Lab 04 - Summation analysis / Recursions

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9-15-21

1) Apply the summation formula:

a. $1+2+\dots+42 = \frac{42 \cdot 43}{2} =$

b. $25+26\dots+100 = 1+2\dots+24+25\dots+100 - (1+2+\dots 24)$
$\Rightarrow \frac{100 \cdot 101}{2} - \frac{24 \cdot 25}{2} = \underline{4750}$

c. $-30-29-\dots-1+0+1+2\dots+100 = (1+\dots+100) - (1+\dots+30)$
$\Rightarrow \frac{100 \cdot 101}{2} - \frac{30 \cdot 31}{2} = \underline{4585}$

d. $2+4+6,\dots+100 = (2+\dots+100) - (1+2)$
$\Rightarrow \frac{100 \cdot 101}{2}/2 - \frac{2/3}{2} = \underline{2522}$

e. $3+6+9+12+\dots+99 = (3+\dots+99) - (1+\dots+3)$
$\Rightarrow 99 \cdot 100/3/2 - \frac{3 \cdot 4}{2} = \underline{1644}$

f. $a+2a+3a+\dots+ka = a(1+2+3+\dots+k) = \underline{a \cdot \frac{k \cdot k+1}{2}}$

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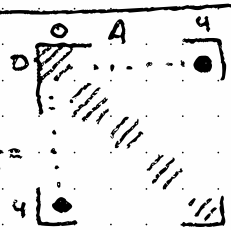
2) Analysis of Non-Recursive Algorithm:




```
Algorithm: Enigma
    for (i ← 0 to n-2) do
        for (j ← i+1 to n-1) do
            if A[i,j] ≠ A[j,i]
                Return false
    Return true
```

- Comparing symetry

a. Symetry about the diagonal!
b. Comparisons
c. Best Case - 1op, Worst Case - $n^2 = 5^2 = 25$ops
d. Exponitial class
e. Some answer goes here, just imagine this is the answer and the right one!

$$\sum_{0}^{n-2}\sum_{i+1}^{n-1} 1 = \sum_{0}^{n-2}\left((n-1)-(i+1)+1\right) = \sum_{0}^{n-2}(n-i-1)$$

$$+\sum_{0}^{n-2} n-1 = (n-1)^2$$

$$= (n-1)\cdot\frac{n}{2}$$

$$-\sum_{0}^{n-2} i = -\frac{(n-2)(n-1)}{2}$$

Order of growth = n^2

4) Analysis of Recursive Algorithm:

