MG4J: Managing Gigabytes for Java

Introduction

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Managing Gigabytes for Java

Schedule:

- Introduction to MG4J framework.
- Exercise: try to set up a search engine on particular collections of documents.

MG4J: introduction (1)

- Free full-text search engine for large document collections
- Written in Java
- Developed by the Department of Computer Science (University of Milan)

- MG4J home: **http://mg4j.di.unimi.it/**
- Documentation: **http://mg4j.di.unimi.it/docs-big/**
- Manual: **http://mg4j.di.unimi.it/man-big/manual.pdf**

MG4J: introduction (2)

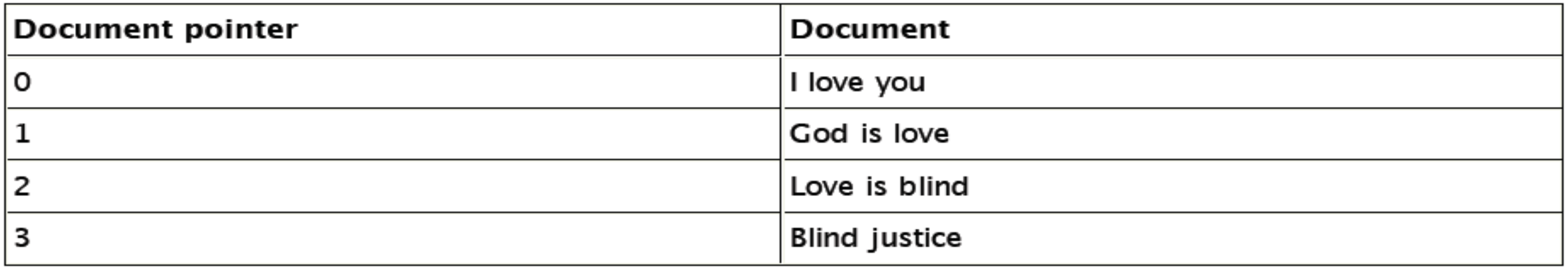
- MG4J can be used for **indexing** and **querying** a large collection of documents
- **INPUT**: set of documents with the ***same*** number and type of fields
- **OUTPUT**: essentially an inverted index

MG4J: introduction (3)

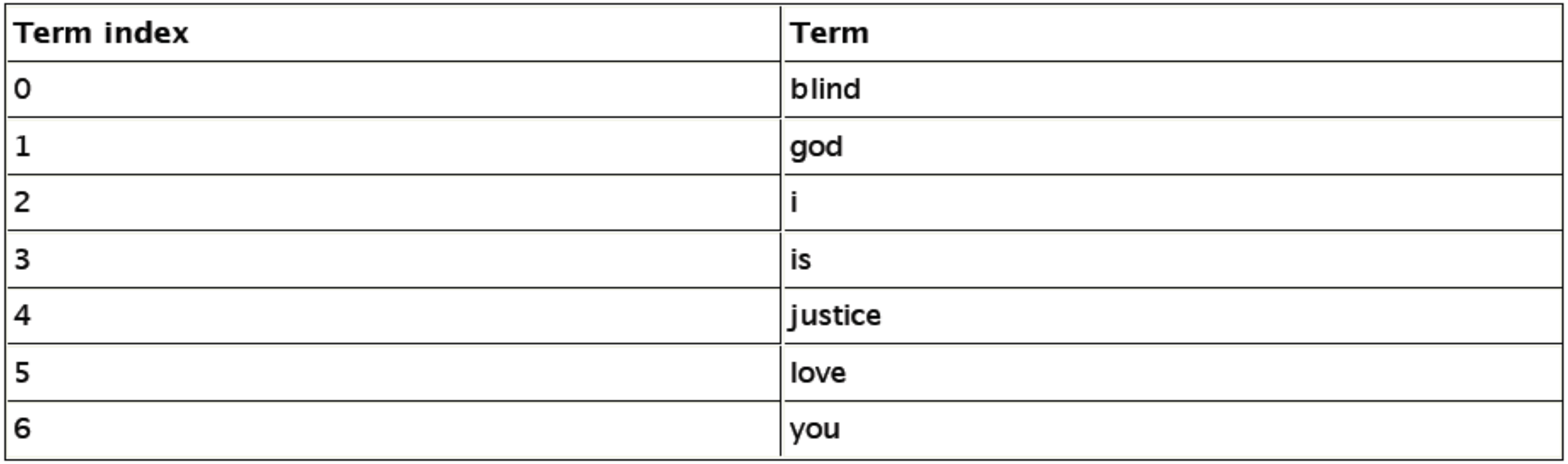
To create and to query an inverted index with MG4J we have to complete these 3 steps:

1. Create a collection of documents.
2. Create an inverted index on the created collection.
3. Query the created inverted.

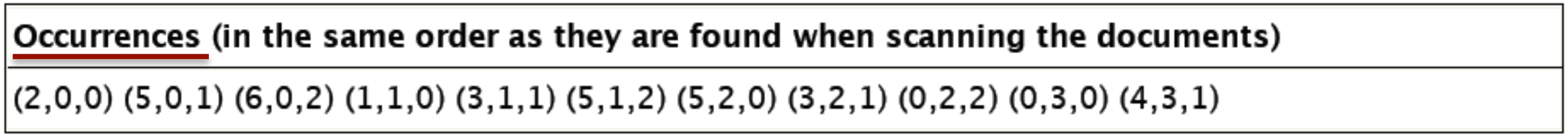
Example of index (1)



Document pointer	Document
0	I love you
1	God is love
2	Love is blind
3	Blind justice



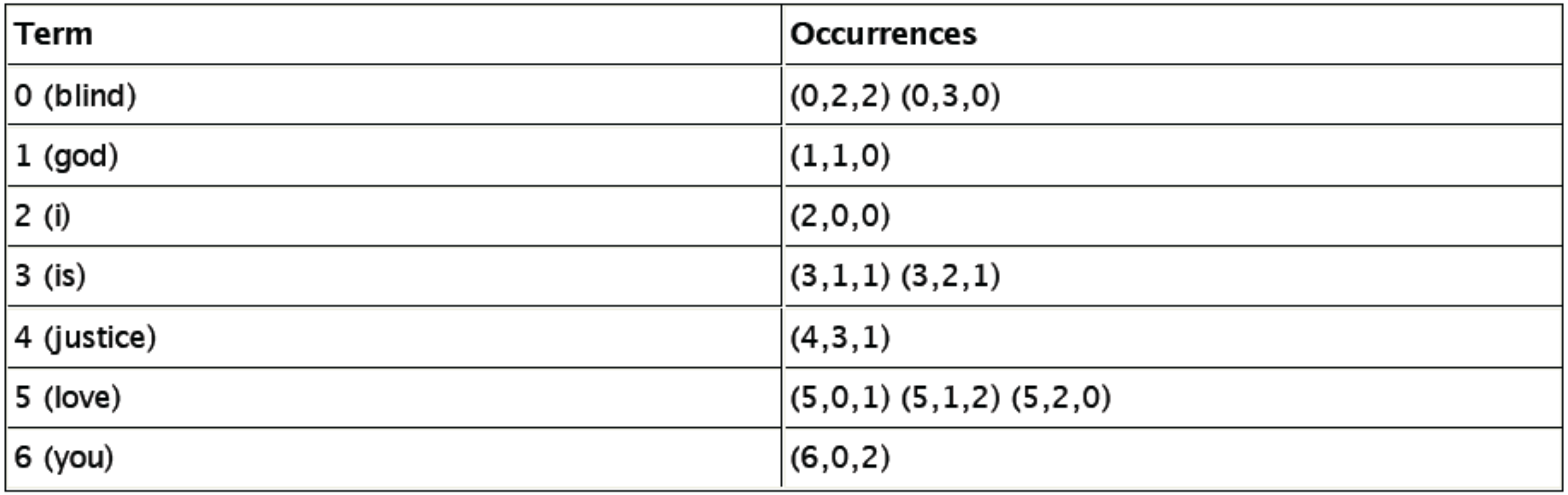
Term index	Term
0	blind
1	god
2	i
3	is
4	justice
5	love
6	you



