67-300 SEARCH ENGINES

INTRODUCTION

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13TH MARCH 2016

CLASS SUMMARY

- Course rules
- Course introduction
- Introduction to Information Retrieval
- Practice Exercises

HOW IS THIS COURSE GOING TO BE?

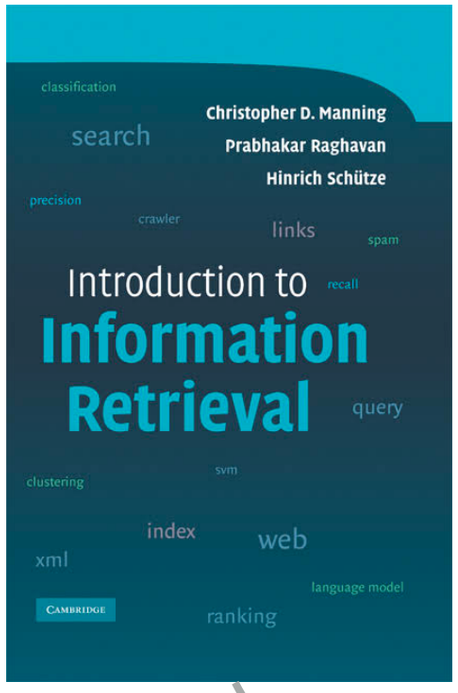
- Sit, relax and **ask questions!!!!**
- **You participation is encouraged and expected!**
- In class exercises whenever possible
- Quizzes at the end of the class to review main concepts (piazza)

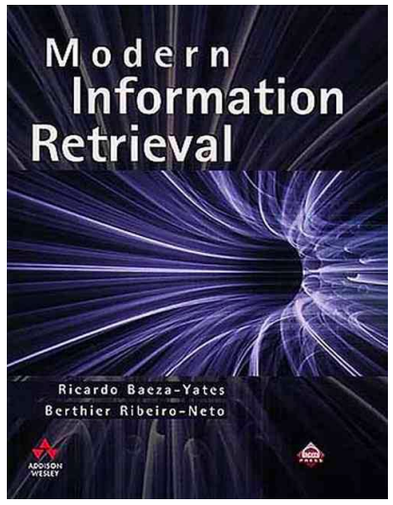
PIAZZA

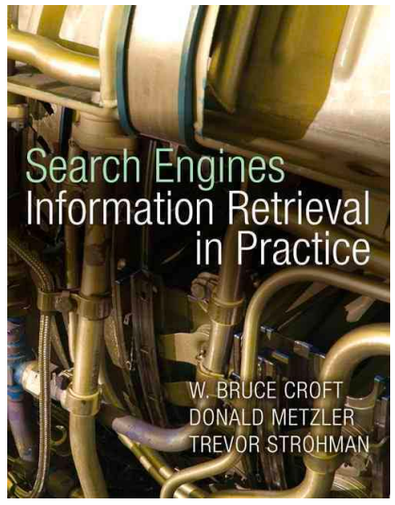
- We will use Piazza for:
  - Communication
  - Submit your weekly quiz
  - Submit your project deliverables

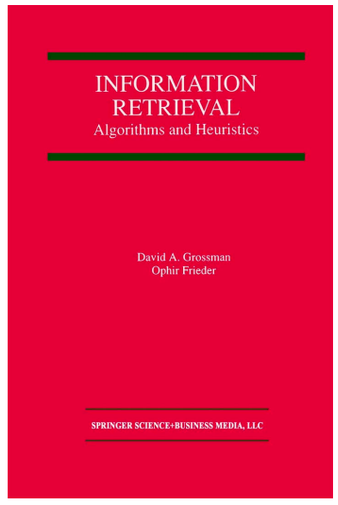
TEXT BOOK

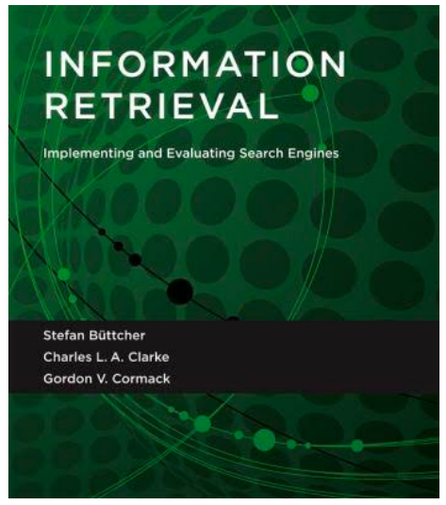
- There are many excellent books in this area:











http://nlp.stanford.edu/IR-book/

POLICIES

- Submit homework via Piazza before class starts
- Do not wait till is too late to start your project
  - Every day that you are late you will lose 10% of the maximum score.
- Do not copy code from any other student
- Do not copy reports from other students

WHAT IS THIS MINI COURSE GOING TO BE ABOUT?

