**GITHUB - https://github.com/DaveLominski/210CT\_CW**

**Week 1**

**1.**

import random

def shuffleArrays():

#an empty array where numbers will be inserted from the user input

array = []

maxArray = int(input("How many numbers would you like to input into an array? "))

#this is going to ask a user for another number to add to an array as long as the length of the

#array is less than the maxArray which is set by the user.

#adds the number into the array

while len(array) < maxArray :

arrayq = input("Please input integers that you want to be shuffled :")

array.append(arrayq)

#Fisher-Yates algorithm, if the length of an array is larger than 1, the following statements will run

if len(array) > 1:

#take one away due to zero based array

index = len(array) - 1

#as long as the index variable is more than 0 the while loop will run

while index > 0:

#selects a random number between 0 and the index value and assigns it to a ranInt variable name

#swaps array[index] and array[randInt] around, randInt variable in this case acts as an index in the list

#decreases value of index variable by 1 everytime the while loop is run to make sure its not an infinite loop

ranInt = random.randint(0, index)

array[index], array[ranInt] = array[ranInt], array[index]

index -= 1

print("The shuffled array is :" ,array)

It’s a simple solution that is using a well-known Fisher-Yates algorithm. Using the random library, and random.randint function. Due to the random.randint function being used as an index, the two values being swapped around are almost always going to be different.

**2.**

def trailingZeros():

number = int(input("Give me a number: "))

trailing = 0

#A for loop checking every number between 5 and the number user inputted + 1

for i in range(5, number + 1):

factorial = int(i)

#an infinite while loop to make sure the calculations below are made for each number

while factorial:

#checking if a number is a factor of 5

if factorial % 5 == 0:

#if the number is a factor of 5, add 1 to trailing variable

trailing += 1

#if the quotient is also a factor of 5, it does the same calculcation, e.g. 25 % 5 = 0 therefore adds one to trailing, then does

#25/5 = 5, since 5%5 = 0, the while loop runs again

factorial = factorial / 5

#if a number is not a factor of 5, the while loop breaks and goes back to the for loop

else:

break

print("There are ",trailing, "zeros")

**3.**

PERFSQ(number)

IF number > 0:  
 square < - number\*\*1/2  
 square < - square – ( square % 1)  
 square < - square \* square  
 RETURN(square)  
ELSE:  
 PRINT(“Error ! Try again with a positive integer”)

def perfSq():

number = int(input("Please enter a number"))

if number >= 0:

#square roots a number insterted by a user

square = number\*\*(1/2)

#takes away square rooted number and takes away the decimal from the square rooted number

square = square - (square % 1)

#sqaures the number to find the closest perfect square number

square = square \* square

print(square)

else:

print("Error ! Try again with a positive integer")

**4.**

**import** random  
  
**def shuffleArrays**():  
  
 array = [] (1)  
 maxArray = int(input("How many numbers would you like to input into an array? ")) (1)  
  
 **while** len(array) < maxArray : (n)  
 arrayq = input("Please input integers that you want to be shuffled :") (n)  
 array.append(arrayq) (n)  
  
 **if** len(array) > 1: (1)  
 index = len(array) - 1 (1)  
 **while** index > 0: (n)  
 ranInt = random.randint(0, index) (n)  
 array[index], array[ranInt] = array[ranInt], array[index] (n)  
 index -= 1 (n)  
 print("The shuffled array is :" ,array) (1)

O(n) 7n + 5

**def trailingZeros**():  
 number = int(input("Give me a number: ")) (1)  
  
 trailing = 0 (1)  
 **for** i **in** range(5, number+1): (n)  
 factorial = int(i) (n)  
 **while** factorial: (n\*n)  
 **if** factorial % 5 == 0: (n\*n)  
 trailing += 1 (n\*n)  
 factorial = factorial / 5 (n\*n)  
 **else**: (n\*n)  
 **break (**n\*n)print("There are ",trailing, "zeros") (1)  
  
  
trailingZeros()

O(n2) 6n2 + 2n + 3

**5.**

ADD-MATRICES:  
 result = []

FOR i in range (0, LENGTH of matrix):  
 FOR j in range (0, LENGTH of matrix2):  
 result[i][j] <- matrix[i][j] + matrix2[i][j]  
return result

SUBTRACT-MATRICES:

result = []

FOR i in range (0, LENGTH of matrix):  
 FOR j in range (0, LENGTH of matrix2):  
 result[i][j] <-matrix[i][j] – matrix2[i][j]  
return result

MULTIPLY-MATRICES:  
 result = []

