NetLogo Mobile: An Agent-Based Modeling Platform and Community for Learners, Teachers, and Researchers

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Abstract: A complex systems perspective provides a major opportunity for learning. NetLogo is a powerful tool to foster computational thinking with complex systems. This poster reports on our prototype of NetLogo Mobile, a new interface to NetLogo designed for wide scaling. We introduce its underlying design principles. Through scaling the community, expanding the interactive repertoire, and scaffolding, we empower a variety of stakeholders to create models and curricula for localized needs, embracing learning designs and social behaviors to emerge.

Introduction

Powerful ideas are ideas that can be used as tools to think with over a lifetime (Papert, 1980). The idea of a complex system is inherently powerful. A complex systems perspective enables overcoming the deterministic-centralized mindset (Wilensky & Resnick, 1999), and provides a major opportunity to bridge the widening gap between our current best understanding in academia and the working knowledge of professionals, policy makers, and citizens (Jacobson & Wilensky, 2006). NetLogo, the most widely used agent-based modeling language (with hundreds of thousands of users worldwide), is a powerful tool to foster computational thinking with complex systems (Wilensky, 2001; Wilensky & Rand, 2015). However, its interactive design and visual representation is now two decades old, and it does not well support mobile platforms, which offer many new opportunities for learning (Sharples, et, al., 2009). While a number of efforts such as NetLogo Web (Wilensky, 2015) or NetTango (Horn & Wilensky 2011; Horn, et al., 2014) have been designed to further scale NetLogo, there still exists much room for an innovative design to draw on the full power of the mobile age and empower all stakeholders.

While NetLogo is in widespread use, our belief is that there is great potential to significantly further scale the NetLogo community. In this poster, we report on a prototype implementation of NetLogo Mobile, a new modern interface to the NetLogo agent-based modeling platform, for which we are designing supports for a community for learners, teachers, and researchers. Our goal is to enable the community to 1) design, develop, and use agent-based models with a more intuitive and scaffolded interactive design; 2) share and discuss their models in an online community; 3) deploy their agent-based modeling experiences more felicitously including educational research-oriented features, 4) collaborate remotely through future design. To sum up, NetLogo Mobile is designed to serve both informal and formal learning, students, citizens, and researchers, aiming at a wide social impact.

Design principles

Focus on the constructionism goal with a mobile-friendly interactive design

Following Logo's example, NetLogo is intentionally built upon constructionist principles (Papert, 1980; Wilensky, 2001). Hence it is our main goal to not only maintain the existing constructionist features and the ability to build an endless variety of simulations, but expand the degree of freedom with a mobile-friendly interactive design. Stakeholders may construct both agent-based models and *interactive curricula* around it; distribute, fetch, and remix them through the built-in online community; draw upon not only the current NetLogo models library and modeling commons, but also a rich library of templates, visual/audio representations, and code snippets. We aim to empower the community to create a mobile-friendly experience with a standardized set of design primitives scaffolded by intuitive interface design and abundant resources from the community.

Leave important design decisions to stakeholders as much as possible

While we are significantly expanding the interactive repertoire of NetLogo, e.g., by introducing a 3D rendering layer and Augmented Reality (AR) support, the nature of learning requires us to maximize stakeholders' design repertoire. By allowing variations in a massive online learning community, we expect a large number of emergent learning designs targeting at different localized contexts and needs. Highlighted features include:

- To create, design, and modify agent-based models in either block-based or text-based editors, or both;
- To switch between realistic 3D, simplistic 3D, or vanilla NetLogo 2D graphics, with or without AR;

- Customizable interface widgets for users to draw upon with a standardized design.

Empower researchers to study a massive audience with research-oriented features

While NetLogo Mobile aims at a massive audience, it is also designed for researchers to study its use. We intend to build several research features into it, including a) contextual surveys, b) session recording and analysis, 3) automatic A/B testing, 4) full privacy control and electronic IRB consent, in order to empower researchers with features available in both localized or general environment.