- Understand what is behind any search bar:
  - Overview of many and many years of empirical research on text processing

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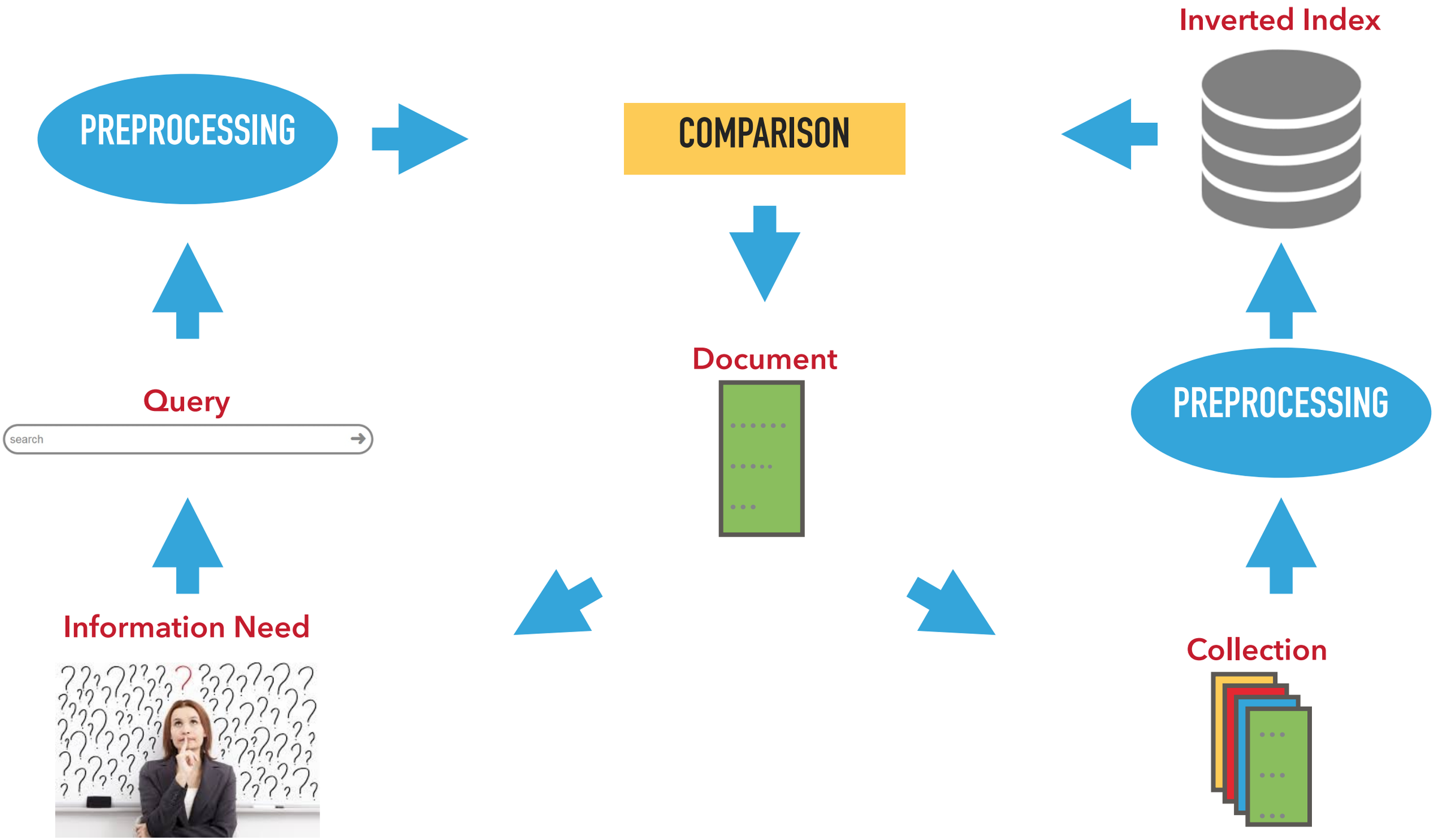
- Understand what is behind any search bar:
  - Overview of many and many years of empirical research on text processing
- Be able to process text using Python:
  - Quick prototyping, excellent for text processing
  - Practice programming

GRADING

- 3 small projects (60)
  - First (15): Text preprocessing Index creation
  - Second (25): Search models
  - Third (20): Evaluation
- Class Participation (10)
- Final exam (30)

BIG PICTURE


PREPROCESSING
COMPARISON
Inverted Index
Query
search
Document
PREPROCESSING
Information Need
Collection

