
Webpage: http://dunfield.info/416

Office hours: My Monday office hours this week are moved to Wednesday, so the complete list is:
Wed 11-12, 3:30-4:30, Thur 3:30-4:30, and by appointment. My office is 378 Altgeld Hall.

Textbooks: In the assignment, the main text is abbreviated as follows:


Problems:

1. Section 2.1 of [FIS], Problem 1.

2. Section 2.1 of [FIS], Problems 2 and 3.

3. Section 2.1 of [FIS], Problem 9 (a, b, c).

4. Section 2.1 of [FIS], Problem 10.

5. Section 2.1 of [FIS], Problems 18.

6. Let $V, W$ be vector spaces, with $\dim(V) = n$, $\dim(W) = m$, and $n > m$.
   (a) Show that there is no one-to-one linear transformation $T: V \rightarrow W$.
   (b) Show that there is no onto linear transformation $T: W \rightarrow V$ (notice that $V, W$ have flipped in this expression!)
   (c) Show that a linear map $T: V \rightarrow W$ need not be onto by giving an example where it is not.
   
   Hint: See Appendix B of [FIS] for the definitions of “onto” and “one-to-one” and consult Theorems 2.4 and 2.5 in §2.1 of [FIS].

7. We define the linear transformation $T_\theta: \mathbb{R}^2 \rightarrow \mathbb{R}^2$ to be rotation counter-clockwise about the origin through angle $\theta$. Let $T_x$ be the transformation that reflects in the $x$-axis.
   (a) Write down the matrices of $T_\theta$ and $T_x$ with the respect to the standard basis $\beta = \{e_1, e_2\}$ for $\mathbb{R}^2$.
   (b) Show that for $\theta \in (0, \pi) \cup (\pi, 2\pi)$ one has
   $$T_x \circ T_\theta \neq T_\theta \circ T_x.$$
   (c) Next, show that there is some angle $\psi$ such that
   $$T_x \circ T_\psi = T_\theta \circ T_x.$$
   
   What is the relationship between $\theta$ and $\psi$? Discuss the geometric meaning of this computation.

8. Section 2.2 of [FIS], Problem 2 (a, b, c).

9. Section 2.2 of [FIS], Problem 3.

10. Section 2.2 of [FIS], Problem 5.