Matching Image Patches

René Magritte, “Golconda”
Template matching

Goal: find eye in image

Main challenge: What is a good similarity or distance measure between two patches?

- Dot product
- (Zero-mean) correlation
- Sum Square Difference
- Normalized Cross Correlation

Slide contents from Derek Hoiem and Alexei Efros
Images as vectors
Matching with filters

Goal: find 🕒 in image

Method 0: filter the image with eye patch

What went wrong?

f = image

g = filter

Side by Derek Hoiem
Matching with filters

Goal: find 🕍 in image

Method 1: filter the image with zero-mean eye

```
\text{True detections}
```

```
\text{False detections}
```

mean of f (here, f is the filter)
Matching with filters

Goal: find \( \begin{array}{c} \text{eye} \\ \text{in image} \end{array} \)

Method 2: SSD

Input

1 - \( \sqrt{\text{SSD}} \)

Thresholded Image

True detections
Matching with filters

Goal: find 🎁 in image

Method 2: SSD

\[ 1 - \sqrt{\text{SSD}} \]

What’s the potential downside of SSD?

Input 1- sqrt(SSD)

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Matching with filters

Goal: find 🎌 in image

Method 3: Normalized cross-correlation

\[
\begin{align*}
\text{mean template} & \quad \text{mean image patch} \\
\end{align*}
\]
Matching with filters

Goal: find 🐱 in image

Method 3: Normalized cross-correlation

Input

Normalized X-Correlation

Thresholded Image

True detections
Matching with filters

Goal: find \( \text{\textbullet} \) in image

Method 3: Normalized cross-correlation

[Images of input, normalized X-correlation, and thresholded image with annotations for true detections]
Q: What is the best method to use?

A: Depends

Zero-mean filter: fastest but not a great matcher

SSD: next fastest, sensitive to overall intensity

Normalized cross-correlation: slowest, invariant to local average intensity and contrast
Image half-sizing

This image is too big to fit on the screen. How can we reduce it?

How to generate a half-sized version?