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MP1

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MTH308B

- We were to design a solution to a problem.

Given,

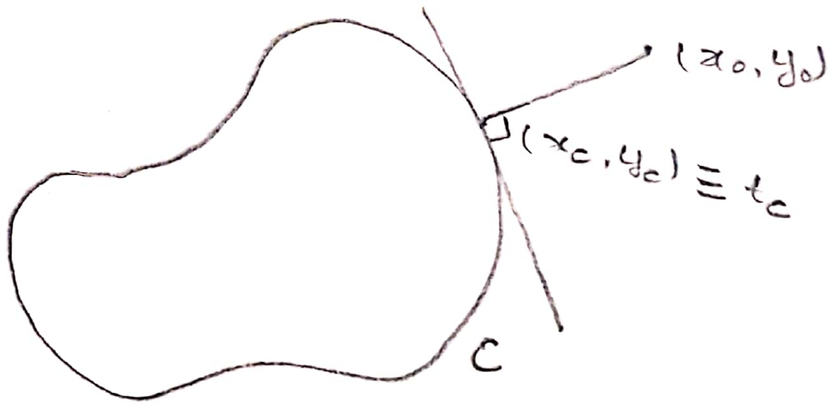
- a simple closed curve C in $\mathbb{R}^2$ given by $C: [0,1] \to \mathbb{R}^2$

s.t. $C(t) = (X(t), Y(t)), \quad 0 \le t \le 1$

where $X, Y : \mathbb{R} \to \mathbb{R}$ are infinitely differentiable function with period 1, and • a point $(x_0, y_0) \in \mathbb{R}^2$.

? we have to find the closest point (x_c, y_c) on the curve C, that is, find $t_c \in [0,1]$ s.t

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



* We start by finding the angle θ between projection vector and the tangent by finding the dot product b/n them and dividing by the magnitude of both the vectors. ~~and~~

$$\alpha = \frac{(X(t) - x_0)\, dX/dt + (Y(t) - y_0)\, dY/dt}{\sqrt{(X(t) - x_0)^2 + (Y(t) - y_0)^2} \times \sqrt{\left(\frac{dX}{dt}\right)^2 + \left(\frac{dY}{dt}\right)^2}}$$

- We compare this value with the eps value (given as an input)
- We now apply the 'Newton-Raphson Method' for finding the approximations to the roots of a real-valued function.
- We run a loop under the condition that the value of 'α'; $-eps \le \alpha \le eps$. In each step, we find the derivative of distance function 'δ' and its derivative '$\delta 1$', then we update the value of the root as approximated by the method.

$$\boxed{x_{n+1} = x_n - \frac{\delta}{\delta 1}}$$

- After finding the value of this point 'x', we find the distance from the given point (x_0, y_0).
- We store the minimum of the distance in a variable 'min' by comparing each obtained answer with this variable and updating it correspondingly. And this corresponding value of the roots in another variable, M.
- Definition of variables.

$$d = \sqrt{(X(t)-x_0)^2 + (Y(t)-y_0)^2}$$

~~deriv.~~

~~d'~~ δ = derivative of square of 'd'.

$$\delta = (X(t)-x_0)\frac{dX}{dt} + (Y(t)-y_0)\frac{dY}{dt}$$

$$\delta 1 = \delta' = (X'(t))^2 + (Y'(t))^2 + (X(t)-x_0)\frac{d^2X}{dt^2} + (Y(t)-y_0)\frac{d^2Y}{dt^2}$$

$$\frac{d^2X}{dt^2} = -\omega^2 X = -4\pi^2 X(t)$$ (as $X(t)$ is infinitely diff. function of period 1).