Exercises in Style

Crista Lopes

modernism

impressionism

abstract expressionism

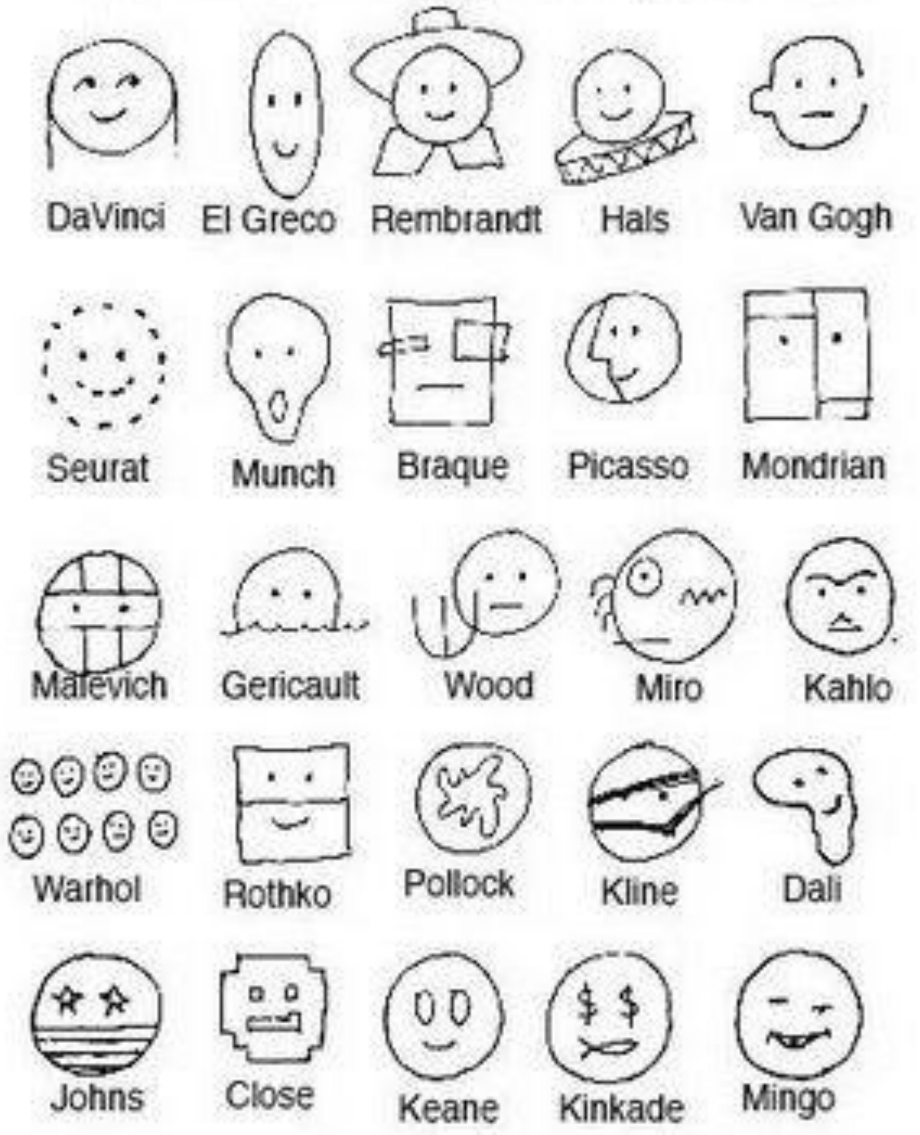
realism

surrealism

cubism

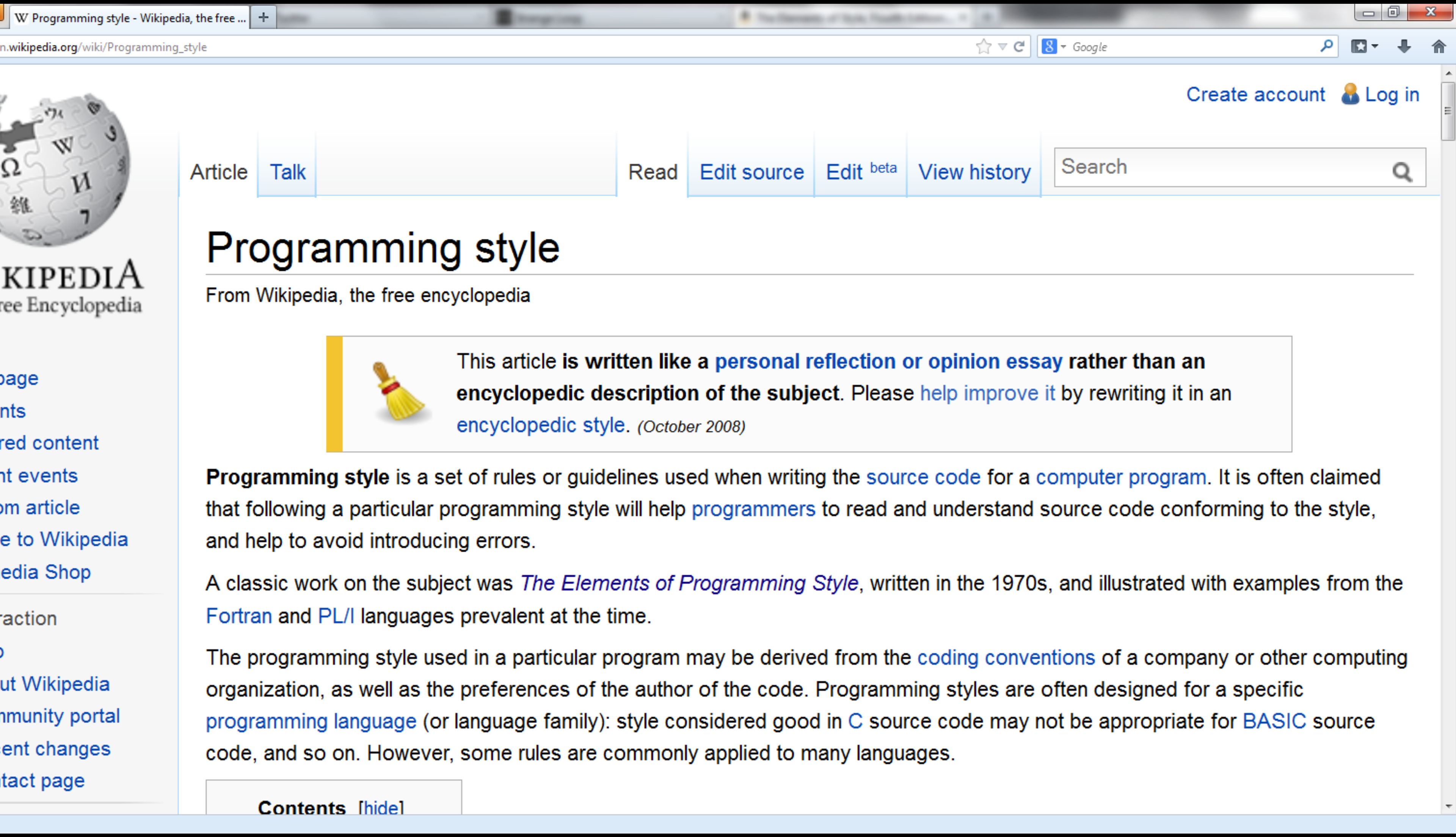
photorealism

Art History, Simplified



Rules and constraints in software construction

PROGRAMMING STYLES



Programming style

From Wikipedia, the free encyclopedia

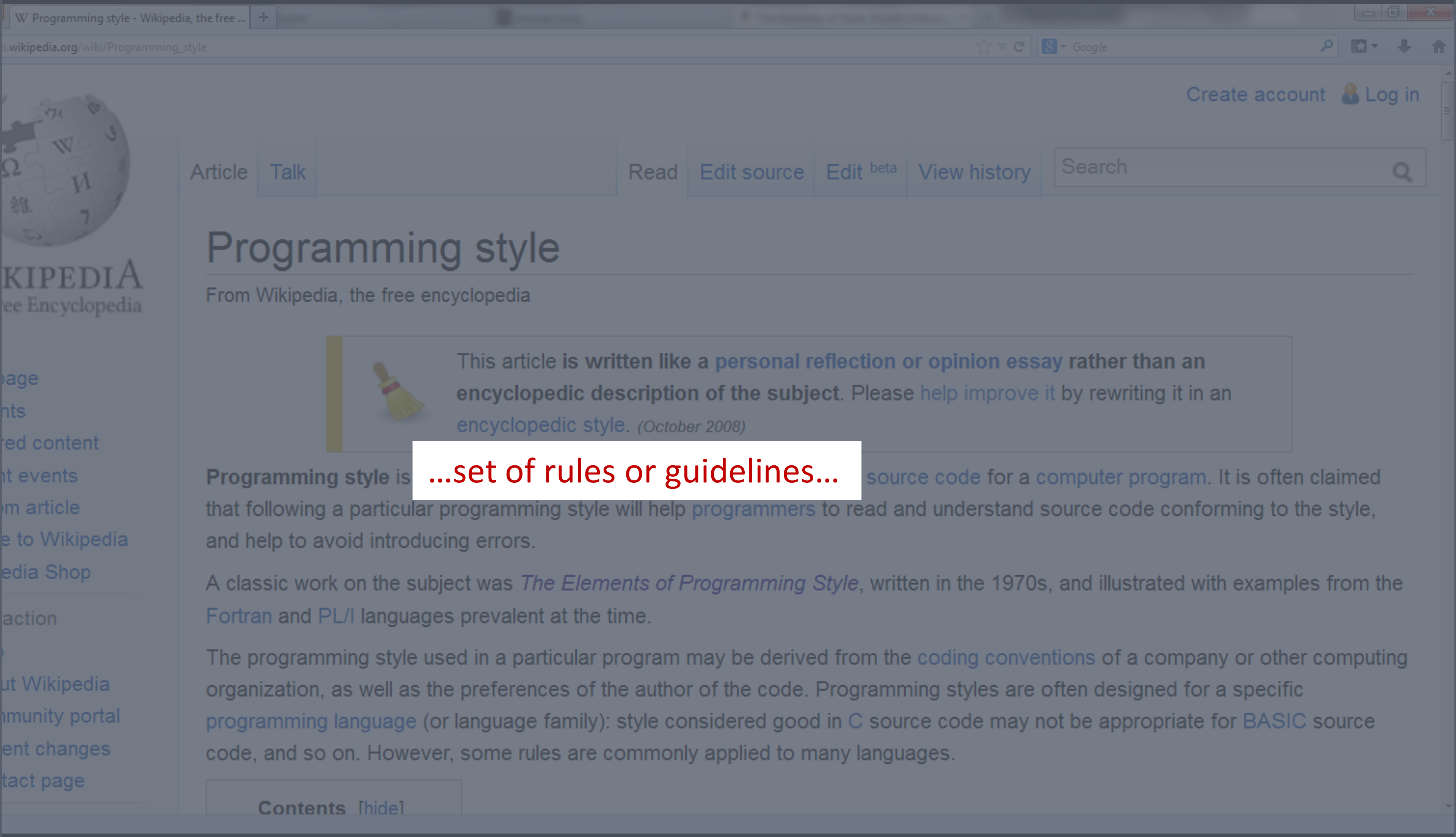
This article **is written like a personal reflection or opinion essay rather than an encyclopedic description of the subject**. Please help improve it by rewriting it in an encyclopedic style. *(October 2008)*

Programming style is a set of rules or guidelines used when writing the source code for a computer program. It is often claimed that following a particular programming style will help programmers to read and understand source code conforming to the style, and help to avoid introducing errors.

A classic work on the subject was *The Elements of Programming Style*, written in the 1970s, and illustrated with examples from the Fortran and PL/I languages prevalent at the time.

The programming style used in a particular program may be derived from the coding conventions of a company or other computing organization, as well as the preferences of the author of the code. Programming styles are often designed for a specific programming language (or language family): style considered good in C source code may not be appropriate for BASIC source code, and so on. However, some rules are commonly applied to many languages.

