Factorial Overflow Detection

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
- unit32_t
- unit64_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);
```

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
```