15-462: Computer Graphics
Homework 3

First, recall that a triangle with vertices ($\boldsymbol{v}_1$, $\boldsymbol{v}_2$, $\boldsymbol{v}_3$) is equivalent to the set:

$$\left\{\alpha_1\mathbf{v}_1 + \alpha_2\mathbf{v}_2 + \alpha_3\mathbf{v}_3 \in \mathbf{R}^3 \mid 0 \leq \alpha_1, \alpha_2, \alpha_3 \leq 1\right\}.$$

Assume a light ray is parameterized by its starting position $\boldsymbol{p} = [p_x, p_y, p_z]^T$ and its direction $\boldsymbol{d} = [d_x, d_y, d_z]^T$. Assume also that you *already have defined* a function:

```
double triangle_intersect(p, d, v1, v2, v3) {...}
```

which returns the time $t > 0$ of intersection with the triangle, or -1 if there is no positive-time intersection.

1) Please write pseudocode for the intersection of a ray with the tetrahedron

$$\left\{\alpha_1\mathbf{v}_1 + \alpha_2\mathbf{v}_2 + \alpha_3\mathbf{v}_3 + \alpha_3\mathbf{v}_3 + \alpha_4\mathbf{v}_4 \in \mathbf{R}^3 \mid 0 \leq \alpha_1, \alpha_2, \alpha_3, \alpha_4 \leq 1\right\}$$

with vertices ($\boldsymbol{v}_1$, $\boldsymbol{v}_2$, $\boldsymbol{v}_3$, $\boldsymbol{v}_4$):

```
double tetrahedron_intersect(p, d, v1, v2, v3);
```

You may use the `triangle_intersect` function as a subroutine, and the return convention should be the same.

2) Please write pseudocode for the intersection of a ray with the quadratic bowl:

$$\left\{(x, y, z) \in \mathbf{R}^3 \mid z = \alpha x^2 + \beta y^2 \right\}$$

```
double bowl_intersect(p, d, α, β);
```

Again, the return convention should be the same.