Contents [hide]



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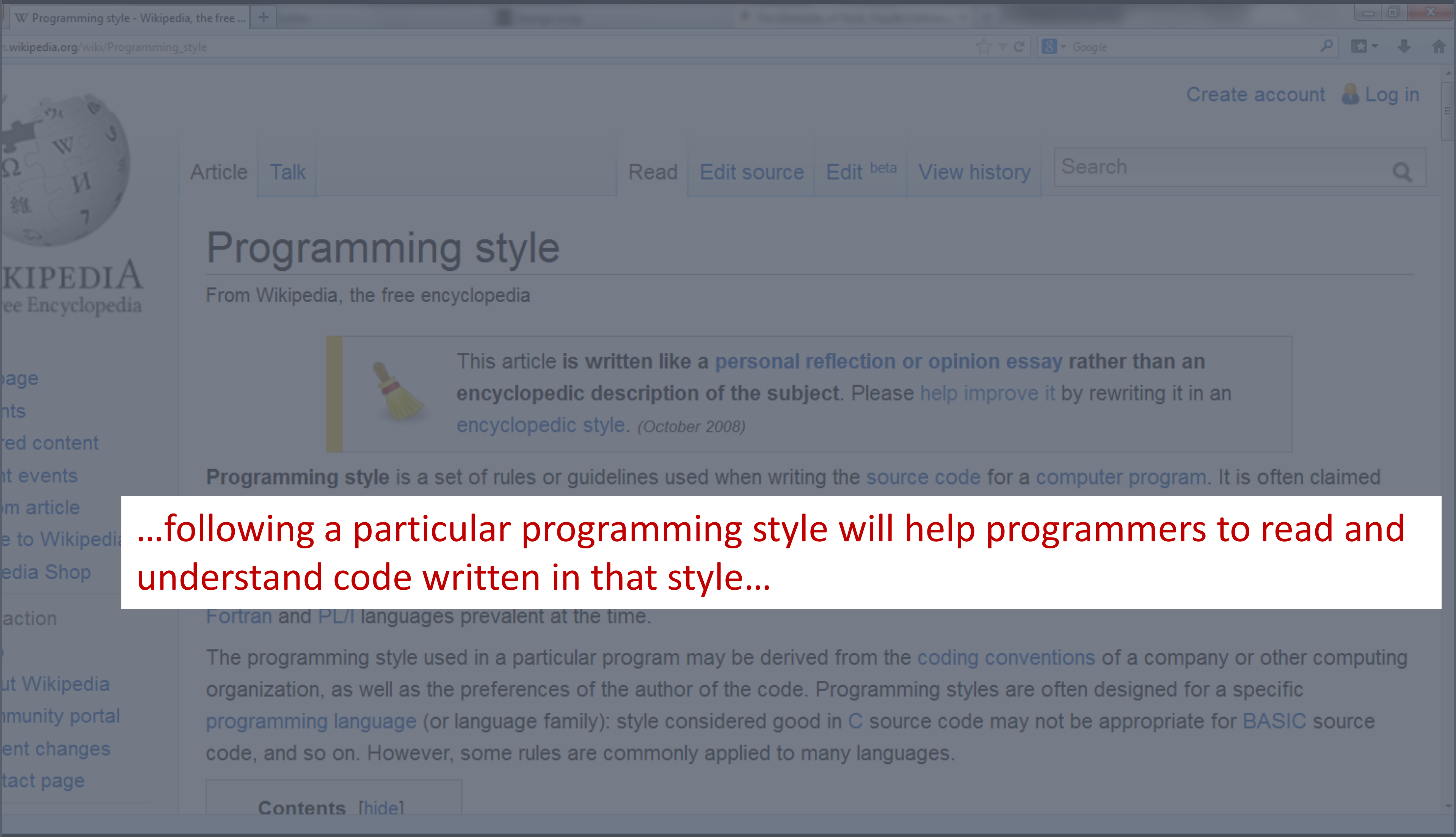
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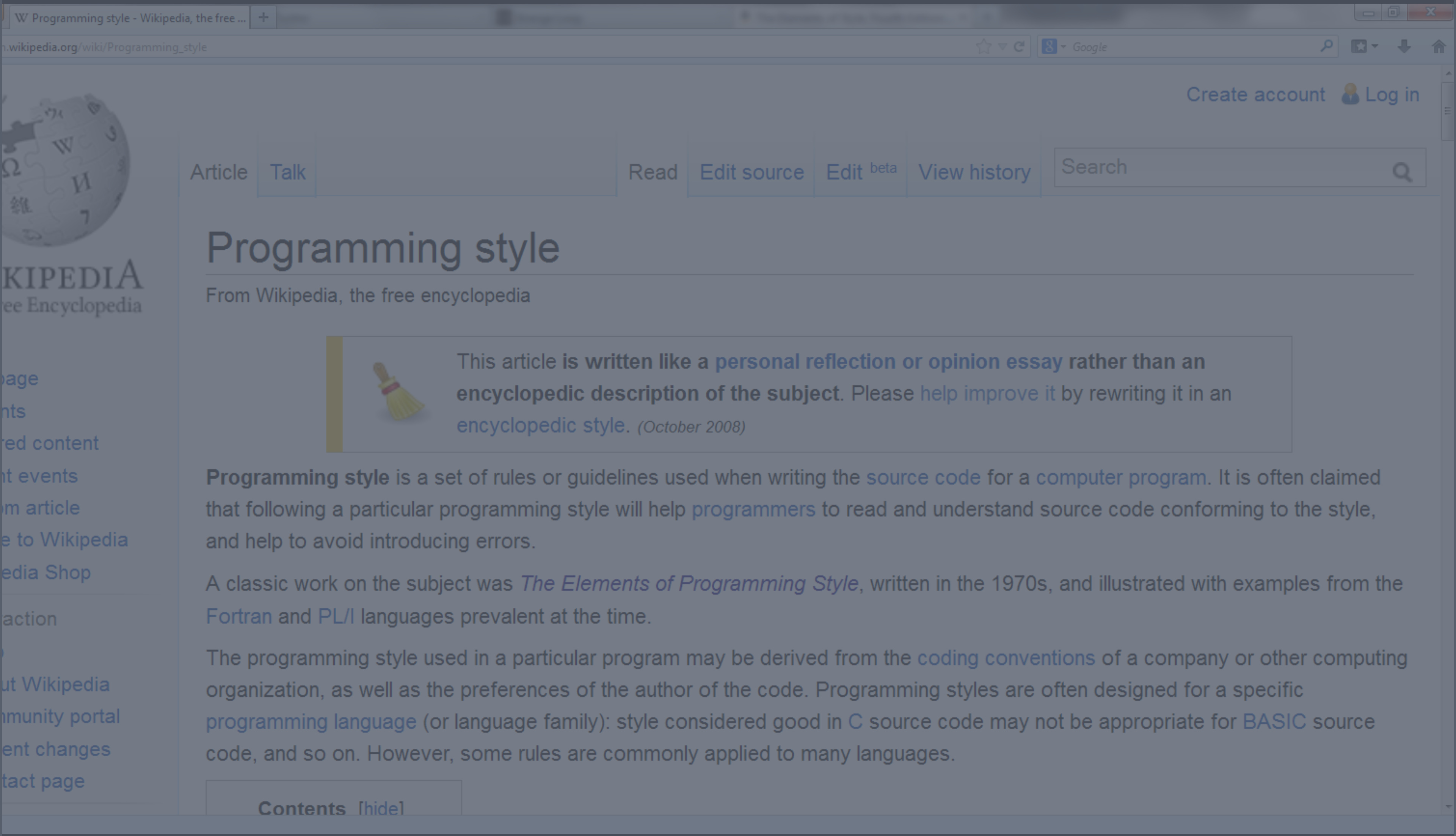

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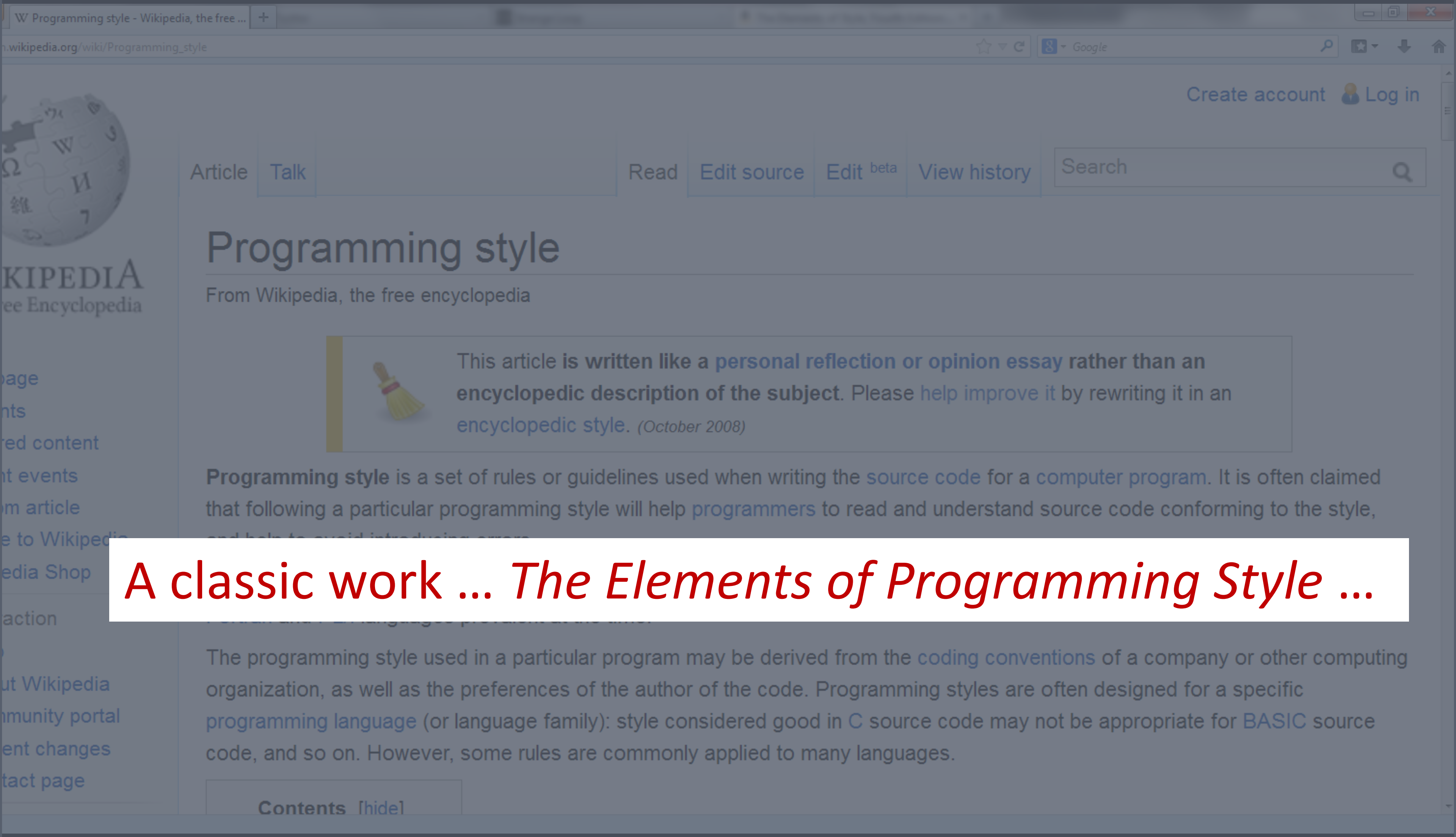
Programming style = code appearance



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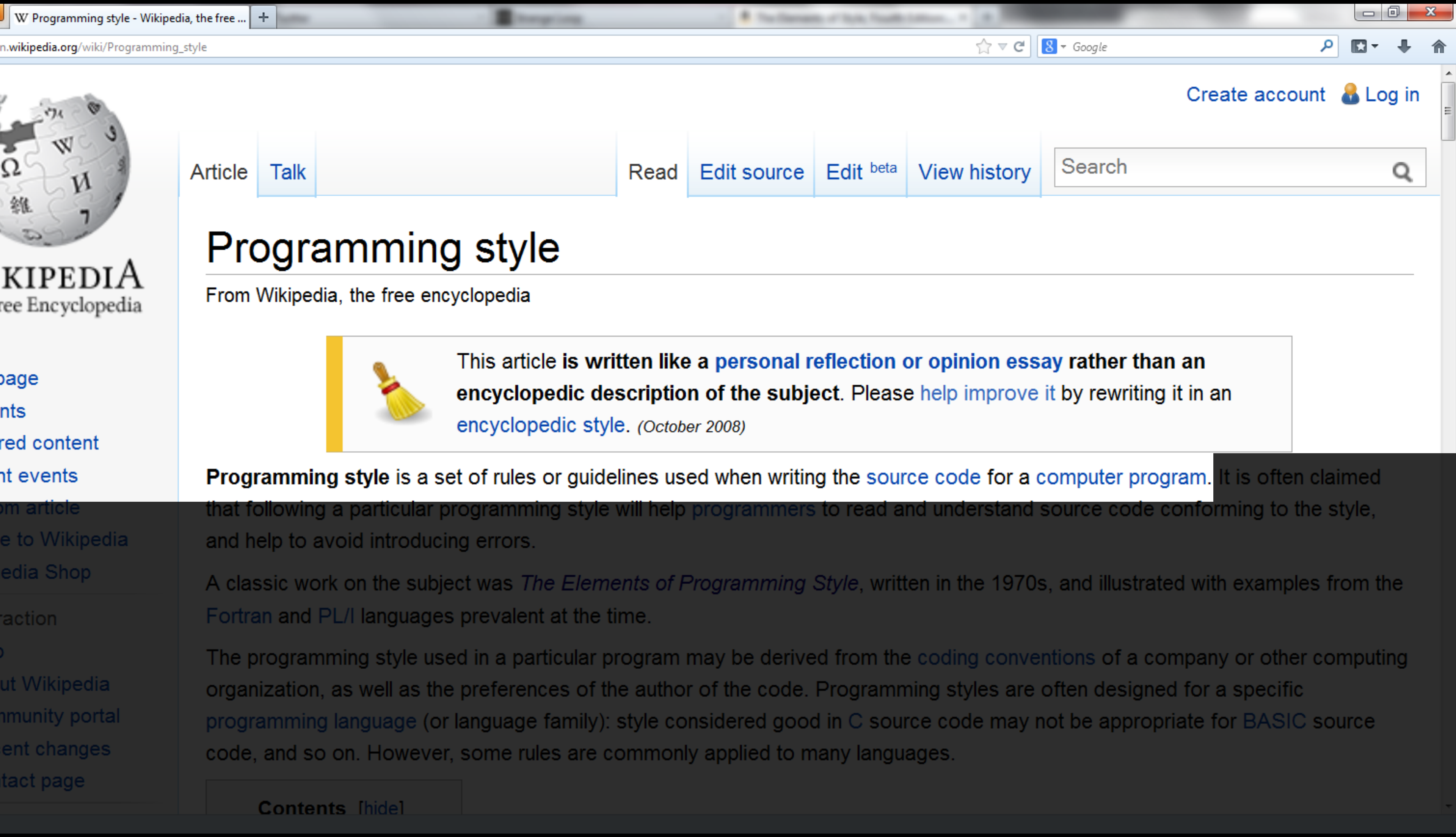

