Edge Detection

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Motivation

- Used to capture important events and changes in properties of an image
- Used as a precomputation filter for different Computer vision algorithms.

Method of Edge Detection

- Search-based
  - First compute gradient magnitude
  - Then, search for local directional maxima in gradient magnitude using gradient direction.

Detection Algorithm

1. Convert to Grayscale

   Formula: L = r * 0.21 + g*0.72 + b* 0.07

Detection Algorithm

2. Gaussian Blur

Detection Algorithm

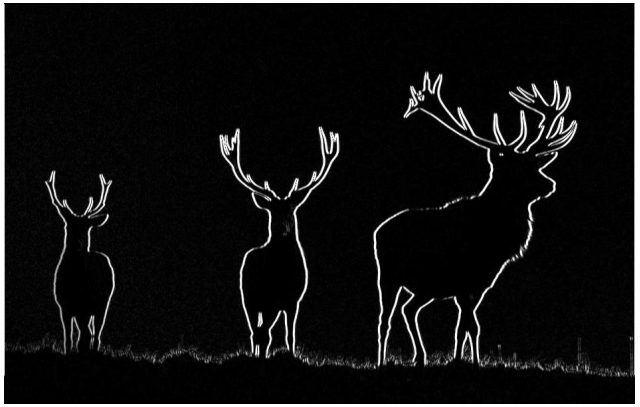
3. Sobel Operators Convolution

$$\begin{bmatrix} -1 & 0 & +1 \\ -2 & 0 & +2 \\ -1 & 0 & +1 \end{bmatrix}$$

Vertical

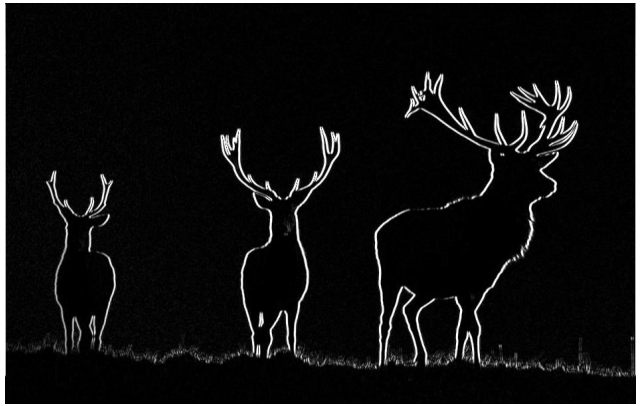
Horizontal

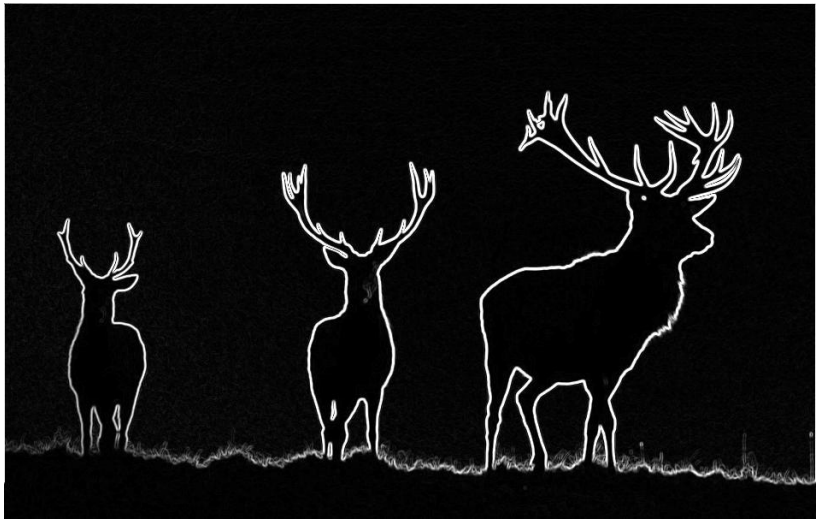
$$\begin{bmatrix} +1 & +2 & +1 \\ 0 & 0 & 0 \\ -1 & -2 & -1 \end{bmatrix}$$