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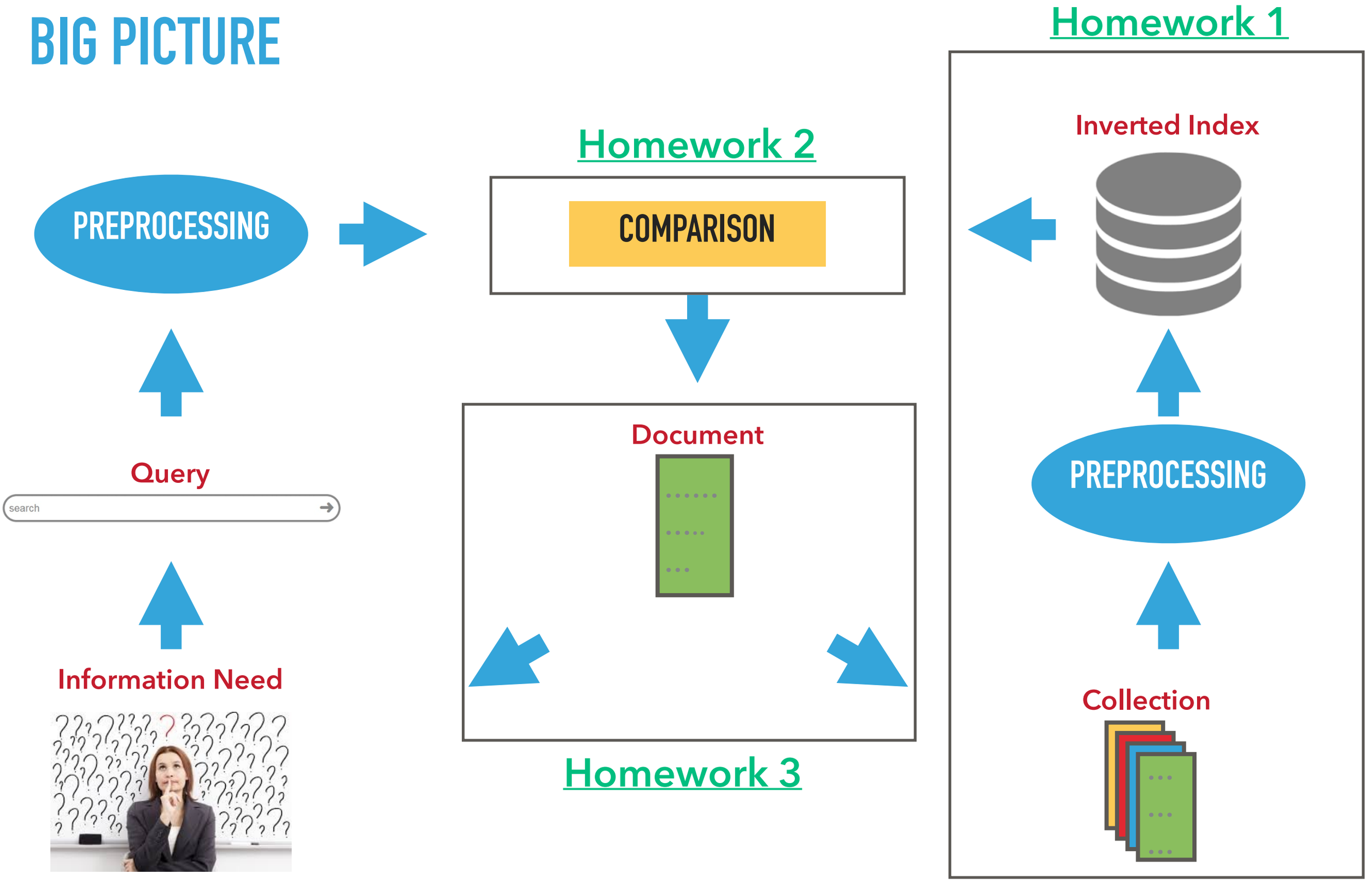
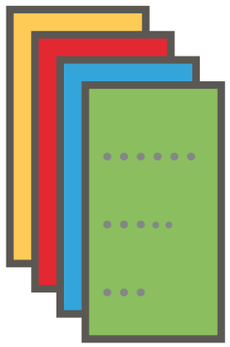
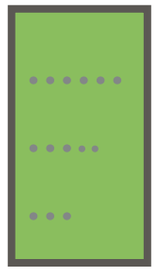

Homework 1
Inverted Index
PREPROCESSING
Collection
Homework 2
COMPARISON
Document
Homework 3
Query
search
Information Need

LET'S START

Collection of Documents



Document



Where is Qatar?

Qatar is a country located in Western Asia, occupying the small Qatar Peninsula on the northeastern coast of the Arabian Peninsula. Its sole land border is with Saudi Arabia to the south, with the rest of its territory surrounded by the Persian Gulf.

