UCSB Four Eyes Lab

Imaging, Interaction, Innovative Interfaces: Current Projects (HCI side)

- **Mobile Sensing and Multimodal User Interfaces**
  - Augmented Reality, Anywhere Augmentation

- **Immersion**
  - Allosphere – A 3-story surround-view immersive space
  - Fogscreen – Towards a 3D Walk-Through Display

- **Interactive Visualization**
  - Visualization/Interaction with Large Graph Structures
  - Information Network Visualization

- **Collaboration**
  - Networked Interaction, Tangible Tele-Immersion

- **Real-Time Graphics**
Motivation
Dynamic Graph Visualization

Insights:

Real-time Interaction and dynamic probing potentially very powerful.
Uses for analysts / information workers / military personnel?

Our approach:

- Make interaction feasible for large-scale data
- Use interaction to predictably explore the data set
- Make these technologies available to every web user
- Perform cognitive analysis, iterate/optimize UI design
Previous Achievements
Dynamic Graph Visualization Methods

• “Subdivision Graphs”: Hierarch. Mass-Spring Model:
  – About 7K nodes interactively on a laptop
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• Mesh Deformation: Transferring Fast CG Methods
  – A Multigrid Solver for Graph Laplacians:
    About 50K nodes interactively
Previous Achievements
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• “Subdivision Graphs”: Hierarch. Mass-Spring Model:
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• Mesh Deformation: Transferring Fast CG Methods
  – A Multigrid Solver for Graph Laplacians:
    About 50K nodes interactively

• A New Graph Interpolation Scheme:
  – About 500K nodes interactively

(All these demonstrated as thick clients)
Problem definition

- Visualize large graphs
  - Hundreds of thousands of nodes and edges
- On the web
  - Regardless of host resources
  - No applets, no plugins, native in the browser
  - Cross browser, cross platform
- Real-time
  - 30 fps refresh rate
  - Interaction
Real-time visual interaction and dynamic probing are powerful tools for data analysis.

**Our approach:**

- Make interaction feasible for large-scale data.
- Use interaction to predictably explore the data.
- Make the tool easily accessible & embeddable.
Server System Architecture

Client Browser

Client Mode

Layout and User Interaction

Mouse Interactions & Client-Side Modifications

Synchronization

Image Data

Server Mode

Server Mode

User Interaction

Layout Algorithms

Image Data

Server-side Graph Model

Query Algorithms

Server-side Graph Model

Interaction Algorithms

Programmatic Upload

User Uploads

XML

SQL

TENA MODEL

Persistent
Multi- and Composite Network Analysis

SmallWorlds Facebook app: Visualizing your social network and get Music/Movie/Book recommendations

TopicNets: Visual Analysis of Large Text Corpora With Topic Modeling

Facebook Recommendation

**Layer 0**
You!

**Layer 1**
Your Tastes (books, movies etc)

**Layer 2**
Your Direct Friends, who have similar tastes
Nodes are closer and BIGGER

**Layer 3**
Things your friends like, but not listed in your profile
(Size represents popularity of the item among your friends)

**Layer 4**
Your Friends who you have little/nothing in common with

**Layer 5**
Items liked by Layer 4 friends

**Layer 6**
Here are the farthest friends in your “Taste Space”
Facebook Recommendation Layout

**Layer-0**
You!

**Layer-1**
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TopicNets

Visual Analysis of Large Text Corpora With Topic Modeling

(Joint work with Padhraic Smyth’s group at UC Irvine)
The Components of TopicNets

1. Raw Text Document(s)
2. Parsing
3. Thresholding
4. Graph Composition
5. Layout
6. Topic Modeling
7. Visualization & Interaction
8. Insight
Large Corpus Visualization

CaILT2 Dataset

10,000 Papers colored by author department affiliation.

Paper colors blended into connected topic nodes.

Layout based on topic similarity using an MDS algorithm.

Clusters show that papers from same field have similar topics.

Papers outside of the main clusters show interdisciplinary work.
Task: Find engineering/CS faculty who work with genetics.

Perform search for “genetics” and remove nodes not related to the search term.

Collapse all papers by author into single node.

Results:
CS: Pierre F. Baldi
Engineering: Sadik C. Esener
Large Corpus Visualization

VisWeek 2009

Papers from VisWeek 2009 and their topics.

Best papers highlighted along with related topics.

Layout based on topic similarity.

Topics such as “volume rendering” mostly connected to Vis papers.

“visual analysis” is mostly connected to VAST and InfoVis papers.
Large Corpus Visualization

NY Times articles

Entire month of November 2004

Documents ordered on a circle based on time.

Color changes from yellow (older) to pink (newer) based on time.

