Assignment #3

Due: 10/05/2018

1) The infinite series $\sum_{n=1}^{\infty} \frac{1}{n}$ is divergent. Write a C or C ++ program to answer the following questions for both single precision (SP) and double precision (DP) calculations. Provide your answers in a table format.

- **a.** What is the largest positive integer that can be represented on CRC's H2P cluster? You have to use a 64-bit computer. You have to print the value from the computer program to practice `printf` function or the equivalent in C++
- **b.** What is the machine epsilon for single precision and double precision computations? You have to print the value from the computer program.
- **c.** At what value of *n* does the partial sum stop changing for SP & DP? You may need to modify the code to find the answer.
- **d.** What is largest value for the divergent series that can be obtained on your computer?
- **e.** How long does it take to run in single precision vs. double precision? Comment on your findings.

Note: Double precision computations takes a lot of time. Use the SLURM script to submit your job to the cluster. Record your final results after running your code for one hour of wall time. Print your results at every 50,000 steps or so in a text file so you can check your results once your job quits.

`timer.h` file can be used to time the sections of your code.

2) Write a C or C++ program to compute the exponential function using the infinite series

$$e^x = 1 + \frac{x}{1!} + \frac{x^2}{2!} + \frac{x^3}{3!} + \cdots, \qquad -\infty < x < \infty$$

Test your program for x=±1, ±5, ±10, ±15, ±20. Print your results in 6 significant digits using single precision computation and 15 significant digits using double precision computations and compare your results with the built-in math function **`exp(x)`**. In developing your program, consider the following and implement your decision

- **a)** Summing in the natural order, what stopping criterion should you use to calculate the infinite series?
- **b)** Can you use the series in this form to obtain accurate results for x<0? (Hint: $e^{-x} = 1/e^x$)
- **c)** Can you rearrange the series or regroup the series terms in any way to obtain more accurate results for single precision calculations?