Chapter 7 - Searching large Collections of Text

-- A Python Course for the Humanities

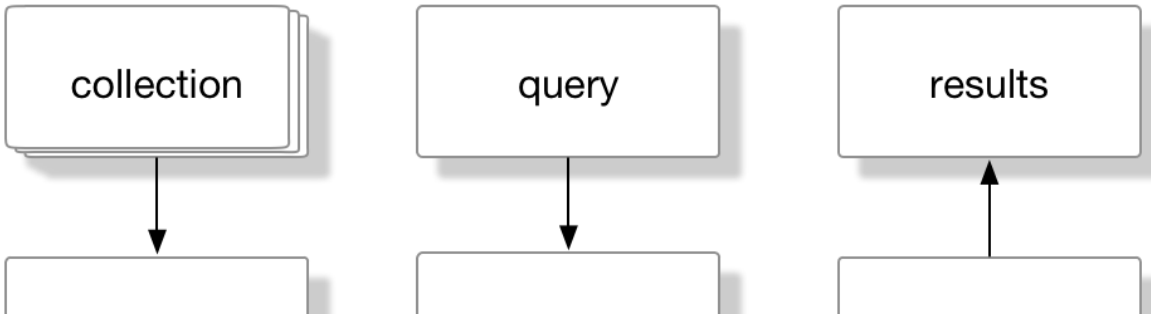
Imagine you have collected a large number of documents for your research. A large collection of Engli novels from Project Gutenberg (http://www.gutenberg.org/), for example, or all volumes of the *New Yo Times* from 1987 until 2007 (see here (https://catalog.ldc.upenn.edu/LDC2008T19)). The *New York Times* corpus contains over 1.8 million articles. If on average each article consists of only 500 words (actual number will probably be higher), the complete corpus will contain about 900 million words. Hov can we search through such large collections of text? How can we efficiently find the information we a looking for?

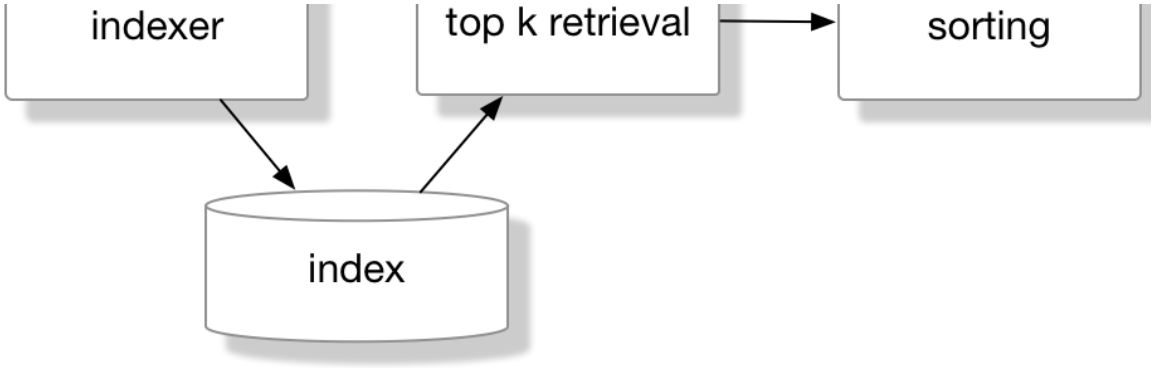
These questions are central to the current chapter. We will discuss important concepts from *Informati Retrieval* to index and search collections (of text), such as the *inverted index* and the ranking metric *Ok BM25*. This wouldn't be a Python course if you didn't have to implement all discussed techniques and methods. We will implement an important search algorithm which allows you to efficiently and reliably extract information from corpora. Along the way we will discuss quite some new and important programming techniques and constructs. We will also further our knowledge about the framework of Object Oriented Programming or OOP. We have quite some ground to cover, so let's get started.

