

EE5600 Assignment 1

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Abstract—This document contains the solution to a Lines and planes problem.

Download all python codes from

<https://github.com/abhishekt711/EE5600/codes>

1 PROBLEM

Quad 1) ABCD is a rectangle formed by the points

$A(-1 \ -1), B(-1 \ 4), C(5 \ 4), D(5 \ -1), P, Q, R, S$

are the midpoints of AB, BC, CD, DA respectively.

Is the Quadrilateral PQRS a

- A) Square?
- B) Rectangle?
- C) Rhombus?

2 SOLUTION

Step1: we will find the midpoint P, Q, R, S

$$P = \frac{A+B}{2} = \left(-1 \ \frac{3}{2}\right) \quad (2.0.1)$$

$$Q = \frac{B+C}{2} = (2 \ 4) \quad (2.0.2)$$

$$R = \frac{C+D}{2} = \left(5 \ \frac{3}{2}\right) \quad (2.0.3)$$

$$S = \frac{A+D}{2} = (2 \ -1) \quad (2.0.4)$$

Join P, Q, R, S to form a quadrilateral

Step2: We will check whether quadrilateral PQRS is parallelogram or not.

Diagonal Bisect Rule:

If,

$$\frac{P+R}{2} = \frac{Q+S}{2} = (2 \ 1.5) \quad (2.0.5)$$

Then, Quadrilateral PQRS is a parallelogram

Step3: We will check whether Parallelogram is rhombus or not.

If adjacent side of parallelogram are equal then it is a rhombus.

$$(P-R) = \begin{pmatrix} -6 & 0 \end{pmatrix} \quad (2.0.6)$$

$$(Q-S) = \begin{pmatrix} 0 & 5 \end{pmatrix} \quad (2.0.7)$$

$$(P-R)^T(Q-S) = \begin{pmatrix} -6 & 0 \end{pmatrix} \begin{pmatrix} 0 \\ 5 \end{pmatrix} \quad (2.0.8)$$

$$(P-R)^T(Q-S) = (0) \quad (2.0.9)$$

Diagonal bisect orthogonally. Therefore, it may be a rhombus or square.

Thus, PQRS is a rhombus.

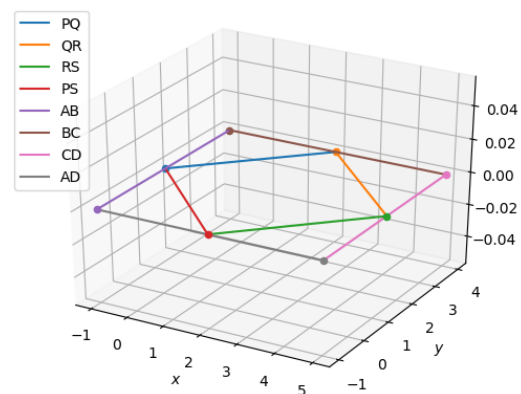


Fig. 0: Simulation of midpoint of ABCD forms PQRS.

Step4: We will check whether Parallelogram

PQRS is Square or not.

$$(\mathbf{P} - \mathbf{Q}) = \begin{pmatrix} -3 & -2.5 \end{pmatrix} \quad (2.0.10)$$

$$(\mathbf{P} - \mathbf{S}) = \begin{pmatrix} -3 & 2.5 \end{pmatrix} \quad (2.0.11)$$

If adjacent side of parallelogram are orthogonal to each other then PQRS is a Square.

$$(\mathbf{P} - \mathbf{Q})^T (\mathbf{P} - \mathbf{S}) = \begin{pmatrix} -3 & -2.5 \end{pmatrix} \begin{pmatrix} -3 \\ -2.5 \end{pmatrix} \quad (2.0.12)$$

$$(\mathbf{P} - \mathbf{Q})^T (\mathbf{P} - \mathbf{S}) = \begin{pmatrix} 2.75 \end{pmatrix} \quad (2.0.13)$$

Here the angle between adjacent side is not 90°

Hence, PQRS is not a Square.

Step 5: We will check whether PQRS is rectangle or not.

If adjacent side of parallelogram and diagonal obeys pythagoras rule then only it is a rectangle.

In (2.0.13) Rectangle condition not satisfying in this question.

Conclusion: PQRS is only a Rhombus. It is not a square and rectangle.