Algorithm: Q(n)
if(n=1) return 1
else return Q(n-1)+2n-1

a. $Q(n) = Q(n-1) + 2n - 1 \quad , Q(1) = 1$ $\qquad n-i=1$, $i=n-1$

$\Rightarrow Q(n-2) + 2(n-1) - 1 + 2n - 1$

$\Rightarrow Q(n-2) - 2 + 2(n-1) + 2n$

$\Rightarrow Q(n-i) - i + 2(n-(i+1)) + \dots + 2(n-1) + 2n$

$\Rightarrow Q(1) - (n-1) + 2(2) + \dots + 2n$

$\Rightarrow 1 - (n-1) + 2(2 + \dots + n)$

$2 + \dots + n = \frac{n(n+1)}{2} - 1$

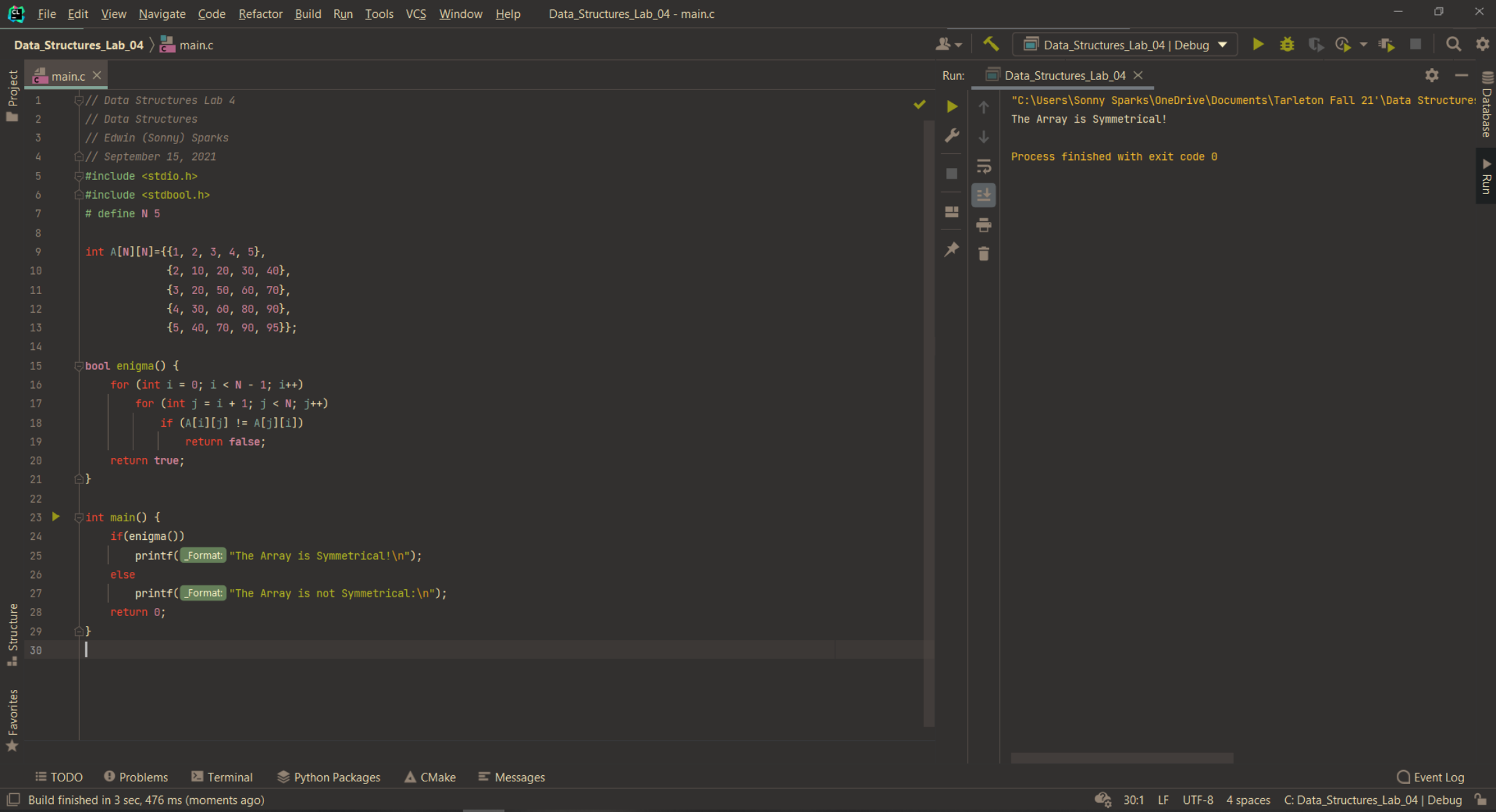
$\Rightarrow 1 - (n-1) + n(n+1) - 2 = n^2$

