Computer Architecture

Teamwork

Escuela Politécnica de Ingeniería de Gijón
Universidad de Oviedo

Fall, 2020

General description

Goal

Image processing with/without parallelism (comparison)

- SIMD instructions
- Multiple threads

Phases

1. Sequential implementation (2 points)
2. SIMD (5 points) + Multi-threaded (3 points)

Algorithms

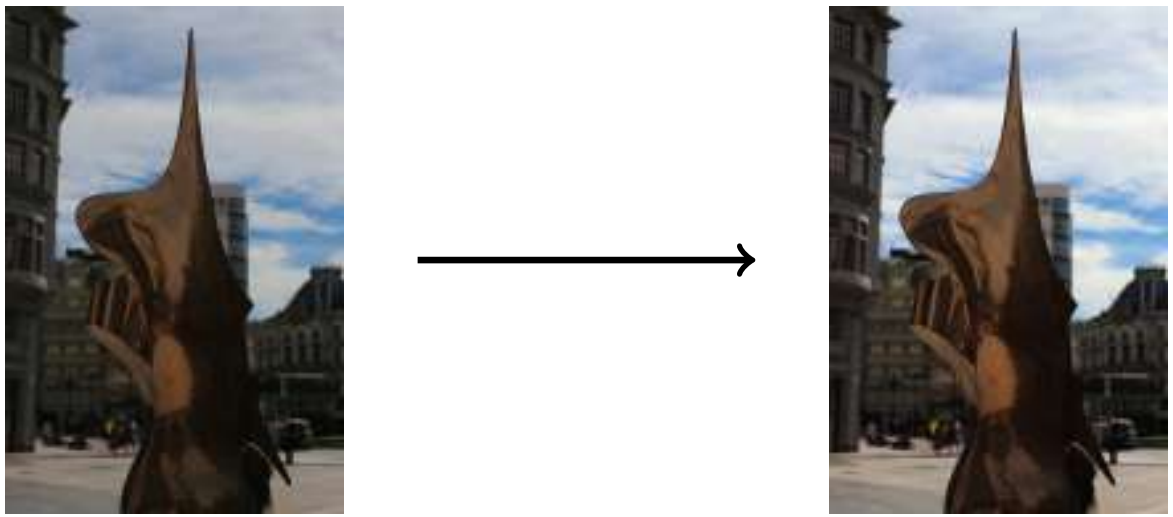
Contrast stretch #1

1. Get minimum and maximum

$$R_{min}, G_{min}, B_{min};\ R_{max}, G_{max}, B_{max}$$

2. Calculate the new values

$$I(c)_i = \frac{I(c)_i - I(c)_{min}}{I(c)_{max} - I(c)_{min}} \times 255, \quad \forall c \in R, G, B$$



