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**Project 1**

**Problem 1:** Fibonacci Sequence

1. Recursive algorithm within 60 seconds:

First try using n= 10-

import time

start\_time = time.time()

def fiboRecur(n):

if n <= 1:

return n

else:

return(fiboRecur(n-1) + fiboRecur(n-2))

nterms = int(input("Enter n: "))

if nterms <= 0:

print("Plese enter a positive integer")

else:

print("Fibonacci sequence:")

for i in range(nterms):

print(fiboRecur(i))

print("-%s seconds -" % (time.time() - start\_time))

output:

52684 -- /Users/harshavaidhyam/Desktop/Pitt\ term-1/Algo\ Design/project\ 1/project1\(1\)/src/prj1\(i\).py

Enter n: 10

Fibonacci sequence:

0

1

1

2

3

5

8

13

21

34

-4.091001272201538 seconds –

N which takes 60 seconds to compute:

n= 42(approx.)

import time

start\_time = time.time()

def fiboRecur(n):

if n <= 1:

return n

else:

return(fiboRecur(n-1) + fiboRecur(n-2))

nterms = int(input("Enter n: "))

if nterms <= 0:

print("Plese enter a positive integer")

else:

print("Fibonacci sequence:")

for i in range(nterms):

print(fiboRecur(i))

print("-%s seconds -" % (time.time() - start\_time))

# time.sleep(60)

Output:

53171 -- /Users/harshavaidhyam/Desktop/Pitt\ term-1/Algo\ Design/project\ 1/project1\(1\)/src/prj1\(i\).py

Enter n: 42

Fibonacci sequence:

0

1

1

2

3

5

8

13

21

34

55

89

144

233

377

610

987

1597

2584

4181

6765

10946

17711

28657

46368

75025

121393

196418

317811

514229

832040

1346269

2178309

3524578

5702887

9227465

14930352

24157817

39088169

63245986

102334155

165580141

**-61.34751772880554 seconds –**

1. Iterative algorithm and the time taken for the same n=42:

import time

start\_time = time.time()

def fiboiter(n):

a=1

b=1

if n==1:

print('0')

elif n==2:

print('0','1')

else:

print(end=' ')

print('0',a,b,end=' ')

for i in range(n-3):

sum = a + b

b=a

a= sum

print(sum,end=' ')

print()

return b

fiboiter(42)

print("- %s seconds -" % (time.time() - start\_time))

**Output:**

harshavaidhyam@Harshas-MacBook-Pro project1(1) % cd /Users/harshavaidhyam/Desktop/Pitt\ term-1/Algo\ Design/project\ 1/project1\(1\) ; /usr/bin/env /u

sr/local/bin/python3 /Users/harshavaidhyam/.vscode/extensions/ms-python.python-2022.14.0/pythonFiles/lib/python/debugpy/adapter/../../debugpy/launcher

53781 -- /Users/harshavaidhyam/Desktop/Pitt\ term-1/Algo\ Design/project\ 1/project1\(1\)/src/ii.py

**0 1 1 2 3 5 8 13 21 34 55 89 144 233 377 610 987 1597 2584 4181 6765 10946 17711 28657 46368 75025 121393 196418 317811 514229 832040 1346269 2178309 3524578 5702887 9227465 14930352 24157817 39088169 63245986 102334155 165580141**

**- 5.1975250244140625e-05 seconds –**

**Problem 2:**

**Testcase 1:**

def balancedArrMax(arr, n):

total = 0

maxsize = -1

for i in range(0, n-1):

total = -1 if(arr[i] == 0) else 1

for j in range(i + 1, n):

total = total + (-1) if (arr[j] == 0) else total + 1

if (total == 0 and maxsize < j-i + 1):

maxsize = j - i + 1

startindex = i

if (maxsize == -1):

print("No balanced subset");

else:

print(startindex, "-", startindex + maxsize-1);

return maxsize

arr = [0, 0, 1, 0, 0, 1, 1, 0, 1, 0, 0, 0, 0, 0, 1]

size = len(arr)

balancedArrMax(arr, size)

**Output:**

harshavaidhyam@Harshas-MacBook-Pro project1(1) % cd /Users/harshavaidhyam/Desktop/Pitt\ term-1/Algo\ Design/project\ 1/project1\(1\) ; /usr/bin/env /u

sr/local/bin/python3 /Users/harshavaidhyam/.vscode/extensions/ms-python.python-2022.14.0/pythonFiles/lib/python/debugpy/adapter/../../debugpy/launcher

55038 -- /Users/harshavaidhyam/Desktop/Pitt\ term-1/Algo\ Design/project\ 1/project1\(1\)/src/prob2.py

**1 – 8**

**Testcase 2:**

arr = [1, 0, 1, 0, 0, 1, 0, 1, 1, 1, 0 ,0]

size = len(arr)

balancedArrMax(arr, size)

