

Computer Graphics

Scan-line Polygon Filling

Aliasing Effects & Anti-Aliasing

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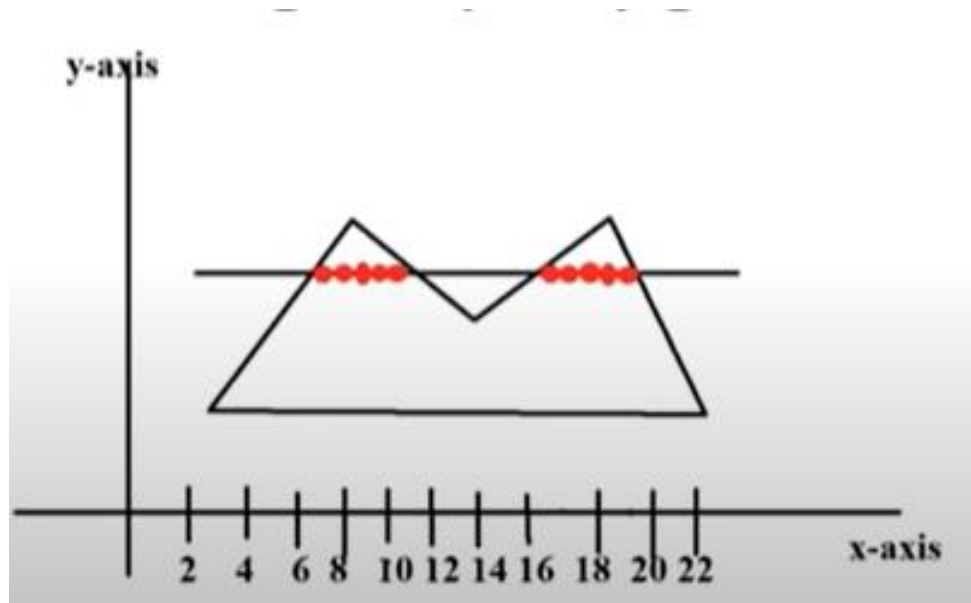
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Scan-Line Algorithm

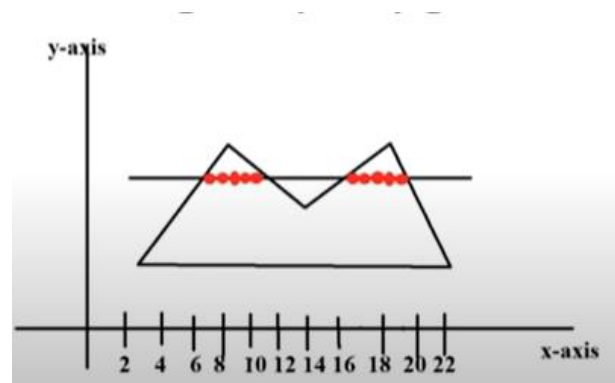
- Scan line polygon filling algorithm is used for solid color filling in polygons.



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Steps to Perform: For scan line polygon filling, there are three steps to perform in the following order:

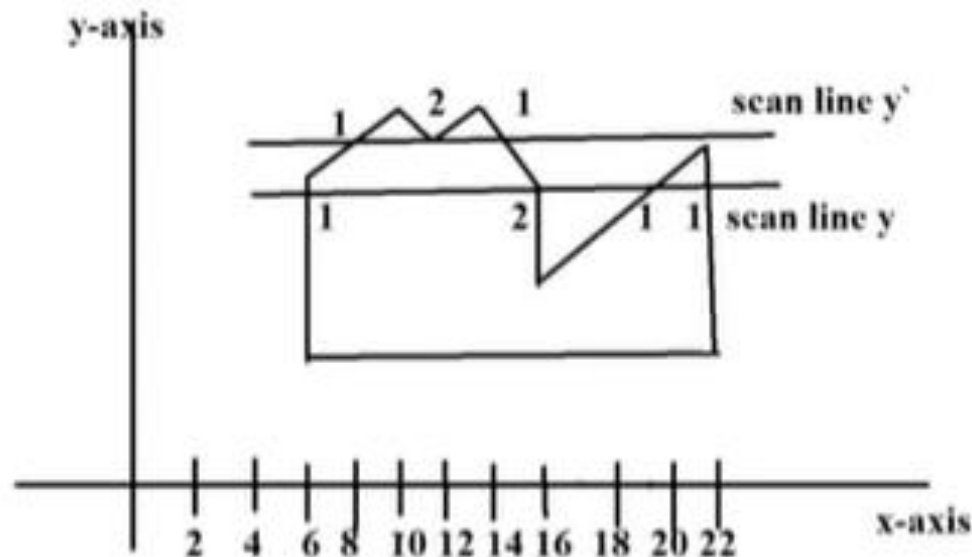
1. Find the intersections of scan line with all edges of the polygon.
2. Sort the intersections by increasing X co-ordinate i.e. from left to right. **[6, 12, 16, 20]**
3. Make pairs of the intersections and fill in color within all the pixels inside the pair. **(6, 12) & (16, 20)**



