1. Let \( R(t) = (1, 1, 1) + t(-1, -1, -1) \) and let \( S \) be the unit sphere at the origin. For what values of \( t \) does \( R(t) \) intersect \( S \)?

2. An *axis-aligned bounding box* (AABB) in 2D is defined by four scalar values:

\[ \langle minX, maxX, minY, maxY \rangle \]

We use \( \langle 1, -1, 1, -1 \rangle \) to denote the empty AABB. Let

\[ bb_1 = \langle minX_1, maxX_1, minY_1, maxY_1 \rangle \]

and

\[ bb_2 = \langle minX_2, maxX_2, minY_2, maxY_2 \rangle \]

be two non-empty AABBs.

(a) What is the minimum AABB that contains the union of \( bb_1 \) and \( bb_2 \)?

(b) What is the minimum AABB that contains the intersection of \( bb_1 \) and \( bb_2 \)?

(c) What is the minimum AABB that contains the difference of \( bb_1 \) and \( bb_2 \) (i.e., \( bb_1 \setminus bb_2 \))?

3. Let \( M = \begin{bmatrix} N & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 \end{bmatrix} \) be a \( 4 \times 4 \) matrix. Show that \( M\langle x, y, z, 1 \rangle^T \) is the same as \( M\langle hx, hy, hz, h \rangle^T \) after homogenization.

4. Suppose you have an application with a near plan of 10 meters, a far plane of 100 kilometers (\( 10^5 \) meters), and a minimum feature size of 1 meter. How many bits of Z-buffer do you need to avoid Z-fighting? What if the near plane is at 1 meter?