Assignment 3

Rajasekhar Jala

Find Python Codes from below link

https://github.com/Sekharjala/Matrix/

and latex-tikz codes from

https://github.com/Sekharjala/Matrix/

1 Examples I

1.1 Question 14

Prove that the point $\begin{pmatrix} -1/14 \\ 39/14 \end{pmatrix}$ is the centre of the circle circumscribing the triangle whose angular points are

$$\mathbf{A} = \begin{pmatrix} 1 \\ 1 \end{pmatrix} \quad \mathbf{B} = \begin{pmatrix} 2 \\ 3 \end{pmatrix} \quad \mathbf{C} = \begin{pmatrix} -2 \\ 2 \end{pmatrix} \tag{1.1.1}$$

2 Solution

let assume that circumecentre of the triangle ABC is **O**

$$\|\mathbf{A}-\mathbf{O}\| = \|\mathbf{B}-\mathbf{O}\| = \|\mathbf{C}-\mathbf{O}\| \tag{2.0.1}$$

$$\|\mathbf{A}-\mathbf{O}\|^2 - \|\mathbf{B}-\mathbf{O}\|^2 = 0 \tag{2.0.2}$$

Which can be simplified as

$$\left(\mathbf{A}-\mathbf{B}\right)^T \mathbf{O} = \frac{(\|A\|^2 - \|B\|^2)}{2} \tag{2.0.3}$$

Similarly,

$$\left(\mathbf{B}-\mathbf{C}\right)^T \mathbf{O} = \frac{(\|B\|^2 - \|C\|^2)}{2} \tag{2.0.4}$$

can be combined to form the matrix equation

$$\mathbf{N}^T = \mathbf{c} \tag{2.0.5}$$

$$\mathbf{O} = \mathbf{c}\mathbf{N}^{-T} \tag{2.0.6}$$

Where

$$\mathbf{N} = \begin{pmatrix} (\mathbf{A}-\mathbf{B}) & (\mathbf{B}-\mathbf{C}) \end{pmatrix} \tag{2.0.7}$$

$$\mathbf{c} = \frac{1}{2}\begin{pmatrix} \|A\|^2 - \|B\|^2 & \|B\|^2 - \|C\|^2 \end{pmatrix} \tag{2.0.8}$$

by substituting A ,B and C in (2.0.7) and (2.0.8) we get

$$\mathbf{N} = \begin{pmatrix} -1 & 4 \\ -2 & 1 \end{pmatrix}$$

$$\mathbf{N}^{-T} = \begin{pmatrix} 1/7 & -4/7 \\ 2/7 & -1/7 \end{pmatrix} \tag{2.0.9}$$

$$\mathbf{c} = \frac{1}{2}\begin{pmatrix} (2-13) & (13-8) \end{pmatrix} = \begin{pmatrix} -11/2 & 5/2 \end{pmatrix} \tag{2.0.10}$$

$$from (2.0.9) and (2.0.10) we get$$

$$\mathbf{O} = \begin{pmatrix} -1/14 & 39/14 \end{pmatrix} \tag{2.0.11}$$

$$\tag{2.0.12}$$

Hence in vector form

$$\mathbf{O} = \begin{pmatrix} -1/14 \\ 39/14 \end{pmatrix}$$

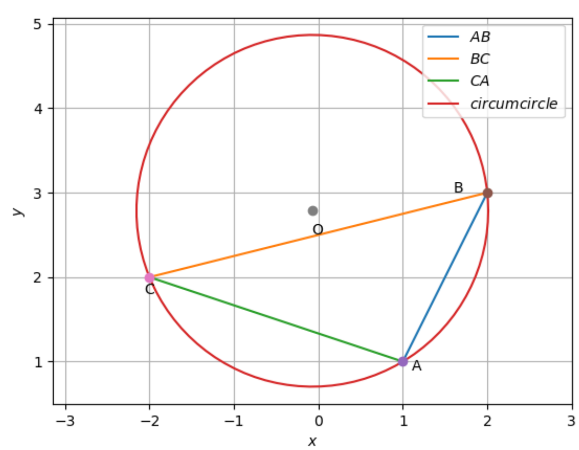

Fig. 0: Circumcircle with **O** as center