Python Exercises - Part II [solutions]

Python and R for Data Science

Data Science and Management

Exercise 1: find number of unique characters

Define a function `count_uniq` that:

- takes as arguments:
    - a string `s`
- returns:
    - the number of unique characters in `s`

In [515]:
```
# Solution goes here
```

Solution

In [516]:
```
def count_uniq(s):
    return len(set(s))
```

Test your code

Run this code to test your solution:

In [517]:
```
try: assert count_uniq("test") == 3 and count_uniq("Aejeje") == 3 and not print("
except: print('Test failed')
```

```
Test passed
```

Exercise 2: remove duplicates

Define a function `remove_duplicates` that:

- takes as arguments:
    - a list `s` of strings
- returns:
    - a copy of `s` without duplicate elements

In [518]:
```
# Solution goes here
```

Solution

In [519]:
```
def remove_duplicates(s):
    return list(set(s))
```

Test your code

Run this code to test your solution:

In [520]:
```
try: assert sorted(remove_duplicates(["test", "luiss", "data", "test", "science"]
except: print('Test failed')
```

```
Test passed
```

Exercise 3: find common elements

Define a function `common_elements` that:

- takes as arguments:
    - a set `s` of strings
    - a set `k` of strings
- returns:
    - a set containing all common elements between `s` and `k`

In [521]:
```
# Solution goes here
```

Solution

In [522]:
```
def common_elements(s, k):
    return s.intersection(k)
```

Test your code

Run this code to test your solution:

In [523]:
```
friend1_companies = {'Google', 'Amazon', 'Apple', 'Microsoft'}
friend2_companies = {'Facebook', 'Google', 'Tesla', 'Amazon'}
try: assert common_elements(friend1_companies, friend2_companies) == {'Google', '
except: print('Test failed')
```

```
Test passed
```

Exercise 4: count word frequency

Define a function `word_freq` that:

- takes as arguments:
    - a string `s`
- returns:
    - a dictionary containing the frequency (value) within `s` of each word (key) contained in `s`.

NOTE:

- count the word case-insensitive.
- split `s` by space to obtain the words.

In [524]:
```
# Solution goes here
```

Solution

In [525]:
```
def word_freq(s):
    words = s.lower().split()
    word_count = {}
    for word in words:
        word_count[word] = word_count.get(word, 0) + 1
    return word_count
```

Test your code

Run this code to test your solution:

In [526]:
```
try: assert word_freq("Python is fun and learning Python is fun") == {'python': 2
except: print('Test failed')
```

```
Test passed
```

Exercise 5: track voting results

Define a function `update_votes` that:

- takes as arguments:
    - a dictionary `votes` having as key names of candidates and as value the number of votes received by each one of them
    - a list `new_votes` of names of candidates
- returns:
    - the `votes` dictionary updated with the new votes received

In [527]:
```
# Solution goes here
```

Solution

In [528]:
```
def update_votes(votes, new_votes):
    for vote in new_votes:
        votes[vote] = votes.get(vote, 0) + 1
    return votes
```

Test your code

Run this code to test your solution:

In [529]:
```
votes = {
    'Alice': 120,
    'Bob': 150,
    'Charlie': 90
}

new_votes = ['Alice', 'Charlie', 'Charlie', 'Bob', 'Alice', 'Alice']
try: assert update_votes(votes, new_votes) == {'Alice': 123, 'Bob': 151, 'Charlie
except: print('Test failed')
```

```
Test passed
```

Exercise 6: find how many equal numbers

Define a function `count_equals` that:

- takes as arguments four numbers
- returns:
    - the maximum number of equal numbers between the four

Example:

- `count_equals(1,2,3,4)` should return `0`
- `count_equals(1,2,5,4)` should return `0`
- `count_equals(1,2,2,2)` should return `3` because there are three `2` in the sequence
- `count_equals(1,1,1,2)` should return `3` because there are three `1` in the sequence

In [530]:
```
# Solution goes here
```

Solution

In [531]:

```
def count_equals(a, b, c, d):
    numbers = [a, b, c, d]
    max_count = 0

    for num in numbers:
        count = 0
        for other in numbers:
            if num == other:
                count += 1
        if count > max_count:
            max_count = count

    return max_count if max_count > 1 else 0
```

Test your code

Run this code to test your solution:

In [532]:
```
try: assert count_equals(1,2,3,4) == 0 and count_equals(1,5,3,4) == 0 and count_e
except: print('Test failed')
```

```
Test passed
```

Exercise 7: Fibonacci's sequence

Define a function `fibonacci` that:

- takes as arguments:
    - an integer number `n`
- returns:
    - a list containing the first `n` numbers of the Fibonacci's sequence

NOTE: The Fibonacci sequence is a series of numbers where each number is the sum of the two previous ones, starting with 0 and 1. To calculate it, you begin with 0 and 1, then add these to get the next number. Continue this process to generate the sequence. It goes 0, 1, 1, 2, 3, 5, 8, and so on.