Document color is blended to connected topic nodes.

Topic position and color represent their position in time.

Topic size represents their frequency across the entire dataset.
Single Document Visualization
PhD Thesis

a) No Deformation
Linear order of sections is mapped to clockwise order on a circle.
Topics shown in green. Section color changes from yellow to purple.

b) Single-Topic Deformation
Interaction deforms this circle based on connectivity to selected topic.

b) All-Topic Deformation
Can enable deformation of all topics.
Sections connected to central topics move towards the center and less important sections stay on periphery.
Single Document Visualization
U.S. Health Care Bill

a) Linear structure ignored.
   Layout based on topic similarity.
   Three apparent clusters.

b) Linear structure mapped to circle.
   Two topics selected and related sections highlighted.

c) Nodes not related to selected set removed.
   Reveals two sections related to grants and training programs.
Single Document Visualization

TopicNets Paper

Topic node “topic model” selected.

Related sections highlighted and moved towards center.
WiGipedia

Wikipedia → DBpedia → WiGipedia

- **Wikipedia**
  - Structured data
    - (infoboxes, categories, etc.)

- **DBpedia**
  - Structured semantic data (RDF)
    - Allows SQL-like querying

- **WiGipedia**
  - Visual interface
    - Allows single-click Wiki edits

(closing the loop)
Pink Floyd were an English rock band who earned recognition for their psychedelic music in the late 1960s, and as they evolved in the 1970s, for their progressive rock music. Pink Floyd's work is marked by the use of philosophical lyrics, sonic experimentation, innovative album cover art, and elaborate live shows. One of rock music's most critically acclaimed and commercially successful acts, the group has sold over 200 million albums worldwide, including 74.5 million certified units in the United States.

Pink Floyd were formed in 1965, and originally consisted of university students Roger Waters, Nick Mason, Richard Wright, and Syd Barrett. The group were a popular fixture on London's underground music scene, and Barrett's leadership released two charting singles, "Arnold Layne" and "See Emily Play", and a commercially and critically successful debut album, The Piper at the Gates of Dawn. In 1968, guitarist and singer David Gilmour joined the line-up, and Barrett was removed due to his increasingly erratic behaviour. Following Barrett's departure, bass player and singer Roger Waters became the lyricist and dominant figure in the band, which thereafter achieved worldwide critical and commercial success with the concept albums The Dark Side of the Moon, Wish You Were Here, Animals, and rock opera The Wall.

Wright left the band in 1979, and Waters in 1985, but Gilmour and Mason (joined by Wright) continued recording and touring under the name Pink Floyd. Waters used legal means to try to keep them from using the name, declaring Pink Floyd a spent force, but the parties reached an out-of-court settlement allowing Gilmour, Mason and Wright to continue as Pink Floyd. The band again enjoyed worldwide success with A Momentary Lapse of Reason (1987) and The Division Bell (1994), and Waters continued as a solo musician, releasing three studio albums. Although for some years relations between Waters and the remaining three members were sour, the band reformed in 2005 for what would be a final one-off performance at Live 8.
Usage Scenario

1) Select two nodes to link

2) Pick a link label

3) Confirm
WiGipedia

Visual interface embedded on every Wiki page
Single-click Wikipedia edits

Provides Context
   Enriches the Wiki with an interactive graph containing relevant contextual information per article

Reduces Incompleteness
   Provides users with a mechanism to detect and create/repair missing/incorrect inter-article and article-category links

Increases Consistency
   Promotes consistency of attributes across infoboxes and other well defined structures

Homogenizes Heterogeneous Data
   Creates a supporting framework to gather user-provided links between previously unstructured and heterogeneous data entities
Data Flow Summary
## Four Eyes People

### Faculty

<table>
<thead>
<tr>
<th>Matthew Turk</th>
<th>Tobias Höllerer</th>
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### Postdocs

<table>
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<th>John O'Donovan</th>
<th>Sehwan Kim</th>
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### PhD Students

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<thead>
<tr>
<th>Justin Muncaster</th>
<th>Christopher Hall</th>
<th>Longbin Chen</th>
<th>Svetlin Bostandiev</th>
<th>Jonathan Ventura</th>
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<tbody>
<tr>
<td>Cha Lee</td>
<td>Christopher Coffin</td>
<td>Brynjar Gretarsson</td>
<td>Daniel Vaquero</td>
<td>Panuakdet Suwannatat</td>
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</tbody>
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### Visitors

<table>
<thead>
<tr>
<th>Sehwan Kim</th>
<th>Juneho Yi</th>
<th>Masayuki Kanbara</th>
<th>Masahiro Toyoura</th>
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