Interactive Exploration of Versions across Multiple Documents

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Introduction

The need to compare two or more documents arises in a variety of situations. Some instances include detection of plagiarism in academic settings and comparing versions of computer programs. Extensive research has been performed on comparing documents based on their content (Si et al., 1997; Brin et al., 1995) and there also exist several tools such as *windiff* to visually compare a pair of documents. However, little work has been done on providing an effective visual interface to facilitate the comparison of more than two documents simultaneously. *Versioning Machine* (Schreibman et al., 2003) is a web-based interface that provides the facility to view multiple versions of a document, along with the changes across versions. Motivated by Versioning machine (VM), we build a tool *MultiVersioner* that facilitates viewing multiple versions of multiple documents at once, and provides the user with a rich set of information regarding their comparison. The primary user during the development of MultiVersioner was Tanya Clement, a doctoral candidate in English at the University of Maryland, who researches the works of experimental poets.

Related Work

ScentHighlights (Chi et al., 2005) has demonstrated the effectiveness of using color-coded highlighting to display the similarities and differences across documents. There exist literature (Brin et al., 1995) and tools like *CHECK* (Si et al., 1997) and *MOSS* (MOSS) on plagiarism and source code comparison, which are relevant to our work. *FeatureLens* (Don et al., 2007) facilitates pattern finding in text collections by providing visualizations of the results of text mining algorithms.

In Tanya Clement's research, she compares not only versions of a single poem, but also multiple versions across several poems. VM can display the versions of just one document at a time. To open another document, all versions of the current document have to be closed first. VM also does not provide any search capabilities.

Description of the Interface

Background

The two-fold goal of MultiVersioner is to provide an effective overview of the content and size of all documents, as well as to provide a detailed display, along with a variety of search capabilities, in accordance with the Info-Viz Mantra *Overview first, zoom and filter, details on demand* (Shneiderman 1996).

MultiVersioner is implemented in Java 6.0 using the Swing GUI toolkit. It uses the same input format file as VM, an XML file, containing information about the various additions and deletions made across all versions of a document. MultiVersioner contains a built-in parser to parse these XML files. Loading an XML file opens all the versions of a poem in separate *version panels* and multiple such documents can be loaded simultaneously. Version panels are displayed in the central part of the interface with a tool panel located on the right. The name of the version appears on top of the respective version panel. The names of all the versions of a particular document are displayed in the same color in order to group them together.

Overview

In the overview, words are denoted by equal sized boxes. Hovering over a box pops up a tooltip containing the entire sentence, with the current word being displayed in bold. In the tooltip, words added in the current version are shown in blue, and words deleted are shown in red. Clicking on a box brings up a *detail window* (Figure 1) containing the entire sentence. The purpose of the detail window is to display a sentence of interest on the screen, analogous to a post-it note. The detail windows can be made either opaque or transparent, and can either be moved around, or aligned together. A line is drawn between a detail window and its corresponding location in the version panel, to keep track of its origin. A detail window could be closed either by right clicking it and choosing close, or by simply dragging it out of the screen.

Text View

Word boxes are used primarily to obtain an overview of all the documents. To explore the versions in detail, a representation displaying the actual sentences, instead of word boxes, is preferred (Figure 2).

Search

The basic search feature is the word search (Figure 2). A search bar is provided where the user can type in a word or a phrase to be searched across all documents. A search can be made case-sensitive if desired. Alternatively, a word can be searched by right-clicking an instance of it. Inspired by ScentHighlights (Chi 2005 et al., 2005), Search results are color-coded. The instances of a searched word in all documents are highlighted using the same color. A search history as well as the facility to clear search results is available.

A line search feature is available as well. Right-clicking the anchor-box present at the beginning of a line triggers a line search, where the specified line will be searched across all documents and lines similar to it are highlighted.

Word Frequency Table

MultiVersioner computes a frequency table containing the number of occurrences of each unique word in all documents and their versions. When comparing different versions of a document or comparing different documents that are related, researchers in literature need to identify unique and common words and sentences. It has been shown that an approach as simple as a frequency table listing is powerful in providing insight by letting users know which words are common across documents and which ones are unique to a single document (Filippova, 2007).

