This is part 3 (of 3) of the homework which is due July 2 at the beginning of class. More problems to this lecture can be found on pages 674-675 and 683-685 in the book.

SUMMARY.

- $v \times w = (v_2w_3 - v_3w_1, v_3w_1 - v_1w_3, v_1w_2 - v_2w_1)$ **cross product**.
- $|v \times w| = |v||w| \sin(\phi)$ where ϕ is the **angle** between vectors.
  Area of parallelogram spanned by v and w.
- $v \times w$ is **orthogonal** to v and to w with length $|v||w| \sin(\phi)$
- $u \cdot (v \times w)$ **triple product**, volume of parallelepiped spanned by u, v, w.
- $n \cdot \mathbf{x} = ax + by + cz = d$, equation $\mathbf{x} = (x, y, z)$ satisfies on the **plane** with normal $n = (a, b, c)$.
- $r(t, s) = r_0 + tv + sw$ parametric equation for a **plane**. r_0, v, w are vectors.
- $r(t) = r_0 + tv$ parametric equation for a **line**, r_0, v are vectors.

1) (4 points, Problem 8 in 9.4) Find a unit vector orthogonal to $(-3, 2, 2)$ and $(6, 3, 1)$.

2) (4 points, Compare Problems 23-24 in 9.5) Find the equation of the form $ax + by + cz = d$ for a plane which passes through the three points $(2, -4, 6), (5, 1, 3)$ and $(1, 1, 1)$.

3) (4 points, Problem 10 in 9.5) Find the parametric equation for the line which is the intersection of $x + y + z = 1$ and $x + z = 0$.

4) (4 points, Problem 40 in 9.5) Find a parametric equation for the line through the point $(0, 1, 2)$ that is perpendicular to the line $x = 1 + t, y = 1 - t, z = 2t$ and intersects this line.

5) (4 points, Problem 46 in 9.5) Find the distance between the point $(3, -2, 7)$ and the plane $4x - 6y + z = 5$.

CHALLENGE PROBLEM:

Find a general formula for the volume of a tetrahedron with edges P, Q, R, S.
Hint. Find first a formula for the area of one of its triangular faces, and then a formula for the distance from the fourth point to that face.

SUPER CHALLENGE PROBLEM:

The coordinates for the edges of a cube in 4D are the 16 points $(\pm 1, \pm 1, \pm 1, \pm 1)$. Find the angle between the big diagonal connecting $(1, 1, 1, 1)$ with $(-1, -1, -1, -1)$ and the "middle diagonal" in one of 3D faces connecting $(1, 1, 1, 1)$ with $(-1, -1, -1, -1)$.
Hint: This problem uses the dot product in $\mathbf{R^4}$ and not the cross product. Could you think of a way to define a cross product in $\mathbf{R}^4$?)