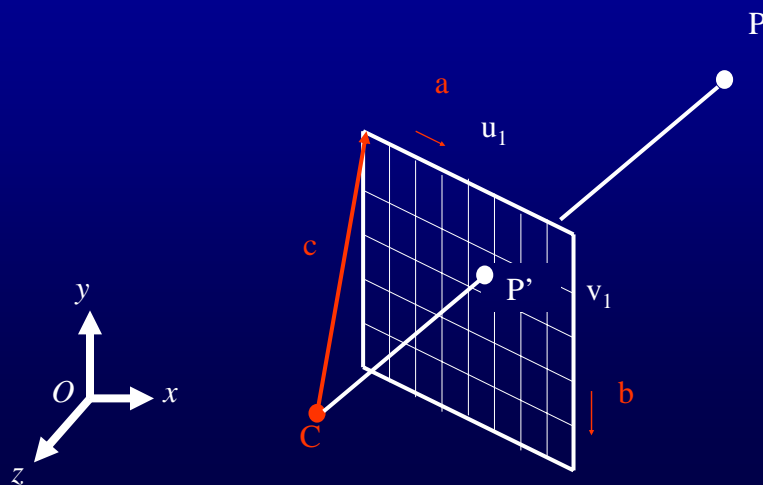


Triangle Rasterization

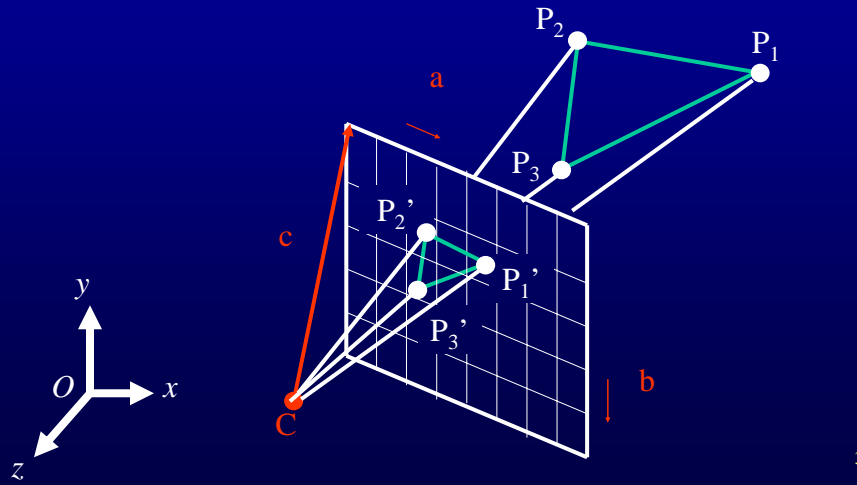
1

Projection of points



2

Projection of triangles



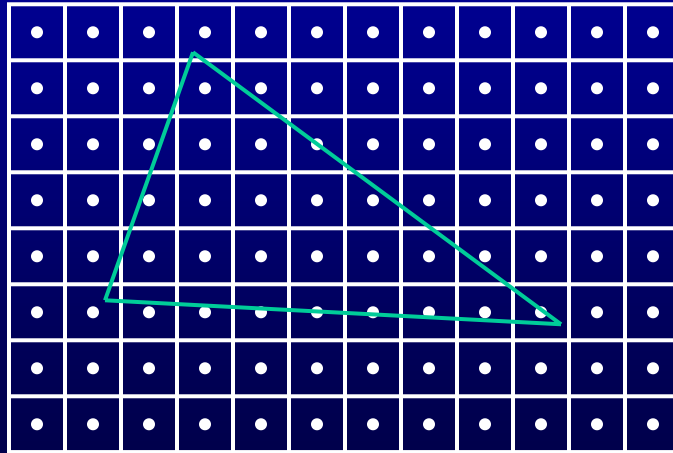
3

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

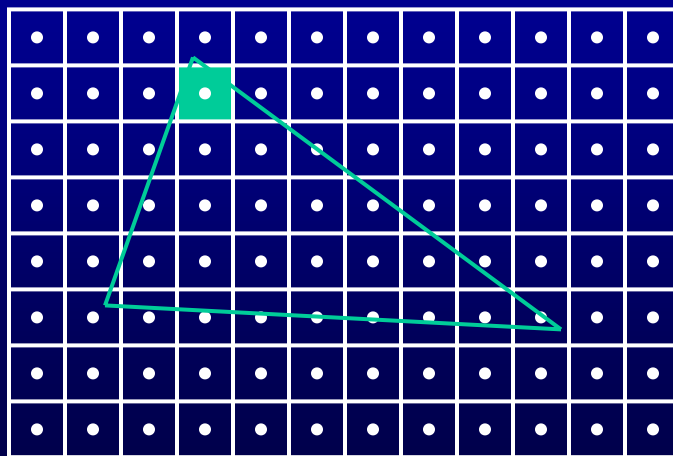
4

Rasterization of triangles



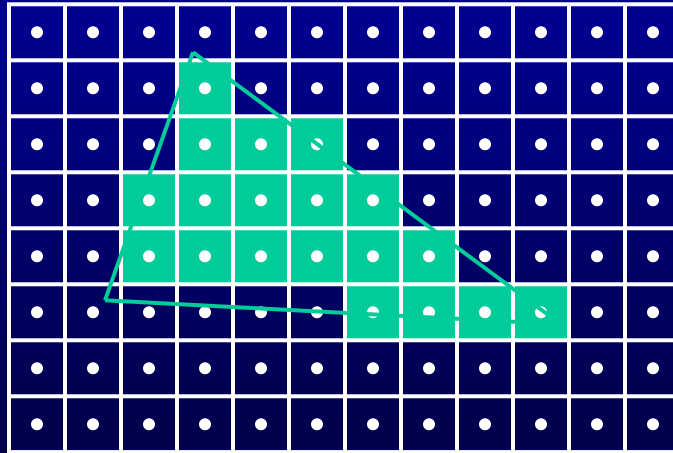
5

Rasterization of triangles



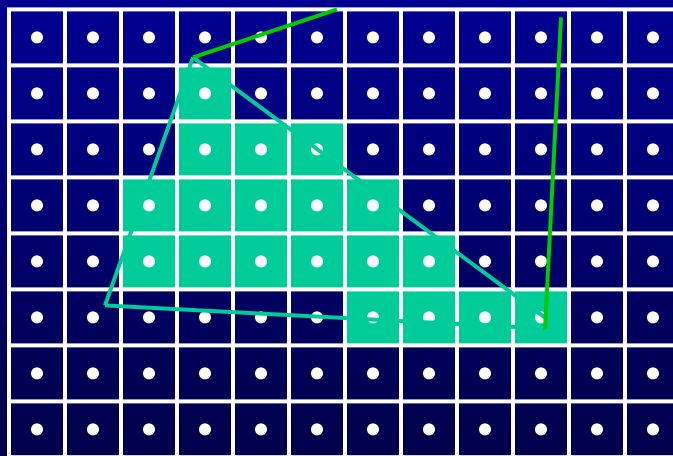
