University of Dayton

Heat maps

CPS 563 – Data Visualization

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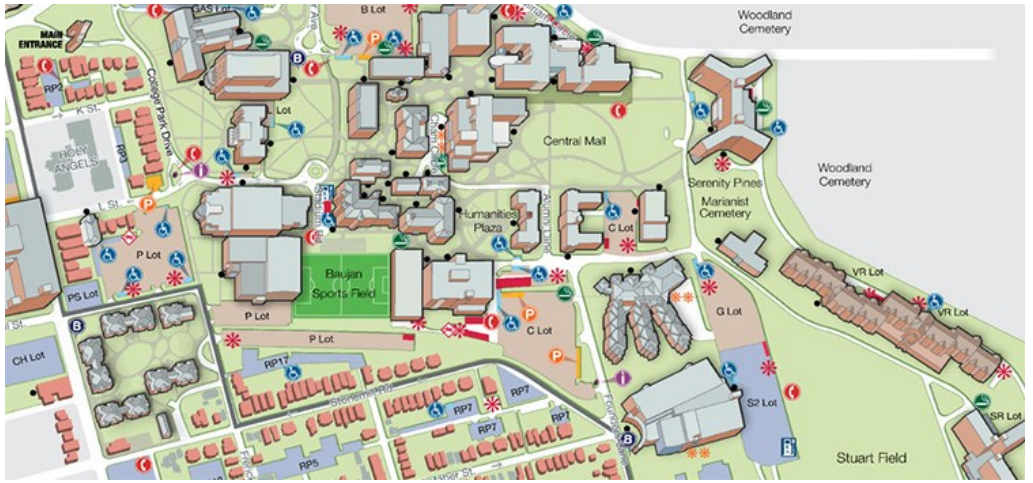
Outline

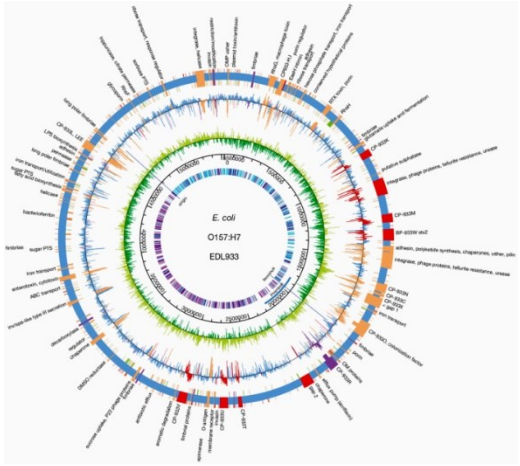
- What is a heatmap?
- Applications of heatmap
- How to generate a heatmap

