

Computer Vision course: Fundamentals and applications

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August 30, 2018



BIVL²ab

MACV Motion Analysis and Computer Vision

MACV- BivLab



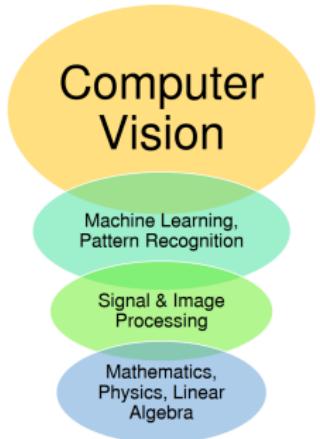
Thanks

This course would not have been possible without the support, participation and initiative of MACV and BivL²ab team.

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What is Computer Vision?

- ▶ Set of computer methods and techniques aimed at interpreting images and videos to replicate human visual abilities.
- ▶ Different fields support the multiple tasks performed in computer vision: acquisition, processing, analysis, understanding, etc.
- ▶ CV differs from image processing in the sense that it steps toward full scene understanding.



What is Computer Vision?



Main differences but complementary areas ... we need to know about all possible!

Human Visual System

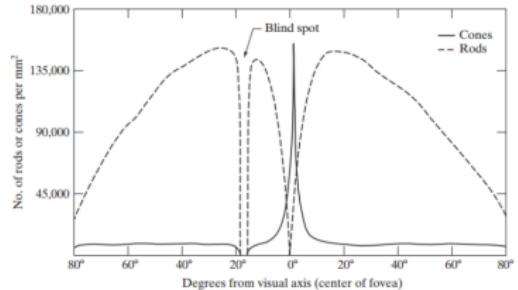
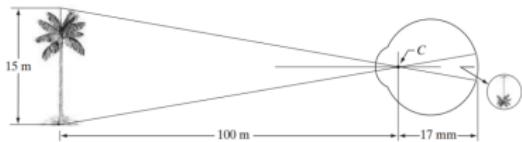
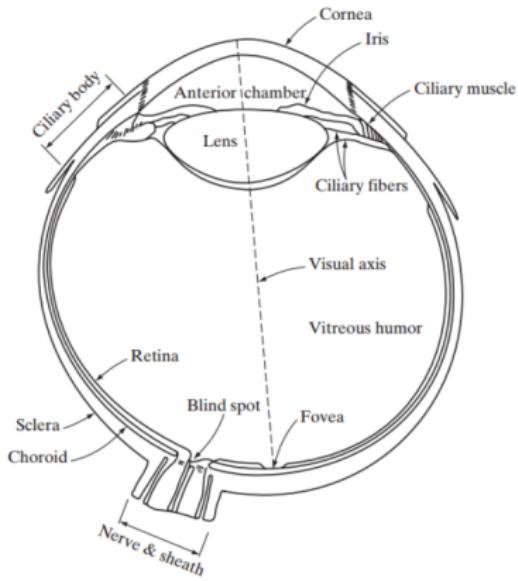


Image Perception: Why is this hard?

