SAND2006-6377P

Cross-Language Ideology Detection Using Linguistics-Based Knowledge Extraction

Department 06641

September 13, 2006

Peter Chew, Stephen Verzi, JT McClain, Travis Bauer
Sandia National Laboratories

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National
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Background

Words, or language, persuade people to join movements which can in turn become threats.

threats

movements

ideas

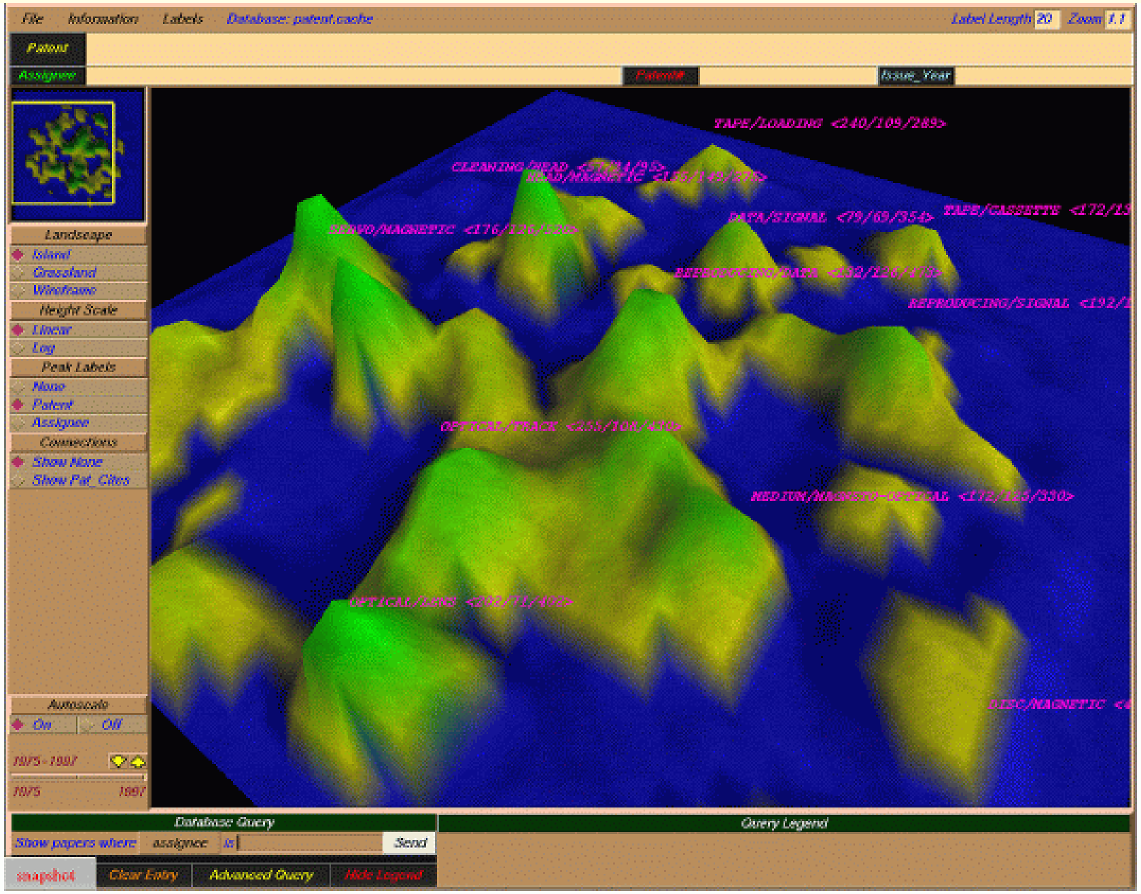
جهاد
коммунизм
global warming

words

Our approach

- Representative sample of web pages, with focus towards blogs, commentaries
  - Multi-lingual (English, Russian, Arabic, French, Spanish)
- Collect in a SQL Server database
- Analyze, based on language and/or links, the prominence of different clusters
  - We expect approach to be ‘blind’ to language
- Analyze changes over time

What we are aiming for – an example



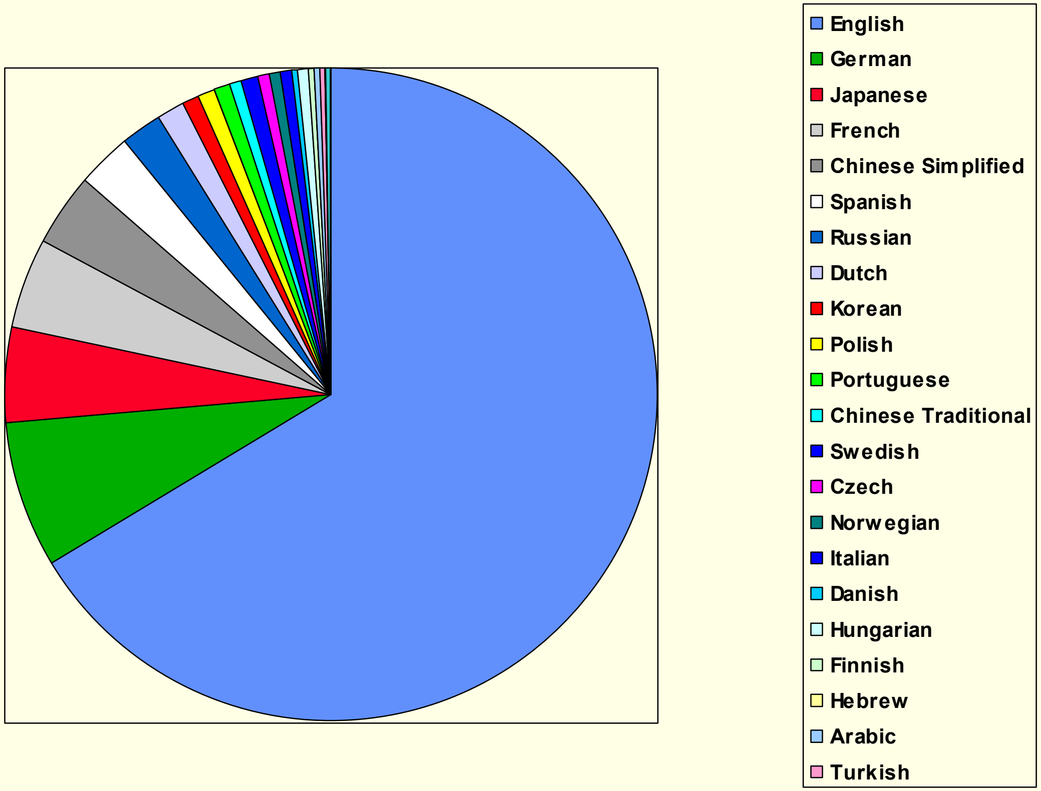
Database: patent.cache

Label Length 20 Zoom 1.1

Show papers where assignee is

Figure 2: The mountain terrain metaphor provides an intuitive exploration environment.

Distribution of internet content by language



Data collection to date

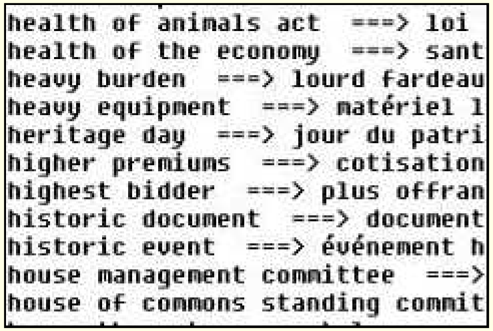
	Number of documents	% in sample	approx. % in population
English	176,307	**50.7**	**66.5**
Russian	62,954	**18.1**	**2.0**
Arabic	30,248	**8.7**	**0.2**
Spanish	39,898	**11.5**	**2.6**
French NEW!	38,479	**11.1**	**4.4**
Others	-	-	**24.3**
TOTAL	**347,886**	**100.0**	**100.0**

Approaches to cross-language information retrieval

- Translate the query
  - Efficacy is constrained by quality of machine translation

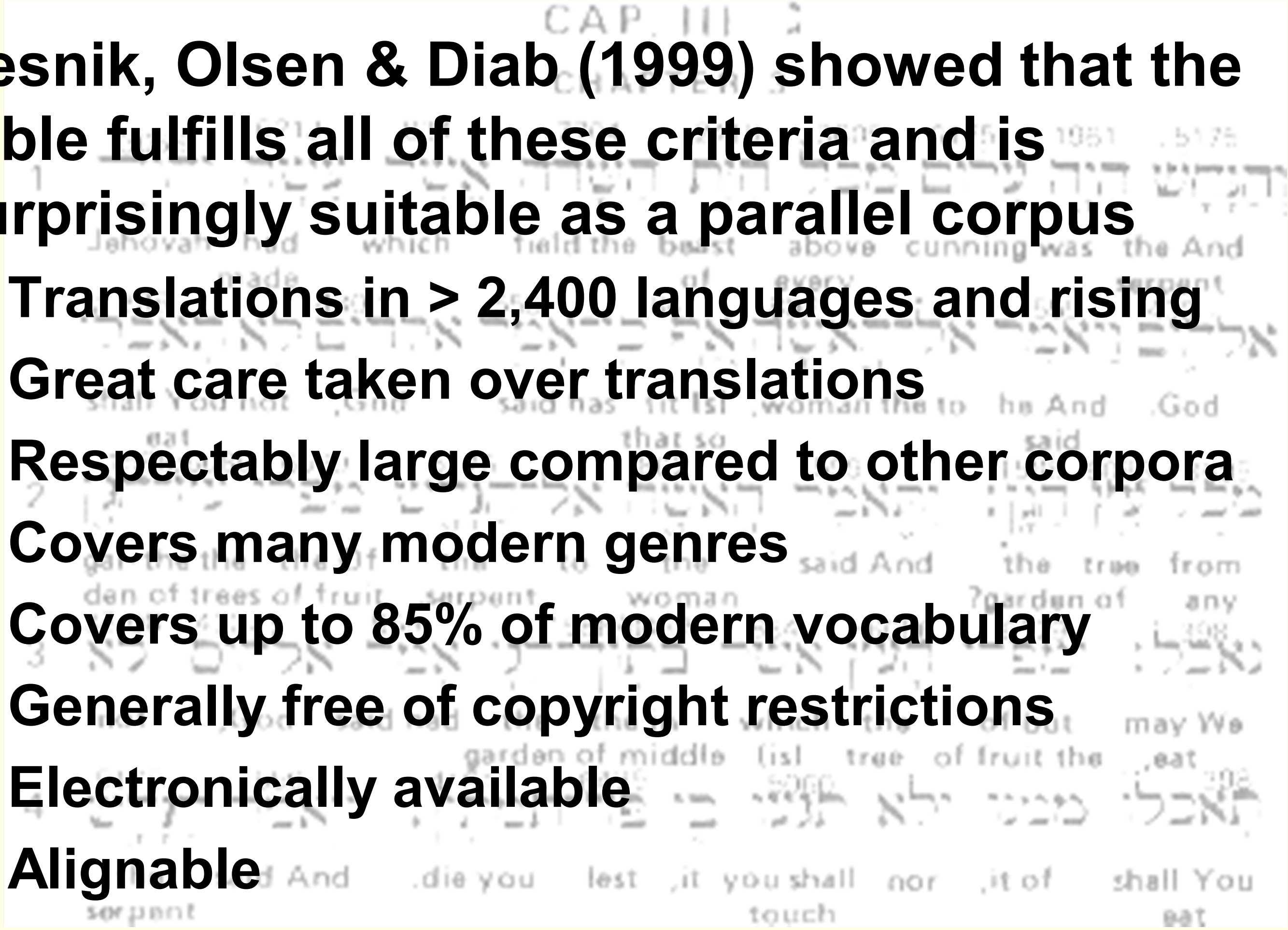
جهاد

- Train algorithm on parallel corpora
  - Translations should:
    - Be available in target languages
    - Be reliable
    - Be sufficiently large in size
    - Cover target subject domain
    - Be free of undue copyright restrictions
    - Be electronically available
    - Be alignable



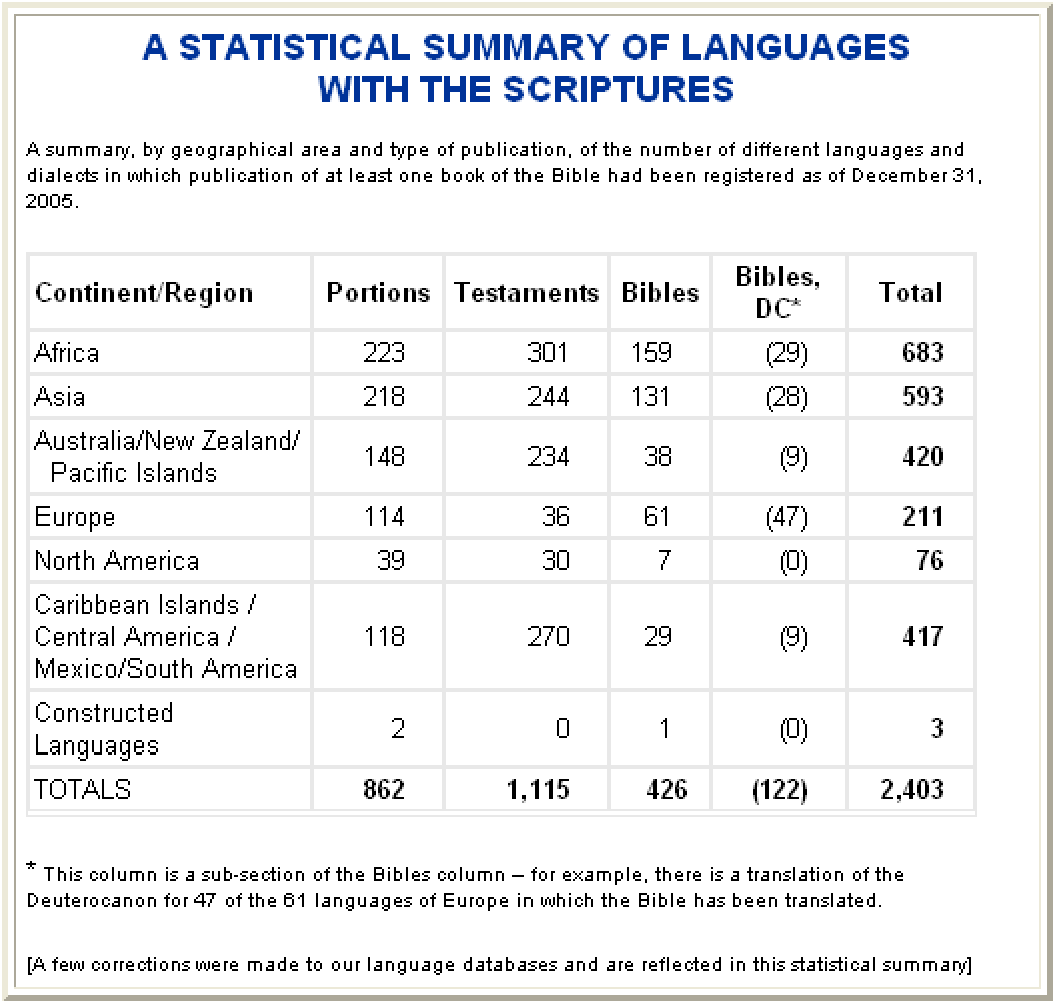
```
health of animals act  ===> loi
health of the economy  ===> sant
heavy burden  ===> lourd fardeau
heavy equipment  ===> matériel l
heritage day  ===> jour du patri
higher premiums  ===> cotisation
highest bidder  ===> plus offran
historic document  ===> document
historic event  ===> événement h
house management committee  ===>
house of commons standing commit
```