WIKIPEDIA ENTRY FOR QATAR

LET'S START

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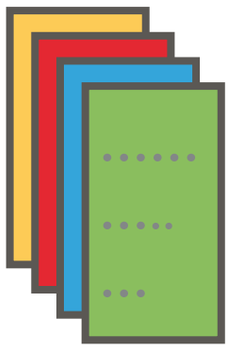

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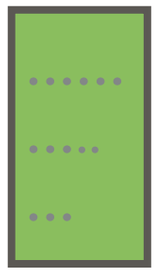

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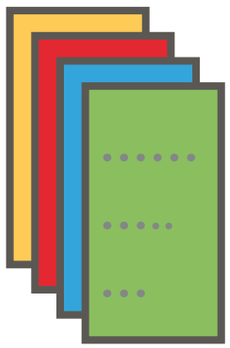

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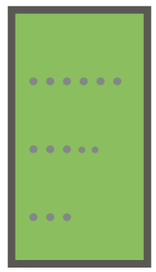

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WIKIPEDIA ENTRY FOR QATAR

What is this text about? How do you know that?

What if you have a query like that?

qatar location →

TOKENIZATION

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2. Is punctuation important?

3. Is the order of the words important?

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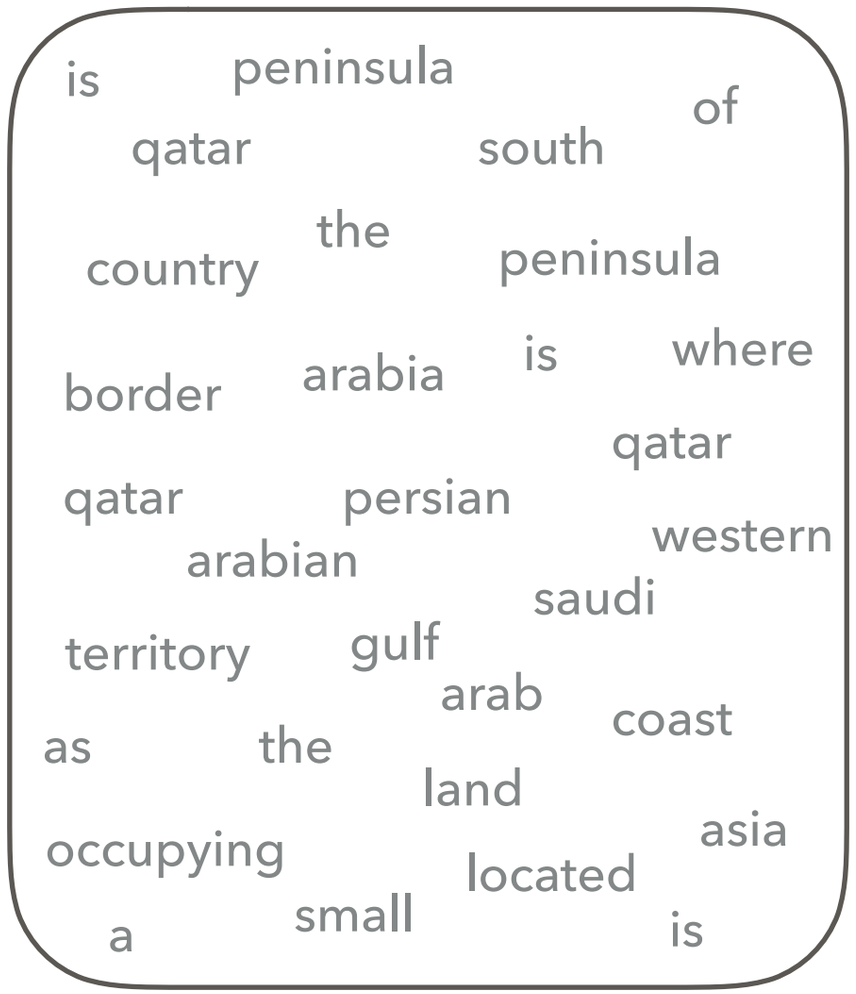
Original Text

