Triangle Rasterization

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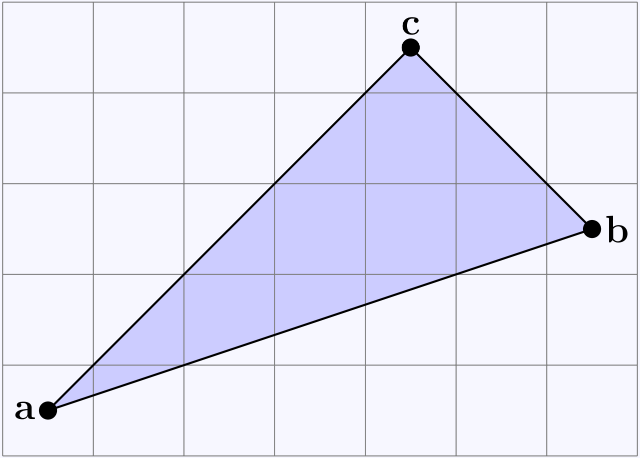
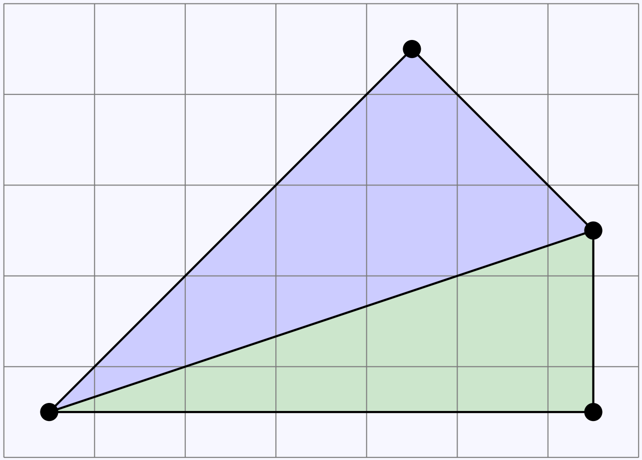
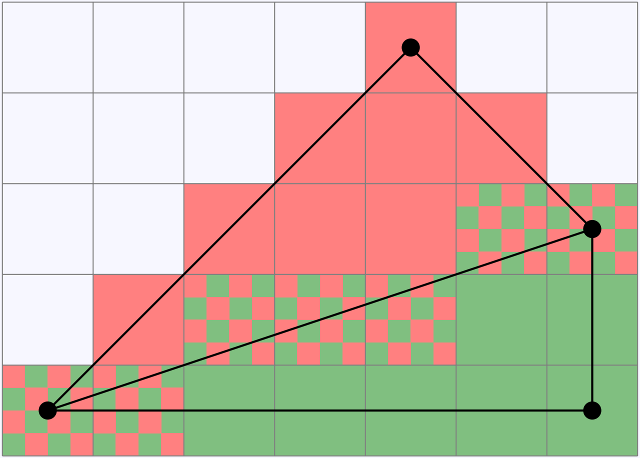
Which pixels?



Rasterizing adjacent triangles

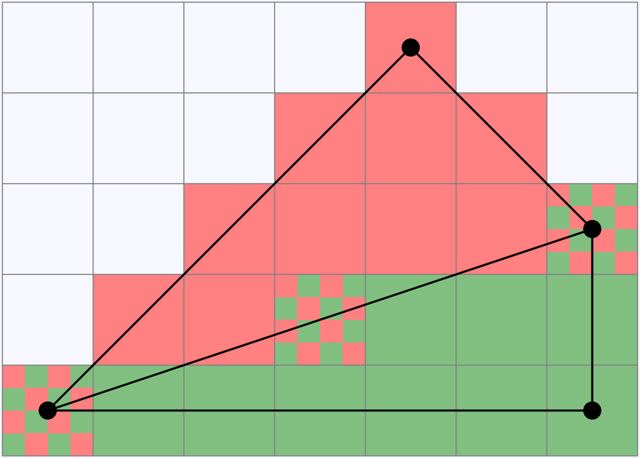


Rasterizing adjacent triangles



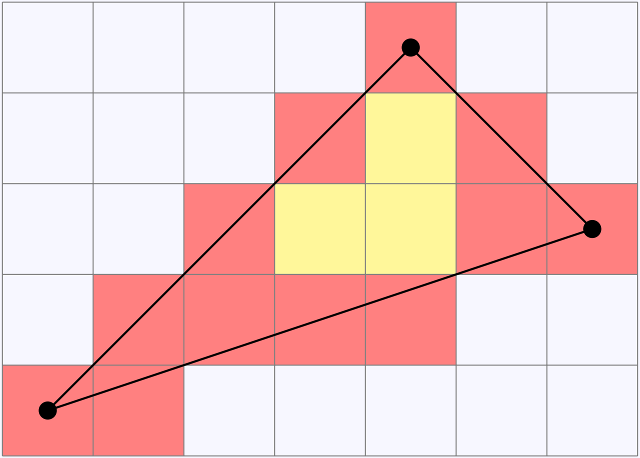
Who fills shared edges?

