
impracticalpythonprojects

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MODULE REFERENCE

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A horizontal bar with a dark grey left section containing the word 'build' and a green right section containing the word 'passing'.A horizontal bar with a dark grey left section containing the word 'coverage' and an orange right section containing the text '84%'.

Example implementations of the practice and challenge projects in [Impractical Python Projects](#). Alternative answers to practice projects and supporting files can be found at the [official GitHub page](#).

It's a fantastic intermediate level book that has truly impractical (but fun) projects. It's a great way to get tricked into learning new conventions, techniques, and modules.

My original [python-tutorials](#) repository is already very nested, so these will be easier to find and review here; however, the original repository still has relevant information about configuring a Python environment/IDE.

Bonus content includes Google style docstrings (such wow), main functions (so standard), pip requirements files (so helpful), and test files (**not** punny at all).

1.1 src package

1.1.1 Subpackages

src.ch01 package

Subpackages

src.ch01.challenge package

Submodules

src.ch01.challenge.c1_foreign_bar_chart module

Return letter 'bar chart' of a non-English sentence.

`src.ch01.challenge.c1_foreign_bar_chart.add_keys_to_dict(dictionary: dict) → dict`
Add keys to dictionary.

Check keys of a letter dictionary and add missing letters.

Parameters `dictionary` (*dict*) – Dictionary to check keys of.

Returns Dictionary with `string.ascii_lowercase` as keys.

Raises `TypeError` – If `dictionary` is not a `dict`.

`src.ch01.challenge.c1_foreign_bar_chart.foreign_freq_analysis(sentence: str) → dict`

Wrap `freq_analysis` and `add_keys_to_dict`.

Passes given sentence through `freq_analysis()` then `add_keys_to_dict()` to fill in missing keys.

Parameters `sentence` (*str*) – String to count letters of.

Returns Dictionary with `string.ascii_lowercase` as keys and a `list` with letters repeated based on their frequency as values.

`src.ch01.challenge.c1_foreign_bar_chart.main()`
Demonstrates the Foreign Bar Chart.

src.ch01.challenge.c2_name_generator module

Generate pseudo-random names from a list of names.

`src.ch01.challenge.c2_name_generator.add_name_to_key` (*name: str, dictionary: dict, key: str*) → None

Add name to key in dictionary.

Add **name** to **dictionary** under **key** if not already present.

Parameters

- **name** (*str*) – Name to add to **dictionary**.
- **key** (*str*) – Key to add **name** under.
- **dictionary** (*dict*) – Dictionary to add **name** to.

Returns None. **name** is added under **key** if not present, **dictionary** is unchanged otherwise.

Raises **TypeError** – If **name** and **key** aren't *str* or if **dictionary** isn't a *dict*.

`src.ch01.challenge.c2_name_generator.build_name_list` (*folderpath: str*) → list

Build name list from folder.

Builds list of names from name files in given folder.

Parameters **folderpath** (*str*) – Path to folder with name files.

Returns List with names from **folderpath**.

Raises **IndexError** – If **folderpath** has no *.txt* files.

`src.ch01.challenge.c2_name_generator.generate_name` (*name_dict: dict*) → str

Generate pseudo-random name.

Use names in dictionary to generate a random name.

Parameters **name_dict** – Dictionary from *split_names()*.

Returns String with a random name.

Raises **KeyError** – If there aren't three keys in the dictionary.

Note: Only add middle name between 1/3 and 1/4 of the time.

`src.ch01.challenge.c2_name_generator.main()`

Demonstrate name generator.

`src.ch01.challenge.c2_name_generator.name_generator` (*folderpath: str*) → str

Wrap `generate_name`, `split_names`, and `build_name_list`.

Passes given **folderpath** through *build_name_list()* to get the names in a *list*, then *split_names()* to split them into a *dict*, and finally through *generate_name()* to make the actual name.

Parameters **folderpath** (*str*) – Path to folder with name files.

Returns String with pseudo-random name.

`src.ch01.challenge.c2_name_generator.read_from_file` (*filepath: str*) → list

Read from file.

Reads lines from text file and returns a *list*.

Parameters **filepath** (*str*) – Path to file with names.

Returns List with each line from the file as an element.

Note: Removes trailing whitespaces.

