Text and Document Visualization 1

CS 7450 - Information Visualization
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Text is Everywhere

• We use documents as primary information artifact in our lives
• Our access to documents has grown tremendously in recent years due to networking infrastructure
  – WWW
  – Digital libraries
  – ...
Big Question

• What can information visualization provide to help users in understanding and gathering information from text and document collections?

Tasks/Goals

• What kinds of analysis questions might a person ask about text & documents?
Example Tasks & Goals

- Which documents contain text on topic XYZ?
- Which documents are of interest to me?
- Are there other documents that are similar to this one (so they are worthwhile)?
- How are different words used in a document or a document collection?
- What are the main themes and ideas in a document or a collection?
- Which documents have an angry tone?
- How are certain words or themes distributed through a document?
- Identify “hidden” messages or stories in this document collection.
- How does one set of documents differ from another set?
- Quickly gain an understanding of a document or collection in order to subsequently do XYZ.
- Understand the history of changes in a document.
- Find connections between documents.

Related Topic - IR

- Information Retrieval
  - Active search process that brings back particular/specific items (will discuss that some today, but not always focus)
  - I think InfoVis and HCI can help some...
- InfoVis, conversely, seems to be most useful when
  - Perhaps not sure precisely what you’re looking for
  - More of a browsing task than a search one
Related Topic - Sensemaking

- Sensemaking
  - Gaining a better understanding of the facts at hand in order to take some next steps
  - (Better definitions in VA lecture)

- InfoVis can help make a large document collection more understandable more rapidly

Challenge

- Text is nominal data
  - Does not seem to map to geometric/graphical presentation as easily as ordinal and quantitative data

- The “Raw data --> Data Table” mapping now becomes more important
This Week’s Agenda

Visualization for IR
  Helping search

Visualizing text
  Showing words, phrases, and sentences

Visualizing document sets
  Words, entities & sentences
  Analysis metrics
  Concepts & themes

Information Retrieval

• Can InfoVis help IR?

• Assume there is some active search or query
  – Show results visually
  – Show how query terms relate to results
  – ...

Fall 2013  CS 7450  9
Improving Text Searches

• What’s wrong with the common search?
  – Is there really anything wrong?

• Visualizing the results of search queries is one potential important area of text infovis

What Hearst Thinks is Wrong

• Query responses do not include:
  – How strong the match is
  – How frequent each term is
  – How each term is distributed in the document
  – Overlap between terms
  – Length of document

• Document ranking is opaque
• Inability to compare between results
• Input limits term relationships

Hearst
CHI ’95
**TileBars**

- **Goal**
  - Minimize time and effort for deciding which documents to view in detail

- **Idea**
  - Show the role of the query terms in the retrieved documents, making use of document structure

**TileBars**

- **Graphical representation of term distribution and overlap**

- **Simultaneously indicate:**
  - Relative document length
  - Frequency of term sets in document
  - Distribution of term sets with respect to the document and each other
**Interface**

- **Search terms**
- **Presentation**

**Technique**

- Relative length of document
- Two search terms
- Blocks indicate “chunks” of text, such as paragraphs
- Blocks are darkened according to the frequency of the term in the document

- Video
Issues

- Horizontal alignment doesn’t match mental model
- May not be the best solution for web searches
  - Non-linear material
  - Images? Apps?
- Anything else?

Generalize More

- How about the “holy grail” of a visual search engine?
  - Hot idea for a while

- My personal view: It’s a mistake in the general case. Text is just better for this.
Search Visualization

Defunct

Sparkler

- Abstract result documents more
- Show “distance” from query in order to give user better feel for quality of match(es)
- Also shows documents in responses to multiple queries

Havre et al
InfoVis ’01
Visualizing One Query

- Triangle – query
- Square – document
- Distance between query and documents represents their relevance

Visualizing Multiple Queries

Six queries here

Bullseye allows viewer to select quality results
Test Example

- Text Retrieval Conference (TREC-3) test document collection
- AP news stories from June 24–30, 1990
- TREC topic: Japan Protectionist Measures
- Sparkler found 16 of 17 relevant documents

Another Idea

Use it to compare search results from different search engines
RankSpiral

Color represents different search engines

Figure 1. (Top) RankSpiral places consecutive documents next to each other so that they do not overlap. Total ranking score of documents increases toward the center. Radial distance between documents that have the same angle can be used to display node fragments. (Right) Shows a static RankSpiral that maintains information density and minimizes occlusions, showing how the 500 unique documents amongst the top 100 documents returned by Google. Terms: AliExpress, Lexus and MSN. MM (51) documents were found by asking (multiple) queries. The top 500 documents were selected and their titles are allowed to extend across the remaining unlabeled and trimmed documents.

ResultMaps

Treemap-style vis for showing query results in a digital library

Truemap - style vis for showing query results in a digital library

Clarkson, Desai & Foley
TVCG (InfoVis) ’09
To Learn More

Marti Hearst's Book
Chapter 10


Transition 1

- OK, let’s move up beyond just search/IR

- How do we represent the words, phrases, and sentences in a document or set of documents?
  - Main goal of *understanding* versus search
One Text Visualization

Uses:
- Layout
- Font
- Style
- Color

Word Counts

Tag/Word Clouds

- Currently very “hot” in research community
- Have proven to be very popular on web
- Idea is to show word/concept importance through visual means
  - Tags: User-specified metadata (descriptors) about something
  - Sometimes generalized to just reflect word frequencies
History

- 90-year old Soviet Constructivism
- Milgram’s ’76 experiment to have people label landmarks in Paris
- Flanagan’s ‘97 “Search referral Zeitgeist”
- Fortune’s ‘01 Money Makes the World Go Round

Flickr Tag Cloud

Viégas & Wattenberg
interactions ’08
delicious Tag Cloud

Alternate Order
Amazon’s Product Concordance

Maybe now a “word cloud”

Sidenote

There are other types of info about a document on Amazon
Many Eyes Tag Cloud

Here, pairs of words are shown

Problems

- Actually not a great visualization. Why?
  - Hard to find a particular word
  - Long words get increased visual emphasis
  - Font sizes are hard to compare
  - Alphabetical ordering not ideal for many tasks

- Studies have even shown they underperform
  
  Gruen et al
  CHI '06
Why So Popular?