The Bible as a Parallel Corpus



- Resnik, Olsen & Diab (1999) showed that the Bible fulfills all of these criteria and is surprisingly suitable as a parallel corpus
  - Translations in > 2,400 languages and rising
  - Great care taken over translations
  - Respectably large compared to other corpora
  - Covers many modern genres
  - Covers up to 85% of modern vocabulary
  - Generally free of copyright restrictions
  - Electronically available
  - Alignable

Language coverage - detail



A STATISTICAL SUMMARY OF LANGUAGES WITH THE SCRIPTURES

A summary, by geographical area and type of publication, of the number of different languages and dialects in which publication of at least one book of the Bible had been registered as of December 31, 2005.

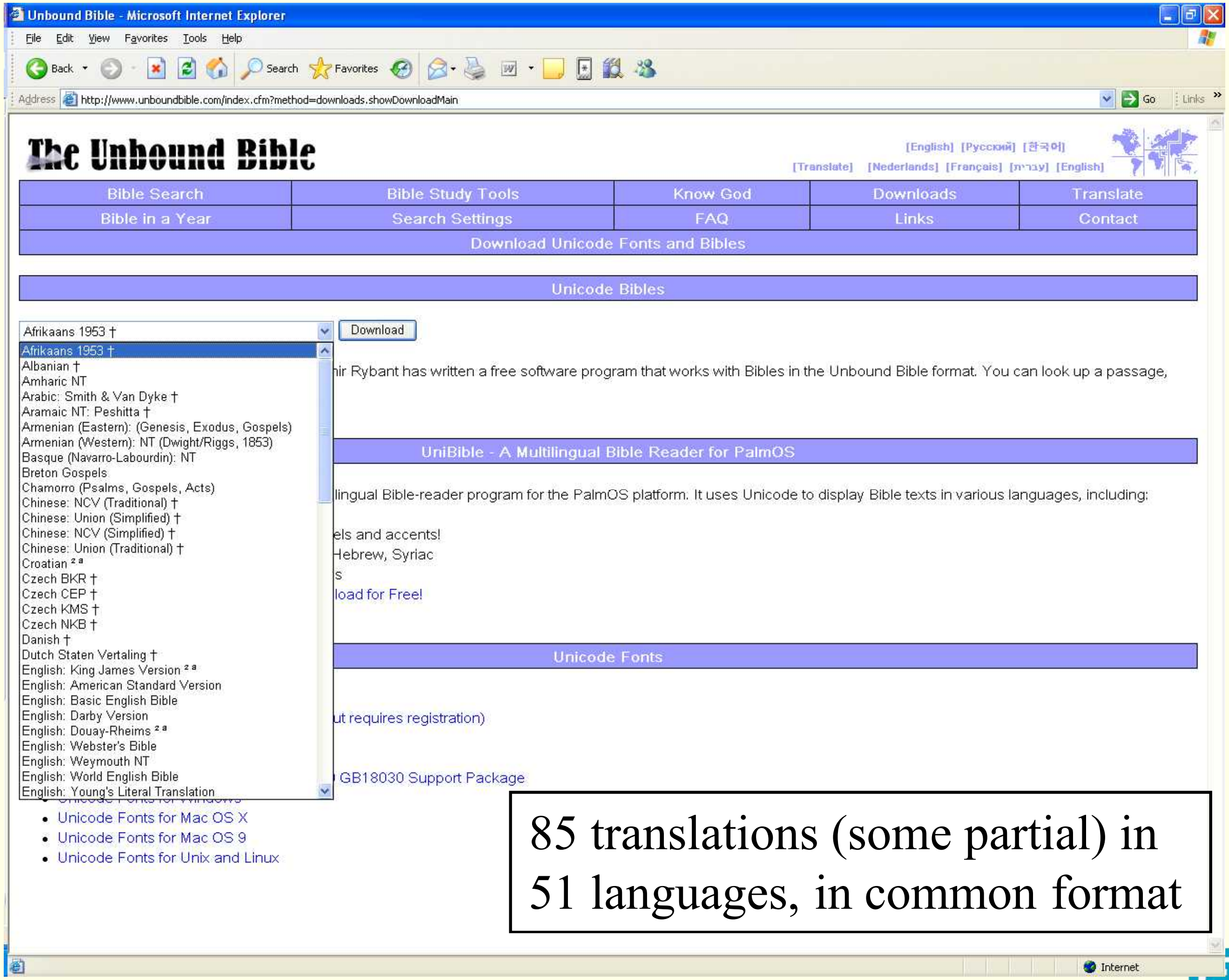
Continent/Region	Portions	Testaments	Bibles	Bibles, DC*	Total
Africa	223	301	159	(29)	**683**
Asia	218	244	131	(28)	**593**
Australia/New Zealand/ Pacific Islands	148	234	38	(9)	**420**
Europe	114	36	61	(47)	**211**
North America	39	30	7	(0)	**76**
Caribbean Islands / Central America / Mexico/South America	118	270	29	(9)	**417**
Constructed Languages	2	0	1	(0)	**3**
TOTALS	**862**	**1,115**	**426**	**(122)**	**2,403**

* This column is a sub-section of the Bibles column – for example, there is a translation of the Deuterocanon for 47 of the 61 languages of Europe in which the Bible has been translated.

[A few corrections were made to our language databases and are reflected in this statistical summary]

Per http://www.biblesociety.org/latestnews/latest341-slr2005stats.html

The ‘Unbound Bible’


Unbound Bible - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://www.unboundbible.com/index.cfm?method=downloads.showDownloadMain
Go Links
The Unbound Bible
[English] [Русский] [한국어]
[Translate] [Nederlands] [Français] [עברית] [English]
Bible Search
Bible Study Tools
Know God
Downloads
Translate
Bible in a Year
Search Settings
FAQ
Links
Contact
Download Unicode Fonts and Bibles
Unicode Bibles
Download
UniBible - A Multilingual Bible Reader for PalmOS
Unicode Fonts
Internet

Afrikaans 1953 †

- Afrikaans 1953 †
- Albanian †
- Amharic NT
- Arabic: Smith & Van Dyke †
- Aramaic NT: Peshitta †
- Armenian (Eastern): (Genesis, Exodus, Gospels)
- Armenian (Western): NT (Dwight/Riggs, 1853)
- Basque (Navarro-Labourdin): NT
- Breton Gospels
- Chamorro (Psalms, Gospels, Acts)
- Chinese: NCV (Traditional) †
- Chinese: Union (Simplified) †
- Chinese: NCV (Simplified) †
- Chinese: Union (Traditional) †
- Croatian ² ª
- Czech BKR †
- Czech CEP †
- Czech KMS †
- Czech NKB †
- Danish †
- Dutch Staten Vertaling †
- English: King James Version ² ª
- English: American Standard Version
- English: Basic English Bible
- English: Darby Version
- English: Douay-Rheims ² ª
- English: Webster's Bible
- English: Weymouth NT
- English: World English Bible
- English: Young's Literal Translation

hir Rybant has written a free software program that works with Bibles in the Unbound Bible format. You can look up a passage,

lingual Bible-reader program for the PalmOS platform. It uses Unicode to display Bible texts in various languages, including:

els and accents!

Hebrew, Syriac

s

load for Free!

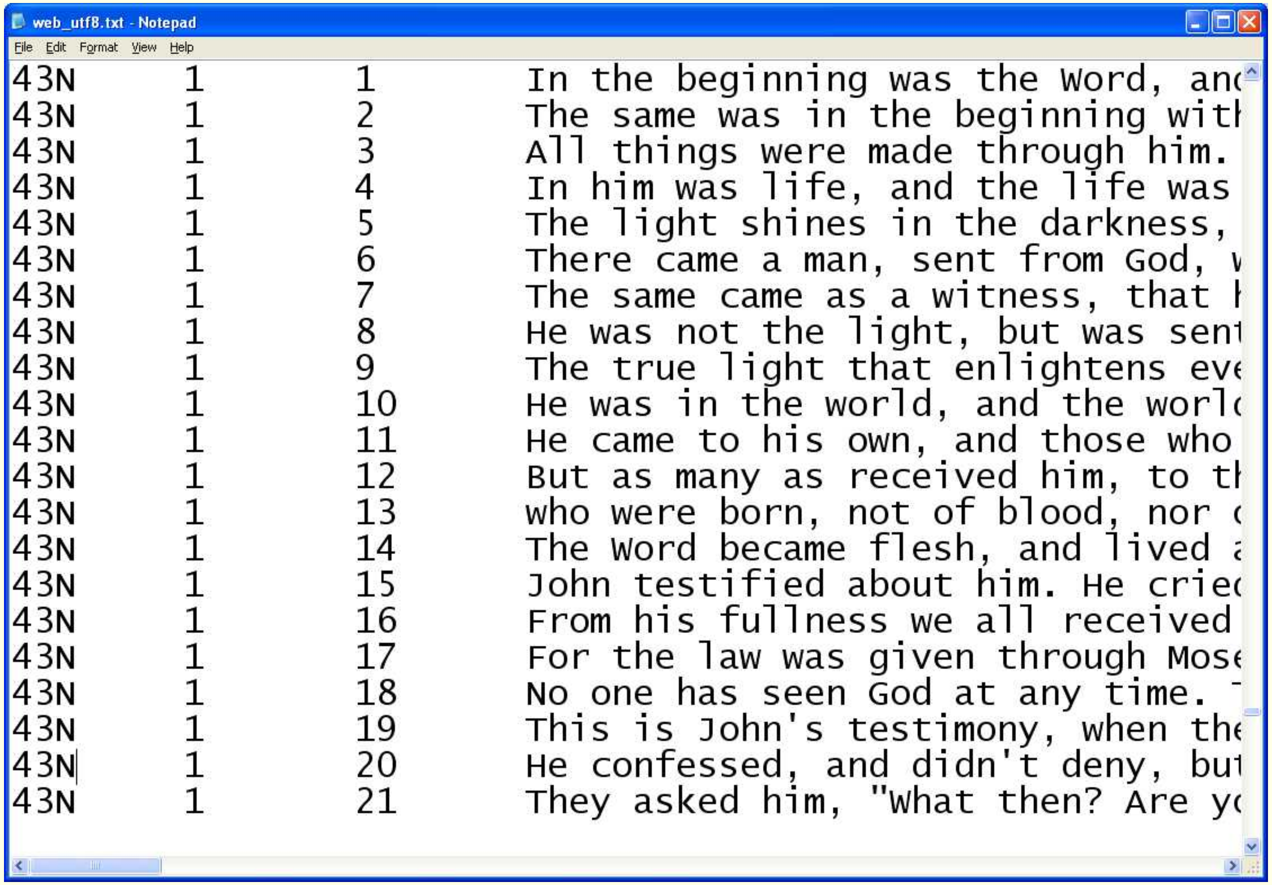
ut requires registration)

GB18030 Support Package

- Unicode Fonts for Mac OS X
- Unicode Fonts for Mac OS 9
- Unicode Fonts for Unix and Linux

