

Indiana University Bloomington Learning Analytics Fellows Program

Application: Cover Sheet

Title: MOOC Visual Analytics Tools

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Abstract:

We propose to develop data mining and visualization tools that render data collected in MOOCs into actionable insights that:

- **Empower Teachers** to make sense of the activities of thousands of students and to guide them individually to reduce student-defection rates endemic to most MOOCs.
- **Empower Students** to navigate learning materials and develop successful learning collaborations across disciplines and time zones, e.g., to conduct client project work.
- **Empower MOOC Platform Designers** to analyze what features help and which hurt learning and collaboration and to evaluate the effectiveness of different social media, e.g., Flickr, Twitter, Google Groups.
- **Empower Researchers** to study what teaching methods and learning styles work in a MOOC.

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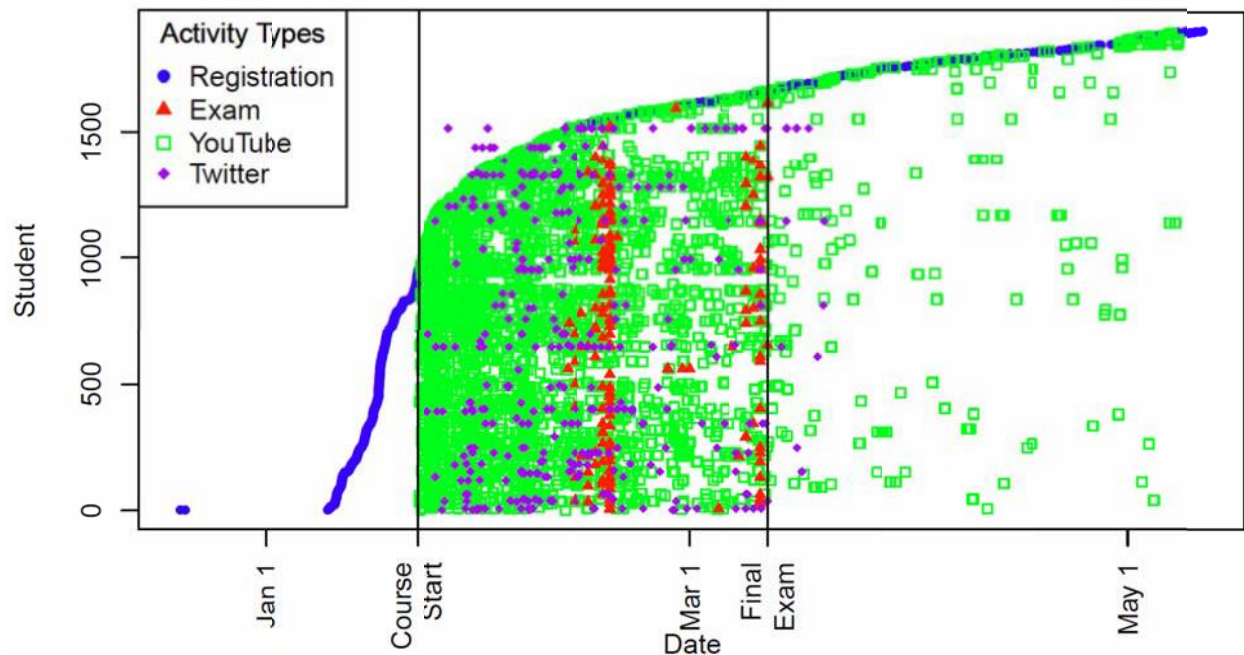
Application: Project Description

We propose to implement a plug-and-play macroscope tool (Börner, 2011, Börner and Polley, 2014) that read data relevant to MOOC instructors, collected from GCB or CANVAS and social networking sites (e.g., Flickr and Twitter), to answer “When”, “Where”, “What”, and “With Whom” questions using advanced temporal, geospatial, topical, and network analysis and visualization algorithms. User studies will be conducted to identify exactly what analyses and visualizations are most relevant to successful decision making by students, teachers, developers, and researchers.