Maps in Visualization

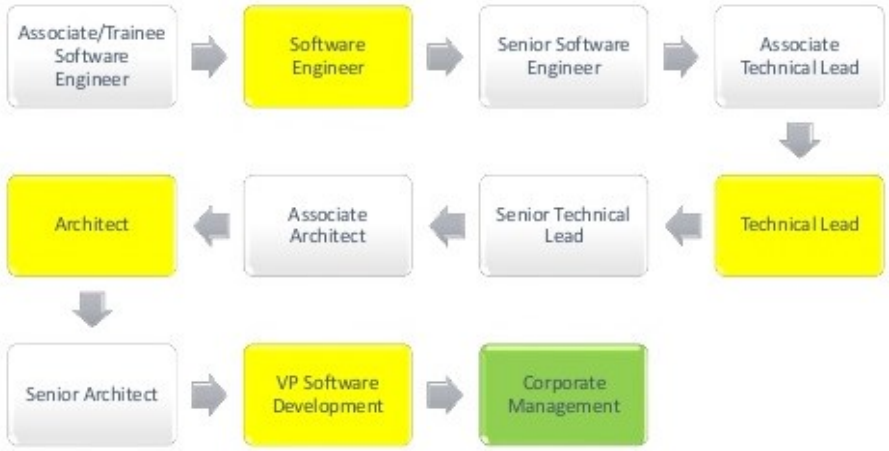
World Map



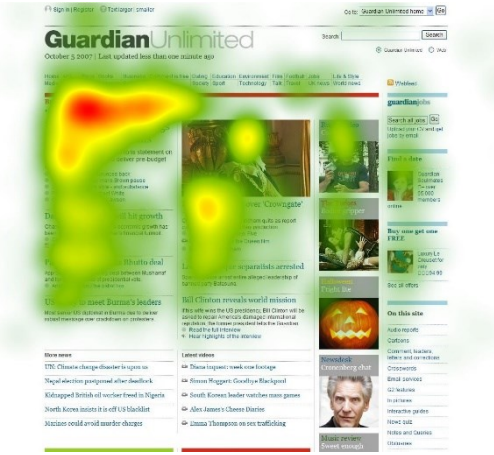
Campus Map



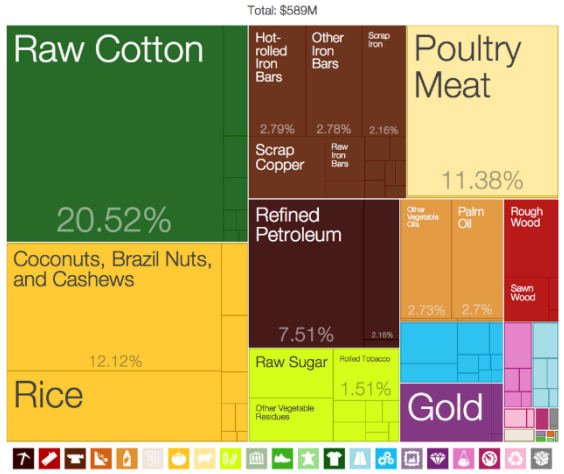
Genome Map



Career Road Map



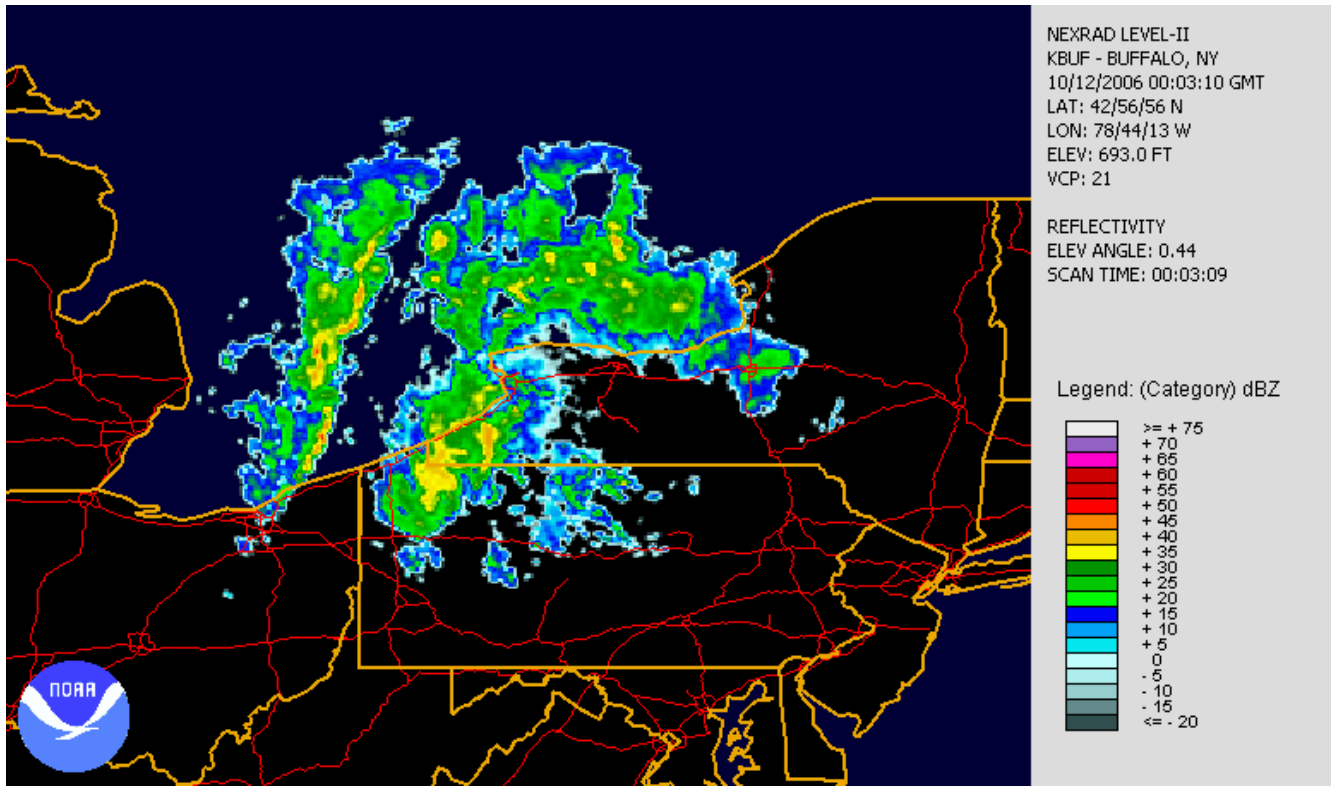
Heat Map



Tree Map

What is a heat map?

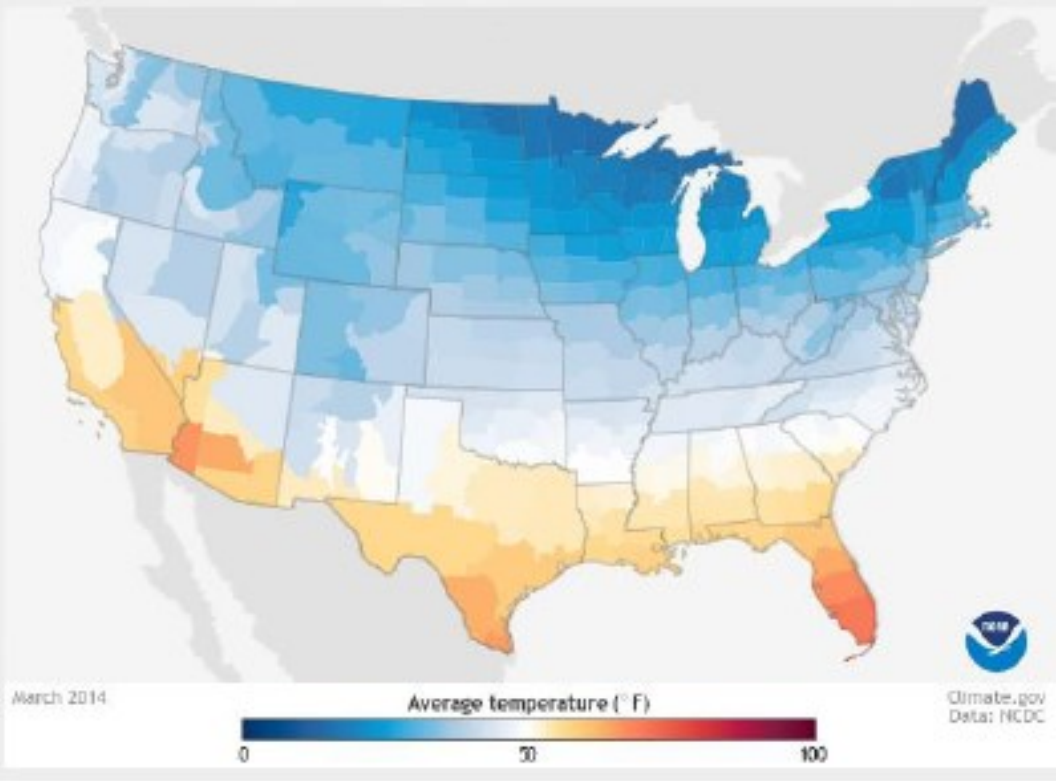
- A **heat map** (or **heatmap**) is a graphical representation of data where the individual values contained in a **matrix** (table) are represented as **colors**.



