Question Set 4

CS 320

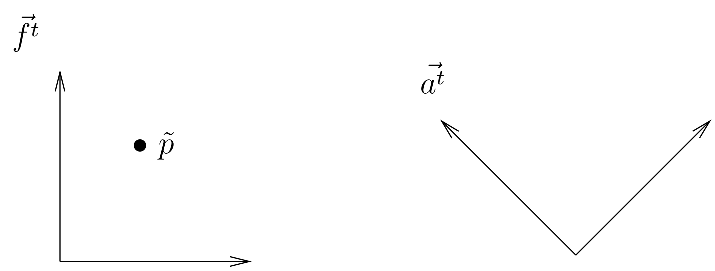
Chapter 4

1. Let

$$S = \begin{bmatrix} 0.5 & 0 & 0 & 0 \\ 0 & 0.5 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

   What transformation is accomplished by this matrix?

2. Consider S from the previous problem.



   (a) Describe $\tilde{p} = \vec{\mathbf{f}}^t\mathbf{c} \Rightarrow \vec{\mathbf{f}}^t S\mathbf{c}$ and draw the transformed point.

   (b) Describe $\tilde{p} = \vec{\mathbf{a}}^t\mathbf{c} \Rightarrow \vec{\mathbf{a}}^t S\mathbf{c}$ and draw the transformed point.

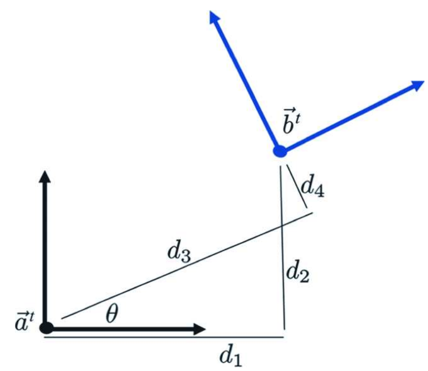
3. Let $\tilde{q} = \vec{\mathbf{f}}^t\mathbf{c}$ and $\vec{\mathbf{a}}^t = \vec{\mathbf{f}}^t A$. What are $\tilde{q}$'s coordinates with respect to $\vec{\mathbf{a}}^t$?

4. State the "left of" rule and illustrate it with an example.

5. Using the definitions of Section 4.2, draw two different sketches illustrating the transformation $\vec{\mathbf{f}}^t \Rightarrow \vec{\mathbf{f}}^t RT$.

6. Suppose $\vec{\mathbf{f}}^t$ is an orthonormal frame, and we apply the transformation $\vec{\mathbf{f}}^t \Rightarrow \vec{\mathbf{f}}^t ST$ where S is a matrix that applies a uniform scale by a factor of 2, and T translates by 1 along the x axis. How far does the frame's origin move, measured in the original units of $\vec{\mathbf{f}}^t$?

7. Consider the following two orthonormal frames $\vec{\mathbf{a}}^t$ and $\vec{\mathbf{b}}^t$



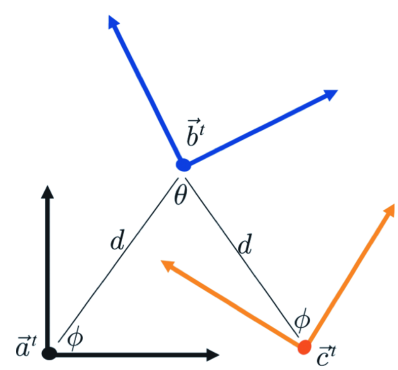
with distances given by the positive quantities d_i.

(a) What are the matrices R and T such that $\vec{\mathbf{b}}^t = \vec{\mathbf{a}}^t T R$?

(b) What are the matrices R and T such that $\vec{\mathbf{b}}^t = \vec{\mathbf{a}}^t R T$?

Your answers should not contain trigonometric terms in the matrix T.

8. Consider the following three frames.



Let $\vec{\mathbf{b}}^t = \vec{\mathbf{a}}^t N$ and $\vec{\mathbf{c}}^t = \vec{\mathbf{a}}^t M$. Express the matrix M in terms of N and θ.