**MATH 3043, Numerical Analysis I**
Fall 2020

**Lab 6**

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

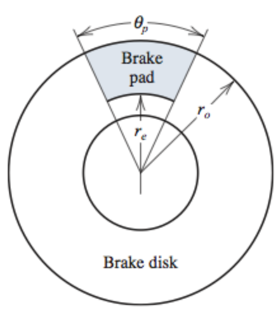
Solutions must be submitted on Canvas by **October 25** at **11:59 PM**. Please submit a single script file `Lab6Lastname.m` and the corresponding published file `Lab6Lastname.pdf` (for example, my submitted files would be `Lab6Zumbrum.m` and `Lab6Zumbrum.pdf`). Each solution should

- 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
$$\int_0^2 x^2 \ln\left(x^2+1\right)\, dx$$
   (a) using the Composite Trapezoidal rule with $n = 10$
   (b) using the Composite Simpson's rule with $n = 10$.

2. 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 using the Composite Simpson's rule with $n = 8$ (to produce an approximation accurate to the nearest meter).

3. To simulate the thermal characteristics of disc brakes (as in 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, $\theta_p$ 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 |