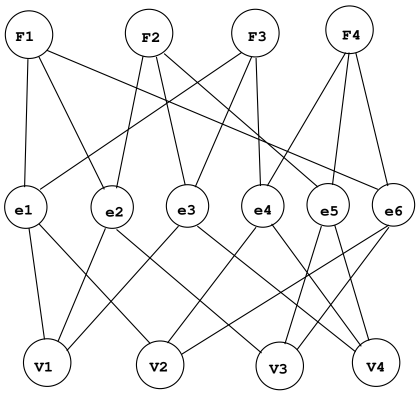
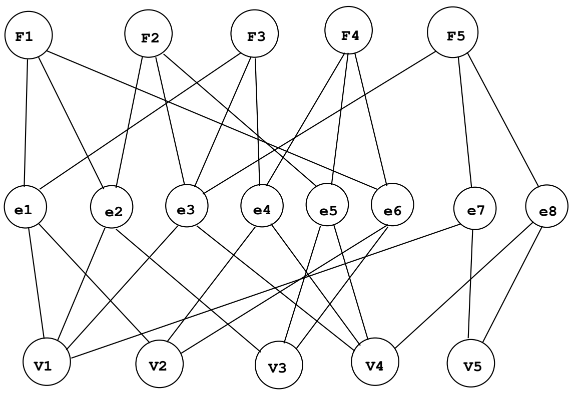
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
DEPARTMENTS OF OCEAN, MECHANICAL,
CIVIL & ENVIRONMENTAL AND AERONAUTICAL &
ASTRONAUTICAL ENGINEERING
13.472J/2.158J/1.128J/16.940J/Computational Geometry
Spring Term, 2000

Problem Set 5 on Solid Modeling
Issued: Thursday, April 13, 2000
Due: Thursday, May 4, 2000
Weight: 20% of total grade

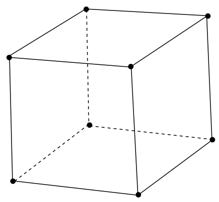
Problem 1. Can this incidence graph be a valid manifold solid's boundary? If yes, sketch a 3-D figure satisfying the incidence graph, otherwise explain. Below, F_i are planar faces, e_j are edges, and V_k are vertices.



Problem 2. Can this incidence graph be a valid 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.