Solutions Manual

Linear Algebra Done Right - 4th Edition

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Contents

Chapter 1

Vector Spaces

1.1 $\mathbb{R}^n$ and $\mathbb{C}^n$

4 Show that $\lambda(\alpha+\beta) = \lambda\alpha + \lambda\beta$ for $\lambda, \alpha, \beta \in \mathbb{C}$.

Proof. Assume $\lambda, \alpha, \beta \in \mathbb{C}$. Thus $\lambda = a + bi, \alpha = c + di$ and $\beta = f + gi$. Thus $\lambda(\alpha+\beta) = (a+bi)(c+di+f+gi)$. From this we get $a(c+di+f+gi)+bi(c+di+f+gi) = (ac+adi+af+agi)+(bci+bdi^2+bfi+bgi^2)$. And finally $[(ac-bd)+(ad+bc)i]+[(af-bg)+(ag+bf)i] = \lambda\alpha+\lambda\beta$. This completes our proof. ∎

7 Show that $\frac{-1+\sqrt{3}i}{2}$ is a cube root of 1 (meaning that its cube equals 1).

Proof.

$$\begin{aligned}
\left(\frac{-1+\sqrt{3}i}{2}\right)^3 &= \frac{(-1+\sqrt{3}i)^3}{2^3} \\
&= \frac{(-1+\sqrt{3}i)(-1+\sqrt{3}i)^2}{8} \\
&= \frac{(-1+\sqrt{3}i)\left[(1-3)+(-\sqrt{3}-\sqrt{3})i\right]}{8} \\
&= \frac{(-1+\sqrt{3}i)(-2+-2\sqrt{3}i)}{8} \\
&= \frac{(2+6)+(2\sqrt{3}-2\sqrt{3})i}{8} \\
&= \frac{8+0i}{8} = 1.
\end{aligned}$$

∎

9 Find $x \in \mathbb{R}^4$ such that

$$(4,-3,1,7) + 2x = (5,9,-6,8).$$

Solution.

$$\begin{aligned}(4,-3,1,7) + 2x &= (5,9,-6,8)\\ 2x &= (5,9,-6,8) - (4,-3,1,7)\\ &= (1,12,-7,1)\\ x &= (0.5,6,-3.5,0.5).\end{aligned}$$

10 Explain why there does not exist $\lambda \in \mathbb{C}$ such that

$$\lambda(2-3i, 5+4i, -6+7i) = (12-5i, 7+22i, -32-9i).$$

Solution. For λ to exist, it would have to satisfy $2\lambda = 12$ and $5\lambda = 7$ (real part of the first two coordinates). But in the first case we get $\lambda = 6$, and in the second case we get $\lambda = 1.4$. Thus λ can't exist.