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Special Cases (Intersection Point - 2)

- **Line y' :** (8, 12) & (12, 14) (both edges – same side)
- **Line y :** (6, 16) & (19, 22) (both edges – different sides)

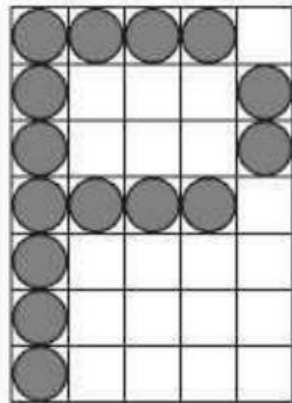


Scan-Converting a Character

- Character such as letters & digits are the building blocks of an image's textual contents.
- They can be presented in a variety of styles and sizes.
- The overall design style of a set of characters is referred to as its typeface or font.
- Font characteristics include: font-size, font-family, font-appearance.
- There are two basic approaches to character representation:
 - ✓ Bitmap Font
 - ✓ Outline Font

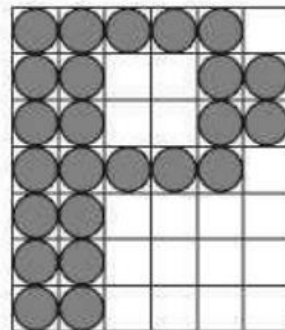
Bitmap Font

- Each character is represented by the on pixels in a bi-level pixel grid pattern called a bitmap.
- This approach is simple & effective since characters are defined in already-scan-converted form.
- Putting a character into an image basically entails a direct mapping or copying of its bitmap to a specific location in the image space.

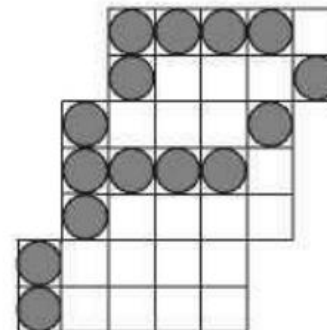


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- Although one might generate variations in appearance and size from one font, the overall result tends to be less than satisfactory.
- The example in following figure shows that we may overlay bitmap in the previous figure onto itself with a horizontal offset of one pixel to produce **bold font**, and shift rows of pixels to produce **italic font**.



(a) Bold



(b) Italic

Fig. Generating variations in appearance

Outline Font

- Graphical primitives such as lines & arcs are used to define the outline of each character.
- Although an outline definition tends to be less compact than a bitmap definition, and requires relatively time-consuming operations, it can be used to produce characters of varying size, appearance and even orientation.
- The following outline definition can be resized through a scaling transformation, made into italic through a shearing transformation, and turned around with respect to a reference point through a rotation transformation.

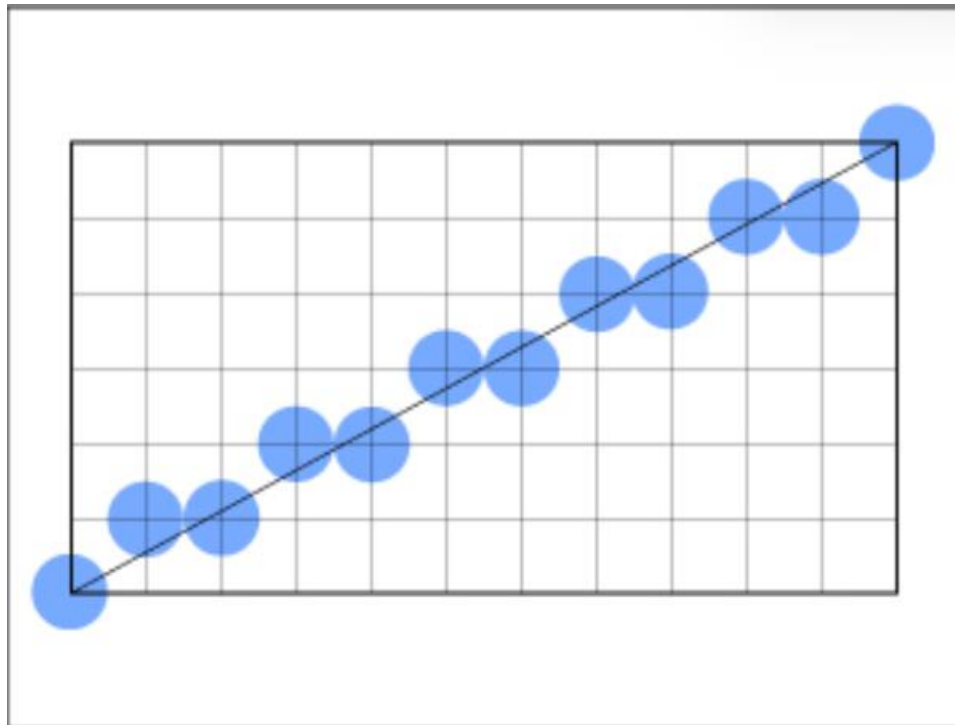


Aliasing Effect

- 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.
- Some effects are:
 - ✓ Staircase;
 - ✓ Unequal Brightness/Intensity;
 - ✓ The Picket Fence Problem;

