Assignment-2

Satya Sangram Mishra

Download all python codes from

https://github.com/satyasm45/Summer−Internship/tree/main/Assignment−2/Codes

and latex-tikz codes from

https://github.com/satyasm45/Summer−Internship/tree/main/Assignment−2

1 Question No. 2.28

Construct a quadrilateral ABCD such that AB =5, $\angle A = 50°$, AC = 4, BD = 5 and AD = 6.

2 Explanation

For this quadrilateral adjacent side lengths AB,AD and diagonal BD is known. So,points A,B and D can be pin-pointed from it.Assuming we are restricted to first quadrant we have:

$$\mathbf{A} = \begin{pmatrix}0\\0\end{pmatrix}, \mathbf{B} = \begin{pmatrix}5\\0\end{pmatrix}, \mathbf{D} = \begin{pmatrix}p\\q\end{pmatrix} \tag{2.0.1}$$

Then,

$$\|\mathbf{B}-\mathbf{A}\| = \|\mathbf{B}\| = 5 \quad (\because \mathbf{A} = 0) \tag{2.0.2}$$

$$\|\mathbf{D}-\mathbf{A}\|^2 = \|\mathbf{D}\|^2 = p^2+q^2 \quad (\because \mathbf{A} = 0) \tag{2.0.3}$$

$$\|\mathbf{D}-\mathbf{B}\|^2 = \|\begin{pmatrix}p\\q\end{pmatrix} - \begin{pmatrix}5\\0\end{pmatrix}\|^2 = (p-5)^2+q^2 \tag{2.0.4}$$

Also AD=6 and BD=5, So

$$\|\mathbf{D}-\mathbf{A}\|^2 = p^2+q^2 = 36 \tag{2.0.5}$$

$$\|\mathbf{D}-\mathbf{B}\|^2 = (p-5)^2+q^2 = 25 \tag{2.0.6}$$

Solving for p and q from above equations and considering values in first quadrant we have:

$$p = 3.6; q = 4.8 \tag{2.0.7}$$

We still have to find co-ordinates of C. The only information we are left with is AC=4 and $\angle A = 50°$. But we can note that $\angle A = 50°$ does not give us any additional information than what we already have. Once A,B and D are fixed, angle of A is also fixed.

So we have to verify that whether this value matches with the given value.

We have, A=Angle between BA and DA.

So, cos A=

$$\frac{(\mathbf{B}-\mathbf{A})^T.(\mathbf{D}-\mathbf{A})}{\|\mathbf{B}-\mathbf{A}\|\|\mathbf{D}-\mathbf{A}\|}$$

$$\implies cosA = (\mathbf{B}^T.\mathbf{D})/(\|\mathbf{B}\|\|\mathbf{D}\|) \quad (\because \mathbf{A} = 0)$$

$$\implies cosA = (5*3.6+4.8*0)/(5*6) = 0.6$$

$$\implies \angle A = arccos(0.6)$$

So $\angle A = 53.13°$.

But $\angle A = 50°$ is given which causes a mismatch. Therefore construction of quadrilateral with given measurements is not possible.

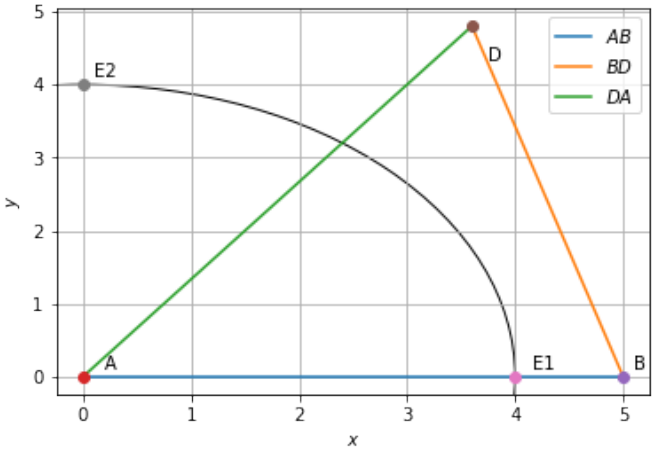

Fig. 2.1: Partial Construction

Additionally,From the above figure we can also argue that after drawing an ARC taking A as center and radius 4 many feasible values for C are possible.But no feasible C can alter $\angle A$ and change it to 50°. So,No quadrilateral is possible.