Homework 1, due Friday, May 23rd in class.

(1) Compute the sum of the vectors \((-1, -1)\) and \((2, 3)\), and illustrate this sum geometrically.

(2) Find the angle between the vectors \((0, 1, 1)\) and \((1, 0, 1)\).

(3) Find a unit vector that is orthogonal to both \(\vec{i} + \vec{j}\) and \(\vec{i} + \vec{k}\).

(4) For \(\vec{a} = (1, 0, 0), \vec{b} = (1, 1, 0),\) and \(\vec{c} = (1, 1, 1)\), compute the following quantities if they have meaningful answers.

(a) \(\vec{a} \times (\vec{b} \times \vec{c})\) 
(b) \((\vec{a} \cdot \vec{b}) \times (\vec{a} \cdot \vec{c})\)

(c) \((\vec{a} \cdot \vec{b}) \vec{c}\) 
(d) \((\vec{a} \times \vec{b}) \cdot (\vec{a} \times \vec{c})\)

(e) \(\vec{a} \cdot (\vec{b} \times \vec{c})\) 
(f) \(\vec{a} \times (\vec{b} \cdot \vec{c})\)

(5) Find an implicit equation for the plane that contains the point \((2, 0, -1)\) and which has normal vector \(2\vec{j} + \vec{k}\).

(6) Find an implicit equation for the plane that contains the points \((1, 1, 0), (1, 0, 1),\) and \((0, 1, 1)\).

(7) Compute the projection of the vector \((1,1,1)\) onto the direction of the vector \((2,0,0)\).

(8) Determine the type of quadric surface defined by \(x^2 + \left(\frac{y}{9}\right)^2 + z^2 = 1\) and describe its intersection with the plane \(y = 0\).

(9) Describe the intersection of a plane \(z = s\) with the surface given by \(x^2 + 4y^2 - 4z^2 = -1\). For which values of \(s\) is the intersection empty?

(10) Rewrite the quadric surface \(z = x^2 - y^2\) in spherical coordinates in the form \(\rho = f(\theta, \phi)\).

(11) Find the center and radius of the sphere \(x^2 + y^2 + z^2 = x + y + z\).

(12) Find the largest sphere contained in the first octant (i.e. \(x \geq 0, y \geq 0, z \geq 0\)) with center \((5, 4, 3)\).