**What are the side effects due to scan conversion? How can the effects be minimized?**

**Aliasing Effects (Side effects of scan conversion)**Scan conversion is essentially a systematic approach to mapping objects that are defined in continuous space to their discrete approximation. The various forms of distortion that result from this operation are collectively referred to as the aliasing effects of scan conversion.

**1. Staircase**A common example of aliasing effects is the staircase of jagged appearance, we see when scan converting a primitive such as a line of a circle. We also see the stair steps of jaggiest along the border of a filled region.

**2. Unequal Brightness** Another side effect that is less noticeable is the unequal brightness of lines of different orientation. A slanted line appears dimmer than a horizontal of vertical line although all are presented at the same intensity level. The reason for this problem can be explained when the pixels on the horizontal line are placed one unit apart, whereas those on the diagonal line are approximately 1.414 units apart. This difference in density produces the perceived difference in brightness.

**3. Picket Fence Problem**The picket fence problem occurs when an object is not aligned with of does not fit into the pixel grid properly. A picket fence can occur when the distance between two adjacent pickets is not a multiple of the unit distance between pixels. Scan converting it normally into the image space will result in uneven distances between pickets since the endpoints will have to be snapped to pixel coordinates. This is sometimes called global aliasing, as the overall length of the picket fence is approximately correct. On the other hand an attempt to maintain equal spacing will greatly distort the overall length of the fence. This is sometimes called local aliasing, as the distances between pickets are kept close to their true distances. Another example of such a problem arises with the outline font. Suppose we want to scan convert the uppercase character E from its outline description to a bitmap consisting of pixels inside the region defined by the outline. The result exhibits both asymmetry and dropout . A slight adjustment and / of realignment of the outline can lead to a reasonable outcome.

**Anti aliasing Techniques**Most aliasing artifacts, when appear in a static image at a moderate resolution are often tolerable and in many cases, negligible, However, they can have a significant impact on our viewing experience when lift untreated in a series of images that animate moving objects. For example a line being rotated around one of its endpoints becomes a rotating escalator with length altering steps. A moving object with small parts of surface details may have some of those features intermittently change shape of even disappear.  Although increasing image resolution is straightforward way to decrease the size of   many aliasing artifacts and alleviate their negative we pay a heavy price in terms of system resource and the results are not always satisfactory. On the other hand there are techniques that can greatly reduce aliasing artifacts and improve the appearance of images without increasing their resolution. These techniques are collectively referred to as anti aliasing techniques. Some anti- aliasing techniques are designed to treat a particular type of artifact. For instance, an outline font can be associated with a set of rules or hints to guide the adjustment and realignment that is necessary for its conversion into bitmaps of relatively low resolution. An example of such approach is called the

**True Type font. 1. Pre- filtering and post- Filtering**Pre- filtering and post-filtering are two types of general- purpose anti- aliasing techniques. The concept of filtering originates from the field of signal processing, where true intensity values are continuous signals that consist of elements of various frequencies. Constant intensity values that correspond to a uniform region are at the low end of the spectrum. In order to lessen the jagged appearance of lines and other contours in the image space, we seek to smooth out sudden intensity changes, or in signal- processing terms, to filter out the high frequency components. A pre- filtering techniques works on the true signal in the continuous space to derive proper values for individual pixels (filtering before sampling), whereas a post- filtering techniques takes discrete samples of the continuous signal and uses the samples to compute pixel values (sampling before filtering).

**2. Area Sampling** Area sampling is a pre- filtering techniques in which we superimpose a pixel grid pattern onto the continuous object, definition. For each pixel area that intersects the object, we calculate the percentage of overlap by the object. This percentage determines the proportion of the overall intensity values of the corresponding pixel that is due to the object's contribution. In other words, the higher the percentage of overlap, the greater influence the object has on the pixel's overall intensity value. This trade- off is characteristic of an anti- aliasing techniques based on supper sampling.

**3. Super Sampling**In this approach we subdivide each pixel into sub pixels and check the position of each sub pixel in relation to the object to be scan- converted. The object's contribution to a pixel's overall intensity value is proportional to the number of sub pixels that are inside the area occupied by the object.

**4. Low pass Filtering**This is a post filtering technique in which we reassign each pixel a new value that is a weighted average of its original value and the original values of its neighbors. A low pass filter in the form of a (2/I + 1) (2/I + 1) grid, where n> 1, holds the weights for the computation. All weight values in a filter should sum to one. A low pass filter with equal weights sometimes referred to as a box filter, is said to be doing neighborhood averaging. On the other hand a filter with its weight values conforming to a two dimensional is called a Gaussian filter. 

**5. Pixel Phasing**Pixel phasing is a hardware based anti aliasing technique. The graphics system in this case is capable of shifting individual pixels from their normal positions to the pixel grid by fraction of the unit distance between pixels. By moving pixels closer to the true line of other contour this technique is very effective in smoothing out the stair steps without reducing the sharpness of the edges.