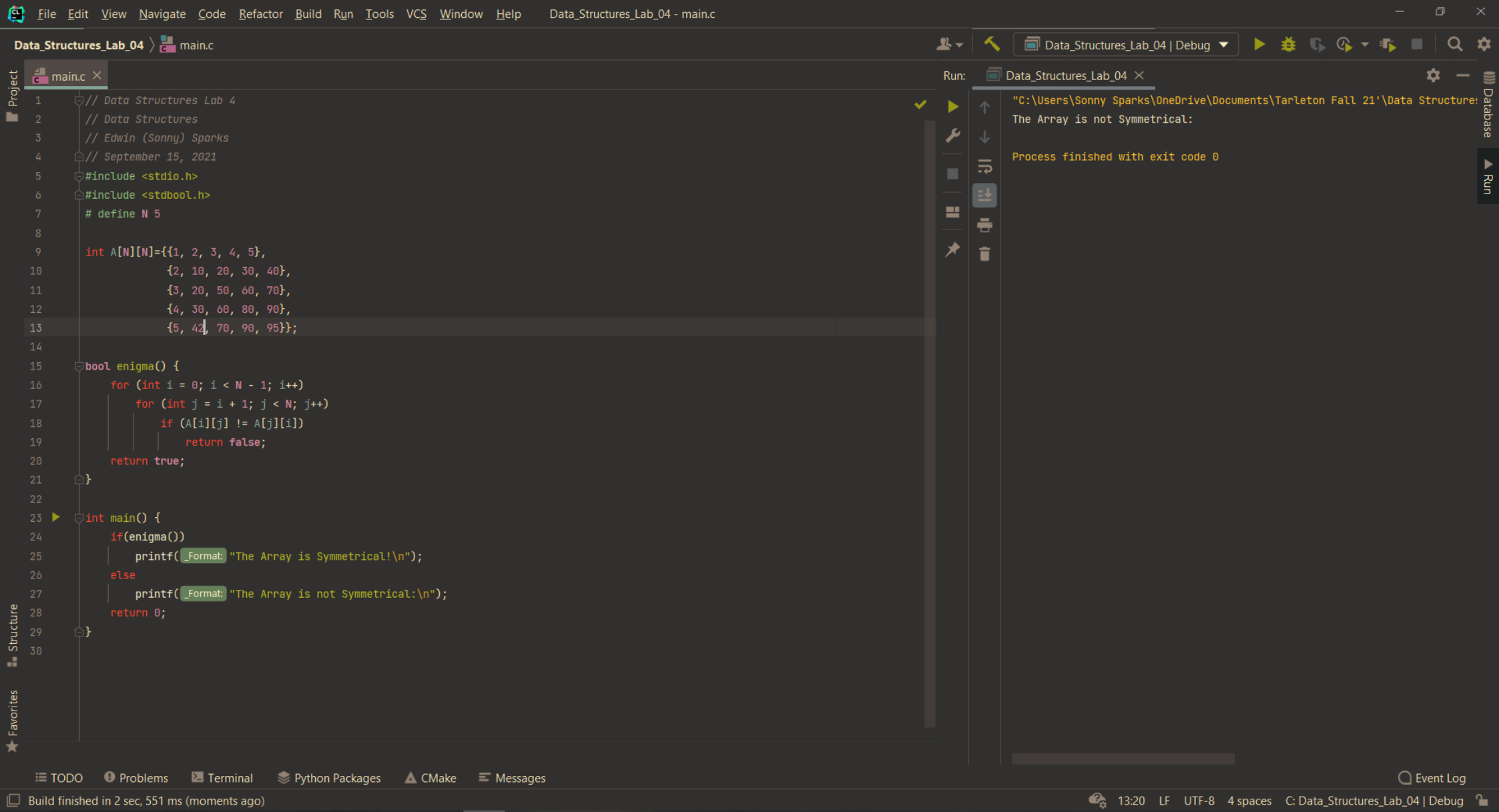
b. $M(n) = M(n-1) + 1 \quad , M(1) = 0$

$\Rightarrow (n-1)^2 + 2n - 1 = ? = n^2$

$n^2 - 2n + 1 + 2n - 1 = n^2$ ✓

c. $M(n) = M(n-1) + 3$


File Edit View Navigate Code Refactor Build Run Tools VCS Window Help Data_Structures_Lab_04 - main.c
Data_Structures_Lab_04 main.c
Data_Structures_Lab_04 | Debug
main.c
// Data Structures Lab 4
// Data Structures
// Edwin (Sonny) Sparks
// September 15, 2021
#include <stdio.h>
#include <stdbool.h>
define N 5
int A[N][N]={{1, 2, 3, 4, 5},
{2, 10, 20, 30, 40},
{3, 20, 50, 60, 70},
{4, 30, 60, 80, 90},
{5, 40, 70, 90, 95}};
bool enigma() {
for (int i = 0; i < N - 1; i++)
for (int j = i + 1; j < N; j++)
if (A[i][j] != A[j][i])
return false;
return true;
}
int main() {
if(enigma())