Indexing Collections of Text

> Information Retrieval (IR) is finding material (usually documents) of an unstructured nature (usually text) that satisfies an information need from within large collections (usually stored on computers. (Manning, NLP course, coursera)

The field of Information Retrieval (IR) deals with developing techniques that allow users to efficiently search through large collections (of text) to find documents that are relevant to the question a particu user has. These days we almost immediately think of *web search* in the context of IR, but there are ma other use case scenarios, such as E-mail search, searching for music (e.g. Spotify) or searching for content on your laptop.





Most search models in Information Retrieval are similar to the schema above. We have a collection of items, text documents, for example, that are indexed using an indexer with a particular indexing schen Given a user query, the index is used to retrieve k documents which, after scoring and sorting, are presented to the user. This might seem all a little abstract, but it will all become clear once we start implementing our own IR system.

Consider a newspaper collection covering the complete 20th century. In this collection we would like t find all documents that mention Albert Einstein (https://en.wikipedia.org/wiki/Albert_einstein) and Ed Hubble (https://en.wikipedia.org/wiki/Edwin_Hubble) but not Enrico Fermi (https://en.wikipedia.org/wiki/Enrico_Fermi). Those of you familiar with the unix search tool grep

(https://en.wikipedia.org/wiki/Grep) might argue that we could simply use grep to search for all documents that contain both Einstein and Hubble and then filter out those documents that mention Fermi.

Quiz!

Come up with at least two reasons why searching with grep is not a good option.

Double click this cell and write down your answer.

Term Document Incidence Matrix

To efficiently give an answer to such queries we need to come up with another representation of our collection instead of plain text. Have a look at the following table.

	12-11-1928	04-04-1946	03-11-1983	19-01-1999
Einstein	1	1	0	0
Hubble	1	1	1	0
Fermi	1	0	0	0
Winfrey	0	0	0	1
Dylan	0	0	1	1

Dylan	0	0	1	1

This table is called a *Term Document incidence matrix* where for each term (rows) we write down a 1 i particular document (columns) contains that term and 0 otherwise. In this representation each term is represented by an incidence vector. If we want to extract all documents that mention Albert Einstein, v can use the binary vector `1100` of Einstein to quickly extract all documents mentioning Einstein. To fin all documents containing both Einstein and Hubble we take the complement of the vectors of Einstein (1100) and Hubble (1110):

```
1100 AND 1110 = 1100
```

Quiz!

a) Given the incidence vectors of Einstein (1100), Hubble (1110) and Fermi (1000), what is the binary representation corresponding to the query `Einstein AND Hubble AND NOT Fermi`?

Double click this cell and write down your answer.

b) Can you implement the function `AND` that takes as argument two incidence vectors (represented a binary lists in Python) and returns the complement of the two?

```
def AND(vector_a, vector_b):
    # insert your code here

# these tests should return True if your code is correct
print(AND([1, 1, 0, 0], [1, 1, 1, 0]) == [1, 1, 0, 0])
print(AND([1, 0, 0, 1, 0, 0, 1], [1, 1, 1, 0, 1, 0, 1]) == [1, 0, 0, 0, 0, 0, 1])
```

c) Rewrite the function `AND` to allow it to take an arbitary number of incidence vectors.

```
def AND(*vectors):
    # insert your code here

# these tests should return True if your code is correct
print(AND([1, 1, 0, 0], [1, 1, 1, 0], [1, 0, 0, 0]) == [1, 0, 0, 0])
print(AND([1, 1, 1, 0, 1], [1, 0, 0, 1, 0], [0, 1, 1, 0, 1]) == [0, 0, 0, 0, 0])
```

d) Implement the function `NOT`. It takes as argument an incidence vector and returns a representation can be used in combination with AND queries.

```
def NOT(vector):
    # insert your code here

# these tests should return True if your code is correct
print(AND([1, 1, 0, 0], [1, 1, 1, 0], NOT([1, 0, 0, 0])) == [0, 1, 0, 0])
```

The binary representation allows us to efficiently search for documents containing particular terms of search query. There are, however, still some problems that need to be overcome. Consider a documer collection of 1 million documents where each document is about a thousand words long. On average such a collection contains approximately 500k unique terms. This means that if we try to build an incidence matrix, we would have to construct a matrix containing $500,000 \times 1,000,000 =$ half a

trillion 0's and 1's. Such a large matrix cannot be stored on a simple laptop.

