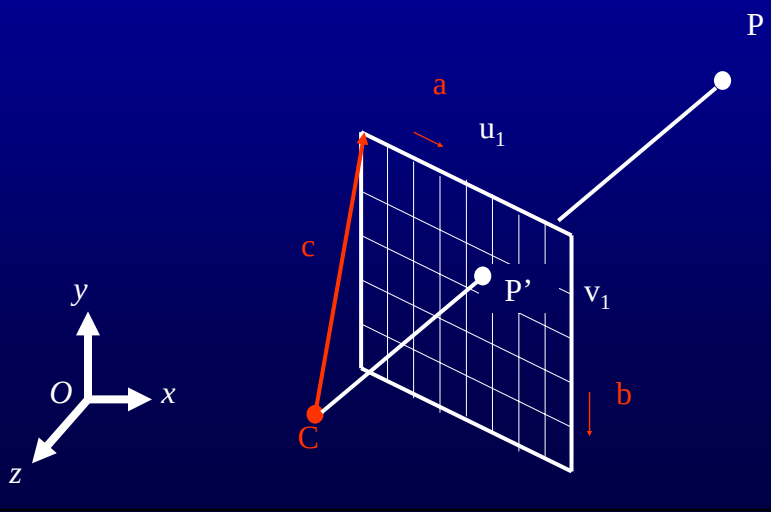
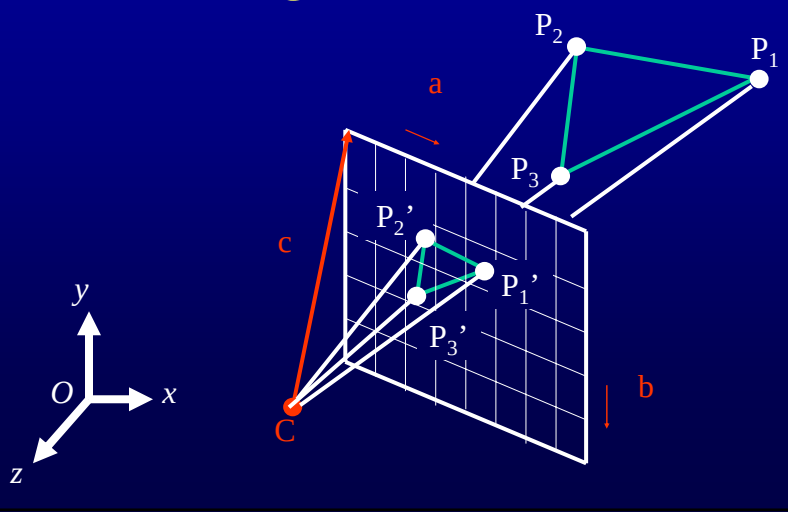
Triangle Rasterization

Projection of points



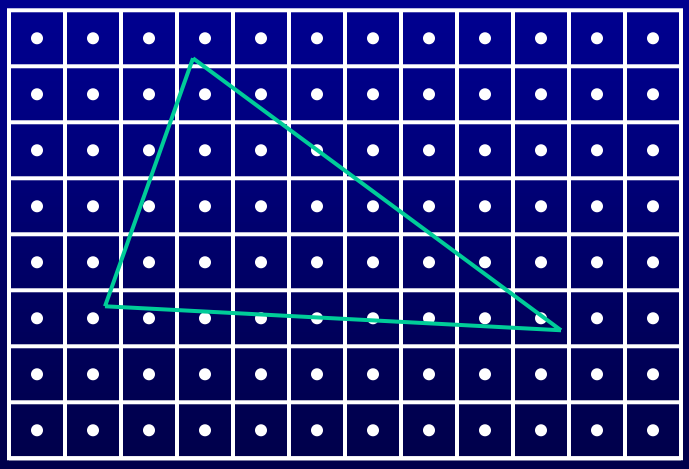
Projection of triangles



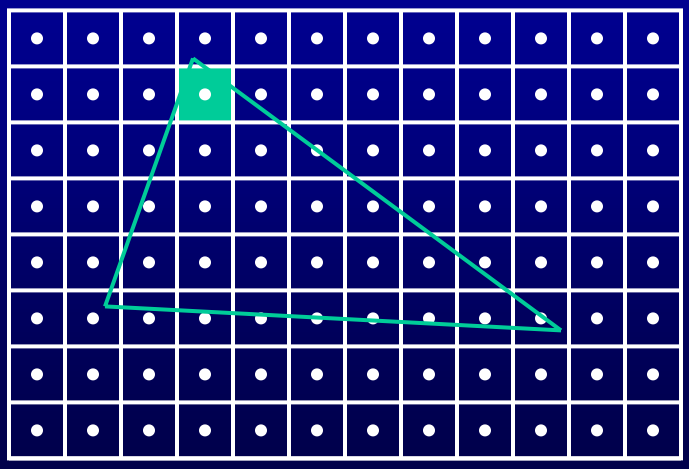
Rasterization of triangles

- Determine all pixels covered by the triangle and color them appropriately
  - a pixel is covered by a triangle if its center is inside the triangle

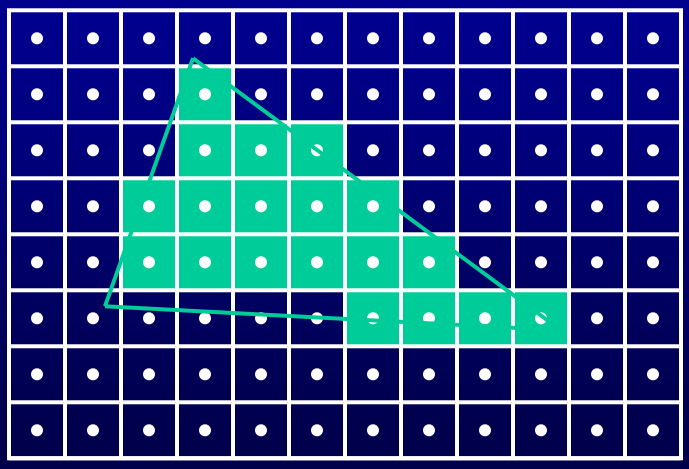
Rasterization of triangles



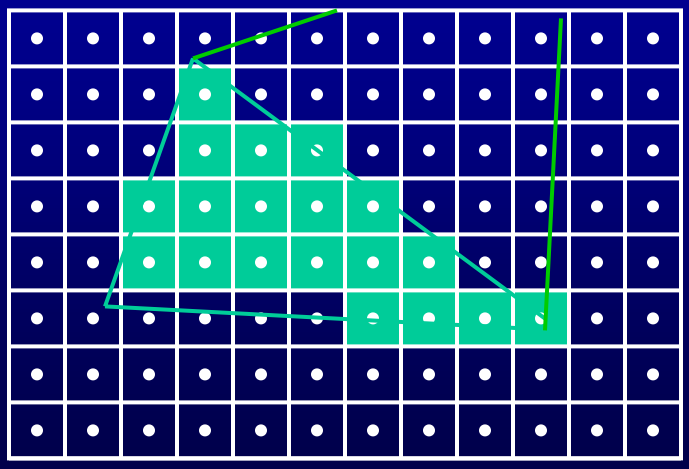
Rasterization of triangles



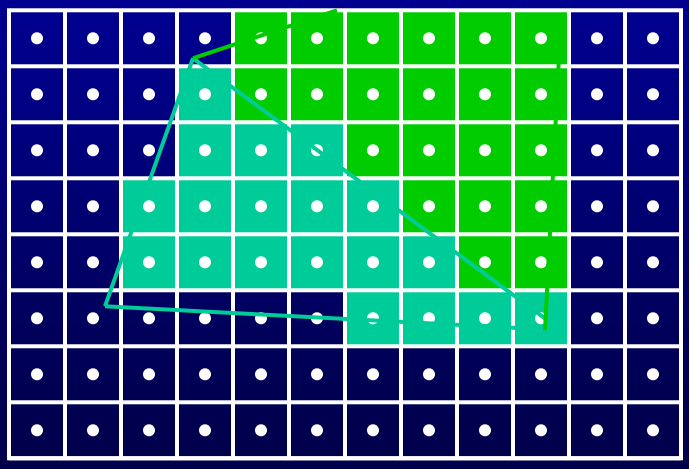
Rasterization of triangles



Rasterization of triangles



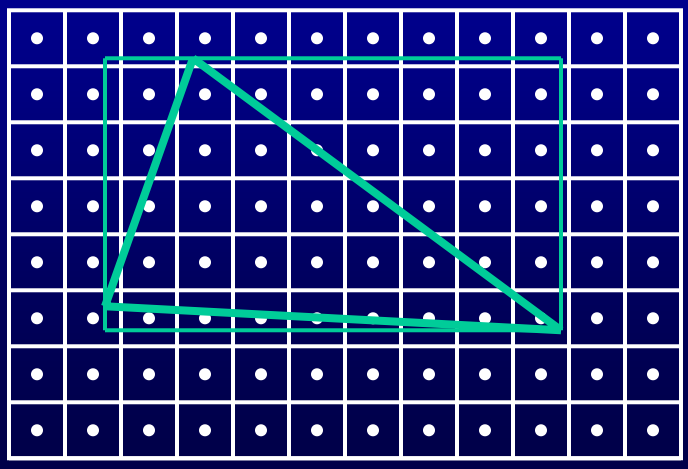
Rasterization of triangles



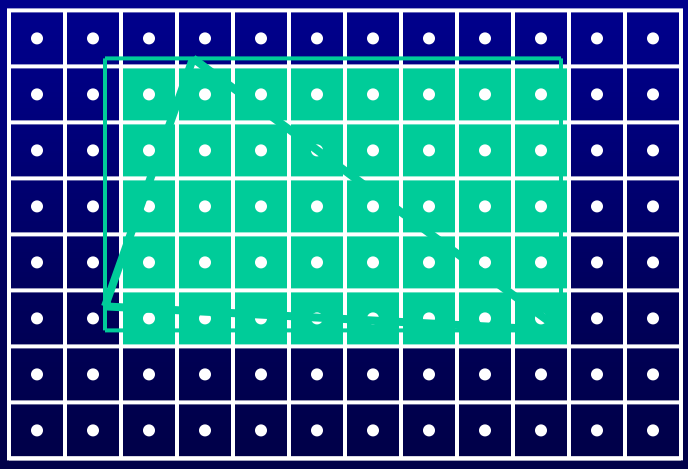
Finding interior pixels

- Several methods
  - edge equations method
  - DDA (Digital Differential Analyzer) method

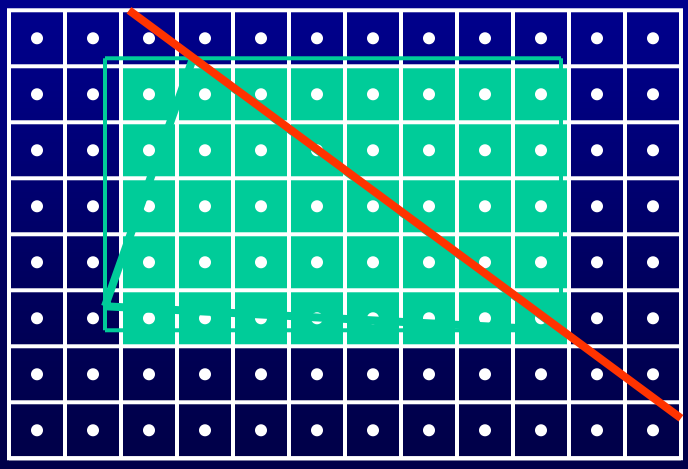
Edge equations rasterization
1. bounding box



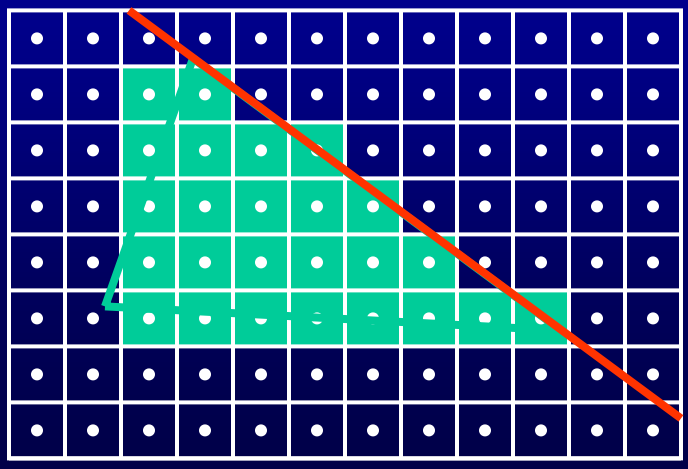
Edge equations rasterization
1. bounding box



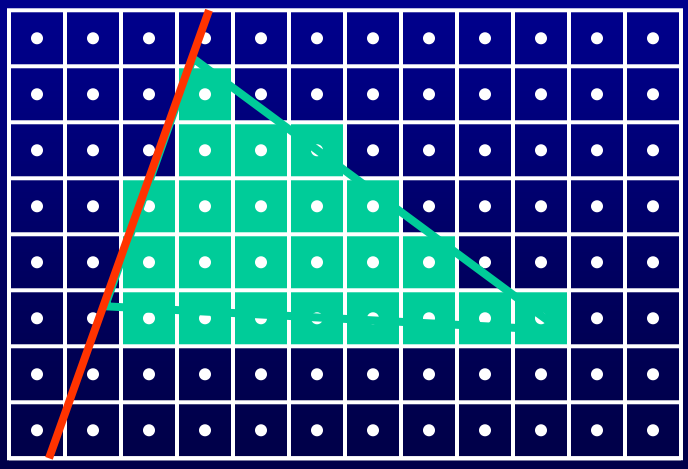
Edge equations rasterization
1. bounding box