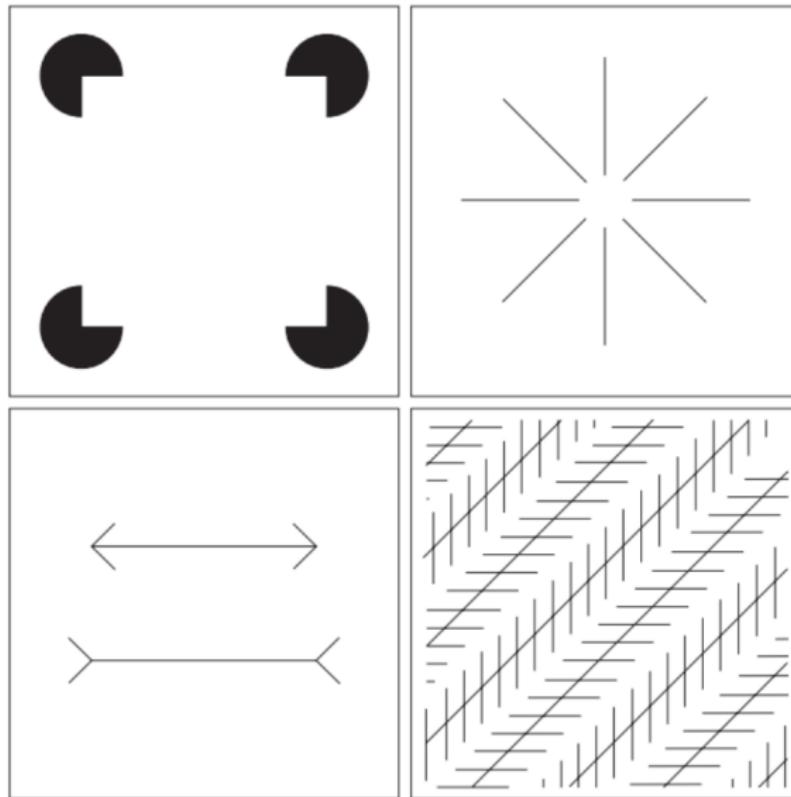


Image Perception: Why is this hard?

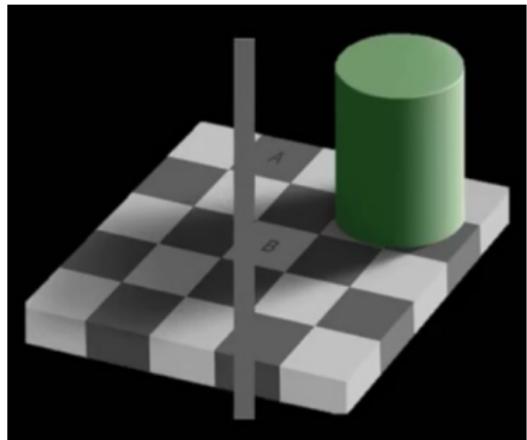
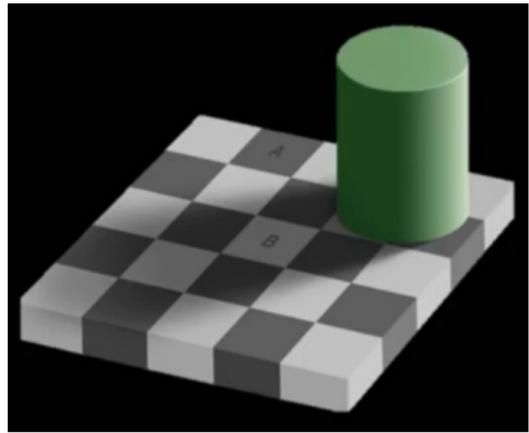
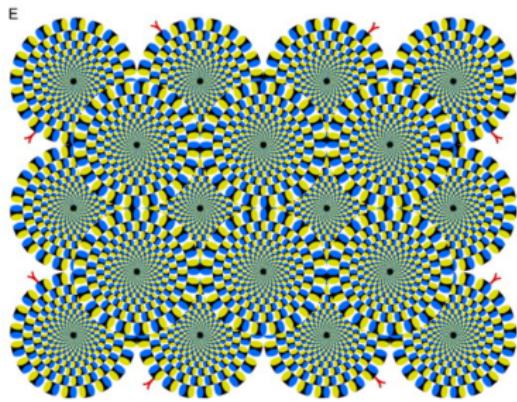
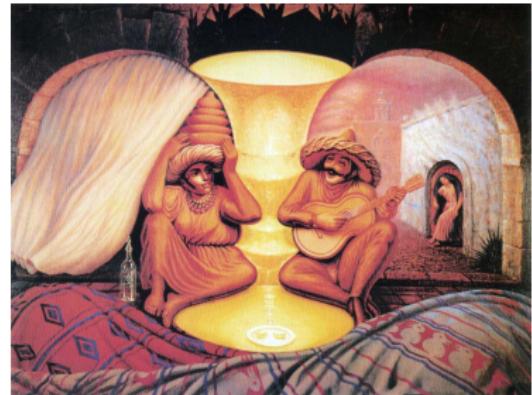


Image Perception: Why is this hard?