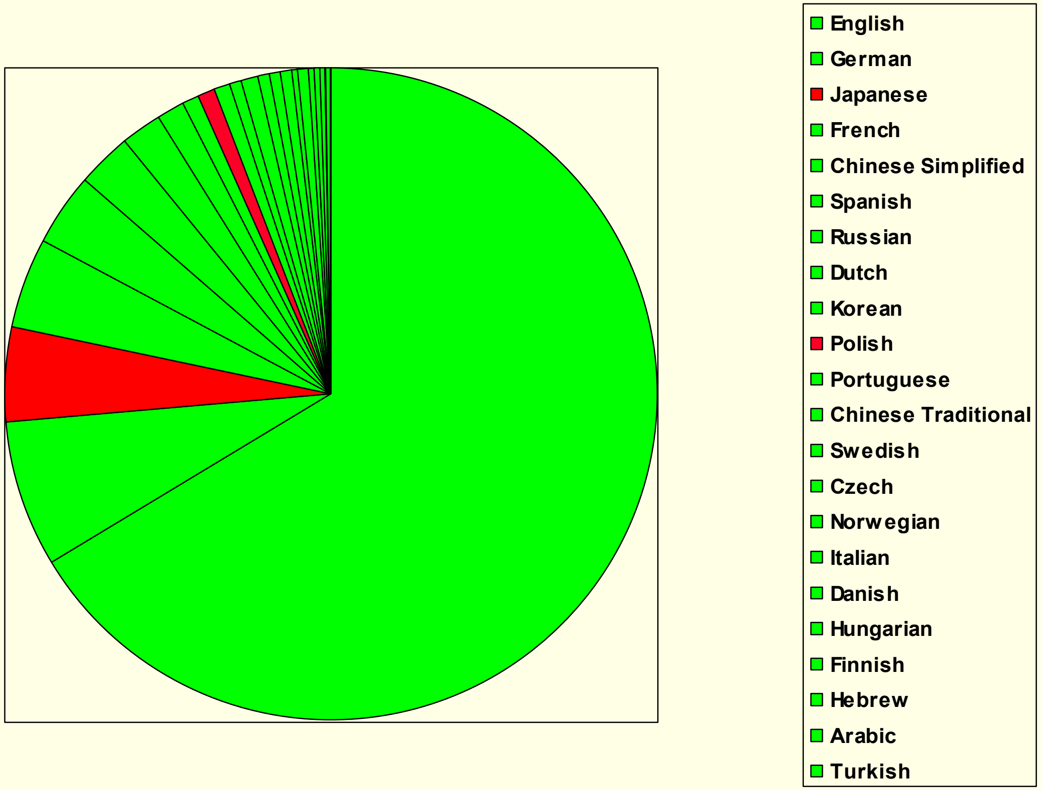
85 translations (some partial) in 51 languages, in common format

The ‘Unbound Bible’ – a sample



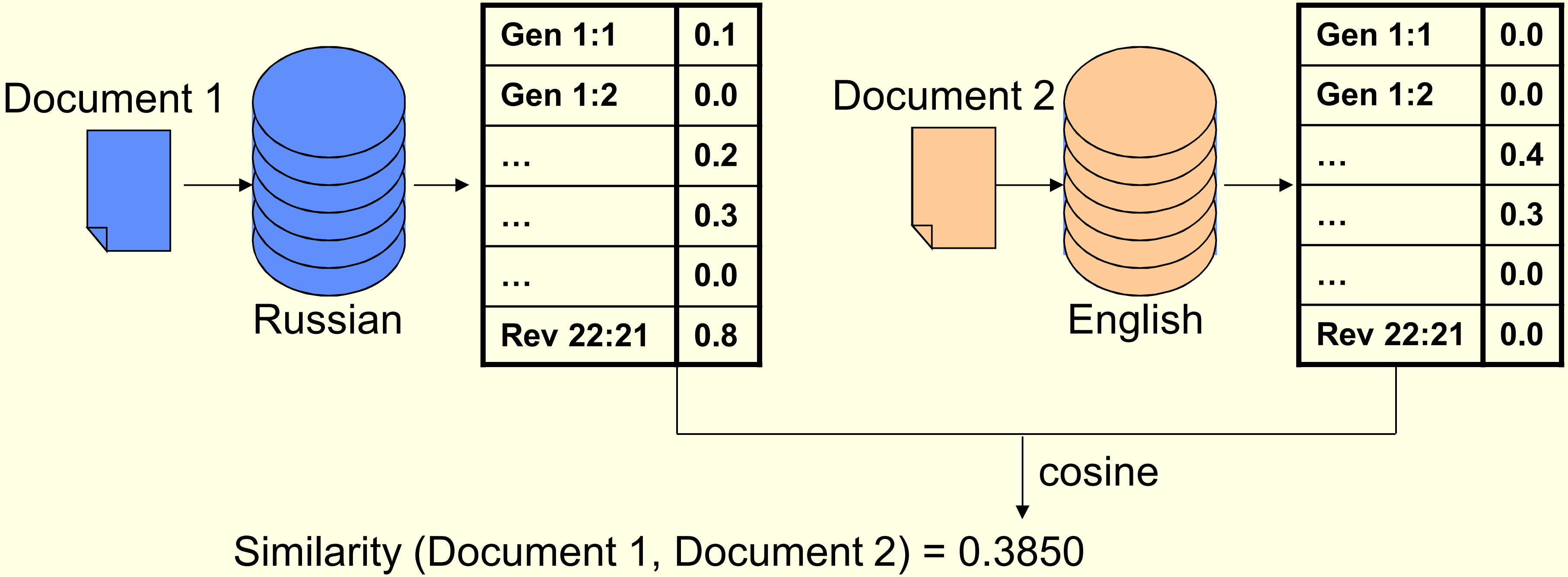
```
43N     1     1       In the beginning was the Word, and
43N     1     2       The same was in the beginning with
43N     1     3       All things were made through him.
43N     1     4       In him was life, and the life was
43N     1     5       The light shines in the darkness,
43N     1     6       There came a man, sent from God, w
43N     1     7       The same came as a witness, that h
43N     1     8       He was not the light, but was sent
43N     1     9       The true light that enlightens eve
43N     1     10      He was in the world, and the world
43N     1     11      He came to his own, and those who
43N     1     12      But as many as received him, to th
43N     1     13      who were born, not of blood, nor o
43N     1     14      The Word became flesh, and lived a
43N     1     15      John testified about him. He cried
43N     1     16      From his fullness we all received
43N     1     17      For the law was given through Mose
43N     1     18      No one has seen God at any time. T
43N     1     19      This is John's testimony, when the
43N     1     20      He confessed, and didn't deny, but
43N     1     21      They asked him, "What then? Are yo
```

Coverage of internet content based on 'Unbound Bible'



Cross-Language Comparison – Method 1

- **Use separate STANLEY textual model for each language**



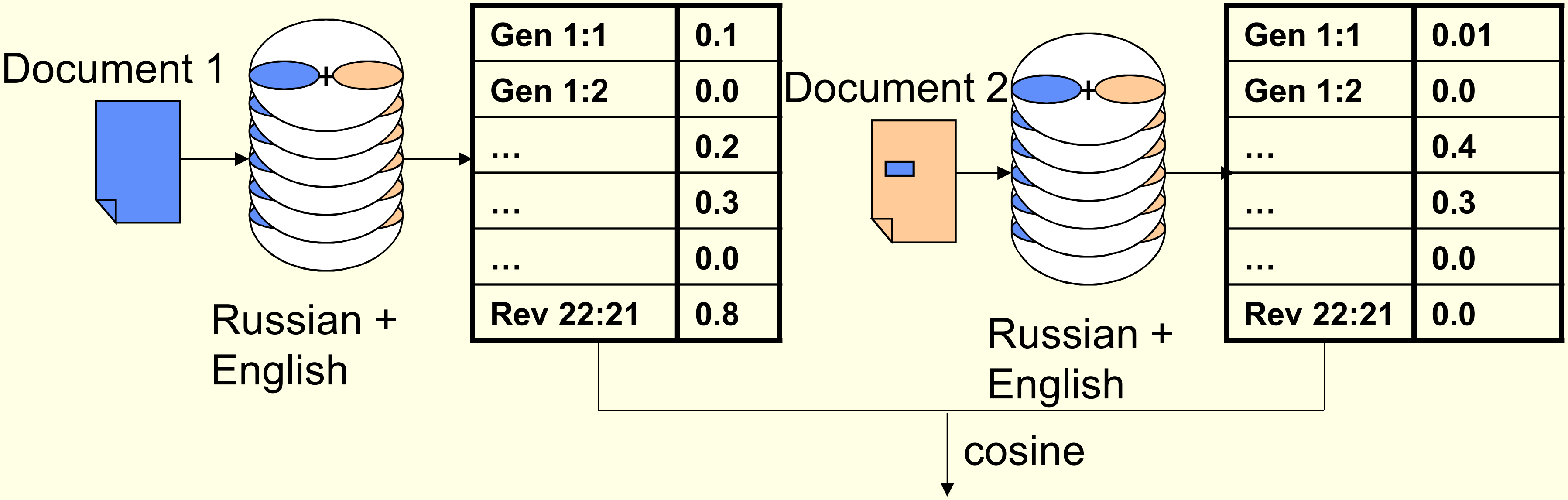
Gen 1:1	0.1
Gen 1:2	0.0
…	0.2
…	0.3
…	0.0
Rev 22:21	0.8

Gen 1:1	0.0
Gen 1:2	0.0
…	0.4
…	0.3
…	0.0
Rev 22:21	0.0

Similarity (Document 1, Document 2) = 0.3850

Cross-Language Comparison – Method 2

- **Use single STANLEY textual model of concatenated language document chunks**



Gen 1:1	**0.1**
Gen 1:2	**0.0**
…	**0.2**
…	**0.3**
…	**0.0**
Rev 22:21	**0.8**

Gen 1:1	**0.01**
Gen 1:2	**0.0**
…	**0.4**
…	**0.3**
…	**0.0**
Rev 22:21	**0.0**

Similarity (Document 1, Document 2) = 0.3872

Validation results: Test set in training set

Method: **Index on entire Bible, measure average uninterpolated precision at doc. 1 for 66 books of Bible**

		To				
		Arabic	English	French	Russian	Spanish
From	Arabic	1.00	1.00	1.00	1.00	1.00
	English	1.00	1.00	1.00	1.00	1.00
	French	1.00	1.00	1.00	1.00	1.00
	Russian	1.00	.99	1.00	1.00	1.00
	Spanish	1.00	1.00	1.00	1.00	1.00

Validation results: Test set not in training set

Method: **Index on entire Bible, obtain matrix of similarity measures for 5 conference abstracts where English and Spanish translations exist**

		English				
		Doc 1	Doc 2	Doc 3	Doc 4	Doc 5
Spanish	Doc 1	.607	.043	.045	.035	.022
	Doc 2	.049	.397	.038	.082	.166
	Doc 3	.030	.050	.045	.101	.049
	Doc 4	.102	.096	.080	.189	.105
	Doc 5	.035	.131	.039	.042	.168

We have also used the framework successfully for Maori, to distinguish between the Treaty of Waitangi and the New Zealand National Anthem

Validation results: Test set not in training set

Method: Index on entire Bible, measure Mean Average Precision for 114 suras of Quran in English, Arabic, Russian, and Spanish (results comparable to McNamee & Mayfield 2004)

- LSA - no removal of stopwords		To			
		Arabic	English	Russian	Spanish
From	Arabic	1.00	.71 .60	.62 .33	.72 .46
	English	.71 .49	1.00	.90 .75	.90 .53
	Russian	.56 .40	.92 .68	1.00	.67 .45
	Spanish	.66 .46	.87 .78	.74 .62	1.00

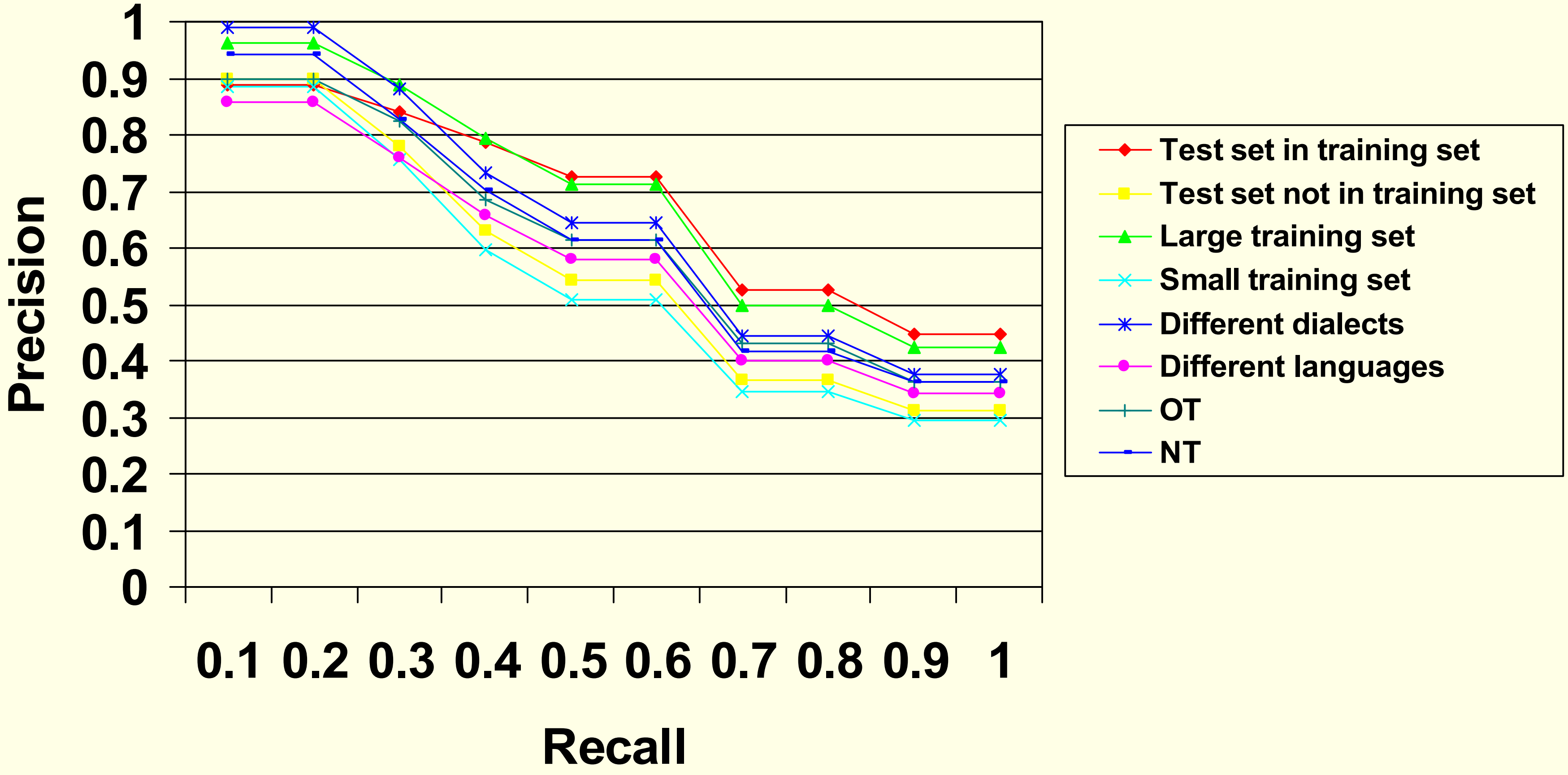
.35

(using 5-grams)