Quiz!

a) Much of the information in the matrix is redundant. Why?

Double click this cell and write down your answer.

b) What would be a better representation of our matrix?

Double click this cell and write down your answer.

Inverted Index

The *Inverted Index* is *the* key data structure in modern Information Retrieval. An inverted index is a structure in which for each unique term t in our collection, we store a list of all document ID's that con t. If we represent our small collection of newspapers in this way, it looks like this:

```
Einstein: [12-11-1928, 04-04-1946]
Hubble: [12-11-1928, 04-04-1946, 03-11-1983]
Fermi: [12-11-1928]
Winfrey: [19-01-1999]
Dylan: [03-11-1983, 19-01-1999]
```

Quiz!

a) What would be a convenient and efficient data structure in Python to represent an inverted index?

Double click this cell and write down your answer.

b) We will implement a first version of an IR system. I choose to implement it as the class `IRSystem`. Implement the method `index_document`. It takes as argument a document ID and a list of words. The function should update the variable `tdf` in such a way that for each term it stores a set of all documer IDs in which that term occurs.

```
import glob, os, re
from collections import defaultdict


def tokenize(text, lowercase=True):
    text = text.lower() if lowercase else text
    for match in re.finditer(r"\w+(\.?\w+)*", text):
        yield match.group()


class IRSystem:
    """A very simple Information Retrieval System. The constructor
    s = IRSystem() builds an empty system. Next, index several documents
    with s.index_document(ID, text).
    """

    def __init__(self):
        "Initialize an IR Sytem."
        self.tdf = defaultdict(set)
        self.doc_ids = []

    def index_document(self, doc_id, words):
        "Add a new unindexed document to the system."
        self.doc_ids.append(doc_id)
        # insert your code here

    def index_collection(self, filenames):
        "Index a collection of documents."
        for filename in filenames:
            self.index_document(os.path.basename(filename),
                                tokenize(open(filename).read()))

# these tests should return True if your code is correct
s = IRSystem()
s.index_collection(glob.glob('data/haggard/*.txt'))

print('The Ghost Kings 8184.txt' in s.tdf['master'])
print('Cleopatra 2769.txt' in s.tdf['children'])
```

Query the Index

Now that we have an efficient, sparse data structure to represent our collection, how can we use that
stucture to efficiently process user queries? Our index is represented as a Python dictionary which allo
us to query the index for single terms, using

```
s = IRSystem()
s.tdf[term]
```

which will return a set of all documents in which that term occurs. But how do we search for documen
that contain two or more terms? Python's data structure `set` defines a convenient method called
`intersection` with which we can extract all items common to two or more sets:

```
a = {'a', 'b', 'c', 'd'}
b = {'c', 'a', 'e', 'f'}
print(a.intersection(b))
```

We can make use of this method to implement the method `query` which takes as argument an arbitra
number of query terms and returns all documents in which those terms occur.

Quiz!

Implement the method `IRSystem.query(*terms)`. The method should return an iterable containing a ID's of the documents in which all query terms occur.

```
class IRSystem:
    """A very simple Information Retrieval System. The constructor
    s = IRSystem() builds an empty system. Next, index several documents
    with s.index_document(ID, text). Then ask queries with
    s.query('term1', 'term2') to retrieve the matching documents."""

    def __init__(self):
        "Initialize an IR Sytem."
        self.tdf = defaultdict(set)
        self.doc_ids = []

    def index_document(self, doc_id, words):
        "Add a new unindexed document to the system."
        self.doc_ids.append(doc_id)
        for word in words:
            self.tdf[word].add(doc_id)

    def index_collection(self, filenames):
        "Index a collection of documents."
        for filename in filenames:
            self.index_document(os.path.basename(filename),
                                tokenize(open(filename).read()))

    def query(self, *terms):
        "Query the system for documents in which all terms occur."
        # insert your code here

# these tests should return True if your code is correct
s = IRSystem()
s.index_collection(glob.glob('data/haggard/*.txt'))

print('Beatrice 3096.txt' in s.query("master", "children"))
print('Fair Margaret 9780.txt' in s.query("eye", "father", "work"))
```

Our Information Retrieval system starts to look quite good. We have written functions to tokenize documents, index documents and query the index for documents. In the query method above, we mad the simplifying assumption that as long as two documents contain a particular search term, they are equally relevant. However, our intuition says that documents that contain more instances of a particul term are more relevant than documents with less instances. To account for this intuition we need a w to score and sort our search results.