Algorithms

White balance. Grey World #2

1. Get means

$$Rm, Gm, Bm$$

2. Calculate the new values

$$R' = R \times Gm/Rm$$
$$G' = G$$
$$B' = B \times Gm/Bm$$

Algorithms

Black and white inversion #3

1. Convert to black & white

$$L_i = 0.3R_i + 0.59G_i + 0.11B_i$$

2. Invert

$$L'_i = 255 - L_i$$

Algorithms

Blend #4

1. Blend two images (X and Y) into image I
2. It uses a blend level C in range $[0, 1]$

$$I(c)_i = C \times X(c) + (1 - C) \times Y(c), \quad \forall c \in R, G, B$$

Algorithms

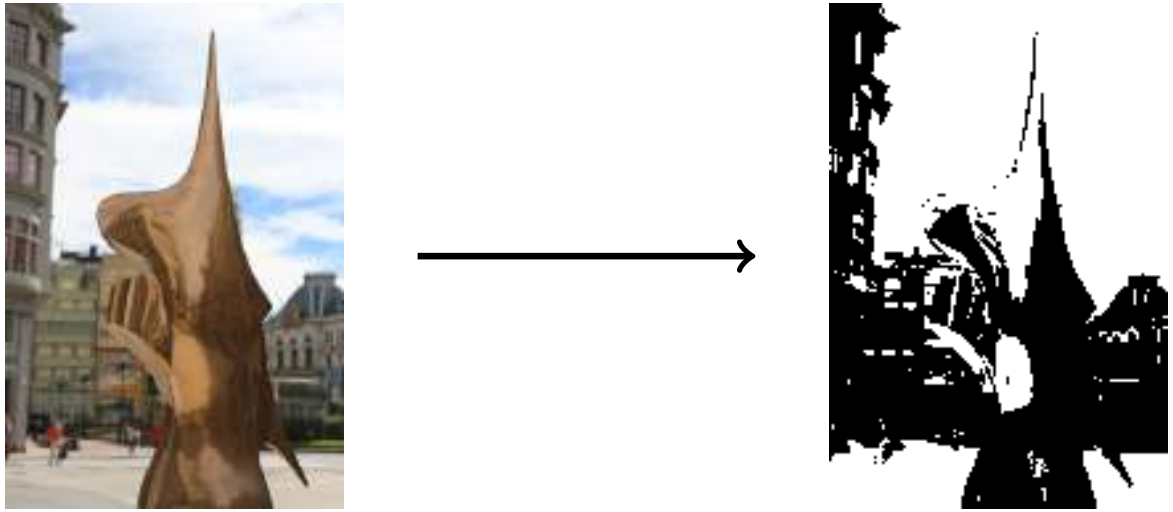
Binarization #5

1. Convert to black & white

$$L_i = 0.3R_i + 0.59G_i + 0.11B_i$$

2. Binarization (threshold T)

$$\text{if } (L_i < T)\ L'_i = 0 \text{ else } L'_i = 255$$



Algorithms

Blend: Amplitude mode #6

1. Blend two images (X and Y) into image I

$$I(c)_i = \frac{\sqrt{X(c)_i^2 + Y(c)_i^2}}{\sqrt{2}}, \quad \forall c \in R, G, B$$



Algorithms

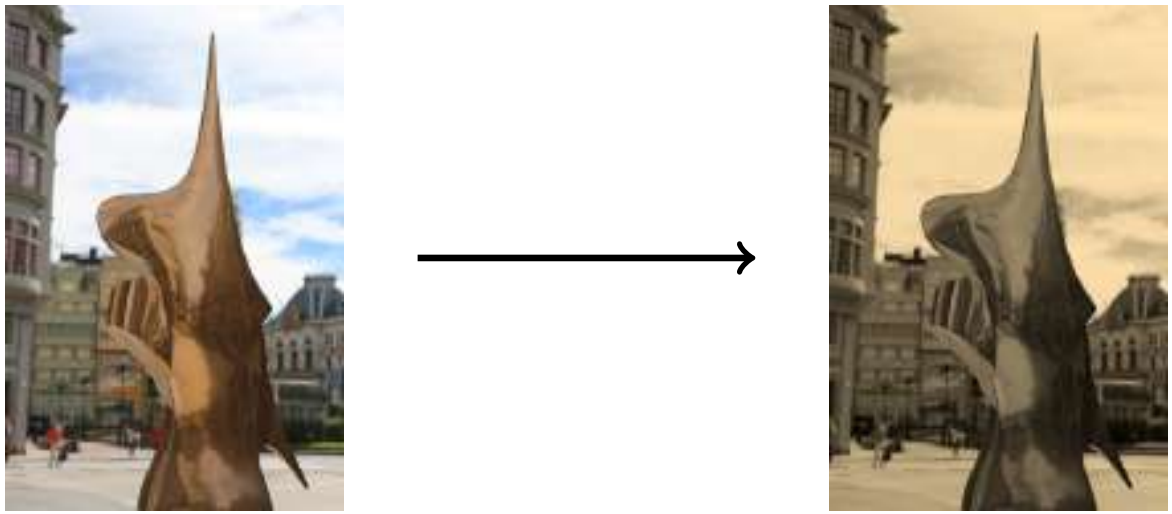
Sepia #7

1. Contrast $T \in [-100, 100] \rightarrow C = \frac{100+T}{100}^2$

$$X'_i = X_i \times C, \quad \forall X \in R, G, B$$

2. Sepia

$$R'_i = 0.393R_i + 0.769G_i + 0.189B_i$$
$$G'_i = 0.349R_i + 0.686G_i + 0.168B_i$$
$$B'_i = 0.272R_i + 0.534G_i + 0.131B_i$$