Current progress

At the time of this abstract, we have created a full-scale working prototype of NetLogo Mobile, received feedback from fellow researchers and another online constructionist learning community (Physics Lab AR) informally. It is compatible with the models library of NetLogo Web and smoothly runs all models without modification. It supports Windows, Mac, iOS, and Android platforms. The poster will be accompanied by an interactive demo.

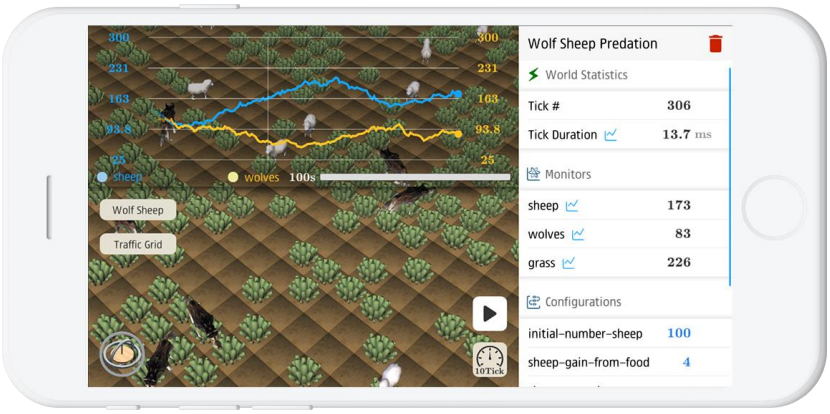

Figure 1. Screenshot. Note the real-time 3D rendering in phones & tablets and mobile-friendly UI.

Future work and implications

NetLogo Mobile is planned to launch an initial release in 2020, with the expectation that it will continue to develop for years to come. We expect that its instrumentation for research studies will lead to realizing its full potential. At this time, we are particularly interested in: a) the emergent learning designs for localized needs and their effects on learners; b) how to convey the powerful ideas in an informal, online, and massive setting; c) the emergent social behaviors in its learning community and how we can design to better support them.

References

Horn, M. S., Brady, C., Hjorth, A., Wagh, A., & Wilensky, U. (2014). Frog Pond: A code-first learning environment on evolution and natural selection. In IDC 2014 - Proceedings of the 2014 Conference on Interaction Design and Children (pp. 357-360).

Sharples, M., Arnedillo-Sánchez, I., Milrad, M., & Vavoula, G. (2009). Mobile Learning. In N. Balacheff, S. Ludvigsen, T. de Jong, A. Lazonder, & S. Barnes (Eds.), Technology-Enhanced Learning: Principles and Products (pp. 233–249).

Jacobson, M. J. & Wilensky, U. (2006). Complex Systems in Education: Scientific and Educational Importance and Implications for the Learning Sciences, Journal of the Learning Sciences, 15:1, 11-34.

Papert, S. (1980). Mindstorms: Children, computers, and powerful ideas. Basic Books, Inc.

Wilensky, U. (1999). NetLogo. Evanston, IL: Center for Connected Learning and Computer-Based Modeling, Northwestern University. http://ccl.northwestern.edu/netlogo.

Wilensky, U. (2001). *Modeling nature's emergent patterns with multi-agent languages*. Proceedings of the Eurologo 2001 Conference, Linz, Austria.

Wilensky, U. (2015). NetLogo Web. Evanston, IL: Center for Connected Learning and Computer-Based Modeling, Northwestern University. http://www.netlogoweb.org.Wilensky, U. & Resnick, M (1999). Thinking in Levels: A Dynamic Systems Approach to Making Sense of the World. Journal of Science Education and Technology. 8:1, 3-19.

Wilensky, U. & Rand, W. (2015). An introduction to agent-based modeling: modeling natural, social, and engineered complex systems with NetLogo. MIT Press.