rain

appears so entirely dramatic,
to true painters.

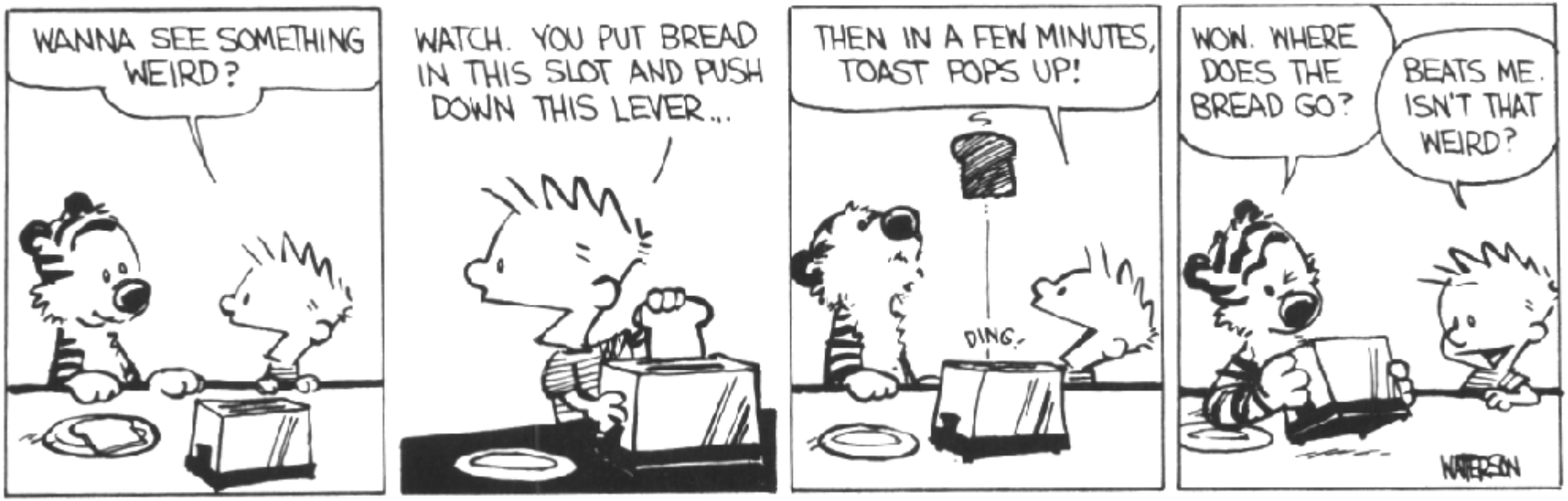
Take Home Message

Colour is the essence of Vision

and yet

Computer Vision researchers do not pay enough attention to it

Ignorance Disclaimer

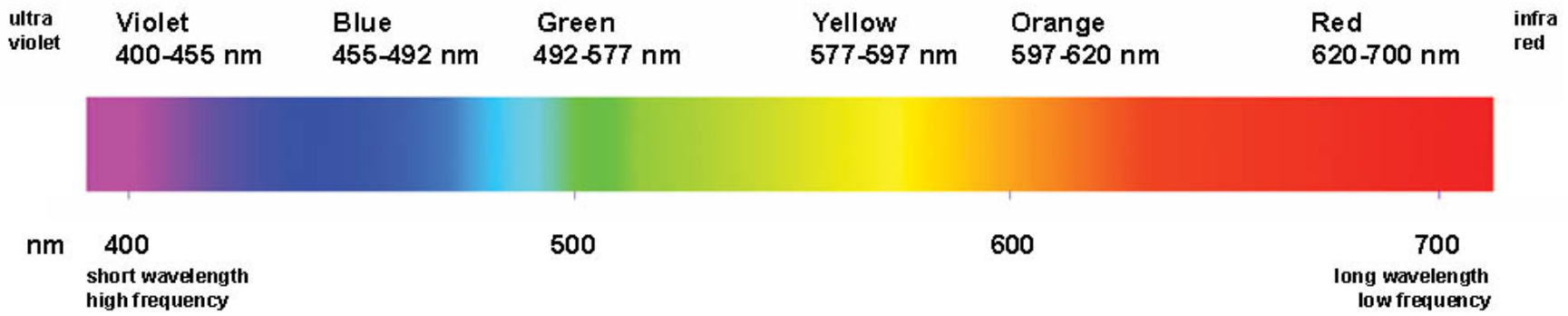


Colour is Complicated

Colour is a **subjective and psychological** phenomenon.