`src.ch01.challenge.c2_name_generator.split_names(name_list: list) → dict`

Split names from list of names.

Splits first, middle, and last names from a given list of names.

Parameters `name_list` (*list*) – List with names as elements.

Returns Dictionary of lists with `first`, `middle`, and `last` as keys and names as values.

Raises

- **TypeError** – If given name list is not a `list` or `tuple`.
- **ValueError** – If given name list is empty.

Note: Drops suffix and adds nickname to middle names.

Module contents

Chapter 1 Challenge Projects.

`src.ch01.challenge.ADD_KEYS_ERROR`

String with `TypeError` for `add_keys_to_dict()`.

Type `str`

`src.ch01.challenge.SPLIT_NAME_LIST_ERROR`

String with `TypeError` for `split_names()`.

Type `str`

`src.ch01.challenge.SPLIT_NAME_EMPTY_ERROR`

String with `ValueError` for `split_names()`.

Type `str`

`src.ch01.challenge.ADD_NAME_TO_KEY_ERROR`

String with `TypeError` for `add_name_to_key()`.

Type `str`

`src.ch01.challenge.GENERATE_NAME_ERROR`

String with `KeyError` for `generate_name()`.

Type `str`

`src.ch01.challenge.BUILD_LIST_ERROR`

String with `IndexError` for `build_name_list()`.

Type `str`

src.ch01.practice package

Submodules

src.ch01.practice.p1_pig_latin module

Takes a word as input and returns its Pig Latin equivalent.

`src.ch01.practice.p1_pig_latin.encode(word: str) → str`
Check if word starts with vowel, then translate to Pig Latin.

If a word begins with a consonant, move the consonant to the end of the word and add 'ay' to the end of the new word. If a word begins with a vowel in `VOWELS`, add 'way' to the end of the word.

Parameters `word` (`str`) – Word to encode to Pig Latin.

Returns Encoded Pig Latin word.

Raises `TypeError` – If `word` is not a string.

`src.ch01.practice.p1_pig_latin.main()`
Demonstrate Pig Latin encoder.

src.ch01.practice.p2_poor_bar_chart module

Takes a sentence as input and returns a 'bar chart' of each letter.

`src.ch01.practice.p2_poor_bar_chart.freq_analysis(sentence: str) → dict`
Perform frequency analysis of letters in sentence.

Iterate through each letter in the sentence and add it to a dictionary of lists using `collections.defaultdict`.

Parameters `sentence` (`str`) – String to count letters of.

Returns `defaultdict` with each letter as keys and a `list` with letters repeated based on their frequency as values.

Example

```
>>> from src.ch01.practice.p2_poor_bar_chart import freq_analysis
>>> test = 'aaabbbccc'
>>> freq_analysis(test)
defaultdict(<class 'list'>, {'a': ['a', 'a', 'a'],
                             'b': ['b', 'b', 'b'],
                             'c': ['c', 'c', 'c']})
```

Raises `TypeError` – If `sentence` is not a string.

`src.ch01.practice.p2_poor_bar_chart.main()`
Demonstrates the Poor Bar Chart.

`src.ch01.practice.p2_poor_bar_chart.print_bar_chart(freq_dict: dict) → None`
Print dictionary to terminal.

Use `pprint.pprint()` to print dictionary with letter frequency analysis to terminal.

Parameters `freq_dict` (*dict*) – Dictionary with frequency analysis from `freq_analysis()`.

Returns `None`. If recursive, prints a recursive-safe string, otherwise prints the dictionary.

Raises `TypeError` – If `freq_dict` is not a dictionary.

Module contents

Chapter 1 Practice Projects.

`src.ch01.practice.VOWELS`

Tuple containing characters of the English vowels (except for 'y')

Type `tuple`

`src.ch01.practice.ENCODE_ERROR`

String with `TypeError` for Pig Latin `encode()`.

Type `str`

`src.ch01.practice.FREQ_ANALYSIS_ERROR`

String with `TypeError` for Poor Bar Chart `freq_analysis()`.

Type `str`

`src.ch01.practice.PRINT_BAR_CHART_ERROR`

String with `TypeError` for Poor Bar Chart `print_bar_chart()`.

