MATH-131 (Numerical Methods for Scientists and Engineers) — Worksheet 10

Semester: Spring 2019, Instructor: Nicholas Knight

Due Apr. 23 at 2359. *Please remember to cite your sources, including collaborators.*

Deliverable: Submit a Live script titled `worksheet10.mlx` via CatCourses (under Assignments). Divide this file into sections, one for each of the following questions, plus an extra (final) section containing all the function definitions. Document each function definition to explain the input and output arguments. Also document key portions of the algorithm to make it clear you understand how your code works.

1. Approximate the following integral,

$$\int_0^1 \exp(x),$$

using the composite midpoint rule, composite trapezoid rule, and composite Simpson's method. Each method should involve exactly $n = 2^k + 1$ integrand evaluations, $k = 1 : 20$. On the same plot, graph the absolute error as a function of n.

2. Approximate the integral from Question 1 using `integral`, Matlab's built-in numerical integrator. What is the absolute error?

3. Repeat Question 1 for

$$\int_0^{48} \sqrt{1 + (\cos x)^2} dx,$$

using `integral` for the "exact" solution.

Optional/ungraded: Improve `integrate`'s approximation using its `AbsTol` and `RelTol` options. Also, exploit the periodicity of the integrand to improve your approximations without increasing the number of integrand evaluations.