

Inferring rules of tissue organisation with neural cellular automata

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The dynamics of a biological tissue arises from the behaviour of its constituent cells and their interactions. Traditionally, in mathematical biology we have built models by combining individual components and interactions into, for example, differential equations or individual-based simulators, and adding further complications as required to describe experimental observations. In this talk I will offer a complementary approach in which we attempt to statistically learn cell-cell interaction models directly from data in interpretable ways. This approach builds on familiar concepts of cellular automata but makes the model differentiable and parameterises the update rule with a neural network, but with physically-informed constraints built in that leave open a path towards interpretation. We have tested this Neural Cellular Automata framework on well established reaction-diffusion models and are now applying it to learn the rules of multicellular pattern formation in vitro models of embryo development.