Technically, the implementation will extend existing code as follows:

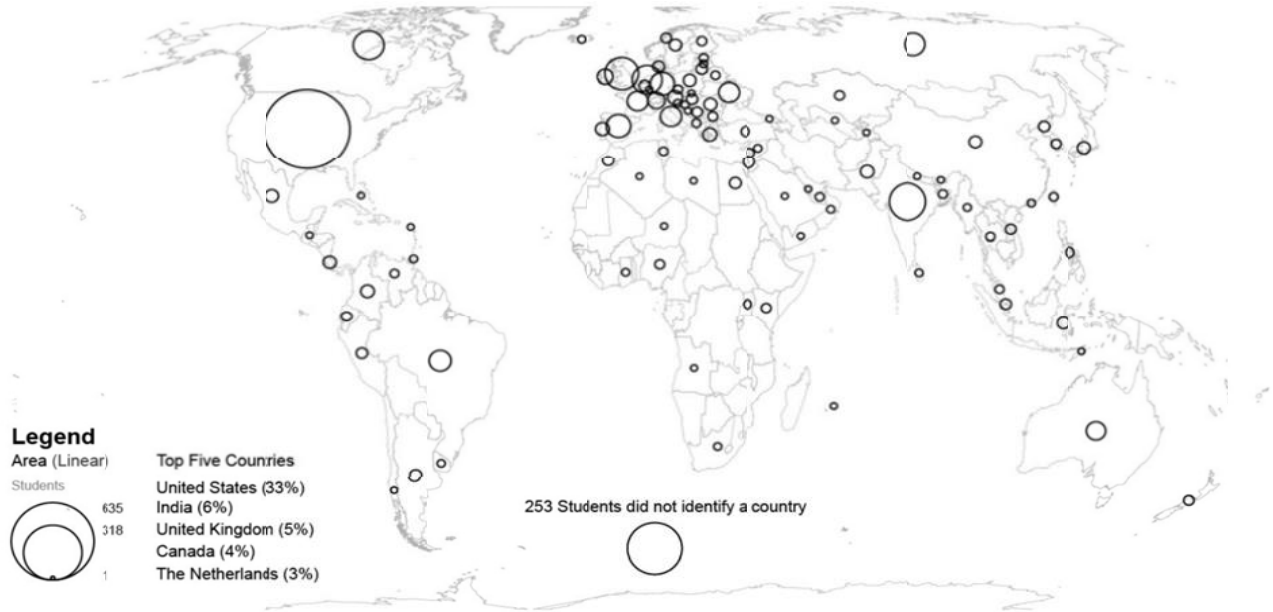
- Implement database reader that reads IVMOOC DB used to save GCB and Drupal Forum data.
- Update crawlers that connect to and read from social media web sites, e.g., Twitter.
- Develop novel visualizations that are specifically tailored to the insight needs of students, teachers, developers, and researchers.
- Implement workflow logging and replay to perform parameter sweeps, e.g., to render networks that evolve over time, and to replicate analyses with subsets of the data (zoom in).

Exemplary visualizations of data collected in the Spring 2013 IVMOOC are given in the Figures A-D and were published in (Börner and Polley, 2014). Visualizations of the 2014 IVMOOC (<http://ivmooc.cns.iu.edu>) are in preparation. The proposed project would commoditize these visualizations and add novel views of the data. It would also make it possible to analyze and visualize data of other MOOCs.



(A) Temporal Visualization: More than 2000 students registered for the first IVMOOC. Many watched movies, downloaded slides, took exams, worked with external clients. Even after the Spring 2013 course completed with the final exam, students still registered to watching videos, even without the incentive of earning a badge.