Let's start with a very naive and simple scoring function: document frequency. This scoring function simply sums the document frequencies of each search term in a particular document:

$$\text{score}(q_1, q_2, \ldots, q_n) = \sum_{i=1}^{n} df(q_i)$$

where n is the number of search terms and df the document frequency of term q_i in a document.

To compute this formula we need to obtain the frequency of each word in each document. The metho `index_document` seems an appropriate place to extract these frequencies. For each term we store ho often that term occurs in each document. Note that in the previous implementation of `index_docume` the variable `tdf` is represented by a dictionary with sets of document ID's as values. We will change th data structure to a structure that allows us to store the document frequencies:

```
from collections import Counter

class IRSystem:
    """A very simple Information Retrieval System. The constructor
    s = IRSystem() builds an empty system. Next, index several documents
    with s.index_document(ID, text). Then ask queries with
    s.query('term1', 'term2') to retrieve the matching documents."""

    def __init__(self):
        "Initialize an IR Sytem."
        self.tdf = defaultdict(Counter) # changed!
        self.doc_ids = []

    def index_document(self, doc_id, words):
        "Add a new unindexed document to the system."
        self.doc_ids.append(doc_id)
        for word in words:
            self.tdf[word][doc_id] += 1 # changed!

    def index_collection(self, filenames):
        "Index a collection of documents."
        for filename in filenames:
            self.index_document(os.path.basename(filename),
                                tokenize(open(filename).read()))

    def query(self, *terms):
        "Query the system for documents in which all terms occur."
        return set.intersection(*map(self.tdf.get, terms))
```

I represent the `tdf` variable as a dictionary with Counter (https://docs.python.org/dev/library/collections.html#collections.Counter) objects as default values. `Counter` object is a very convenient structure for counting hashable objects. As you can see, we only h to adjust two lines in our original system. Before we continue, make sure you understand what is happening here. We reinitialize our IR system:

```
s = IRSystem()
s.index_collection(glob.glob('data/haggard/*.txt'))
```

Let's inspect the term-document frequency matrix:

```
s.tdf['master'].most_common(n=10)
```

The class `Counter` has a method called `most_common`. It returns the n most common items in a `Coun` object. We have a data structure that stores the information about the frequency of words in documer The next step will be to to adapt our query function in such a way that it returns a ranked list of documents where each document is sorted on the basis of the equation above.

Quiz!

a) The method `query` in the class definition below calls the method `score`. This method takes as arguments a document ID and an arbitrary number of terms. It returns the sum of the frequencies of these terms in this document. Implement the method `score`.

```
class IRSystem:
    """A very simple Information Retrieval System. The constructor
    s = IRSystem() builds an empty system. Next, index several
    documents with s.index_document(ID, text). Then ask queries
    with s.query('term1', 'term2') to retrieve the top n matching
    documents."""

    def __init__(self):
        "Initialize an IR Sytem."
        self.tdf = defaultdict(Counter)
        self.doc_ids = []

    def index_document(self, doc_id, words):
        "Add a new unindexed document to the system."
        self.doc_ids.append(doc_id)
        for word in words:
            self.tdf[word][doc_id] += 1

    def index_collection(self, filenames):
        "Index a collection of documents."
        for filename in filenames:
            self.index_document(os.path.basename(filename),
                                tokenize(open(filename).read()))

    def score(self, doc_id, *terms):
        "Score a document for a particular query using the sum of the term frequencies."
        # insert your code here

    def query(self, *terms, n=10):
        """Query the system for documents in which all terms occur. Returns
        the top n matching documents."""
        scores = {doc_id: self.score(doc_id, *terms) for doc_id in self.doc_ids}
        return sorted(scores, key=scores.get, reverse=True)[:n]


# these tests should return True if your code is correct
s = IRSystem()
s.index_collection(glob.glob('data/haggard/*.txt'))

print(s.query("master")[0] == 'The Ancient Allan 5746.txt')
print(s.query("egg", "shell")[0] == 'Dawn 10892.txt')
```

b) Give at least two reasons why this way of scoring and sorting our documents is probably not such a good idea, after all.

