

# Adventures in Modeling - Exploring Complex Systems with StarLogo

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Research on complex, adaptive systems has made significant advances in recent years in the study of natural and social phenomena. Powerful theories and tools for explaining and predicting the behavior of self-organizing, emergent systems ranging from natural selection and adaptation in local ecologies to economic supply chains now exist. New technologies, especially modeling tools that facilitate parallel computations on models that include many individual agents, have played an important role in developing this area of study.

To model complex adaptive systems, a very specific set of capabilities is needed for modeling tools. Although common modeling programs like Stella and MatLab enable the design and creation of models, to model a system in one of these environments, the creator needs to describe how aggregate quantities change in the system. This top-down method of modeling is not amenable to studying complex systems or systems that are spatially structured. In contrast, agent based modeling tools, in which the behaviors of individuals are modeled, are easy to understand, develop and incorporate spatial structure into.

StarLogo is an agent based modeling tool designed to enable people to build their own models of complex, dynamic systems. Unlike many aggregate based modeling tools, StarLogo supports a tangible process of building, analyzing, and describing models that does not require advanced mathematical or programming skills. In StarLogo (<http://www.media.mit.edu/starlogo>), one writes simple rules for individual behaviors of agents that “live” and move in a two-dimensional environment. For instance, you might create rules for a car, which describe how fast it should accelerate and how far ahead it should look for obstacles. Because StarLogo makes use of graphical output, when you watch many cars simultaneously following those rules, you can observe how patterns in the system, like traffic jams, arise out of the individual behaviors. Building models from the individual, or “car”, level enables people to develop a better understanding of the system level behaviors.

In this class we will explore the process of building and testing models of complex systems, and investigate specific models of traffic jams and pedestrian walkways.

*Below: A StarLogo model of a traffic jam*