Physical measurements do not fully capture colour experience:

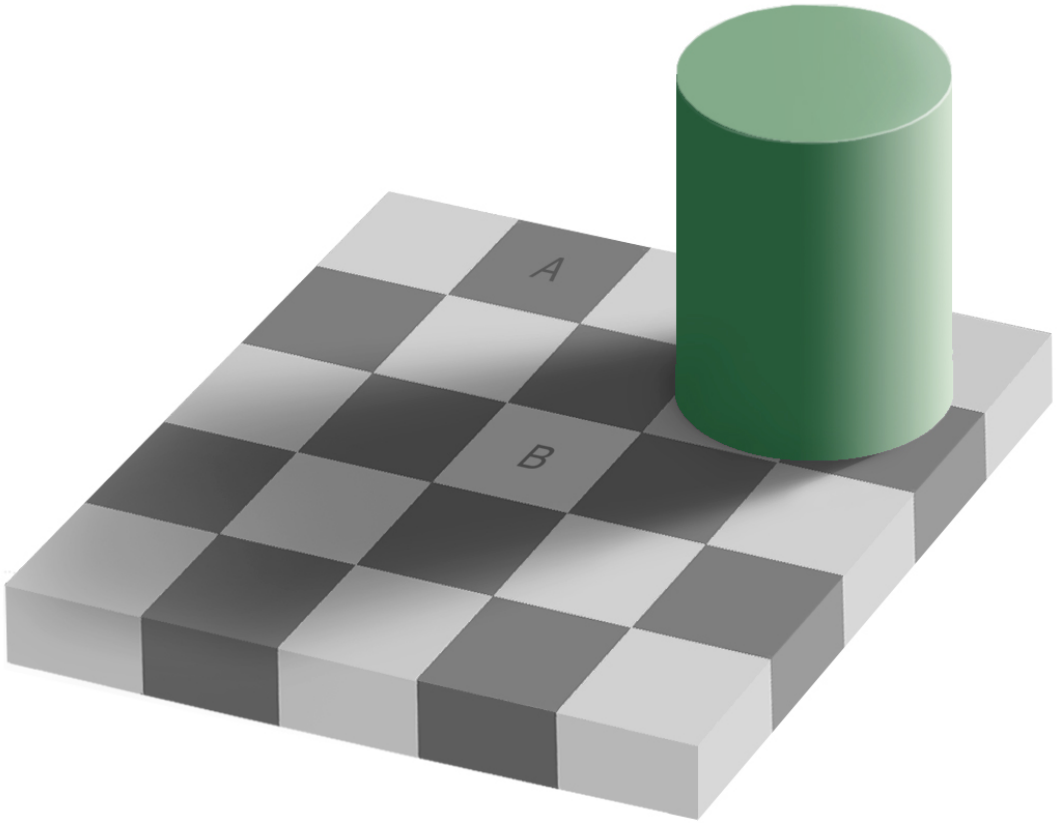
A. *Reds* and v*iolets* are perceptually similar and yet they are the **extrema of the visible spectrum**



