Group Cognition: Learning in Engineering Project Teams

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Problem
Learning in engineering project classes usually involves developing a shared understanding of the design artifact within the team
- Students are novices in design; They are learning process and content simultaneously
- In student design teams, much of the learning takes place out of view of the instructor
- Students get overwhelmed by information overload and lose sight of the big picture:
  - students lack support infrastructure to help them locate relevant knowledge
  - instructors find it difficult to keep track of student activities outside the classroom

Project goal
- Build support infrastructure, called DesignWebs, to assist students and instructors in synthesizing the design knowledge from multiple sources of information in engineering project teams
- Evaluate evidence for learning events from conceptual maps in team communications constructed automatically from the project corpus

Questions
- Can the knowledge about an artifact be extracted and synthesized from multiple sources of information used and created by students during an engineering design project?
- Can we identify evidence of the success/failure of a group from the team vocabulary?
- Can we automatically detect inception and connectivity of key ideas in groups at various artifact milestones?

Design Education Testbed
- RPCS: Rapid prototyping of computer systems
  - Interdisciplinary, capstone design course
  - Ambitious projects, e.g.
    - GM companion car-driver interface
    - Context aware cell-phone
    - Wireless classroom on the Voyager science boat

Need for DesignWebs
- Knowledge isolation
- Transient team membership
- Knowledge messiness
- Lack of knowledge synthesis

DesignWebs will enable:
- Within team knowledge-sharing
- Across team knowledge-sharing
- Global information access and integration

Approach
1. Extract the Latent Dirichlet Allocation topic model
2. Apply hierarchical clustering over the terms in our collection
3. Label clusters and extract phrases
4. Calculate connections between topics and terms
5. Make relevant documents accessible
6. Generate the web-based navigable DesignWeb

Initial experiment
- User study to test the effectiveness of DesignWebs in enabling users to grasp concepts embedded in a corpus of documents
- Scenario is a class of engineering graduate students who are about to embark on a project involving an analysis of hybrid cars
- To simulate a typical knowledge base at the start of such a project class, students were asked to perform a literature review from a corpus of 250 articles from Google Scholar
- User group consisted of 5 engineering graduate students; none had studied hybrid cars as their research focus

Current tool development
- How does the DesignWeb interface compare with a plain search on research papers?
- How can we most effectively use the graphical representation of the DesignWeb interface style to communicate the maximum information to the users without overwhelming them?

Data capture
With the Kiva, we capture most of the student conversations that would normally go through email and chat. For the project courses we studied, each course Kiva contained hundreds of topic threads and thousands of individual posts and files.

Kiva (Web based Asynchronous Collaboration Tool)
Prototype of DesignWebs