ALGONQUIN COLLEGE

Computer Engineering Technology – Computing Science

**Course:** Numerical Computing – CST8233
**Term:** Fall 2021

# Lab #8

## • Objectives

The main objective of this lab is to use R program to implement Taylor Series.

## • Earning

This lab worth 1.5 % of your final course mark. Each student should complete this lab and demo the codes of the exercises to the lab professor during the lab session.

## • Steps

### Step 1. Taylor Series

Taylor series are used to expand a function around a constant value, $c$. This series is infinite series and is given as follows:

$$f(x) = \sum_{n=0}^{\infty} \frac{f^n(c)}{n!}(x-c)^n$$

where $f^n(c)$ is the $n^{th}$ derivative of $f(x)$ and $c$ is a constant. In Maclaurin series, the value of this constant is zero.

### Step 2. Exercise

A. Find Taylor series for $f(x) = \ln x$. You need to follow the same steps explained in the class except that using the constant $c$ instead of zero. Show that Taylor series is given as follows:

$$\ln x = \sum_{n=1}^{\infty} \frac{(-1)^{n-1}}{n}(x-c)^n$$

B. Write R program that takes the value of $x$ as an input from the user and then, it computes the value of the series for up to ten terms $n = 1, 2, \dots, 10$. The output of your code must be a table that shows the value of the function at each term around $c = 1$. Also, the table should show the absolute and relative errors of each result. The output should look like the following:

```
Please enter the value of x:

Term  ln(x)       Absolute error    Relative error
-------------------------------------------------
1
2
3
4
5
6
7
8
9
10
```

C. Change the number of terms from 10 to 100 and plot the value of the series as a function of the number of terms.

You need to demo this to your lab professor.