CSE 4345 – Homework #9

Assigned: Tuesday, April 23, 2019
Due: Tuesday, April 30, 2019 at 4:00pm at my office (ERB 648)
note the time and place for submitting

Note the following about the homework:

1. You must show your work to receive credit.
2. If your submission has more than one page, staple the pages. If I have to staple it, the cost is 10 points.

Assignment:

1. (do by hand) Use trigonometric functions to produce a least squares approximation (stop after producing a_0, a_1, and b_1) and the trigonometric interpolant of the following points. Keep all answers in fractional form.

t	0	$2\pi/4$	$4\pi/4$	$6\pi/4$
y	5/2	3	11/4	2

   Write the final approximation and interpolation equations (make sure to deal with evenness appropriately). Be clear for what value of t each equation holds.

2. (hand and Python solution) Given the points {(2, 2), (4, 6), (10, 5), (9, 3)}, use Monte Carlo simulation to estimate the area enclosed by the points.

   Submit a hard-copy of your calculations for the following:

   (a) The equations of the lines that form each side of the polygon.
   (b) The inequalities to use in your program.
   (c) The exact area of the polygon. The area of the polygon is found by taking one half of the sum of the determinants formed by each successive pair of points. That is, if the points in counterclockwise order (clockwise will give you the negative of the area) are (x_1, y_1), (x_2, y_2), $\ldots$, (x_n, y_n), then the area is found by

$$\text{area} = \frac{1}{2}\left(\begin{vmatrix} x_1 & x_2 \\ y_1 & y_2 \end{vmatrix} + \begin{vmatrix} x_2 & x_3 \\ y_2 & y_3 \end{vmatrix} + \cdots + \begin{vmatrix} x_n & x_1 \\ y_n & y_1 \end{vmatrix}\right)$$

   For the programming part,

   (a) On the course website is a skeleton file, `monteArea.py`, that you should add your code to and then submit.
   (b) You will write the function `estArea`, which has the signature

```
estArea(samples)
```

where

- `samples` is the number of sample points to generate for estimation

Write your own logic for determining which values fall within the polygon; do not use any built-in Python functions for doing this.

The program should produce the following output:

i. a plot of the points that fall within the enclosed area.

ii. your final estimate of the enclosed area.

3. We have a project that consists of four tasks (A, B, C and D) that must be performed sequentially. The number of days required for each task can vary. Use Monte Carlo simulation to estimate the total number of days to complete the entire project based upon the table of days required for each task.

   See Use Monte Carlo analysis for sophisticated project scheduling for more details.

Task A		Task B		Task C		Task D	
days to complete	prob.	days to complete	prob.	days to complete	prob.	days to complete	prob.
3	70%	1	50%	6	60%	4	80%
4	20%	2	50%	8	20%	5	10%
2	10%			5	20%	3	5%
						2	5%

Write the logic to generate the days conforming to the probabilities given above using the output of Numpy's `random.uniform()` function; don't use any other built-in function for getting random numbers.

(a) On the course website is a skeleton file, `monteProject.py`, that you should add your code to and then submit.

(b) You will write the function `estDuration`, which has the signature

```
minDays, maxDays, avg = estDuration(runs)
```

where

- `runs` is the number of sample projects to generate for estimation
- `minDays` is the minimum number of days estimated for the project
- `maxDays` is the maximum number of days estimated for the project
- `avg` is the average number of days of the project

General requirements about the Python problems:

a) As a comment in your source code, include your name.

b) Do not rename the skeleton file.

c) Add your code the function(s) specified above, but do not change the name of the function(s) or the way arguments are pass to/from the function(s).

d) Do not submit a Jupyter notebook.

e) The Python program should do the work. Don't perform the calculations and then hard-code the values in the code or look at the data and hard-code to this data unless instructed to do so.

f) The program should not prompt the user for values, read from files unless instructed to do so, or print things not specified to be printed in the requirements.

To submit the Python portion, do the following:

a) Create a directory using your net ID in lowercase characters plus the specific homework. For example, if your net ID is `abc1234` and the homework is `hw04`, then the directory should be named `abc1234-hw04` (zero-pad the number if necessary to make it two digits).

b) Place your .py files in this directory.

c) Do not submit the data files unless instructed to do so.

d) Zip the directory, not just the files within the directory. You must use the zip format and the name of the file (using the example above) will be `abc1234-hw04.zip`.

e) Upload the zip'd file to Blackboard.