Assignment 2

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vector

Abstract—This document contains the solution to find the vertex of parabola

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and latex codes from

Problem

Vector-2, Example-4, Question-5

Sketch the loci of the following equation

$$y^2 = x \tag{0.0.1}$$

Solution: Given equation is

$$y^2 = x \tag{0.0.2}$$

We can write above equation as

$$\mathbf{x}^T \mathbf{V} \mathbf{x} + 2\mathbf{u}^T \mathbf{x} + f = 0 \tag{0.0.3}$$

where,

$$\mathbf{V} = \begin{pmatrix} 0 & 0 \\ 0 & 1 \end{pmatrix}, \mathbf{u} = \begin{pmatrix} -\frac{1}{2} \\ 0 \end{pmatrix}, f = 0 \tag{0.0.4}$$

$$|V| = 0 \tag{0.0.5}$$

From above equation we can say that the curve is parabola.

The vertex of parabola can be given as **c**

$$\begin{pmatrix} \mathbf{u}^T + \eta \mathbf{p_1}^T \\ V \end{pmatrix} \mathbf{c} = \begin{pmatrix} -f \\ \eta \mathbf{p_1} - \mathbf{u} \end{pmatrix} \tag{0.0.6}$$

where

$$\mathbf{p_1} = \begin{pmatrix} 1 \\ 0 \end{pmatrix}, \eta = \mathbf{p_1}^T \mathbf{u} \tag{0.0.7}$$

$$\eta = \begin{pmatrix} 1 & 0 \end{pmatrix} \begin{pmatrix} -\frac{1}{2} \\ 0 \end{pmatrix} = \begin{pmatrix} -\frac{1}{2} \end{pmatrix} \tag{0.0.8}$$

From 0.0.6 we can find out few values given below

$$\begin{pmatrix} \mathbf{u}^T + \eta \mathbf{p_1}^T \end{pmatrix} = \begin{pmatrix} -\frac{1}{2} & 0 \end{pmatrix} + \begin{pmatrix} -\frac{1}{2} \end{pmatrix} \begin{pmatrix} 1 & 0 \end{pmatrix} = \begin{pmatrix} -1 & 0 \end{pmatrix} \tag{0.0.9}$$

$$\begin{pmatrix} \eta \mathbf{p_1} - \mathbf{u} \end{pmatrix} = \begin{pmatrix} -\frac{1}{2} \end{pmatrix} \begin{pmatrix} 1 \\ 0 \end{pmatrix} - \begin{pmatrix} -\frac{1}{2} \\ 0 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \end{pmatrix} \tag{0.0.10}$$

Substituting all the values in equation 0.0.6

$$\begin{pmatrix} -1 & 0 \\ 0 & 0 \\ 0 & 1 \end{pmatrix} \mathbf{c} = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix} \tag{0.0.11}$$

$$\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix} \mathbf{c} = \begin{pmatrix} 0 \\ 0 \end{pmatrix} \tag{0.0.12}$$

$$\mathbf{c} = \begin{pmatrix} 0 \\ 0 \end{pmatrix} \tag{0.0.13}$$
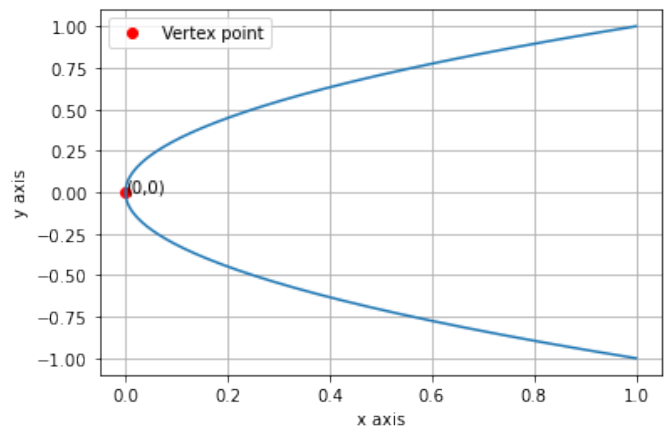
Plot of parabola obtained from Python code is shown below.

Fig. 0: Parabola with vertex c(0,0)