Method 1: Separate index for each language

Method 2: Single index for all languages

Precision-recall graphs for different test parameters



Observations

- Cross-language approach is easily extensible to new languages and corpora, including minority languages

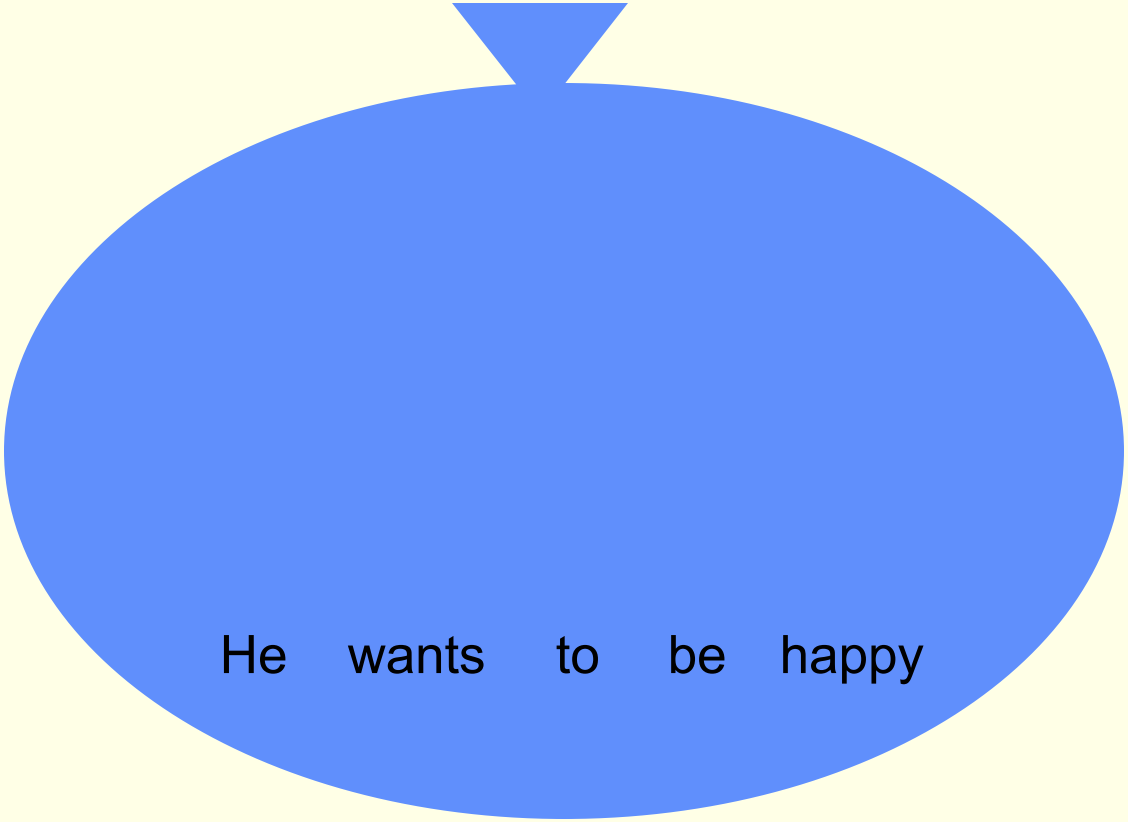
- Resources exist which allow large parallel corpora to be built up from scratch in hours, at no monetary cost

- Unsurprisingly, the larger the training set, the better the precision-recall results

- Results appear to be comparable to, or better than, those achieved by other methods and reported recently in research literature; further testing may be needed

- Our best results were obtained using LSA, a single index for all languages, and without removing stopwords. This has the advantage of requiring no language-specific expertise to set up.

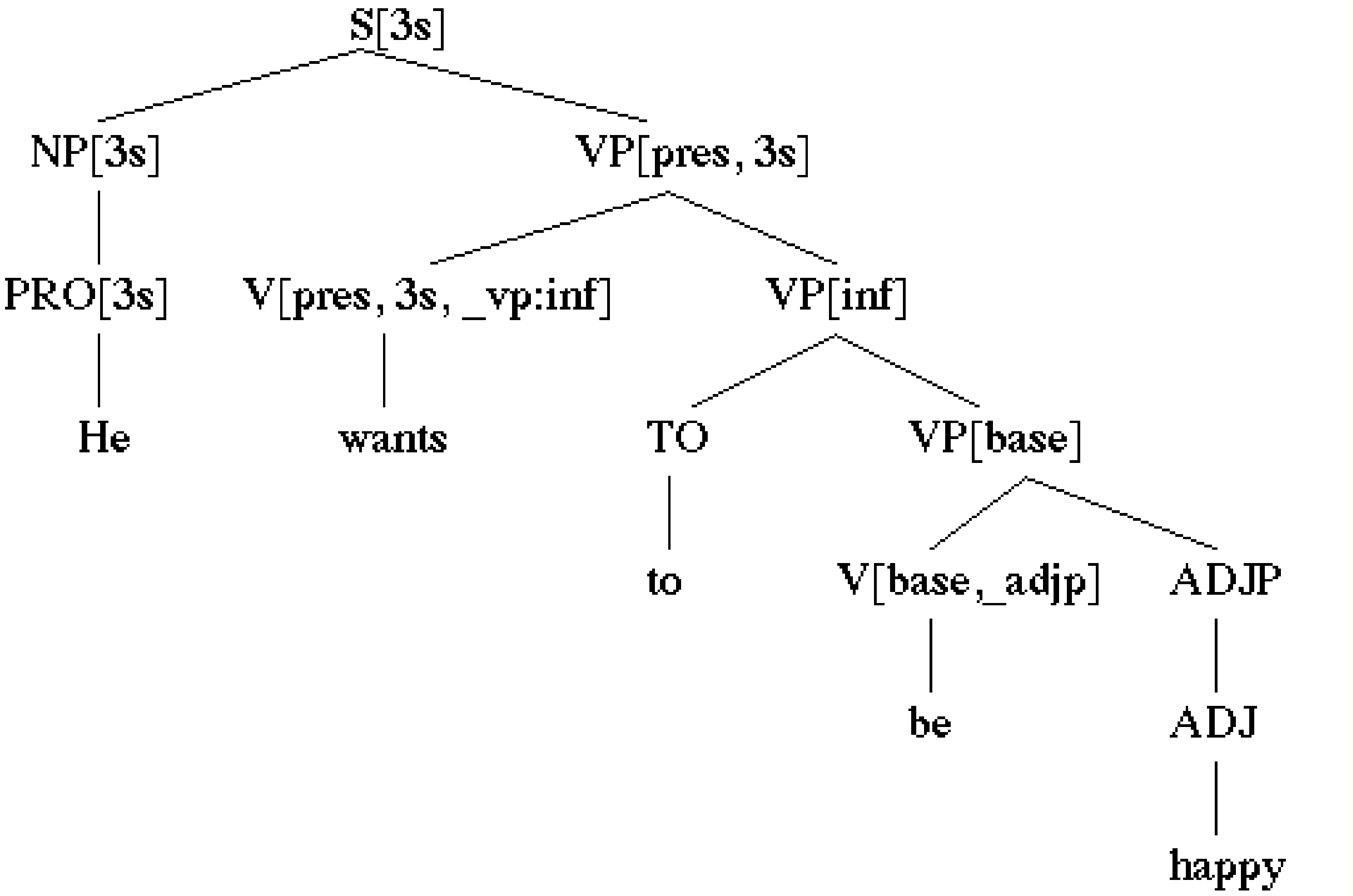
Beyond the ‘bundle of words’



He wants to be happy

The ‘bundle of words’

Of course, order does matter in language



Why does the bundle of words approach work at all?

Assume:

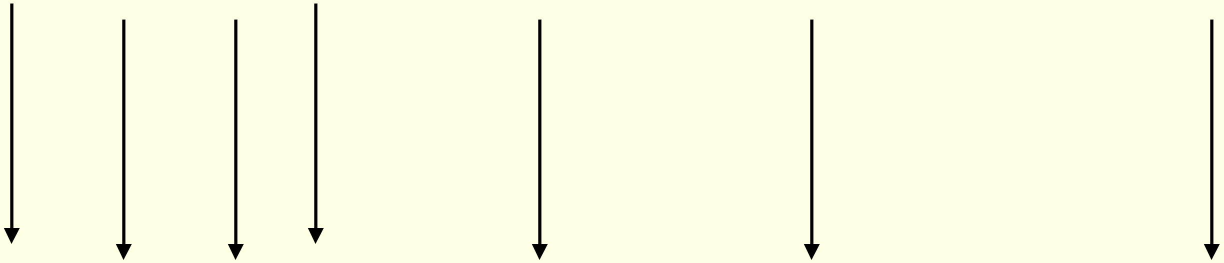
- vocabulary of 100,000 (10^5) words
- sentences are 20 words long
- word order important only within sentences

⇒ Contribution (in bits) to passage ‘information’:

–	**From word *choice*:**	$\log_2(20!)$	≈	**61·0774**	**84.47%**
–	**From word *order*:**	$\log_2((10^5)^{20})$	≈	**332·1928**	**15.53%**
–	**Total**	$\log_2(20! \times 10^{100})$	≈	**393.2702**	**100.00%**

N-Word-Grams

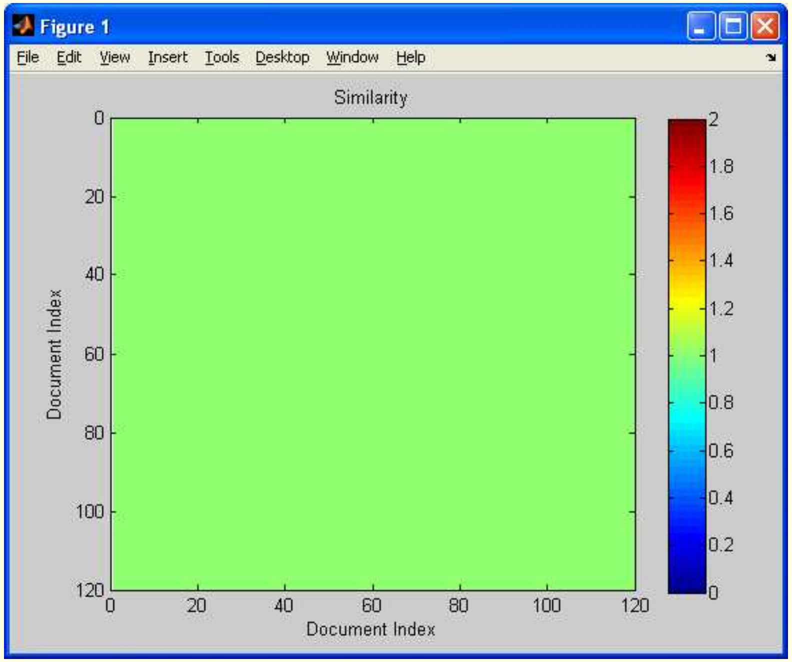
- Consecutive N-Word Lexical Entities
- Statistical Windowing Technique
  - window width
  - step size

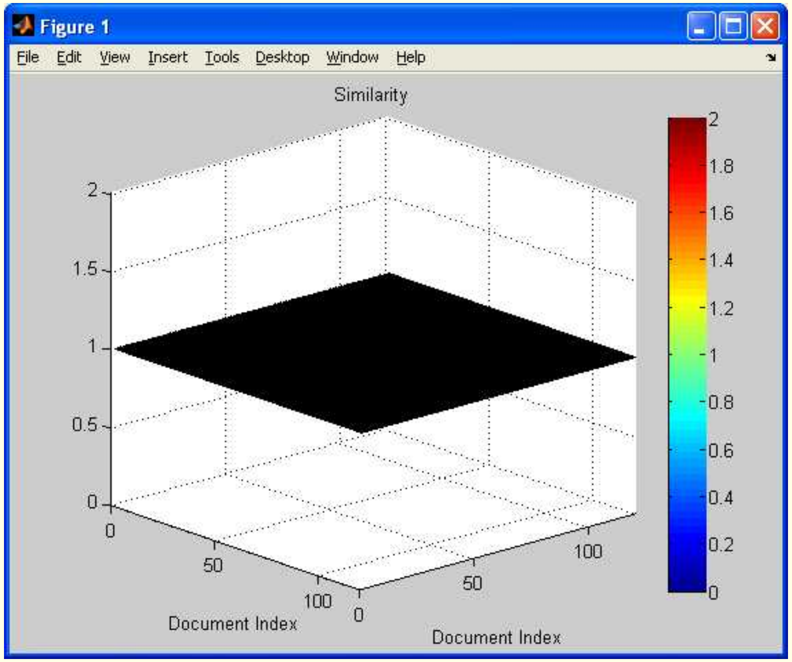


- We are at Sandia National Laboratories …

Document-to-Document Similarities

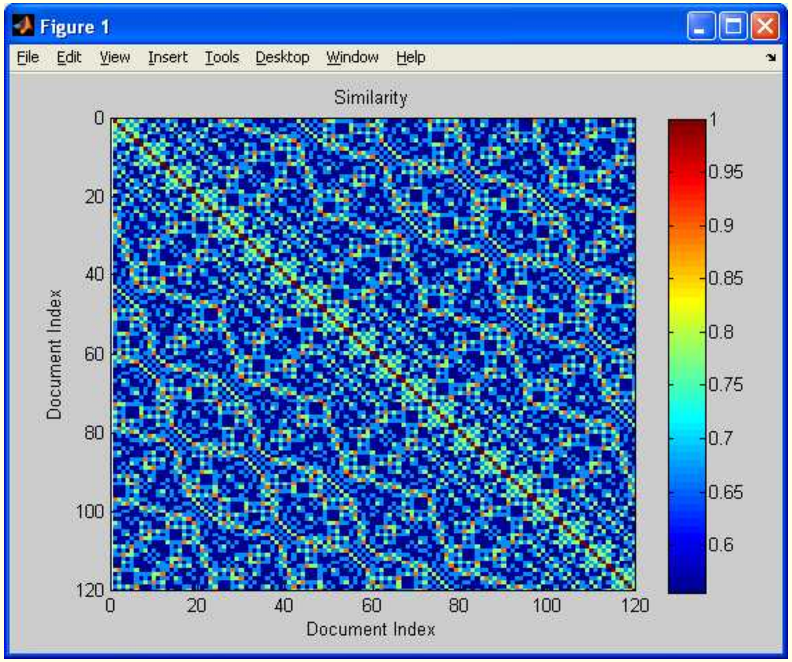
- **All 120 permutations (n = 1 word-grams)**