printf(_Format: "The Array is Symmetrical!\n");
else
printf(_Format: "The Array is not Symmetrical:\n");
return 0;
}
Run: Data_Structures_Lab_04
"C:\Users\Sonny Sparks\OneDrive\Documents\Tarleton Fall 21'\Data Structures
The Array is Symmetrical!
Process finished with exit code 0
Project
Structure
Favorites
Database
Run
TODO
Problems
Terminal
Python Packages
CMake
Messages
Event Log
Build finished in 3 sec, 476 ms (moments ago)
30:1
LF
UTF-8
4 spaces
C: Data_Structures_Lab_04 | Debug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// September 15, 2021
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#include <stdbool.h>
define N 5
int A[N][N]={{1, 2, 3, 4, 5},
{2, 10, 20, 30, 40},
{3, 20, 50, 60, 70},
{4, 30, 60, 80, 90},
{5, 42, 70, 90, 95}};
bool enigma() {
for (int i = 0; i < N - 1; i++)
for (int j = i + 1; j < N; j++)
if (A[i][j] != A[j][i])
return false;
return true;
}
int main() {
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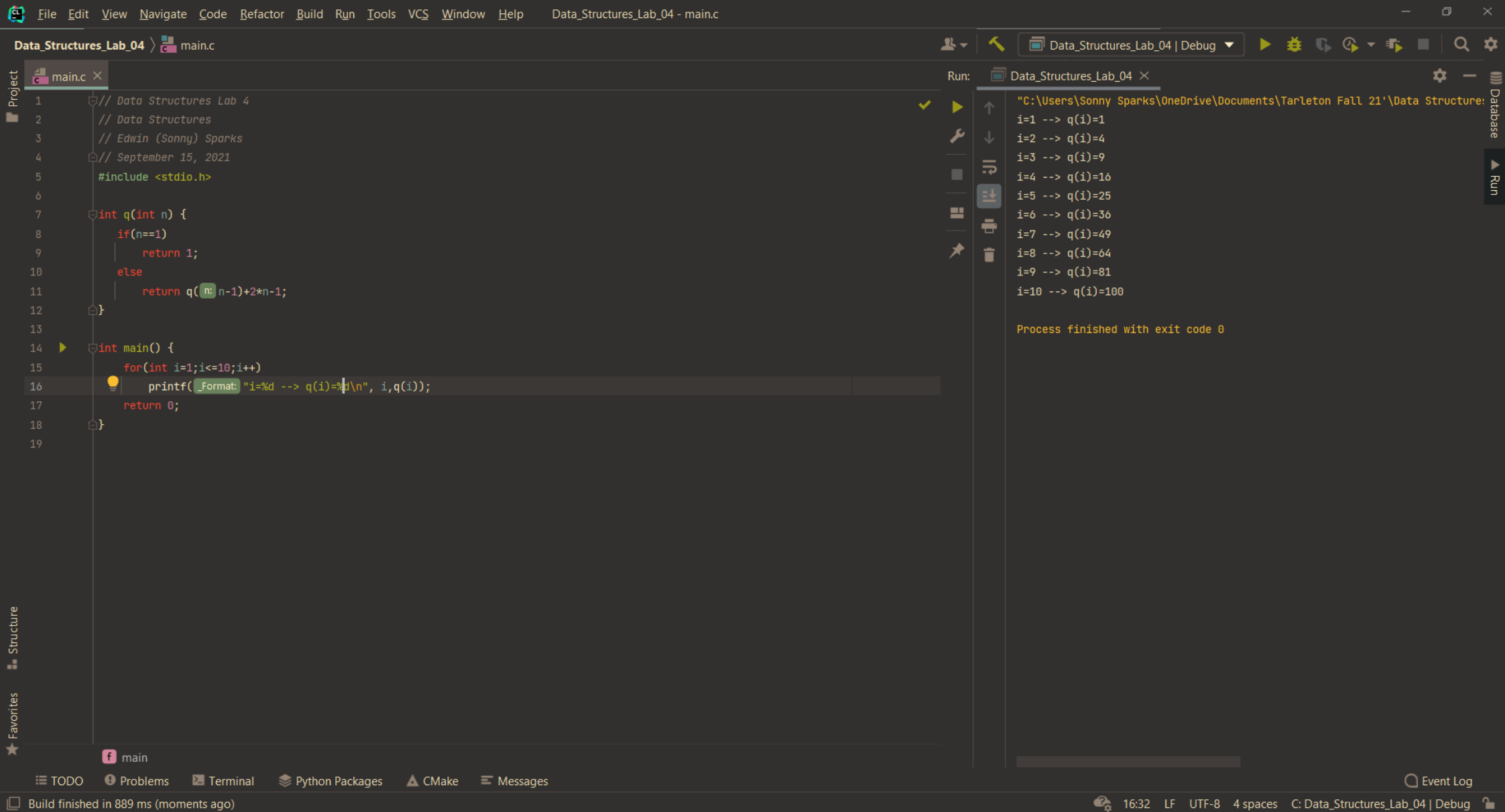
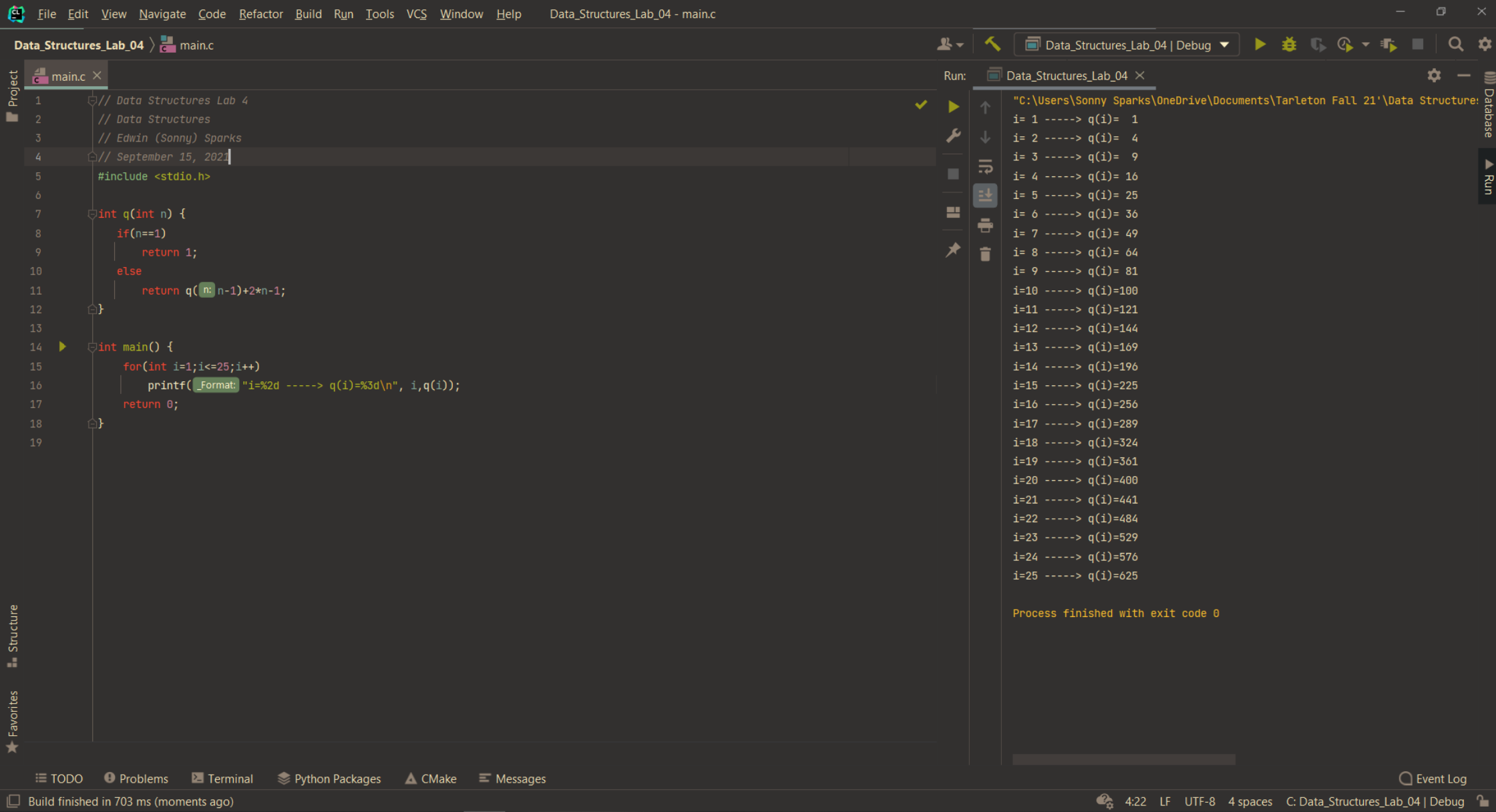
printf(_Format: "The Array is Symmetrical!\n");
else
printf(_Format: "The Array is not Symmetrical:\n");
return 0;
}
Run: Data_Structures_Lab_04
"C:\Users\Sonny Sparks\OneDrive\Documents\Tarleton Fall 21'\Data Structures
The Array is not Symmetrical:
Process finished with exit code 0
Project
Structure
Favorites
Database
Run
TODO
Problems
Terminal
Python Packages
CMake
Messages
Event Log
Build finished in 2 sec, 551 ms (moments ago)
13:20
LF
UTF-8
4 spaces
C: Data_Structures_Lab_04 | Debug