Other features

There are sliders available to control the version panel height, width and the sizes of the word boxes. MultiVersioner also has a scroll lock, used when the documents are long, to synchronize the scrolling of the documents with each other.

EVALUATION

The first three authors were the developers who benefitted from regular feedback from the last three authors. Feedback on specific sections of MultiVersioner are listed below.

Document layout: Tanya Clement wanted all versions of a single document to be distinguishable from other documents. We achieved this by using the same color for the titles of all the version panels associated with the same document.
Search: The ability to search for words across the documents was greatly appreciated by Clement. She also provided positive feedback on the color-coded highlighting of the search results.
Text View vs Overview: Clement stressed that while she prefers seeing the actual words, rather than they being represented as word boxes (a thought which was echoed by Shneiderman and Plaisant). She added that though view consisting of a large number of documents and versions, the text view was more useful for her analysis.
Miscellaneous features: Clement found the synchronized scrolling to be helpful. As it was difficult to associate the detail window to its originating location, she suggested linking them by drawing a line.

Conclusions and Future Work

While several tools compare documents, our work facilitates the visual comparison of multiple versions of documents. We build on the Versioning Machine by allowing the user to compare multiple documents, each of which consists of multiple versions. We also provide the ability to search for entities such as words and lines across the documents and versions and analyze their frequency patterns. MultiVersioner was designed to compare small poems, and future work need to address the problem of longer documents. Utilizing the entire screen space, by dynamically resizing all open documents to fit the screen, should be examined.

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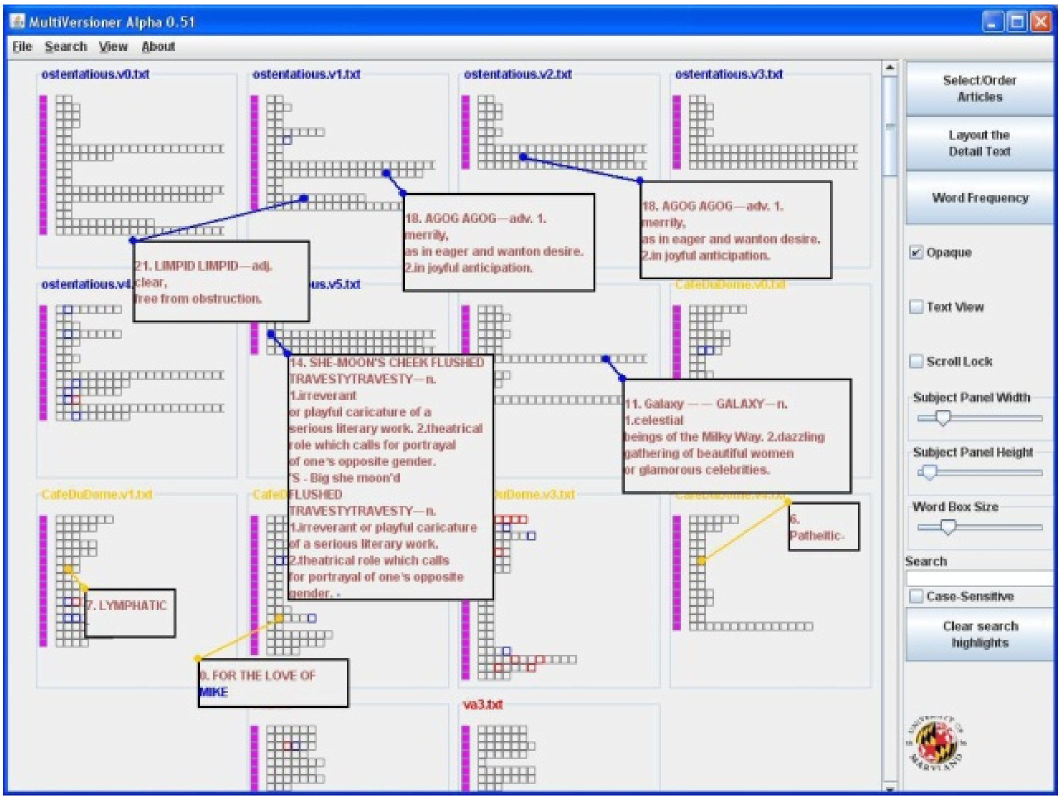
Si, A., Leong, H. V., Lau, R. W. H. (1997). *CHECK: a document plagiarism detection system*, Proc. of the 1997 ACM symposium on Applied computing, 70-77.