BAG OF WORDS



Computer representation

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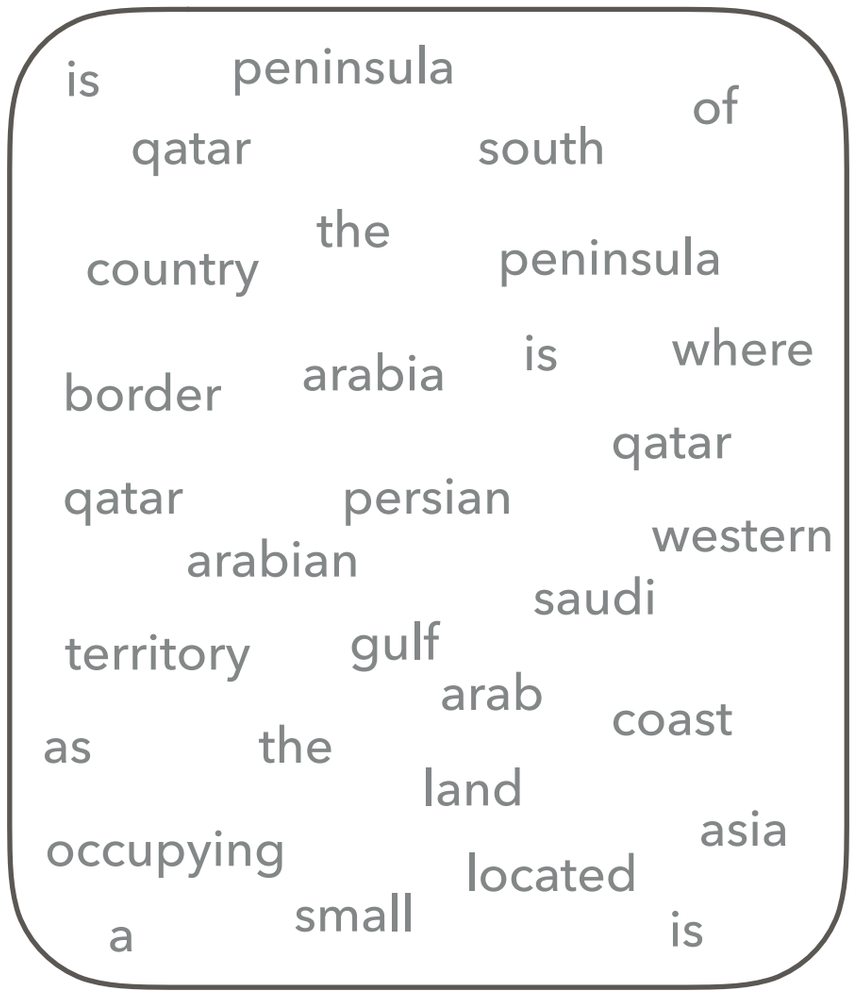
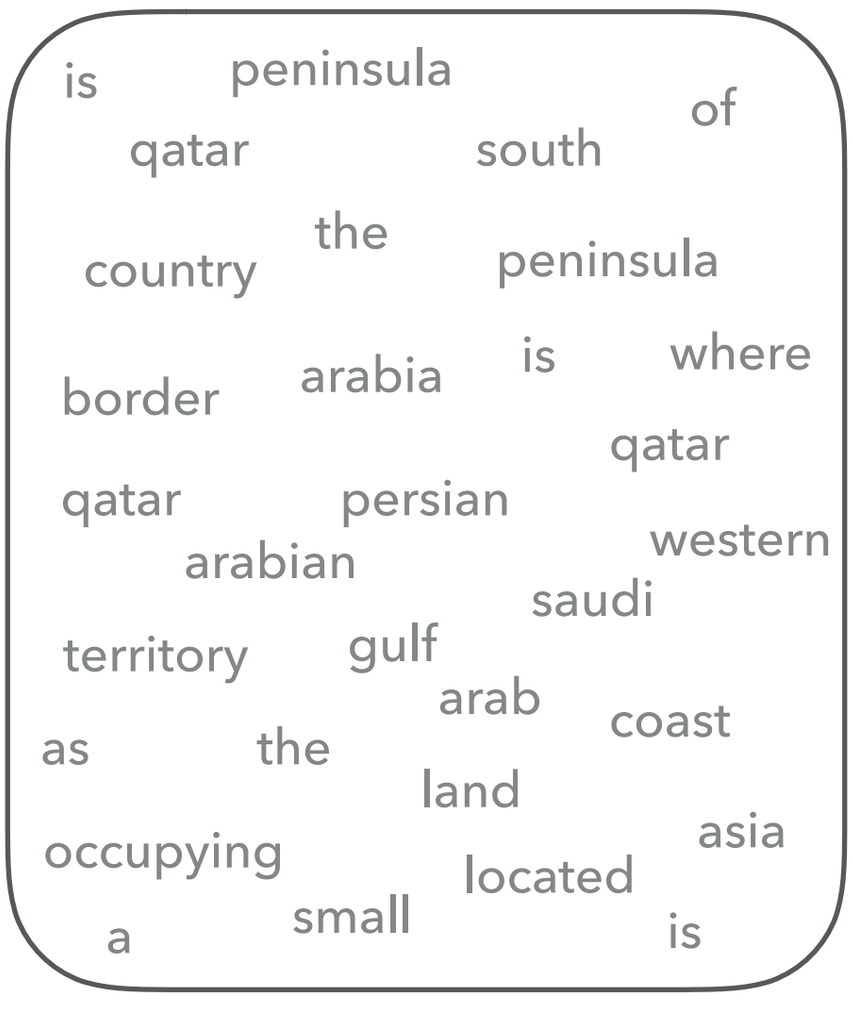


Computer representation

Does it work?