**Output:**

harshavaidhyam@Harshas-MacBook-Pro project1(1) % cd /Users/harshavaidhyam/Desktop/Pitt\ term-1/Algo\ Design/project\ 1/project1\(1\) ; /usr/bin/env /u

sr/local/bin/python3 /Users/harshavaidhyam/.vscode/extensions/ms-python.python-2022.14.0/pythonFiles/lib/python/debugpy/adapter/../../debugpy/launcher

55046 -- /Users/harshavaidhyam/Desktop/Pitt\ term-1/Algo\ Design/project\ 1/project1\(1\)/src/prob2.py

**0 - 11**

**Testcase 3:**

arr = [1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 0]

size = len(arr)

balancedArrMax(arr, size)

**Output:**

harshavaidhyam@Harshas-MacBook-Pro project1(1) % cd /Users/harshavaidhyam/Desktop/Pitt\ term-1/Algo\ Design/project\ 1/project1\(1\) ; /usr/bin/env /u

sr/local/bin/python3 /Users/harshavaidhyam/.vscode/extensions/ms-python.python-2022.14.0/pythonFiles/lib/python/debugpy/adapter/../../debugpy/launcher

55054 -- /Users/harshavaidhyam/Desktop/Pitt\ term-1/Algo\ Design/project\ 1/project1\(1\)/src/prob2.py

**28 - 29**

**Testcase 4:**

arr = [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]

size = len(arr)

balancedArrMax(arr, size)

harshavaidhyam@Harshas-MacBook-Pro project1(1) % cd /Users/harshavaidhyam/Desktop/Pitt\ term-1/Algo\ Design/project\ 1/project1\(1\) ; /usr/bin/env /u

sr/local/bin/python3 /Users/harshavaidhyam/.vscode/extensions/ms-python.python-2022.14.0/pythonFiles/lib/python/debugpy/adapter/../../debugpy/launcher

55067 -- /Users/harshavaidhyam/Desktop/Pitt\ term-1/Algo\ Design/project\ 1/project1\(1\)/src/prob2.py

**No balanced subset**

**Problem 3:**

import random

from sys import maxsize

import time

import matplotlib.pyplot as plt

start\_time=time.time()

def maxSubArraySum(a, size):

x = -maxsize - 1

y = 0

start = 0

end = 0

s = 0

for i in range(0, size):

y += a[i]

if x < y:

x = y

start = s

end = i

if y < 0:

y = 0

s = i+1

print("i is %d" % (start+1))

print("j is %d" % (end+1))

#test case 1

# a = [-2, -5, 6, -2, -3, 1, 5, -6]

# maxSubArraySum(a, len(a))

# print("=%s seconds -" % (time.time() - start\_time))

#test case 2: uncomment to run

a = [1, 2, 3, 4, 5, 6, 7, 8, 9, -10, -100, 10, 9, 8, 7, 6, 5, 4, 3, 2, 1]

maxSubArraySum(a, len(a))

print("=%s seconds -" % (time.time() - start\_time))

#plotting of time complexity

x\_coordinate = []

y\_coordinate = []

for k in range(1, 2000, 100):

a = [random.randint(0, 200000) for i in range(k \* 100)]

# start = time.time()

maxSubArraySum(a, len(a))

print("Time taken: ", round(time.time() - start\_time, 6))

x\_coordinate.append(k \* 100)

y\_coordinate.append(round(time.time() - start\_time, 6))

plt.plot(x\_coordinate, y\_coordinate, marker="o")

plt.xlabel("Size")

plt.ylabel("Time")

plt.show()

**Output:**

Test case 1;

harshavaidhyam@Harshas-MacBook-Pro project1(1) % cd /Users/harshavaidhyam/Desktop/Pitt\ term-1/Algo\ Design/project\ 1/project1\(1\) ; /usr/bin/env /u

sr/local/bin/python3 /Users/harshavaidhyam/.vscode/extensions/ms-python.python-2022.14.0/pythonFiles/lib/python/debugpy/adapter/../../debugpy/launcher

58499 -- /Users/harshavaidhyam/Desktop/Pitt\ term-1/Algo\ Design/project\ 1/project1\(1\)/src/prob3.py

**i is 3**

**j is 7**

**=1.0967254638671875e-05 seconds -**

Test case 2:

harshavaidhyam@Harshas-MacBook-Pro project1(1) % cd /Users/harshavaidhyam/Desktop/Pitt\ term-1/Algo\ Design/project\ 1/project1\(1\) ; /usr/bin/env /u

sr/local/bin/python3 /Users/harshavaidhyam/.vscode/extensions/ms-python.python-2022.14.0/pythonFiles/lib/python/debugpy/adapter/../../debugpy/launcher

58504 -- /Users/harshavaidhyam/Desktop/Pitt\ term-1/Algo\ Design/project\ 1/project1\(1\)/src/prob3.py

**i is 12**

**j is 21**

**=1.4066696166992188e-05 seconds –**

**Plotting of time complexity using MathPlotLib and using random function in python:**

Screenshot of plot:

**Chart, line chart

Description automatically generated**