Collaboratively Managing Science

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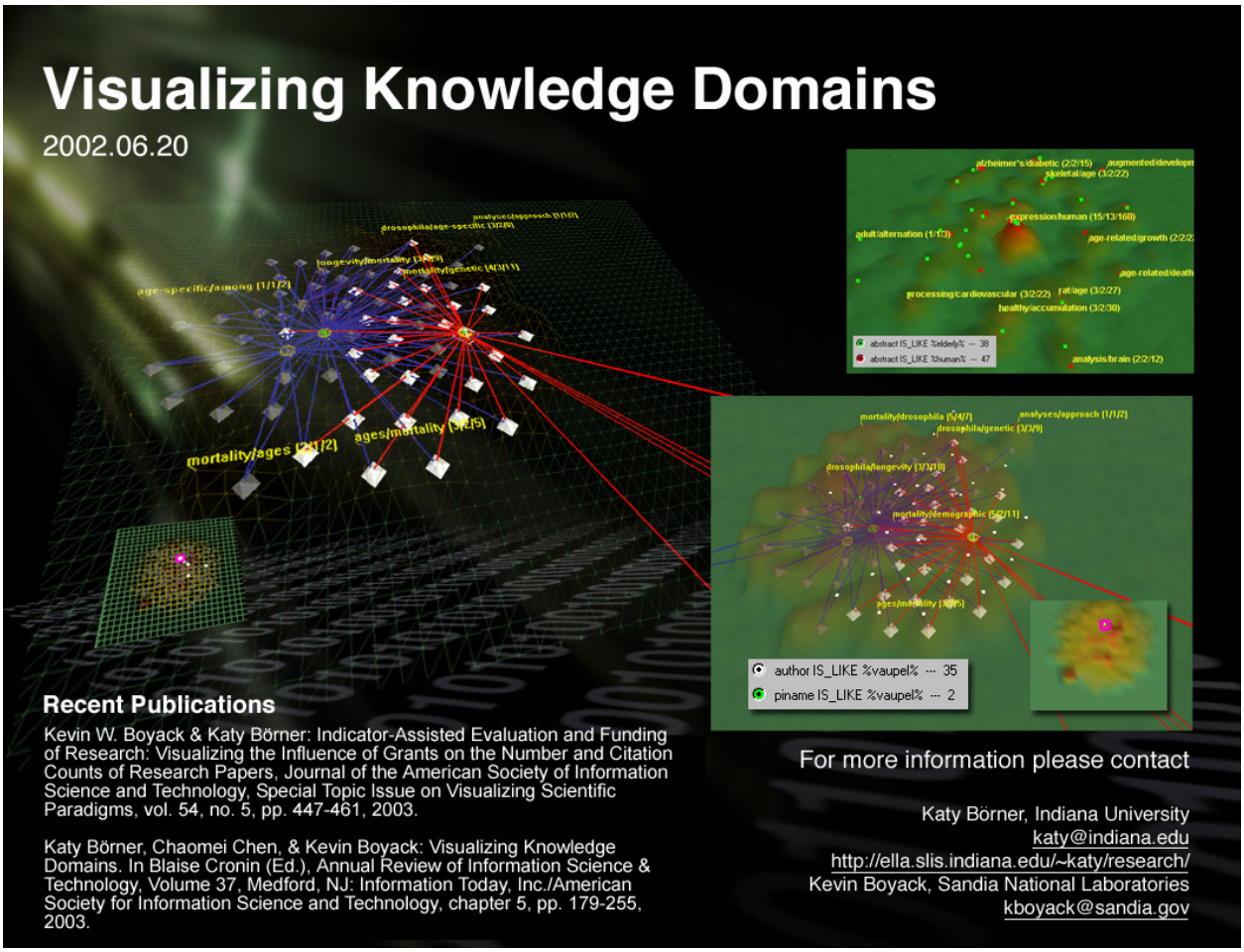
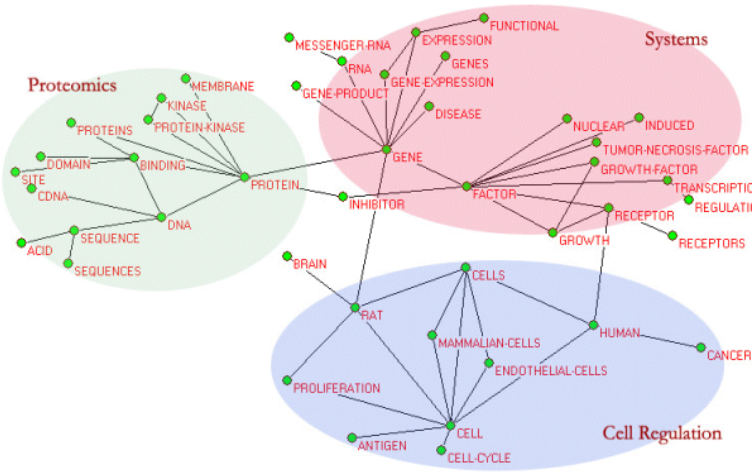


For centuries, we have developed tools that extend our physical powers, e.g., hammers, microscopes, or the phone. It is now time to design tools that empower our minds by enabling us to easily access and manage the sum of human knowledge stored in books, digital libraries, repositories or the brains of human experts.

The Information Visualization Lab at Indiana University works on the systematic development, validation, and deployment of *Knowledge Domain Visualization* (KDV) techniques. KDVs are a special kind of *Information Visualization* (IV) that exploit powerful human vision and spatial cognition to help humans mentally organize and electronically access and manage large, complex information spaces. Unlike scientific visualizations, KDVs are created from data that have no spatial reference, such as publications, patents, and grants stored in *Digital Libraries*.

KDVs use sophisticated data analysis and visualization techniques to objectively identify major research areas, experts, institutions, grants, publications, journals, etc., in a domain of interest. They can be used to gain an overview of a knowledge domain; its homogeneity, import-export factors, and relative speed; to track the emergence and evolution of topics; or to help identify the most productive as well as new research areas. See figure on the right for an overview of co-occurring keywords used in PNAS articles published in 2001.

Benefits of KDVs include reducing visual search time, revealing hidden relations, displaying data sets from several perspectives simultaneously, facilitating hypothesis formulation, serving as effective means of communication, and prompting users to think in new ways about document data.



Today, KDVs are typically generated semi-automatically, from rather small, static data sets, and for a specific knowledge domain and information need. Many of the algorithms and software developed in the KDV field have traditionally been kept secret or sold for profit.

KDVs have the potential to dramatically improve the communication and management of scientific results within and across scientific domains for students, researchers, grant agencies, research and development managers, data providers, and society.

The poster will present descriptive models and visualizations of the structure and evolution of research in biology. In addition, we will discuss first results on simple process models that aim to increase our understanding of the structure and evolution of mankind's scientific endeavor. The models simultaneously grow co-author and paper-citation networks and conform to measured data in terms of resulting citation, co-author, etc. networks but also at the level where the more elementary mechanisms are observable and verifiable.

Our ultimate goal is the creation of a dynamic map of science that resembles familiar weather forecast maps but shows the structure and evolution of different fields of science and their interrelations. The map will be fed by an incoming stream of data, e.g., publication, gene, protein data, and will be deployed as a screen saver to utilize the compute cycles of client machines for the computation of data associations. Researchers will be able to zoom into their area of interest and to query for specific words, author names, grants, etc. Similar to the map of our world, the map of science will provide semantic orientation and navigation guidance for researchers and practitioners to collaboratively access and manage scientific results within and across scientific domains.

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