File Edit View Navigate Code Refactor Build Run Tools VCS Window Help Data_Structures_Lab_04 - main.c
Data_Structures_Lab_04 main.c
Data_Structures_Lab_04 | Debug
main.c
1 // Data Structures Lab 4
2 // Data Structures
3 // Edwin (Sonny) Sparks
4 // September 15, 2021
5 #include <stdio.h>
6
7 int q(int n) {
8 if(n==1)
9 return 1;
10 else
11 return q(n: n-1)+2*n-1;
12 }
13
14 int main() {
15 for(int i=1;i<=10;i++)
16 printf(_Format: "i=%d --> q(i)=%d\n", i,q(i));
17 return 0;
18 }
19
Run: Data_Structures_Lab_04
"C:\Users\Sonny Sparks\OneDrive\Documents\Tarleton Fall 21'\Data Structures
i=1 --> q(i)=1
i=2 --> q(i)=4
i=3 --> q(i)=9
i=4 --> q(i)=16
i=5 --> q(i)=25
i=6 --> q(i)=36
i=7 --> q(i)=49
i=8 --> q(i)=64
i=9 --> q(i)=81
i=10 --> q(i)=100
Process finished with exit code 0
Project
Structure
Favorites
Database
Run
main
TODO
Problems
Terminal
Python Packages
CMake
Messages
Event Log
Build finished in 889 ms (moments ago)
16:32 LF UTF-8 4 spaces C: Data_Structures_Lab_04 | Debug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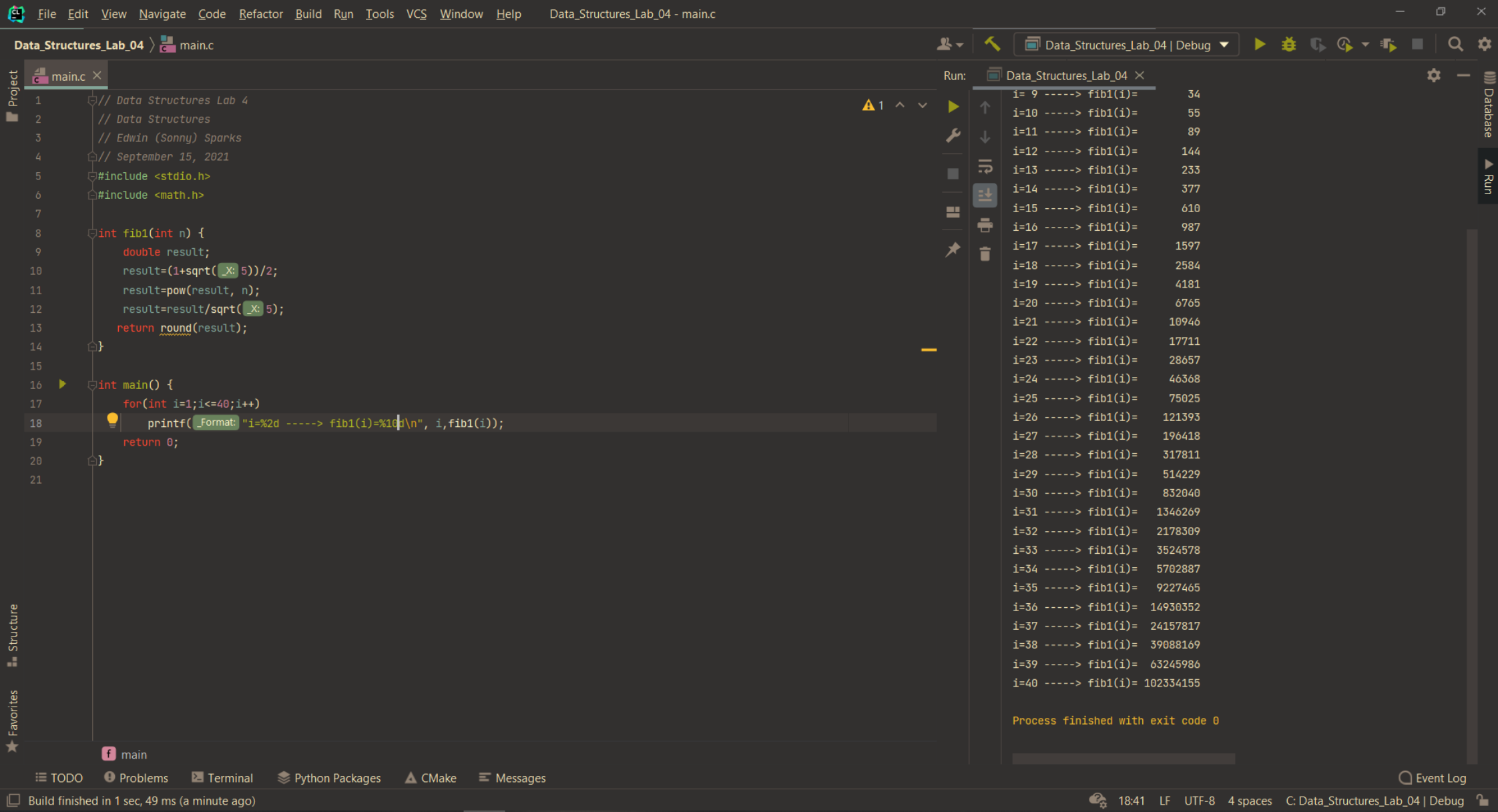
Data_Structures_Lab_04 | Debug
main.c