Double click this cell and write down your answer.

Okapi BM25

Our scoring method contains multiple flaws. Most worrying is that it does not control for the lengths o our documents. Needless to say, this greatly influences our final lists. We need to think harder about v makes it that a search term is more or less relevant for a particular document.

The frequency with which terms occur in a document functions as an important cue to the importance a document. The document is even more important when it contains many examples of this search te while the term occurs only in a limited number of other documents. In Information Retrieval a ranking metric that attempts to capture this intuition is Okapi BM25 (https://en.wikipedia.org/wiki/Okapi_BM2 The metric has proven to be one of the most successful ranking functions. In one of its many versions is computed as follows:

$$score(q_1, q_2, \ldots, q_n) = \sum_{i=1}^{n} IDF(q_i) \cdot \frac{df(q_i, D) \cdot (k_1 + 1)}{df(q_i, D) + k_1 \cdot (1 - b + b \cdot \frac{|D|}{\text{avgdl}})}$$

where Q represents a query and $df(q_i, D)$ is the frequency of the i'th term in Q in document D. $|D|$ the length of document D in number of word tokens and avgdl is the average document length. The parameters b and k_1 are commonly set to 0.75 and 1.2, respectively. We compute the I(nverse) D(ocument) F(requency) weight using:

$$IDF(q_i) = \log \frac{N - n(q_i) + 0.5}{n(q_i) + 0.5}$$

where N is the number of documents in the corpus and $n(q_i)$ the number of documents that contain

We will implement this formula in our `score` method. Before we do that, we will first make a list of all t information we need to compute the formula:

1. the frequency of a term q_i in document D;
2. the length of document D;
3. the average length of all documents in the collection;
4. the IDF weight of a term q_i.

Our current implementation already stores the document frequency of each term in each document (1 Thus, we only need to write code to extract the last three items: (2) the length of each document, (3) tl average document length and (4) the IDF weight of each unique term.

Quiz!

a) In this exercise you have to add the length of each document in our collection to the IR system. Reimplement the `index_document` method. Besides updating the term-document frequencies of eacl term, it should update the `Counter` object `lengths` in such a way that for each document ID it stores t length of the document being indexed.

```
class IRSystem:
    """A very simple Information Retrieval System. The constructor
    s = IRSystem() builds an empty system. Next, index several
    documents with s.index_document(ID, text). Then ask queries
    with s.query('term1', 'term2') to retrieve the top n matching
    documents."""

    def __init__(self):
        "Initialize an IR Sytem."
        self.tdf = defaultdict(Counter)
        self.lengths = Counter()
        self.doc_ids = []

    def index_document(self, doc_id, words):
        "Add a new unindexed document to the system."
        self.doc_ids.append(doc_id)
        # insert your code here

    def index_collection(self, filenames):
        "Index a collection of documents."
        for filename in filenames:
            self.index_document(os.path.basename(filename),
                                tokenize(open(filename).read()))

    def score(self, doc_id, *terms):
        "Score a document for a particular query using the sum of the term frequencies."
        return sum(self.tdf[term][doc_id] for term in terms)

    def query(self, *terms, n=10):
        """Query the system for documents in which all terms occur. Returns
        the top n matching documents."""
        scores = {doc_id: self.score(doc_id, *terms) for doc_id in self.doc_ids}
        return sorted(scores, key=scores.get, reverse=True)[:n]


# these tests should return True if your code is correct
s = IRSystem()
s.index_collection(glob.glob('data/haggard/*.txt'))

print(s.lengths['Dawn 10892.txt'] == 192299)
```

b) Once we have obtained the document length for each document, computing the average document length is trivial. In this exercise we will focus on the IDF weights. To compute the IDF weight for a particular term q_i we need to know two things:

1. how many documents N there are in our collection;
2. in how many documents that term occurs: $n(q_i)$.