6

Rasterization of triangles



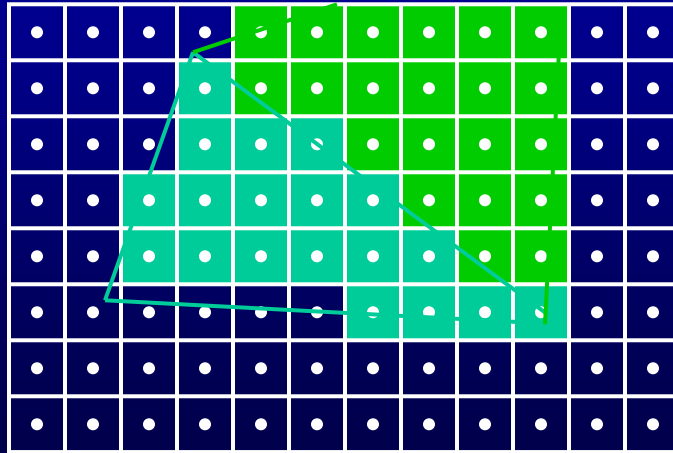
7

Rasterization of triangles



8

Rasterization of triangles



9

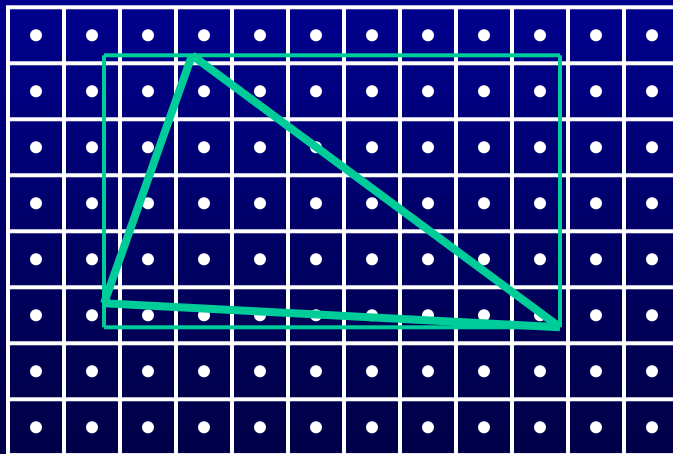
Finding interior pixels

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

10

Edge equations rasterization

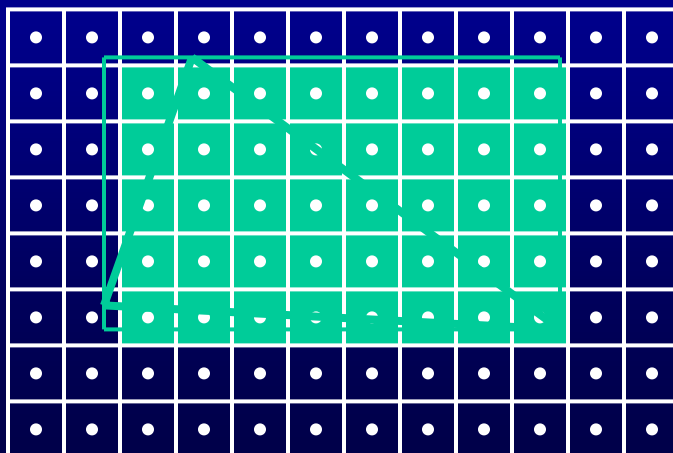
1. bounding box



11

Edge equations rasterization

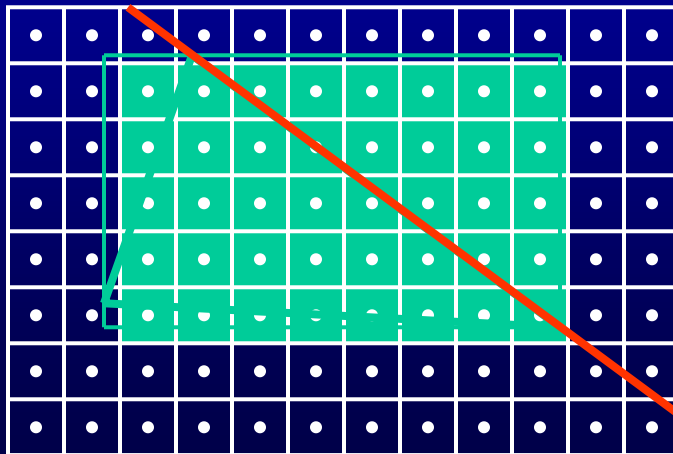
1. bounding box



12