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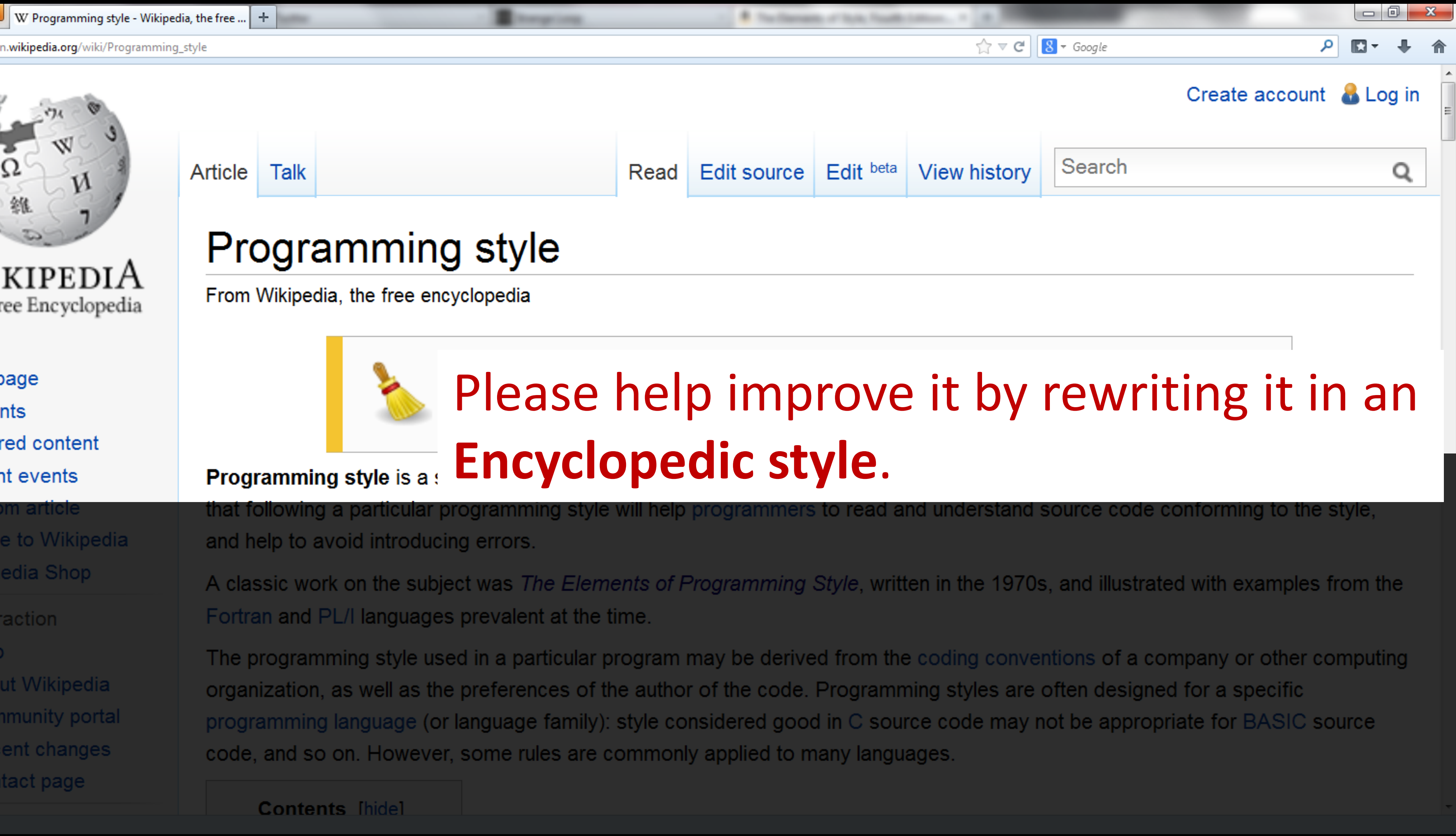

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Contents [hide]

Programming Styles

- Ways of expressing tasks
- Exist at all scales
- Recur in multiple scales
- Codified in PLs

Why Are Styles Important?

- Many
- Common vocabularies
- Basic frames of reference
- Some better than others
  - Depending on many things!

Programming Styles

How do you teach this?

Raymond Queneau

EXERCISES IN STYLE

RAYMOND QUENEAU

Queneau's Exercises in Style

- Metaphor
- Surprises
- Dream
- Prognostication
- Hesitation
- Precision
- Negativities
- Asides
- Anagrams
- Logical analysis
- Past
- Present
- …
- (99)

Exercises in Programming Style

The story:

Term Frequency

given a text file,
output a list of the 25
most frequently-occurring
words, ordered by decreasing
frequency

Exercises in Programming Style

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$$\begin{tikzcd} \textit{Pride and Prejudice} \arrow[r] & \boxed{\text{TF}} \arrow[r] & {} \end{tikzcd}$$

mr - 786
elizabeth - 635
very - 488
darcy - 418
such - 395
mrs - 343
much - 329
more - 327
bennet - 323
bingley - 306
jane - 295
miss - 283
one - 275
know - 239
before - 229
herself - 227
though - 226
well - 224
never - 220
…

@cristalopes #style1 *name*

STYLE #1

```python
import sys, string
# the global list of [word, frequency] pairs
word_freqs = []
# the list of stop words
with open('../stop_words.txt') as f:
    stop_words = f.read().split(',')
stop_words.extend(list(string.ascii_lowercase))

# iterate through the file one line at a time
for line in open(sys.argv[1]):
    start_char = None
    i = 0
    for c in line:
        if start_char == None:
            if c.isalnum():
                # We found the start of a word
                start_char = i
        else:
            if not c.isalnum():
                # We found the end of a word. Process it
                found = False
                word = line[start_char:i].lower()
                # Ignore stop words
                if word not in stop_words:
                    pair_index = 0
                    # Let's see if it already exists
                    for pair in word_freqs:
                        if word == pair[0]:
                            pair[1] += 1
                            found = True
                            found_at = pair_index
                            break
                        pair_index += 1
                    if not found:
                        word_freqs.append([word, 1])
                    elif len(word_freqs) > 1:
                        # We may need to reorder
                        for n in reversed(range(pair_index)):
                            if word_freqs[pair_index][1] >
                                word_freqs[n][1]:
                                # swap
                                word_freqs[n], word_freqs[
                                    pair_index] = word_freqs[
                                    pair_index], word_freqs[n]
                                pair_index = n
                # Let's reset
                start_char = None
        i += 1

for tf in word_freqs[0:25]:
    print tf[0], ' - ', tf[1]
```

```python
# the global list of [word, frequency] pairs
word_freqs = []
# the list of stop words
with open('../stop_words.txt') as f:
    stop_words = f.read().split(',')
stop_words.extend(list(string.ascii_lowercase))
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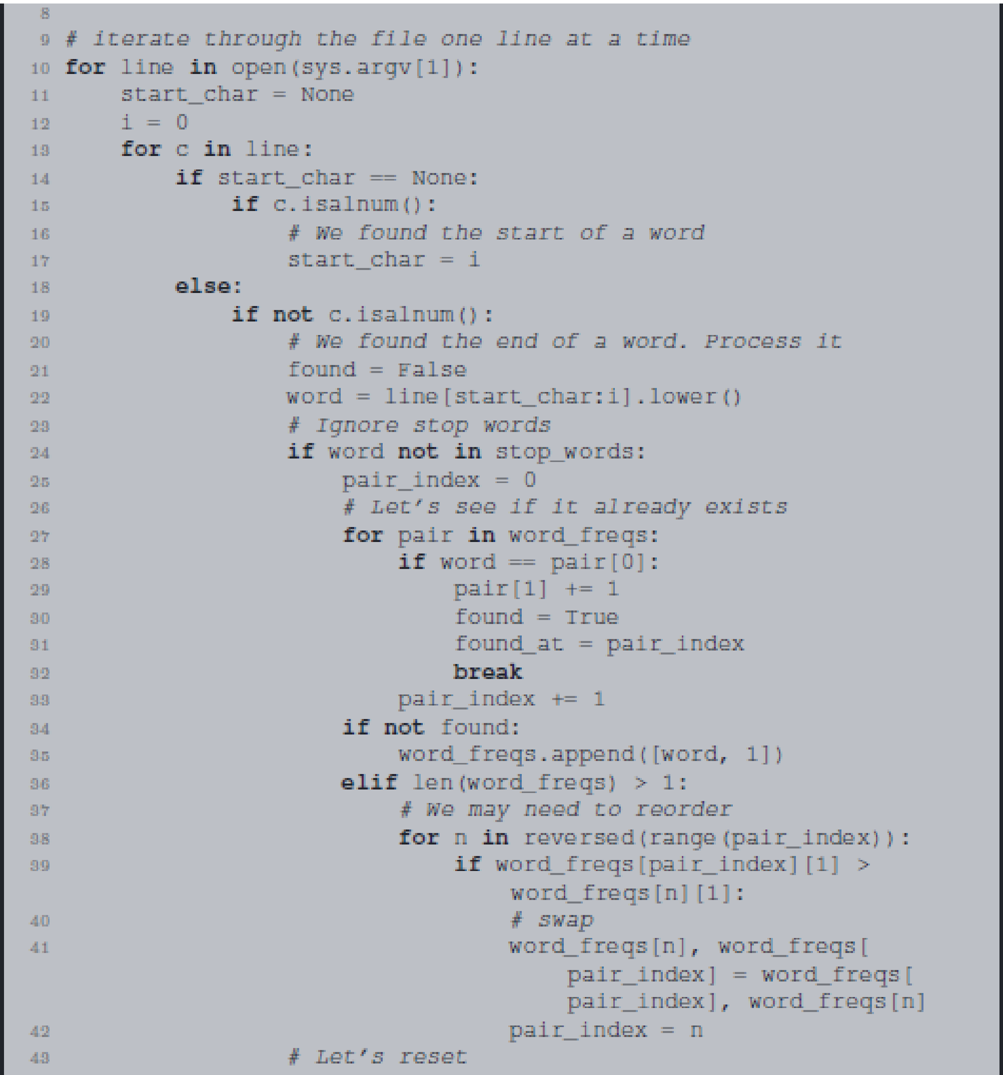

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                        pair_index += 1
                    if not found:
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                    elif len(word_freqs) > 1:
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                                pair_index = n
                # Let's reset
```

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```python
for line in open(sys.argv[1]):
```

```python
    for c in line:
```

```python
        if start_char == None:
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                start_char = i
        else:
            if not c.isalnum():
                # We found the end of a word. Process it
                found = False
                word = line[start_char:i].lower()
                # Ignore stop words
                if word not in stop_words:
                    pair_index = 0
                    # Let's see if it already exists
                    for pair in word_freqs:
                        if word == pair[0]:
                            pair[1] += 1
                            found = True
                            found_at = pair_index
                            break
                        pair_index += 1
                    if not found:
                        word_freqs.append([word, 1])
                    elif len(word_freqs) > 1:
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                        for n in reversed(range(pair_index)):
                            if word_freqs[pair_index][1] >
                                word_freqs[n][1]:
                                # swap
                                word_freqs[n], word_freqs[
                                    pair_index] = word_freqs[
                                    pair_index], word_freqs[n]
                                pair_index = n
                # Let's reset
                start_char = None
        i += 1

for tf in word_freqs[0:25]:
    print tf[0], ' - ', tf[1]
```

Style #1 Main Characteristics

- No abstractions
- Heavy control flow

Style #1 Main Characteristics

- No abstractions
- Heavy control flow

Brain-dump Style

@cristalopes #style1 *name*

@cristalopes #style2 *name*

STYLE #2