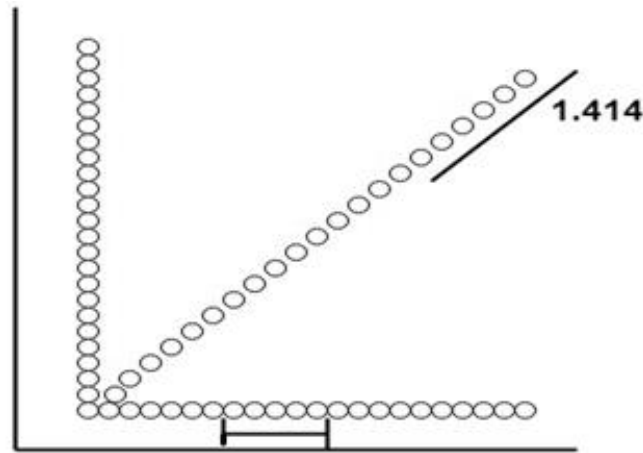
Staircase

- A common example of aliasing effects is the staircase or jagged appearance.
- It happens when primitives like line or circle are scan-converted.
- It also found sometimes along the border of a filled region.



Unequal Intensity

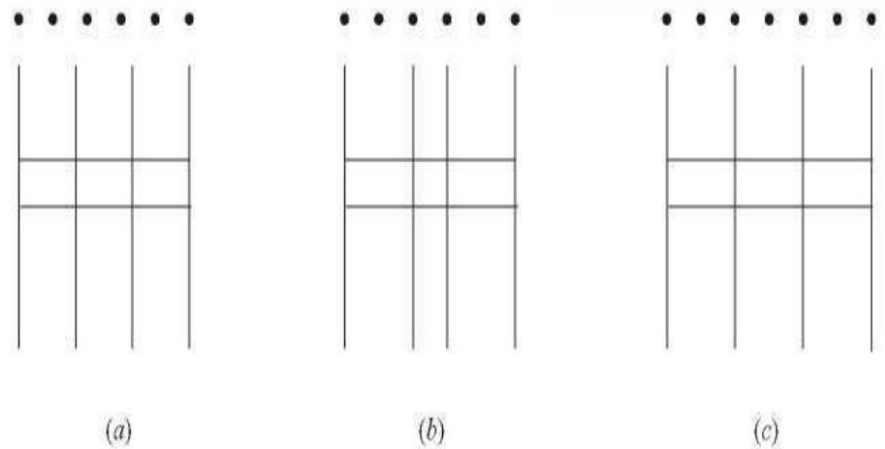
- It deals with unequal appearance of the brightness of different lines.
- An inclined line appears less bright as compared to the horizontal and vertical line.



Pixels along with horizontal line are 1 unit apart and vertical.
Pixels along diagonal line are 1.414 units.

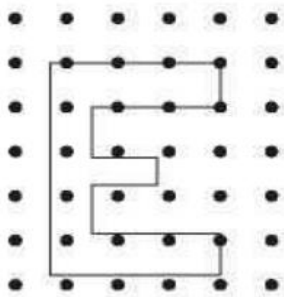
The Picket Fence Problem

- The picket fence problem occurs when an object is not aligned with, or does not fit into, the pixel grid properly.
- Figure (a) shows a picket fence where 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 of the pickets will have to be snapped to pixel coordinates [Fig. (b)]. This is 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 [Fig. (c)].
- This is sometimes called **local aliasing**, as the distances between pickets are kept close to their true distances.

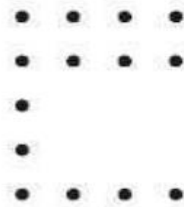


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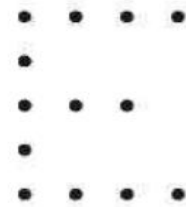
- Another example of such a problem arises with the outline font.
- Suppose we want to scan-convert the uppercase character "E" in Fig. (a) from its outline description to a bitmap consisting of pixels inside the region defined by the outline.
- The result in Fig. (b) exhibits both asymmetry (the upper arm of the character is twice as thick as the other parts) and dropout (the middle arm is absent).
- A slight adjustment and/or realignment of the outline can lead to a reasonable outcome [see Fig. (c)].



(a)



(b)



(c)

Anti-Aliasing

- In some cases, aliasing are tolerable, in many cases, negligible.
- However, they can have significant impacts on our viewing experience when left untreated in a series of images that animate moving objects.
- Increasing image resolution is a straight-forward way of mitigating aliasing effects. But it is not always feasible.
- There are techniques, that can greatly reduce aliasing artifacts, and improve the appearance of images without increasing resolution.
- These techniques are collectively called anti-aliasing technique.
 - ✓ Pre-filtering & post-filtering;
 - ✓ Area sampling;
 - ✓ Super-sampling;
 - ✓ Lowpass-filtering;
 - ✓ Pixel Phasing;

Details from Book

Thank You!