CMSC 23700	**Introduction to Computer Graphics**	**Homework 3**
Fall 2005		**Due November 3**

1. 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.,* $bb_1 \setminus bb_2$).?

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

3. 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?

4. Assuming 4 bytes per index, how many bytes are required for the *winged-edge* representation of an cube? Do not count the vertex data (*i.e.*, position), but just the topological information.

5. Consider a *closed manifold triangle mesh* of N faces. How many edges does the mesh have? Justify your answer.