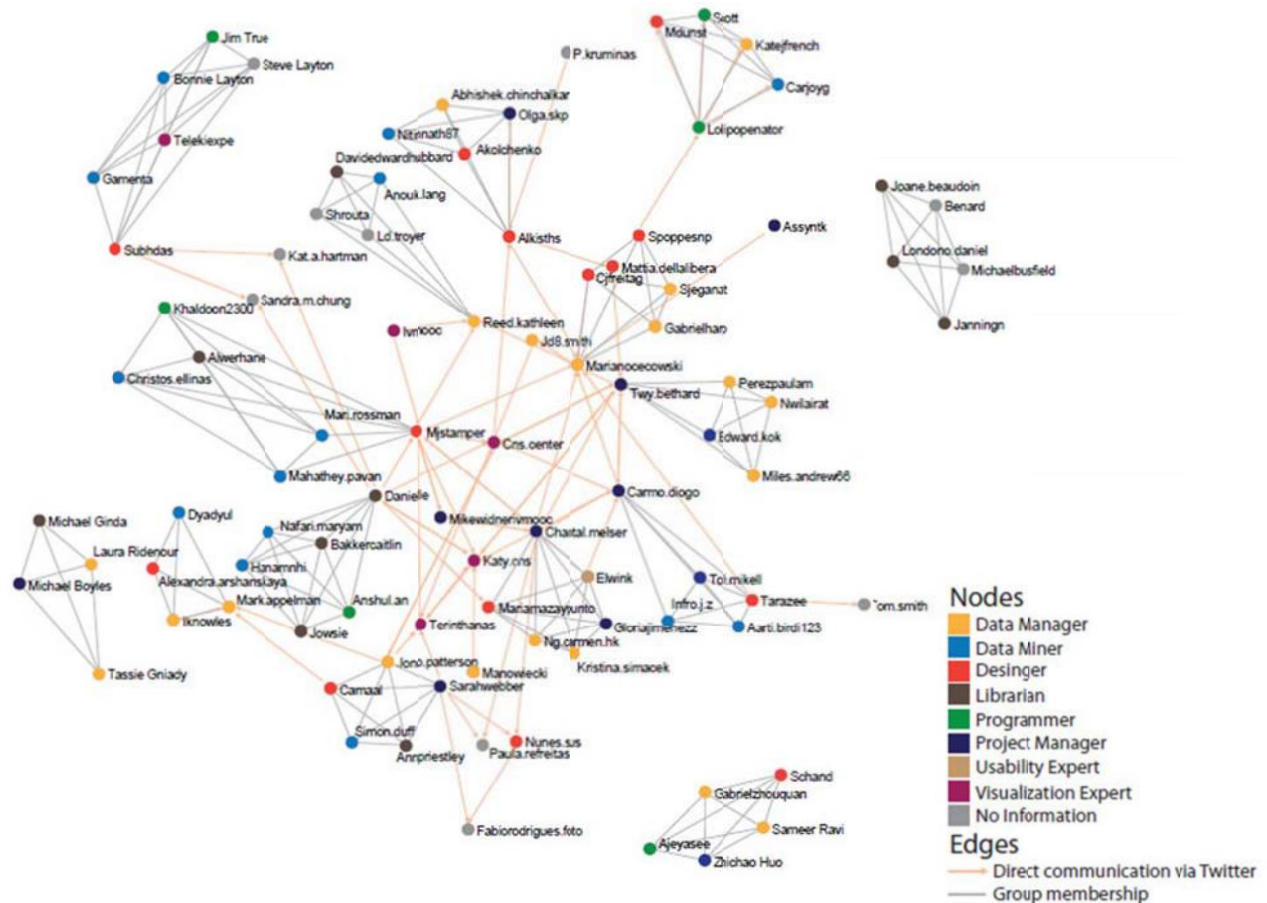
The MOOC Visual Analytics tools will then be used in an extended 15-week Information Visualization MOOC that starts in January, 2015. Using the tool, teachers and students of the IVMOOC will be able to track the flow of students from more than 100 countries through the MOOC. The tool will help users make sense of evolving social networks, learning accomplishments, social media activity of course participants. Our past participation has been around 2,000 students per year. With the additional visual analytic tools, we will gain the ability to scale up course enrollment to accommodate 5,000 students and add 100 clients, including institutions, non-profits, and corporations, for student led projects.



(B) Geospatial Visualization: Students came from over 100 countries. The geospatial map demonstrates that while more students came from the United States than any other country, they did not make up a majority of students even if the unidentified students were all assumed to be American, showing the relative ease with which a MOOC can reach a global audience.



(C) Topical Visualization: Wordle visualizations of the text students submitted when asked: What do you hope to learn? Proposed work would make a linguistic analysis of the text possible.



(D) Network Visualization: Student interactions via Twitter (orange links) and via client project collaborations (gray links). Nodes are color coded by 'expertise'.