Lake effect snow

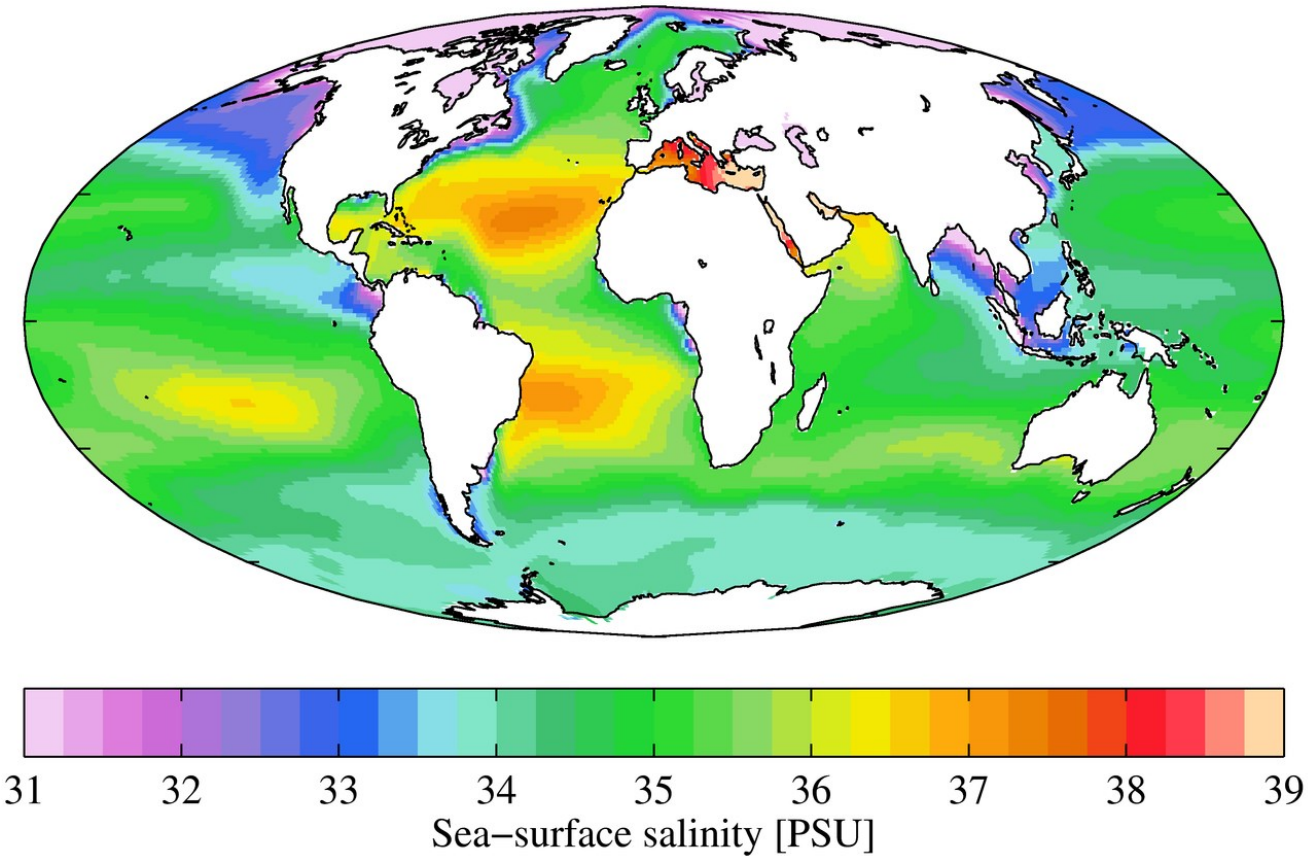
Heat map

- **Table** where entries are displayed as a color
- Weather maps are heat maps on a table with columns = latitude and rows = longitude



Heat map

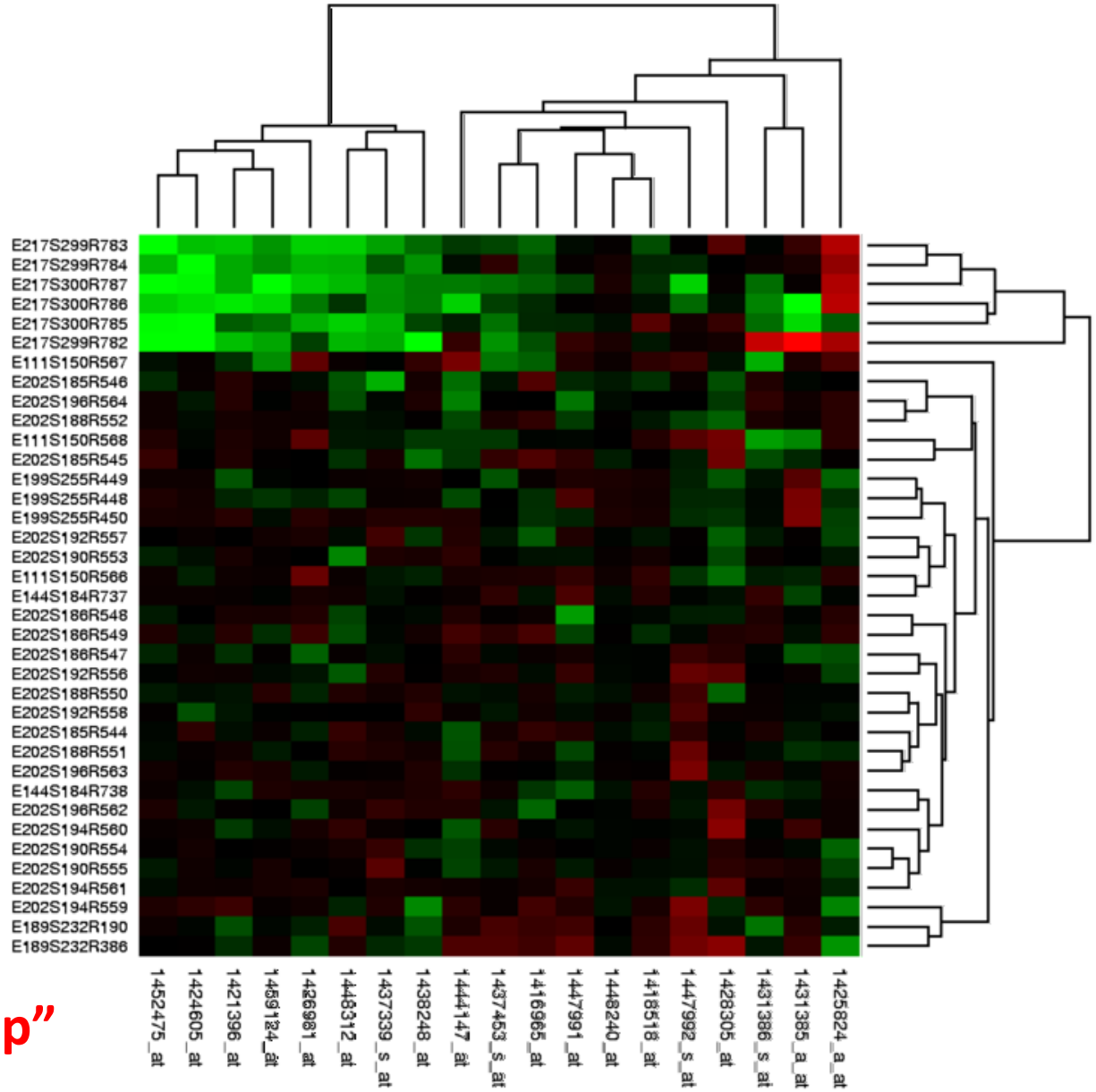
- Each heatmap has a **color map**.



