Math 220 Assignment

November 5, 2001

Due Wednesday, November 7

Let U denote the 3×3 matrix

$$\frac{1}{3} \begin{pmatrix} 2 & 2 & 1 \\ -2 & 1 & 2 \\ -1 & 2 & -2 \end{pmatrix} ,$$

and let φ be the linear function from $\mathbf{R}^3$ to $\mathbf{R}^3$ defined by $\varphi(x) = Ux$ for all x in $\mathbf{R}^3$.

1. Show that the columns of U are mutually perpendicular vectors in $\mathbf{R}^3$ of length 1.

2. Show that the rows of the transposed matrix U^t are mutually perpendicular vectors in $\mathbf{R}^3$ of length 1.

3. Compute the matrix product U^tU.

4. Show that φ is an invertible linear function, and find the matrix for φ^{-1}.

5. Explain why the function φ preserves lengths and angles. *Hint.* What effect does applying φ have on the "dot" product of two vectors?

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http://math.albany.edu:8000/math/pers/hammond/course/mat220/assgt/la011105.html