18. AGOG AGOG—adv. 1.
merrily,
as in eager and wanton desire.
2.in joyful anticipation.

18. AGOG AGOG—adv. 1.
merrily,
as in eager and wanton desire.
2.in joyful anticipation.

21. LIMPID LIMPID—adj.
clear,
free from obstruction.

14. SHE-MOON'S CHEEK FLUSHED
TRAVESTYTRAVESTY—n.
1.irreverant
or playful caricature of a
serious literary work. 2.theatrical
role which calls for portrayal
of one's opposite gender.
'S - Big she moon'd
FLUSHED
TRAVESTYTRAVESTY—n.
1.irreverant or playful caricature
of a serious literary work.
2.theatrical role which calls
for portrayal of one's opposite
gender. -

11. Galaxy — — GALAXY—n.
1.celestial
beings of the Milky Way. 2.dazzling
gathering of beautiful women
or glamorous celebrities.

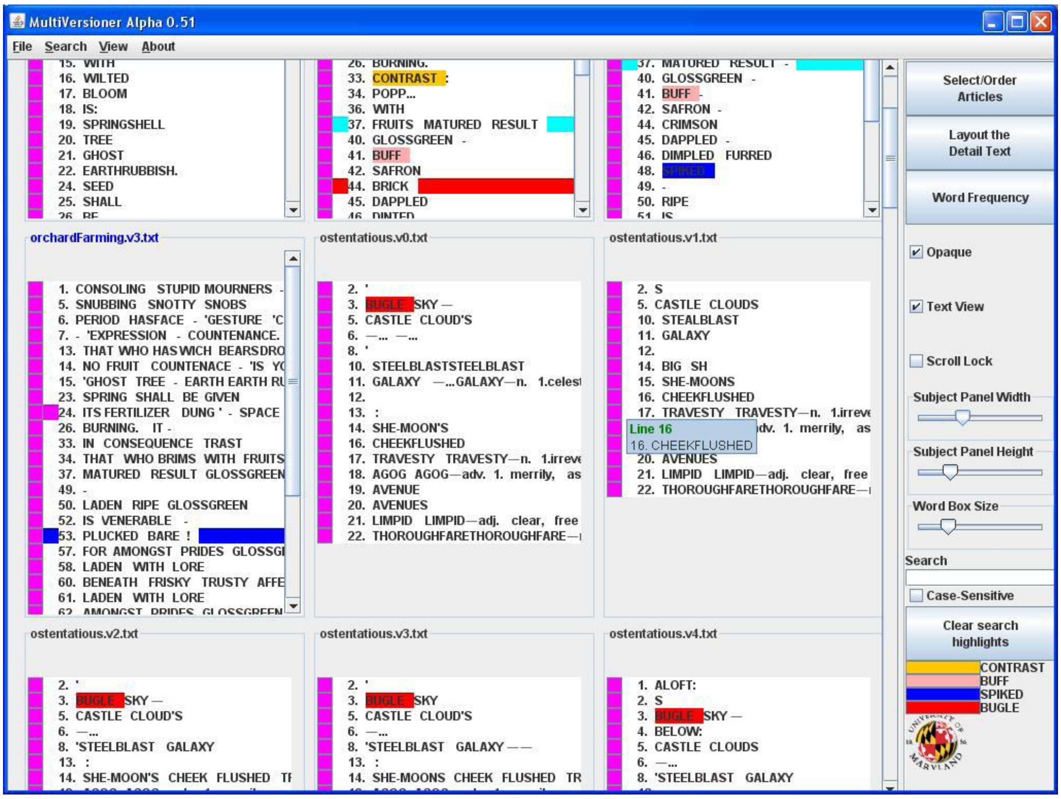
6.
Pathetic-

7. LYMPHATIC

0. FOR THE LOVE OF
MIKE

☑ Opaque
□ Text View
□ Scroll Lock
□ Case-Sensitive

Fig. 1 Overview of multiple versions of two poems. Sentences of interest are shown using detail windows, which are linked to their respective version panels by lines.



