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11.4.2 Change of Basis

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 Calculator

Week 11 due Dec 22, 2023 21:12 IST Completed

11.4.2 Change of Basis

Video

Back to orthonormal bases (of \mathbb{R}^n) - continued

$$\begin{aligned} b &= \underbrace{QQ^{-1}}_I b = QQ^T b \\ &= \left(\begin{array}{c|c|c|c} q_0 & q_1 & \cdots & q_{n-1} \end{array} \right) \left(\begin{array}{c|c|c|c} q_0 & q_1 & \cdots & q_{n-1} \end{array} \right)^T b \end{aligned}$$

26 / 28

7:01 / 7:33

2.0x

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Reading Assignment

0 points possible (ungraded)
Read Unit 11.4.2 of the notes. [\[LINK\]](#)

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Homework 11.4.1

1/1 point (graded)
The vectors

$$\mathbf{q}_0 = \frac{\sqrt{2}}{2} \begin{pmatrix} 1 \\ 1 \end{pmatrix} = \begin{pmatrix} \frac{\sqrt{2}}{2} \\ \frac{\sqrt{2}}{2} \end{pmatrix}, \quad \mathbf{q}_1 = \frac{\sqrt{2}}{2} \begin{pmatrix} -1 \\ 1 \end{pmatrix} = \begin{pmatrix} -\frac{\sqrt{2}}{2} \\ \frac{\sqrt{2}}{2} \end{pmatrix}.$$

are mutually orthonormal.

TRUE

✔ Answer: TRUE

TRUE

Let $\mathbf{Q} = \left(\begin{array}{c|c} \mathbf{q}_0 & \mathbf{q}_1 \end{array} \right)$. Then \mathbf{q}_0 and \mathbf{q}_1 are mutually orthonormal if and only if $\mathbf{Q}^T \mathbf{Q} = \mathbf{I}$. Now,

$$\mathbf{Q}^T \mathbf{Q} = \begin{pmatrix} \frac{\sqrt{2}}{2} & -\frac{\sqrt{2}}{2} \\ \frac{\sqrt{2}}{2} & \frac{\sqrt{2}}{2} \end{pmatrix}^T \begin{pmatrix} \frac{\sqrt{2}}{2} & -\frac{\sqrt{2}}{2} \\ \frac{\sqrt{2}}{2} & \frac{\sqrt{2}}{2} \end{pmatrix} = \begin{pmatrix} \frac{\sqrt{2}}{2} & \frac{\sqrt{2}}{2} \\ -\frac{\sqrt{2}}{2} & \frac{\sqrt{2}}{2} \end{pmatrix} \begin{pmatrix} \frac{\sqrt{2}}{2} & -\frac{\sqrt{2}}{2} \\ \frac{\sqrt{2}}{2} & \frac{\sqrt{2}}{2} \end{pmatrix} = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}.$$

Hence, the vectors are mutually orthonormal.

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Answers are displayed within the problem

Homework 11.4.2.2

4/4 points (graded)
If $\mathbf{Q} \in \mathbb{R}^{n \times n}$ has mutually orthonormal columns then which of the following are true:

1. $\mathbf{Q}^T \mathbf{Q} = \mathbf{I}$

TRUE

✔ Answer: TRUE

2. $\mathbf{Q} \mathbf{Q}^T = \mathbf{I}$

TRUE

✔ Answer: TRUE

3. $\mathbf{Q} \mathbf{Q}^{-1} = \mathbf{I}$

TRUE

✔ Answer: TRUE

4. $\mathbf{Q}^{-1} = \mathbf{Q}^T$

TRUE

✔ Answer: TRUE

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Answers are displayed within the problem



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