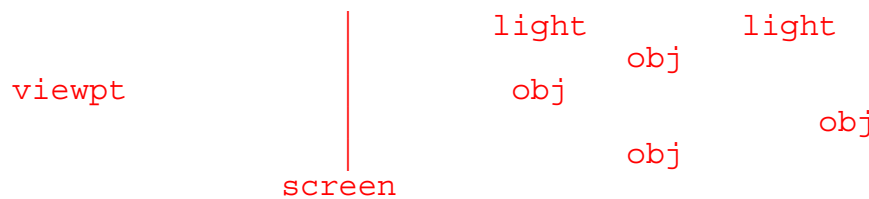


Ray tracing introduction

The objective of a ray tracing program is to render a photo-realistic image of a virtual scene in 3 dimensional space. There are three major elements involved in the process:

- 1 - *The viewpoint* This is the location in 3-d space at which the viewer of the scene is located
- 2 - *The screen* This defines a virtual *window* through which the viewer observes the scene. The window can be viewed as a discrete 2-D pixel array (pixmap) . The *raytracing* procedure computes the color of each pixel. When all pixels have been computed, the *pixmap* is written out as a .ppm file
- 3 - *The scene* The scene consists of objects and light sources



Two coordinate systems will be involved and it will be necessary to map between them:

- 1 - **Window coordinates** the coordinates of individual pixels in the window. These are two dimensional (x, y) integer numbers For example, if a 400 cols \times 300 rows image is being created the window x coordinates range from 0 to 399 and the window y coordinates range from 0 to 299.
- 2 - **World coordinates** the “natural” coordinates of the scene measured in feet/meters etc. Since world coordinates describe the entire scene these coordinates are three dimensional (x, y, z) floating point numbers.

For the sake of simplicity we will assume that

- the *screen* lies in the $z = 0.0$ plane
- the *center* of the *window* has *world coordinates* (0.0, 0.0, 0.0)
- the *lower left* corner of the *window* has *window (pixel) coordinates* (0, 0)
- the location of the *viewpoint* has a positive z coordinate
- all objects have *negative* z coordinates.