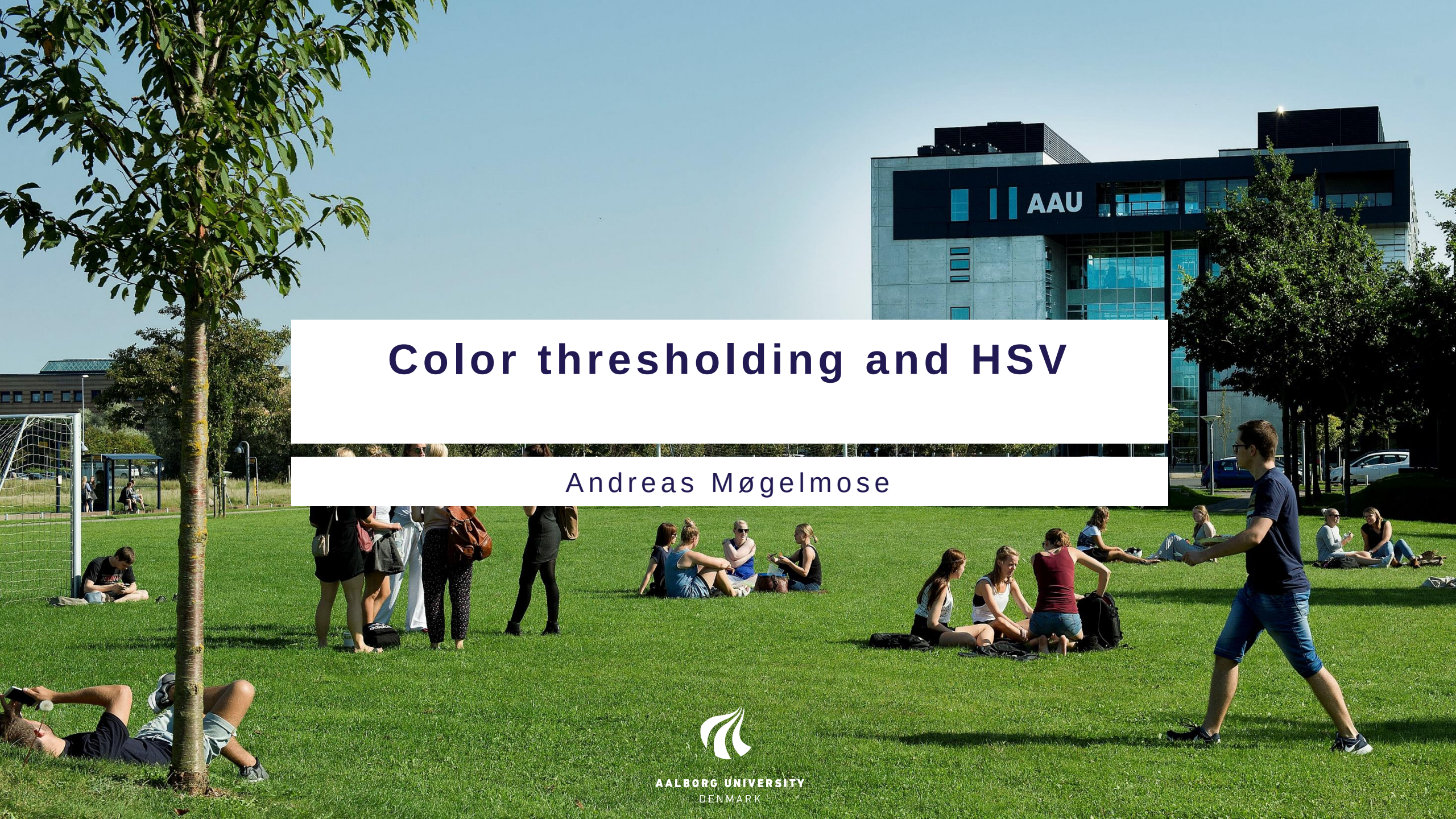

Color thresholding and HSV

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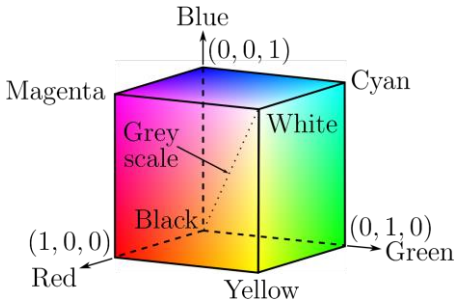
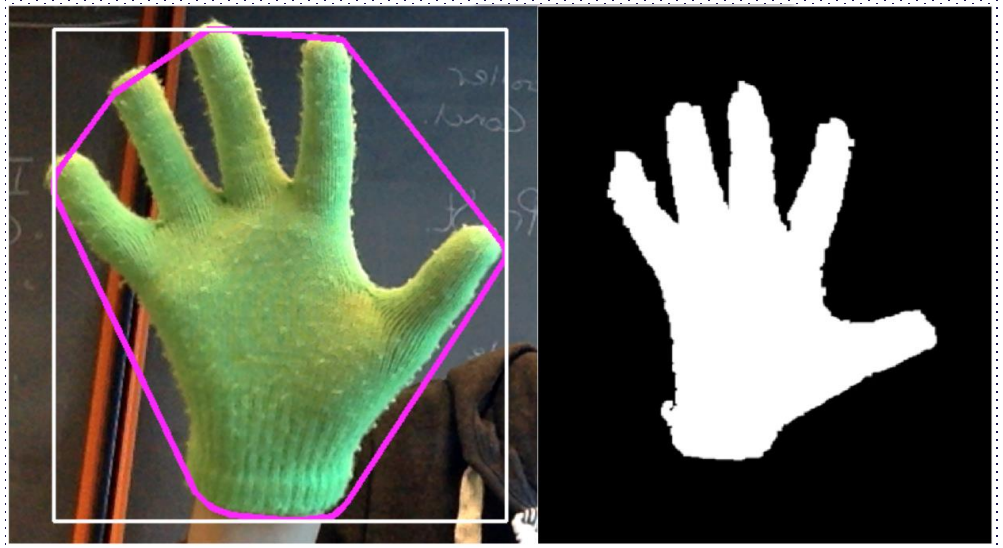
Color thresholding



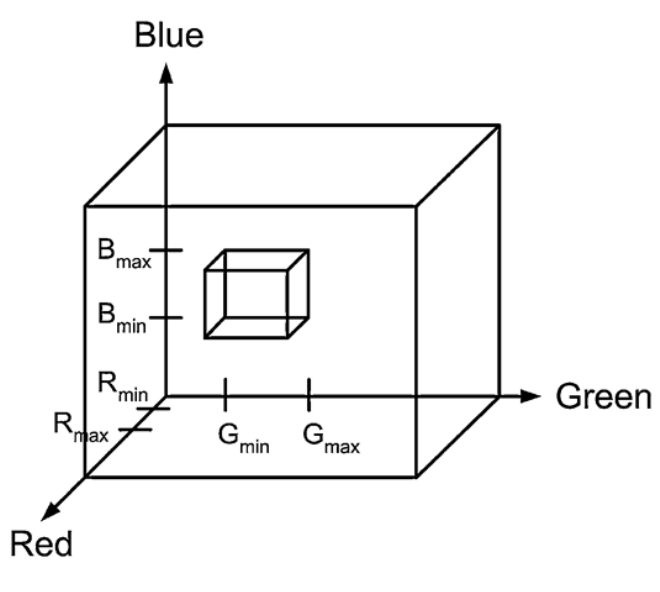


- For example: we want to detect light green objects using the color

- 3D thresholding in RGB
- If: $R_{min} < R < R_{max}$ AND
- $G_{min} < G < G_{max}$ AND
  $B_{min} < B < B_{max}$
- Then: object pixel
- Else: non-object pixel

- Problem: If the intensity changes, we need larger TH => non-object pixels will be detected

- Solution: Seperate color and intensity



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Color thresholding: Chromaticities

