

University of Utah  
Math 2210, Fall 2008

Name: Solutions

Quiz # 1  
Time: 10 minutes

Please try to carefully explain/justify the steps leading to your solutions.

Part 1: (10 points) Consider the vectors  $\mathbf{u} = (1, -1, 1)$  and  $\mathbf{v} = (-1, 1, 2)$ . Find  $\mathbf{u} + \mathbf{v}$ ,  $\mathbf{u} \cdot \mathbf{v}$ , and  $\mathbf{u} \times \mathbf{v}$ .

$$\begin{aligned}\vec{u} + \vec{v} &= (1-1, -1+1, 1+2) = (0, 0, 3) \\ \vec{u} \cdot \vec{v} &= 1 \times (-1) + (-1) \times 1 + 1 \times 2 = 0 \quad (\vec{u} \text{ and } \vec{v} \text{ are orthogonal}) \\ \vec{u} \times \vec{v} &= \begin{pmatrix} 1 \\ -1 \\ 1 \end{pmatrix} \times \begin{pmatrix} -1 \\ 1 \\ 2 \end{pmatrix} = \begin{pmatrix} (-1) \times 2 - 1 \times 1 \\ -(1 \times 2 - 1 \times (-1)) \\ 1 \times 1 - (-1) \times (-1) \end{pmatrix} = \begin{pmatrix} -3 \\ -3 \\ 0 \end{pmatrix}\end{aligned}$$

Part 2: (10 points) Consider the 3 points  $P_1 = (1, 0, 1)$ ,  $P_2 = (2, -1, 2)$ , and  $P_3 = (0, 1, 3)$ . Note that  $\overrightarrow{P_1P_2} = \mathbf{u}$  and  $\overrightarrow{P_1P_3} = \mathbf{v}$  where  $\mathbf{u}$  and  $\mathbf{v}$  are as in Part 1. (a) Find a vector orthogonal to the plane  $P$  containing  $P_1$ ,  $P_2$ , and  $P_3$ . (b) Find an equation for  $P$ .

(a) Since  $\overrightarrow{P_1P_2} = \vec{u}$  and  $\overrightarrow{P_1P_3} = \vec{v}$ , we know that  $\vec{u} \times \vec{v} = \begin{pmatrix} -3 \\ -3 \\ 0 \end{pmatrix}$  is a vector orthogonal to the plane  $P$  containing  $P_1, P_2, P_3$ .

(b) An equation for this plane is therefore:  
$$-3(x-1) - 3(y-0) + 0(z-1) = 0$$
  
coordinates of  $P_1$   
coordinates of  $\vec{u} \times \vec{v}$

which can be rewritten as:  $-3x - 3y = -3$ .