Geographical heat map of ocean salinity with a **colormap**

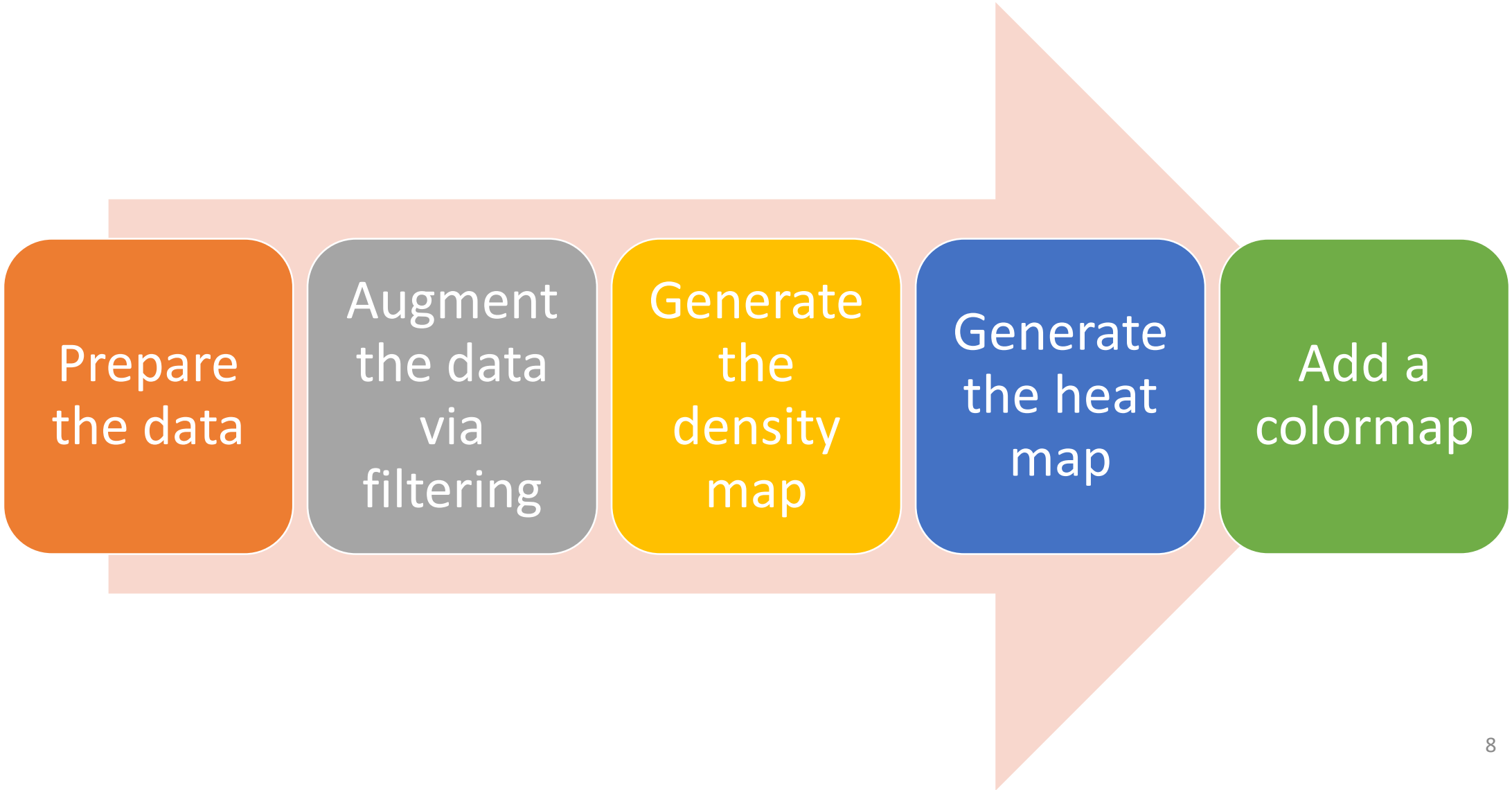
Biology heat maps

- Heat map generated from DNA microarray data reflecting gene expression values in several conditions



Paper "The History of the Cluster Heat Map"

Steps to generate a heatmap



Example: Heat map for fixation collection

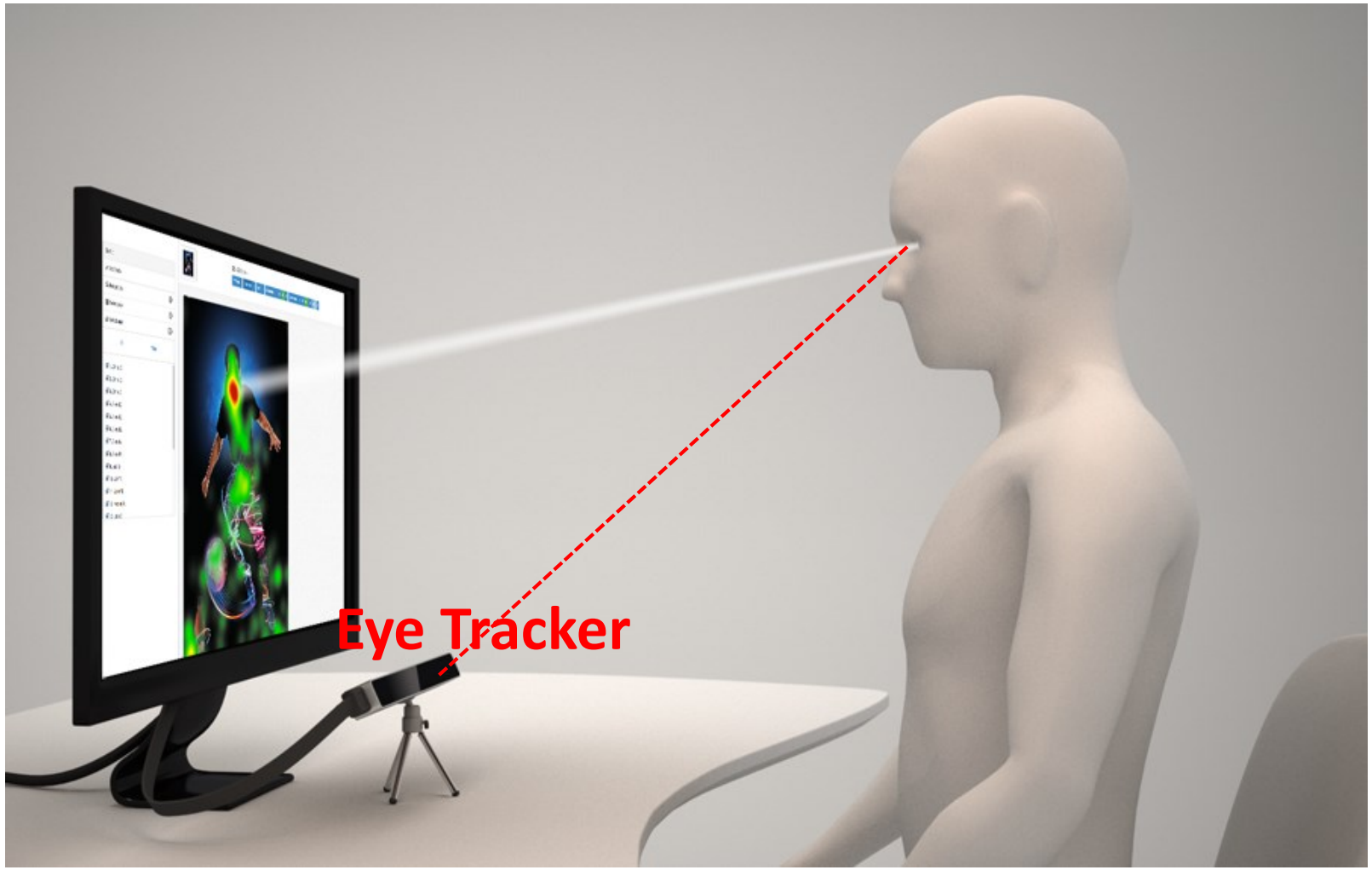
Using heat map from human attention to improve UX