"Vision Science" S. Palmer, 1999

Colour is Complicated

B. Colour perception depends on **context** rather then per-pixel measurements



Colour is Complicated

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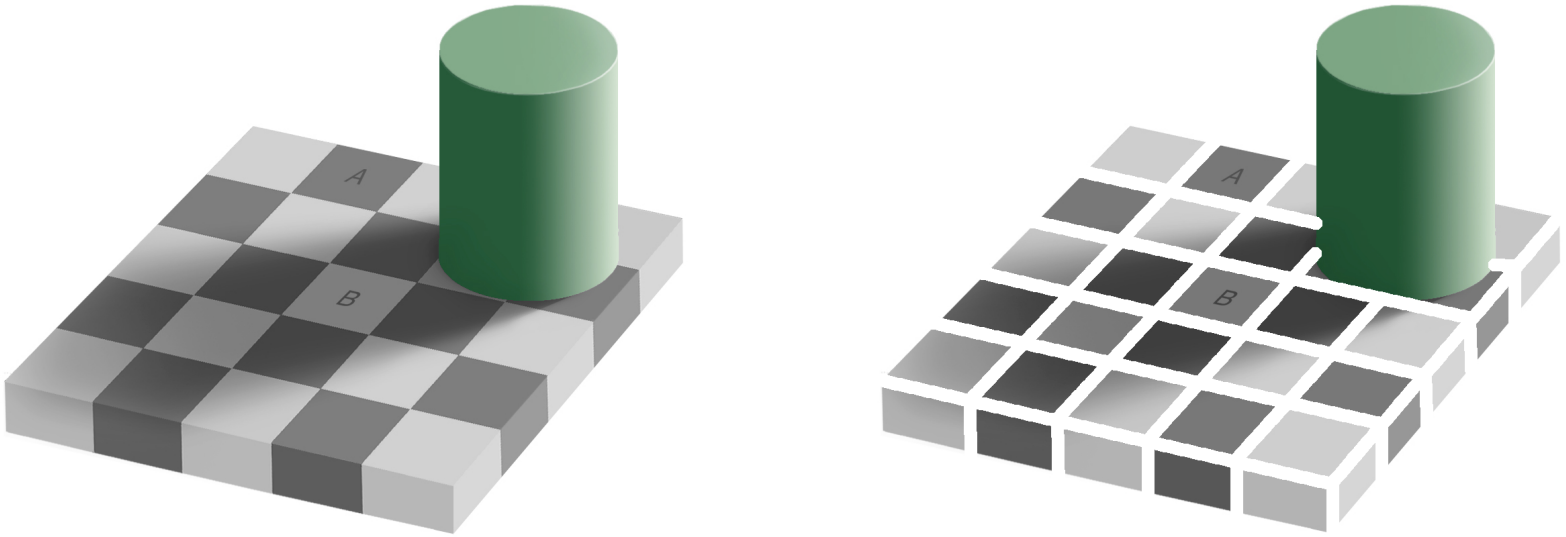


Colour and Computer Vision

In light of the previous ideas **Computer Vision should** try to **recreate colour perception before anything else** but...

...typically these aspects are not a big concern for researchers.

Main reasons:

A. The high **variability at sensor level** does not help

B. **Higher-level tasks are more appealing**

C. **Low-level** things (e.g. features) would require complete **redesign**

A Short History of Colour in Computer Vision

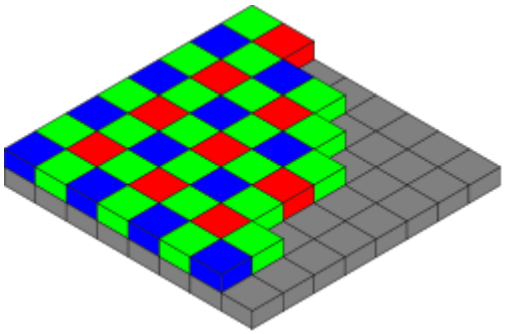
The evolution of Colour in Computer Vision:

A. **The Dark Ages of Greyscale** (not entirely over)

B. **The RGB Era**

C. Towards **perception-driven colour-spaces**

Crash Course on Images



Acquisition
[H x W]

Demosaicing

R

G

B

Image
[H x W x 3]