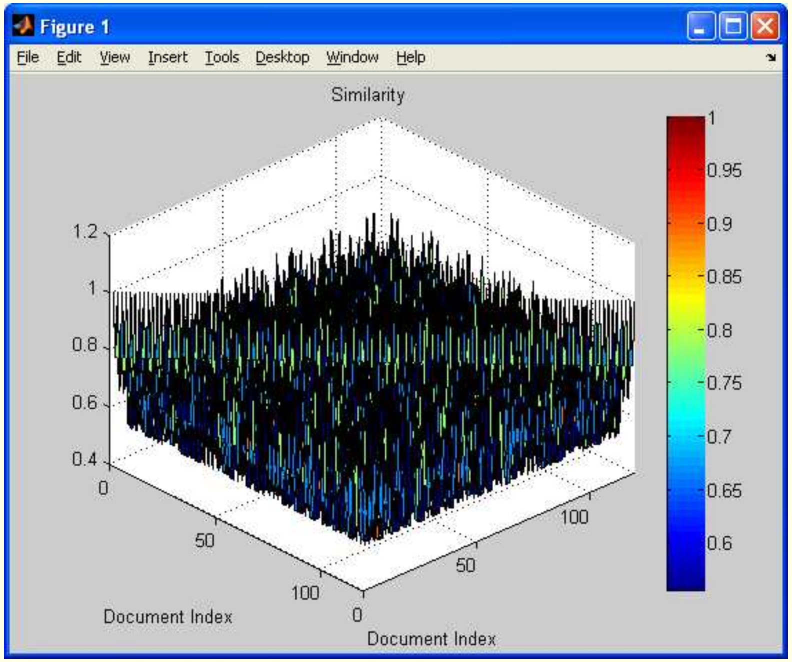




Document-to-Document Similarities

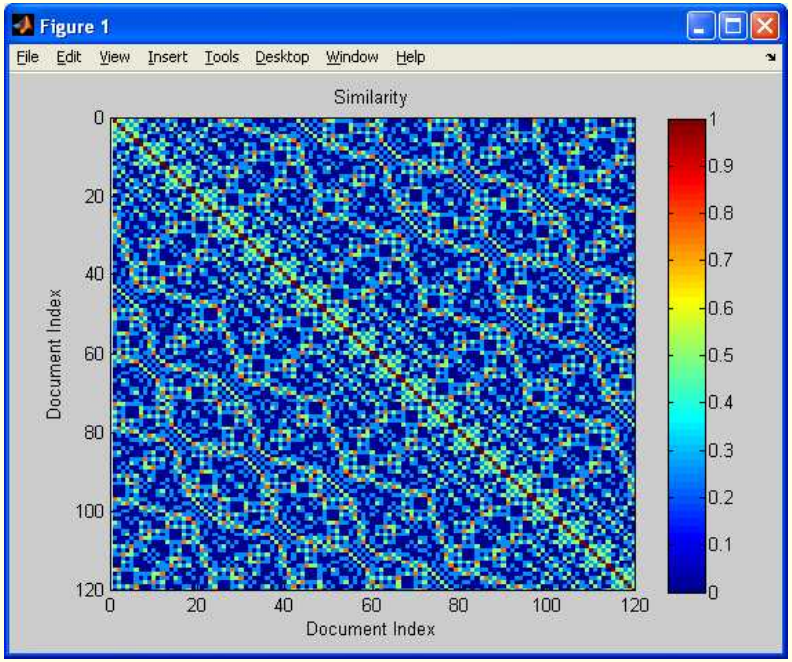
- All 120 permutations (n <= 2 word-grams)

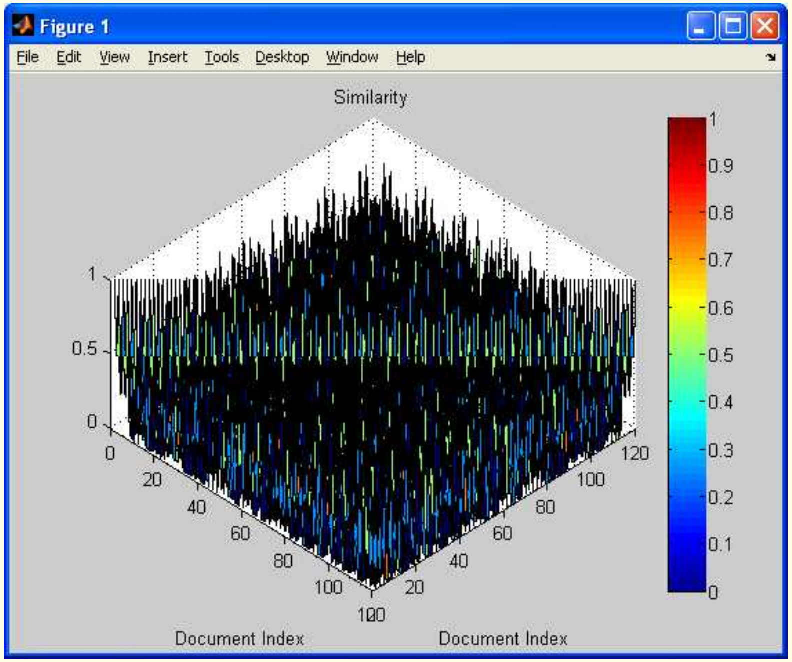




Document-to-Document Similarities

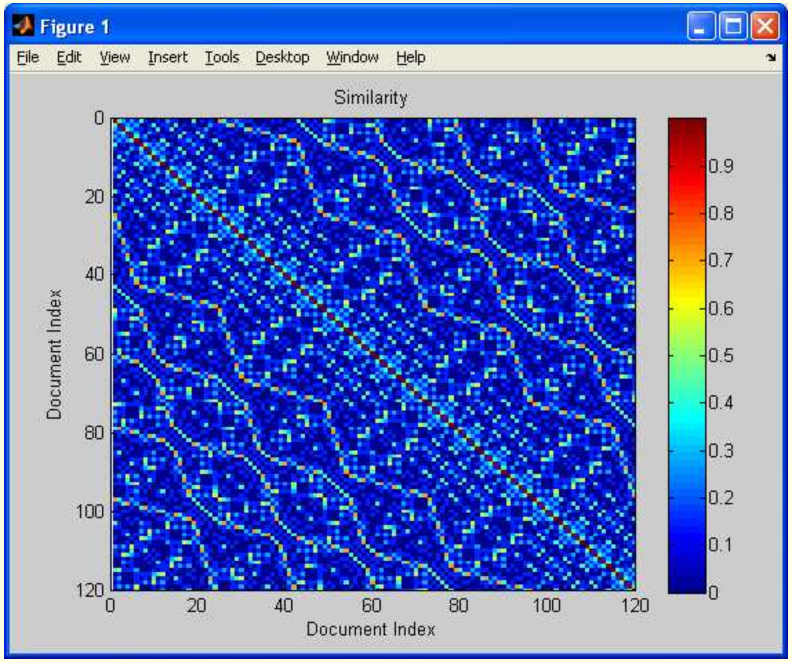
- All 120 permutations (n = 2 word-grams)

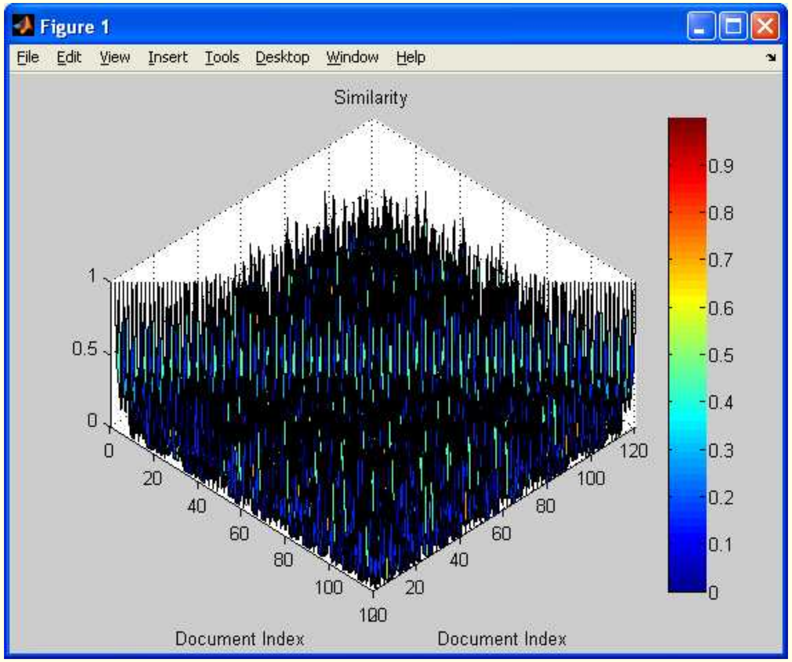




Document-to-Document Similarities

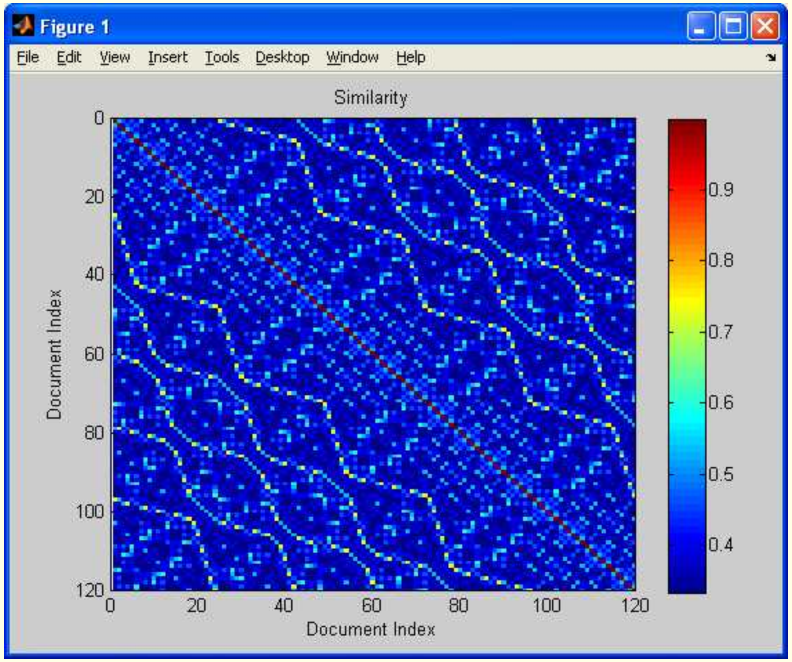
- All 120 permutations (2 <= n <= 3 word-grams)

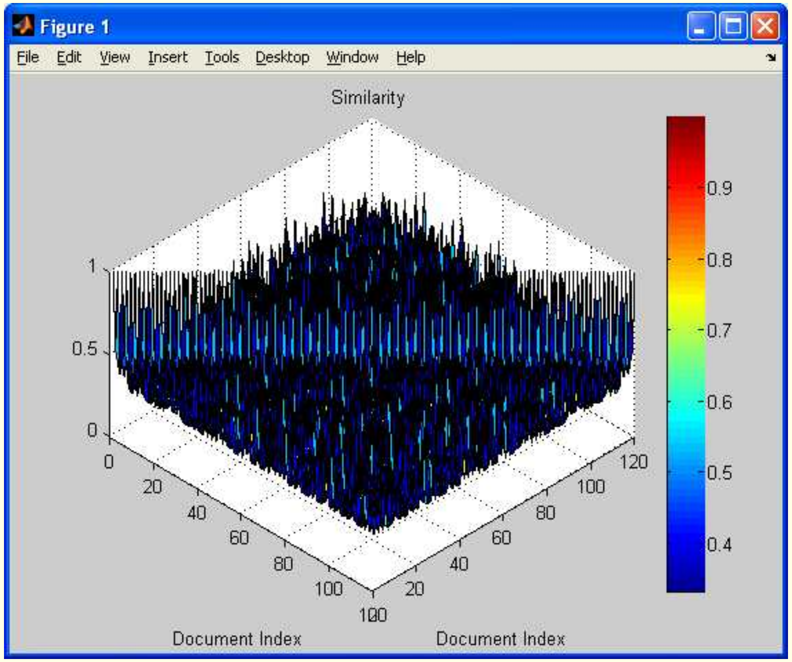




Document-to-Document Similarities

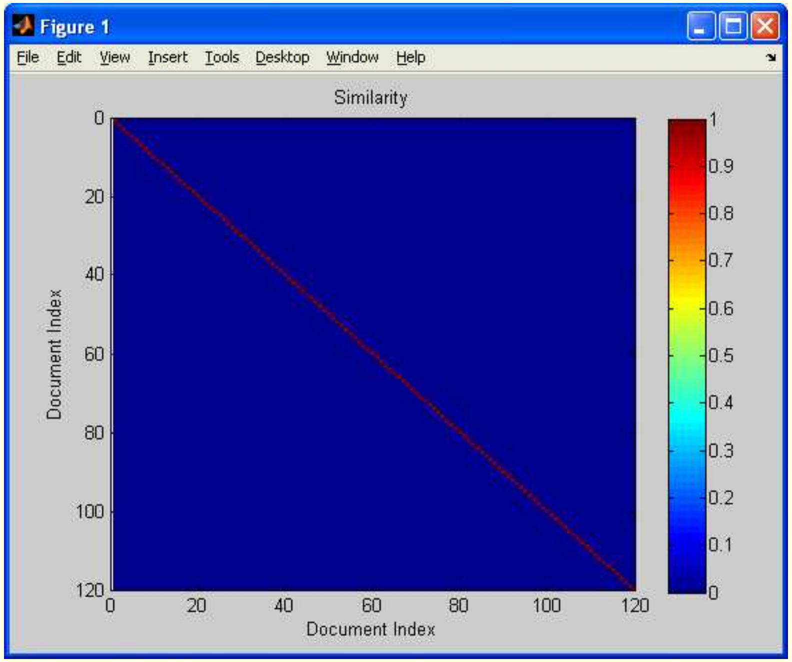
- All 120 permutations (n <= 5 word-grams)

