1. Multiply the matrices

$$\begin{pmatrix} 2 & 5 & 1 \end{pmatrix} \begin{pmatrix} -2 \\ 3 \\ 7 \end{pmatrix}$$

   How does this relate to the dot product?

2. Multiply the matrices

$$\begin{pmatrix} 3 & 2 & 1 \\ -1 & 0 & 6 \end{pmatrix} \begin{pmatrix} 4 & -1 \\ 3 & 2 \\ 0 & 4 \end{pmatrix}$$

3. Multiply the matrices

$$\begin{pmatrix} 4 & 5 & 1 & 2 \\ -2 & 0 & 6 & 1 \\ 5 & 2 & 4 & 2 \end{pmatrix} \begin{pmatrix} -4 & -2 & 3 \\ 1 & 4 & 9 \\ 2 & 3 & -4 \\ 2 & 4 & 0 \end{pmatrix}$$

4. Multiply the matrices

$$\begin{pmatrix} 3 & 2 & 1 \\ -1 & 0 & 6 \end{pmatrix} \begin{pmatrix} 4 & -1 \\ 3 & 2 \\ 0 & 4 \end{pmatrix}$$

5. Multiply the matrices

$$\begin{pmatrix} 1 & 2 & 4 \\ 2 & 4 & 1 \\ -1 & 0 & 3 \end{pmatrix} \begin{pmatrix} \frac{6}{7} & -\frac{3}{7} & -1 \\ -\frac{1}{2} & \frac{1}{2} & \frac{1}{2} \\ \frac{2}{7} & -\frac{1}{7} & 0 \end{pmatrix}$$

6. Explain why you can not multiply the matricies

$$\begin{pmatrix} 4 & 5 & 1 & 2 & 3 \\ -2 & 0 & 6 & 1 & 1 \\ 5 & 2 & 4 & 2 & 0 \end{pmatrix} \begin{pmatrix} -4 & -2 & 3 \\ 1 & 4 & 9 \\ 2 & 3 & -4 \\ 2 & 4 & 0 \end{pmatrix}$$

7. Suppose that $w = f(x, y) = x^2 + 2xy$, $(x, y) = g(r, \theta) = (r\cos\theta, r\sin\theta)$. Write the Jacobian for f, the Jacobian for g and the Jacobian for $f \circ g$. Identify the partial deriviatives of w with respect to r and with respect to θ.

8. Suppose that $(q, w, t) = f(x, y, z) = (x^2 + y^2 + z^2, x + y, z^2 - xy)$ and $(x, y, z) = g(\rho, \theta, \phi) = (\rho\sin\phi\cos\theta, \rho\sin\phi\sin\theta, \rho\cos\phi)$. Write the Jacobian for fa and the Jacobian for g. Then use these matrices to compute the Jacobian for $f \circ g$. Identify the partial deriviatives as entires in the Jacobian for $g \circ f$.

9. Suppose that $(w, z) = (x^2y, e^x + y)$ and $(x, y) = (\ln st, s^2 + t)$. Compute the partial derivates of w and z by directly computing the composition of functions (substitute first then compute the partials) and then by multiplying the appropriate Jacobians. Be sure to identify the functions f and g.

10. Suppose that $(w, v, u) = (yz, zx, xy)$ and $(x, y, z) = (se^r, st, rs)$. Compute the partial derivates of w, v, and u by directly computing the composition of functions (substitute first then compute the partials) and then by multiplying the appropriate Jacobians. Be sure to identify the functions f and g.