TOKENIZATION

BAG OF WORDS



Computer representation

TOKENS

Word Occurrences

31 tokens

VS

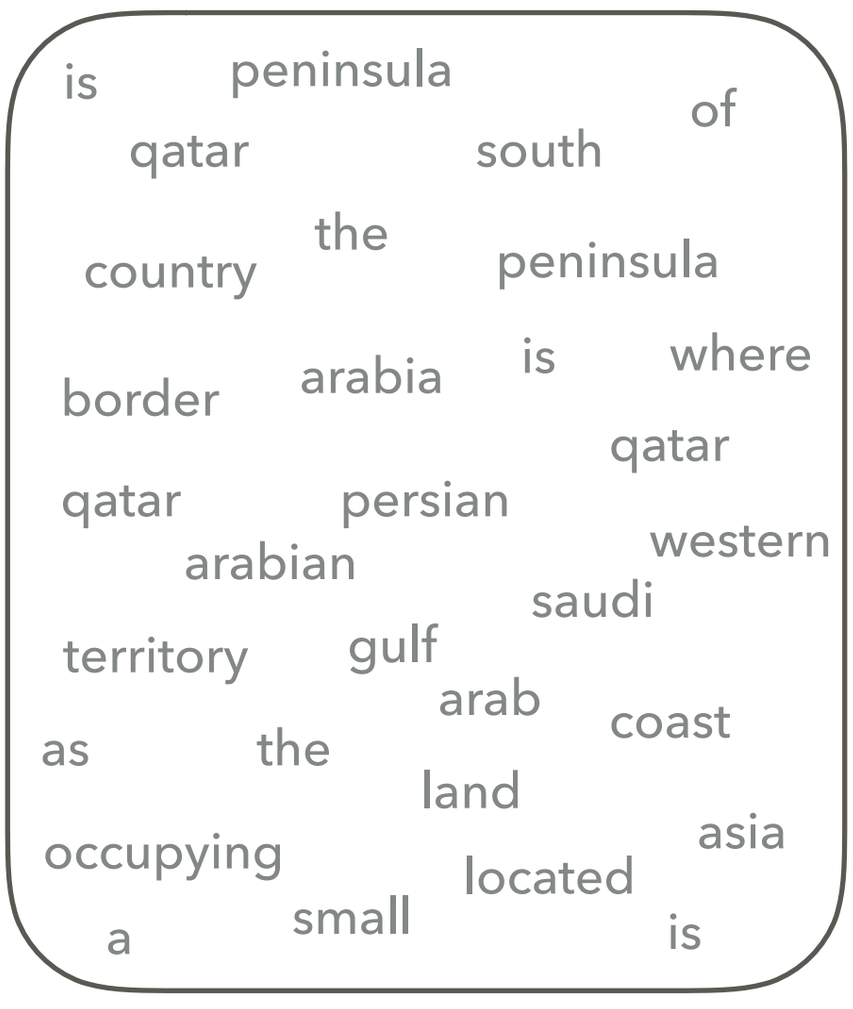
TYPES

Unique Words

26 types

TOKENIZATION

BAG OF WORDS



Computer representation

TOKENS VS TYPES

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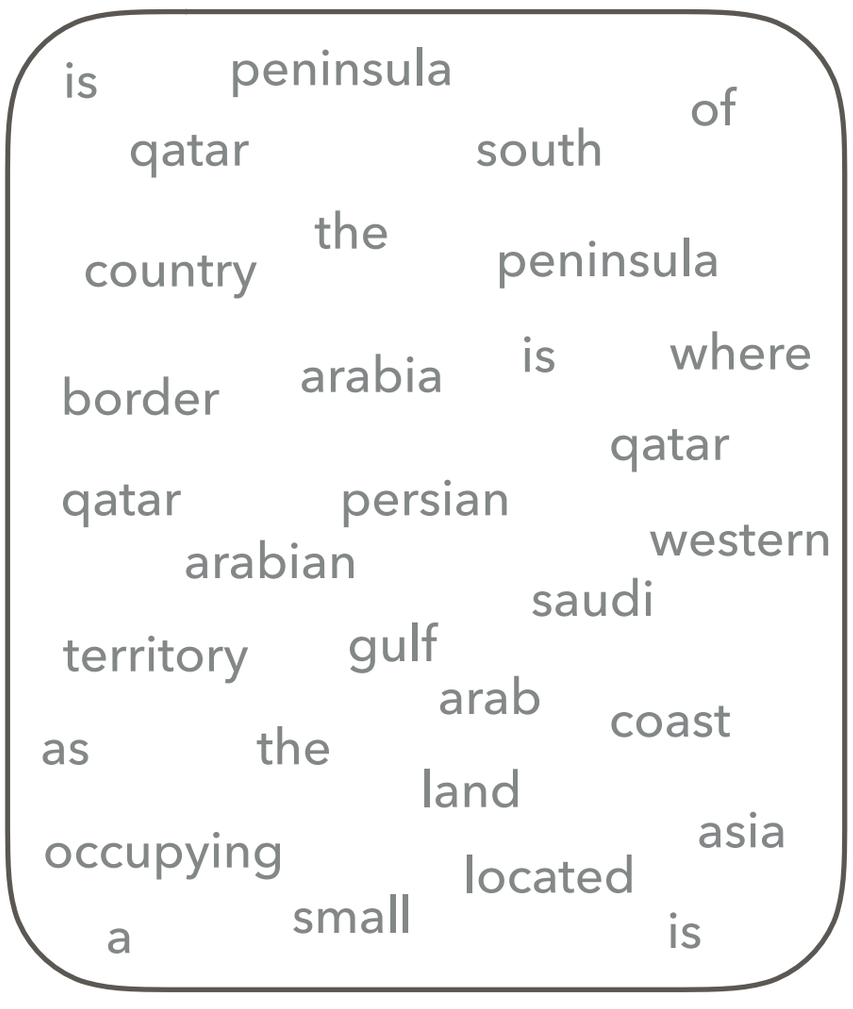
Are all words necessary?

