# Chapter 2 Solutions

2.3 Each iteration removes the central triangle of the four created by subdivision. If we start with an equalateral triangle, the area is reduced by 3/4 by each iteration. Hence, in the limit we have no area left. If we consider the perimeter, again starting with an equaliateral triangle, we find that if the original triangle had a side length of one unit and a perimeter of three units, the three remaining triangles created by the subdivision have a combined perimeter of 4 1/2 units. Thus the perimeter increases at each iteration and in the limit we have an object with no area and an infinite perimeter.

2.9 The subtractive colors are often called the complementary colors. Suppose each color in the RGB system can be written as the triplet (r,g,b) where each value is between 0 and 1. Then, the complement of the color (r,g,b) is the color in CMY space (c,m,y) = (1-r, 1-g, 1-b). If we want a color C in RGB space, we specify its complement in CMY space. For example, if we want a full red, in RGB it is (1,0,0) and its complement is (0,1,1). In CMY, (0,1,1) is magenta and yellow, which have red in common.

2.11 The biggest advantage of relative positioning is that it corresponds to the way we think. We use terms lke "in front of," "next to,", "to the right," "forward," and "back" in speech to describe the location of objects. For structures that we will consider in Chapter 8, we shall see that when objects have parts such as a model of the human figure, we can describne their motion much easier in terms of the relative positioning of the components. In implementation, there are additional advantages to relative positioning. For example, if we store the postions of the vertices that determine and object in terms of their relative positions from a particular vertex, we can move the whole object by simpling moving the base vertex. The major disadvantage of relative positioning is that if an error is made, all furthor positions are incorrect.
To add relative positioning we must add some sort of graphics cursor which contains the position we measure from.

2.13 One strategy is to work a scanline at a time. Thus, we can find all the points along a scanline that are inside the polygon in a single calculation. Another strategy is to work with the bounding box of the polygon, the smallest box with sides aligned with the sides of the window that contains the polygon. We can obtain the bounding box by a single scan of the vertices. Then we check if a point is inside the bounding box before we check if it is inside the polygon, thus enabling us to eliminate many points without detailed consideration of the polygon.

2.15 A conceptually simple test can be based on the fact that if we circle a convex polygon in a clockwise direction, a point inside the polygon is to the right of every line determined by an edge of the polygon. We can compute the equation of each of these lines from successive pairs of vertices. If we insert the location of the interior point to be tested into the equation of the line, the resulting sign of the right side determines if the point is on the right side, left side or on the line.