Optimization-Assignment

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1 Problem Statement

If x and y are positive real numbers such that $x^2 + y^2 = 1$ then Find the maximum value of (x+y)

2 Solution

Given Problem can be expressed as

$$\max_{\mathbf{x}} \mathbf{n}^T\mathbf{x} \tag{1}$$

$$\text{s.t. } \mathbf{x}^T\mathbf{V}\mathbf{x} + \mathbf{u}^T\mathbf{x} + d = 0 \tag{2}$$

where

$$\mathbf{V} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} or \mathbf{I} \tag{3}$$

$$\mathbf{u} = -\begin{pmatrix} 0 \\ 0 \end{pmatrix} \tag{4}$$

$$d = -1 \tag{5}$$

$$\mathbf{n} = \begin{pmatrix} 1 \\ 1 \end{pmatrix} \tag{6}$$

the following relaxation makes (1) a convex optimization

$$\max_{\mathbf{x}} (\mathbf{n})^T\mathbf{x} \tag{7}$$

$$\text{s.t. } \mathbf{x}^T\mathbf{V}\mathbf{x} + \mathbf{u}^T\mathbf{x} + d \leq 0 \tag{8}$$

Solve (1) using cvxpy.
The following code yields the maximum value of given condtion for the point on the curve as

https://github.com/chanduputta/FWC-Module1Assignments/blob/main/optimization/cvxopt.py

$$\mathbf{Q} = \begin{pmatrix} 1.4142 \\ 1.4142 \end{pmatrix} \tag{9}$$

from

$$\boxed{\text{Maximum value} = 1.4142 \approx \sqrt{2}} \tag{10}$$

2.1 verification

Graphically verify the solution to . by drawing a figure.
The above code plots Fig. of given curve

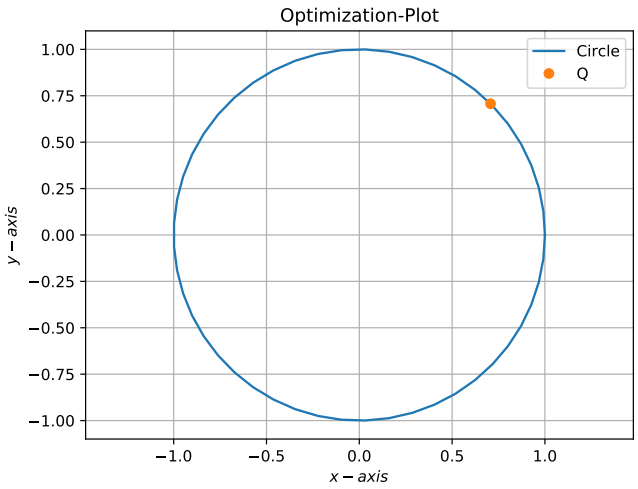

Figure 1: at **Q** the (1) gives $\sqrt{2}$ which is maximum
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