```
import re, string, sys

stops = set(open("../stop_words.txt").read().split(",") + list(string.ascii_lowercase))
words = [x.lower() for x in re.split("[^a-zA-Z]+", open(sys.argv[1]).read()) if len(x) > 0 and x.lower() not in stops]
unique_words = list(set(words))
unique_words.sort(lambda x, y: cmp(words.count(y), words.count(x)))
print "\n".join(["%s - %s" % (x, words.count(x)) for x in unique_words[:25]])
```

Credit: *Laurie Tratt*, Kings College London

```
import re, string, sys

stops = set(open("../stop_words.txt").read().split(",") +
            list(string.ascii_lowercase))
words = [x.lower() for x in re.split("[^a-zA-Z]+",
                                     open(sys.argv[1]).read())
                 if len(x) > 0 and x.lower() not in stops]
unique_words = list(set(words))
unique_words.sort(lambda x, y: cmp(words.count(y),
                                       words.count(x)))
print "\n".join(["%s - %s" % (x, words.count(x))
                              for x in unique_words[:25]])
```

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import re, string, sys

stops = set(open("../stop_words.txt").read().split(",") +
            list(string.ascii_lowercase))
words = [x.lower() for x in re.split("[^a-zA-Z]+",
                                      open(sys.argv[1]).read())
                 if len(x) > 0 and x.lower() not in stops]
unique_words = list(set(words))
unique_words.sort(lambda x,y:cmp(words.count(y),
                                 words.count(x)))
print "\n".join(["%s - %s" % (x, words.count(x))
                              for x in unique_words[:25]])
```

Style #2 Main Characteristics

- No [named] abstractions
- Very few [long] lines of code
- Advanced libraries / constructs

Style #2 Main Characteristics

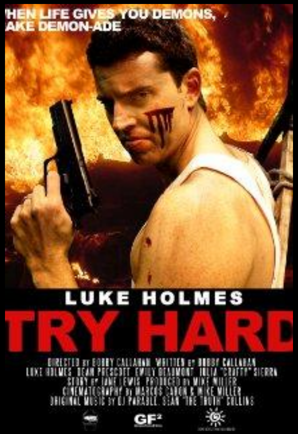
- ▻ No [named] abstractions
- ▻ Very few [long] lines of code
- ▻ Advanced libraries / constructs

Code Golf Style

@cristalopes #style2 *name*

Style #2 Main Characteristics

- No [named] abstractions
- Very few [long] lines of code
- Advanced libraries / constructs



Try Hard Style

@cristalopes #style3 *name*

STYLE #3

```python
import sys, string

# The shared mutable data
data = []
words = []
word_freqs = []

#
# The functions
#
def read_file(path_to_file):
    """
    Takes a path to a file and assigns the entire
    contents of the file to the global variable data
    """
    global data
    f = open(path_to_file)
    data = data + list(f.read())
    f.close()

def filter_chars_and_normalize():
    """
    Replaces all nonalphanumeric chars in data with white space
    """
    global data
    for i in range(len(data)):
        if not data[i].isalnum():
            data[i] = ' '
        else:
            data[i] = data[i].lower()

def scan():
    """
    Scans data for words, filling the global variable words
    """
    global data
    global words
    data_str = ''.join(data)
    words = words + data_str.split()

def remove_stop_words():
    global words
    f = open('../stop_words.txt')
    stop_words = f.read().split(',')
    f.close()
    # add single-letter words
    stop_words.extend(list(string.ascii_lowercase))
    indeces = []
    for i in range(len(words)):
        if words[i] in stop_words:
            indeces.append(i)
    for i in reversed(indeces):
        words.pop(i)

def frequencies():
    """
    Creates a list of pairs associating
    words with frequencies
    """
    global words
    global word_freqs
    for w in words:
        keys = [wd[0] for wd in word_freqs]
        if w in keys:
            word_freqs[keys.index(w)][1] += 1
        else:
            word_freqs.append([w, 1])

def sort():
    """
    Sorts word_freqs by frequency
    """
    global word_freqs
    word_freqs.sort(lambda x, y: cmp(y[1], x[1]))


#
# The main function
#
read_file(sys.argv[1])
filter_chars_and_normalize()
scan()
remove_stop_words()
frequencies()
sort()

for tf in word_freqs[0:25]:
    print tf[0], ' - ', tf[1]
```

```
data=[]
words=[]
freqs=[]

def read_file(path):
    """
    Takes a path to a file and assigns the entire
    contents of the file to the global variable data
    """
    global data
    f = open(path_to_file)
    data = data + list(f.read())
def filter_normalize():
    """
    Replaces all nonalphanumeric chars in data with white space
    """
    global data
    for i in range(len(data)):
        if not data[i].isalnum():
            data[i] = ' '
        else:
            data[i] = data[i].lower()
def scan():
    Scans data for words, filling the global variable words
    """
    global data
    global words
    data_str = ''.join(data)
    words = words + data_str.split()
def rem_stop_words():
    f = open('../stop_words.txt')
    stop_words = f.read().split(',')
    f.close()
    # add single-letter words
    stop_words.extend(list(string.ascii_lowercase))
    indeces = []
    for i in range(len(words)):
        if words[i] in stop_words:
            indeces.append(i)
    for i in reversed(indeces):
        words.pop(i)
```

```
def frequencies():
    words with frequencies
    """
    global words
    global word_freqs
    for w in words:
        keys = [wd[0] for wd in word_freqs]
        if w in keys:
            word_freqs[keys.index(w)][1] += 1
        else:
            word_freqs.append([w, 1])
def sort():
    Sorts word_freqs by frequency
    """
    global word_freqs
    word_freqs.sort(lambda x, y: cmp(y[1], x[1]))
```

```
#
# Main
#
read_file(sys.argv[1])
filter_normalize()
scan()
rem_stop_words()
frequencies()
sort()

for tf in word_freqs[0:25]:
    print tf[0], ' - ', tf[1]
```

Style #3 Main Characteristics

- Procedural abstractions
  - maybe input, no output
- Shared state
- Commands

Style #3 Main Characteristics

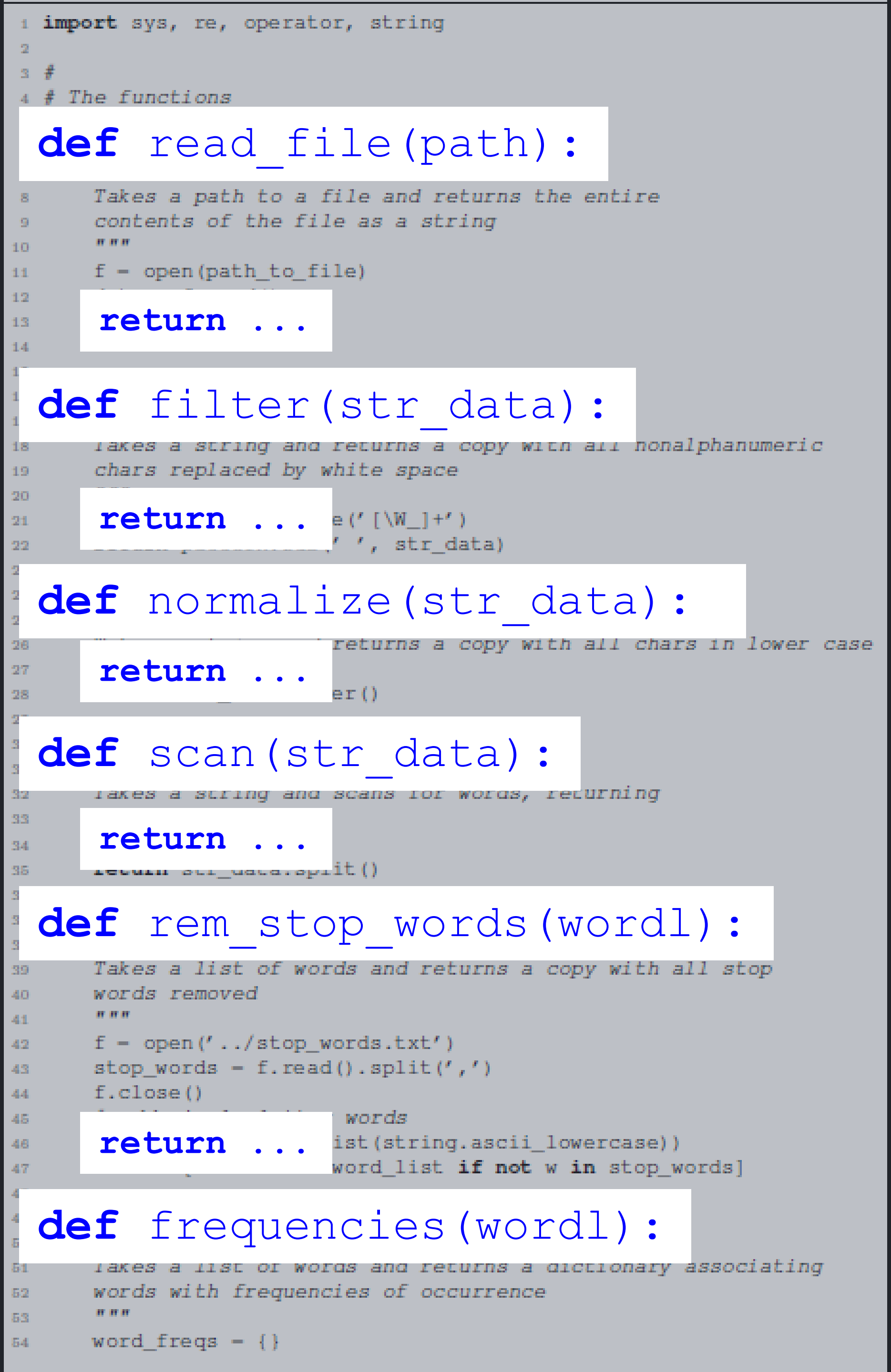
- Procedural abstractions
  - maybe input, no output
- Shared state
- Commands

Cook Book Style

@cristalopes #style4 *name*

STYLE #4

```python
import sys, re, operator, string

#
# The functions
#
def read_file(path_to_file):
    """
    Takes a path to a file and returns the entire
    contents of the file as a string
    """
    f = open(path_to_file)
    data = f.read()
    f.close()
    return data

def filter_chars(str_data):
    """
    Takes a string and returns a copy with all nonalphanumeric
    chars replaced by white space
    """
    pattern = re.compile('[\W_]+')
    return pattern.sub(' ', str_data)

def normalize(str_data):
    """
    Takes a string and returns a copy with all chars in lower case
    """
    return str_data.lower()

def scan(str_data):
    """
    Takes a string and scans for words, returning
    a list of words.
    """
    return str_data.split()

def remove_stop_words(word_list):
    """
    Takes a list of words and returns a copy with all stop
    words removed
    """
    f = open('../stop_words.txt')
    stop_words = f.read().split(',')
    f.close()
    # add single-letter words
    stop_words.extend(list(string.ascii_lowercase))
    return [w for w in word_list if not w in stop_words]

def frequencies(word_list):
    """
    Takes a list of words and returns a dictionary associating
    words with frequencies of occurrence
    """
    word_freqs = {}
    for w in word_list:
        if w in word_freqs:
            word_freqs[w] += 1
        else:
            word_freqs[w] = 1
    return word_freqs

def sort(word_freq):
    """
    Takes a dictionary of words and their frequencies
    and returns a list of pairs where the entries are
    sorted by frequency
    """
    return sorted(word_freq.iteritems(), key=operator.itemgetter(1), reverse=True)


#
# The main function
#
word_freqs = sort(frequencies(remove_stop_words(scan(normalize(filter_chars(read_file(sys.argv[1])))))))

for tf in word_freqs[0:25]:
    print tf[0], ' - ', tf[1]
```



```
import sys, re, operator, string

#
# The functions
def read_file(path):
    Takes a path to a file and returns the entire
    contents of the file as a string
    """
    f = open(path_to_file)
  return ...

def filter(str_data):
    takes a string and returns a copy with all nonalphanumeric
    chars replaced by white space

  return ...    e('[\W_]+')
                ' ', str_data)
def normalize(str_data):
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    word_freqs = {}
```
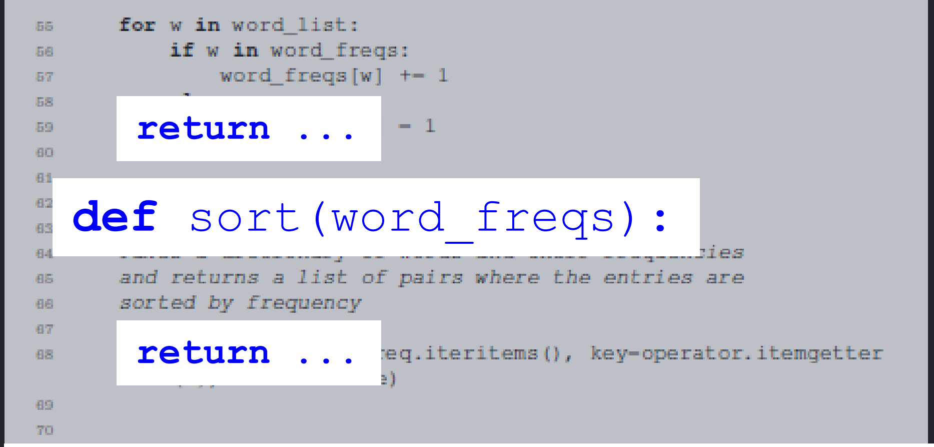



```
    for w in word_list:
        if w in word_freqs:
            word_freqs[w] += 1

    return ...      = 1


def sort(word_freqs):

    and returns a list of pairs where the entries are
    sorted by frequency

    return ...  eq.iteritems(), key=operator.itemgetter
                e)
```

