**MA 341 Homework #6**

Due Friday, October 17, in Class

For each of the following five polyhedra (see separate handout on Polyhedra), provide a good sketch (or printout from SketchUp) and the list of coordinates of its vertices.

1. 333: triangle-triangle-triangle

   **Solution.** This is the regular *tetrahedron.* (`http://en.wikipedia.org/wiki/Tetrahedron`.) Begin with the coordinates of a cube, (`http://en.wikipedia.org/wiki/Cube`) say, centered at $(0, 0, 0)$. These coordinates are

   $$\begin{array}{cc} A & (-1,-1,-1) \\ B & (-1,-1,1) \\ C & (-1,1,-1) \\ D & (-1,1,1) \\ E & (1,-1,-1) \\ F & (1,-1,1) \\ G & (1,1,-1) \\ H & (1,1,1) \end{array}$$

   Select half of the vertices—a set of four vertices that are not joined by edges of the cube. So you can choose either $A, D, F, G$ or $B, C, E, H$.

2. 3333: triangle-triangle-triangle-triangle

   **Soluion.** This is the *octahedron.* (`http://en.wikipedia.org/wiki/Octahedron`.) The easiest set of vertices is to choose points on the coordinate axes.

   $$\begin{array}{cc} I & (1,0,0) \\ J & (-1,0,0) \\ K & (0,1,0) \\ L & (0,-1,0) \\ M & (0,0,1) \\ N & (0,0,-1) \end{array}$$

3. 3434: triangle-square-triangle-square

   **Solution.** This is the *cuboctahedron.* (`http://en.wikipedia.org/wiki/Cuboctahedron`.) Slice off the eight corners of the cube at the midpoints of the cube's edges. The vertices will be these twelve midpoints.

| midpoint of: | coordinates |
|---|---|
| $AB$ | $(-1,-1,0)$ |
| $CD$ | $(-1,1,0)$ |
| $EF$ | $(1,-1,0)$ |
| $GH$ | $(1,1,0)$ |
| $AC$ | $(-1,0,-1)$ |
| $BD$ | $(-1,0,1)$ |
| $EG$ | $(1,0,-1)$ |
| $FH$ | $(1,0,1)$ |
| $AE$ | $(0,-1,-1)$ |
| $BF$ | $(0,-1,1)$ |
| $CG$ | $(0,1,-1)$ |
| $DH$ | $(0,1,1)$ |

4. 366: triangle-hexagon-hexagon

   **Solution.** This is the *truncated tetrahedron.* (`http://en.wikipedia.org/wiki/Truncated_tetrahedron`.) Slice off the four corners of the tetrahedron one third of the way along the edges. Each edge of the tetrahedron will thus yield two points as it is divided into thirds.

| tetrahedron edge | dividing points |
|---|---|
| $AD$ | $(-1,-1/3,-1/3),(-1,1/3,1/3)$ |
| $AF$ | $(-1/3,-1,-1/3),(1/3,-1,1/3)$ |
| $AG$ | $(-1/3,-1/3,-1),(1/3,1/3,-1)$ |
| $DF$ | $(-1/3,1/3,1),(1/3,-1/3,1)$ |
| $DG$ | $(-1/3,1,1/3),(1/3,1,-1/3)$ |
| $FG$ | $(1,-1/3,1/3),(1,1/3,-1/3)$ |

5. 466: square-hexagon-hexagon

   **Solution.** This is the *truncated octahedron.* (`http://en.wikipedia.org/wiki/Truncated_octahedron`.) Slice off the six corners of the octahedron one third of the way along the edges. Each edge of the octahedron will thus yield two points as it is divided into thirds.

| octahedron edge | dividing points |
|---|---|
| $IK$ | $(2/3, 1/3, 0), (1/3, 2/3, 0)$ |
| $IL$ | $(2/3, -1/3), (1/3, -2/3, 0)$ |
| $IM$ | $(2/3, 0, 1/3), (1/3, 0, 2/3)$ |
| $IN$ | $(2/3, 0, -1/3), (1/3, 0, -2/3)$ |
| $JK$ | $(-2/3, 1/3, 0), (-1/3, 2/3, 0)$ |
| $JL$ | $(-2/3, -1/3, 0), (-1/3, -2/3, 0)$ |
| $JM$ | $(-2/3, 0, 1/3), (-1/3, 0, 2/3)$ |
| $JN$ | $(-2/3, 0, -1/3), (-1/3, 0, -2/3)$ |
| $KM$ | $(0, 2/3, 1/3), (0, 1/3, 2/3)$ |
| $KN$ | $(0, 2/3, -1/3), (0, 1/3, -2/3)$ |
| $LM$ | $(0, -2/3, 1/3), (0, -1/3, 2/3)$ |
| $LN$ | $(0, -2/3, -1/3), (0, -1/3, -2/3)$ |