

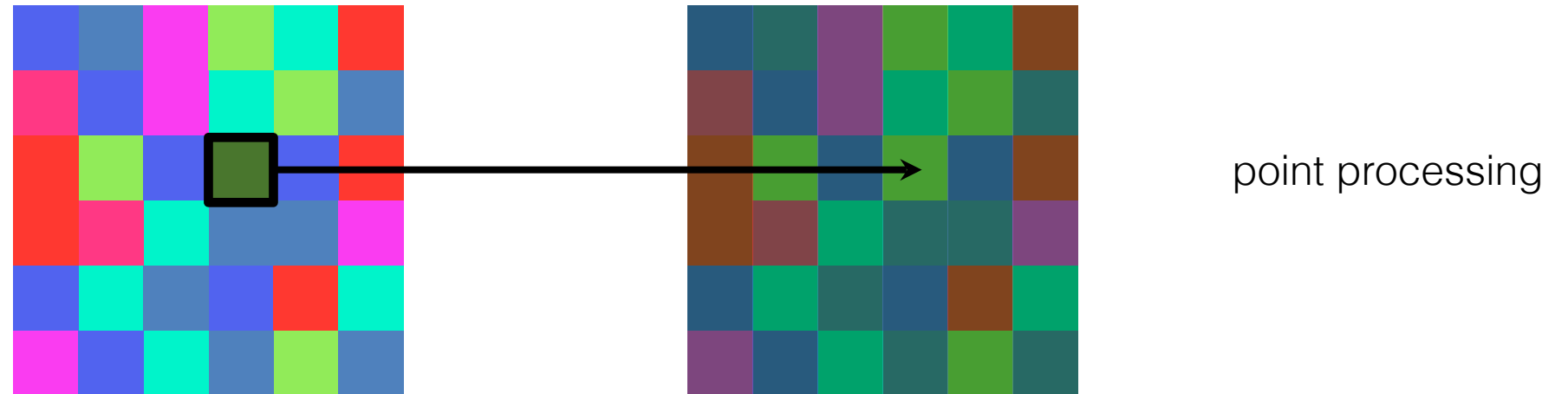


# Point Processing

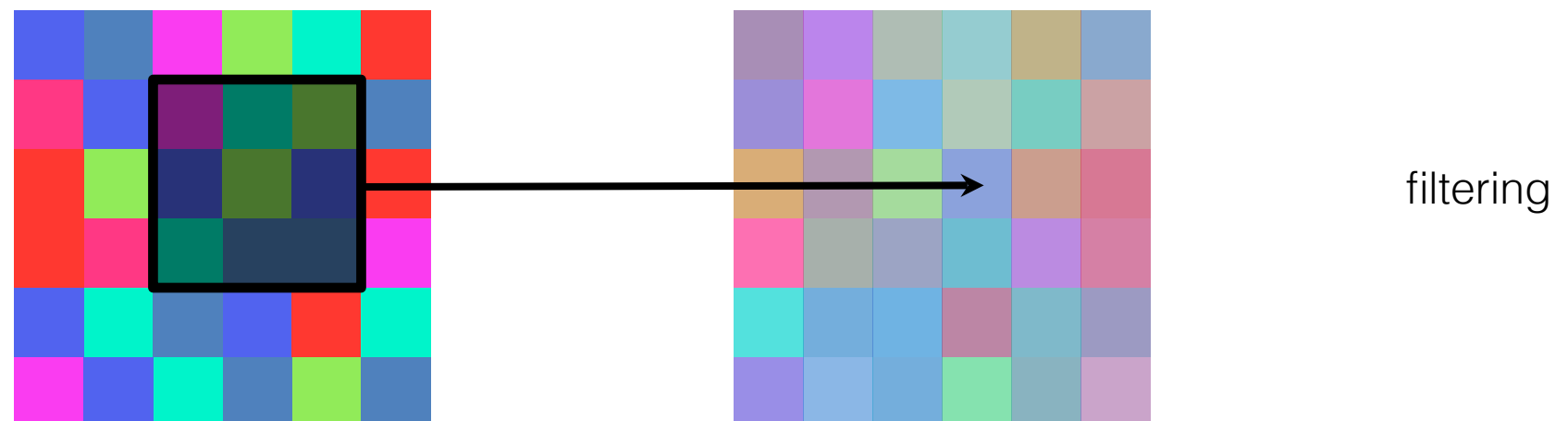
16-720 Computer Vision  
**Carnegie Mellon University (Kris Kitani)**

What kind of image filtering can we perform?

