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# Predicting Network Dynamics Based on Neural Connectivity

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Predicting Network Dynamics Based on Neural Connectivity

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Many networks in the brain exhibit internally-generated dynamics—patterned activity that does not reflect changes in external stimuli, but rather is generated intrinsically by the network itself. The source of this internally-generated activity is not well understood, but explanations range from single-cell properties, such as intrinsically oscillatory neurons, to network-level properties, such as complex network connectivity. Past efforts to model and explain the full range of behaviors have involved a variety of complex ingredients, making the models mathematically intractable. In this presentation, we focus on a new minimal model with simple threshold-linear neurons and two-valued synapses whose dynamics are controlled solely by an underlying directed connectivity graph. This model is simple enough to be mathematically tractable, and yet still captures the full variety of internally-generated behaviors. Through this model, we can isolate the role that connectivity plays alone to address the question of how neural connectivity shapes network dynamics.

To answer, we simulate trials of various network connectivity structures to determine patterns of behavior that occur within a family of related connected networks, called necklaces. Within this family, we investigate the roles of various parameters in determining network behavior, such as the number of neurons in each component of the necklace. In particular, we give conditions for the presence/absence of limit cycles. This project is relevant to experimentalists who are investigating the connectome, which is a mapping of the neural connectivity in the brains of different organisms. Our work may help determine why certain network structures developed based on their functionality and may help experimentalists predict the type of connectivity within a given region based on experimental records of neural activity.