MATH 3043, Numerical Analysis I
Fall 2018

Lab 7

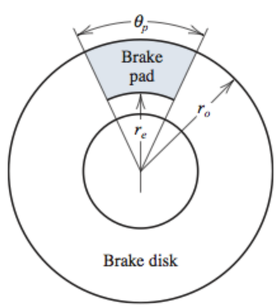
This lab will have you implementing composite numerical integration methods to approximate definite integrals.

Solutions must be submitted on Canvas and are due **October 29** at the beginning of lab. Please submit a single script file `Lab7Lastname.m` and the corresponding published file `Lab7Lastname.pdf` (for example, my submitted files would be `Lab7Zumbrum.m` and `Lab7Zumbrum.pdf`). Each solution should

- be contained in a separate cell which includes the problem number and short problem description,
- run independent of other cells,
- be adequately commented.

1. Approximate
$$\int_e^{e+2} \frac{1}{x \ln x}\, dx$$
   (a) using the Composite Trapezoidal rule with $n = 8$,
   (b) using the Composite Simpson's rule with $n = 8$.

2. To simulate the thermal characteristics of disc brakes (see the following figure), D. A. Secrist and



R. W. Hornbeck needed to approximate numerically the "area averaged lining temperature," T, of the brake pad from the equation
$$T = \frac{\displaystyle\int_{r_e}^{r_o} T(r) r\theta_p\, dr}{\displaystyle\int_{r_e}^{r_o} r\theta_p\, dr},$$
where r_e represents the radius at which the pad-disk contact begins, r_o represents the outside radius of the pad-disk contact, θ_p represents the angle subtended by the sector brake pads, and $T(r)$ is the temperature at each point of the pad, obtained numerically from analyzing the heat equation. Suppose $r_e = 0.308$ ft, $r_o = 0.478$ ft, $\theta_p = 0.7051$ radians, and the temperatures given in the following table have been calculated at the various points on the disk. Approximate T using the Composite Trapezoidal rule.

r (ft)	$T(r)$ (°F)
0.308	640
0.325	794
0.342	885
0.359	943
0.376	1034
0.393	1064
0.410	1114
0.427	1152
0.444	1204
0.461	1222
0.478	1239

3. The Gateway Arch in St. Louis was constructed using the equation

$$y = 211.49 - 20.96 \cosh 0.03291765x$$

for the central curve of the arch, where x and y are measured in meters and $|x| \leq 91.20$. Set up an integral for the length of the central curve, and approximate the length to the nearest meter using the Composite Simpson's rule (with an even n required to achieve this accuracy from the error bound).