underlying theoretical reasons are not fully understood. In this talk, we present inverse approximation theorems for nonlinear recurrent neural networks and state-space models. Our analysis reveals that appropriate reparameterizations of recurrent weights are crucial for stably approximating targets with long-term memory. We demonstrate that a broad class of stable reparameterizations allows state-space models to consistently approximate any target functional sequence with decaying memory. Additionally, these reparameterizations mitigate the vanishing and exploding gradient problems commonly encountered in training recurrent models.