WORKSHEET, SEP 1

0.1. **Lines and Planes.**

(1) Let ℓ defined by

$$x = t + 1$$
$$y = -1$$
$$z = -t$$

Find a new line ℓ_1 which Contains the origin and is perpendicular to our original line ℓ.

(2) Let P_1, P_2 and P_3 be three planes. Suppose that P_1, P_2, P_3 all contain a common line. Show that the respective normal vectors $\hat{n}_1, \hat{n}_2$, and $\hat{n}_3$ to these planes all lie in the same plane.

(3) (Harder!) Describe an algorithm which finds the minimal distance between 2 lines (which does not involve taking a derivative!) *Hint: Set up the first line as* $t\vec{v}_1 + p_1$ *and the second as* $s\vec{v}_2 + p_2$*. Also, try drawing a picture.*

0.2. **Parametric Functions.**

(1) Show that the curve
$$\vec{r}(t) = \langle 1 + t^2, 1 + t^2, 1 + t \rangle$$
does not intersect the plane
$$-2x + 3y + z = 1.$$

(2) Find $\vec{r}(t)$, the parametric equation for the circle centered at the origin with radius 1, and $\vec{s}(t)$ the parametric equation for the circle centered at $(1, 0)$. Find the points of intersection (if any) between these two curves.

(3) Two gears of radius 1 are placed side by side, with the first gear centered at the origin. A point p is marked on the boundary of the second gear. What is the parametric equation describing the path of the point as we rotate the second gear around the first gear?