We will implement a helper method called `_document_frequency`. It should return a dictionary in whic we store for each term the number of documents in which that term occurs. You will also need to ada the `index_document` method in such a way that the variable `N` represents the number of documents tl have been indexed.

```
class IRSystem:
    """A very simple Information Retrieval System. The constructor
    s = IRSystem() builds an empty system. Next, index several
    documents with s.index_document(ID, text). Then ask queries
    with s.query('term1', 'term2') to retrieve the top n matching
    documents."""

    def __init__(self):
        "Initialize an IR Sytem."
        self.tdf = defaultdict(Counter)
        self.lengths = Counter()
        self.doc_ids = []
        self.N = 0

    def index_document(self, doc_id, words):
        "Add a new unindexed document to the system."
        self.doc_ids.append(doc_id)
        # insert you code here

    def index_collection(self, filenames):
        "Index a collection of documents."
        for filename in filenames:
            self.index_document(os.path.basename(filename),
                                tokenize(open(filename).read()))

    def _document_frequency(self):
        "Return the document frequency for each term in self.tdf."
        # insert your code here

    def score(self, doc_id, *terms):
        "Score a document for a particular query using the sum of the term frequencies."
        return sum(self.tdf[term][doc_id] for term in terms)

    def query(self, *terms, n=10):
        """Query the system for documents in which all terms occur. Returns
        the top n matching documents."""
        scores = {doc_id: self.score(doc_id, *terms) for doc_id in self.doc_ids}
        return sorted(scores, key=scores.get, reverse=True)[:n]


# these tests should return True if your code is correct
s = IRSystem()
s.index_collection(glob.glob('data/haggard/*.txt'))

print(s._document_frequency()['children'] == 59)
```

We now have all the ingredients to compute the Okapi BM25 score. Lets put everything together and implement a complete version of our IR system:

```
import glob, os
from math import log

class IRSystem:
    """A very simple Information Retrieval System. The constructor
    s = IRSystem() builds an empty system. Next, index several documents
    with s.index_document(text, url). Then ask queries with
    s.query('term1', 'term2', n=10) to retrieve the top n
    matching documents."""

    def __init__(self, b=0.75, k1=1.2):
        "Initialize an IR Sytem."
        self.N = 0
        self.lengths = Counter()
        self.tdf = defaultdict(Counter)
        self.doc_ids = []
        self.b = b
        self.k1 = k1
        self._all_set = False

    def __repr__(self):
        return '<IRSystem(b={self.b}, k1={self.k1}, N={self.N})>'.format(self=self)

    def index_document(self, doc_id, words):
        "Add a new unindexed document to the system."
        self.N += 1
        self.doc_ids.append(doc_id)
        for word in words:
            self.tdf[word][doc_id] += 1
            self.lengths[doc_id] += 1
        self._all_set = False

    def index_collection(self, filenames):
        "Index a collection of documents."
        for filename in filenames:
            self.index_document(os.path.basename(filename),
                                tokenize(open(filename).read()))

    def _document_frequency(self):
        "Return the document frequency for each term in self.tdf."
        return {term: len(documents) for term, documents in self.tdf.items()}

    def score(self, doc_id, *query):
        "Score a document for a particular query using Okapi BM25."
        score = 0
        length = self.lengths[doc_id]
        for term in query:

            tf = self.tdf[term][doc_id]
            df = self.df.get(term, 0)
            idf = log((self.N - df + 0.5) / (df + 0.5))
            score += (idf * (tf * (self.k1 + 1)) /
                          (tf + self.k1 * (1 - self.b + (self.b * length / self.avg_len))))
        return score

    def query(self, *query, n=10):
        """Query an indexed collection. Returns a ranked list of doc ID's sorted by
        the computation of Okapi BM25."""
        if not self._all_set:
            self.df = self._document_frequency()
            self.avg_len = sum(self.lengths.values()) / self.N
            self._all_set = True

        scores = {doc_id: self.score(doc_id, *query) for doc_id in self.doc_ids}
        return sorted(scores.items(), key=lambda i: i[1], reverse=True)[:n]

    def present(self, results):
        "Present the query results as a list."
        for doc_id, score in results:
            print("%5.2f | %s" % (100 * score, doc_id))

    def present_results(self, *query):
        "Query the collection and present the results."
        return self.present(self.query(*query))
```

