

# Bio-Design Automation in Synthetic Biology - Prof. Douglas Densmore, Boston University

Synthetic biology looks to engineer novel biological systems. One approach is through the use of standardized biological parts. These parts are combined to realize specific functionality in the areas of bio-remediation, bio-sensing, and bio-therapeutics. However, currently the complexity of these systems (e.g. part integration, part performance, environmental factors) are limiting our ability to reliably and consistently develop larger biological devices. Computer aided design techniques have the potential to address this growing complexity in the following areas:

1. **Specification** - High level descriptions of biological systems constructed from primitive biological “parts” need to be formally described with domain specific syntax and semantics. In addition to the system composition, expressive constraint systems must be formally developed regarding part composition and characterization.
2. **Design** - Multiple abstraction levels (e.g. DNA sequence vs. biological function) must be available to designers in a coherent design environment. Specifically tools must be available for the management, creation, and storage of new biological data in standardized, community based repositories of biological building blocks.
3. **Assembly** - The optimized, physical assembly of DNA information for a wide variety of assembly chemistries must be explicitly part of the tool chain and introduce design automation concepts such as advanced laboratory information management systems and liquid handling robotics.

My research proposes a software tool ecosystem which explicitly addresses these three areas. The cornerstones of this ecosystem are the *Clotho* [3] design environment and the *Eugene* [2], [1] domain specific language. Not only are these approaches revolutionary in the synthetic biology community but also are currently poised to set the benchmark for state of the art in the field.

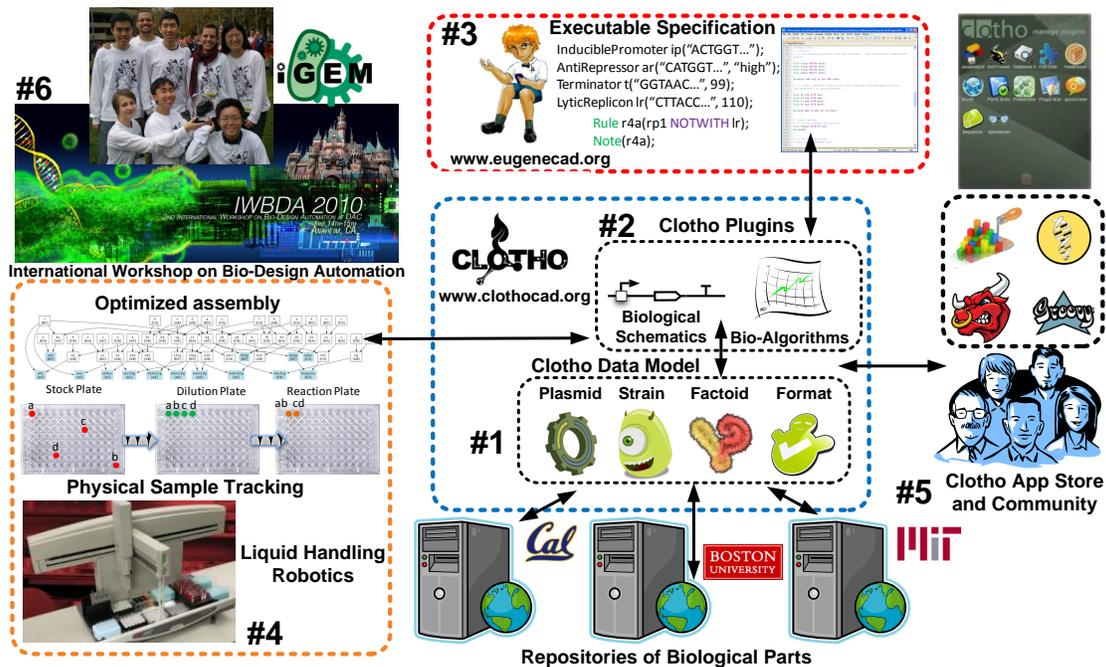


Figure 1: Proposed Ecosystem for the Specification, Design, and Assembly of Synthetic Biological Systems

Clotho and Eugene together create an ecosystem (Figure 1) composed of **six distinct areas** each designed to **further the state of the art, create a collaborative community, and most importantly design the synthetic biology systems of the future.**

## References

- [1] Lesia Bilitchenko, Adam Liu, Sherine Cheung, Emma Weeding, Bing Xia, Mariana Leguia, J. Christopher Anderson, and Douglas Densmore. Eugene: A domain specific language for specifying and constraining synthetic biological parts, devices, and systems. *PLoS ONE*, 6(4):e18882, 04 2011.
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- [3] Douglas Densmore, Anne Van Devender, Matthew Johnson, and Nade Sritanyaratana. A platform-based design environment for synthetic biological systems. In *TAPIA '09: The Fifth Richard Tapia Celebration of Diversity in Computing Conference*, pages 24–29, New York, NY, USA, 2009. ACM.