The Dark Ages of Greyscale

Dealing with **colour is complicated and** anyway **computationally expensive**

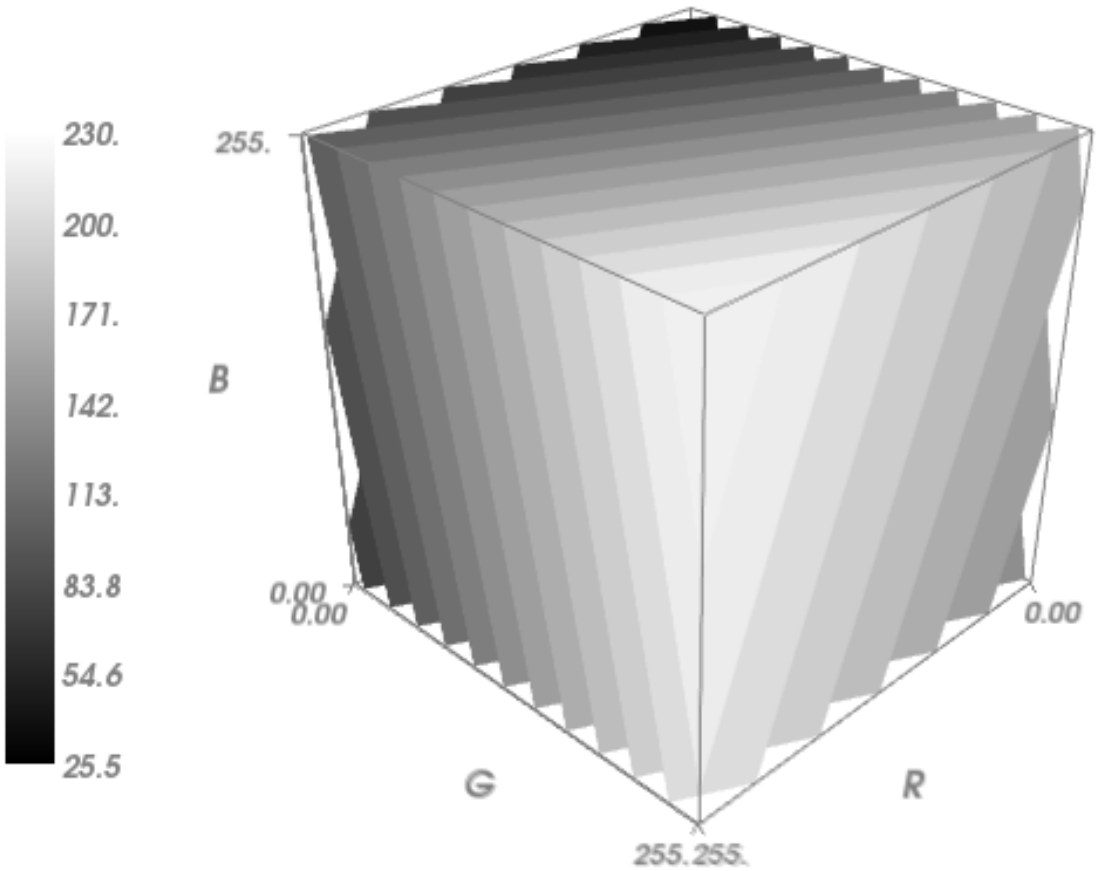
Let's go grey!

Single most used function in the MATLAB Image Toolbox:

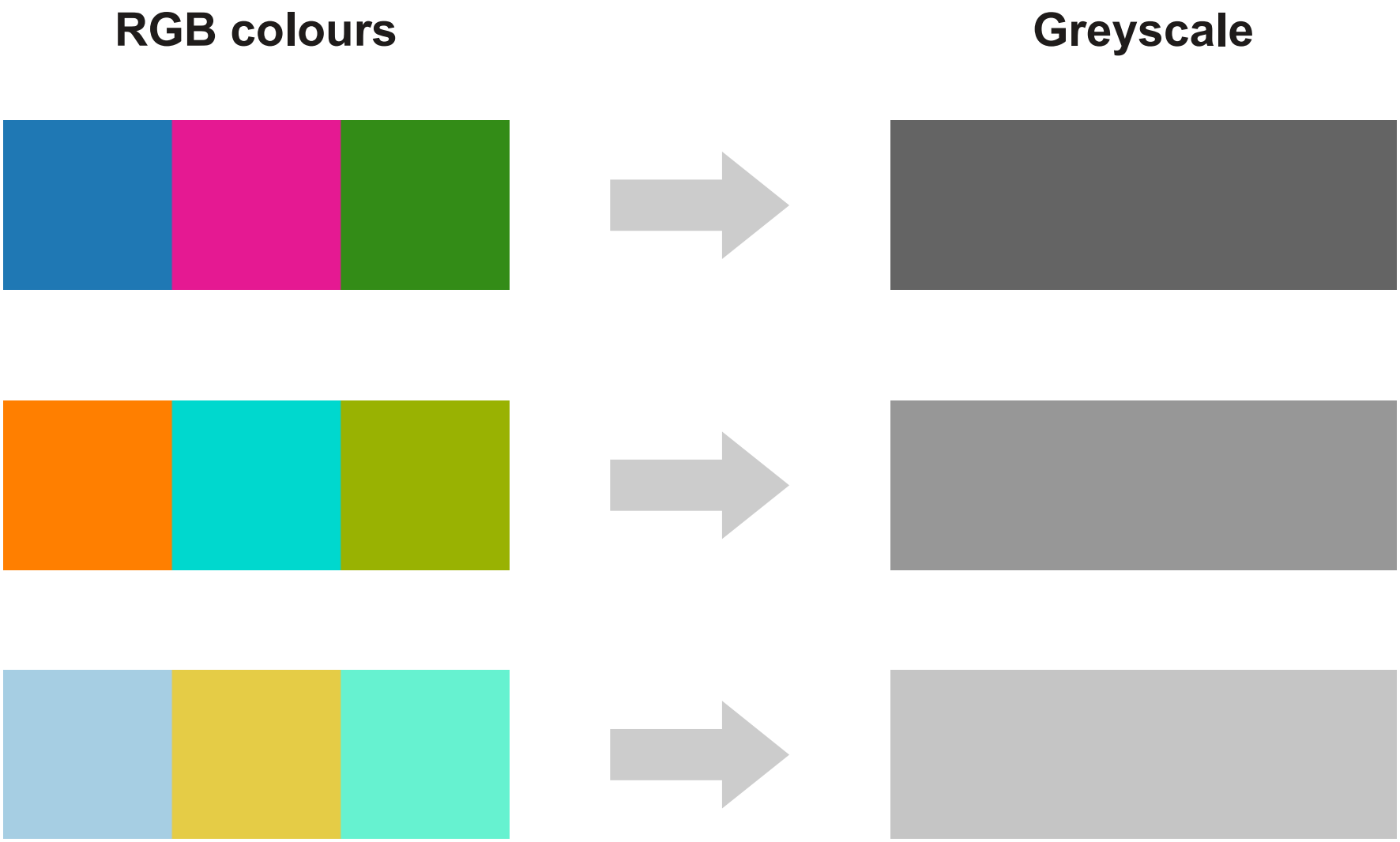
rgb2gray()

The Greyscale Transformation

$$\text{Grey} = 0.2989 * R + 0.5870 * G + 0.1140 * B$$



But Things Can Go Wrong...



...Very Wrong...

Turning a quotation by Cézanne...

Colour is the place where our
brain and the universe meet.
That's why colour
appears so entirely dramatic,
to true painters.

Paul Cézanne

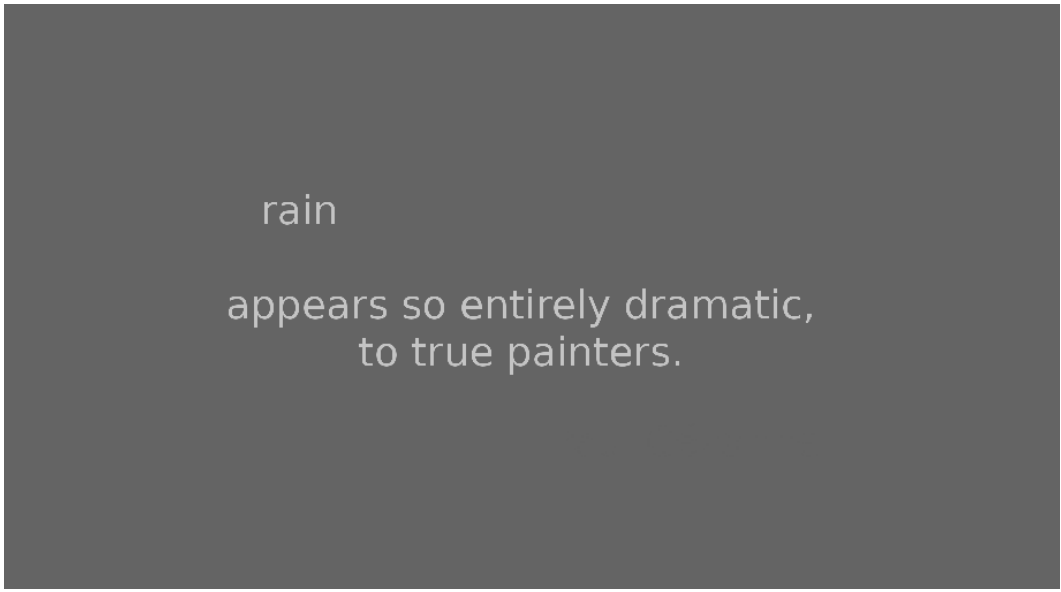
...Very Wrong...

Turning a quotation by Cézanne...

Colour is the place where our brain and the universe meet. That's why colour appears so entirely dramatic, to true painters.

Paul Cézanne

...in an odd Tea-talk title if you print it in greyscale...



The RGB Era

The transformation to greyscale implies a **huge information loss**.

Let's use RGB!

Why RGB?

