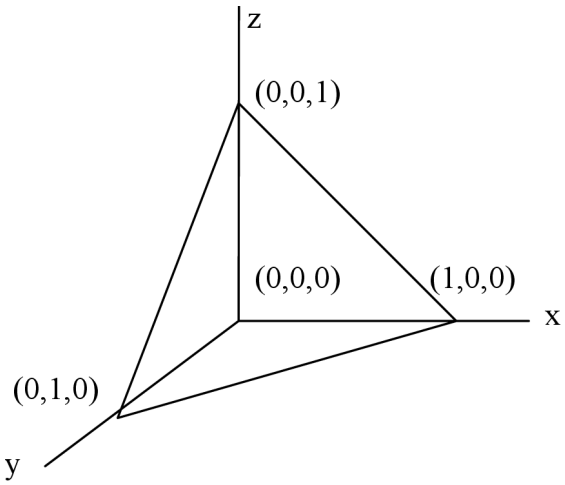
CSE 668 Spring 2013 Midterm Exam

Instructions: 50 min closed book, notes. Answer all questions in the bluebook provided.

Question 1



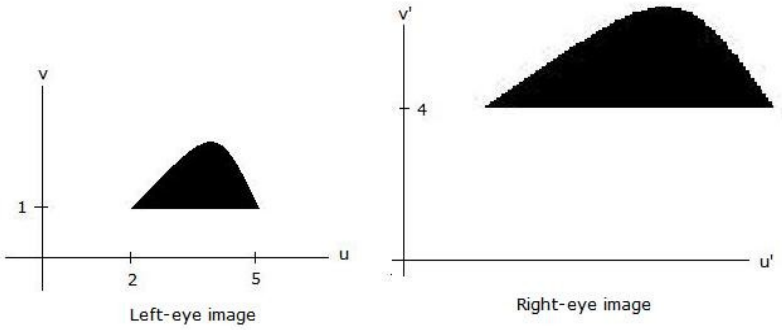
(a) Construct a polyhedral volumetric model for the given tetrahedron.
(b) Construct a sweep model for the given tetrahedron.

Question 2

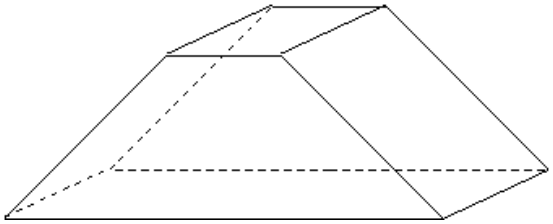
(a) Explain how computation of an epipolar line facilitates stereopsis.
(b) The Longuet-Higgins Equation for a given camera model is $u^T F u' = 0$ where the fundamental matrix F is

$$F = \begin{bmatrix} 0 & 0 & 6 \\ 0 & 0 & -1 \\ -1 & 1 & 0 \end{bmatrix}$$

The left-eye image, corresponding to the unprimed vector u in the Longuet-Higgins Equation above, is shown below. The visible black object has a straight edge in the image at v=1 which is of length 3. The same straight edge is visible in the right-eye image at v'=4. What is its length?



Question 3

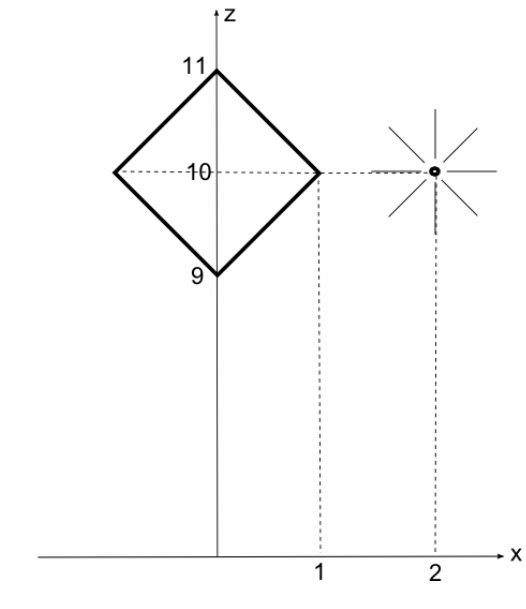


The front and back faces of this 6-sided object are trapezoids, the other 4 are rectangles. The top and bottom faces are parallel, also the front and back faces are parallel.

(a) Consider the aspect from which you can see only the front face. Sketch all the adjacent aspects, ie. all aspects connected to the front-face aspect in the aspect graph.
(b) How many topologically distinct characteristic views are there? Justify.
(c) How many nodes are there in the entire aspect graph for this object? HINT: Count all the nodes corresponding to aspects in which you see 1 face, then 2 faces, then 3 faces, etc.

Question 4

The diagram below shows the cross section in the xz plane of a three dimensional scene. The Lambertian object in the center has a square cross section which is constant for all y. This object is illuminated by a line source of light (like a thin florescent tube) oriented parallel to the y axis, so it appears as a single point at x=2, z=10 in this cross section.



(a) What point (x,y) in the image plane will be illuminated the brightest by the light reflected from the object? Use orthographic projection. Explain your reasoning.
(b) Compute the ratio of irradiance at the point (x,y)=(1/2,1/2) in the image plane to the irradiance at the point (1/4,1/4).