Edge equations rasterization

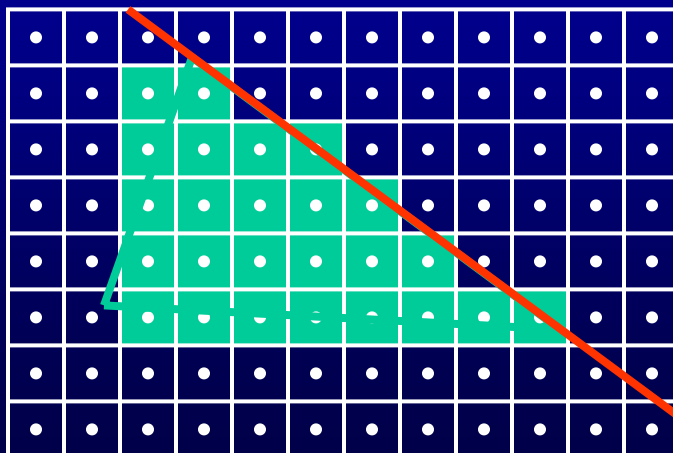
1. bounding box



13

Edge equations rasterization

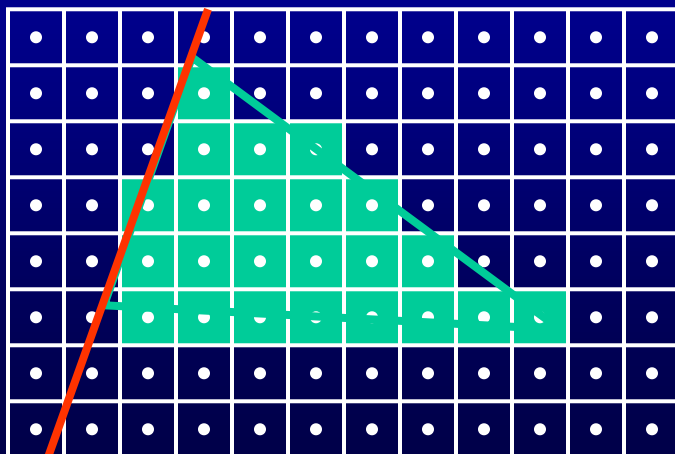
2. use edges



14

Edge equations rasterization

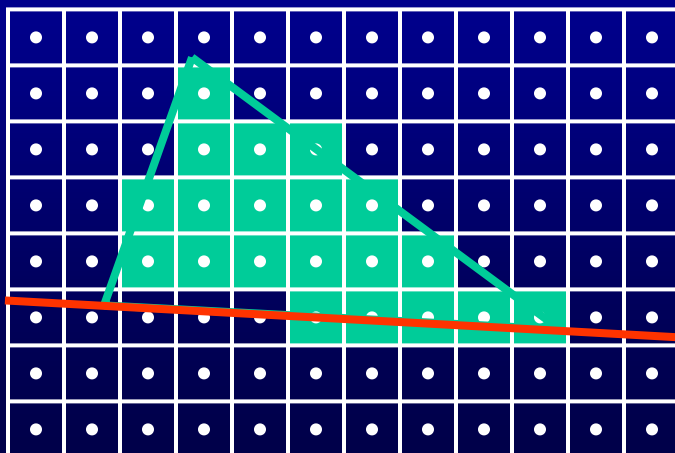
2. use edges



15

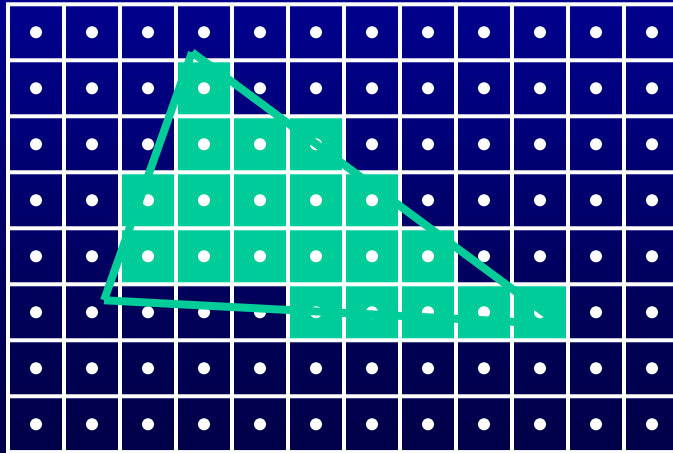
Edge equations rasterization

2. use edges



16

Edge equations rasterization



17

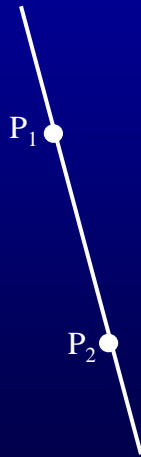
Edge equation