## Point Operation



## Neighborhood Operation





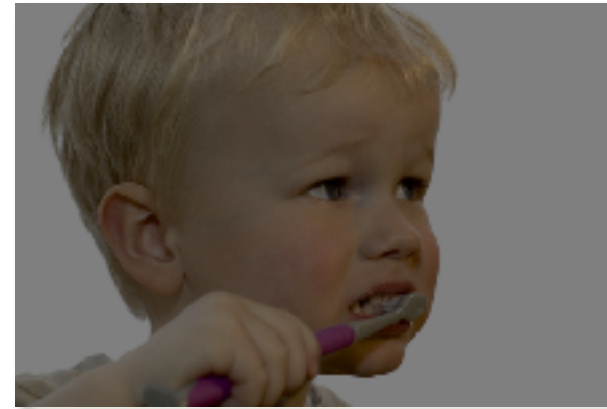
**Original**



**Darken**



**Lower Contrast**



**Nonlinear Lower Contrast**



$x$

*pixel value*

**Invert**



**Lighten**



**Raise Contrast**



**Nonlinear Raise Contrast**



**Original**



$x$

**Darken**



$x - 128$

*how would you code this?*

**Lower Contrast**



**Nonlinear Lower Contrast**



**Invert**



**Lighten**



**Raise Contrast**



**Nonlinear Raise Contrast**



**Original**



$$x$$

**Darken**



$$x - 128$$

**Lower Contrast**



$$\frac{x}{2}$$

**Nonlinear Lower Contrast**



**Invert**



**Lighten**



**Raise Contrast**



**Nonlinear Raise Contrast**



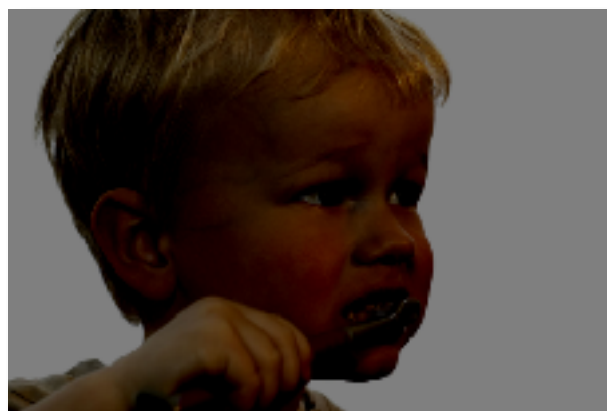


Original



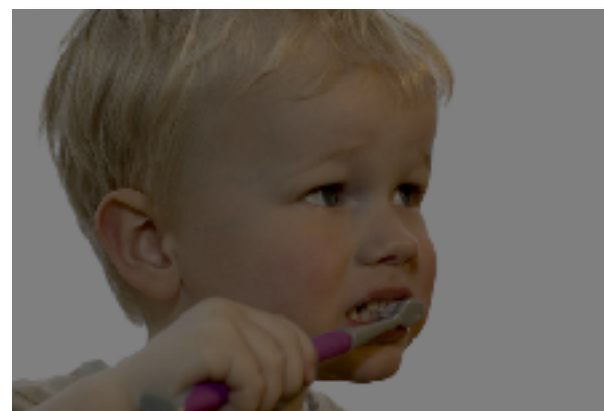
$$x$$

Darken



$$x - 128$$

Lower Contrast



$$\frac{x}{2}$$

Nonlinear Lower Contrast



$$\left( \frac{x}{255} \right)^{1/3} \times 255$$

Invert



Lighten



Raise Contrast



Nonlinear Raise Contrast



Original



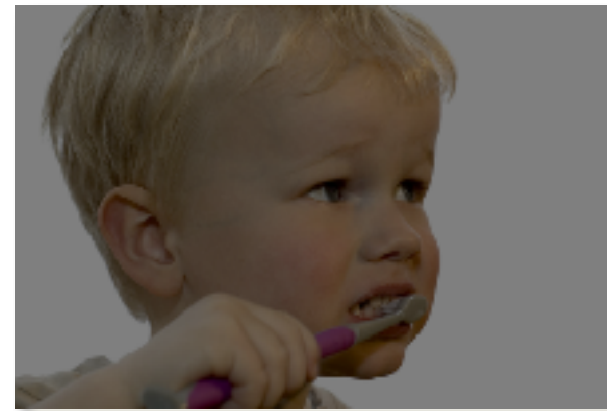
$$x$$

Darken



$$x - 128$$

Lower Contrast



$$\frac{x}{2}$$

Nonlinear Lower Contrast



$$\left( \frac{x}{255} \right)^{1/3} \times 255$$

Invert



$$255 - x$$

Lighten



Raise Contrast



Nonlinear Raise Contrast



Original



$$x$$

Darken



$$x - 128$$

Lower Contrast



$$\frac{x}{2}$$

Nonlinear Lower Contrast



$$\left( \frac{x}{255} \right)^{1/3} \times 255$$

Invert



$$255 - x$$

Lighten



$$x + 128$$

Raise Contrast



Nonlinear Raise Contrast





Original



$$x$$

Darken



$$x - 128$$

Lower Contrast



$$\frac{x}{2}$$

Nonlinear Lower Contrast



$$\left( \frac{x}{255} \right)^{1/3} \times 255$$

Invert



$$255 - x$$

Lighten



$$x + 128$$

Raise Contrast



$$x \times 2$$

Nonlinear Raise Contrast



Original



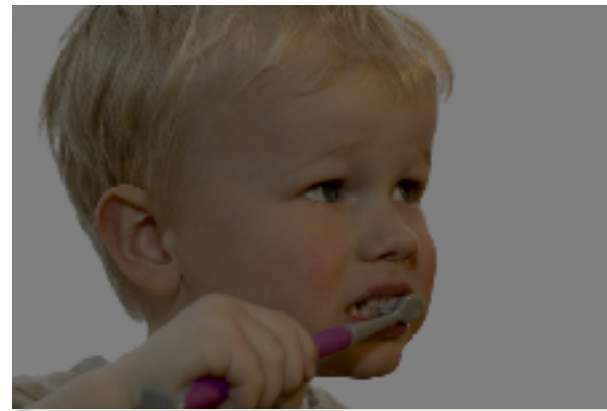
$$x$$

Darken



$$x - 128$$

Lower Contrast



$$\frac{x}{2}$$

Nonlinear Lower Contrast



$$\left( \frac{x}{255} \right)^{1/3} \times 255$$

Invert



$$255 - x$$

Lighten



$$x + 128$$

Raise Contrast



$$x \times 2$$

Nonlinear Raise Contrast



$$\left( \frac{x}{255} \right)^2 \times 255$$



# Other point processes



*Are these point-processes?*