In [533]:
```
# Solution goes here
```

Solution

In [534]:

```
def fibonacci(n):
    fib_sequence = [0, 1]

    if n == 1:
        return [0]

    for i in range(2, n):
        next_fib = fib_sequence[-1] + fib_sequence[-2]
        fib_sequence.append(next_fib)

    return fib_sequence[:n]
```

Test your code

Run this code to test your solution:

In [535]:
```
try: assert fibonacci(1) == [0] and fibonacci(3) == [0,1,1] and fibonacci(7) == [
except: print('Test failed')
```

```
Test passed
```

Exercise 8: zero-sum triplets

Define a function `zero_sum_triplets` that:

- takes as arguments:
    - a list of integers `numbers`
- returns:
    - the number of triplets whose sum is zero

Example:

- `zero_sum_triplets([1,-1,0,7,12])` should return `1` because the sum of 1,-1,0 is `0`
- `zero_sum_triplets([1,9,0,7,12])` should return `0` because there are no triplets that sum up to zero
- `zero_sum_triplets([1,-9,8,6,-14])` should return `2` because the sum of 1,-1,0 is `0` and the sum of 8,6,-14 is `0`

In [536]:
```
# Solution goes here
```

Solution

In [537]:

```
def zero_sum_triplets(numbers):
    n = len(numbers)
    count = 0

    for i in range(n - 2):
        for j in range(i + 1, n - 1):
            for k in range(j + 1, n):
                if numbers[i] + numbers[j] + numbers[k] == 0:
                    count += 1

    return count
```

Test your code

Run this code to test your solution:

In [538]:
```
try: assert zero_sum_triplets([1,-1,0,7,12]) == 1 and zero_sum_triplets([1,9,0,7,
except: print('Test failed')
```

```
Test passed
```

Exercise 9: Collatz

Define a function `collatz` that:

- takes as argument an integer number `n`
- returns:
    - a list containing all the numbers generated by the Collatz conjecture (stopping when reaching `1`)

NOTE: The Collatz Conjecture is a mathematical problem that starts with any positive integer. The process involves two steps: if the number is even, divide it by 2; if it's odd, multiply it by 3 and add 1. Repeat this process with the resulting number. The conjecture suggests that, no matter what number you start with, you'll eventually reach the number 1.

In [539]:
```
# Solution goes here
```

Solution

In [540]:
```
def collatz(n):
    sequence = []

    while n != 1:
        if n % 2 == 0:
            n = n // 2
        else:
            n = 3 * n + 1
        sequence.append(n)

    return sequence
```

Test your code

Run this code to test your solution:

In [541]:
```
try: assert collatz(12) == [6,3,10,5,16,8,4,2,1] and collatz(1) == [] and collatz
except: print('Test failed')
```

```
Test passed
```

Exercise 10: Greatest Common Divisor (GCD)

Define a function `gcd` that:

- takes as argument two integer numbers `a` and `b`
- returns:
    - the gcd between `a` and `b`

In [542]:
```
# Solution goes here
```

Solution

In [543]:
```
def gcd(x, y):
    while y != 0:
        (x, y) = (y, x % y)
    return x
```

Test your code

Run this code to test your solution:

In [544]:
```
try: assert gcd(1,2) == 1 and gcd(7,2) == 1 and gcd(4,2) == 2 and gcd(15,25) == 5
except: print('Test failed')
```

```
Test passed
```

Exercise 11: Factorial of a number

Define a function `factorial` that:

- takes as argument two integer numbers `a`
- returns:
    - the factorial of `a` (i.e., `n! = n * (n-1) * (n-2) * ... * 1`)

In [545]:
```
# Solution goes here
```

Solution

In [546]:
```
def factorial(x):
    result = 1
    for i in range(0,x):
        result *= x-i
    return result
```

Test your code

Run this code to test your solution:

In [547]:
```
try: assert factorial(1) == 1 and factorial(0) == 1 and factorial(5) == 120 and n
except: print('Test failed')
```

```
Test passed
```

Exercise 12: Count vowels in a string

Define a function `vowels_counter` that:

- takes as argument a string `a`
- returns:
    - a dictionary with as key each vowel and as values the occurrencies of each vowel

In [548]:
```
# Solution goes here
```

Solution

In [549]:

```
def vowels_counter(x):
    result = {}
    vowels = ["a", "e", "i", "o", "u"]
    for i in x:
        if i in vowels:
            if i in result:
                result[i] = result[i]+1
            else:
                result[i] = 1
    return result
```

Test your code

Run this code to test your solution:

In [550]:
```
try: assert vowels_counter("ciao") == {'i': 1, 'a': 1, 'o': 1} and vowels_counter
except: print('Test failed')
```

```
Test passed
```

Exercise 13: Find missing number in a sequence

Define a function `find_missing` that:

- Takes a list of `n-1` integers, which represents a sequence of numbers from 1 to `n`, but one number is missing.
- Returns the missing number.

NOTE: Suppose that there is always only one number missing

Example:

- `find_missing([1, 2, 4, 5])` should return `3`.
- `find_missing([2, 3, 4, 6, 1])` should return `5`.