Type `str`

Module contents

Chapter 1.

src.ch02 package

Submodules

src.ch02.c1_recursive_palindrome module

Recursively determine if a word is a palindrome.

`src.ch02.c1_recursive_palindrome.main()`

Demonstrate the recursive palindrome tester.

`src.ch02.c1_recursive_palindrome.recursive_ispalindrome(word: str) → bool`

Recursively check if a word is a palindrome.

Parameters `word` (*str*) – String to check palindrome-ness.

Returns `True` if the word is a palindrome, `False` otherwise.

Raises `TypeError` – If `word` is not a string.

src.ch02.p1_cleanup_dictionary module

Cleanup word dictionary.

Various functions for cleaning up a word dictionary.

`src.ch02.p1_cleanup_dictionary.APPROVED_WORDS`

Words that should always appear in a word dictionary.

Type `list`

`src.ch02.p1_cleanup_dictionary.cleanup_dict(filepath: str) → list`

Wrap `read_from_file` and `cleanup_list`.

Passes given **filepath** through `read_from_file()` to get a list of words, then `cleanup_list()` to remove single letter words.

Parameters `filepath` (`str`) – String with path to word dictionary file.

Returns List with words as elements excluding single letter words.

`src.ch02.p1_cleanup_dictionary.cleanup_list(word_list: list) → list`

Cleanup word list.

Remove single letter words from a `list` of words.

Parameters `word_list` (`list`) – List with words as elements.

Returns List with words as elements excluding single letter words.

Raises `IndexError` – If `word_list` is empty.

`src.ch02.p1_cleanup_dictionary.cleanup_list_more(word_list: list) → list`

Cleanup word list even more.

First, remove words with apostrophes, double letter words, duplicates, and words with letters not in `string.ascii_lowercase` from a `list` of words. Then, add `APPROVED_WORDS` back into list. Finally, sort list.

Parameters `word_list` (`list`) – List with words as elements.

Returns Sorted list with words as elements excluding cleaned words and `APPROVED_WORDS` added.

Raises `IndexError` – If `word_list` is empty.

`src.ch02.p1_cleanup_dictionary.main()`

Demonstrate cleanup dictionary.

Module contents

Chapter 2.

`src.ch02.DICTIONARY_FILE_PATH`

String with path to Ubuntu 18.04.2's American English dictionary file.

Type `str`

`src.ch02.CLEANUP_LIST_ERROR`

String with `IndexError` for Cleanup Dictionary `cleanup_list()`.

Type `str`

`src.ch02.RECURSIVE_ISPALINDROME_ERROR`

String with `TypeError` for Recursive Palindrome `recursive_ispalindrome()`.

Type `str`

src.ch03 package

Submodules

src.ch03.c1_anagram_generator module

Generate phrase anagrams from a word or phrase.

`src.ch03.c1_anagram_generator.anagram_generator(word: str) → list`

Generate phrase anagrams.

Make phrase anagrams from a given word or phrase.

Parameters `word` (`str`) – Word to get phrase anagrams of.

Returns `list` of phrase anagrams of `word`.

`src.ch03.c1_anagram_generator.extend_anagram_dict(word_list: list, dictionary: dict)`

Extend an anagram dictionary.

Adds words from given word list to a given anagram dictionary.

Parameters

- `word_list` (`list`) – List of words to add to anagram dictionary.
- `dictionary` (`dict`) – Anagram dictionary to add words to.

Returns `None`. If words in `word_list` are in `dictionary` they are not added. Otherwise, they are added.

`src.ch03.c1_anagram_generator.find_anagram_phrases(phrases: list, word: str, anagram_dict: dict, phrase: list) → None`

Find anagram phrases.

Recursively finds anagram phrases of `word` by removing unusable words from the `anagram_dict`, finding remaining anagrams given the `phrase`, then adding any found anagram phrases to `phrases`.

Parameters

- `phrases` (`list`) – List of anagram phrases.
- `word` (`str`) – Current word to find anagram phrases of.
- `anagram_dict` (`dict`) – Current anagram dictionary to find anagrams with.
- `phrase` (`list`) – Current anagram phrase candidate.

Returns `None`. `phrases` is updated with any found anagram phrases.

