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Selected Problem Set 10

1. What is the difference between an extent and a projective extent?

   An extent is a 3D object (such as a cube) that encloses a generic object, while a projective extent is a rectangular screen area that contains the object as it appears on the screen.

2. Why is projective extent optimization superior to the simple extent method? Use *number of intersections to compute* as your central argument.

   Projective extents do not require any intersection computation, whereas normal extents do. For example, the cubic extent may require up to six intersection computations to see if the ray goes through it.

3. What type of data structure would one use to implement projective extents such that for every pixel we exactly know with which object to compute an intersection?

   Each pixel would be given a linked list in which each element indicates an object the ray for that pixel must be intersected with.

4. Devise an algorithm to project the 8 corners of a generic cube transformed with the the matrix of the object it encloses back onto the near plane in pixel coordinates.

   Use the 8 corners of the smallest cube that contains the generic object to trace. Transform these points from generic coordinates to world coordinates with the matrix M *associated with the object. Transform these points from world coordinates to pixel coordinates. Form the smallest rectangle (in pixel coordinates) that contains all the projected points. This rectangular region is the projective extent of the object.*

5. What is an octree? Give an example that relates to ray-tracing optimization.

   An octree is a data structure that is used to subdivide 3D space. It is used in ray tracing to indicate volumes of space where objects are present or absent.