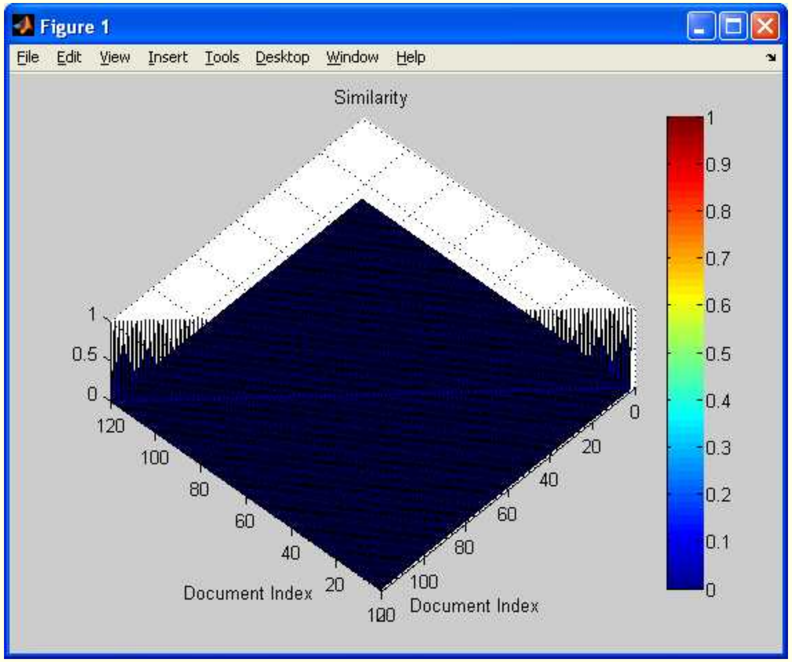




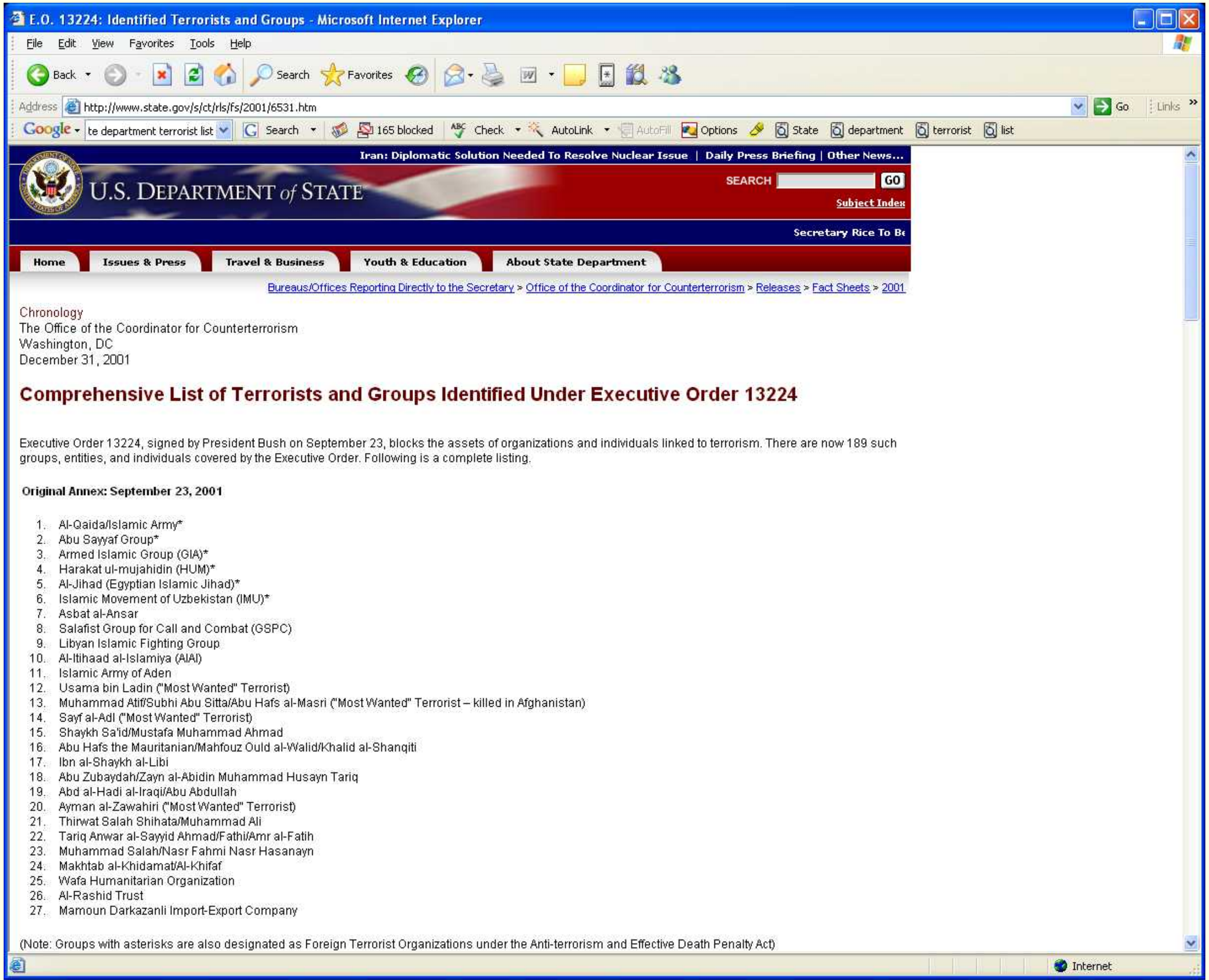
Document-to-Document Similarities

- All 120 permutations (n = 5 word-grams)





Ideological documents of known threat level


E.O. 13224: Identified Terrorists and Groups - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back
Search
Favorites
Address http://www.state.gov/s/ct/rls/fs/2001/6531.htm
Go
Links
Google te department terrorist list
Search
165 blocked
Check
AutoLink
AutoFill
Options
State
department
terrorist
list
Iran: Diplomatic Solution Needed To Resolve Nuclear Issue | Daily Press Briefing | Other News...
U.S. DEPARTMENT of STATE
SEARCH
GO
Subject Index
Secretary Rice To Be
Home
Issues & Press
Travel & Business
Youth & Education
About State Department
Bureaus/Offices Reporting Directly to the Secretary > Office of the Coordinator for Counterterrorism > Releases > Fact Sheets > 2001
Internet

Chronology
The Office of the Coordinator for Counterterrorism
Washington, DC
December 31, 2001

Comprehensive List of Terrorists and Groups Identified Under Executive Order 13224

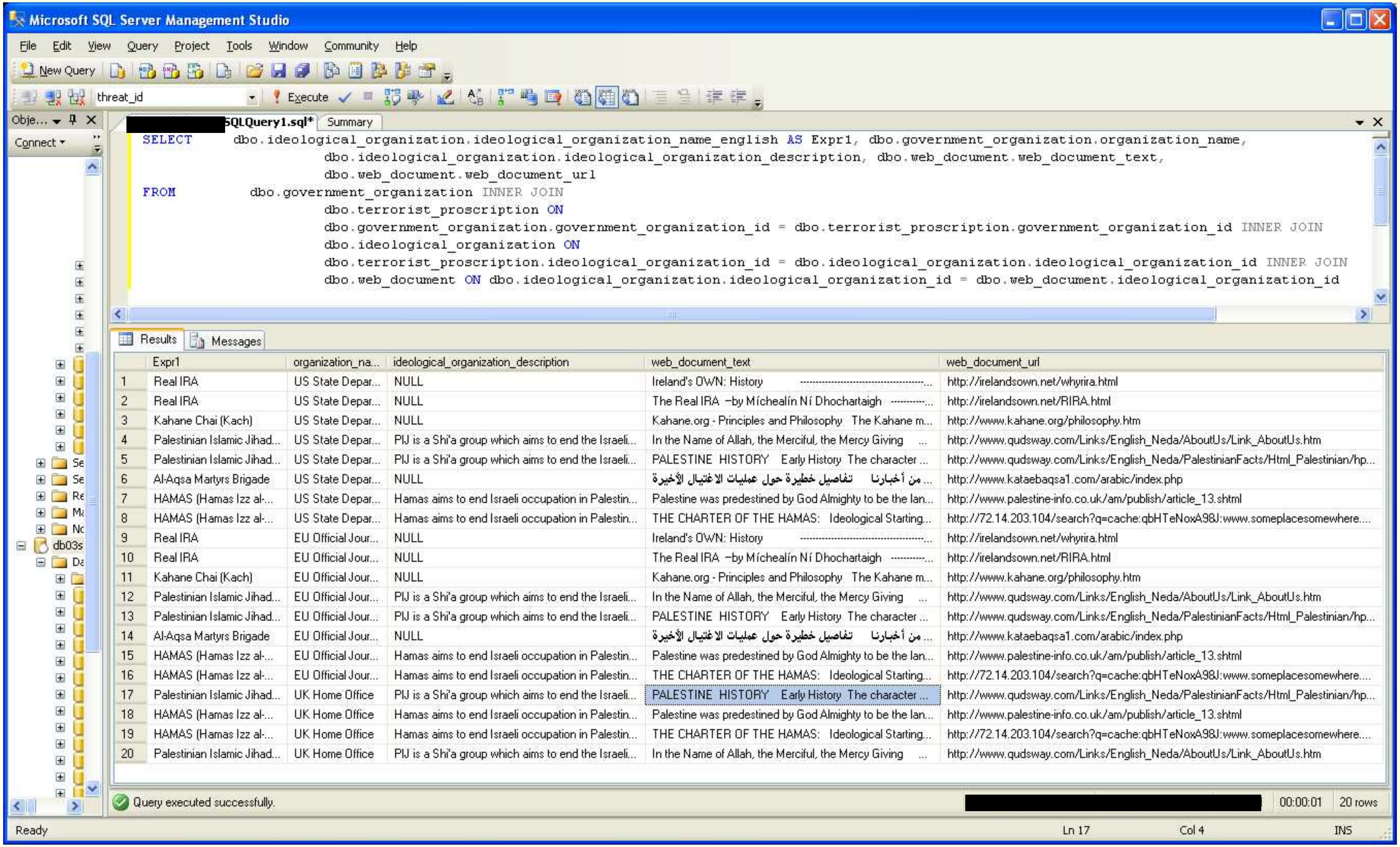
Executive Order 13224, signed by President Bush on September 23, blocks the assets of organizations and individuals linked to terrorism. There are now 189 such groups, entities, and individuals covered by the Executive Order. Following is a complete listing.

Original Annex: September 23, 2001

1. Al-Qaida/Islamic Army*
2. Abu Sayyaf Group*
3. Armed Islamic Group (GIA)*
4. Harakat ul-mujahidin (HUM)*
5. Al-Jihad (Egyptian Islamic Jihad)*
6. Islamic Movement of Uzbekistan (IMU)*
7. Asbat al-Ansar
8. Salafist Group for Call and Combat (GSPC)
9. Libyan Islamic Fighting Group
10. Al-Itihaad al-Islamiya (AIAI)
11. Islamic Army of Aden
12. Usama bin Ladin ("Most Wanted" Terrorist)
13. Muhammad Atif/Subhi Abu Sitta/Abu Hafs al-Masri ("Most Wanted" Terrorist – killed in Afghanistan)
14. Sayf al-Adl ("Most Wanted" Terrorist)
15. Shaykh Sa'id/Mustafa Muhammad Ahmad
16. Abu Hafs the Mauritanian/Mahfouz Ould al-Walid/Khalid al-Shanqiti
17. Ibn al-Shaykh al-Libi
18. Abu Zubaydah/Zayn al-Abidin Muhammad Husayn Tariq
19. Abd al-Hadi al-Iraqi/Abu Abdullah
20. Ayman al-Zawahiri ("Most Wanted" Terrorist)
21. Thirwat Salah Shihata/Muhammad Ali
22. Tariq Anwar al-Sayyid Ahmad/Fathi/Amr al-Fatih
23. Muhammad Salah/Nasr Fahmi Nasr Hasanayn
24. Makhtab al-Khidamat/Al-Khifaf
25. Wafa Humanitarian Organization
26. Al-Rashid Trust
27. Mamoun Darkazanli Import-Export Company

(Note: Groups with asterisks are also designated as Foreign Terrorist Organizations under the Anti-terrorism and Effective Death Penalty Act)

Ideological documents of known threat level


Microsoft SQL Server Management Studio
File Edit View Query Project Tools Window Community Help
New Query
threat_id
Execute
Obje...
Connect
[redacted]SQLQuery1.sql*
Summary
Results
Messages
db03s

```
SELECT     dbo.ideological_organization.ideological_organization_name_english AS Expr1, dbo.government_organization.organization_name,
                      dbo.ideological_organization.ideological_organization_description, dbo.web_document.web_document_text,
                      dbo.web_document.web_document_url
FROM         dbo.government_organization INNER JOIN
                      dbo.terrorist_proscription ON
                      dbo.government_organization.government_organization_id = dbo.terrorist_proscription.government_organization_id INNER JOIN
                      dbo.ideological_organization ON
                      dbo.terrorist_proscription.ideological_organization_id = dbo.ideological_organization.ideological_organization_id INNER JOIN
                      dbo.web_document ON dbo.ideological_organization.ideological_organization_id = dbo.web_document.ideological_organization_id
```