`src.ch03.c1_anagram_generator.find_anagrams(word: str, anagram_dict: dict) → list`

Find anagrams in word.

Find all anagrams in a given word (or phrase) using anagram dictionary.

Parameters

- `word` (`str`) – Word to find anagrams of.

- **anagram_dict** – Dictionary from `get_anagram_dict()`.

Returns `list` of `str` with all anagrams in `word`.

`src.ch03.c1_anagram_generator.get_anagram_dict(word_list: list) → dict`
Get an anagram dictionary from `word_list`.

Get the ID of each word in `word list` and add it to a dictionary with the ID as the key.

Parameters `word_list (list)` – List of words to make into anagram dictionary.

Returns `defaultdict` of `list` with an ID (`int`) as the key and words whose product of letters equal that ID as values.

`src.ch03.c1_anagram_generator.get_id(word: str) → int`
Get ID number of word.

Assign a unique prime number to each letter in `ascii_lowercase`. The product of each letter in `word` is its ID number.

Parameters `word (str)` – Word to get ID of.

Returns `int` representing ID of `word`.

`src.ch03.c1_anagram_generator.get_primes(length: int = 26, min_prime: int = 2, max_prime: int = 101) → list`

Get list of primes.

Given a length, minimum, and maximum prime number, return a list of prime numbers.

Parameters

- **length** (`int`) – Number of prime numbers to return. Defaults to 26.
- **min_prime** (`int`) – Smallest prime number to return. Defaults to 2.
- **max_prime** (`int`) – Largest prime number to return. Defaults to 101.

Returns `list` of `length` prime numbers with `min_prime` as the smallest prime number and `max_prime` as the largest prime number in the list.

`src.ch03.c1_anagram_generator.main()`
Demonstrate the Anagram Generator.

`src.ch03.c1_anagram_generator.multi_get_anagram_dict(word_list: list) → dict`
Multithreaded get anagram dictionary.

Uses `os.cpu_count()` and `threading.Thread` to use all CPUs to make an anagram dictionary with the intent of being more efficient than `get_anagram_dict()`.

Parameters `word_list (list)` – List of words to make into anagram dictionary.

Returns `defaultdict` of `list` with an ID (`int`) as the key and words whose product of letters equal that ID as values.

Warning: Avoids race conditions by heavily relying on CPython's [Global Interpreter Lock](#). More info about [Thread Objects](#).

`src.ch03.c1_anagram_generator.remove_unusable_words(anagram_dict: dict, usable_letters: list) → dict`

Remove unusable words from anagram dictionary.

Creates new anagram dictionary by including only IDs that can be IN `usable_letters`.

Parameters

- **anagram_dict** (*dict*) – Anagram dictionary to prune.
- **usable_letters** (*list*) – List of letters that must be used.

Returns `defaultdict` of *list* with an ID (*int*) as the key and words whose product of letters equal that ID as values.

`src.ch03.c1_anagram_generator.split` (*a_list: list, parts: int*) → *list*
Split a list into parts.

Split given list into given number of parts.

Parameters

- **a_list** (*list*) – List to split.
- **parts** (*int*) – Number of parts to split list into.

Returns List of lists with **a_list** split into **parts**.

Example

```
>>> import src.ch03.c1_anagram_generator.split as split
>>> some_list = ['this', 'is', 'a', 'list']
>>> split_list = split(some_list, 2)
>>> print(split_list)
[['this', 'is'], ['a', 'list']]
```

src.ch03.p1_digram_counter module

Counts the occurrence of all possible digrams of a word in a dictionary.

`src.ch03.p1_digram_counter.count_digrams` (*digrams: set, dict_list: list*) → *dict*
Count digrams in word dictionary.

Count frequency of each digram in the set in a word dictionary list.

Parameters

- **digrams** (*set*) – Set of digrams to count frequency of.
- **dict_list** (*list*) – Word dictionary list.

Returns `Counter` with digrams as keys and their counts as values.

Raises `TypeError` – If **digrams** isn't a set or if **dict_list** isn't a list.

`src.ch03.p1_digram_counter.digram_counter` (*word: str, dict_file: str* = `"/usr/share/dict/american-english"`) → *dict*

Wrap `get_digrams`, `count_digrams`, and `read_from_file`.