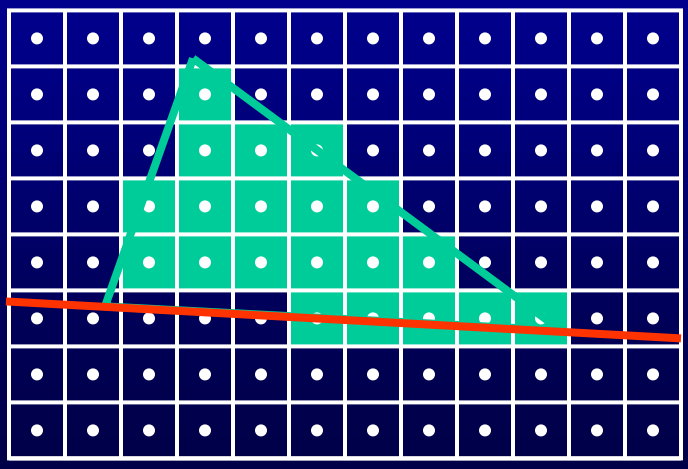
Edge equations rasterization
2. use edges



Edge equations rasterization
2. use edges



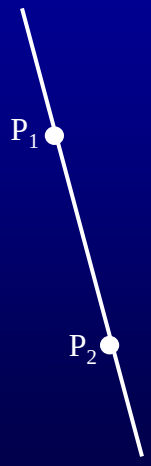
Edge equations rasterization
2. use edges



Edge equations rasterization

Edge equation

$$x(y_2 - y_1) - y(x_2 - x_1) - x_1 y_2 + y_1 x_2 = 0$$



Edge sidedness

$$E(x,y) = ax + by + c =$$
$$= x(y_2 - y_1) - y(x_2 - x_1) - x_1 y_2 + y_1 x_2$$

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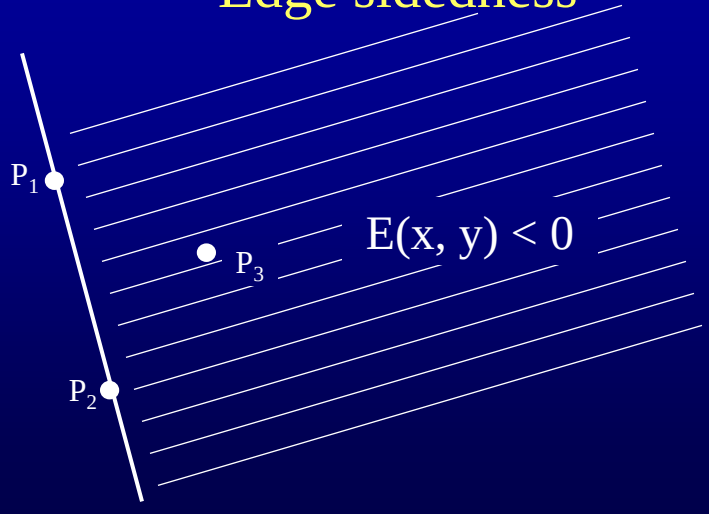
$$E(x_3,y_3) = x_3(y_2 - y_1) - y_3(x_2 - x_1) - x_1 y_2 + y_1 x_2$$
$$E(x_3,y_3) < 0$$

Edge sidedness



Triangle rasterization implementation guidelines

```
float x[3], y[3]; // image space coordinates of the 3 vertices in pixels (input)

float a[3], b[3], c[3]; // a, b, c for the 3 edge expressions
// establish the three edge equations
// edge that goes through vertices 0 and 1
a[0] = y[1]-y[0]; b[0] = -x[1] + x[0]; c[0] = -x[0]*y[1] + y[0]*x[1];
float sidedness; // temporary variable used to establish correct sidedness
sidedness = a[0]*x[2] + b[0]*y[2] + c[0];
if (sidedness < 0) {
 a[0] = -a[0]; b[0] = -b[0]; c[0] = -c[0];
}
// similar for the other two edges

// compute screen axes-aligned bounding box for triangle
float bbox[2][2]; // for each x and y, store the min and max values
ComputeBBox(x, y, bbox);
ClipBBox(bbox, 0, w, 0, h);
int left = (int) (bbox[0][0] + .5), right = (int) (bbox[0][1] - .5);
int top= (int) (bbox[1][0] +.5), bottom = (int) (bbox[1][1] - .5);
```


Triangle rasterization implementation guidelines

```
…
int left = (int) (bbox[0][0] + .5), right = (int) (bbox[0][1] - .5);
int top= (int) (bbox[1][0] +.5), bottom = (int) (bbox[1][1] - .5);

int currPixX, currPixY; // current pixel considered
float currEELS[3], currEE[3]; // edge expression values for line starts and within line
for ( currPixY = top, currEELS[i] = a[i]*(left+.5) + b[i]*(top+.5) +c[i];
       currPixY <= bottom;
       currPixY++, currEELS[i] += b[i])
  for ( currPixX = left, currEE[i] = currEELS[i];
        currPixX <= right; currPixX++, currEE[i] += a[i]) {
    if (currEE[i] < 0)
      continue; // outside triangle
    // found pixel inside of triangle; set it to right color
  }
```