Islamic University of Technology (IUT)

Organization of Islamic Cooperation (OIC)

Department of Electrical and Electronic Engineering (EEE)

EEE 4416: Simulation Lab

Lab – 03 Assignment

Exercise - 01

Problem statement: Tribonacci sequence

The Tribonacci sequence is a generalization of the Fibonacci sequence where each term is the sum of the three preceding terms instead of two.

- T0=0, T1=0, T2=1
- $T_n = T_{n-1} + T_{n-2} + T_{n-3}\ for\ n \geq 3$

The sequence looks like this - 0, 0, 1, 1, 2, 4, 7, 13, 24, 44, … …

Given an input integer n, return the Tribonacci sequence up to that integer.

Test Case - 01

- Input: 15
- Output: [0, 0, 1, 1, 2, 4, 7, 13]

Test case – 02

- Input: 4
- Output: [0, 0, 1, 1, 2, 4]

Test case – 03

- Input: 100
- Output: [0, 0, 1, 1, 2, 4, 7, 13, 24, 44, 81]

Test case – 04

- Input: -4
- Output: [ ]

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<p align="center">**Exercise – 02***</p>

Problem statement: Emirp

An emirp ("prime" spelled backward) is a prime whose reversal is also prime, but which is not a palindromic prime. The first few are 13, 17, 31, 37, 71, 73, 79, 97, 107, 113, 149, 157, … … .

List the emirps less than or equal to the input number.

Test Case - 01

- Input: 20
- Output: [13, 17]

Test case – 02

- Input: 100
- Output: [13 17 31 37 71 73 79 97]

Test case – 03

- Input: 12
- Output: [ ]

Test case – 04

- Input: 1000
- Output: [13 17 31 37 71 73 79 97 107 113 149 157 167 179 199 311 337 347 359 389 701 709 733 739 743 751 761 769 907 937 941 953 967 971 983 991]

*Hint: *primes(n)* is a built-in function in MATLAB that returns the prime numbers up to n.

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Exercise – 03

Problem statement: Collatz conjecture

The Collatz conjecture is one of the most famous unsolved problems in mathematics. The conjecture asks whether repeating two simple arithmetic operations will eventually transform every positive integer into 1. It concerns sequences of integers in which each term is obtained from the previous term as follows: if the previous term is even, the next term is one-half of the previous term. If the previous term is odd, the next term is 3 times the previous term plus 1. The conjecture is that these sequences always reach 1, no matter which positive integer is chosen to start the sequence.

A Cool video: https://www.youtube.com/watch?v=094y1Z2wpJg

A Collatz sequence is a sequence where, for a given number n, the next number in the sequence is either n/2 if the number is even or 3n+1 if the number is odd. The sequence always terminates with 1.
Take an integer 'n' as input and return the sequence.

Test Case - 01

- Input: 13
- Output: [13   40   20   10   5   16   8   4   2   1]

Test case – 02

- Input: 100
- Output:
  [100, 50, 25, 76, 38, 19, 58, 29, 88, 44, 22, 11, 34, 17, 52, 26, 13, 40, 20, 10, 5, 16, 8, 4, 2, 1]

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Exercise - 04

Problem statement:

Given an array of integers, print elements that are greater than the one before them.

Take the arrays given in the following test cases as input (directly in a variable – no need to use a user prompt) and return *an array as output.*

Test Case - 01

- Input: [1, 3, 2, 4, 3, 5]
- Output: [3, 4, 5]

Test case – 02

- Input: [5, 5, 10, 2, 10, 20, 5, 2, 2, 20]
- Output: [10, 10, 20, 20]

Test case – 03

- Input: zeros(1,7)
- Output: [ ]

Exercise - 05

Problem Statement: Swap

Given an array, swap every pair of adjacent elements.

Test Case - 01

- Input: [1, 2, 3, 4, 5, 6]
- Output: [2, 1, 4, 3, 6, 5]

Test Case - 02

- Input: [3, 4, 5]
- Output: [4, 3, 5]

Test Case - 03

- Input: [2, -2, 4, -4, 10, -10]
- Output: [-2, 2, -4, 4, -10, 10]

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Exercise - 06

Problem Statement: Pairs with Given Sum

Given an array of integers and a target sum, return all unique pairs whose sum is equal to the target. The output should be a matrix with 2 columns representing each pair.

Assume pairs are unordered, i.e., (2, 3) and (3, 2) are considered the same pair.

Test Case - 01

- Input-1: [1, 2, 3, 4, 5]
- Target: 6
- Output: [1, 5; 2, 4]

Test case – 02

- Input-1: [15, 5, 20]
- Target: 25
- Output: [5, 20]

Test case – 03

- Input-1: [15, 5, 20]
- Target: 3
- Output: [ ]

Test case – 04

- Input-1: [5, 1, 3, 7, 5, 9, 2, 8, 4, 6, 0, -1, 10, 3, 7]
- Target: 10
- Output: [5, 5; 1, 9; 3, 7; 4, 6; 2, 8; 0, 10]

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Exercise - 07

Problem statement: Alternating Sum

Given an array, find alternating sum i.e. –

$$y = x\,(1) - x\,(2) + x\,(3) - x\,(4) + x\,(5) - \ldots$$

- Try to solve the problem without using any loops.

Test Case – 01:

- Input: [2, 5, 4, 6,1]
- Output: - 4

Test Case – 02:

- Input: repmat([1,0],1,20)
- Output: 20

Exercise - 08

Problem statement: First Duplicate

Previously, you have seen the unique function that returns the unique elements in an array. In this problem, given an array of integers, find the first duplicate element — that is, the element whose second occurrence has the smallest index. If no duplicates exist, print "No duplicates found".

Test Case – 01:

- Input: [2, 5, 1, 2, 3, 5, 1]
- Output: 2

Test Case – 02:

- Input: [1, 2, 3, 4, 5]
- Output: "No duplicates found"

Test Case – 03:

- Input: [2, 5, 1, 10, 3, 5, 1, 1, 1, 2]
- Output: 1

- use break statement to stop unnecessary iterations early.

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