Assignment 01: Iterations and control flow
Assigned: 16th September 2019
Due: 27th September 2019 at 5 PM

Note: Please upload your solution as an ipynb file to the Canvas page.

The purpose of this assignment is to develop your skills in writing iterations (for) and control flow (if/else).

1. Write a python code to calculate the sum of first n elements for the following series. Use $n = 15$.

   (a) Maclaurin series for $\sin(x)$.

   $$x - \frac{x^3}{3!} + \frac{x^5}{5!} - \dots$$

   for $x = 2.5$. Check your result using `math.sin(x)`. Hint. To calculate the factorial of a number use the inbuilt function in `math` module `math.factorial(x)`

   (b) For $a = 9$ and $r = 1/3$, evaluate the geometric series for the first n terms:

   $$a + ar + ar^2 + ar^3 + \dots + ar^{n-1}$$

   Check your solution using the geometric series formula:

   $$\sum_{k=0}^{n-1} ar^k = a\left(\frac{1-r^n}{1-r}\right)$$

2. Using control flow statements write a code that tests the location of a given point $P(x_p, y_p)$ with respect to an annular ring of inner radius R_i and outer radius R_o centered at point $C(x_c, y_c)$ and report if the point lies:

   (a) inside the annulus

   (b) on the annulus

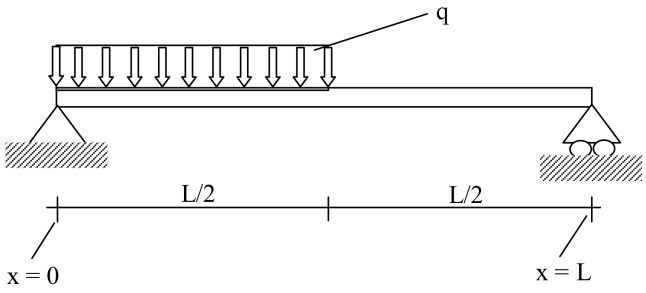
   (c) beyond the outer radius

   (d) within the inner radius

   Test your code for the following annular ring with its center located at $(x_c, y_c) = (2.0, 3.0)$ and the outer radius is 2.0 and inner radius is 1.0. Test for all possible locations of point P (inside, outside, and on either of the two circles).

3. A simply supported beam of length 20 feet is supporting a uniformly distributed load q of 4000 lb/ft to half its length as shown below. Write a Python code using conditional statements (if/else) to compute the deflection at any location x along the length of the beam.

   For the given loading, the deflection $\delta(x)$ is:



$$\delta(x) = \frac{qx}{384EI}(9L^3 - 24Lx^2 + 16x^3) \qquad 0 \leq x \leq \frac{L}{2}$$

and

$$\delta(x) = \frac{qL}{384EI}(8x^3 - 24Lx^2 + 17L^2x - L^3) \qquad \frac{L}{2} \leq x \leq L$$

Note that $x < 0$ and $x > L$ are invalid locations. Use the following values for the various parameters involved in the above expressions:

$$q = 4000\ lb/ft$$
$$L = 20\ ft$$
$$EI = 1.2x10^8\ lb.ft^2$$

Using these values, obtain the deflection at 3 locations: $x = L/4, L/2, 3L/4$.

4. Modify the above code using a for-loop to plot the displacement of the beam along its length. Plot the displacement profile when calculating x at every $0.5, 1, 2$ and 5 feet (4 different plots).