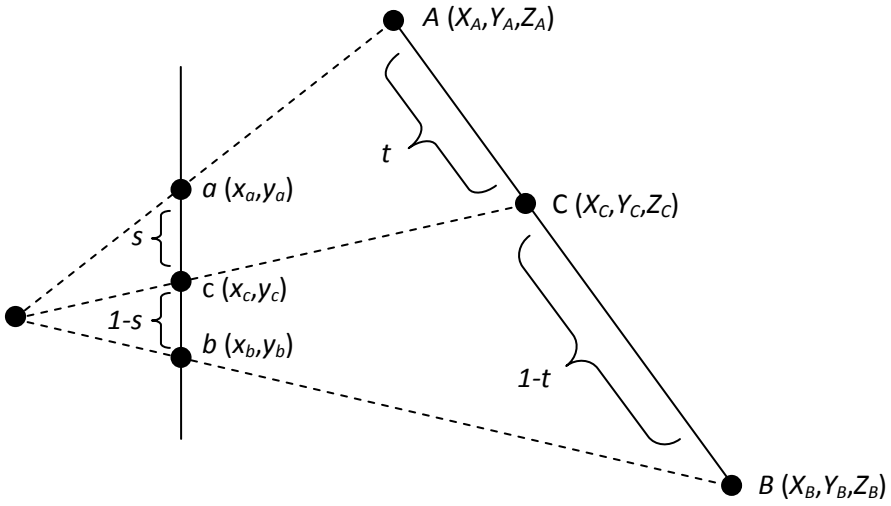
CSC 418/2504 Computer Graphics, Winter 2008

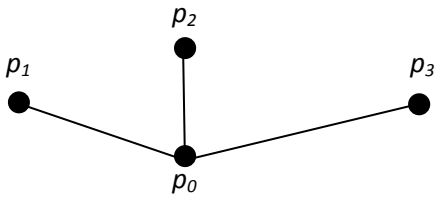
Assignment no. 2. Due: February 4 (beginning of tutorial)

1. In the figure below, the 3D segment *AB* is projected by a standard perspective camera to the image segment *ab*. The point *C* on *AB* bisects *AB* in a ratio of *t*:(1-*t*), and its projection *c* bisects *ab* in a ratio of *s*:(1-*s*). Denote by Z_A,Z_B,Z_C the depths of *A*,*B* and *C*.
   A. Express *t* as a function of s,Z_A,Z_B (in particular show it is independent of the focal length).
   B. Express Z_C as a function of s,Z_A,Z_B (simplify the result).



2. In this question we explore recovering information from the perspective projection of a rectangle. Assume the camera is a standard perspective camera, i.e. the focal point is at the origin and the X and Y axes of the world coordinate system are aligned with the x and y axes of the camera. A rectangle (on some tilted plane) is projected by the perspective camera into a quadrilateral. The vertices of the quadrilateral in the image are at p_1=(0,0.2828), p_2=(0.1818,0.5143), p_3=(0.0952,0.6734) and p_4(-0.1053,0.4466).
   A. The edges of the rectangle define two directions in 3D. Find their vanishing points.
   B. Find the vanishing line of the 3D plane of the rectangle.
   C. Let $r_1$be a ray from the focal point of the camera through one vanishing point on the screen, and r_2 a ray from the focal point through the second vanishing point. Are r_1,r_2 orthogonal?
   D. Compute the focal length.
   E. Find the normal to the plane of the rectangle.

3. A corner of a box (with three orthogonal faces) is imaged under orthographic projection as shown below, where $p_0=(0,0)$, $p_1=(-2,1)$, $p_2=(0,2)$ and $p_3(3,1)$.
   A. Compute $Z_1-Z_0, Z_2-Z_0, Z_3-Z_0$, where Z_i is the depth of p_i.
   B. Compute the normals to the box faces .



4. Read chapters 1-5 in the OpenGL programming guide (the "red book"). An online version is at http://www.glprogramming.com/red/index.html . This reading is intended to prepare you for the next programming assignments.