

## Math351 Homework 5, Fall 2008

*Due Monday, November 3*

1. For the given vectors, compute  $3\mathbf{u} - 2\mathbf{v}$ ,  $\|\mathbf{u}\|$ ,  $\|\mathbf{v}\|$ ,  $(\mathbf{u} \cdot \mathbf{v})$  and the angle  $\theta$  between  $\mathbf{u}$  and  $\mathbf{v}$ . Normalize  $\mathbf{u}$  (i.e. compute the unit vector  $\frac{\mathbf{u}}{\|\mathbf{u}\|}$ ).

(a)

$$\mathbf{u} = [1, 2, -2] \quad \mathbf{v} = [2, 0, -2] \quad \text{in } \mathbb{R}^3.$$

(b)

$$\mathbf{u} = [3, 2, 0, -1, 1] \quad \mathbf{v} = [-5, 0, 0, 2, 4] \quad \text{in } \mathbb{R}^5.$$

2. Using vector algebra, solve the vector  $\mathbf{x} \in \mathbb{R}^n$  in terms of vectors  $\mathbf{a} \in \mathbb{R}^n$  and  $\mathbf{b} \in \mathbb{R}^n$

$$\mathbf{x} + 2\mathbf{a} - \mathbf{b} = 3(\mathbf{x} + \mathbf{a}) - 2(2\mathbf{a} - \mathbf{b}).$$

3. Find all values of  $k$  for which the two vectors are orthogonal

$$\mathbf{u} = [3, -3, 2, 1], \quad \mathbf{v} = [-2, k, 1, k^2] \quad \text{in } \mathbb{R}^4.$$

4. Find all vectors  $\mathbf{u} = [x, y, 1]$  that are orthogonal to both  $\mathbf{a} = [3, 1, -1]$  and  $\mathbf{b} = [-3, 2, 2]$ .

5. Find the projection of  $\mathbf{v}$  onto  $\mathbf{u}$  and the distance of  $\mathbf{v}$  from  $\mathbf{u}$

(a)

$$\mathbf{u} = [1, 1, -1], \quad \mathbf{v} = [2, -1, -1], \quad \text{in } \mathbb{R}^3.$$

(b)

$$\mathbf{u} = [1, -1, 0, 2], \quad \mathbf{v} = [2, 1, 0, 1], \quad \text{in } \mathbb{R}^4.$$

6. (a) Find the equation of the line in  $\mathbb{R}^2$  passing through  $P = (1, 2)$  with normal vector  $\mathbf{n} = [5, -3]$ .

- (b) Find the equation of the plane in  $\mathbb{R}^3$  passing through  $P = (0, 0, 0)$  with normal vector  $\mathbf{n} = [2, -3, 1]$ .

7. (a) Find the equation of the line in  $\mathbb{R}^2$  passing through  $P = (1, -1)$  with directional vector  $\mathbf{d} = [1, -2]$ .

- (b) Find the equation of the plane in  $\mathbb{R}^3$  passing through  $P = (1, 2, 1)$  with directional vectors  $\mathbf{u} = [1, -1, 1]$  and  $\mathbf{v} = [1, 0, -1]$ .