// Data Structures Lab 4
// Data Structures
// Edwin (Sonny) Sparks
// September 15, 2021
#include <stdio.h>
int q(int n) {
if(n==1)
return 1;
else
return q(n: n-1)+2*n-1;
}
int main() {
for(int i=1;i<=25;i++)
printf(_Format: "i=%2d -----> q(i)=%3d\n", i,q(i));
return 0;
}
Run: Data_Structures_Lab_04
"C:\Users\Sonny Sparks\OneDrive\Documents\Tarleton Fall 21'\Data Structures
i= 1 -----> q(i)= 1
i= 2 -----> q(i)= 4
i= 3 -----> q(i)= 9
i= 4 -----> q(i)= 16
i= 5 -----> q(i)= 25
i= 6 -----> q(i)= 36
i= 7 -----> q(i)= 49
i= 8 -----> q(i)= 64
i= 9 -----> q(i)= 81
i=10 -----> q(i)=100
i=11 -----> q(i)=121
i=12 -----> q(i)=144
i=13 -----> q(i)=169
i=14 -----> q(i)=196
i=15 -----> q(i)=225
i=16 -----> q(i)=256
i=17 -----> q(i)=289
i=18 -----> q(i)=324
i=19 -----> q(i)=361
i=20 -----> q(i)=400
i=21 -----> q(i)=441
i=22 -----> q(i)=484
i=23 -----> q(i)=529
i=24 -----> q(i)=576
i=25 -----> q(i)=625
Process finished with exit code 0
Project
Structure
Favorites
Database
Run
TODO
Problems
Terminal
Python Packages
CMake
Messages
Event Log
Build finished in 703 ms (moments ago)
4:22 LF UTF-8 4 spaces C: Data_Structures_Lab_04 | Debug


