CMPT/MATH 420: Numerical Analysis

Laboratory 9

Due: End of Lab Period Nov. 14

********** For this lab, work in the Lab09_shell.ipynb file on Moodle **********

1. Write a function `ClosedNewtonCotes(f, a, b, n)` that takes a continuous function on the interval $[a, b]$ and returns the approximation for $\int_a^b f(x)dx$ using basic Closed Newton-Cotes with the polynomial interpolation of `f` of degree at most `n`. When $n \leq 4$, you should use the appropriate formula from Table 1 on Worksheet 5.6, otherwise use the general method for Newton-Cotes. Your function should print a descriptive error if the function cannot be evaluated at one of the necessary points (i.e., catch any exceptions that might arise).

2. Run the code in the next cell to test which will, for each $1 \leq n \leq 7$, test your function by approximating the following integrals:

   - $\int_1^5 \left(\sin(x) - 1 + \sqrt{x}\right) dx$,
   - $\int_1^e \frac{\sin(x)}{x} dx$,
   - $\int_1^e e^{x^2} dx$,
   - $\int_0^1 \ln(x) dx$ and
   - $\int_0^5 \left(\sin(x) - 1 + \sqrt{x}\right) dx$

3. Tell Dr. Cameron if you think that as n increases, then so does the accuracy for Closed Newton-Cotes?

4. How does sage give an answer for $\int_0^1 \ln(x) dx$ when our methods failed?