A. RGB is **directly linked to the sensor input**

B. RGB is perceived as a “engineering-ly sound” **measure of “real” colours**

C. That's the **output of cameras**...it's easily accessible

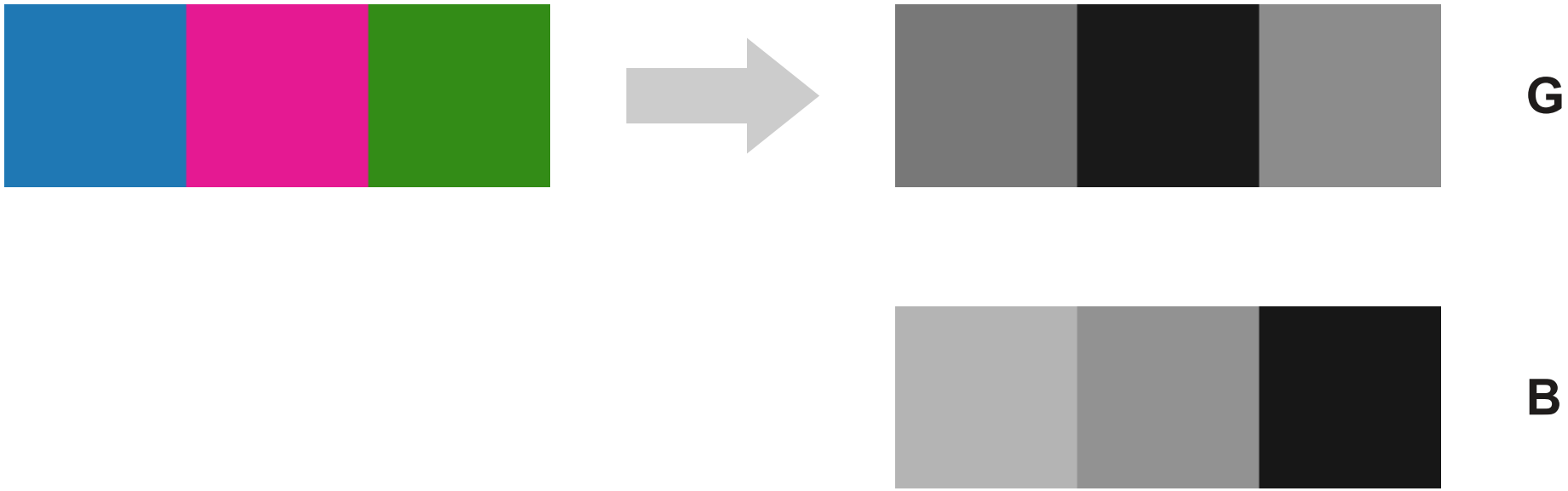
The RGB Era

Most of contemporary Computer Vision is based on **gradients** (SIFT, HOG, …)

People started computing **traditional greyscale features on the different channels separately**.

This means assuming the three channels are independent and colour is not a phenomenon in itself.

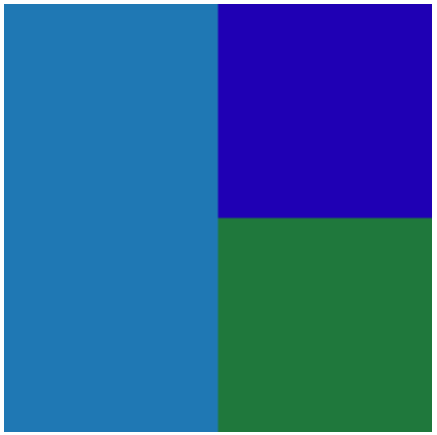
The RGB Era



The RGB Era

...but the space of sensor measurements (RGB) does not reflect well our colour perception

No perceptual uniformity



The colours on the right are equally distant from the one on the left

Towards perception-driven colour-spaces

New colour-spaces were created
to obtain **perceptual uniformity**

Euclidean distances in the colour-space
are **proportional to perceptual difference**

Towards perception-driven colour-spaces

CIELab/CIELuv

*Separate **lightness** from*
colour components

Example: CIE Lab

L	*lightness*
a	*green-magenta opponent channel*
b	*blue-yellow opponent channel*

...but that's for the next Tea Talk...

Final Remarks

A. Most of **Computer Vision is not really centred around perception**

B. Approaching Computer Vision only through **greyscale images** is a bad idea!

C. Attempts to use colours are not yet satisfactory

D. **RGB is not a good colour-space** to consider human perception