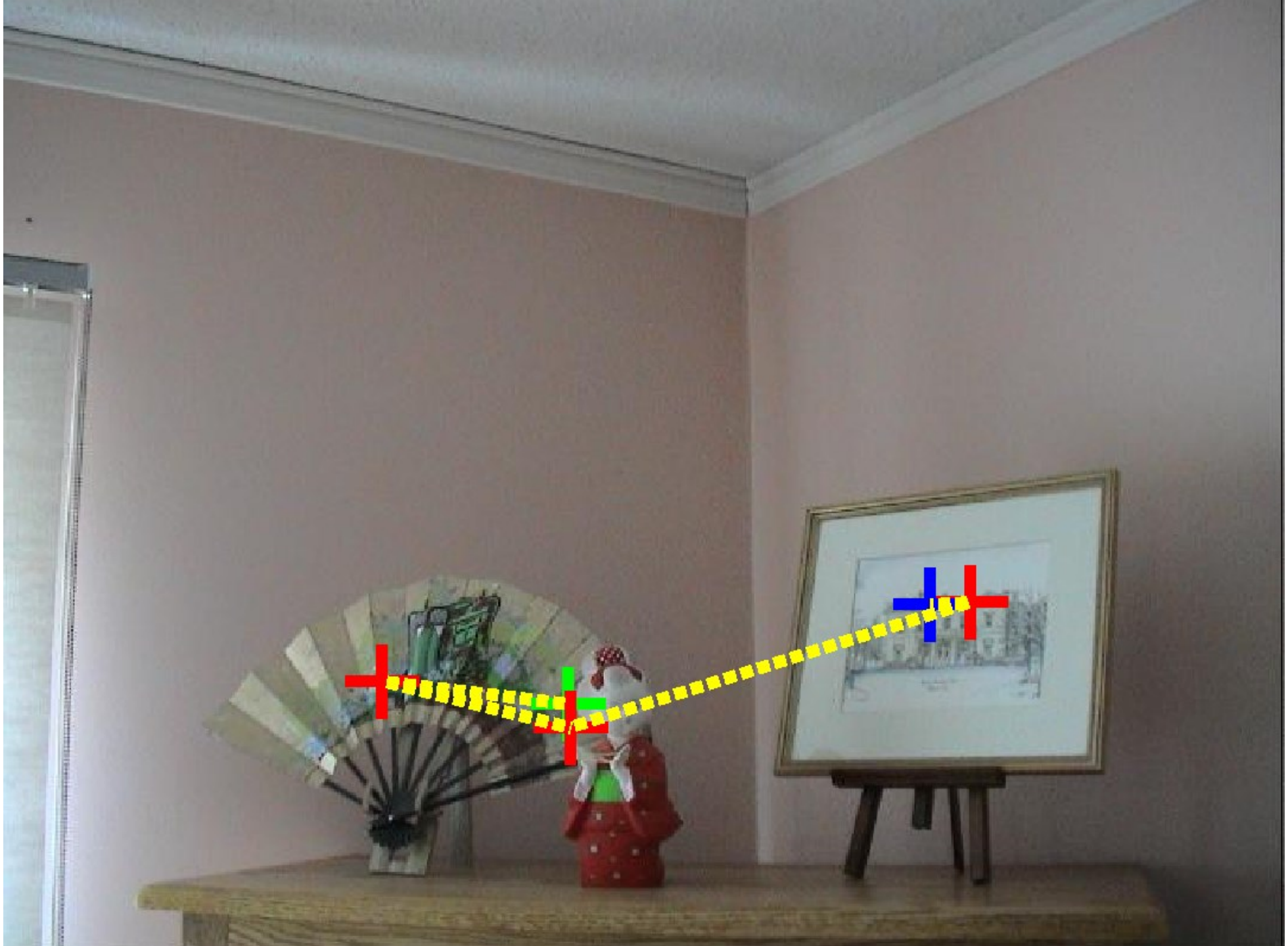
Eye-tracking Shop Heatmap

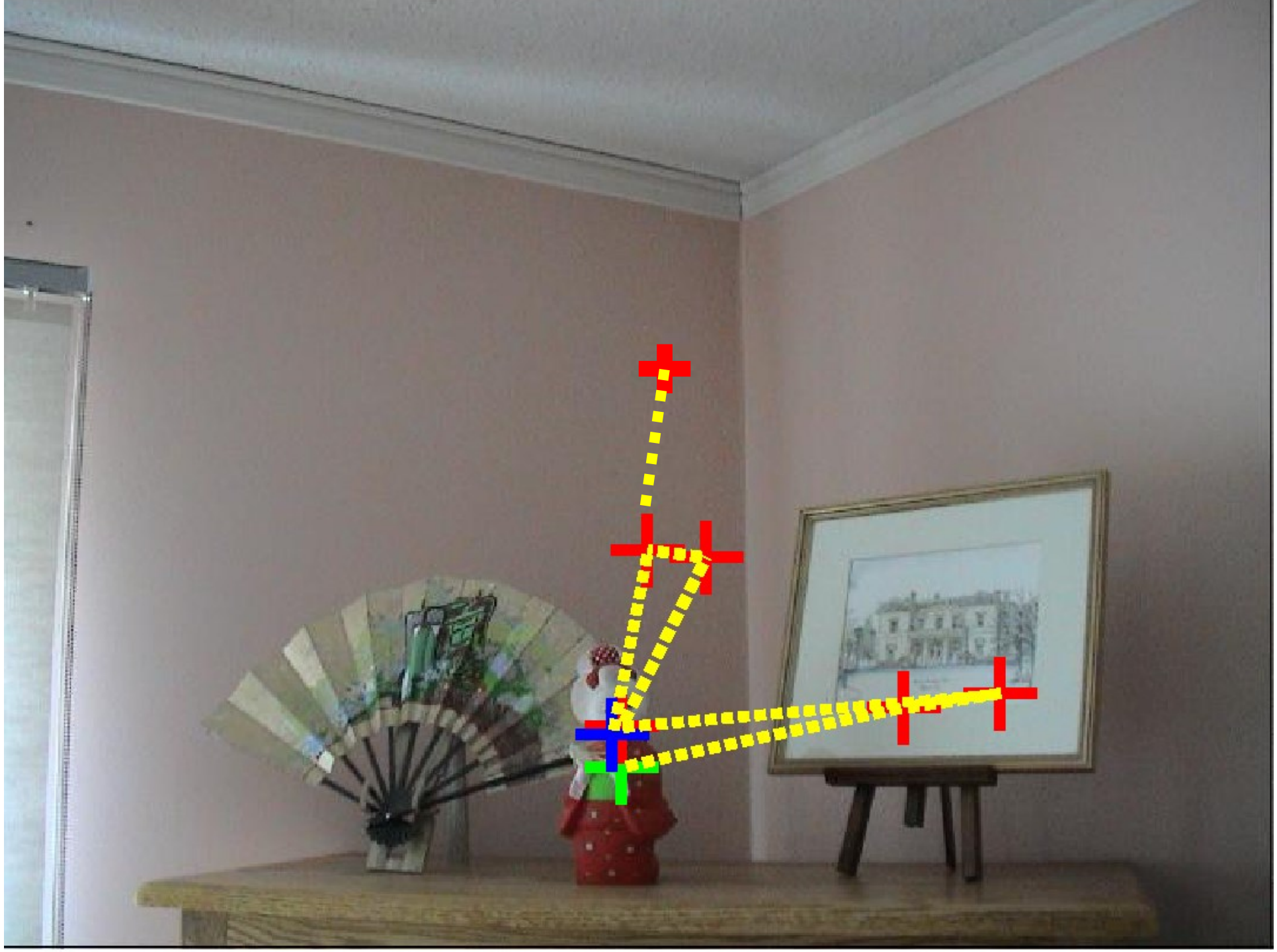
Example: Heat map for fixation collection

