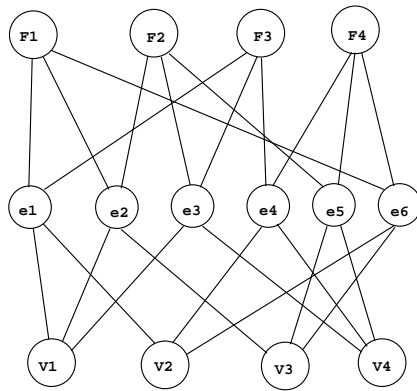


MASSACHUSETTS INSTITUTE OF TECHNOLOGY  
 13.472J/1.128J/2.158J/16.940J  
 Computational Geometry  
 Spring Term, 2003  
 Problem Set 5 on Solid Modeling

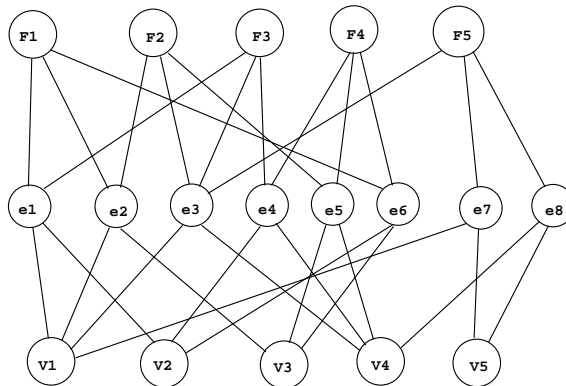
**Issued:** April 14, 2003  
**Due:** May 7, 2003  
**Weight:** 15% of total grade

**Individual Effort**

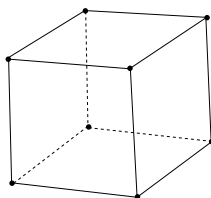
**Problem 1.** Can this incidence graph be a valid two-manifold solid's boundary? If yes, sketch a 3-D figure satisfying the incidence graph, otherwise explain. Below,  $F_i$  are planar faces,  $e_j$  are edges, and  $V_k$  are vertices.



**Problem 2.** Can this incidence graph be a valid two-manifold solid's boundary? If yes, sketch a 3-D figure satisfying the incidence graph, otherwise explain. Below,  $F_i$  are planar faces,  $e_j$  are edges, and  $V_k$  are vertices.



**Problem 3.** Given a cube, which has one solid volume, six faces, twelve edges, and eight vertices, please develop a procedure, using Euler operators, to subdivide it so that each subdivided 3-D solid is a tetrahedron and every tetrahedron is connected to one point. Draw a figure that demonstrates your result.



**Problem 4.** Verify the fact that a complete binary tree with depth  $k$  has  $2^{k+1} - 1$  nodes. How many nodes are there in a complete quadtree and a complete octree?

**Problem 5.** Show that for the octree representation of a homogeneous object, the storage requirements are a function of the surface area of boundary, rather than volume.