Matrix Assignment

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1 Problem Statement

In a triangle ABC, E is the mid-point of median AD.

Show that ar(ΔBED) = $\frac{1}{4}$ ar(ΔABC)

2 Diagram

Plot of Triangle is shown in figure 1, where point B is origin and points A, B, C and D are the vertices of Triangle.

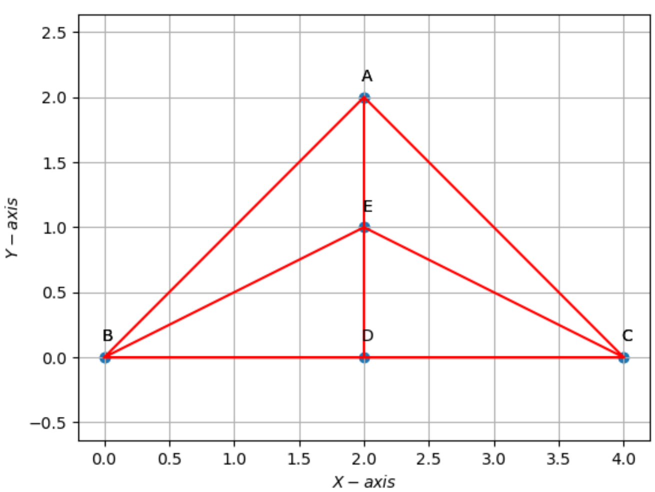

Figure 1: Triangle

3 PROOF

In ΔABC,with AD as median E is the mid-point of AD

$$||\mathbf{E}-\mathbf{A}|| = ||\mathbf{E}-\mathbf{D}||$$

$$||\mathbf{D}-\mathbf{B}|| = \frac{1}{2}||\mathbf{C}-\mathbf{B}|| \tag{1}$$

From ΔABC

$$ar(\Delta ABC) = \frac{1}{2} \times ||\mathbf{B}-\mathbf{A}|| \times ||\mathbf{C}-\mathbf{B}|| \tag{2}$$

From ΔBED

ar(ΔBED) = $\frac{1}{2} \times ||\mathbf{E}-\mathbf{B}|| \times ||\mathbf{D}-\mathbf{B}||$

From Eq(1) we can write as

$$ar(\Delta BED) = \frac{1}{2} \times ||\mathbf{E}-\mathbf{B}|| \times \frac{1}{2}||\mathbf{C}-\mathbf{B}|| \tag{3}$$

We know that from Parallelogram law of Vector Addition

$$\mathbf{E}-\mathbf{B} = \frac{1}{2}((\mathbf{B}-\mathbf{A})+\mathbf{C}-\mathbf{B})) \tag{4}$$

Substituting Eq(4) in Eq(3) & re-writing the Eq(3)

ar(ΔBED) = $\frac{1}{2} \times ((\frac{1}{2}||(\mathbf{B}-\mathbf{A})+(\mathbf{C}-\mathbf{B})||) \times \frac{1}{2}\ ||\mathbf{C}-\mathbf{B}||)$

ar(ΔBED) = $\frac{1}{2} \times \frac{1}{4}(||\mathbf{B}-\mathbf{A}|| \times ||\mathbf{C}-\mathbf{B}||)$

ar(ΔBED) =$\frac{1}{4}$ ($\frac{1}{2} \times ||\mathbf{B}-\mathbf{A}|| \times ||\mathbf{C}-\mathbf{B}||$)

From Eq(2)

ar(ΔBED) =$\frac{1}{4}$(ar(ΔABC)

$$\boxed{\text{Ar}(\Delta\ \text{BED}) = \tfrac{1}{4}\ \text{Ar}(\Delta\ \text{ABC})}$$

Hence Proved

4 Software

Download the codes given in the link below and execute them.

https://raw.githubusercontent.com/19PA1AO410/FWC-Module-1/main/Matrix