Vector Space Scoring

Introduction to Information Retrieval
INF 141
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Content adapted from Hinrich Schütze
http://www.informationretrieval.org

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- How do we use df?

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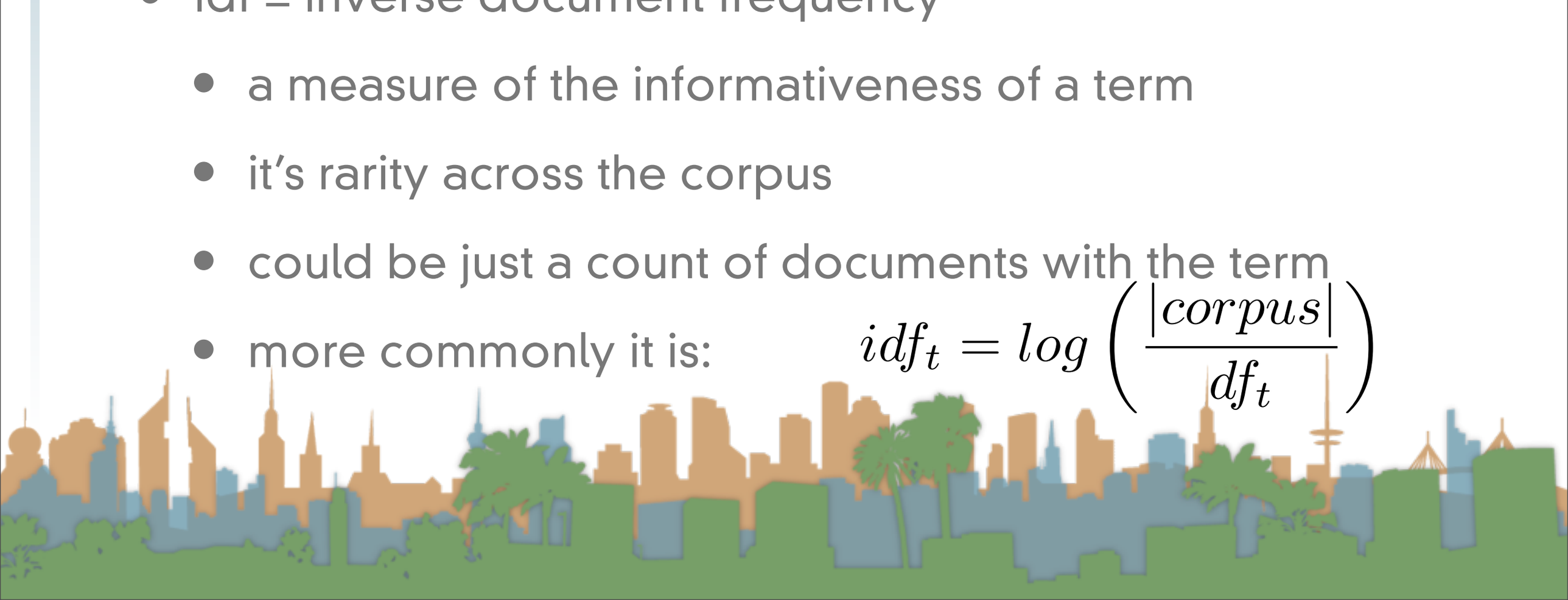
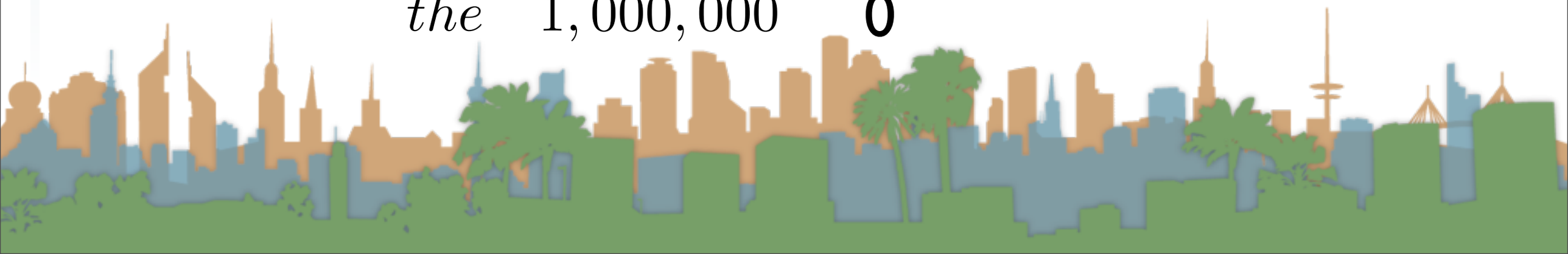