Send **word** through `get_digrams()` to get a set of digrams which is then passed through `count_digrams()` along with the list made by passing **dict_file** through `read_from_file()`.

Parameters

- **word** (*str*) – Word to get digrams of.
- **dict_file** (*str*) – Path of dictionary file to get a frequency analysis of each digram. Defaults to `DICTIONARY_FILE_PATH`.

Returns `Counter` with digrams as keys and their counts as values.

```
src.ch03.pl_digram_counter.get_digrams(word: str) → set
```

Get a set of digrams given a word.

Generate all possible digrams of a given word.

Parameters `word` (*str*) – String to get digrams of.

Returns `set` of all possible digrams of the given word.

Raises `TypeError` – If `word` isn't a string.

```
src.ch03.pl_digram_counter.main()
```

Demonstrate the digram counter.

Module contents

Chapter 3.

```
src.ch03.GET_DIGRAMS_ERROR
```

String with `TypeError` for `get_digrams()`.

Type `str`

```
src.ch03.COUNT_DIGRAMS_ERROR
```

String with `TypeError` for `count_digrams()`.

Type `str`

src.ch04 package

Subpackages

src.ch04.practice package

Submodules

src.ch04.practice.p1_hack_lincoln module

Hack route cipher sent by Abraham Lincoln.

```
src.ch04.practice.p1_hack_lincoln.decode_route(keys: list, cipherlist: list) → list
```

Decode route cipher.

Decode `cipherlist` encoded with a route cipher using `keys`.

Parameters

- `keys` (*list*) – List of signed, integer keys.
- `cipherlist` (*list*) – List of strings representing encoded message.

Returns List of strings representing plaintext message.

Note: Assumes vertical encoding route.

`src.ch04.practice.p1_hack_lincoln.get_factors(integer: int) → list`
Get factors of integer.

Calculate factors of a given integer.

Parameters `integer` (*int*) – Number to get factors of.

Returns List of integer factors of `integer`.

`src.ch04.practice.p1_hack_lincoln.hack_route(ciphertext: str) → None`
Hack route cipher.

Hack route cipher by using `get_factors()` to find all possible key lengths. Then use `keygen()` to generate all possible keys and pass each one through `decode_route()`.

Parameters `ciphertext` (*str*) – Message encoded with route cipher.

Returns None. Prints all possible decoded messages.

`src.ch04.practice.p1_hack_lincoln.keygen(length: int) → list`
Generate all possible route cipher keys.

Generates a list of all possible route cipher keys of `length`.

Parameters `length` (*int*) – Length of route cipher key.

Returns List of lists of integers representing all possible route cipher keys of `length`.

Example

```
>>> from src.ch04.practice.p1_hack_lincoln import keygen
>>> keygen(2)
[[-1, 2], [1, -2], [1, 2], [-1, -2]]
```

`src.ch04.practice.p1_hack_lincoln.main()`
Demonstrate hack of Lincoln's route cipher.

src.ch04.practice.p2_identify_cipher module

Identify letter transposition or substitution cipher.

`src.ch04.practice.p2_identify_cipher.identify_cipher(ciphertext: str, threshold: float) → bool`

Identify letter transposition or substitution cipher.

Compare most frequent letters in `ciphertext` with the most frequent letters in the English alphabet. If above **threshold**, it is a letter transposition cipher. If not, it is a letter substitution cipher.

Parameters

- **ciphertext** (*str*) – Encrypted message to identify.
- **threshold** (*float*) – Percent match in decimal form.

Returns `True` if the `ciphertext` is a letter transposition cipher. `False` otherwise.

`src.ch04.practice.p2_identify_cipher.is_substitution(ciphertext: str) → bool`
Identify letter substitution cipher.

Wrapper for `identify_cipher()`. **threshold** defaults to 0.45.

Parameters `ciphertext` (*str*) – Encrypted message to identify.

Returns `True` if the `ciphertext` is a letter substitution cipher. `False` otherwise.

`src.ch04.practice.p2_identify_cipher.is_transposition(ciphertext: str) → bool`
Identify letter transposition cipher.

Wrapper for `identify_cipher()`. `threshold` defaults to `0.75`.

Parameters `ciphertext` (`str`) – Encrypted message to identify.