Occurrences (in the same order as they are found when scanning the documents)
(2,0,0) (5,0,1) (6,0,2) (1,1,0) (3,1,1) (5,1,2) (5,2,0) (3,2,1) (0,2,2) (0,3,0) (4,3,1)

Example of index (2)

- An *occurrence* is a group of three numbers *(t,d,p)*
- *(t,d,p)* means that the ***term*** whose index is *t appears in **document** d at **position** p*
- Inverted lists can be obtained by re-sorting the occurrences in increasing term order, so that occurrences relative to the same term appear consecutively



Term	Occurrences
0 (blind)	(0,2,2) (0,3,0)
1 (god)	(1,1,0)
2 (i)	(2,0,0)
3 (is)	(3,1,1) (3,2,1)
4 (justice)	(4,3,1)
5 (love)	(5,0,1) (5,1,2) (5,2,0)
6 (you)	(6,0,2)

Building batches

- MG4J scans the whole document collection producing ***batches***

- Batches are sub-indices limited to a subset of documents, and they are created each time the number of indexed documents reaches a user-provided threshold, or when the available memory is too little

- Once the batches are created, they are combined in a **single index**

Time and space requirements

- Scanning phase is time and space consuming
- MG4J is able to work with little memory, but more memory allows to create larger batches which can be merged quickly :)
- The indexer produces a number of subindexes proportional to the number of occurrences
- But combining subindexes is a resource consuming activity.

- **Good strategy**: Try to create batches *as large as possible* and check the logs to avoid to work with an *almost full heap* (this slows down Java)

Querying the index

- Once the index is built we can query it using a web server

- MG4J allows to use command line and the web browser

Sophisticated query: scorer

- MG4J provides very sophisticated query tuning
- To use this features, **we must** use the command line interface. All settings are then used for subsequent queries (sticky behavior)

- MG4J allows to choose the **scorer** for the ranking of the results of a query
- Scorers assign a score to the document, depending on some criterion (e.g. the frequency of query terms in the document)
- Documents are ordered using the scores, so that the most relevant documents appear at the beginning of the result list

Performance (1)

- MG4J provides a great flexibility for the index construction, and all the choices have a significant impact on performance
- If we have enough memory, building large batches is a good trick
- We can choose several different codes for the components of the index.

Performance (2)

- Another trick is ***discarding what is not necessary***: pointers, counts, positions, etc.

  For example, if we use *TF/IDF* scoring, we do not need to store positions in the index (use **-c POSITIONS:none**)

- Indexes contain *skipping structures* to skip index entries. However, skipping structures introduce a slight overhead when scanning sequentially a list (use **--no-skips** option to disable skipping structure)

Performance (3)

- The index can be:
  - read from disk
  - memory mapped
  - directly loaded into main memory
- The three solutions work with increasing speed and increased main memory usage
- The default is to read the index from disk
- We can add suitable options to the index URI (e.g. **mapped=1** or **inmemory=1**) to use the other solutions

Partitioning

- Partitioning an index means dividing an index using some criterion
- Partitioning can be:
    - Documental (*splitting using documents*)
    - Lexical (*splitting using terms*)
    - Personalized
- Improving performance: we can partition our index, and once we have several subindexes, we can decide which ones will be loaded into main memory, which ones will be mapped, etc.

End of MG4J Presentation.

Let’s move now to mg4j-exercise.pdf ;)