

Project 1

Problem 1: Fibonacci Sequence

i) 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\1\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\1\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 –

ii) 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
```

```

fibonacci(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/adapters/.../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/adapters/../../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/adapters/../../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, 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/adapters/../../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\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\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/adapters/.../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:

