PIXEL ADDRESSING AND OBJECT GEOMETRY

Pixel addressing and object geometry

- When an object is scan converted into the frame buffer, the input description is transformed to pixel coordinates.
- So, the displayed image may not correspond exactly with the relative dimensions of the input object.
- To preserve the specified geometry of world objects, we need to compensate for the mapping of mathematical input points to finite pixel area, we use one of the two ways:

Pixel addressing and object geometry (cont.)

1) Adjust the dimensions of displayed objects to account for the amount of overlap of pixel areas with the object boundaries.

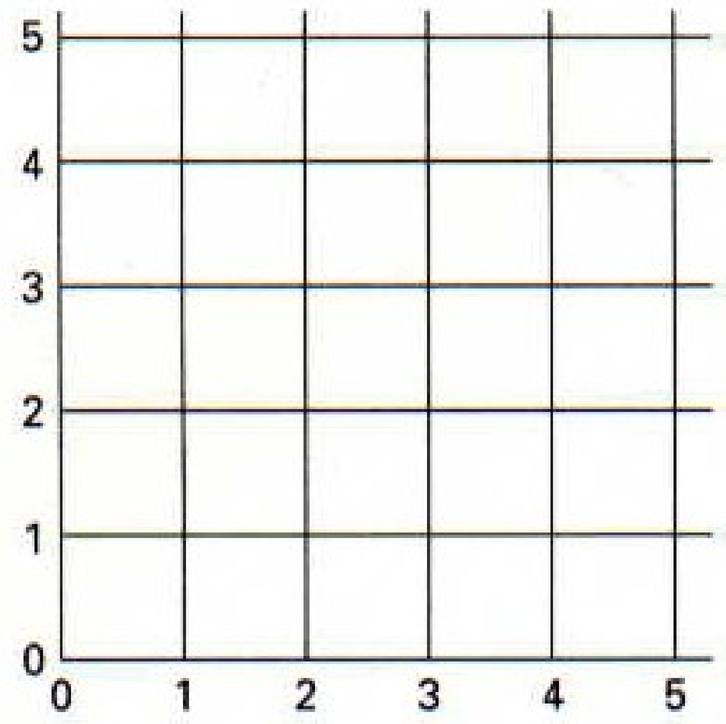
(i.e. a rectangle with 40 cm width, will be displayed in 40 pixel)

2) Map world coordinates onto screen positions between pixels, so that we align objects boundaries with pixel boundaries instead of pixel centers.

Pixel addressing and object geometry (cont.)

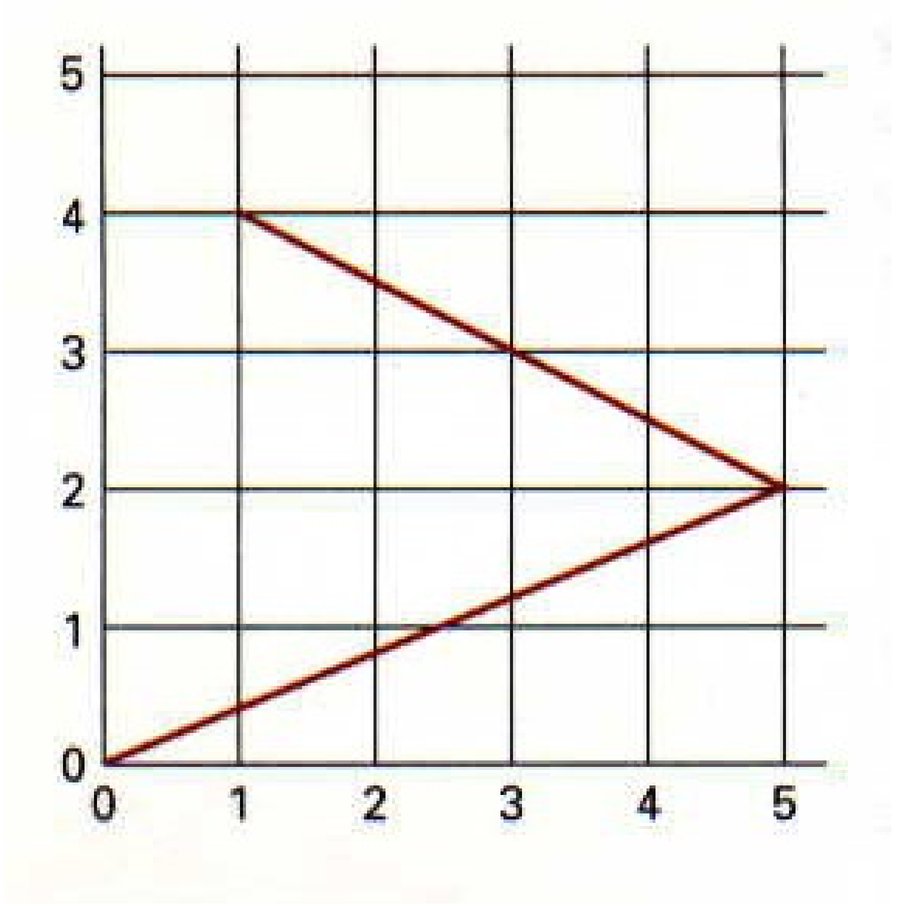
Screen Grid Coordinates:

An alternative to addressing display positions in terms of pixel centers is to reference screen coordinates with respect to the grid of horizontal and vertical pixel boundary lines spaced one unit a part.



Pixel addressing and object geometry (cont.)

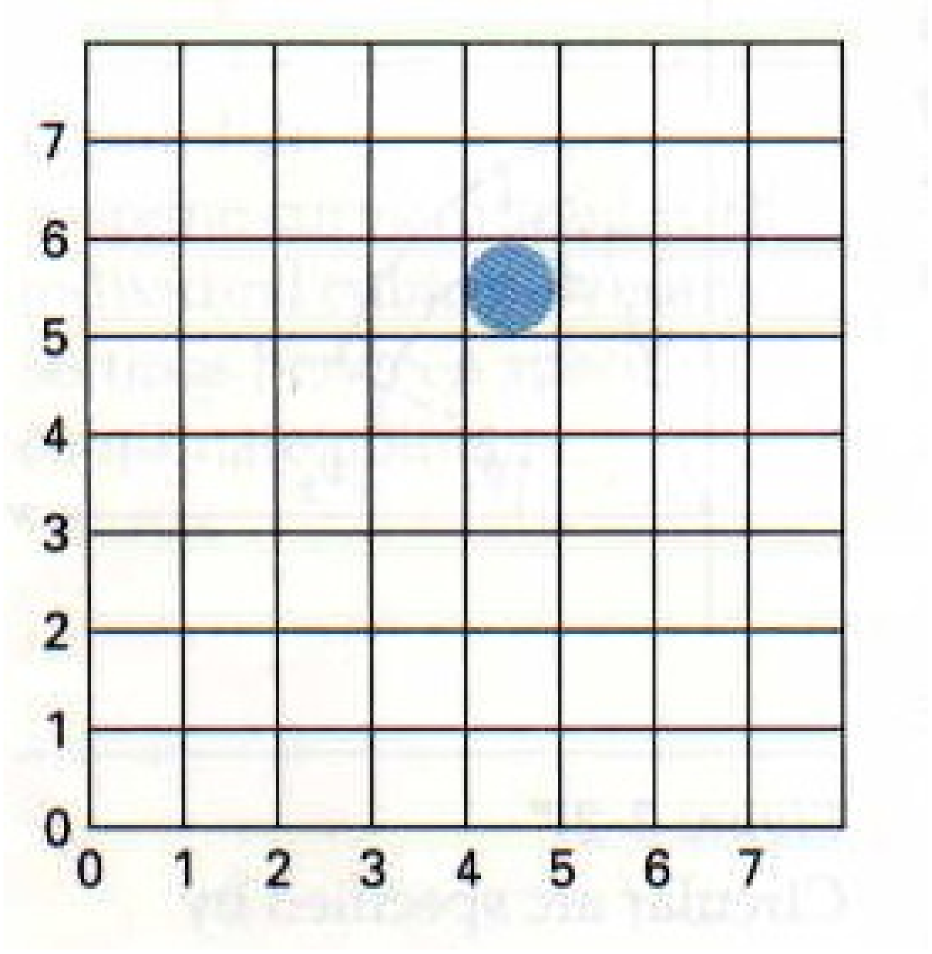
- Screen coordinate position is then the pair of integer values identifying a grid intersection position between two pixels.
- For example, the mathematical line path for a polyline with screen endpoints (0, 0), (5, 2), and (1,4) is shown beside.



Pixel addressing and object geometry (cont.)

- With the coordinate origin at the lower left of the screen, each pixel area can be referenced by the integer grid coordinates of its lower left corner.

- The following figure illustrates this convention for an 8 by 8 section of a raster, with a single illuminated pixel at screen coordinate position (4, 5).



Pixel addressing and object geometry (cont.)

- In general, we identify the area occupied by a pixel with screen coordinates (x, y) as the unit square with diagonally opposite corners at (x, y) and ($x + 1$, $y + 1$).
- This pixel addressing scheme has several advantages:
  1. It avoids half-integer pixel boundary
  2. It facilitates precise object representations.
  3. Simplifies the processing involved in many scan conversion algorithms and in other raster procedures

Pixel addressing and object geometry (cont.)

Notes:

1) The previous algorithms for drawing line, circle, …etc are still valid when applied to input positions expressed as screen grid coordinates.

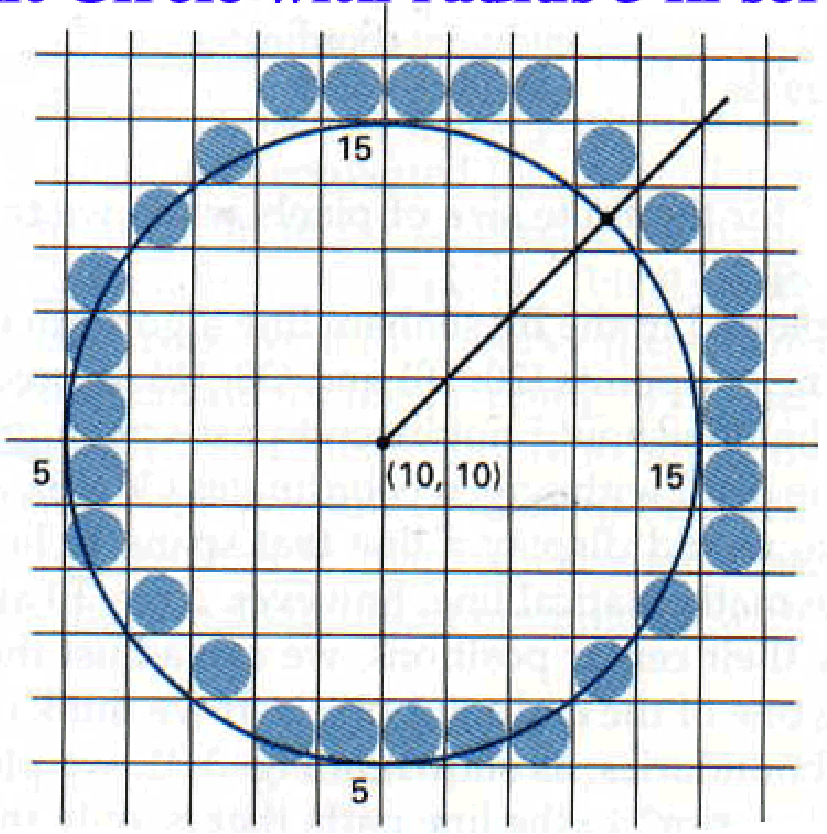
2) The decision parameter P_k is a measure of screen grid separation differences rather than separation differences from pixel centers.

Pixel addressing and object geometry (cont.)

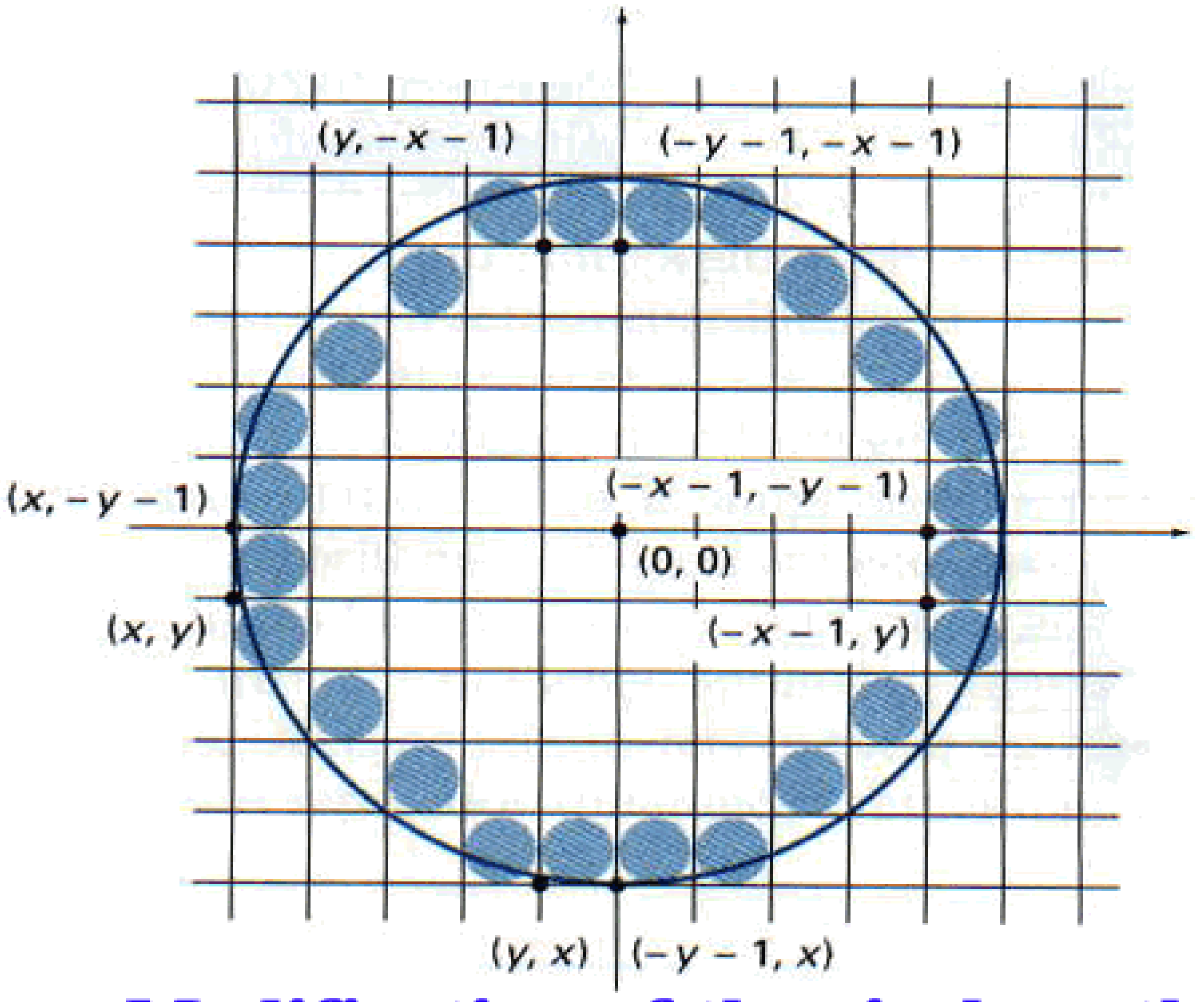
- A circle of radius 5 and center position (10, 10), for instance, would be displayed by the midpoint circle algorithm using screen grid coordinate positions.
- But the plotted circle has a diameter of 11, To plot the circle with the defined diameter of 10, we can modify the circle algorithm to shorten each pixel scan line and each pixel column.

Pixel addressing and object geometry (cont.)

Midpoint Circle with radius 5 in screen coordinates



Pixel addressing and object geometry (cont.)



Modification of the circle path