SynBioWave 2.0 - A Collaborative Toolkit for Synthetic Biology

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Motivation

Nowadays, the web offers a wide range of tools to communicate, collaborate and share personal data. People share their pictures with Flickr, students interact in social networks like Facebook, programmers contribute to software projects using platforms like SourceForge. In contrast, science communication is still making very little use of the collaborative web wide web. In particular, synthetic biology is highly inter-disciplinary and requires many scientists to work together in order to build complex biological systems starting from genes, gene assemblies, synthetic protein devices and later even genomes.

From the outset, the synthetic biology community has made efforts to cross-link the results of their research in open repositories and wikis. We wish to push this process to the next level: Why only store and share results? Why not making use of the web to collaborate? Scientists could make the whole process transparent, or even better, design and create data together.

Therefore we have created this web based software called SynBioWave which acts as a biological collaboration platform on top of the Wave protocol. It enables research collaboration by real-time sharing of parts, design and documentation. With the help of playback function in the Wave, every step by all the members are traceable thereby enabling biologists record and share the process of creating research data.

In the form of Add-on robots, SynBioWave provides aid in various functions to be performed by biologists in day to day life. We provide add-on robots for Blast-searches, ORF translation, sequence alignments, checking codon usage and restriction sites mapping. Also SynBioWave can be customized easily to match the particular needs of the user by extending add-on robots. We provide blue-print robot which enables the development of the add-on robots.

Architecture

SynBioWave turns Google wave a biosynthetic software suit. At present Google wave can be extending by developing Robots or Gadgets. We make use of both of these technologies in SynBioWave.

Robots are the automated chat participants in the Google wave which can interact with other participants. Also they can add or remove other participants.

Gadgets are little web programs included in a wavelet and communicating with it via Google’s Wave API. Typically they are small add-ons that improve certain types of conversations.

The main components of the SynBioWave are Wave Client, Wave Server and SynBioWave Robot. Various types of communications that take place among these components can be explained as follows:

- User logs into the Wave Client, which itself is a Gadget.
- Wave client communicates with the wave server about user details.
- The user then adds SynBioWave Robot to the Wave Client. It indirectly makes the HTTP request to the App-Engine server and then it is added to the wave.
- User can add the add-on Robots similarly.
- The SynBioWave Robot communicates with the Add-on Robots using HTTP requests.
- Some Add-on Robots like Blast Robot or REBase Robot communicate with external servers via HTTP requests to import external data or use services external to the wave.

User Interface

Wave communications are separated into different Wavelets which are separated into Blips. SynBioWave uses the first Blip of a Wavelet to display its menu and creates a second wavelet that is used to store the sequences.

The Workspace

In previous versions of SynBioWave, sequences were stored in the Appengine Datastore, a Database that applications hosted on Appengine can use to store information. The data were only visible to the program and thus the user was not very intuitive.

To increase the usability of SynBioWave, we created the Workspace. The Workspace is an additional Wavelet that the main robot creates as soon as it gets added to a Wavelet. It will also add all participants of the original Wavelet to the Workspace so the interaction Wavelet and the Workspace become one instance of SynBioWave.

In the Workspace every sequence is represented in one Blip and easily accessible by all users. Sequences in the workspace can either be active or inactive, enabling users to select the sequences they want to work with.

Development

The Google Wave API allows developers to create extensions for Google Wave in Python and Java. We decided to develop SynBioWave in Java so we could make use of the BioJava library that provides several data structures and methods used in bioinformatics.

Our Robots are Java programs that is why we need a server to run them on. For this purpose we use Google Appengine.

SynBioWave is an open source project and everybody is welcome to contribute to its development. For this reason we host all our source files and development libraries on Sourceforge:

http://sourceforge.net/projects/synbiowave/

Make your own robot

One of the main aspects of SynBioWave 2.0 is its extensibility. With the modular architecture of different robots communicating with each other we achieve a remarkable developer-friendliness. If a user is missing a certain feature in SynBioWave and knows a little bit about Java development the user can develop their own implementation of the SynBioWave Robot that does exactly what the users wants. On our website www.synbiowave.org and on our iGEM wiki we provide a step-by-step developer guide that makes it easy to learn how to create a robot.