File Edit View Navigate Code Refactor Build Run Tools VCS Window Help Data_Structures_Lab_04 - main.c
Data_Structures_Lab_04 main.c
Data_Structures_Lab_04 | Debug
main.c
// Data Structures Lab 4
// Data Structures
// Edwin (Sonny) Sparks
// September 15, 2021
#include <stdio.h>
#include <math.h>
int fib1(int n) {
double result;
result=(1+sqrt(_X: 5))/2;
result=pow(result, n);
result=result/sqrt(_X: 5);
return round(result);
}
int main() {
for(int i=1;i<=40;i++)
printf(_Format: "i=%2d -----> fib1(i)=%10d\n", i,fib1(i));
return 0;
}
Run: Data_Structures_Lab_04
i= 9 -----> fib1(i)= 34
i=10 -----> fib1(i)= 55
i=11 -----> fib1(i)= 89
i=12 -----> fib1(i)= 144
i=13 -----> fib1(i)= 233
i=14 -----> fib1(i)= 377
i=15 -----> fib1(i)= 610
i=16 -----> fib1(i)= 987
i=17 -----> fib1(i)= 1597
i=18 -----> fib1(i)= 2584
i=19 -----> fib1(i)= 4181
i=20 -----> fib1(i)= 6765
i=21 -----> fib1(i)= 10946
i=22 -----> fib1(i)= 17711
i=23 -----> fib1(i)= 28657
i=24 -----> fib1(i)= 46368
i=25 -----> fib1(i)= 75025
i=26 -----> fib1(i)= 121393
i=27 -----> fib1(i)= 196418
i=28 -----> fib1(i)= 317811
i=29 -----> fib1(i)= 514229
i=30 -----> fib1(i)= 832040
i=31 -----> fib1(i)= 1346269
i=32 -----> fib1(i)= 2178309
i=33 -----> fib1(i)= 3524578
i=34 -----> fib1(i)= 5702887
i=35 -----> fib1(i)= 9227465
i=36 -----> fib1(i)= 14930352
i=37 -----> fib1(i)= 24157817
i=38 -----> fib1(i)= 39088169
i=39 -----> fib1(i)= 63245986
i=40 -----> fib1(i)= 102334155
Process finished with exit code 0
main
TODO Problems Terminal Python Packages CMake Messages
Event Log
Build finished in 1 sec, 49 ms (a minute ago)
18:41 LF UTF-8 4 spaces C: Data_Structures_Lab_04 | Debug