Returns `True` if the `ciphertext` is a letter transposition cipher. `False` otherwise.

`src.ch04.practice.p2_identify_cipher.main()`
Demonstrate the cipher identifier.

src.ch04.practice.p2_identify_cipher_deco module

Identify letter transposition or substitution cipher using decorator.

Note: Not part of the book, I was just curious about decorators and decided to tinker with them a bit.

`src.ch04.practice.p2_identify_cipher_deco.identify(threshold: float = 0.5)`
Make decorator for `identify_cipher`.

Decorator factory to replace a decorated function with `identify_cipher()`. A bit like going around the world to reach the teleporter across the street, but at import time instead of runtime, so it doesn't matter.

Luciano Ramalho's book *Fluent Python* appropriately calls decorators "syntactic sugar" when it isn't used in classes. It also references the `wrapt` module's [blog on GitHub](#) for a deeper explanation of decorators.

Not sure what a decorator factory would be called... syntactic caramel?

Parameters `threshold` (`float`) – Percent match in decimal form.

Returns Whatever the output of `identify_cipher()` would be given the decorated function's input.

`src.ch04.practice.p2_identify_cipher_deco.identify_cipher(ciphertext: str, threshold: float) → bool`

Identify letter transposition or substitution cipher.

Compare most frequent letters in `ciphertext` with the most frequent letters in the English alphabet. If above `threshold`, it is a letter transposition cipher. If not, it is a letter substitution cipher.

Parameters

- `ciphertext` (`str`) – Encrypted message to identify.
- `threshold` (`float`) – Percent match in decimal form.

Returns `True` if the `ciphertext` is a letter transposition cipher. `False` otherwise.

`src.ch04.practice.p2_identify_cipher_deco.is_substitution(ciphertext: str) → bool`
Identify letter substitution cipher.

Empty function to wrap with `identify_cipher()` using `identify()`. `threshold` defaults to `0.45`.

Parameters `ciphertext` (`str`) – Encrypted message to identify.

Returns `True` if the `ciphertext` is a letter substitution cipher. `False` otherwise.

```
src.ch04.practice.p2_identify_cipher_deco.is_transposition(ciphertext: str) → bool
```

Identify letter transposition cipher.

Empty function to wrap with `identify_cipher()` using `identify()`. `threshold` defaults to 0.75.

Parameters `ciphertext` (*str*) – Encrypted message to identify.

Returns `True` if the `ciphertext` is a letter transposition cipher. `False` otherwise.

```
src.ch04.practice.p2_identify_cipher_deco.main()
```

Demonstrate the cipher identifier.

src.ch04.practice.p3_get_keys module

Get route cipher key from user and store as dictionary.

Note: Assumes vertical cipher routes.

```
src.ch04.practice.p3_get_keys.get_keys() → list
```

Get route cipher keys from user.

User only has to enter positive/negative integers. Each gets added to a list and returned when the user has no other keys to add.

Returns List of integers as column numbers and positive/negative values as route direction.

```
src.ch04.practice.p3_get_keys.key_to_dict(keys: list) → dict
```

Convert route cipher key to dictionary.

Take a route cipher key in list format where integers are column numbers and positive/negative is the route direction and convert to a dictionary where the column numbers are keys and the route direction as up/down are the values.

Parameters `keys` (*list*) – List of integers with direction as positive/negative.

Returns Integers keys and up/down as values.

```
src.ch04.practice.p3_get_keys.main()
```

Demonstrate getting route cipher keys from the user.

src.ch04.practice.p4_generate_keys module

Generate route cipher keys for brute-forcing a route cipher.

Already implemented with `keygen()`, but this version will return a list of tuples.

```
src.ch04.practice.p4_generate_keys.generate_keys(length: int) → list
```

Generate all possible route cipher keys.

Generates a list of all possible route cipher keys of `length`.

Parameters `length` (*int*) – Length of route cipher key.

Returns List of tuples of integers representing all possible route cipher keys of `length`.

```
src.ch04.practice.p4_generate_keys.main()
```

Demonstrate the key generator.

Module contents

Chapter 4 Practice Projects.

Module contents

Chapter 4.

1.1.2 Module contents

impracticalpythonprojects.

Example implementations of the projects in Impractical Python Projects.

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