Collaborators within and outside of the organization

- Other faculty teaching in the Online Data Science Program by the School of Informatics and Computing, see <http://news.iu.edu/releases/iu/2013/11/data-science-program-soic.shtml> and <http://www.soic.indiana.edu/graduate/programs/data-science/how-to-apply.shtml>
- Students from 100+ countries taking the IVMOOC in 2014, 2015
- The 50+ different organizations that served as clients in IVMOOC in 2014, 2015, see <http://ivmooc.cns.iu.edu/clients.html>

Objectives and expected outcomes

- The proposed work will provide new GCB tools that empower our IVMOOC team and teachers of other MOOCs to convert data into insights in order to:
 - **Empower Teachers** to make sense of the activities of thousands of students and to guide them individually to reduce student-defection rates that are endemic in most MOOCs.
 - **Empower Students** to navigate learning materials and develop successful learning collaborations across disciplines and time zones, e.g., to conduct client project work.

- **Empower MOOC Platform Designers** to analyze what features help and which hurt learning and collaboration and to evaluate the effectiveness of different social media, e.g., Flickr, Twitter, Google Groups.
- **Empower Researchers** to study what teaching methods and learning styles work in a MOOC.

Benefits to the student community you are trying to reach

- Manyika et al. (2011) estimate that by 2018, there will be some 450,000 positions for people with deep analytical skills and some 300,000 graduates with the requisite skills in the marketplace and project some 4 million positions for data-savvy managers with 2.5 million graduates with the requisite skills in the marketplace.
- The IVMOOC aims to close this gap between expertise supply and demand.

References

- Börner, Katy. 2011. "Plug-and-Play Microscopes". *Communications of the ACM* 54 (3): 60-69.
- Börner, Katy, and David E. Polley. 2014. [*Visual Insights: A Practical Guide to Making Sense of Data*](#). Cambridge, MA: The MIT Press.
- Manyika, J., Chui, M., Brown, B., Bughin, J., Dobbs, R., Roxburgh, C. and Byers, A.H. 2011. Big data: The next frontier for innovation, competitiveness and productivity. McKinsey Global Institute.

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Application: Short CV

Katy Börner

Current Position

Victor H. Yngve Professor, Department of Information and Library Science, School of Informatics and Computing, Indiana University

Adjunct Professor, Department of Statistics, College of Arts and Sciences, Indiana University

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PERSONAL INFORMATION

- Month and Place of Birth: October 1967 in Leipzig, Germany
- Nationality: German & American

EDUCATION

- Ph.D. in Computer Science, University of Kaiserslautern, 1997
- Master of Engineering in Electronics, University of Technology Leipzig, 1991
- Technical School Examinations, RFT Fernmeldewerk Leipzig, 1987

RESEARCH AREAS

- Scientometrics, Knowledge Management, Information Visualization, Data Mining & Modeling, Cyberinfrastructure Design, Virtual Reality Interfaces, Human Computer Interaction, Cognitive Science, Artificial Intelligence

ACADEMIC/PROFESSIONAL APPOINTMENTS

- Visiting Research Fellow at the Science, Technology, and Innovation Branch of the Organisation for Economic Co-Operation and Development (OECD) in Paris, France, Sabbatical in Spring 2014.
- Victor H. Yngve Professor, School of Library and Information Science, Indiana University, Aug 2009 – present. (Associate Professor, June 2005 - July 2009 / Visiting Assistant Professor, Aug - Dec 1999 / Assistant Professor, Jan 2000 - June 2005.)
- Visiting Professor, Royal Netherlands Academy of Arts and Sciences (KNAW), Amsterdam, The Netherlands, Jan. 2012 - present.