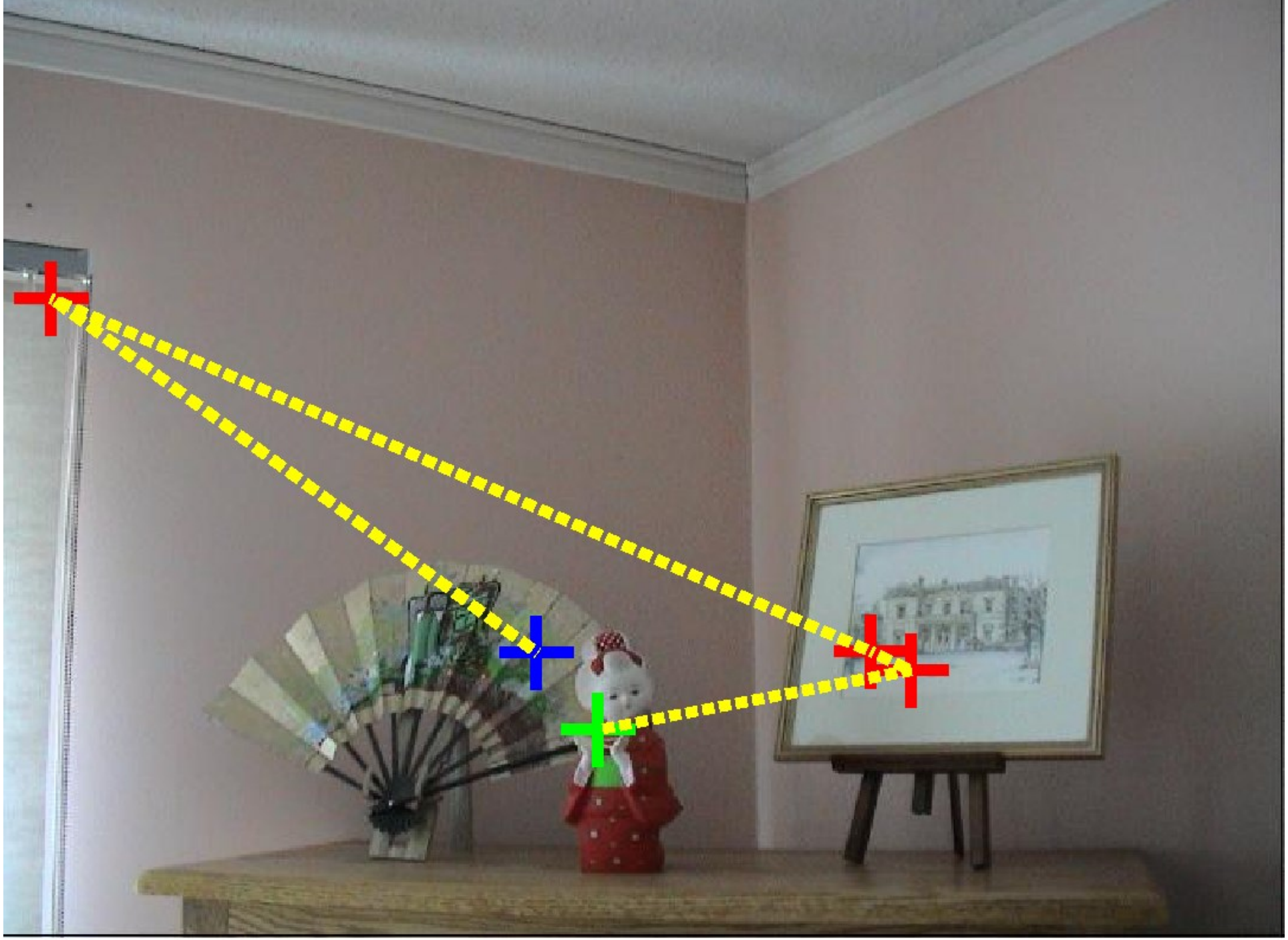
Fixation: period when eye is relatively stationary between saccades.

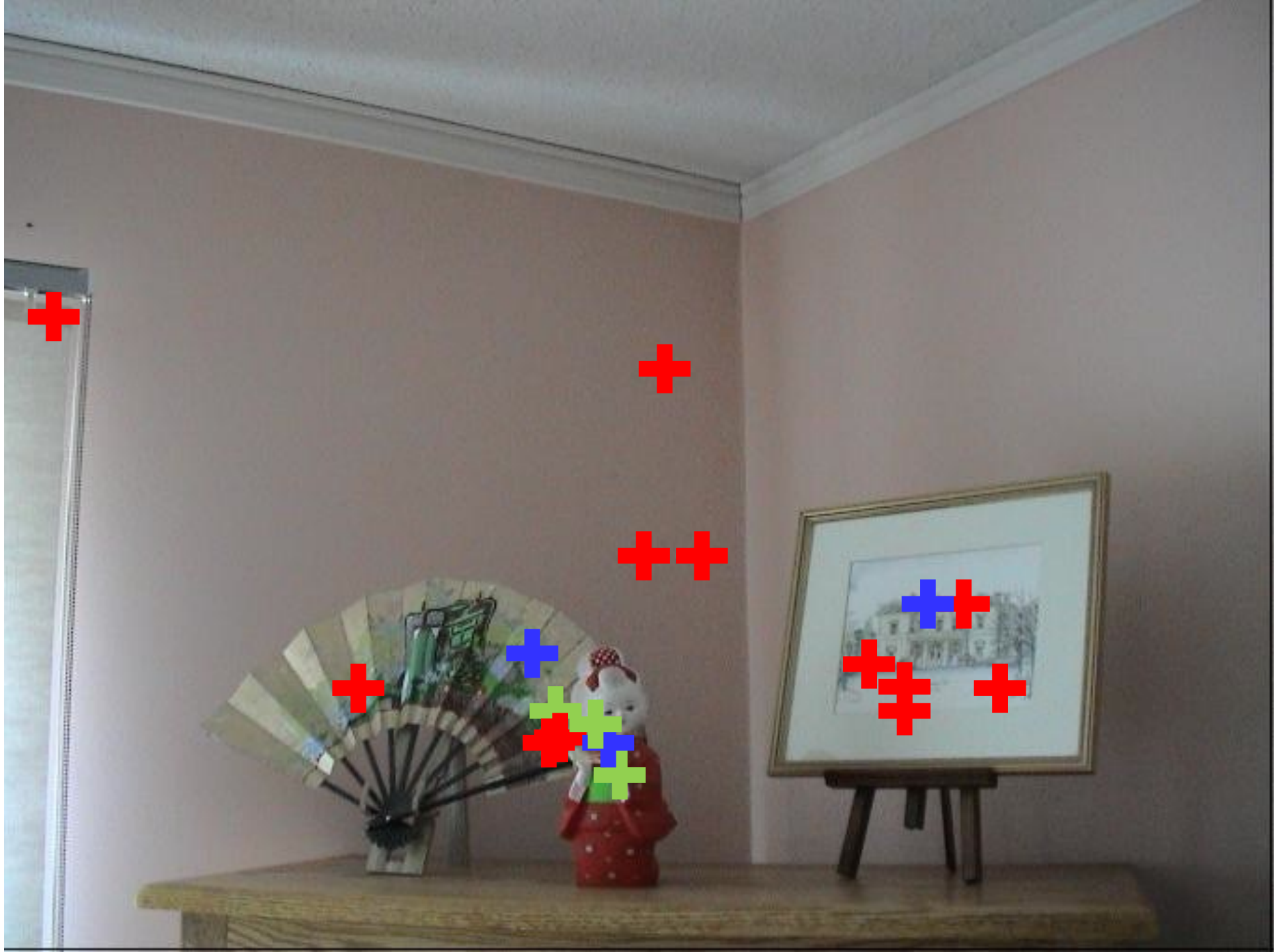
How to collect eye fixation?