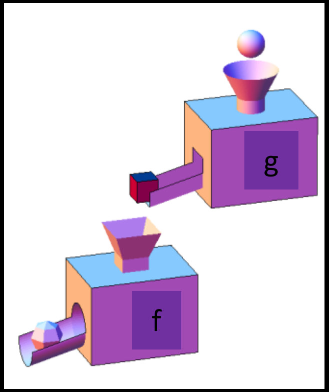
```
#
# Main
#
wfreqs=st(fq(r(sc(n(fc(rf(sys.argv[1])))))))

for tf in wfreqs[0:25]:
    print tf[0], ' - ', tf[1]
```

Style #4 Main Characteristics

- Function abstractions
  - *f: Input → Output*
- No shared state
- Function composition *f º g*

Style #4 Main Characteristics

- Function abstractions
  - *f: Input → Output*
- No shared state
- Function composition *f* ° *g*



Chocolate Factory Style

@cristalopes #style4 *name*

Image credit: Nykamp DQ, From *Math Insight*. http://mathinsight.org/image/function_machines_composed

@cristalopes #style5 *name*

STYLE #5

```python
import sys, re, operator, string

#
# The functions
#
def read_file(path_to_file, func):
    """
    Takes a path to a file and returns the entire
    contents of the file as a string
    """
    f = open(path_to_file)
    data = f.read()
    f.close()
    return func(data, normalize)

def filter_chars(str_data, func):
    """
    Takes a string and returns a copy with all nonalphanumeric
        chars
    replaced by white space
    """
    pattern = re.compile('[\W_]+')
    return func(pattern.sub(' ', str_data), scan)

def normalize(str_data, func):
    """
    Takes a string and returns a copy with all characters in lower
        case
    """
    return func(str_data.lower(), remove_stop_words)

def scan(str_data, func):
    """
    Takes a string and scans for words, returning
    a list of words.
    """
    return func(str_data.split(), frequencies)

def remove_stop_words(word_list, func):
    """ Takes a list of words and returns a copy with all stop
        words removed """
    f = open('../stop_words.txt')
    stop_words = f.read().split(',')
    f.close()
    # add single-letter words
    stop_words.extend(list(string.ascii_lowercase))
    return func([w for w in word_list if not w in stop_words],
        sort)

def frequencies(word_list, func):
    """
    Takes a list of words and returns a dictionary associating
    words with frequencies of occurrence
    """
    word_freqs = {}
    for w in word_list:
        if w in word_freqs:
            word_freqs[w] += 1
        else:
            word_freqs[w] = 1
    return func(word_freqs, no_op)

def sort(word_freq, func):
    """
    Takes a dictionary of words and their frequencies
    and returns a list of pairs where the entries are
    sorted by frequency
    """
    return func(sorted(word_freq.iteritems(), key=operator.
        itemgetter(1), reverse=True), None)

def no_op(a, func):
    return a

#
# The main function
#
word_freqs = read_file(sys.argv[1], filter_chars)

for tf in word_freqs[0:25]:
    print tf[0], ' - ', tf[1]
```

```
import sys, re, operator, string

#
# The functions
#
```

```
def read_file(path, func):
    ...
    return func(…, normalize)
```

```
def filter_chars(data, func):
    ...
    return func(…, scan)
```

```
def normalize(data, func):
    ...
    return func(…,remove_stops)
```

```
def scan(data, func):
    ...
    return func(…, frequencies)
```

```
def remove_stops(data, func):
    ...
    return func(…, sort)
```

```
def frequencies(
    """
    Takes a list                 dictionary associating
    words with f                 e
    """
```

Etc.

```
    word_freqs = {}
    for w in word_list:
        if w in word_freqs:
            word_freqs[w] += 1
        else:
            word_freqs[w] = 1
    return func(word_freqs, no_op)

def sort(word_freq, func):
    """
    Takes a dictionary of words and their frequencies
    and returns a list of pairs where the entries are
    sorted by frequency
    """
    return func(sorted(word_freq.iteritems(), key=operator.
        itemgetter(1), reverse=True), None)

def no_op(a, func):
    return a
```

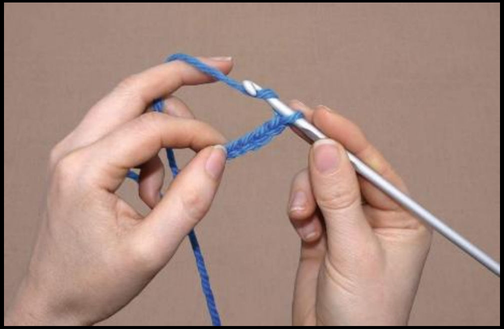
```
# Main
w_freqs=read_file(sys.argv[1],
                  filter_chars)

for tf in w_freqs[0:25]:
    print tf[0], ' - ', tf[1]
```

Style #5 Main Characteristics

- Functions take one additional parameter, f
  - called at the end
  - given what would normally be the return value plus the next function

Style #5 Main Characteristics

- Functions take one additional parameter, f
  - called at the end
  - given what would normally be the return value plus the next function



Crochet Style

@cristalopes #style5 *name*

@cristalopes #style6 *name*

STYLE #6

```python
import sys, re, operator, string
from abc import ABCMeta

#
# The classes
#
class TFExercise(object):
    __metaclass__ = ABCMeta

    def info(self):
        return self.__class__.__name__ + ": No major data structure"

class DataStorageManager(TFExercise):
    """ Models the contents of the file """
    _data = ''
    def __init__(self, path_to_file):
        f = open(path_to_file)
        self._data = f.read()
        f.close()
        self.__filter_chars()
        self.__normalize()

    def __filter_chars(self):
        """
        Takes a string and returns a copy with all nonalphanumeric chars
        replaced by white space
        """
        pattern = re.compile('[\W_]+')
        self._data = pattern.sub(' ', self._data)

    def __normalize(self):
        """
        Takes a string and returns a copy with all characters in lower case
        """
        self._data = self._data.lower()

    def words(self):
        """
        Returns the list words in storage
        """
        data_str = ''.join(self._data)
        return data_str.split()

    def info(self):
        return self.__class__.__name__ + ": My major data structure is a " + self._data.__class__.__name__

class StopWordManager(TFExercise):
    """ Models the stop word filter """
    _stop_words = []
    def __init__(self):
        f = open('../stop_words.txt')
        self._stop_words = f.read().split(',')
        f.close()
        # add single-letter words
        self._stop_words.extend(list(string.ascii_lowercase))

    def is_stop_word(self, word):
        return word in self._stop_words

    def info(self):
        return self.__class__.__name__ + ": My major data structure is a " + self._stop_words.__class__.__name__

class WordFrequencyManager(TFExercise):
    """ Keeps the word frequency data """
    _word_freqs = {}

    def increment_count(self, word):
        if word in self._word_freqs:
            self._word_freqs[word] += 1
        else:
            self._word_freqs[word] = 1

    def sorted(self):
        return sorted(self._word_freqs.iteritems(), key=operator.itemgetter(1), reverse=True)

    def info(self):
        return self.__class__.__name__ + ": My major data structure is a " + self._word_freqs.__class__.__name__


class WordFrequencyController(TFExercise):
    def __init__(self, path_to_file):
        self._storage_manager = DataStorageManager(path_to_file)
        self._stop_word_manager = StopWordManager()
        self._word_freq_manager = WordFrequencyManager()

    def run(self):
        for w in self._storage_manager.words():
            if not self._stop_word_manager.is_stop_word(w):
                self._word_freq_manager.increment_count(w)

        word_freqs = self._word_freq_manager.sorted()
        for tf in word_freqs[0:25]:
            print tf[0], ' - ', tf[1]

#
# The main function
#
WordFrequencyController(sys.argv[1]).run()
```

```
import sys, re, operator, string
from abc import ABCMeta

#
# The classes
```

```
class TFExercise():
```

```
    def info(self):
                                            + ": No major data
          structure"
```

```
class DataStorageManager(TFExercise):
```

```
    _data = ''
    def __init__(self, path_to_file):
        f = open(path_to_file)
        self._data = f.read()
        f.close()
        self.__filter_chars()
        self.__normalize()

    def __filter_chars(self):
        """
        Takes a string and returns a copy with all nonalphanumeric
            chars
        replaced by white space
        """
        pattern = re.compile('[\W_]+')
        self._data = pattern.sub(' ', self._data)

    def __normalize(self):
        """
        Takes a string and returns a copy with all characters in
            lower case
        """
        self._data = self._data.lower()
```

```
    def words(self):
```

```
        Returns the list words in storage
        """
        data_str = ''.join(self._data)
```

```
    def info(self):
```

```
        return self.__class__.__name__ + ": My major data
```

```
class StopWordManager(TFExercise):
```

```
    """ Models the stop word filter """
    _stop_words = []
    def __init__(self):
        f = open('../stop_words.txt')
        self._stop_words = f.read().split(',')
        f.close()
        # add single-letter words
```

```
    def is_stop_word(self, word):
```

```
        return word in self._stop_words
```

```
    def info(self):
```

```
                                        + ": My major data
          structure is a " + self._stop_words.__class__.__name__
```

```
class WordFreqManager(TFExercise):
```

```
    def inc_count(self, word):
```

```
            self._word_freqs[word] += 1
        else:
```

```
    def sorted(self):
```

```
                                       ritems(), key=operator.
          itemgetter(1), reverse=True)
```

```
    def info(self):
```

```
                                        + ": My major data
          structure is a " + self._word_freqs.__class__.__name__
```

```
class WordFreqController(TFExercise):
```

```
    def __init__(self, path_to_file):
        self._storage_manager = DataStorageManager(path_to_file)
        self._stop_word_manager = StopWordManager()
        self._word_freq_manager = WordFrequencyManager()
```

```
    def run(self):
```

```
                                      r.words():
                                   manager.is_stop_word(w):
                self._word_freq_manager.increment_count(w)

        word_freqs = self._word_freq_manager.sorted()
        for tf in word_freqs[0:25]:
            print tf[0], ' - ', tf[1]
```

```
# Main
WordFreqController(sys.argv[1]).run()
```

Style #6 Main Characteristics

- ▻ Things, things and more things!
- ▻ Capsules of data and procedures
- ▻ Data is never accessed directly
- ▻ Capsules say "I do the same things as that one, and more!"

Style #6 Main Characteristics

- Things, things and more things!
- Capsules of data and procedures
- Data is never accessed directly
- Capsules say “I do the same things as that one, and more!”