Detection Algorithm

4. Gradient Magnitude and Direction



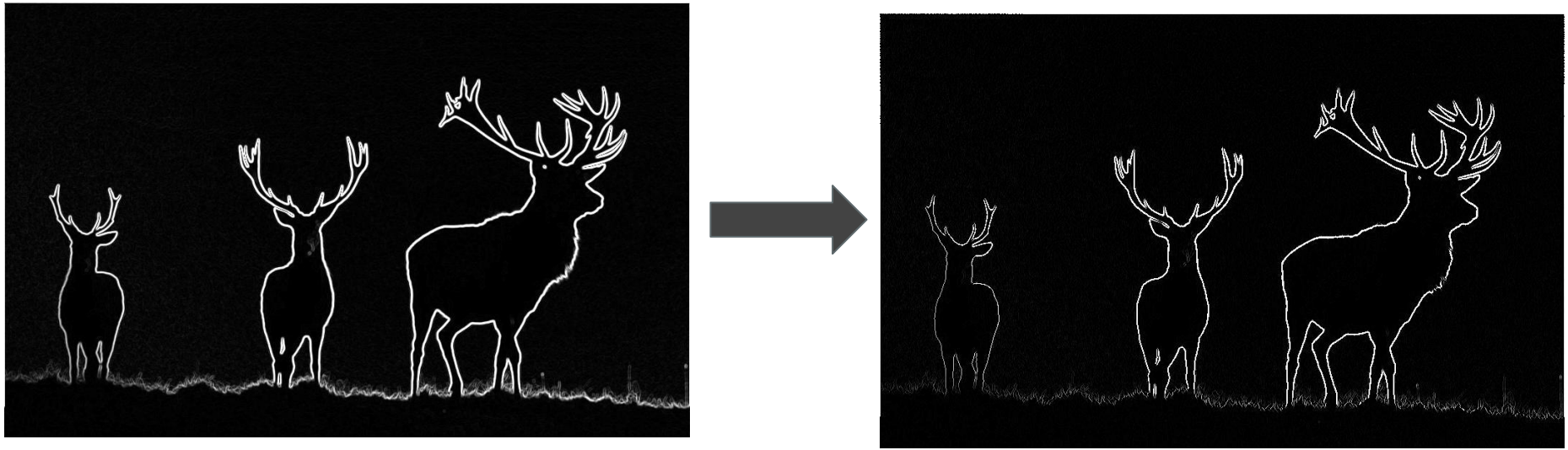


$$\mathbf{G} = \sqrt{\mathbf{G}_x{}^2 + \mathbf{G}_y{}^2}$$

$$\mathbf{\Theta} = \operatorname{atan}\left(\frac{\mathbf{G}_y}{\mathbf{G}_x}\right)$$