- Adjunct Professor, School of Informatics, Indiana University, July 2005 - present
- Director, Cyberinfrastructure for Network Science Center, Indiana University, Sept 2005 - present
- Core Faculty in Cognitive Science, Indiana University, Jan 2000 – present
- Visiting Assistant Professor, Computer Science, Indiana University, Aug 1998 - July 1999
- Research Associate and Instructor, University of Bielefeld, Faculty of Technology, 1996 - 1998
- Research Assistant, University of Freiburg, Center for Cognitive Science, 1994 - 1996
- Development Engineer, Horiba LTD, Kyoto, Japan, July / Aug 1993

PUBLICATIONS

- Börner, Katy. (2015). *Atlas of Knowledge: Anyone Can Map*. Cambridge, MA: The MIT Press.
- Börner, Katy, and Ted Polley. 2014. *Visual Insights: A Practical Guide to Making Sense of Data*. Cambridge, MA: The MIT Press.
- Scharnhorst, Andrea, Katy Börner, and Peter van den Besselaar (Eds). (2012). *Models of Science Dynamics: Encounters Between Complexity Theory and Information Science*. Springer Verlag.
- Börner, Katy, Richard Klavans, Michael Patek, Angela Zoss, Joseph R. Biberstine, Robert Light, Vincent Larivière, and Kevin W. Boyack. (2012). Design and Update of a Classification System: The UCSD Map of Science. *PLoS One* 7 (7): e39464.
- Börner, Katy. (2011). Plug-and-Play Macroscopes. *Communications of the ACM* 54 (3):60-69.
- Börner, Katy. (2010). *Atlas of Science: Visualizing What We Know*. Cambridge, MA: The MIT Press.
- Börner, Katy, Noshir S. Contractor, Holly J. Falk-Krzesinski, Stephen M. Fiore, Kara L. Hall, Joann Keyton, Bonnie Spring, Daniel Stokols, William Trochim, and Brian Uzzi. (2010). A Multi-Level Systems Perspective for the Science of Team Science. *Science Translational Medicine* 2 (49): 49(cm)24.
- Ketan Mane & Katy Börner. (2004) Mapping Topics and Topic Bursts in PNAS. *Proceedings of the National Academy of Sciences USA* 101(Suppl. 1):5287-5290.
- Katy Börner, Chaomei Chen, & Kevin Boyack. (2003) Visualizing Knowledge Domains. In Blaise Cronin (Ed.), *Annual Review of Information Science & Technology*, Volume 37, Medford, NJ: Information Today, Inc./American Society for Information Science and Technology, pp. 179-255.

Please see complete listing at <http://info.ils.indiana.edu/~katy/cv.html#publications>

TEACHING

- Information Visualization MOOC, ILS, SOIC, Indiana University (graduate course)
- Information Visualization, SLIS, Indiana University (graduate course)
- Structural Data Mining and Modeling, SLIS, Indiana University (graduate course)
- Interface Design for 3-D Collaborative Information Spaces, SLIS, Indiana University (graduate course)
- User Interface Design, SLIS, Indiana University (graduate course)
- Human Computer Interaction, SLIS, Indiana University (graduate course)
- Introduction to Software Systems Using Java, Computer Science, Indiana University (undergraduate course)
- Virtual Reality: Foundations and Applications, University of Bielefeld, Germany (graduate course)

SERVICE

- Symposium Co-Organizer: *International Symposium on Knowledge Domain Visualization (KDViz)* at the International Conference on Information Visualization 2002-2012.
- Member of NSF's Alan T. Waterman award committee, Feb. 2007- March 2010.
- Member of the U.S. National Research Council panel on NSF fields of science classification and the Federal Funds survey, 2008.
- Board Member of Elsevier's Bibliometrics Research Program (Jan. 2012 - Dec. 2013)
- Member of Board on Global Science and Technology, The National Academies (Oct. 2011-Sept. 2013)
- Reviewer of NRC Report on "The Shift to Multicore Processors and the Future of Computing Performance: Global Assessment and Implications for U.S. S&T" (2012) and "Geospatial Intelligence Workforce" (2012).
- Reviewer for U.S. Department of Energy Data Challenge (2014), WebSci Data Visualization Challenge (2014), British Library Visualising Research Competition (2014)

Please see complete listing at <http://info.ils.indiana.edu/~katy/cv.html#service>

Indiana University Bloomington Learning Analytics Fellows Program Application: Nominating Letter

This letter will be submitted by Pnina Fichman, Chair of the Department of Information and Library Science, School of Informatics and Computing and Director of the Rob Kling Center for Social Informatics