Kingdom of Nouns Style

@cristalopes #style6 *name*

@cristalopes #style7 *name*

STYLE #7

```python
import sys, re, operator, string

class DataStorageManager():
    """ Models the contents of the file """
    _data = ''

    def dispatch(self, message):
        if message[0] == 'init':
            return self._init(message[1])
        elif message[0] == 'words':
            return self._words()
        else:
            raise Exception("Message not understood " + message[0])

    def _init(self, path_to_file):
        f = open(path_to_file)
        self._data = f.read()
        f.close()
        pattern = re.compile('[\W_]+')
        self._data = pattern.sub(' ', self._data).lower()

    def _words(self):
        """
        Returns the list words in storage
        """
        data_str = ''.join(self._data)
        return data_str.split()


class StopWordManager():
    """ Models the stop word filter """
    _stop_words = []

    def dispatch(self, message):
        if message[0] == 'init':
            return self._init()
        elif message[0] == 'is_stop_word':
            return self._is_stop_word(message[1])
        else:
            raise Exception("Message not understood " + message[0])

    def _init(self):
        f = open('../stop_words.txt')
        self._stop_words = f.read().split(',')
        f.close()
        self._stop_words.extend(list(string.ascii_lowercase))

    def _is_stop_word(self, word):
        return word in self._stop_words

class WordFrequencyManager():
    """ Keeps the word frequency data """
    _word_freqs = {}

    def dispatch(self, message):
        if message[0] == 'increment_count':
            return self._increment_count(message[1])
        elif message[0] == 'sorted':
            return self._sorted()
        else:
            raise Exception("Message not understood " + message[0])

    def _increment_count(self, word):
        if word in self._word_freqs:
            self._word_freqs[word] += 1
        else:
            self._word_freqs[word] = 1

    def _sorted(self):
        return sorted(self._word_freqs.iteritems(), key=operator.itemgetter(1), reverse=True)

class WordFrequencyController():

    def dispatch(self, message):
        if message[0] == 'init':
            return self._init(message[1])
        elif message[0] == 'run':
            return self._run()
        else:
            raise Exception("Message not understood " + message[0])

    def _init(self, path_to_file):
        self._storage_manager = DataStorageManager()
        self._stop_word_manager = StopWordManager()
        self._word_freq_manager = WordFrequencyManager()
        self._storage_manager.dispatch(['init', path_to_file])
        self._stop_word_manager.dispatch(['init'])

    def _run(self):
        for w in self._storage_manager.dispatch(['words']):
            if not self._stop_word_manager.dispatch(['is_stop_word', w]):
                self._word_freq_manager.dispatch(['increment_count', w])

        word_freqs = self._word_freq_manager.dispatch(['sorted'])
        for tf in word_freqs[0:25]:
            print tf[0], ' - ', tf[1]

#
# The main function
#
wfcontroller = WordFrequencyController()
wfcontroller.dispatch(['init', sys.argv[1]])
wfcontroller.dispatch(['run'])
```

```
import sys, re, operator, string
class DataStorageManager():
    def dispatch(self, message):
        if message[0] == 'init':
            return self._init(message[1])
        elif message[0] == 'words':
            return self._words()
        else:
            raise Exception("Message not understood " + message
                [0])

    def _init(self, path_to_file):
        f = open(path_to_file)
        self._data = f.read()
        f.close()
        pattern = re.compile('[\W_]+')
        self._data = pattern.sub(' ', self._data).lower()

    def _words(self):
        """
        Returns the list words in storage
        """
        data_str = ''.join(self._data)
        return data_str.split()

class StopWordManager():
    def dispatch(self, message):
        if message[0] == 'init':
            return self._init()
        elif message[0] == 'is_stop_word':
            return self._is_stop_word(message[1])
        else:
            raise Exception("Message not understood " + message
                [0])

    def _init(self):
        f = open('../stop_words.txt')
        self._stop_words = f.read().split(',')
        f.close()
        self._stop_words.extend(list(string.ascii_lowercase))

    def _is_stop_word(self, word):
        return word in self._stop_words
class WordFrequencyManager():
```

```
        _word_freqs = {}
    def dispatch(self, message):
            return self._increment_count(message[1])
        elif message[0] == 'sorted':
            return self._sorted()
        else:
            raise Exception("Message not understood " + message
                [0])

    def _increment_count(self, word):
        if word in self._word_freqs:
            self._word_freqs[word] += 1
        else:
            self._word_freqs[word] = 1

    def _sorted(self):
        return sorted(self._word_freqs.iteritems(), key=operator.
            itemgetter(1), reverse=True)
class WordFrequencyController():
    def dispatch(self, message):
            return self._init(message[1])
        elif message[0] == 'run':
            return self._run()
        else:
            raise Exception("Message not understood " + message
                [0])

    def _init(self, path_to_file):
        self._storage_manager = DataStorageManager()
        self._stop_word_manager = StopWordManager()
        self._word_freq_manager = WordFrequencyManager()
        self._storage_manager.dispatch(['init', path_to_file])
        self._stop_word_manager.dispatch(['init'])

    def _run(self):
        for w in self._storage_manager.dispatch(['words']):
            if not self._stop_word_manager.dispatch(['is_stop_word
                ', w]):
                self._word_freq_manager.dispatch(['increment_count
                    ', w])

        word_freqs = self._word_freq_manager.dispatch(['sorted'])
```

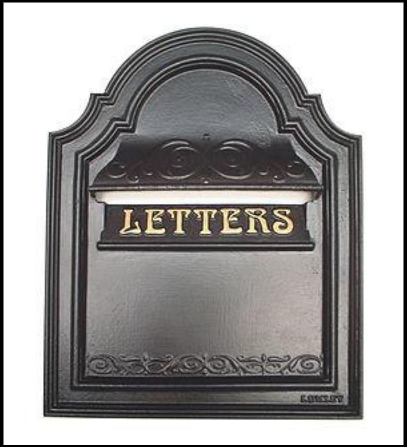
```
# Main
wfcntrl = WordFrequencyController()
wfcntrl.dispatch(['init',sys.argv[1]])
wfcntrl.dispatch(['run'])
```

