Tutorial 4: Analysis of 3D Space

1. Given three points **P1**=[10,20,5], **P2**=[15,10,10], **P3**=[25,20,10].

    a. Find a normal vector to the plane defined by **P1**, **P2** and **P3**.

    b. Let **P1**, **P2**, **P3** and **P4**=[30,20,10] define a tetrahedron. Determine if the normal vector calculated in a is an inner surface normal and, if not find the inner surface normal.

2. A tetrahedron is defined by the following four points: [10,20,5] [5,10,5] [10,10,5] [10,10,10]. The tetrahedron is part of a graphics scene to be projected perspectively onto the plane z=1 with the viewpoint at the origin.

    a. Determine whether it will be totally visible in a window with corners at [0,0] [0,5] [5,0] and [5,5].

    b. Check to see if the point [8,15,8] lies within the tetrahedron. (Hint: you can test three of the faces by inspection, the fourth requires calculating a dot product).

3. A convex object has a face with vertices (1,0,-1) (0,-1,1) and (1,1,0)

    a. What is the Cartesian equation of the plane in which the face lies?

    b. If an internal point of the object is (5,-1,5) determine if the face is visible with the viewpoint at the origin.

4. Two points of a 3D scene are (5,5,5) and (20,10,10). If the scene is viewed from the origin with plane of projection z=2, what 3D point corresponds to the mid point of the projected line?