I have taken the liberty to make some minor adjustments to the class and add some methods to prese the results of a query. The method `score` implements Okapi BM25 quite straightforwardly. Note that I

added a boolean attribute called `_all_set` to the class. This attribute tells the system whether all the pieces of information to compute the Okapi BM25 scores have been collected. In the method `query` w ask whether all is set. If not, we first compute the document frequencies of each unique term in our collection as well as the average document length. The reason I do not compute this earlier is that aft document has been added to the index, we need to recompute all these values (note that we set `_all_set` in `index_document` to `False`). Since we do not know whether a user of this class will add some more documents after having indexed a complete collection earlier, it is safer to postpone these computations. The methods `present` and `present_results` are two helper methods to more conveniently print the results of a query.

Let's test out IR System!

```
s = IRSystem()
s.index_collection(glob.glob('data/haggard/*.txt'))
```

```
s.present_results("regeneration", "pharao", "odds")
```

Final exercise

Perhaps the biggest advantage of Object Oriented Programming is the ability to subclass objects. You could, for example, make a specialized IRSystem for searching through particular directories on your c laptop. In this final exercise you will implement a simple web searcher. This searcher can be initialized with a number of URLs of web pages. The searcher downloads these pages, strips all HTML markup a indexes the raw text. The searcher can then be used to query for particular web pages.

Our implementation starts with a function to retrieve a webpage given a URL. The module urllib.reques (https://docs.python.org/3/library/urllib.request.html#module-urllib.request) in Python's standard libr defines a number of functions and classes to open and read URLs. The function `urlopen` opens a `HTTPResponse` object, which has a method called `read`. Upon calling the `read` method, the complete webpage will be downloaded:

```
import urllib.request

response = urllib.request.urlopen("https://en.wikipedia.org/wiki/Albert_einstein")
response.read()[:1000]
```

The transcendent BeautifulSoup (http://www.crummy.com/software/BeautifulSoup/) is a package to parse and create HTML (and a lot more). We will use this package to read the web pages:

```
from bs4 import BeautifulSoup

response = urllib.request.urlopen("https://en.wikipedia.org/wiki/Albert_einstein")
page = BeautifulSoup(response.read())
```

We call the method `get_text` on this web page to obtain a textual representation of the web page.

```
text = page.get_text()
print(text[-1000:])
```

a) Implement the function `fetch_page`. It takes as input a URL and returns a textual representation of corresponding web page.

```
def fetch_page(url):
    # insert your code here
```

b) We implement the searcher as a subclass of the IRSystem:

```
    class WebSearcher(IRSystem):
```

Overwrite the method `index_collection`. The new method takes as input a list of URLs, fetches the textual contents for each of those URLs and adds the contents to the index.

```
class WebSearcher(IRSystem):
    # insert your code here
```

Initialize your searcher and add a collection of web pages:

```
searcher = WebSearcher()
searcher.index_collection(["https://en.wikipedia.org/wiki/Albert_einstein",
                           "http://nlp.stanford.edu/IR-book/",
                           "http://www.crummy.com/software/BeautifulSoup/"])
```

Finally search for documents in the index using different queries:

```
searcher.present_results("soup")
```

```
searcher.present_results("retrieval")
```

You've reached the end of the chapter. Ignore the code below, it's just here to make the page pretty:

```
from IPython.core.display import HTML
def css_styling():
    styles = open("styles/custom.css", "r").read()
    return HTML(styles)
css_styling()
```

/* Placeholder for custom user CSS mainly to be overridden in profile/static/custom/custom.css This will always be an empty file in IPython */