Style #7 Main Characteristics

- (Similar to #6)
- Capsules receive messages via single receiving procedure

Style #7 Main Characteristics

- (Similar to #6)
- Capsules receive messages via single receiving procedure



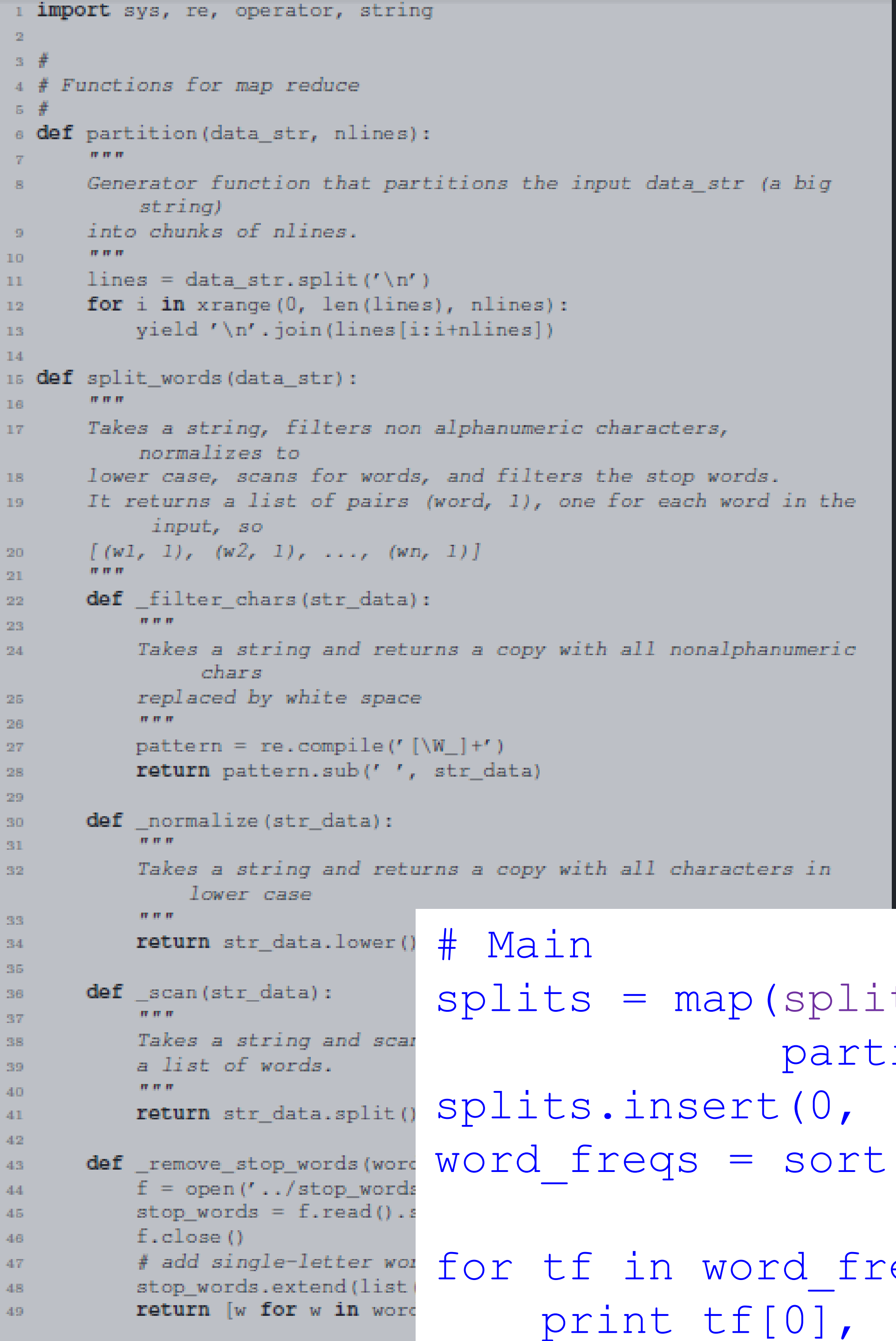
Letterbox Style

@cristalopes #style7 *name*

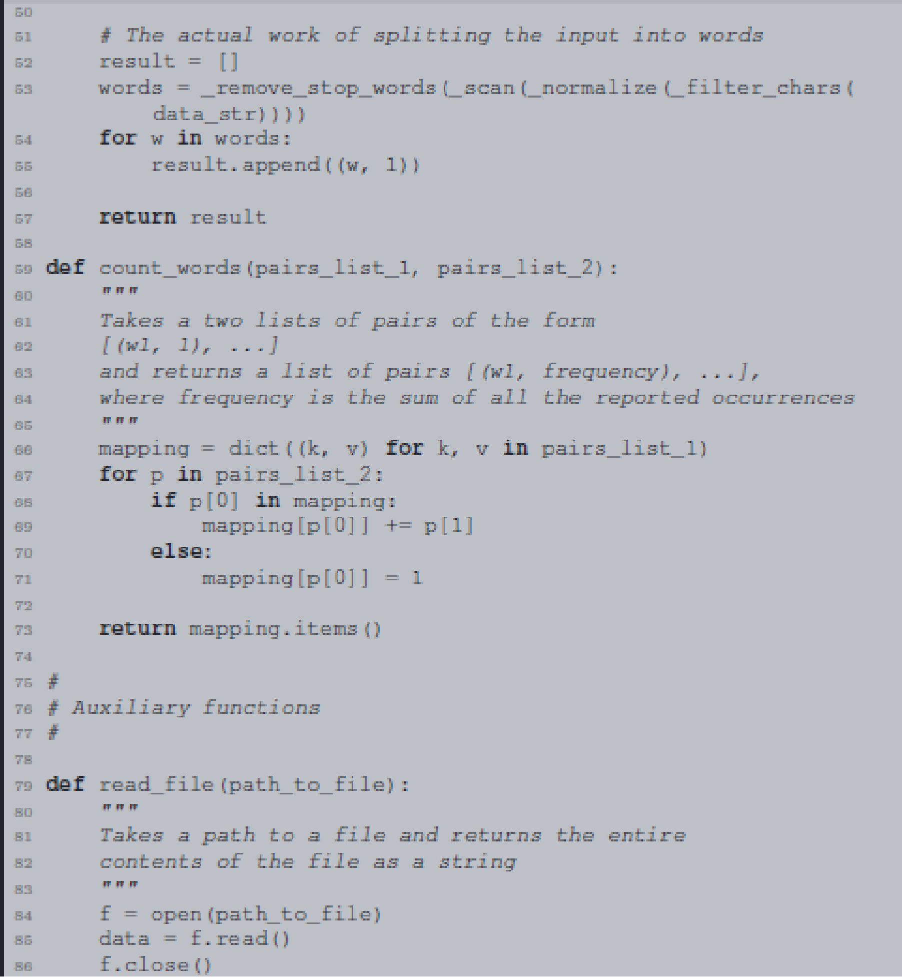
@cristalopes #style8 *name*

STYLE #8

```python
import sys, re, operator, string

#
# Functions for map reduce
#
def partition(data_str, nlines):
    """
    Generator function that partitions the input data_str (a big string)
    into chunks of nlines.
    """
    lines = data_str.split('\n')
    for i in xrange(0, len(lines), nlines):
        yield '\n'.join(lines[i:i+nlines])

def split_words(data_str):
    """
    Takes a string, filters non alphanumeric characters, normalizes to
    lower case, scans for words, and filters the stop words.
    It returns a list of pairs (word, 1), one for each word in the input, so
    [(w1, 1), (w2, 1), ..., (wn, 1)]
    """
    def _filter_chars(str_data):
        """
        Takes a string and returns a copy with all nonalphanumeric chars
        replaced by white space
        """
        pattern = re.compile('[\W_]+')
        return pattern.sub(' ', str_data)

    def _normalize(str_data):
        """
        Takes a string and returns a copy with all characters in lower case
        """
        return str_data.lower()

    def _scan(str_data):
        """
        Takes a string and scans for words, returning
        a list of words.
        """
        return str_data.split()

    def _remove_stop_words(word_list):
        f = open('../stop_words.txt')
        stop_words = f.read().split(',')
        f.close()
        # add single-letter words
        stop_words.extend(list(string.ascii_lowercase))
        return [w for w in word_list if not w in stop_words]

    # The actual work of splitting the input into words
    result = []
    words = _remove_stop_words(_scan(_normalize(_filter_chars(data_str))))
    for w in words:
        result.append((w, 1))

    return result

def count_words(pairs_list_1, pairs_list_2):
    """
    Takes a two lists of pairs of the form
    [(w1, 1), ...]
    and returns a list of pairs [(w1, frequency), ...],
    where frequency is the sum of all the reported occurrences
    """
    mapping = dict((k, v) for k, v in pairs_list_1)
    for p in pairs_list_2:
        if p[0] in mapping:
            mapping[p[0]] += p[1]
        else:
            mapping[p[0]] = 1

    return mapping.items()

#
# Auxiliary functions
#

def read_file(path_to_file):
    """
    Takes a path to a file and returns the entire
    contents of the file as a string
    """
    f = open(path_to_file)
    data = f.read()
    f.close()
    return data

def sort(word_freq):
    """
    Takes a collection of words and their frequencies
    and returns a collection of pairs where the entries are
    sorted by frequency
    """
    return sorted(word_freq, key=operator.itemgetter(1), reverse=True)


#
# The main function
#
splits = map(split_words, partition(read_file(sys.argv[1]), 200))
splits.insert(0, []) # Normalize input to reduce
word_freqs = sort(reduce(count_words, splits))
```



```
import sys, re, operator, string

#
# Functions for map reduce
#
def partition(data_str, nlines):
    """
    Generator function that partitions the input data_str (a big
        string)
    into chunks of nlines.
    """
    lines = data_str.split('\n')
    for i in xrange(0, len(lines), nlines):
        yield '\n'.join(lines[i:i+nlines])

def split_words(data_str):
    """
    Takes a string, filters non alphanumeric characters,
        normalizes to
    lower case, scans for words, and filters the stop words.
    It returns a list of pairs (word, 1), one for each word in the
        input, so
    [(w1, 1), (w2, 1), ..., (wn, 1)]
    """
    def _filter_chars(str_data):
        """
        Takes a string and returns a copy with all nonalphanumeric
            chars
        replaced by white space
        """
        pattern = re.compile('[\W_]+')
        return pattern.sub(' ', str_data)

    def _normalize(str_data):
        """
        Takes a string and returns a copy with all characters in
            lower case
        """
        return str_data.lower()

    def _scan(str_data):
        """
        Takes a string and scar
        a list of words.
        """
        return str_data.split()

    def _remove_stop_words(word
        f = open('../stop_words
        stop_words = f.read().s
        f.close()
        # add single-letter wor
        stop_words.extend(list(
        return [w for w in word
```



```

    # The actual work of splitting the input into words
    result = []
    words = _remove_stop_words(_scan(_normalize(_filter_chars(
        data_str))))
    for w in words:
        result.append((w, 1))

    return result

def count_words(pairs_list_1, pairs_list_2):
    """
    Takes a two lists of pairs of the form
    [(w1, 1), ...]
    and returns a list of pairs [(w1, frequency), ...],
    where frequency is the sum of all the reported occurrences
    """
    mapping = dict((k, v) for k, v in pairs_list_1)
    for p in pairs_list_2:
        if p[0] in mapping:
            mapping[p[0]] += p[1]
        else:
            mapping[p[0]] = 1

    return mapping.items()

#
# Auxiliary functions
#

def read_file(path_to_file):
    """
    Takes a path to a file and returns the entire
    contents of the file as a string
    """
    f = open(path_to_file)
    data = f.read()
    f.close()
```

```
# Main
splits = map(split_words,
             partition(read_file(sys.argv[1]), 200))
splits.insert(0, [])
word_freqs = sort(reduce(count_words, splits))

for tf in word_freqs[0:25]:
    print tf[0], ' - ', tf[1]
```

```python
import sys, re, operator, string

#
# Functions for map reduce
#
def partition(data_str, nlines):
    """
    Generator function that partitions the input data_str (a big
        string)
    into chunks of nlines.
    """
    lines = data_str.split('\n')
    for i in xrange(0, len(lines), nlines):
        yield '\n'.join(lines[i:i+nlines])
```

```python

    # The actual work of splitting the input into words
    result = []
    words = _remove_stop_words(_scan(_normalize(_filter_chars(
        data_str))))
    for w in words:
        result.append((w, 1))

    return result

def count_words(pairs_list_1, pairs_list_2):
    """
    Takes a two lists of pairs of the form
    [(w1, 1), ...]
```

```python
def split_words(data_str)
    """
    Takes a string (many lines), filters, normalizes to
    lower case, scans for words, and filters the stop words.
    Returns a list of pairs (word, 1), so
    [(w1, 1), (w2, 1), ..., (wn, 1)]
    """

    ...
    result = []
    words = _rem_stop_words(_scan(_normalize(_filter(data_str))))
    for w in words:
        result.append((w, 1))
    return result
```

```python
        a list of words.
        """
        return str_data.split()

    def _remove_stop_words(word_list):
        f = open('../stop_words.txt')
        stop_words = f.read().split(',')
        f.close()
        # add single-letter words
        stop_words.extend(list(string.ascii_lowercase))
        return [w for w in word_list if not w in stop_words]
```

```python
    sorted by frequency
    """
    return sorted(word_freq, key=operator.itemgetter(1), reverse=
        True)


#
# The main function
#
splits = map(split_words, partition(read_file(sys.argv[1]), 200))
splits.insert(0, []) # Normalize input to reduce
word_freqs = sort(reduce(count_words, splits))
```

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    """
    Takes a strin
        normalize
    lower case,
    It returns a
      input,
    [(w1, 1), (w
    """
    def _filter_
        """
        Takes a
            char
        replaced
        """
        pattern =
        return pa

    def _normaliz
        """
        Takes a
            lowe
        """
        return st

    def _scan(str
        """
        Takes a
        a list of words.
        """
        return str_data.split()

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    for w in words:
        result.append((w, 1))

    return result
```

```python
def count_words(pairs_list_1, pairs_list_2)
    """
    Takes two lists of pairs of the form
    [(w1, 1), ...]
    and returns a list of pairs [(w1, frequency), ...],
    where frequency is the sum of all occurrences
    """
    mapping = dict((k, v) for k, v in pairs_list_1)
    for p in pairs_list_2:
        if p[0] in mapping:
            mapping[p[0]] += p[1]
        else:
            mapping[p[0]] = 1

    return mapping.items()
```

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    return sorted(word_freq, key=operator.itemgetter(1), reverse=
        True)


#
# The main function
#
splits = map(split_words, partition(read_file(sys.argv[1]), 200))
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Style #8 Main Characteristics

- Two key abstractions: map(f, chunks) and reduce(g, results)

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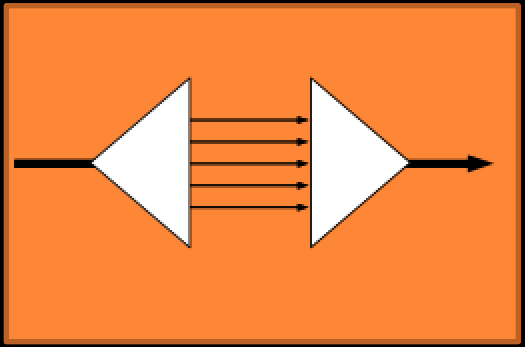


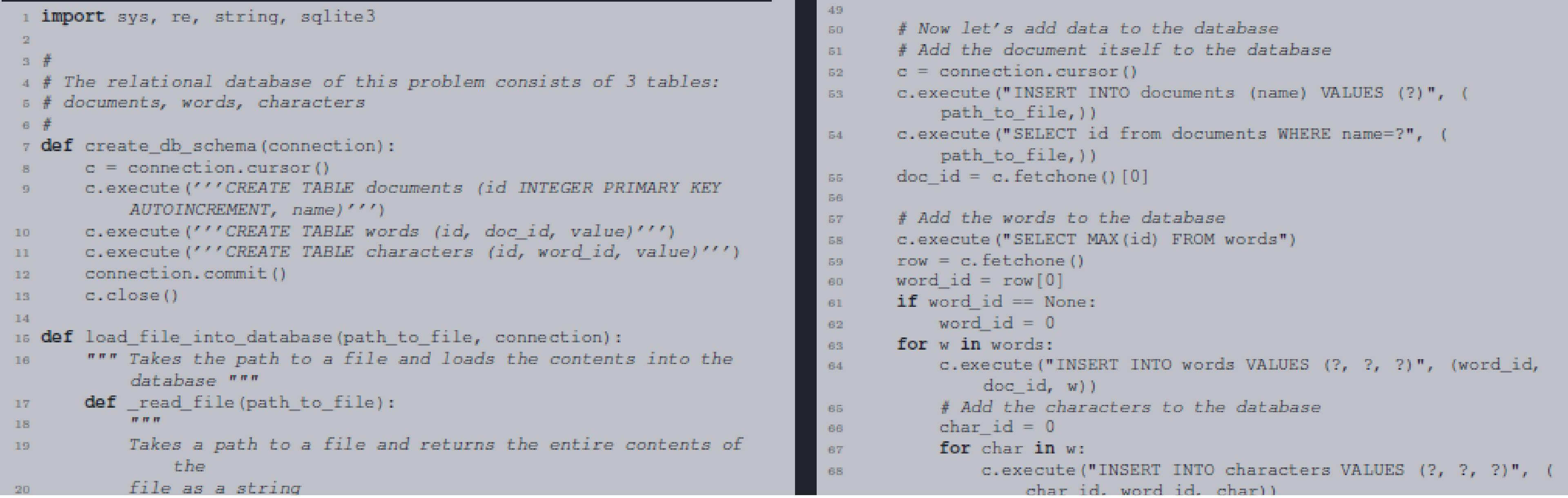
iMux Style

@cristalopes #style8 *name*

@cristalopes #style9 *name*

STYLE #9

```python
import sys, re, string, sqlite3

#
# The relational database of this problem consists of 3 tables:
# documents, words, characters
#
def create_db_schema(connection):
    c = connection.cursor()
    c.execute('''CREATE TABLE documents (id INTEGER PRIMARY KEY AUTOINCREMENT, name)''')
    c.execute('''CREATE TABLE words (id, doc_id, value)''')
    c.execute('''CREATE TABLE characters (id, word_id, value)''')
    connection.commit()
    c.close()

def load_file_into_database(path_to_file, connection):
    """ Takes the path to a file and loads the contents into the database """
    def _read_file(path_to_file):
        """
        Takes a path to a file and returns the entire contents of the
        file as a string
        """
        f = open(path_to_file)
        data = f.read()
        f.close()
        return data

    def _filter_chars_and_normalize(str_data):
        """
        Takes a string and returns a copy with all nonalphanumeric chars
        replaced by white space, and all characters lower-cased
        """
        pattern = re.compile('[\W_]+')
        return pattern.sub(' ', str_data).lower()

    def _scan(str_data):
        """ Takes a string and scans for words, returning a list of words. """
        return str_data.split()

    def _remove_stop_words(word_list):
        f = open('../stop_words.txt')
        stop_words = f.read().split(',')
        f.close()
        # add single-letter words
        stop_words.extend(list(string.ascii_lowercase))
        return [w for w in word_list if not w in stop_words]

    # The actual work of splitting the input into words
    words = _remove_stop_words(_scan(_filter_chars_and_normalize(_read_file(path_to_file))))

    # Now let's add data to the database
    # Add the document itself to the database
    c = connection.cursor()
    c.execute("INSERT INTO documents (name) VALUES (?)", (path_to_file,))
    c.execute("SELECT id from documents WHERE name=?", (path_to_file,))
    doc_id = c.fetchone()[0]

    # Add the words to the database
    c.execute("SELECT MAX(id) FROM words")
    row = c.fetchone()
    word_id = row[0]
    if word_id == None:
        word_id = 0
    for w in words:
        c.execute("INSERT INTO words VALUES (?, ?, ?)", (word_id, doc_id, w))
        # Add the characters to the database
        char_id = 0
        for char in w:
            c.execute("INSERT INTO characters VALUES (?, ?, ?)", (char_id, word_id, char))
            char_id += 1
        word_id += 1
    connection.commit()
    c.close()

#
# The main function
#
connection = sqlite3.connect(':memory:')
create_db_schema(connection)
load_file_into_database(sys.argv[1], connection)