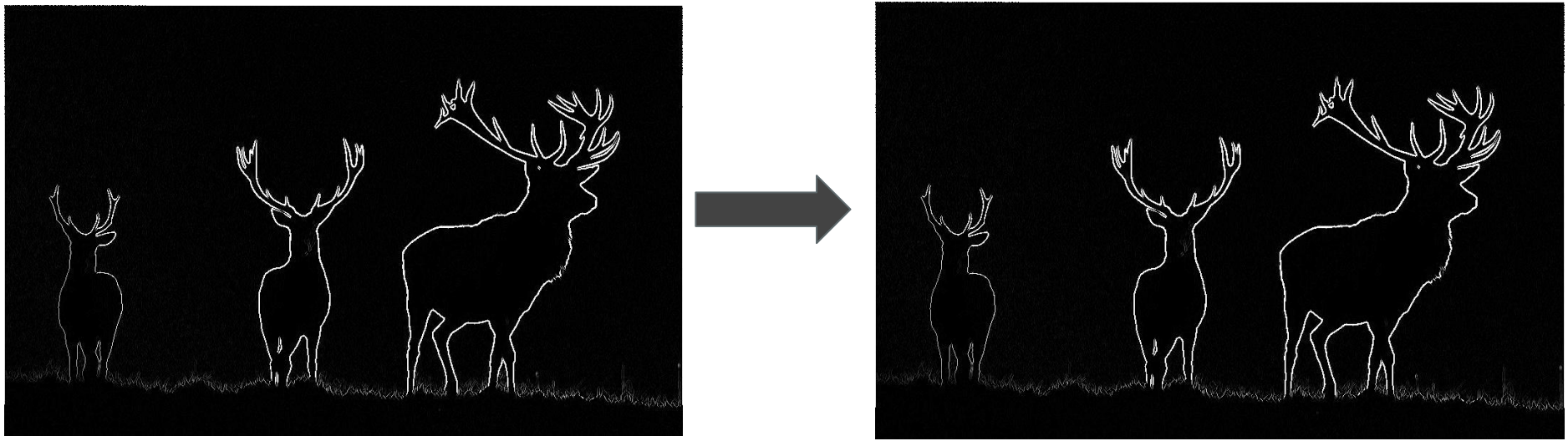
Detection Algorithm

5. Non max compression

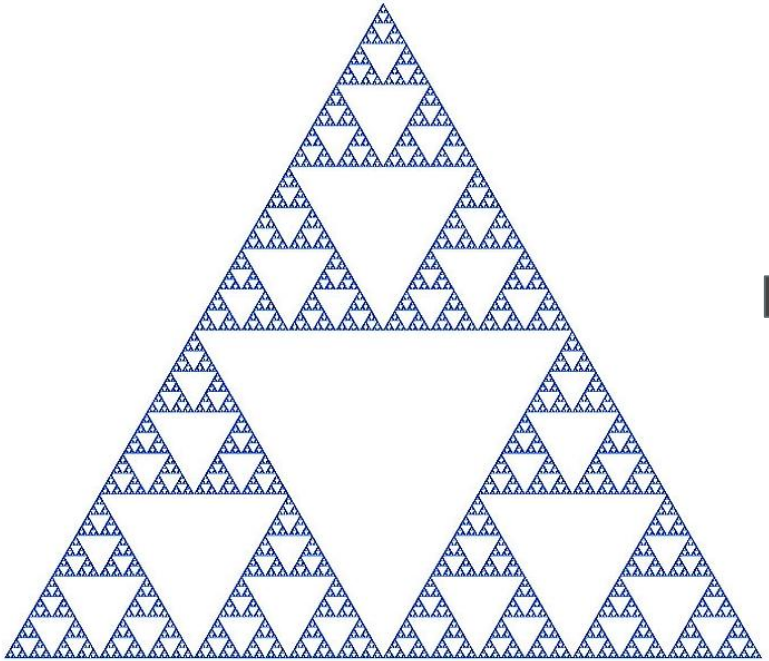


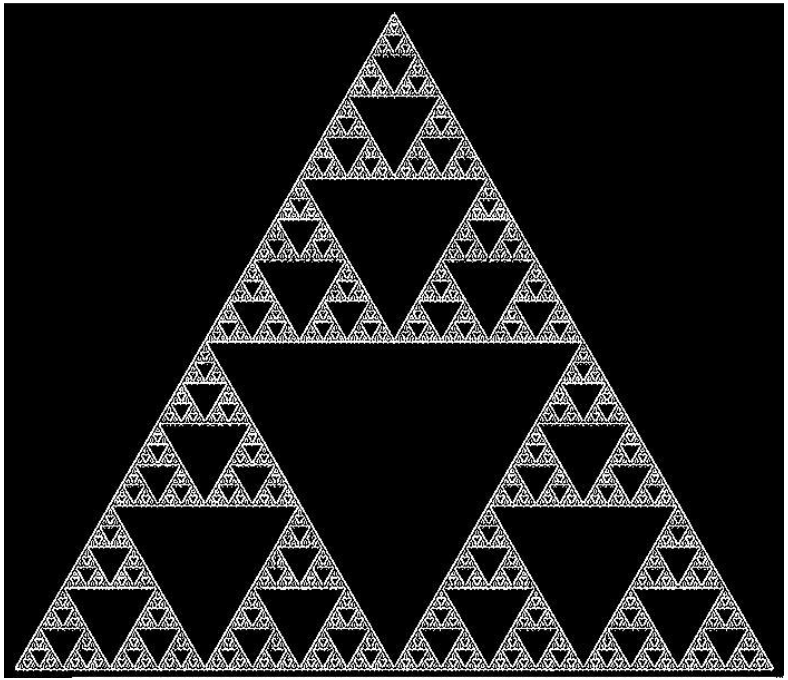
Detection Algorithm

6. Double Threshold

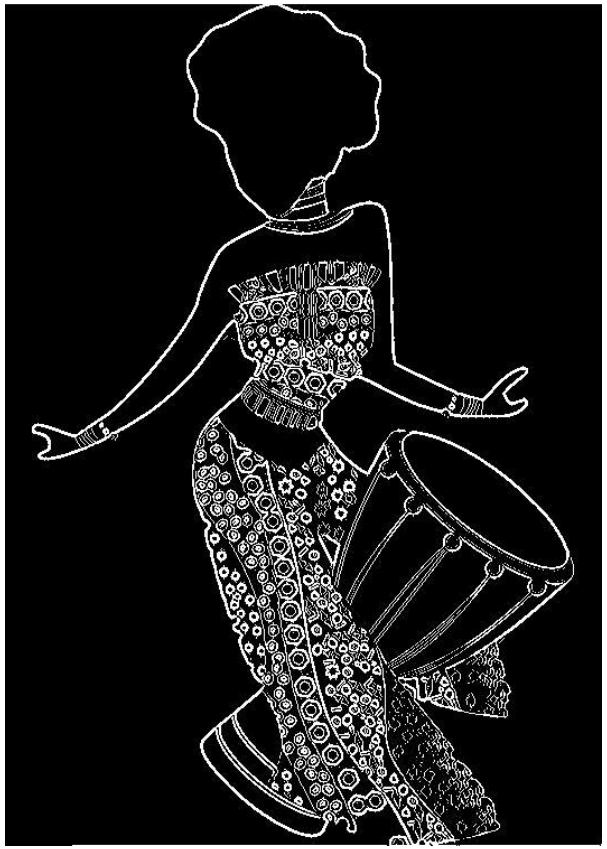


Results





Sierpinski Triangle



Optimizations

- Parameter Selection in Double Thresholding phase.
- Kernel Filters in Shared/Constant Memory
- Adjacent Pixels in Shared Memory for each Convolution.
- Different Block Configurations when launching kernels.