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## Mini Project 1

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The following problem is due **Friday, April 7 at 5:00 PM**.

Steps you should follow :

1. While submitting, all of your programs should be arranged as follows: main directory should be called MP1-ID where ID stands for your roll number. For example, if your roll number is 12345, then the directory name will be MP1-12345; if your roll number is 123456, then the directory name will be MP1-123456.
2. The directory should contain two files, (i) a function file called `orthoProjectionOnCurve.m` that implements the function to solve the problem described below and (ii) a script file named `main.m` that reads as follows:

```
% the script file for testing the code

% the curve
X = @(t) X(t); % function description for X, e.g., X = @(t) 2*cos(2*pi*t)
Y = @(t) Y(t); % function description for Y, e.g., Y = @(t) 3*sin(2*pi*t)
dXdT = @(t) X'(t); % derivative for X(t), e.g., X = @(t) -4*pi*sin(2*pi*t)
dYdt = @(t) Y'(t); % derivative for Y(t), e.g., Y = @(t) 6*pi*cos(2*pi*t)

% point to be projected
x0 = xValue; % the value for x0 goes here
y0 = yValue; % the value for y0 goes here

% desired accuracy
eps = epsValue; % an epsilon specifying desired absolute error
                % in the solution

tic;
tc = orthoProjectionOnCurve(x0, y0, X, Y, dXdT, dYdt, eps);
toc;

[X(tc) Y(tc)]
```

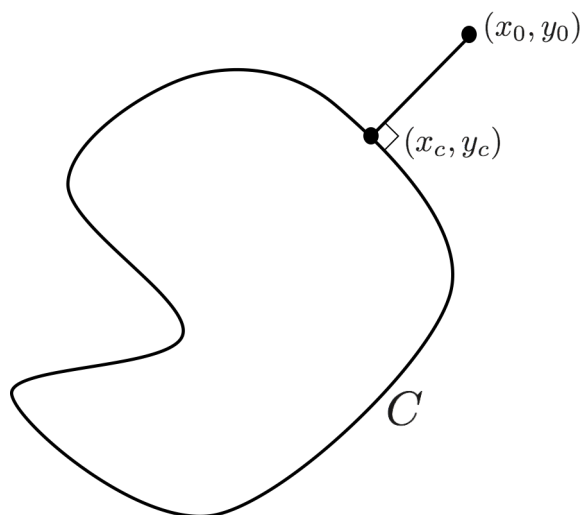
3. Upon completion of the work, once you are ready for submission, go to the directory that contains the directory MP1-ID and compress it using following command at the xterm/terminal command prompt

\$ tar cvfz MP1-ID.tgz MP1-ID

which will create a file called MP1-ID.tgz .

4. Attach this file in an email with subject MP1-ID and send it to akasha@iitk.ac.in by 5.00 pm on April 7. The supporting short report (not more than two pages) should also be submitted by 5:00 pm in hard or soft-copy. Late submission will not get any credit.

Design and implement (in MATLAB) a numerical scheme that solves the following problem:



Given

- a *simple closed curve*  $C$  in  $\mathbb{R}^2$  given by  $C : [0, 1] \rightarrow \mathbb{R}^2$  such that

$$C(t) = (X(t), Y(t)), \quad 0 \leq t \leq 1,$$

where  $X, Y : \mathbb{R} \rightarrow \mathbb{R}$  are infinitely differentiable periodic functions with period 1 (for instance, the ellipse given by  $C(t) = (2 \cos(2\pi t), 3 \sin(2\pi t))$  is one such curve), and

- a point  $(x_0, y_0) \in \mathbb{R}^2$ ,

find the *closest point*  $(x_c, y_c)$  on the curve  $C$ , that is, find  $t_c \in [0, 1)$  such that

$$\sqrt{(X(t_c) - x_0)^2 + (Y(t_c) - y_0)^2} = \min_{t \in [0, 1]} \sqrt{(X(t) - x_0)^2 + (Y(t) - y_0)^2}.$$