Algorithms

Blend: Divide + ink #8

1. Ink (Select a color with components Rt, Gt and Bt in %)
2. Example with (1,0.5,0.5) as values for (Rt,Gt,Bt))

$$R' = R \times Rt$$
$$G' = G \times Gt$$
$$B' = B \times Bt$$

3. Blend image (X) with another image (Y) in division mode into image (I)

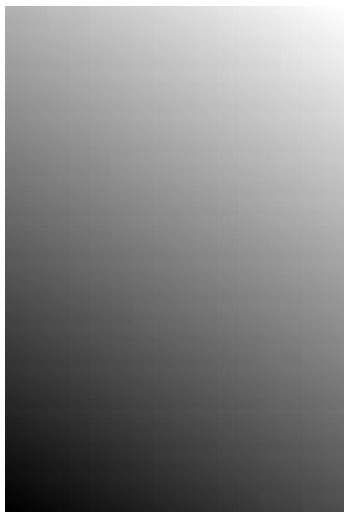
$$I(c)_i = \frac{256 \times Y(c)_i}{X(c)_i + 1}, \quad \forall c \in R, G, B$$

Algorithms

Blend: screen #9

1. Blend of two images (X and Y) into image I

$$I(c)_i = 255 - \frac{(255 - X(c)_i) \times (255 - Y(c)_i)}{255}, \quad \forall c \in R, G, B$$

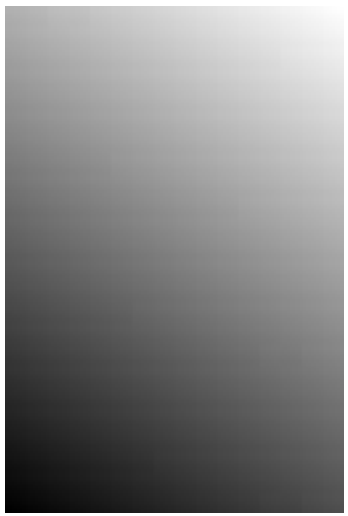




Algorithms

Blend: Overlap mode #10

1. Blend of two images (X and Y) into image I

$$I(c)_i = \frac{Y(c)_i}{255} \times \left(Y(c)_i + \frac{2 \times X(c)_i}{255} \times (255 - Y(c)_i) \right), \quad \forall c \in R, G, B$$

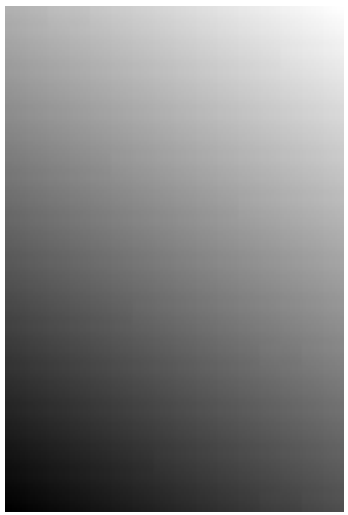


Algorithms

Blend: whiten mode#11

1. Blend of two images (X and Y) into image I

$$I(c)_i = \frac{256 \times Y(c)_i}{(255 - X(c)_i) + 1}, \quad \forall c \in R, G, B$$

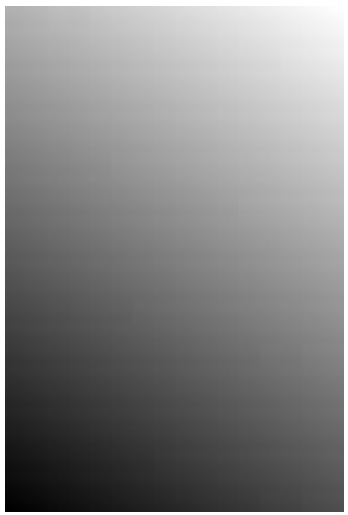




Algorithms

Blend: blacken mode#12

1. Blend of two images (X and Y) into image I

$$I(c)_i = 255 - \frac{256 \times (255 - Y(c)_i)}{X(c)_i + 1}, \quad \forall c \in R, G, B$$



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