ABSTRACT FOR THE POSTER

Understanding information encoding in single neuron pairs with functional modelling

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Understanding the mechanisms underlying neuronal spiking activity is essential to study higher- level brain functionalities. This thesis, rooted in bottom - up neuroscience, investigates this phenomenon by culturing neurons on CMOS microelectrode array (MEA) chips to record their electrophysiological activity. A novel dataset was curated to rigorously explore neuronal dynamics and it enabled the training of deep learning models that aimed to replicate single – neuron activity. Building on insights from the paper "Single Cortical Neurons as Deep Artificial Neural Networks", this work extends the scope by modelling biological data using the time – series transformer architecture to address key questions in neural information processing, including the distribution and encoding of information within neuronal spikes, the temporal extent of neuronal memory, and the patterns underlying spiking behaviour. Through the implementation and testing of multiple transformer configurations, this study provides a data - driven perspective on how neurons function. The results underscore the potential of functional modelling for neuronal dynamics, bridge biological and artificial intelligence systems and insinuate where the answers to these questions might lie.