FOR i in range (0, LENGTH of matrix):  
 FOR j in range (0, LENGTH of matrix2[0]):  
 FOR z in matrix2:  
 result[i][j] <- result[i][j] + matrix[i][z] \* matrix2[z][j]  
 return result

matrix <- USER INPUT TO POPULATE FIRST MATRIX  
matrix2 <- USER INPUT TO POPULATE SECOND MATRIX

A = B\*C-2\*(B+C)

//Worst case of order n = (n^3) – Addition and subtraction has 2 loops and only 1 nested loops whereas multiplication has 3 loops, of which 2 are nested therefore worst case is doing the multiplication which is (n^3)

**6.**

REVERSING-WORDS-IN-A-SENTENCE

A < - USER INPUT  
 FOR EACH character i in A:

B < - SPLIT EACH WORD AND PUT IT IN A LIST  
 C < - REVERSE THE LIST

ENDFOR

FOR EACH element j in REVERSED LIST c:

RETURN j

ENDFOR

**def reversingWordsInaSentence**():  
 a = str(input("Enter a sentence that you want to be reversed :")) (1)  
 **for** i **in** a: (n)  
 b = a.split(" ") (n)  
 c = b[::-1] (n)  
 **for** j **in** c: (n)  
 print(j, end= " ") (n)  
  
  
  
  
  
  
reversingWordsInaSentence()

5n + 1 O(n)

def reversingWordsInaSentence():

a = str(input("Enter a sentence that you want to be reversed :"))

#starts a for loop which goes through every character in the user input

for i in a:

#splits the words in a sentence, detects a new word whenever there is a SPACE in the sentence

b = a.split(" ")

#reverses a list

c = b[::-1]

#a for loop that changes a list into normal looking sentence

for j in c:

#prints the sentence, end= " " basically takes care of the sentence being in one line

print(j, end= " ")

**7.**

PRIME-NUMBER(number, counter=NONE):

IF counter = 1:  
 RETURN TRUE  
ELIF number < 2:  
 RETURN FALSE  
ELIF counter = None:  
 counter <- number -1   
 PRIME-NUMBER(number, counter)  
ELIF number % counter = 0:  
 RETURN FALSE  
ELSE:  
 RETURN PRIME-NUMBER(number, counter -1)

def primeNumber(number, counter=None):

#if the number is not divisible by the counter as it goes down, and the

#counter gets to 1, it means that the number only divides by itself and 1

if counter == 1:

print(number, "is a prime number")

#if number is below 2, it's not a prime number

elif number < 2:

print(number, "is not a prime number")

#only runs at the beginning to make the counter 1 less than a number

elif counter == None:

counter = number-1

primeNumber(number, counter)

#checks if the number is divisible by a counter

elif number % counter == 0:

print(number, "is not a prime number")

#if the number is not divisible by the counter, the counter decreases by 1

else:

return primeNumber(number, counter - 1)

**8.**

REMOVE-VOWELS(c <- 0):

vowels <- A LIST OF ALL VOWELS

IF c = LENGTH of vowels:

RETURN TRUE

ELSE IF vowels[c] in USER INPUT:  
 REMOVE ONE VOWEL AT A TIME FROM USER INPUT

RETURN the word after vowel has been removed

REMOVE-VOWELS(c)

ELSE:

REMOVE-VOWELS(C + 1)

s < - USER INPUT

s1 < - CHANGE USER INPUT into a list

def removeVowels(c = 0):

vowels = ["a","e","i","o","u"]

if c == len(vowels):

return True

#check every vowel if it's in the word

elif vowels[c] in s1:

#removes a vowel from the word if found

s1.remove(vowels[c])

#prints the word after one vowel has been removed

print(s1)

#calls the function to check if there are multiples of the same vowel

removeVowels(c)

#calls the function if there are no more multiples of the vowels and adds one to the counter to move onto the next vowels in the list

else:

removeVowels(c + 1)

#converts user input to lower case letters

s = input("Type a word : ").lower()

#changes the user input into a list

s1 = list(s)

**9.**

BINARY-SEARCH(array, a, b):

firstIndex <- 0

lastIndex <- LENGTH OF AN ARRAY - 1

itemFound <- FALSE

WHILE (firstIndex <= lastIndex AND NOT itemFound):

mp <- FLOOR[(firstIndex + lastIndex) / 2]

IF array[mp] >= a and array[mp] <=b:

itemFound <-TRUE

ELSE:

IF a < array[mp] AND b < array[mp]:

lastIndex = mp - 1

ELSE:

firstIndex = mp + 1

RETURN(itemFound)

def binarySearch(array, a, b):

#first index in an array is always 0 (1)

firstIndex = 0 (1)

#since array start with 0, to get an actual length of an array we need to take 1 away

lastIndex = (len(array) - 1) (1)

itemFound = False (1)

while firstIndex <= lastIndex and not itemFound: (n)

#finds the mid-point

mp = (firstIndex + lastIndex) // 2 (n)

#if statement that checks if midpoint is in the between the numbers that user inputted

if array[mp] >= a and array[mp] <= b: (n)

#if number is in range, variable value is change to TRUE

itemFound = True (n)

else: (n)

#if a and b are smaller than the mid-point, take one away from the mid-point,

if a < array[mp] and b < array[mp]: (n)

#and start looking for a number in the first half of an array

lastIndex = mp - 1 (n)

else: (n)

#otherwise add one to the mid-point and start looking for a number in the second half of an array

firstIndex = mp + 1 (n)

print(itemFound) (1)

binarySearch([1,5,7,8,9,10,15],-1,0)

5 + 9n = O(n)

**10.**

def sequences(L, a, b):

#the for loops that goes through the whole list

for i in range (0, len(L)):

if i == 0:

#always adds the first element of the list to a

a.append(L[0])

#if value of i is smaller than the value before it

elif L[i] <= (L[i-1]):

#if length of list a is larger than length of list b

if len(a) > len(b):

#list b = a

b = a[:]

#clear all the elements in list a

a[:] = []

#add element i to the list a

a.append(L[i])

#if length of b is larger than length of a

else:

a[:] = []  
 a.append(L[i])

#if value of i is larger than the previous value

elif L[i] > (L[i-1]):

#add the value to the list a

a.append(L[i])

#if length of a is larger than b, print list a

if len(a) > len(b):

print("The longest sequence so far is ", a)

#if length of list a and b are the same, print both of them

elif len(a) == len(b):

print("The two longest sequences are ", a, b)

#if length of b is larger, print b

else:

print("The longest sequence so far is ", b)

else:

pass

sequences([1,2,3,4,5,8,9,10,1,2,3,4,1,6,7,8,9,10,11,12,12],[],[])

**11.**

class Node(object):

def \_\_init\_\_(self, value):

self.value=value

self.next=None

self.prev=None

class List(object):

def \_\_init\_\_(self):

self.head=None

self.tail=None

def insert(self,n,x):

#Not actually perfect: how do we prepend to an existing list?

if n!=None:

x.next=n.next

n.next=x

x.prev=n

if x.next!=None:

x.next.prev=x

if self.head==None:

self.head=self.tail=x

x.prev=x.next=None

elif self.tail==n:

self.tail=x

def listRemove(self,n):

if n.prev != 0:

n.prev.next = n.next

else:

self.head = n.next

if n.next != 0:

n.next.prev = n.prev

else:

self.tail = n.prev

def display(self):

values=[]

n=self.head

while n!=None:

values.append(str(n.value))

n=n.next

print ("List: ",",".join(values))

if \_\_name\_\_ == '\_\_main\_\_':

l=List()

l.insert(None, Node(4))

l.insert(l.head,Node(6))

l.insert(l.head,Node(8))

l.listRemove(l.head.next)

l.display()

class BinTreeNode(object):

def \_\_init\_\_(self, value):

self.value=value

self.left=None

self.right=None

def tree\_insert( tree, item):

if tree==None:

tree=BinTreeNode(item)

else:

if(item < tree.value):

if(tree.left==None):

tree.left=BinTreeNode(item)

else:

tree\_insert(tree.left,item)

else:

if(tree.right==None):

tree.right=BinTreeNode(item)

else:

tree\_insert(tree.right,item)

return tree

def postorder(tree):

if(tree.left!=None):

postorder(tree.left)

if(tree.right!=None):

postorder(tree.right)

print (tree.value)

def in\_order(tree):

s = [] #Initializing an empty stack

while True:

if tree != None: #If tree does not equal None

s.append(tree) #add the tree value to the stack

tree = tree.left #move the the left value

else: #if there is nothing to the left of the tree value

if len(s) > 0: #if length of s is more than 0

tree = s.pop() #pop from the stack

print(tree.value) #print the tree value

tree = tree.right #move to the right

else:

return False

if \_\_name\_\_ == '\_\_main\_\_':

t=tree\_insert(None,6);

tree\_insert(t,10)

tree\_insert(t,5)

tree\_insert(t,2)

tree\_insert(t,3)

tree\_insert(t,4)

tree\_insert(t,11)

in\_order(t)