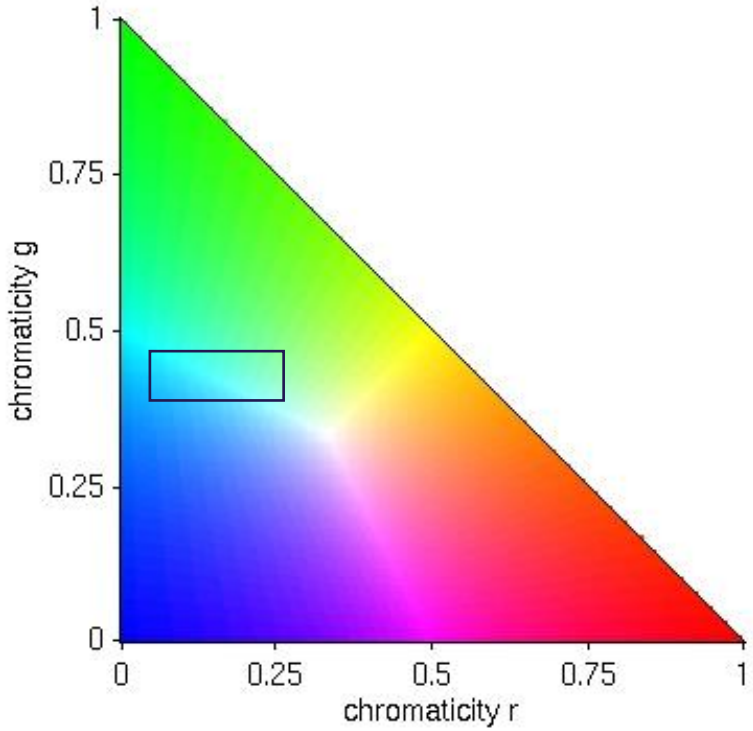
- Normalized RGB: R+G+B = 1

$$r = \frac{R}{R+G+B} \quad g = \frac{G}{R+G+B} \quad b = \frac{B}{R+G+B}$$

- Threshold in chromaticities:
- If: $R_{min} < R_{chroma} < R_{max}$ AND

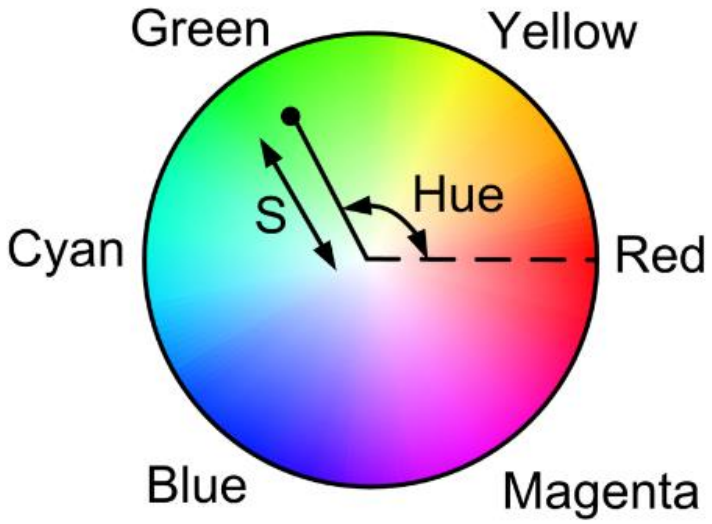
  $G_{min} < G_{chroma} < G_{max}$
- Then: object pixel
- Else: non-object pixel

Still not great for colors which are on the boundaries between the primaries ☹



HSI color space to the rescue!

- Hue: The dominant wavelength in the mixture of light waves, as perceived by an observer. The “pure” color.
- Saturation: Relative purity; inverse of the amount of white light mixed with hue
- Intensity: The average of R, G, B



- **RGB → HSI**

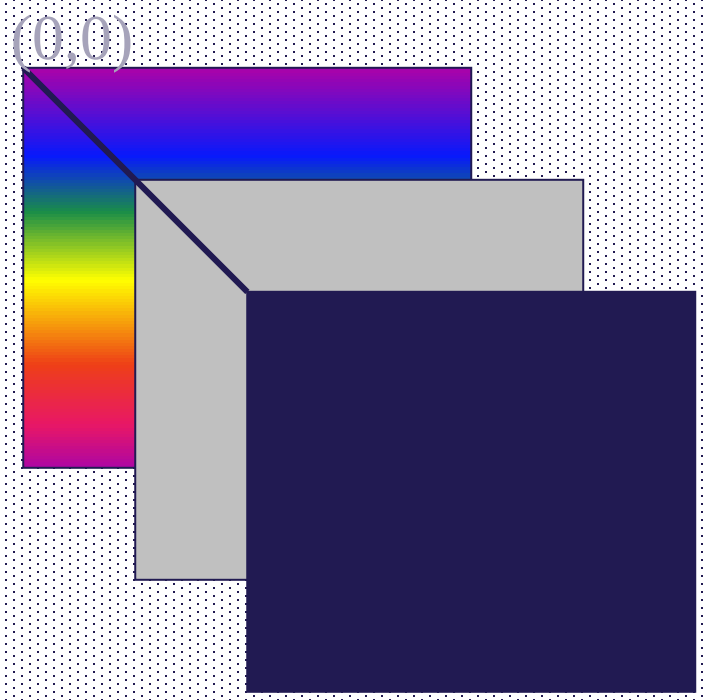
$$\theta = \cos^{-1}\left\{\frac{[(R-G)+(R-B)]/2}{\sqrt{(R-G)^2+(R-B)(G-B)}}\right\}$$

$$H = \begin{cases} \theta & B \le G \\ 360-\theta & B > G \end{cases}$$

$$S = 1 - \frac{3\cdot\min(R,G,B)}{R+G+B}$$

$$I = (R+G+B)/3$$

HSI pixels



A single pixel consists of three components.
Each pixel is a **Vector**.

128	251	60

=

Pixel-Vector in the computer memory

Final pixel in the image

HSI example

Original Image

Hue

Saturation

Intensity

HSI, HSV, HSL, HSB

- Note: HSI is closely related to HSV, HSL, or HSB (for Value, Lightness, and Brightness).
- There are minor differences, but they do pretty much the same thing.
- Look them up if you care.

- OpenCV has a built in converter:

```
cvtColor(in, out, COLOR_BGR2HSV)
```

- Know that quite a few other color spaces/color models exist.