Images and Videos Everywhere!



Image and video data have become ubiquitous in both production and consumption.

Images and Videos Everywhere!



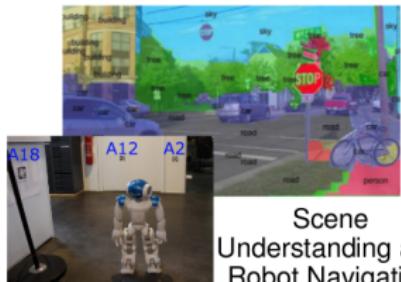
Therefore applications to manipulate these data and extract information from them are becoming core.

Images and Videos Everywhere!



Computer vision can be then developed to accomplish these different visual tasks automatically.

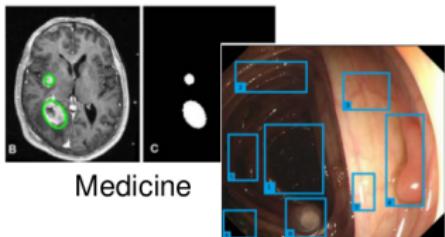
Some Applications!



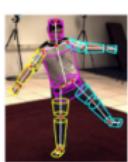
Scene
Understanding and
Robot Navigation



Face Recognition

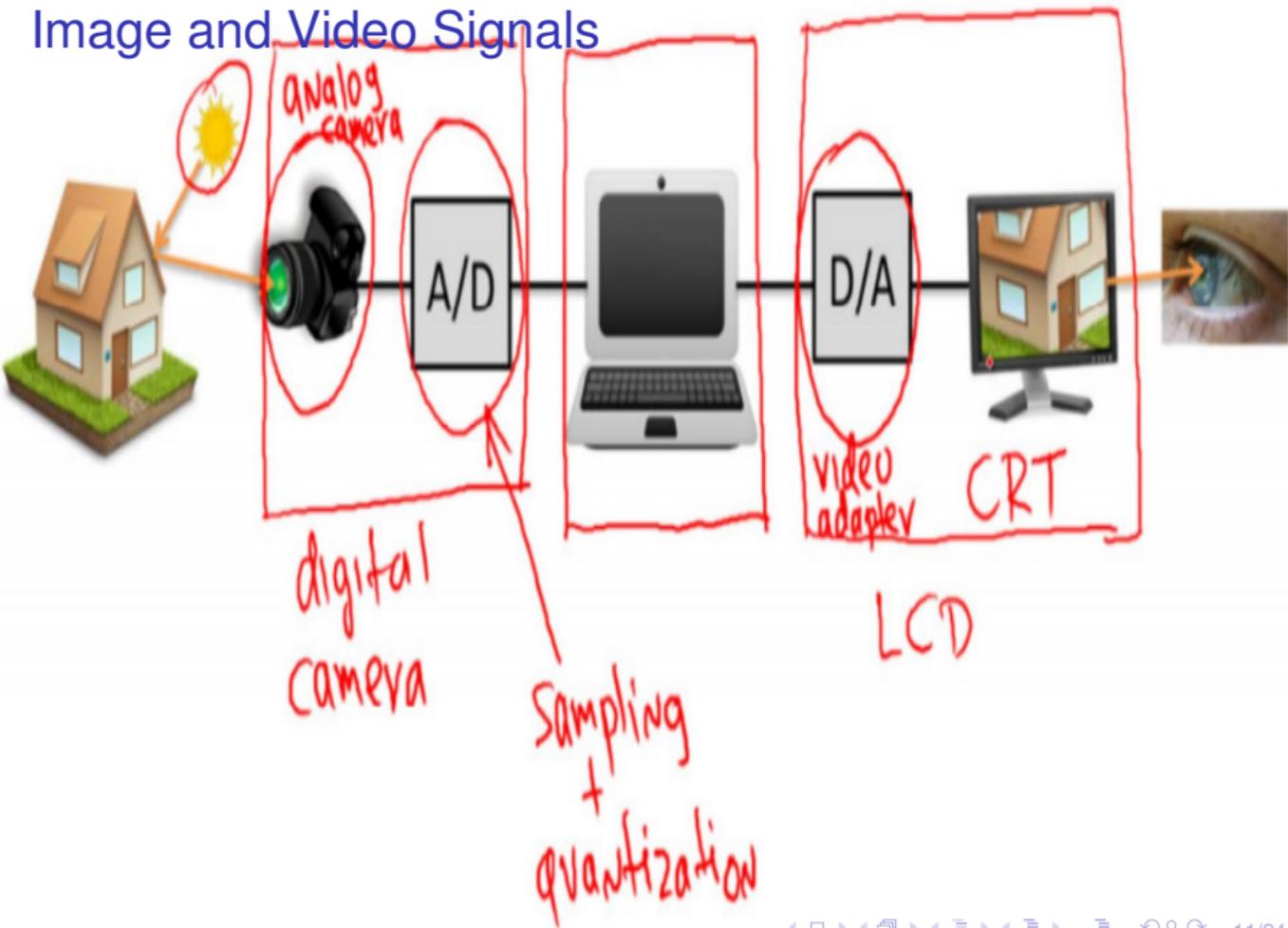


Medicine

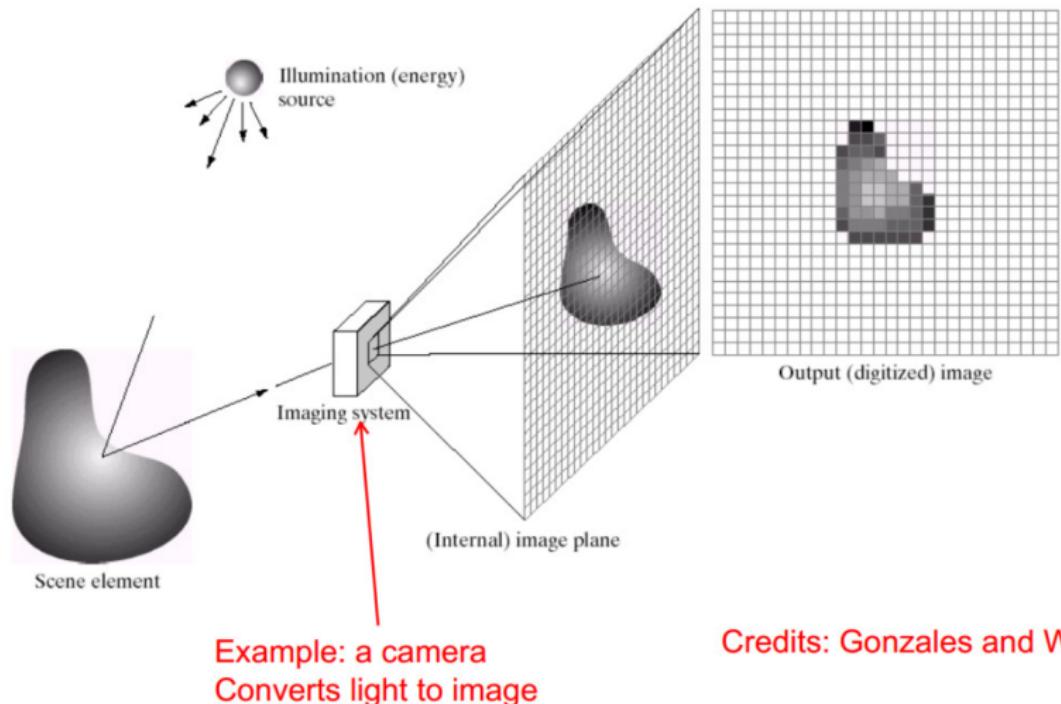


Human Activity
Analysis

Image and Video Signals

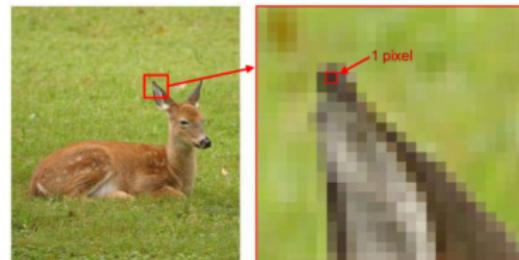
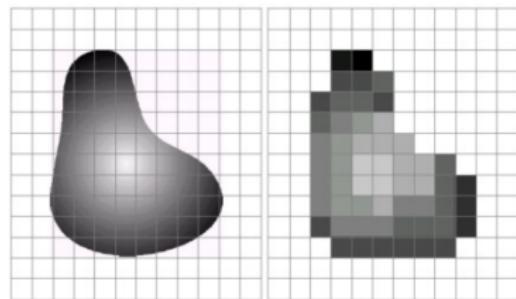


Imaging System: Sampling



Digital image as an approximation of real world

- ▶ A digital image is a numerical representation of the imaged scene
- ▶ Digitization causes a digital image to become an approximation of a real scene.



Digitalization also implies Quantization!

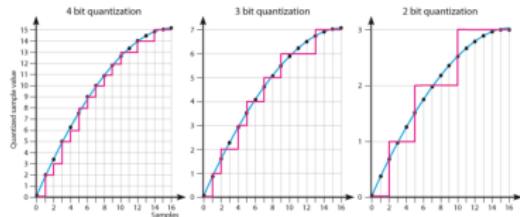
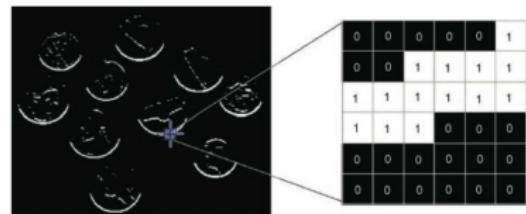


Image Types: Binary Image



2 Bits

Depending on the image format, pixel values can take a finite number of possible values.

A 7x7 binary matrix representing a 2-bit image. To its right, seven green arrows point from each row of the matrix to a corresponding 2-bit binary value below it, illustrating how each 1-bit pixel in the original image is represented by two bits in this format.

0	0	0	1	1	1	1	0	0	0
0	0	0	1	0	0	1	0	0	0
0	0	0	1	0	0	1	0	0	0
1	1	1	1	1	1	1	1	1	1
1	1	1	1	1	1	1	1	1	1
0	1	0	0	0	0	0	1	0	0
1	1	1	0	0	0	0	1	1	1
1	0	1	0	0	0	0	1	0	1
1	0	1	0	0	0	0	1	0	1
1	0	1	0	0	0	0	1	0	1