	Expr1	organization_na...	ideological_organization_description	web_document_text	web_document_url
1	Real IRA	US State Depar...	NULL	Ireland's OWN: History --...	http://irelandsown.net/whyrira.html
2	Real IRA	US State Depar...	NULL	The Real IRA –by Míchealín Ní Dhochartaigh ----------...	http://irelandsown.net/RIRA.html
3	Kahane Chai (Kach)	US State Depar...	NULL	Kahane.org - Principles and Philosophy The Kahane m...	http://www.kahane.org/philosophy.htm
4	Palestinian Islamic Jihad...	US State Depar...	PIJ is a Shi'a group which aims to end the Israeli...	In the Name of Allah, the Merciful, the Mercy Giving ...	http://www.qudsway.com/Links/English_Neda/AboutUs/Link_AboutUs.htm
5	Palestinian Islamic Jihad...	US State Depar...	PIJ is a Shi'a group which aims to end the Israeli...	PALESTINE HISTORY Early History The character ...	http://www.qudsway.com/Links/English_Neda/PalestinianFacts/Html_Palestinian/hp...
6	Al-Aqsa Martyrs Brigade	US State Depar...	NULL	... من أخبارنا تفاصيل خطيرة حول عمليات الاغتيال الأخيرة	http://www.kataebaqsa1.com/arabic/index.php
7	HAMAS (Hamas Izz al-...	US State Depar...	Hamas aims to end Israeli occupation in Palestin...	Palestine was predestined by God Almighty to be the lan...	http://www.palestine-info.co.uk/am/publish/article_13.shtml
8	HAMAS (Hamas Izz al-...	US State Depar...	Hamas aims to end Israeli occupation in Palestin...	THE CHARTER OF THE HAMAS: Ideological Starting...	http://72.14.203.104/search?q=cache:qbHTeNoxA98J:www.someplacesomewhere....
9	Real IRA	EU Official Jour...	NULL	Ireland's OWN: History --...	http://irelandsown.net/whyrira.html
10	Real IRA	EU Official Jour...	NULL	The Real IRA –by Míchealín Ní Dhochartaigh ----------...	http://irelandsown.net/RIRA.html
11	Kahane Chai (Kach)	EU Official Jour...	NULL	Kahane.org - Principles and Philosophy The Kahane m...	http://www.kahane.org/philosophy.htm
12	Palestinian Islamic Jihad...	EU Official Jour...	PIJ is a Shi'a group which aims to end the Israeli...	In the Name of Allah, the Merciful, the Mercy Giving ...	http://www.qudsway.com/Links/English_Neda/AboutUs/Link_AboutUs.htm
13	Palestinian Islamic Jihad...	EU Official Jour...	PIJ is a Shi'a group which aims to end the Israeli...	PALESTINE HISTORY Early History The character ...	http://www.qudsway.com/Links/English_Neda/PalestinianFacts/Html_Palestinian/hp...
14	Al-Aqsa Martyrs Brigade	EU Official Jour...	NULL	... من أخبارنا تفاصيل خطيرة حول عمليات الاغتيال الأخيرة	http://www.kataebaqsa1.com/arabic/index.php
15	HAMAS (Hamas Izz al-...	EU Official Jour...	Hamas aims to end Israeli occupation in Palestin...	Palestine was predestined by God Almighty to be the lan...	http://www.palestine-info.co.uk/am/publish/article_13.shtml
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17	Palestinian Islamic Jihad...	UK Home Office	PIJ is a Shi'a group which aims to end the Israeli...	PALESTINE HISTORY Early History The character ...	http://www.qudsway.com/Links/English_Neda/PalestinianFacts/Html_Palestinian/hp...
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19	HAMAS (Hamas Izz al-...	UK Home Office	Hamas aims to end Israeli occupation in Palestin...	THE CHARTER OF THE HAMAS: Ideological Starting...	http://72.14.203.104/search?q=cache:qbHTeNoxA98J:www.someplacesomewhere....
20	Palestinian Islamic Jihad...	UK Home Office	PIJ is a Shi'a group which aims to end the Israeli...	In the Name of Allah, the Merciful, the Mercy Giving ...	http://www.qudsway.com/Links/English_Neda/AboutUs/Link_AboutUs.htm

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Detecting Ideology

Words, or language, persuade people to join movements which can in turn become threats.

threats

movements

ideas

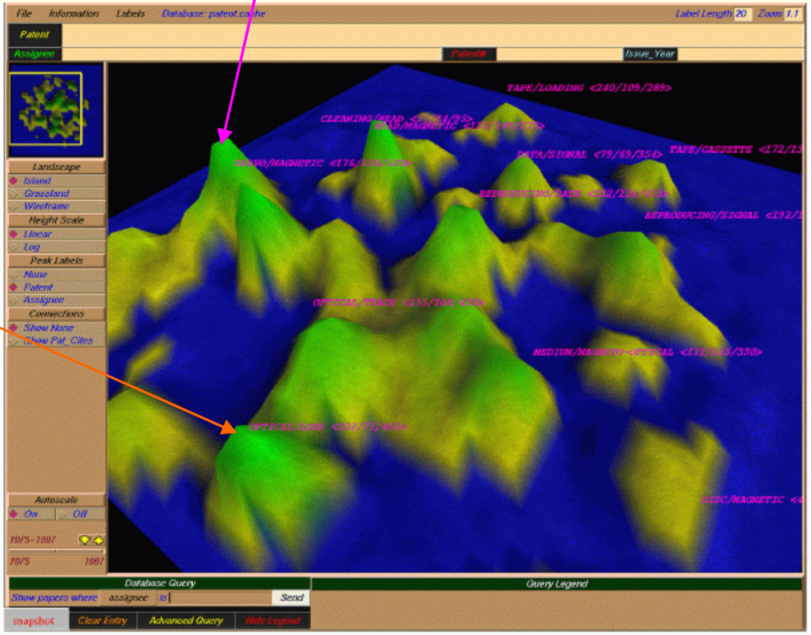
جهاد
коммунизм
global warming

words

Similar Web Documents

Communist Manifesto

Mein Kampf



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Label Length 20 Zoom 1.1

Show papers where assignee is

Figure 2: The mountain terrain metaphor provides an intuitive exploration environment.

Future directions

- Continue to test CLIR algorithm to identify its strengths and weaknesses
- What chunk size yields best cross-language IR results, and why?
- Can we use the output of cross-language comparison to characterize documents by their ideology?
- Add further languages for more coverage of WWW
- Linguistic analysis beyond the ‘bundle of words’ approach

QUESTIONS?

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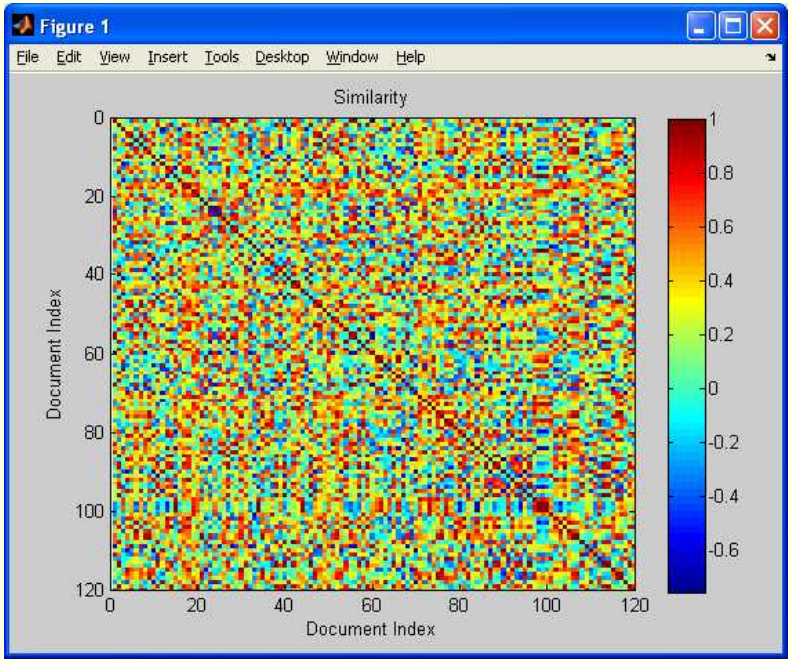
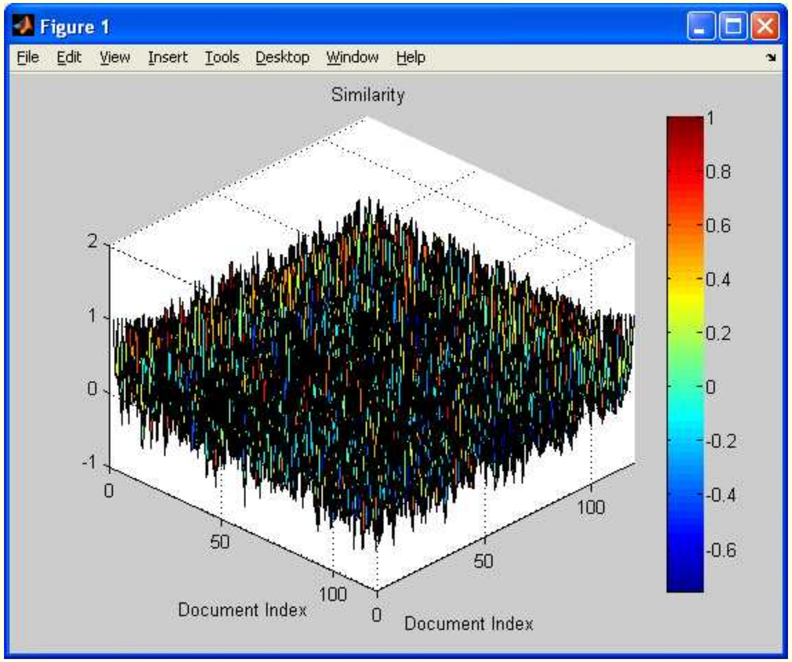
Backup Slides

Document-to-Document Similarities

- All permutations (n = 1 word-grams) - LSA





Document-to-Document Similarities

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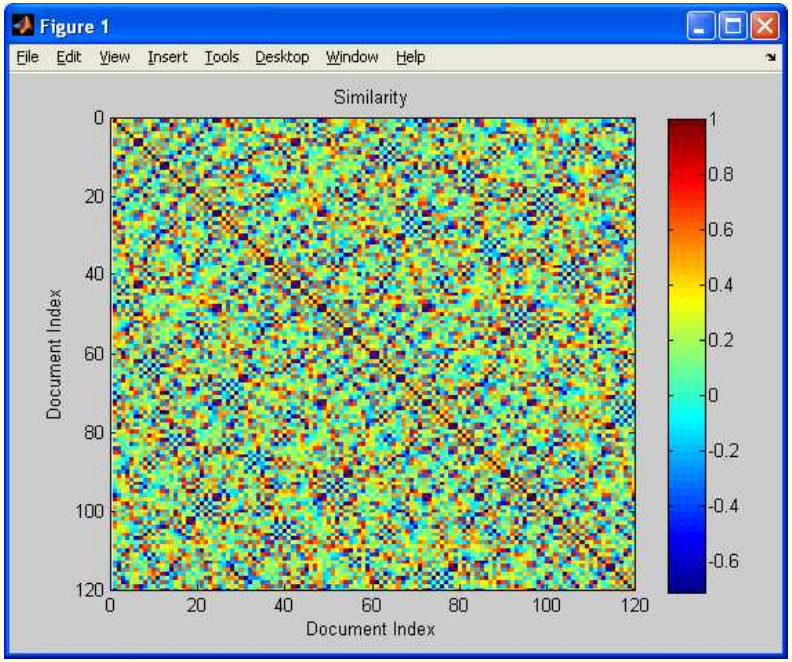

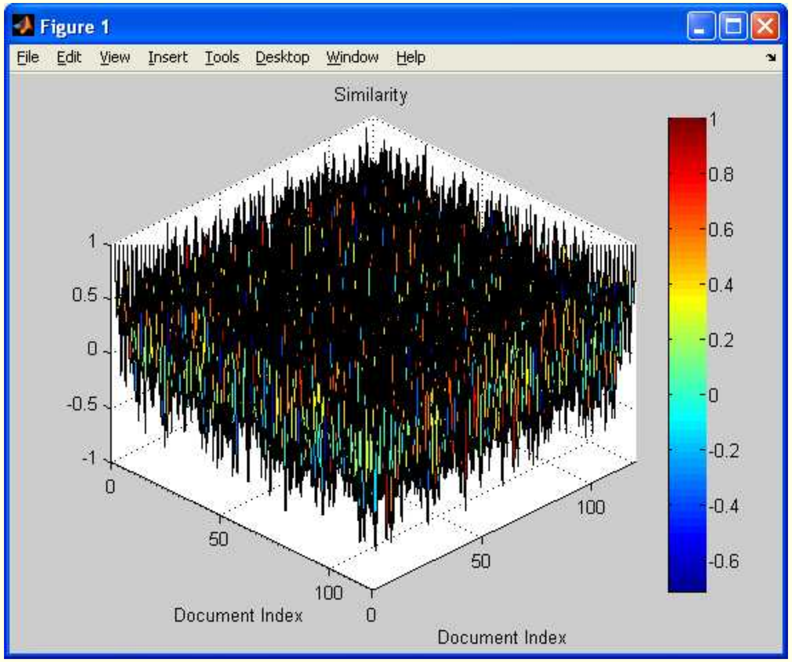

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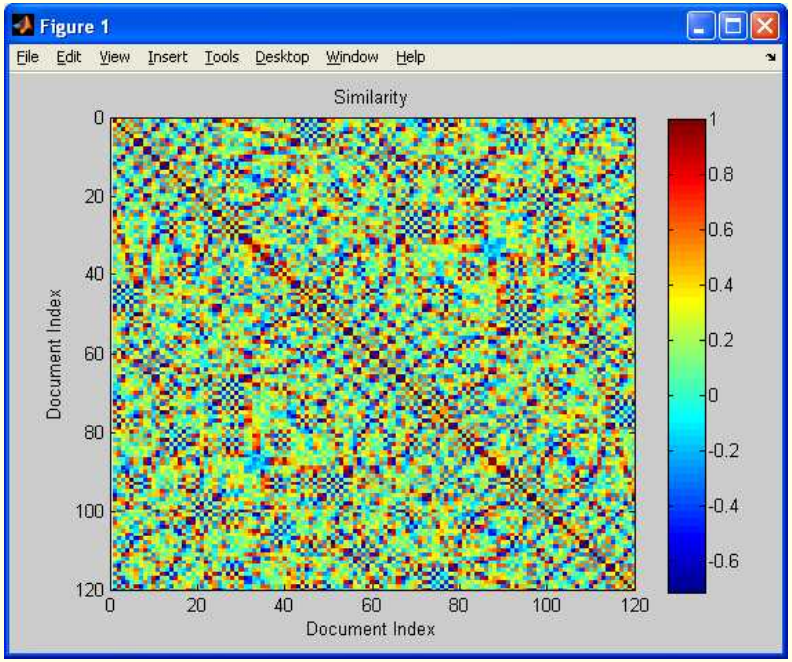