TF-IDF Examples

$$idf_t = log\left(\frac{|corpus|}{df_t}\right) \qquad idf_t = log_{10}\left(\frac{1,000,000}{df_t}\right)$$

$term$	df_t	idf_t
$calpurnia$	1	6
$animal$	10	4
$sunday$	1000	3
fly	$10,000$	2
$under$	$100,000$	1
the	$1,000,000$	0



TF-IDF Summary

- Assign tf-idf weight for each term t in a document d:

$$tfidf(t,d) \quad = \quad (1 + log(tf_{t,d})) * log\left(\frac{|corpus|}{df_{t,d}}\right)$$

  - Increases with number of occurrences of term in a doc.
  - Increases with rarity of term across entire corpus
  - Three different metrics
    - term frequency
    - document frequency
    - collection/corpus frequency

Now, real-valued term-document matrices

- Bag of words model
- Each element of matrix is tf-idf value

	Antony and Cleopatra	*Julius Caesar*	*The Tempest*	*Hamlet*	*Othello*	*Macbeth*
Antony	13.1	11.4	0.0	0.0	0.0	0.0
Brutus	3.0	8.3	0.0	1.0	0.0	0.0
Caesar	2.3	2.3	0.0	0.5	0.3	0.3
Calpurnia	0.0	11.2	0.0	0.0	0.0	0.0
Cleopatra	17.7	0.0	0.0	0.0	0.0	0.0
mercy	0.5	0.0	0.7	0.9	0.9	0.3
worser	1.2	0.0	0.6	0.6	0.6	0.0

Vector Space Scoring

- That is a nice matrix, but
  - How does it relate to scoring?
  - Next, vector space scoring

Vector Space Model

- Define: Vector Space Model
  - Representing a set of documents as vectors in a common vector space.
  - It is fundamental to many operations
    - (query,document) pair scoring
    - document classification
    - document clustering
- Queries are represented as a document
  - A short one, but mathematically equivalent

Vector Space Model

- Define: Vector Space Model
  - A document, d, is defined as a vector: $\vec{V}(d)$
    - One component for each term in the dictionary
    - Assume the term is the tf-idf score

$$\vec{V}(d)_t = (1 + log(tf_{t,d})) * log\left(\frac{|corpus|}{df_{t,d}}\right)$$

- A corpus is many vectors together.
- A document can be thought of as a point in a multi-dimensional space, with axes related to terms.

Vector Space Model

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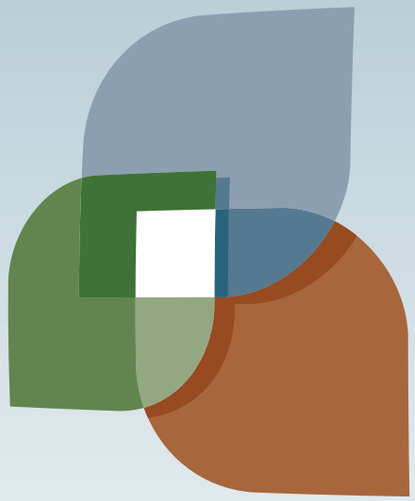
$\vec{V}(d_6)_7$



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