CMSC 23700	**Introduction to Computer Graphics**	**Homework 1**
Autumn 2017		**Due October 19**

1. Given a ray $R(t) = \mathbf{o} + t\mathbf{d}$, with $\|\mathbf{d}\| = 1$, and a cone whose radius is r and height is h with its base centered at the origin of the $X - Y$ plane and its apex at $\langle 0, 0, h\rangle$.
   (a) What is the polynomial whose roots determine the intersection points of $R(t)$ with the side of the cone?
   (b) If the ray intersects the side of the code at the point $\mathbf{p} = \langle x, y, z\rangle$, where $0 < z < h$, what is the unit surface normal of the cone's surface at $\mathbf{p}$.
2. Given a sphere $S = \langle \mathbf{c}, r\rangle$ and a line $L(t) = \mathbf{p} + t\mathbf{d}$, such that S and L do **not** intersect, find an expression for the closest distance from the line to the sphere
3. An *oriented bounding box* (OBB) can be represented by a center point $\mathbf{p}$, a 3x3 rotation matrix $\mathbf{R}$ (the columns of this matrix define the axes of the OBB), and a vector $\mathbf{s}$ of extents (the distances from the center to the sides along each of the OBB's axes).
   (a) Define an affine transformation that takes the axis-aligned $2 \times 2 \times 2$ cube centered at the origin to the OBB.
   (b) Given a sphere $\langle \mathbf{c}, r\rangle$, outline a test to determine if the sphere intersects the OBB.