

Factorial Overflow Detection

This assignment is designed to demonstrate the various ways to execute iteration using an iteration and equivalent recursion to calculate factorials.

In this assignment the program will create a calculation class that has a template parameter that indicates the data type to do the calculations on.

The program is to be designed to calculate factorials until an overflow is encountered using a loop technique and a recursive method. Both calculation techniques use forward calculation.

The methods in the calculation class will have methods that calculate using a class template data type

The objects for the calculation class will get instantiated and use 3 template arguments:

- `uint16_t`
- `uint32_t`
- `uint64_t`

The following demonstrates how to time an activity:

```
auto timeStart = steady_clock::now();
```

do something...

```
auto timeElapsed = duration_cast<nanoseconds> (steady_clock::now() - timeStart);
```

Use the following statement to put commas in integers sent to cout:

```
cout.imbue(locale(""));
```

This statement should be one the first statements in main.

The main.cpp file is provided in the assignment.

Do not change any of the provided code.

For your code development efforts, you will look for comments that have \$\$ to denote areas that you need to code up a solution.

See the following to see a correct output and to guide your display output.

Factorial Overflow Detection

Sample Output

16-bit unsigned Factorial Loop

1	1
2	2
3	6
4	24
5	120
6	720
7	5,040
8	40,320

Unsigned overflow at : 9
Time Elapsed (nano) : 17,328,500

16 bit unsigned Factorial Recursion

1	1
2	2
3	6
4	24
5	120
6	720
7	5,040
8	40,320

Unsigned overflow at : 9
Time Elapsed (nano) : 15,974,500

32 bit unsigned Factorial Loop

1	1
2	2
3	6
4	24
5	120
6	720
7	5,040
8	40,320
9	362,880
10	3,628,800
11	39,916,800
12	479,001,600

Unsigned overflow at : 13
Time Elapsed (nano) : 36,162,800

32 bit unsigned Factorial Recursion

1	1
2	2
3	6
4	24
5	120
6	720
7	5,040
8	40,320
9	362,880
10	3,628,800
11	39,916,800
12	479,001,600

Unsigned overflow at : 13
Time Elapsed (nano) : 29,614,500

Factorial Overflow Detection

64 bit unsigned Factorial Loop

1	1
2	2
3	6
4	24
5	120
6	720
7	5,040
8	40,320
9	362,880
10	3,628,800
11	39,916,800
12	479,001,600
13	6,227,020,800
14	87,178,291,200
15	1,307,674,368,000
16	20,922,789,888,000
17	355,687,428,096,000
18	6,402,373,705,728,000
19	121,645,100,408,832,000
20	2,432,902,008,176,640,000

Unsigned overflow at : 21
Time Elapsed (nano) : 51,811,700

64 bit unsigned Factorial Recursion

1	1
2	2
3	6
4	24
5	120
6	720
7	5,040
8	40,320
9	362,880
10	3,628,800
11	39,916,800
12	479,001,600
13	6,227,020,800
14	87,178,291,200
15	1,307,674,368,000
16	20,922,789,888,000
17	355,687,428,096,000
18	6,402,373,705,728,000
19	121,645,100,408,832,000
20	2,432,902,008,176,640,000

Unsigned overflow at : 21
Time Elapsed (nano) : 46,383,000

Press enter key to end