Biological Concept Diagram Editor for Knowledge Capture and Sharing

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Biological Concept Diagram Editor (BCDE) is a conceptual relationship diagramming tool specifically designed for biomedical researchers. Compared to existing diagramming/drawing tools, BCDE has several advantages. It allows for efficient knowledge/data capture, fast diagram creation, easy data retrieval and flexible exporting.

The BCDE application is the main diagramming tool in the system. It is based on the JHotDraw (1) framework. Through it, users can create, modify, load, and save BCDE diagrams. The diagrams created with BCDE application are network oriented. When the diagram is displayed on the BCDE application's canvas, it is represented by a network of nodes (figures) and edges. Each BCDE figure can be annotated using fields from the BioPAX level II format. In addition, a user can add URL links and attachments to a BCDE figure. Diagrams generated in BCDE are stored in the BCDE XML format for better database integration and better data extraction. The XML files can be saved onto a local hard drive or uploaded to the BCDE database.

A major design goal of BCDE is to greatly increase efficiency of capturing data from electronic sources; to this end we develop a transfer function to allow for drag-and-drop input methods with text, images, and files. The transfer function, the BCDEBar, is in the style of Google/Yahoo toolbar. With the help of BCDEBar users are able to select text, images or a mixture of both from a webpage or a local document they are working on and simply drag-and-drop the selection atop a designated place on the BCDEBar, which will automatically transfer the selection to BCDE. In addition to transferring user selected input, we also include certain metadata such as the location address (URL) of the page currently displayed and time/date of the transfer. The actual transfer is dependant on type of the data that was dropped.

BCDE supports adding attachments to any of the BCDE figures. Attachments could be text files, pictures, word documents, or other files the user may have on their computer. In addition to simply storing attachments, BCDE acts as a data repository where the stored attachments can be accessed and modified using native handlers provided by the operating system.

Since BioPAX is likely to become the common data exchange format for biological pathways in future, we implemented support for BioPAX in BCDE. Currently, BCDE allows the user to import a BioPAX file, up to BioPAX Level II format, onto the canvas. We use four BCDE figures from our collection to represent all the physical entities in BioPAX. They are RNA, Membrane, Small Molecule, and Protein. For interactions, we use the Process figure to indicate the interaction and edges to link the concepts that are involved in the interaction.

Diagrams are often used for presentation purposes and it will be important for users to be able to easily modify diagrams using other popular presentation programs such as PowerPoint or Visio. One of the problems of existing diagram editors or knowledge bases is they mostly use proprietary data formats and can only export diagrams in jpg or bmp format, losing annotations associated with various objects in diagrams. To overcome this shortcoming, BCDE currently supports exporting BCDE diagrams to PowerPoint and Visio. When exporting to Visio and PowerPoint, BCDE will embed almost all the annotations into the generated documents. Currently, we do not export attachments for the BCDE figures due to the fact that PowerPoint and Visio do not support attachments for individual figures.

Although the BCDE is still under development, the unique functions we already implemented make BCDE distinct among other pathway editors in terms of knowledge/data capture efficiency and compatibility with other programs and data formats. We plan to add support for Cytoscape format as well as the upcoming BioPAX Level III format. Advanced searching, comparison and merging functions will also be included for knowledge mining. The current beta version of BCDE application can be downloaded at http://brainarray.mbni.med.umich.edu/Brainarray/default.asp by selecting "Graphic Editor (BCDE)" under the "Data Mining" menu.

References:
1.   JHotDraw. http://www.jhotdraw.org/.