15. WITH
16. WILTED
17. BLOOM
18. IS:
19. SPRINGSHELL
20. TREE
21. GHOST
22. EARTHRUBBISH.
24. SEED
25. SHALL
26. BE

26. BURNING.
33. CONTRAST :
34. POPP...
36. WITH
37. FRUITS MATURED RESULT
40. GLOSSGREEN -
41. BUFF
42. SAFRON
44. BRICK
45. DAPPLED
46. DINTED

37. MATURED RESULT -
40. GLOSSGREEN -
41. BUFF -
42. SAFRON -
44. CRIMSON
45. DAPPLED -
46. DIMPLED FURRED
48. SPIKED
49. -
50. RIPE
51. IS

orchardFarming.v3.txt

1. CONSOLING STUPID MOURNERS -
5. SNUBBING SNOTTY SNOBS
6. PERIOD HASFACE - 'GESTURE 'C
7. - 'EXPRESSION - COUNTENANCE.
13. THAT WHO HAS WICH BEARSDRO
14. NO FRUIT COUNTENACE - 'IS YO
15. 'GHOST TREE - EARTH EARTH RU
23. SPRING SHALL BE GIVEN
24. ITS FERTILIZER DUNG ' - SPACE
26. BURNING. IT -
33. IN CONSEQUENCE TRAST
34. THAT WHO BRIMS WITH FRUITS
37. MATURED RESULT GLOSSGREEN
49. -
50. LADEN RIPE GLOSSGREEN
52. IS VENERABLE -
53. PLUCKED BARE !
57. FOR AMONGST PRIDES GLOSSGI
58. LADEN WITH LORE
60. BENEATH FRISKY TRUSTY AFFE
61. LADEN WITH LORE
62. AMONGST PRIDES GLOSSGREEN

ostentatious.v0.txt

2. '
3. BUGLE SKY —
5. CASTLE CLOUD'S
6. —... —...
8. '
10. STEELBLASTSTEELBLAST
11. GALAXY —...GALAXY—n. 1.celest
12.
13. :
14. SHE-MOON'S
16. CHEEKFLUSHED
17. TRAVESTY TRAVESTY—n. 1.irreve
18. AGOG AGOG—adv. 1. merrily, as
19. AVENUE
20. AVENUES
21. LIMPID LIMPID—adj. clear, free
22. THOROUGHFARETHOROUGHFARE—

ostentatious.v1.txt

2. S
5. CASTLE CLOUDS
10. STEALBLAST
11. GALAXY
12.
14. BIG SH
15. SHE-MOONS
16. CHEEKFLUSHED
17. TRAVESTY TRAVESTY—n. 1.irreve
Line 16
16. CHEEKFLUSHED
dv. 1. merrily, as
20. AVENUES
21. LIMPID LIMPID—adj. clear, free
22. THOROUGHFARETHOROUGHFARE—

ostentatious.v2.txt

2. '
3. BUGLE SKY —
5. CASTLE CLOUD'S
6. —...
8. 'STEELBLAST GALAXY
13. :
14. SHE-MOON'S CHEEK FLUSHED TF

ostentatious.v3.txt

2. '
3. BUGLE SKY
5. CASTLE CLOUD'S
6. —...
8. 'STEELBLAST GALAXY ——
13. :
14. SHE-MOONS CHEEK FLUSHED TR

ostentatious.v4.txt

1. ALOFT:
2. S
3. BUGLE SKY —
4. BELOW:
5. CASTLE CLOUDS
6. —...
8. 'STEELBLAST GALAXY

Fig. 2 A text view of versions of two poems. Four different searches for the words “contrast”, “buff”, “spiked” and “bugle” are performed across all versions of both poems. Each instance of searched word is highlighted using the same color in all documents.