Are all words equally important?

TOKENIZATION

BAG OF WORDS



Computer representation

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No! **Stopwords** are usually not important....

TOKENIZATION

BAG OF WORDS

Computer representation

TOKENS VS TYPES

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TOKENIZATION

BAG OF WORDS

Computer representation

TOKENS VS **TYPES**

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TOKENIZATION

BAG OF WORDS

Computer representation

What else can we do?

TOKENIZATION

BAG OF WORDS

Computer representation

What else can we do?

arab, arabia, arabian, arabic

TOKENIZATION

BAG OF WORDS

Computer representation

What else can we do?

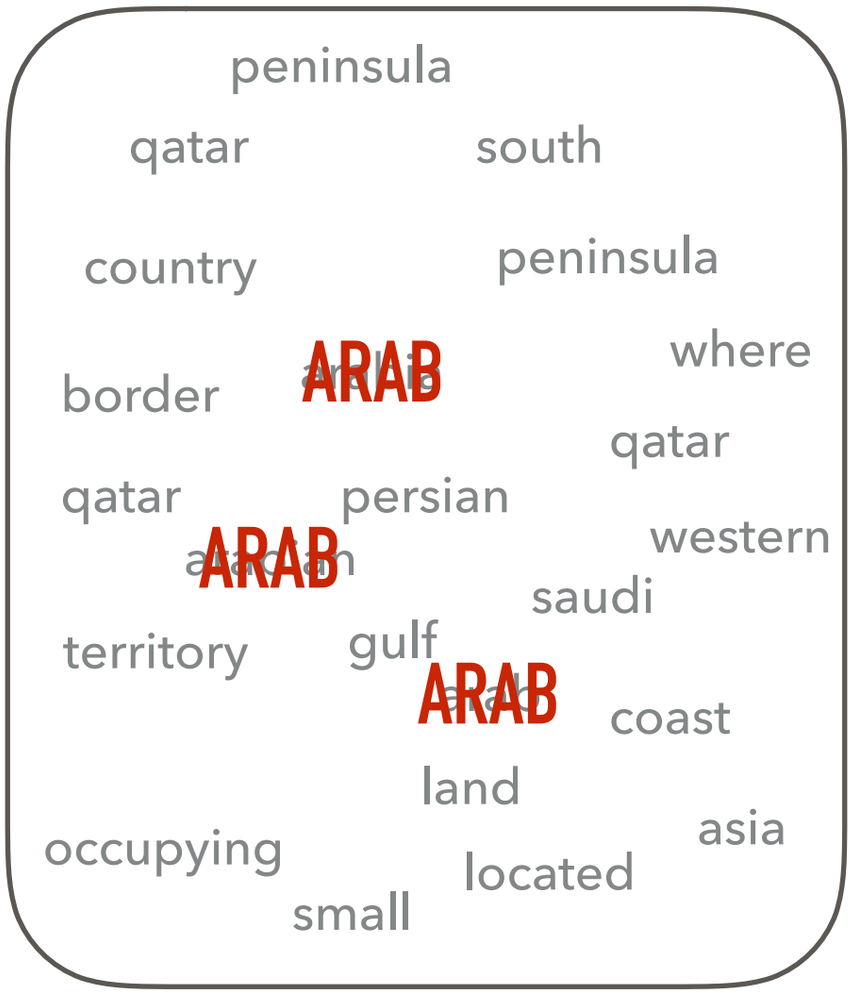
arab, arabia, arabian, arabic

STEMMER

ARAB

TOKENIZATION

BAG OF WORDS



Computer representation

What else can we do?

arab, arabia, arabian, arabic

STEMMER

ARAB

TOKENIZATION

BAG OF WORDS

peninsl
qatar south
countri peninsl
where
arab
border
qatar
qatar persian
western
arab
saudi
territori gulf
arab
coast
land
asia
occupi
locat
small

Computer representation

What else can we do?

arab, arabia, arabian, arabic

STEMMER

ARAB

Note the use of stemmer in all tokens of our example

PREPROCESSING/NORMALIZATION STEPS

- Tokenization summary:

1. Lower/Upper case
2. Split text into tokens
3. Deal with punctuation
4. Stopwords removal
5. Stemming

BAG OF WORDS (BOW)

Computer representation

Bonus: accents/diacritics; date format; British/American spelling; Equivalence classes

Language challenges (Chinese has no white space between words)

IS THERE ANY OTHER TEXT REPRESENTATION APART FROM BOW?