$$x(y_2 - y_1) - y(x_2 - x_1) - x_1y_2 + y_1x_2 = 0$$



18

Edge sidedness

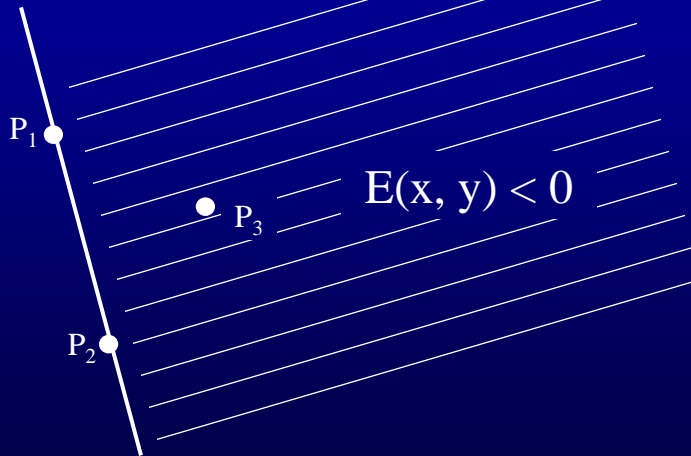


$$E(x, y) = ax + by + c = \\ = x(y_2 - y_1) - y(x_2 - x_1) - x_1y_2 + y_1x_2$$

$$E(x_3, y_3) = x_3(y_2 - y_1) - y_3(x_2 - x_1) - x_1y_2 + y_1x_2 \\ E(x_3, y_3) < 0$$

19

Edge sidedness



20

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);
```

21

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
    }
}
```

22