Rasterizing adjacent triangles



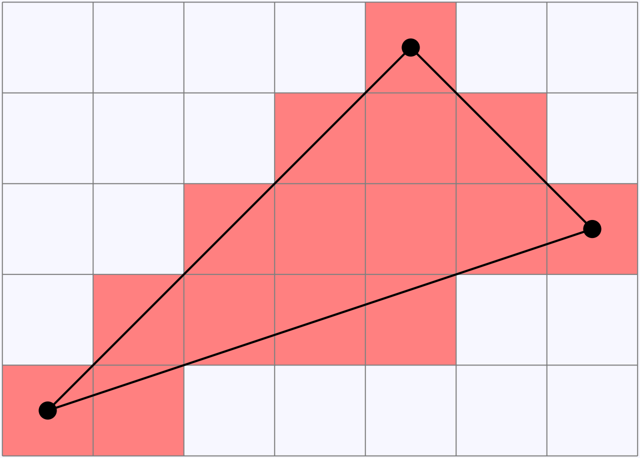
Who fills shared edges?

Algorithm choices



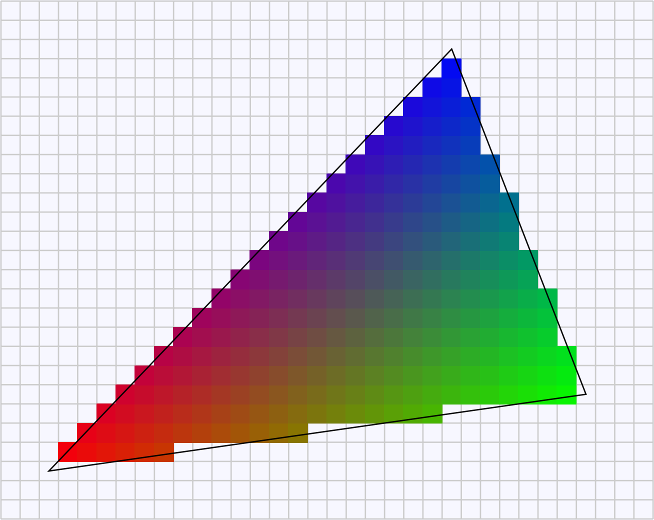
Midpoint algorithm for edges, then fill?

Algorithm choices



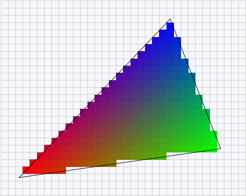
Use an approach based on inside/outside queries.

Interpolate using barycentric coordinates



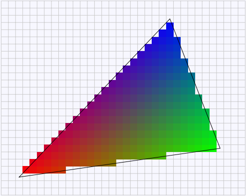
Gouraud shading: $\mathbf{c} = \alpha \mathbf{c_0} + \beta \mathbf{c_1} + \gamma \mathbf{c_2}$

Triangle rasterization algorithm



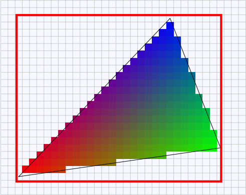
for all x **do**
    for all y **do**
        Compute (α, β, γ) for (x, y)
        if $0 \leq \alpha, \beta, \gamma \leq 1$ **then**
            $\mathbf{c} = \alpha \mathbf{c_0} + \beta \mathbf{c_1} + \gamma \mathbf{c_2}$
            Draw pixel (x, y) with color $\mathbf{c}$

Triangle rasterization algorithm



for all x **do**
  for all y **do**
    Compute (α, β, γ) for (x, y)
    if $0 \leq \alpha, \beta, \gamma \leq 1$ **then**
      $\mathbf{c} = \alpha\mathbf{c_0} + \beta\mathbf{c_1} + \gamma\mathbf{c_2}$
      Draw pixel (x, y) with color $\mathbf{c}$

Triangle rasterization algorithm



for all $x \in [x_{min}, x_{max}]$ **do**
  for all $y \in [y_{min}, y_{max}]$ **do**
    Compute (α, β, γ) for (x, y)
    if $0 \leq \alpha, \beta, \gamma \leq 1$ **then**
      $\mathbf{c} = \alpha \mathbf{c_0} + \beta \mathbf{c_1} + \gamma \mathbf{c_2}$
      Draw pixel (x, y) with color $\mathbf{c}$

Optimizations

- $0 \leq \alpha, \beta, \gamma$ implies $\alpha, \beta, \gamma \leq 1$
  - only check $0 \leq \alpha, \beta, \gamma$

Optimizations

Observation:

$$\alpha = \frac{\text{area}(P, B, C)}{\text{area}(A, B, C)} = k_0 + k_1 x + k_2 y$$

$$k_0 = \frac{\text{area}(\mathbf{o}, B, C)}{\text{area}(A, B, C)} \qquad \mathbf{o} = (0, 0)$$

$$x_0 + k_1 = \frac{\text{area}(\mathbf{e}_1, B, C)}{\text{area}(A, B, C)} \qquad \mathbf{e_1} = (1, 0)$$

$$x_0 + k_2 = \frac{\text{area}(\mathbf{e}_2, B, C)}{\text{area}(A, B, C)} \qquad \mathbf{e_2} = (0, 1)$$

Optimizations

Quantities like this: $\alpha = k_0 + k_1 x + k_2 y$

Can be updated like this:

$$x \leftarrow x + 1 \implies \alpha \leftarrow \alpha + k_1$$
$$y \leftarrow y + 1 \implies \alpha \leftarrow \alpha + k_2$$

Similar for β and γ.