Finding Similar Sets

Applications
Shingling
Minhashing
Locality-Sensitive Hashing

Mining of Massive Datasets
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Applications of Set-Similarity

Many data-mining problems can be expressed as finding "similar" sets:

1. Pages with similar words, e.g., for classification by topic.
2. NetFlix users with similar tastes in movies, for recommendation systems.
3. Dual: movies with similar sets of fans.
4. Entity resolution.

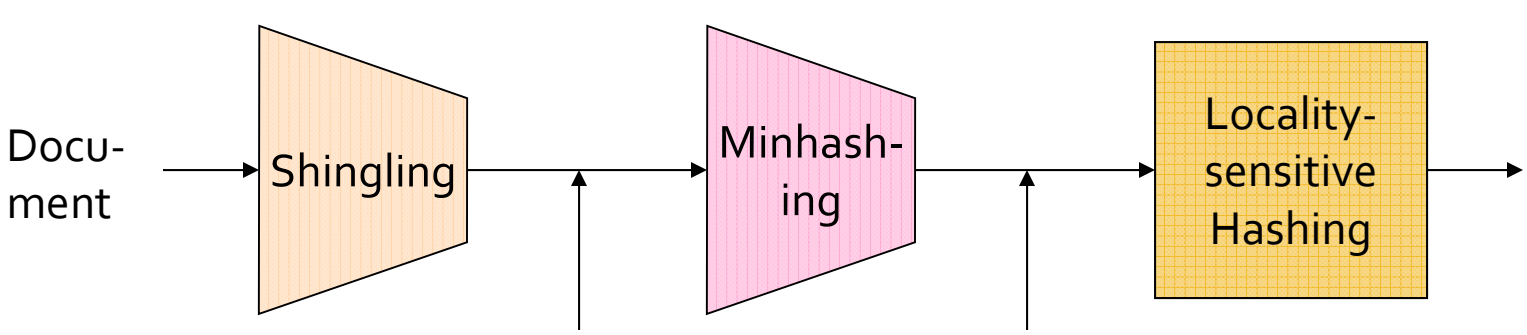
Similar Documents

- Given a body of documents, e.g., the Web, find pairs of documents with a lot of text in common, such as:
  - Mirror sites, or approximate mirrors.
    - Application: Don't want to show both in a search.
  - Plagiarism, including large quotations.
  - Similar news articles at many news sites.
    - Application: Cluster articles by "same story."

Three Essential Techniques for Similar Documents

1. *Shingling* : convert documents, emails, etc., to sets.
2. *Minhashing* : convert large sets to short signatures, while preserving similarity.
3. *Locality-sensitive hashing* : focus on pairs of signatures likely to be similar.

The Big Picture



The set of strings of length *k* that appear in the doc-ument

Signatures : short integer vectors that represent the sets, and reflect their similarity

Candidate pairs : those pairs of signatures that we need to test for similarity.

Shingles

- A *k* -shingle (or *k* -gram) for a document is a sequence of *k* characters that appears in the document.
- Example: k=2; doc = abcab. Set of 2-shingles = {ab, bc, ca}.
- Represent a doc by its set of *k*-shingles.

Shingles and Similarity

- Documents that are intuitively similar will have many shingles in common.
- Changing a word only affects k-shingles within distance k from the word.
- Reordering paragraphs only affects the 2k shingles that cross paragraph boundaries.
- Example: k=3, "The dog which chased the cat" versus "The dog that chased the cat".
  - Only 3-shingles replaced are g_w, _wh, whi, hic, ich, ch_, and h_c.

Shingles: Compression Option

- To compress long shingles, we can hash them to (say) 4 bytes.
  - Called *tokens*.
- Represent a doc by its tokens, that is, the set of hash values of its *k*-shingles.
- Two documents could (rarely) appear to have shingles in common, when in fact only the hash-values were shared.