In [551]:
```
# Solution goes here
```

Solution

In [552]:
```python
def find_missing(nums):
    n = len(nums) + 1
    total_sum = n * (n + 1) // 2
    actual_sum = sum(nums)

    return total_sum - actual_sum
```

Test your code

Run this code to test your solution:

In [553]:
```
try: assert find_missing([1, 2, 4, 5]) == 3 and find_missing([2, 3, 4, 6, 1]) ==
except: print('Test failed')
```

```
Test passed
```

Exercise 14: Longest Substring Without Repeating Characters

Define a function `longest_unique_substring` that:

- Takes a string as input.
- Returns the length of the longest substring that contains only unique characters.

Example:

- `longest_unique_substring("abcabcbb")` should return `3` (substring "abc").
- `longest_unique_substring("bbbbb")` should return `1`.

In [554]:
```
# Solution goes here
```

Solution

In [555]:

```
def longest_unique_substring(s):
    max_length = 0

    for i in range(len(s)):
        seen_chars = set()

        for j in range(i, len(s)):
            if s[j] in seen_chars:
                break
            seen_chars.add(s[j])

        max_length = max(max_length, j - i)

    return max_length
```

Test your code

Run this code to test your solution:

In [556]:
```
try: assert longest_unique_substring("abcabcbb") == 3 and longest_unique_substrin
except: print('Test failed')
```

```
Test passed
```

Exercise 15: Find the Majority Element

Define a function `majority_element` that:

- Takes a list of integers as input.
- Returns the element that appears more than half of the time in the list (if it exists). If no such element exists, return `None`.

Example:

- `majority_element([3, 3, 4, 2, 3, 3, 5])` should return `3`.
- `majority_element([1, 2, 3, 4, 5])` should return `None`.

In [557]:
```
# Solution goes here
```

Solution

In [558]:

```
def majority_element(nums):
    count = {}
    n = len(nums)

    for num in nums:
        if num in count:
            count[num] = count[num] + 1
        else:
            count[num] = 1

        if count[num] > n // 2:
            return num

    return None
```

Test your code

Run this code to test your solution:

In [559]:
```
try: assert majority_element([3, 3, 4, 2, 3, 3, 5]) == 3 and majority_element([1,
except: print('Test failed')
```

```
Test passed
```

Exercise 16: Check Palindrome

Define a function `is_palindrome` that:

- Takes a string as input.
- Returns `True` if the string is a palindrome, and `False` otherwise.

NOTE: A palindrome is a word, phrase, number, or other sequence of characters that reads the same forward and backward (ignoring spaces, punctuation, and capitalization).

Example:

- `is_palindrome("racecar")` should return `True`.
- `is_palindrome("hello")` should return `False`.
- `is_palindrome("A man, a plan, a canal, Panama")` should return `True`.

In [560]:
```
# Solution goes here
```

Solution

In [561]:

```
def is_palindrome(s):
    s2 = ""
    for i in range(len(s)):
        if s[i].isalpha():
            s2 += s[i].lower()

    for i in range(0, int(len(s2)/2)):
        if s2[i] != s2[len(s2)-i-1]:
            return False

    return True
```

Test your code

Run this code to test your solution:

In [562]:
```
try: assert is_palindrome("racecar") and not is_palindrome("hello") and is_palind
except: print('Test failed')
```

```
Test passed
```

Exercise 17: Implement ROT13 Cipher

Define a function `rot13` that:

- Takes a string as input.
- Returns a new string where each letter is replaced by the letter 13 positions after it in the alphabet. If the shift passes the end of the alphabet, it wraps around to the beginning. Non-alphabetic characters should remain unchanged.

NOTE:

- ROT13 is a special case of the Caesar cipher, which is a simple substitution cipher where each letter in the plaintext is shifted a certain number of places down or up the alphabet. In the case of ROT13, the shift is 13 places.
- Consider an alphabet of 26 letters: `"abcdefghijklmnopqrstuvwxyz"`
- `ord(c)` returns an integer representing `c`.
- `chr(x)` returns the character associated with integer `x`.

Example:

- `rot13("hello")` should return `"uryyb"`.
- `rot13("uryyb")` should return `"hello"`.
- `rot13("hello, world!")` should return `"uryyb, jbeyq!"`.

In [563]:
```
# Solution goes here
```

Solution

In [564]:

```
def rot13(s):
    result = []
    for char in s:
        if 'a' <= char <= 'z':
            result.append(chr((ord(char) - ord('a') + 13) % 26 + ord('a')))
        elif 'A' <= char <= 'Z':
            result.append(chr((ord(char) - ord('A') + 13) % 26 + ord('A')))
        else:
            result.append(char)
    return ''.join(result)
```

Test your code

Run this code to test your solution:

In [565]:
```
try: assert rot13("hello") == "uryyb" and rot13("uryyb") == "hello" and rot13("he
except: print('Test failed')
```

```
Test passed
```