

National University of Singapore  
School of Computing  
CS1010S: Programming Methodology  
Semester I, 2021/2022

**Extra Practice 3**

## Help

Yes, we put these functions here so that you can refer to them easily.

```
def sum(term, a, next, b):
    if a > b:
        return 0
    else:
        return term(a) + sum(term, next(a), next, b)

def fold(op, f, n):
    if n == 0:
        return f(0)
    else:
        return op(f(n), fold(op, f, n-1))
```

## Order of Growth

Determine the time and space complexity of all these functions.

- (a) 

```
def lol1(n, m):
    result = 0
    for i in range(n):
        for j in range(m):
            result += 1
    return result
```
- (b) 

```
def lol2(n):
    result = 0
    for i in range(n):
        for j in range(n):
            result += 1
    return result
```
- (c) 

```
def lol3(n):
    result = ''
    for i in range(n):
        result += 'a'
    return result
```

```
(d) def lol4(n):
    if n == 0:
        return 0
    else:
        return lol4(n - 1)

(e) def lol5(n):
    result = 0
    for i in range(n):
        for j in range(i, n):
            result += 1
    return result

(f) def lol6(n):
    if n >= 1:
        return 0
    print("CS1010S is fun!")
    lol6(n // 2)
    lol6(n // 2)

(g) def lol7(n):
    for i in range(n):
        for j in range(n + 1, i):
            print("Hello, I am Baymax")

(h) def lol8(n):
    if n < 2:
        print("Less than two")
        return 1
    else:
        for j in range(1, n):
            print("CS1010S is fun!")
        a = lol8(n // 3)
        b = lol8(n // 3)
        c = lol8(n // 3)
        return a + b + c

(i) def lol9(n):
    if n <= 1:
        return
    print("CS1010S")
    for i in range(1, 2):
        lol9(n - 1)
```

## Higher Order Functions

- (a) Define a function **total** that produces the output of the following code using either **sum** or **fold**.

$$2 + 4 + 6 + 8 + 10$$

- (b) I would like to convert a password such as "orange" into a string that comprises **only** of "\*", depending on how long my word is. This function will be named **convert** and take in a word string as an input while returning the converted word. You may assume that the word will be at least one letter long.

**Sample Output:**

```
>>> convert("orange")
'*****'
>>> convert("ap13")
'****'
```

- Use an iterative approach to solve this. What is the time and space complexity?
  - Use an iterative approach to solve this. What is the time and space complexity?
  - Use the **fold** function to solve this.
  - Explain if the **sum** function can be used to solve this. If not, explain what change needs to be made to the original function and define it in terms of **sum**.
- (c) Now, I would like to filter out the letters "o" and "a" because I don't really like them. Define a function **remove** that takes in a word and returns the new word with all the "o"s and "a"s removed.

```
>>> remove("orange")
'rnge'
>>> remove("ooaaaat")
't'
```

- Use an iterative approach to solve this. What is the time and space complexity?
- Use an iterative approach to solve this. What is the time and space complexity?
- Use the **fold** function to solve this.
- Explain if the **sum** function can be used to solve this. If not, explain what change needs to be made to the original function and define it in terms of **sum**.
- **How do you modify the functions to remove all vowels in a word?**