3080/GV10 Exercises

Exercise 1

Drawing polygons need to be done in a certain order (back to front) to make sure that you display the correct information. Several algorithms exist.

a) The Active Edge Table (AET) algorithm is used to scan-convert polygons to the screen. Give an overview of the algorithm and describe the data structures that it uses.

b) Two planar polygons, A and B, are to be scan-converted to the screen. It is important that if A occludes B or B occludes A, then A and B are scan-converted in the correct order. If the 2D screen coordinates of the polygons are known, give a series of conditions by which it can be determined that A and B do not overlap and thus it does not matter in which order they are scan-converted.

c) Describe the principles behind Schumacker's algorithm for object-space occlusion culling.

d) The algorithm in Question 2b is an example of a screen-space occlusion culling technique whereas the algorithm in Question 2c is an example of an object-space occlusion culling technique. Discuss the trade-offs in doing occlusion culling in screen-space or object-space.

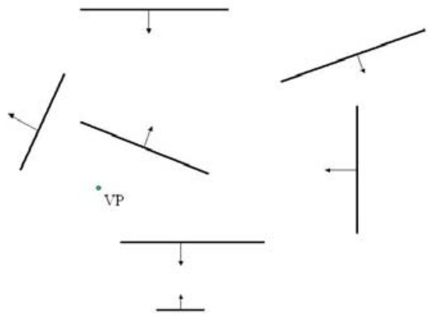
Exercise 2

a) The z-buffer algorithm extends a polygon scan conversion algorithm such as the Active Edge Table algorithm so that it supports visibility determination. Explain how the AET is extended to support z-buffering. Make sure you state what extensions you need to the AET algorithm to make it work and what other data structures you need.

b) The z-buffer algorithm is simple but uses a lot of fill rate and a lot of memory. Explain these two statements.

c) Image space algorithms try to avoid the problems of the z-buffer by calculating visibility ordering amongst the polygons. Describe one such image-space visibility ordering algorithm.

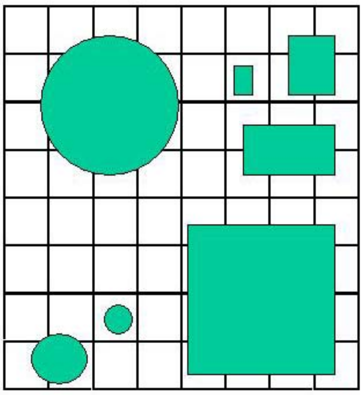
d) To determine visibility it is sometimes useful to understand where the viewpoint is situated compared to the object of the scene. BSP trees can be used for that purpose. For the following scene configuration build a BSP tree, by outlining both the partition on a drawing representing the scene and in a tree representation.



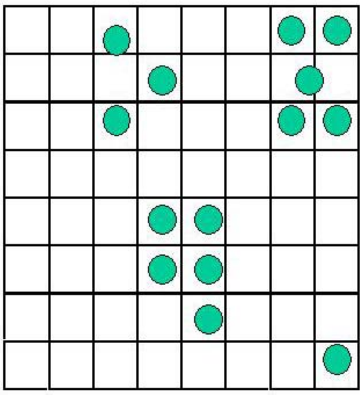
e) Provide the algorithm used to traverse the BSP tree structure to draw the polygons with a correct visibility from point VP. Apply this algorithm to the BSP representation in Question 4(d).

Exercise 3

a) Scene partitioning can be used to accelerate ray-tracing computation. Explain how ray tracing uses hierarchical bounding volumes to accelerate the computation. For the following two scenes (scene A and scene B) create a scene partitioning using hierarchical bounding volumes. Provide an explanation of the choices made to do the partition. Compare the hierarchical bounding volume partitioning to the use of a regular grid for the scenes A and B.



Scene A



Scene B

b) Try on Scene A and B other scene partitioning methods. Which one over all is the most appropriate?