- Serve as social signifiers that provide a friendly atmosphere that provide a point of entry into a complex site
- Act as individual and group mirrors
- Fun, not business-like

Hearst & Rosner
HICSS '08
Wordle

- Tightly packed words, sometimes vertical or diagonal
- Word size is linearly correlated with frequency (typically square root in cloud)
- Multiple color palettes
- User gets some control

Viegas, Wattenberg, & Feinberg
TVCG (InfoVis) '09
**Layout Algorithm**

- Details not published

- **Idea:**
  - sort words by weight, decreasing order
  - for each word w
    - w.position := makeInitialPosition(w);
    - while w intersects other words:
      - updatePosition(w);
  - Init position randomly chosen according to distribution for target shape
  - Update position moves out radially

**Fun Uses**

- Political speeches
- Songs and poems
- Love letters (for “boyfriend points”)
- Wedding vows
- Course syllabi
- Teaching writing
- Gifts
2-day Survey in Jan. 09

- 2/3 respondents were women
- Interest came from design, visual appeal, beauty
- Why preferred over word clouds:
  - Emotional impact
  - Attention-keeping visuals
  - Organic, non-linear
- Fair percentage didn’t know what size signified

SoTU Wordles

[Image of word cloud]

A Little More Order

Order the words more by frequency

Cui et al  
*IEEE CG&A* ’10

Wordle Characteristics

- Layout, words are automatic
- If you had some control, what would you like to change or alter?
Mani-Wordle

- Start with nice default algorithm
- Give user more control over design
  - Alter color (within a palette)
  - Pin words, redo the rest
  - Move and rotate words
  - Smooth animation and collision detection for tracking changes

Koh et al
TVCG (InfoVis) '10

Video
Text Analysis on Web

http://voyeurtools.org/

Multiple Documents?

- How to show word frequencies across multiple related documents?
Parallel Tag Clouds

Different circuit courts

Collins et al VAST ’09

Analytic Support

- Note: Word Clouds and Wordles are really more overview-style visualizations
  - Don’t really support queries, searches, drill-down

- How might we also support queries and search?
**DocuBurst**

Uses WordNet, sets of synonyms grouped together

Size – # of leaves in subtree
Hue – diff synsets of word
Shade – frequency of use

http://faculty.uoit.ca/collins/research/docuburst

Collins et al.
EuroVis '09

**Overview & Timeline**

State of the Union Addresses

### FeatureLens

#### Video
Show patterns of words or n-grams

- Don et al
- CIKM '07

#### SeeSoft Display
Like taping text to the wall and walking far away

- New Testament
- Eick
- Journal Comput. & Graph. Stats '94

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SeeSoft Display

![SeeSoft Display](http://www.cs.umd.edu/hcil/textvis/featurelens/)

New Testament

![New Testament](http://www.cs.umd.edu/hcil/textvis/featurelens/)

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FeatureLens

![FeatureLens](http://www.cs.umd.edu/hcil/textvis/featurelens/)

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http://www.cs.umd.edu/hcil/textvis/featurelens/
Beyond Individual Words

• Can we show combinations of words, phrases, and sentences?

Concordance

Definition
Concordance in Text

Word Tree

From King James Bible
Word Tree

- Shows context of a word or words
  - Follow word with all the phrases that follow it
- Font size shows frequency of appearance
- Continue branch until hitting unique phrase
- Clicking on phrase makes it the focus
- Ordered alphabetically, by frequency, or by first appearance

Interaction

Click on “blind” and it will become the focus.
## Phrase Nets

- Examine unstructured text documents
- Presents pairs of terms from phrases such as
  - X and Y
  - X’s Y
  - X at Y
  - X (is|are|was|were) Y
- Uses special graph layout algorithm with compression and simplification

In Many Eyes now

van Ham et al. *TVCG* (InfoVis) ’09
Examples

Fig 4. Matching the same pattern on different texts. Here we used the pattern “X of Y” to compare the old and new testaments, Israel takes a central place in the Old Testament, while God acts as the main pattern receiver in the New Testament.

Fig 5. Matching different patterns on the same text. Here we analyzed Jane Austen’s Pride and Prejudice with “X and Y” and “X at Y” respectively. The left image shows relationships between the main characters amongst others, while the right image shows relationships between locations.
User Interface

Another Challenge

- Visualize an entire book
- What does that mean?
  - Word appearances
  - Sentences
  - ...
Next Time

- More about collections of documents and showing other characteristics of documents
  - Analysis metrics
  - Entities
  - Concepts & themes
Upcoming

- Text and Documents 2
  - Reading
    Keim & Oelke ’07

- Visual Analytics 1
  - Reading
    Keim et al ’08

References

- Marti Hearst’s i247 slides
- All referred to papers