- **N-Grams**: a continuous sequence of n items from a given sequence of text.

- Input Text: **search engines are great.**
- **BoW:** [“are”, “engines”, “great”, “search”]
- **2-gram:** [“<bos>_search”, “search_engine”, “engines_are”, “are_great”, “great_<eos>”]
- 3-**gram:** [“<bos>_search_engine”, “search_engine_are”, “engines_are_great”, “are_great_<eos>”]

IS THERE ANY OTHER TEXT REPRESENTATION APART FROM BOW?

	Pros	Cons
BoW	Very very simple and widely used	Grammar and order are missing
n-grams	Capture local dependency and partial order	Largely increase vocabulary

POWER LAWS

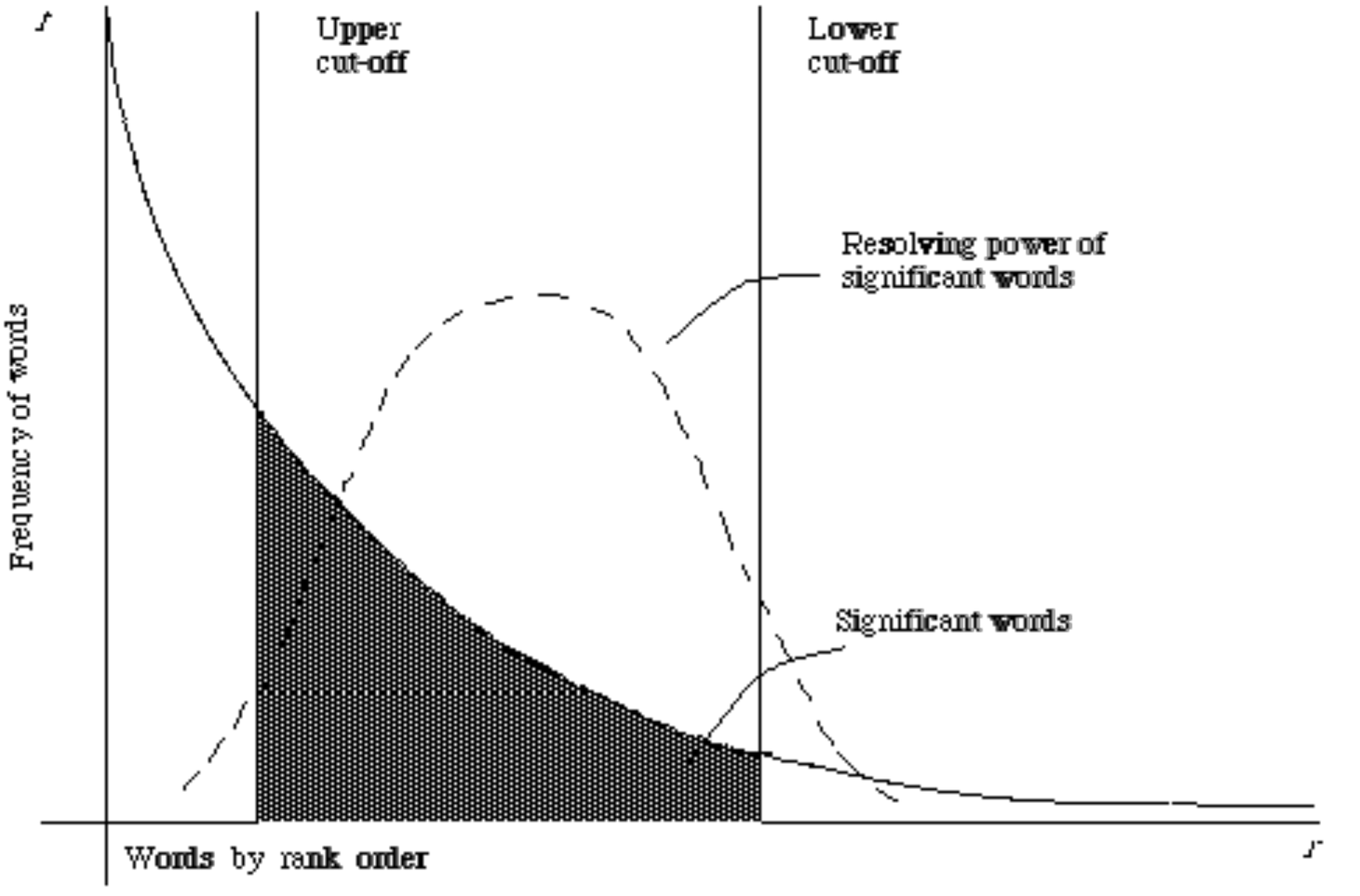


Figure 2.1. A plot of the hyperbolic curve relating f, the frequency of occurrence and r, the rank order (Adapted from Schultz[44] page 120)

LET'S MOVE TO OUR EXAMPLES WITH

PYTHON NOTEBOOK