**12.**

**13.**

class Graph():

def \_\_init\_\_(self):

self.nodes = []

self.edges = dict()

def addVertex(self,value):  
 #adding a node value to a list

self.nodes.append(value)  
 #adding a node to a dictionary and creating an empty list for the edges

self.edges[value] = []

def printVertices(self):  
 #returning the nodes list

return self.nodes

def addEdges(self, node1, node2):  
 #if nodes not in the nodes list, append the nodes to the list

if node1 not in self.nodes:

self.nodes.append(node1)

if node2 not in self.nodes:

self.nodes.append(node2)  
 #adding the edges to the dictionaries, the edges are being added to an empty list created earlier

self.edges[node1].append(node2)

self.edges[node2].append(node1)

if \_\_name\_\_ == '\_\_main\_\_':

g = Graph()

g.addVertex(1)

g.addVertex(5)

g.addVertex(3)

g.addVertex(4)

g.addVertex(10)

g.addVertex(7)

g.addEdges(1,5)

g.addEdges(1,3)

g.addEdges(10,7)

g.addEdges(4,10)

g.addEdges(5,10)

for node in g.edges:

print(node, ":", g.edges[node])

print(g.printVertices())

CLASS GRAPH  
 INITIALIZING FUNCTION  
 nodes <- EMPTY ARRAY  
 edges <- EMPTRY DICTIONARY  
 ADD-VERTEX(value)  
 ADD value to the nodes array  
 ADD value to the dictionary, MAKING it EQUAL to en empty array  
 PRINT-VERTICES  
 RETURN nodes  
 ADD-EDGES(node1, node2)  
 IF node1 and node2 NOT IN nodes  
 ADD node1 and node2 to nodes  
 ADD node2 as a corresponding value to node1  
 ADD node1 as a corresponding value to node2

class Stack:

def \_\_init\_\_(self):

self.items = []

def isEmpty(self):

return self.items == []

def push(self, item):

self.items.append(item)

def pop(self):

return self.items.pop()

def peek(self):

return self.items[len(self.items) - 1]

def size(self):

return len(self.items)

class Queue:

def \_\_init\_\_(self):

self.items = []

def isEmpty(self):

return self.items == []

def enqueue(self, item):

self.items.insert(0,item)

def dequeue(self):

return self.items.pop()

def size(self):

return len(self.items)

class Graph():

def \_\_init\_\_(self):

self.nodes = []

self.edges = dict()

def addVertex(self,value):

self.nodes.append(value)

if value in self.nodes:

self.edges[value] = []

else:

pass

def printVertices(self):

return self.nodes

def addEdges(self, node1, node2):

if node1 not in self.nodes:

self.nodes.append(node1)

if node2 not in self.nodes:

self.nodes.append(node2)

self.edges[node1].append(node2)

self.edges[node2].append(node1)

**14.**

def DFS(self, start):

visited = []

stack = Stack()

stack.push(start)

while stack.isEmpty() == False:

u = stack.pop()

if u not in visited:

visited.append(u)

for edge in self.edges[u]:

stack.push(edge)

dfsText = open("dfsTraversalOutput.txt", "w")

dfsText.write("DFS Traversal: %s " % visited)

dfsText.close()

def BFS(self, start):

Q = Queue()

visited = []

Q.enqueue(start)

while Q.isEmpty() == False:

u = Q.dequeue()

if u not in visited:

visited.append(u)

for edge in self.edges[u]:

Q.enqueue(edge)

bfsText = open("bfsTraversalOutput.txt", "w")

bfsText.write("BFS Traversal: %s " % visited)

bfsText.close()

if \_\_name\_\_ == '\_\_main\_\_':

g = Graph()

g.addVertex(1)

g.addVertex(5)

g.addVertex(3)

g.addVertex(4)

g.addVertex(10)

g.addVertex(7)

g.addEdges(1,5)

g.addEdges(1,3)

g.addEdges(10,7)

g.addEdges(4,10)

g.addEdges(5,10)

for node in g.edges:

print(node, ":", g.edges[node])

print(g.printVertices())

print(g.DFS(7))

print(g.BFS(7))

REFERENCES:

Miller, B. (n.d.) *5.4. The binary search — problem solving with Algorithms and data structures*. Available at: https://interactivepython.org/runestone/static/pythonds/SortSearch/TheBinarySearch.html (Accessed: 16 November 2016).