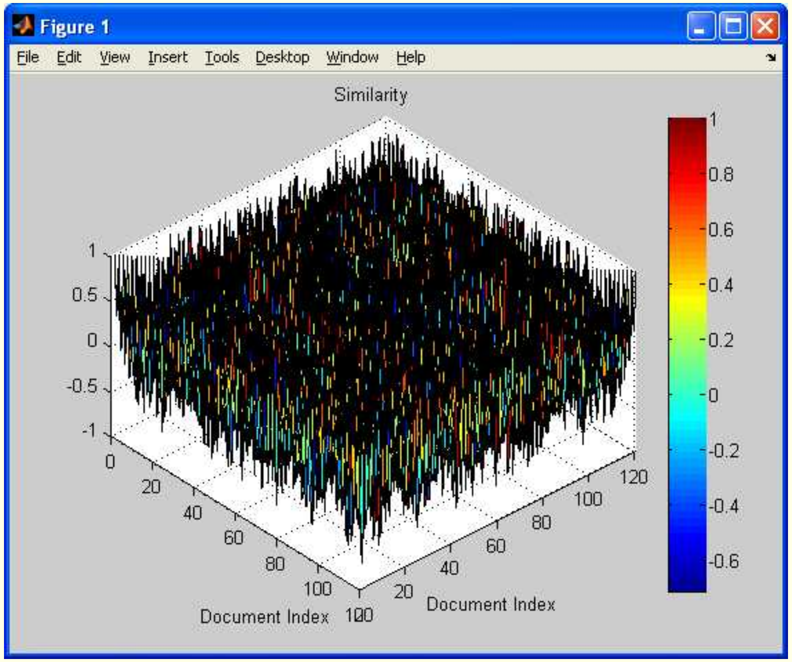

Document-to-Document Similarities

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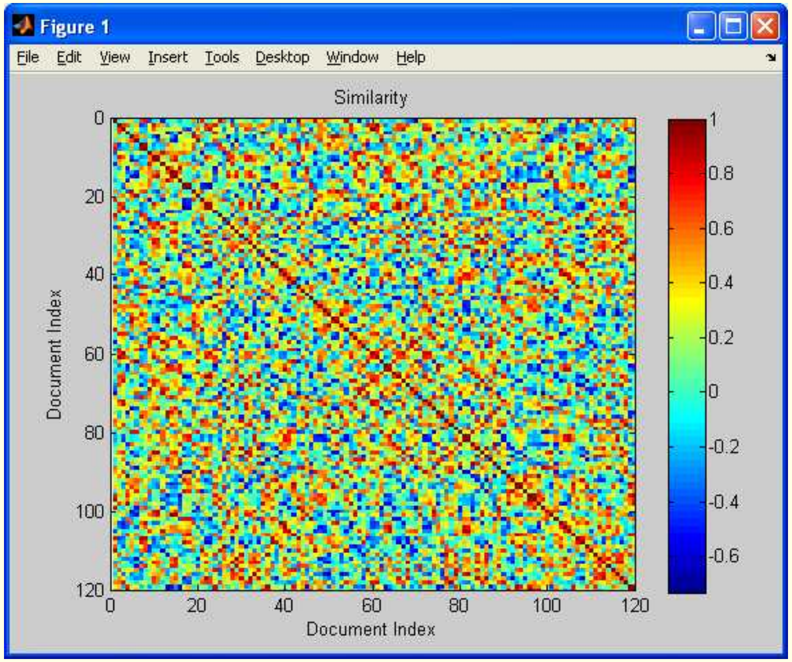
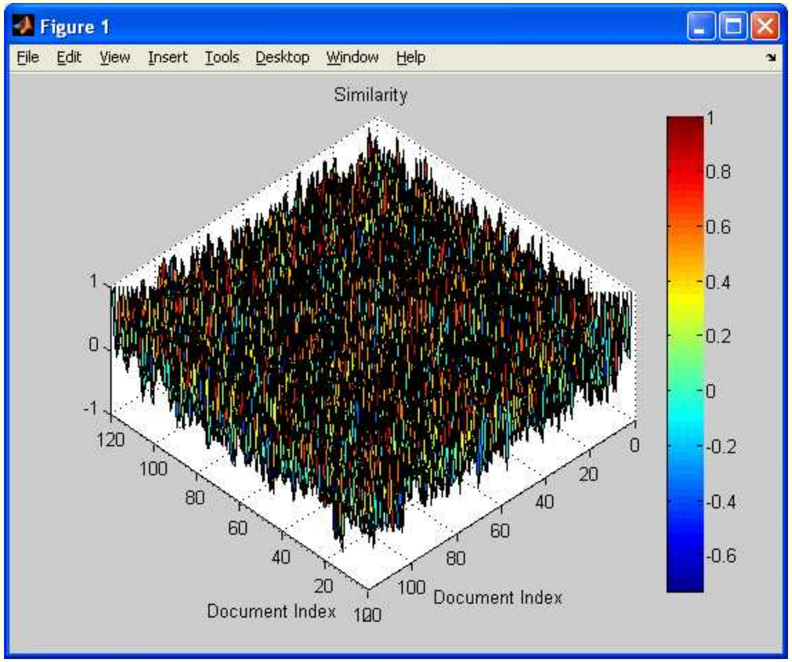
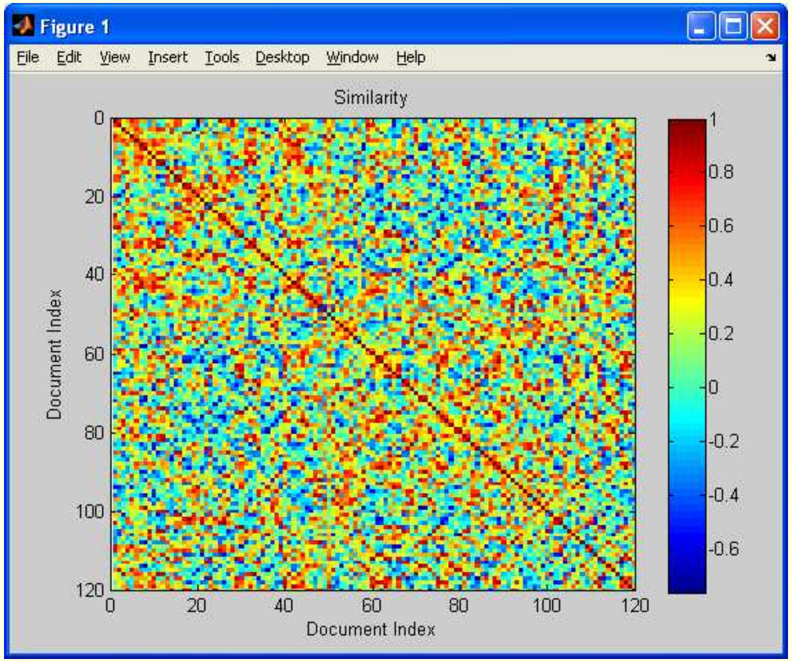
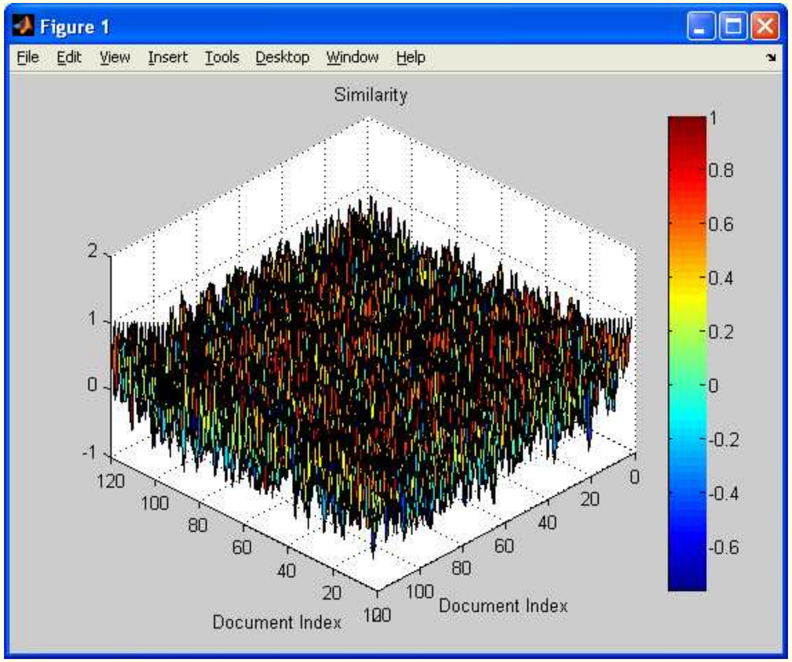




Document-to-Document Similarities

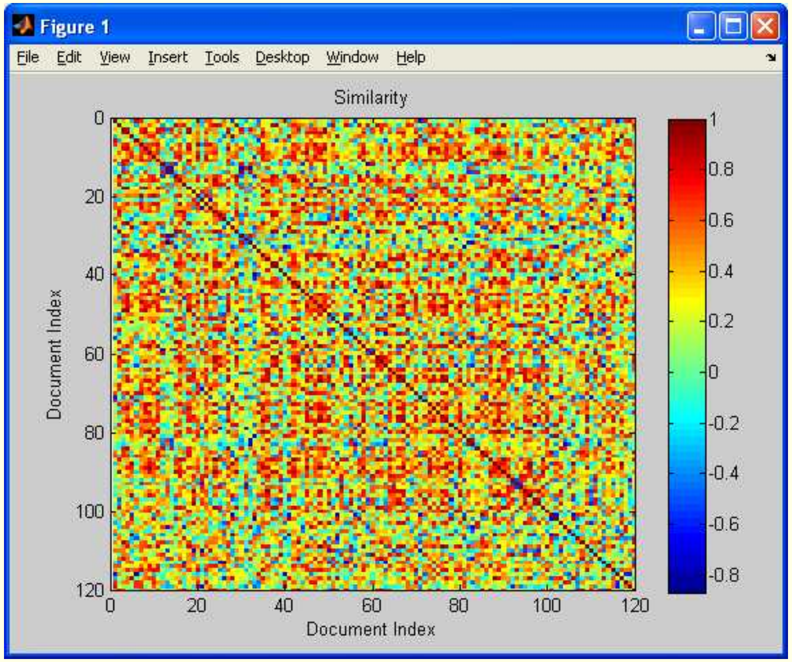
- All permutations (n <= 5 word-grams) - LSA





Document-to-Document Similarities

- All permutations (n = 5 word-grams) - LSA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File Edit View Insert Tools Desktop Window Help
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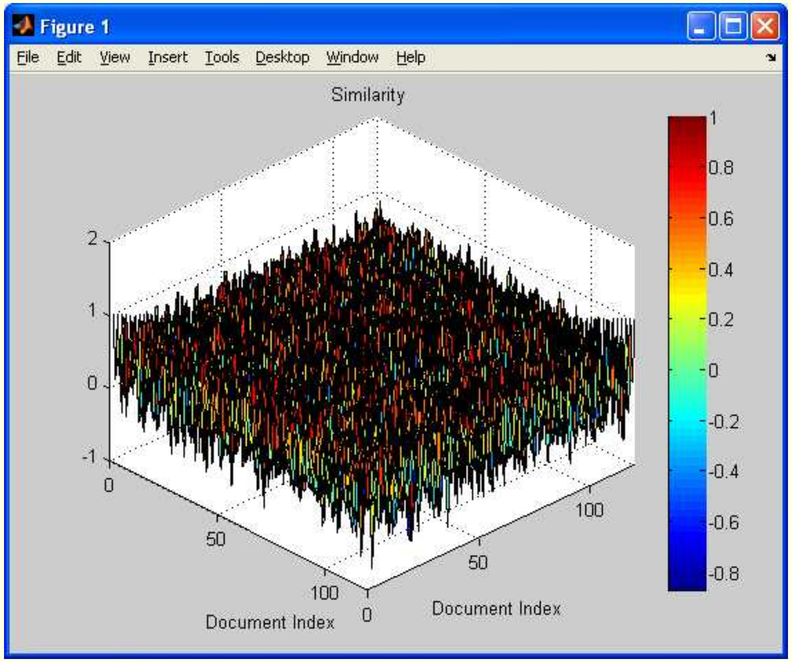
Figure 1
File Edit View Insert Tools Desktop Window Help
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