# Now, let's query
c = connection.cursor()
c.execute("SELECT value, COUNT(*) as C FROM words GROUP BY value ORDER BY C DESC")
for i in range(25):
    row = c.fetchone()
    if row != None:
        print row[0] + ' - ' + str(row[1])

connection.close()
```



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    c.execute("SELECT id from documents WHERE name=?", (
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    doc_id = c.fetchone()[0]

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    c.execute("SELECT MAX(id) FROM words")
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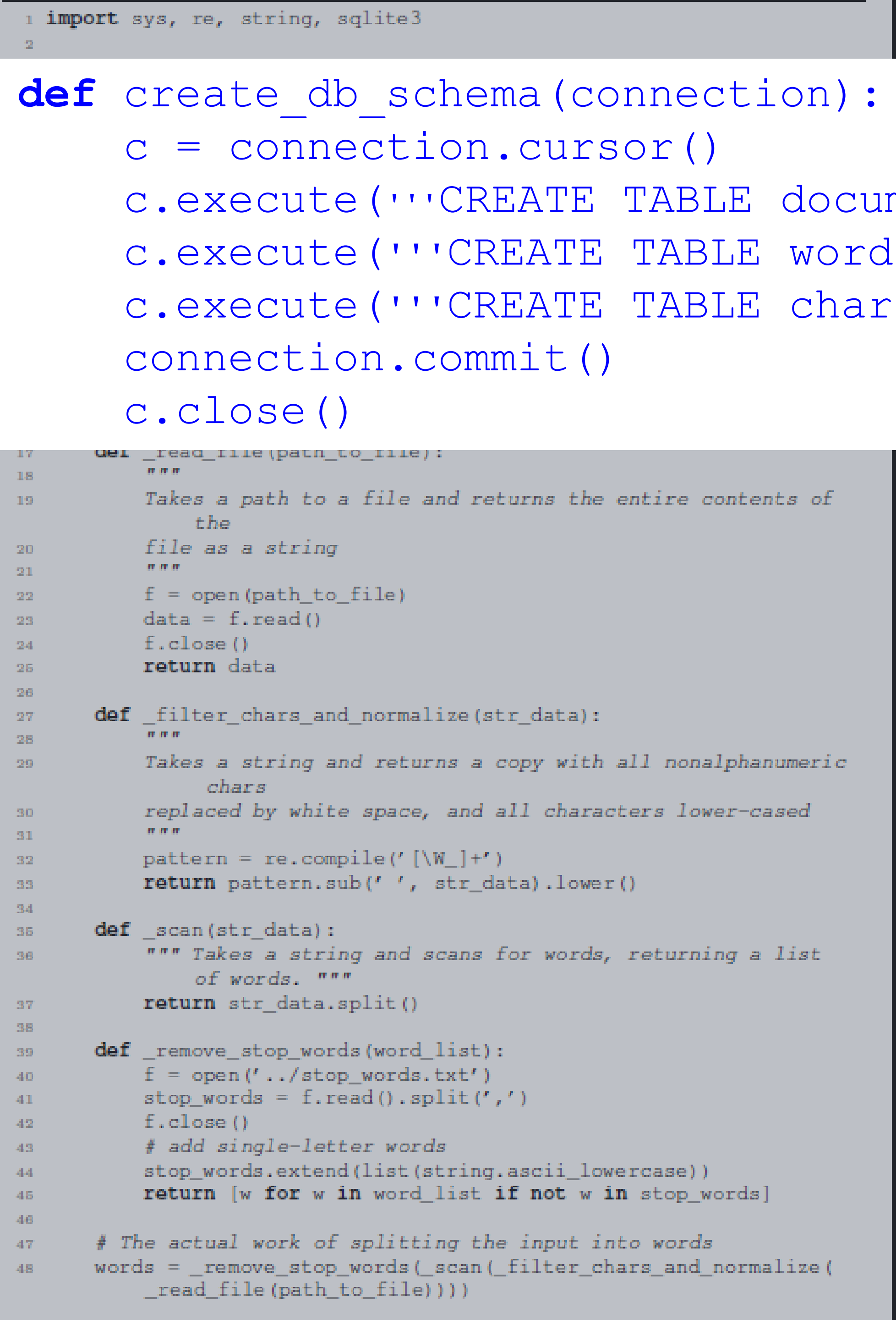
```



```
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    def _read_file(path_to_file):
        """
        Takes a path to a file and returns the entire contents of
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        f = open(path_to_file)
        data = f.read()
        f.close()
        return data

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    # The actual work of splitting the input into words
    words = _remove_stop_words(_scan(_filter_chars_and_normalize(
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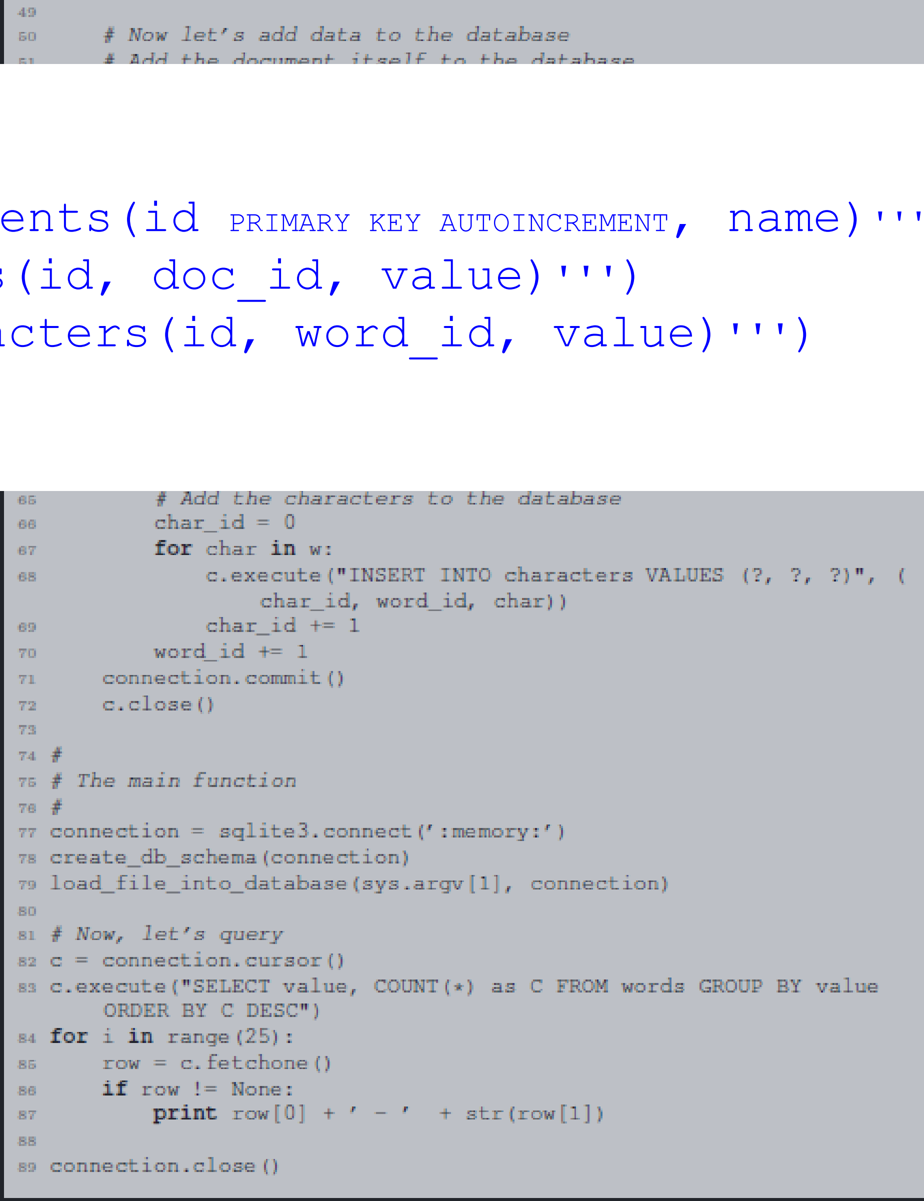
```



```
    # Now let's add data to the database
    # Add the document itself to the database

        # Add the characters to the database
        char_id = 0
        for char in w:
            c.execute("INSERT INTO characters VALUES (?, ?, ?)", (
                char_id, word_id, char))
            char_id += 1
        word_id += 1
    connection.commit()
    c.close()

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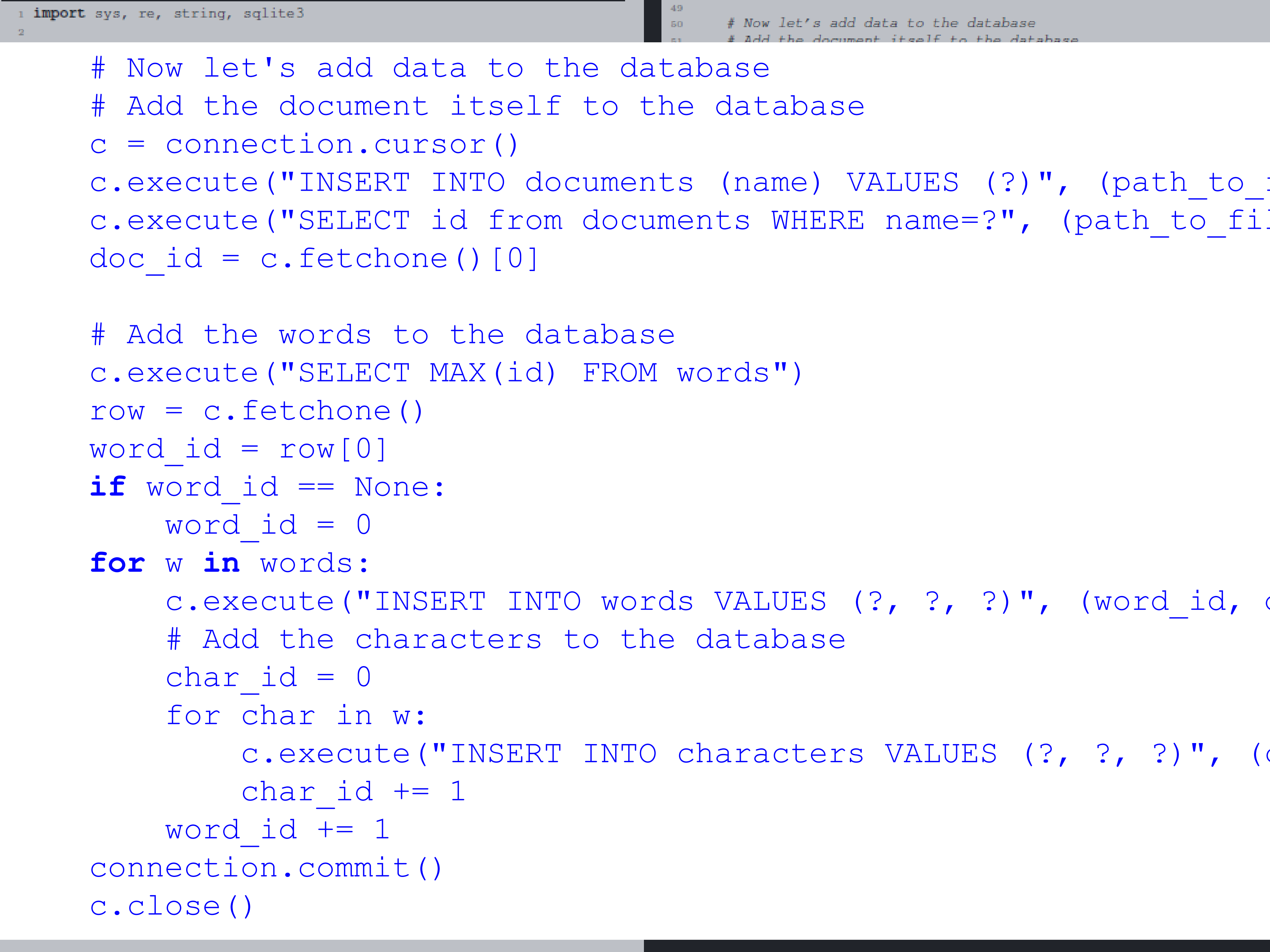

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    connection.commit()
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Style #9 Main Characteristics

- ▻ Entities and relations between them
- ▻ Query engine
  - Declarative queries

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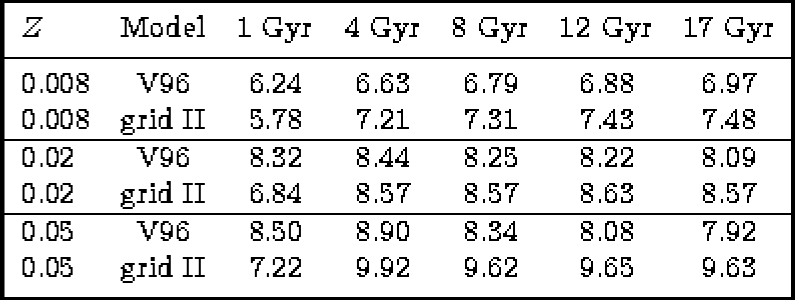
  - Declarative queries



Z	Model	1 Gyr	4 Gyr	8 Gyr	12 Gyr	17 Gyr
0.008	V96	6.24	6.63	6.79	6.88	6.97
0.008	grid II	5.78	7.21	7.31	7.43	7.48
0.02	V96	8.32	8.44	8.25	8.22	8.09
0.02	grid II	6.84	8.57	8.57	8.63	8.57
0.05	V96	8.50	8.90	8.34	8.08	7.92
0.05	grid II	7.22	9.92	9.62	9.65	9.63

Tabular Style

@cristalopes #style9 *name*

Exercises in Programming Style*

@cristalopes

*in bookstores Spring 14