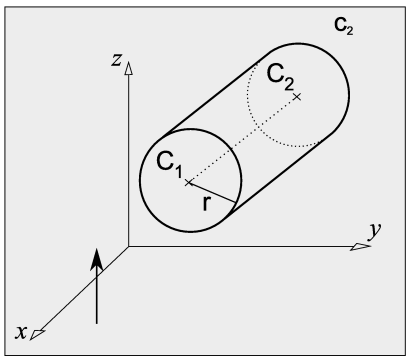
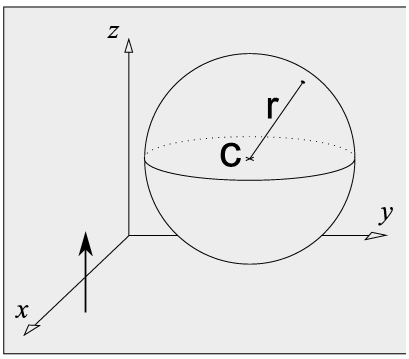
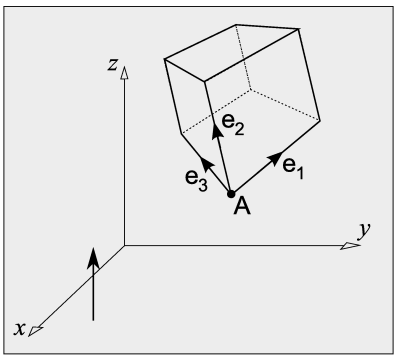
Tutorial 4: Ray Tracing

A solid modelling system uses the following primitives:

Cylinder : $\mathbf{C_1}$, $\mathbf{C_2}$, r
Sphere : $\mathbf{C}$, r
Box : $\mathbf{A}$, $\mathbf{e_1}$, $\mathbf{e_2}$, $\mathbf{e_3}$







The system is to draw the scene in orthographic projection. The viewing direction is parallel to the z axis: $(0,0,1)$.

1. Assuming a ray starts from a pixel with location (x_{pix}, y_{pix}), devise a test for each primitive to identify simple cases when the ray cannot intersect it.

2. Use your tests to decide if the following rays:

	(x_{pix}, y_{pix})
Ray 1	(32, 52)
Ray 2	(32, 58)

can be ruled out from intersecting the following objects:

	$\mathbf{C_1}$	$\mathbf{C_2}$	r
Cylinder 1	(20, 50, 50)	(50, 50, 50)	10
Cylinder 2	(35, 55, 40)	(35, 55, 60)	5

	$\mathbf{C}$	r
Sphere 1	(20, 50, 50)	10

	$\mathbf{A}$	$\mathbf{e_1}$	$\mathbf{e_2}$	$\mathbf{e_3}$
Box 1	(35, 45, 40)	(15, 0, 0)	(0, 15, 0)	(0, 0, 20)
Box 2	(30, 55, 40)	(5, 0, 0)	(0, -5, 0)	(0, 0, 20)

3. For rays that intersect in Q2, what is the surface normal at the point of intersection?

4. Devise a suitable general test for use in perspective projection.