Image Types: Grayscale Image

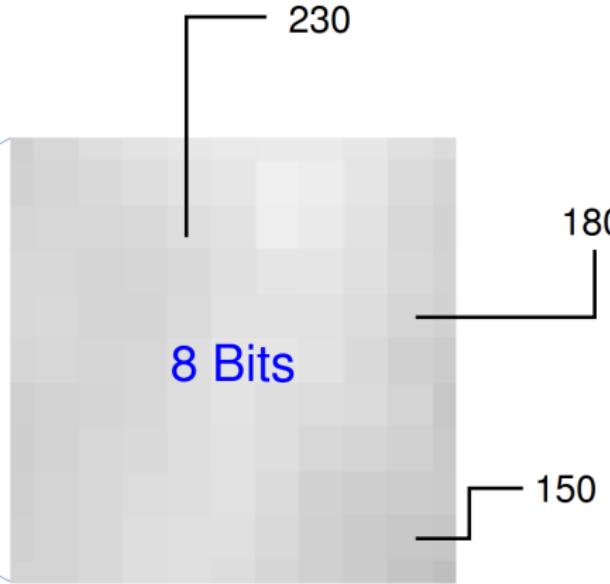
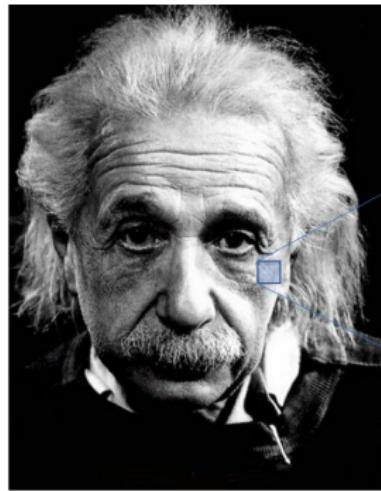
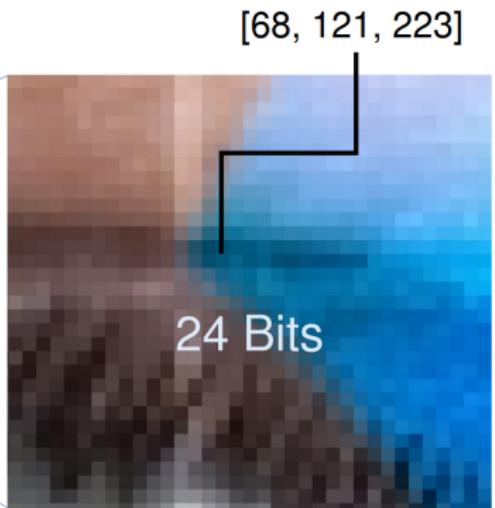
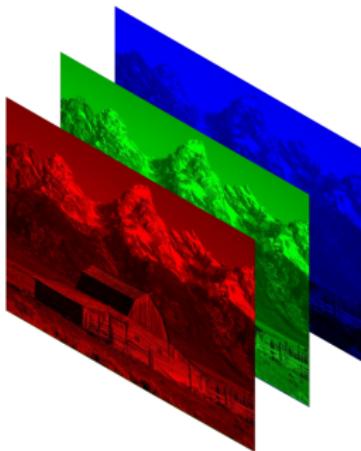
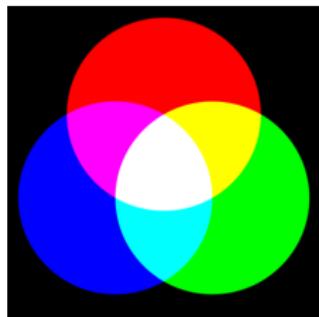


Image Types: RGB Image



RGB Images

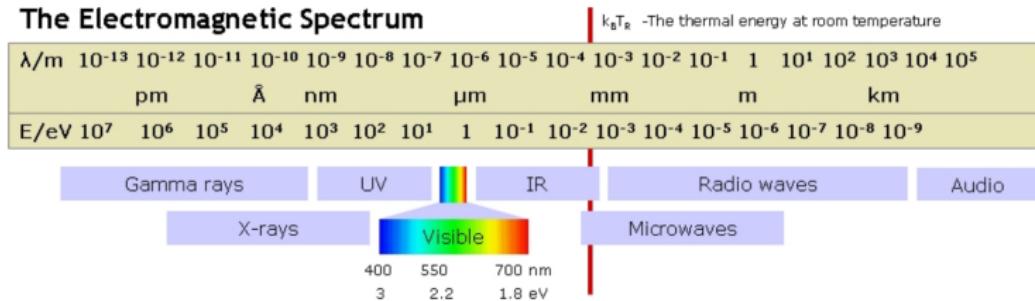
In RGB format, each color is coded by the combination of three color components:



RGB Images

- ▶ Perceived color is related to the wavelength of light waves.
- ▶ Visible spectrum is in the range, $\lambda = 400 - 700\text{nm}$

The Electromagnetic Spectrum



Arithmetic operators: Image Addition





$$\bar{f}(x, y)$$



$$f_{40}(x, y)$$



$$\bar{f}(x, y) - f_{40}(x, y)$$

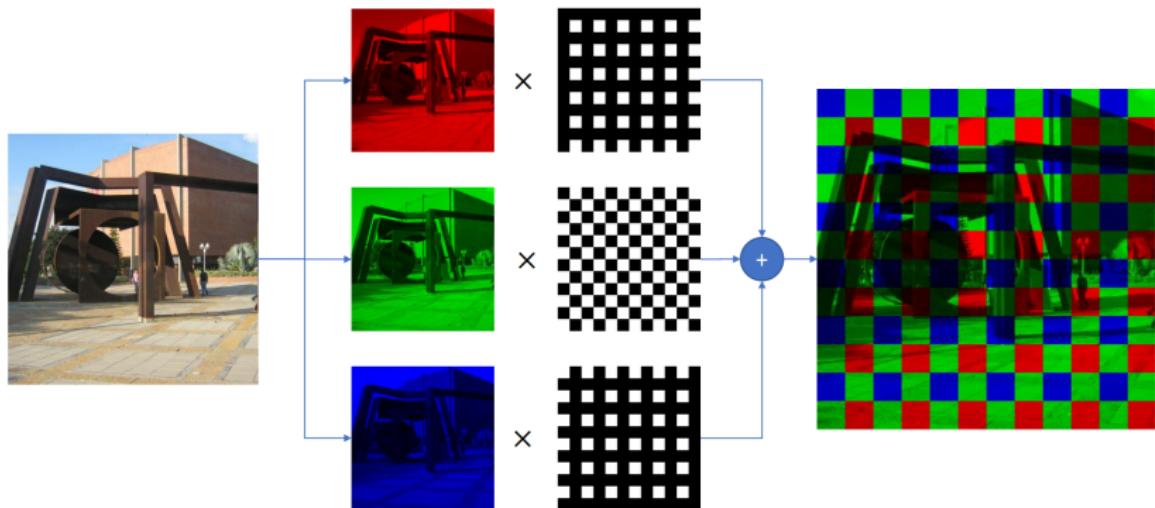
Arithmetic operators: Image Blending

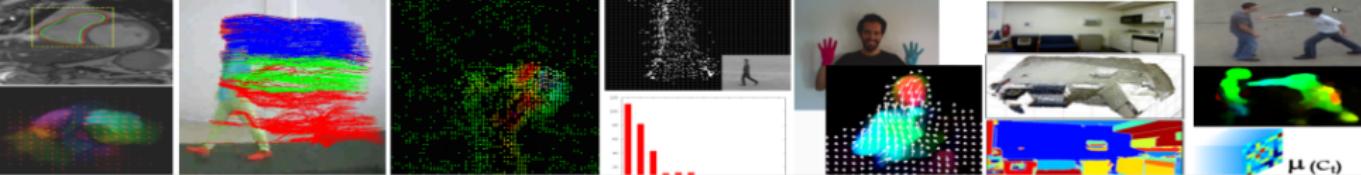
This is also image addition, but different weights are given so that it gives a feeling of blending or transparency, as:

$$B(x, y) = \alpha I_1(x, y) + (1 + \alpha) I_2(x, y)$$



Arithmetic operators: Image Multiplication





Thank you for your attention ...



... It's time to wake up

1