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15-826: Multimedia Databases and Data Mining

Text - part IV (LSI)
C. Faloutsos

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Outline

Goal: 'Find similar / interesting things'

- Intro to DB
- ➔ • Indexing - similarity search
- Data Mining

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Indexing - Detailed outline

- primary key indexing
- secondary key / multi-key indexing
- spatial access methods
- fractals
- ➔ • text
- SVD: a powerful tool
- multimedia
- ...

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Text - Detailed outline

- text
 - problem
 - full text scanning
 - inversion
 - signature files
 - clustering
 - ➔ – information filtering and LSI

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LSI - Detailed outline

- LSI
 - ➔ – problem definition
 - main idea
 - experiments

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Information Filtering + LSI

- [Foltz+, '92] Goal:
 - users specify interests (= keywords)
 - system alerts them, on suitable news-documents
- Major contribution: LSI = Latent Semantic Indexing
 - latent ('hidden') concepts

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Information Filtering + LSI

Main idea

- map each document into some 'concepts'
- map each term into some 'concepts'

'Concept': ~ a set of terms, with weights, e.g.

- "data" (0.8), "system" (0.5), "retrieval" (0.6) -> DBMS_concept

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Information Filtering + LSI

Pictorially: term-document matrix (BEFORE)

	'data'	'system'	'retrieval'	'lung'	'ear'
TR1	1	1	1		
TR2	1	1	1		
TR3				1	1
TR4				1	1

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Pictorially: concept-document matrix and...

	'DBMS-concept'	'medical-concept'
TR1	1	
TR2	1	
TR3		1
TR4		1

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... and concept-term matrix

	'DBMS- concept'	'medical- concept'
data	1	
system	1	
retrieval	1	
lung		1
ear		1

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Q: How to search, eg., for 'system'?

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Information Filtering + LSI

A: find the corresponding concept(s); and the corresponding documents

	'DBMS- concept'	'medical- concept'
data	1	
system	1 ↑	
retrieval	1	
lung		1
ear		1

	'DBMS- concept'	'medical- concept'
TR1	1	
TR2	1	
TR3		1
TR4		1

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Information Filtering + LSI

A: find the corresponding concept(s); and the corresponding documents

	'DBMS- concept'	'medical- concept'
data	1	
system	1 ↑	
retrieval	1	
lung		1
ear		1

	'DBMS- concept'	'medical- concept'
TR1	1 ←	
TR2	1 ←	
TR3		1
TR4		1

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Information Filtering + LSI

Thus it works like an (automatically constructed) thesaurus:
we may retrieve documents that DON'T have the term 'system', but they contain almost everything else ('data', 'retrieval')

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LSI - Detailed outline

- LSI
 - problem definition
 - main idea
 - – experiments

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LSI - Experiments

- 150 Tech Memos (TM) / month
- 34 users submitted 'profiles' (6-66 words per profile)
- 100-300 concepts

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LSI - Experiments

- four methods, cross-product of:
 - vector-space or LSI, for similarity scoring
 - keywords or document-sample, for profile specification
- measured: precision/recall

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LSI - Experiments

- LSI, with document-based profiles, were better

precision

recall

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LSI - Discussion - Conclusions

- Great idea,
 - to derive ‘concepts’ from documents
 - to build a ‘statistical thesaurus’ automatically
 - to reduce dimensionality
- Often leads to better precision/recall
- but:
 - Needs ‘training’ set of documents
 - ‘concept’ vectors are not sparse anymore

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LSI - Discussion - Conclusions

Observations

- Bellcore (-> Telcordia) has a patent
- used for multi-lingual retrieval

How exactly SVD works?


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References

- Foltz, P. W. and S. T. Dumais (Dec. 1992). "Personalized Information Delivery: An Analysis of Information Filtering Methods." *Comm. of ACM (CACM)* 35(12): 51-60.

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