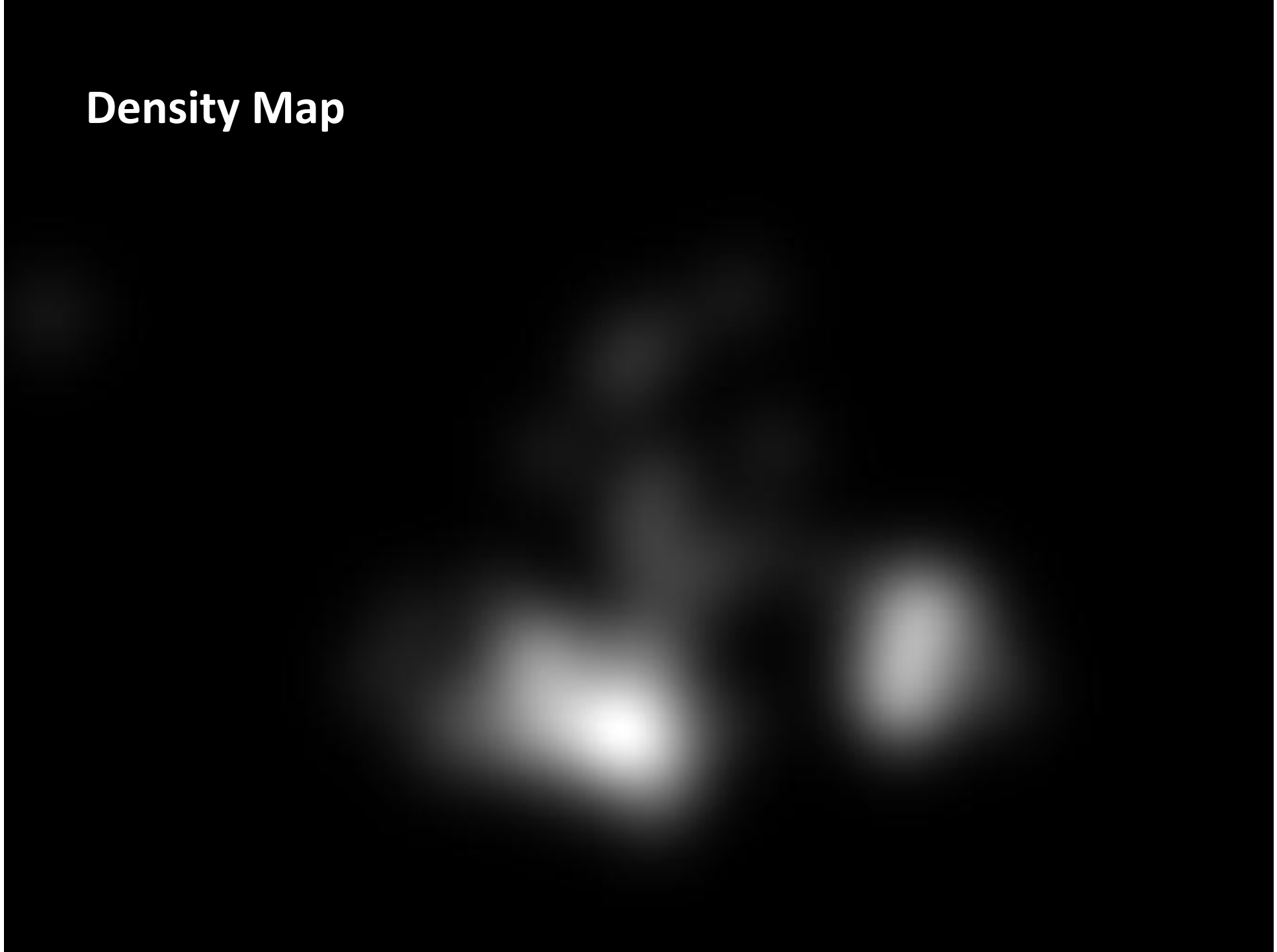




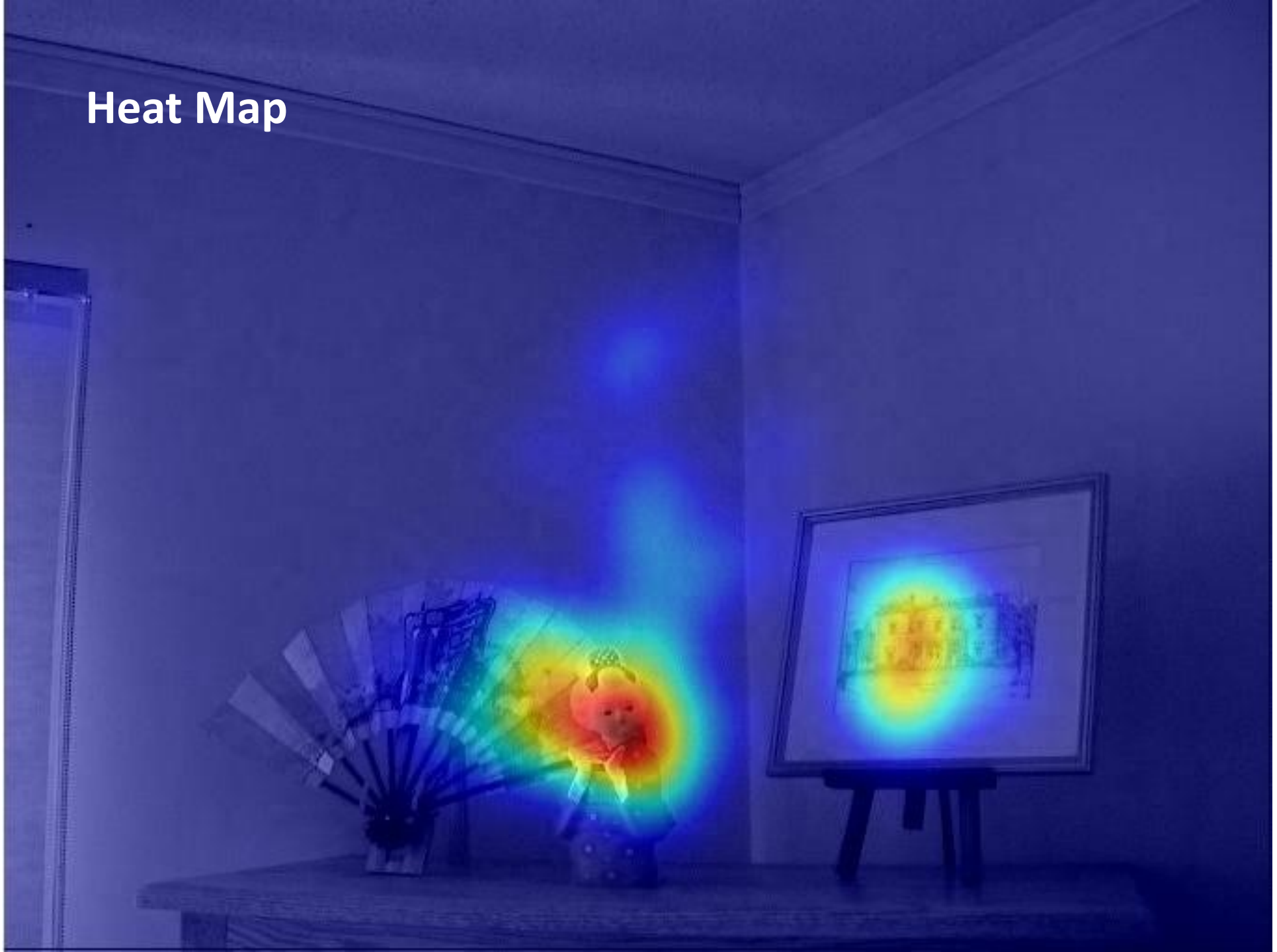




Density Map

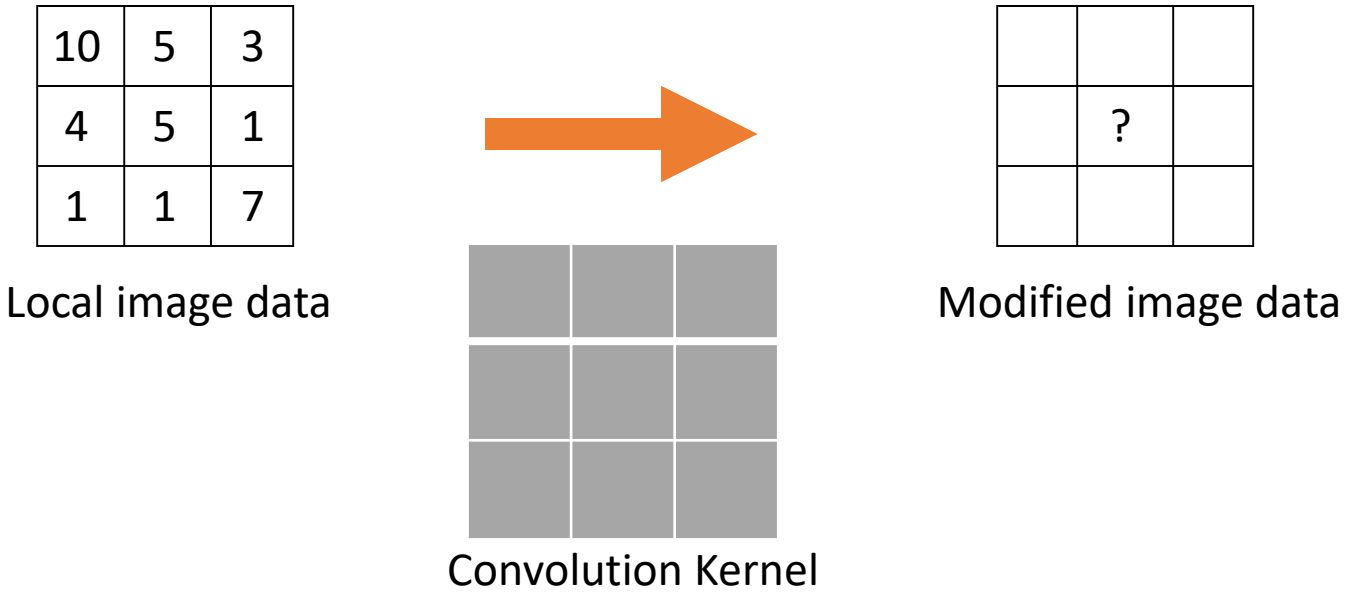


Heat Map

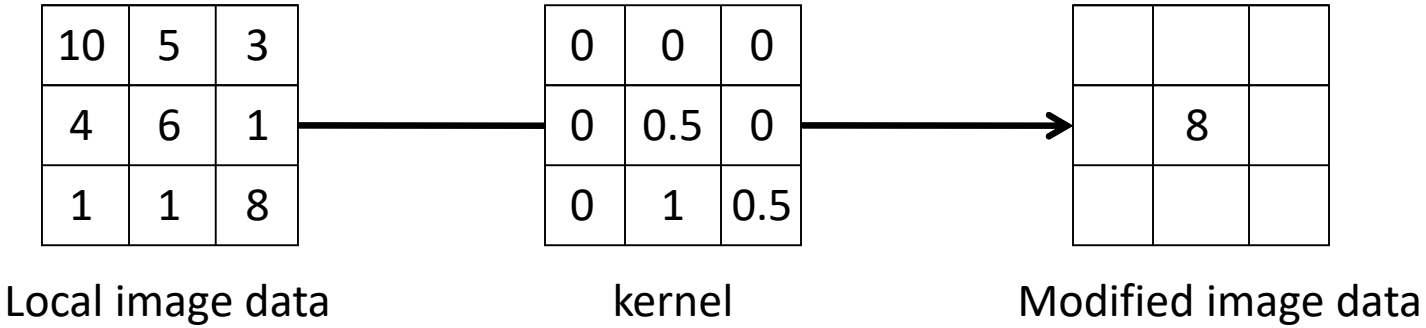


How can we generate the density map from points?

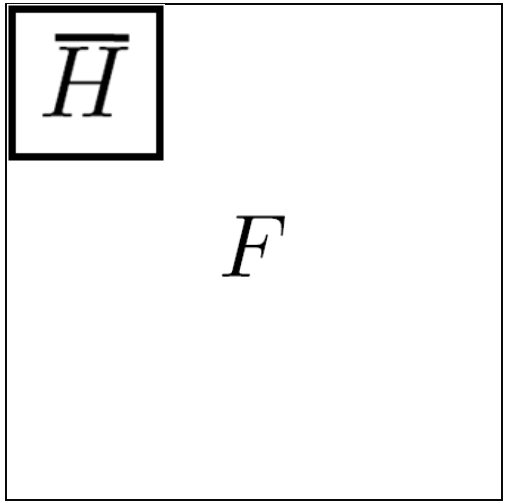
- Image Filtering: Modify the pixels in an image based on some function of a local neighborhood of each pixel



Example


10 5 3
4 6 1
1 1 8
0 0 0
0 0.5 0
0 1 0.5
8
Local image data
kernel
Modified image data

How filtering works?



Adapted from F. Durand

Mean filtering

H

F

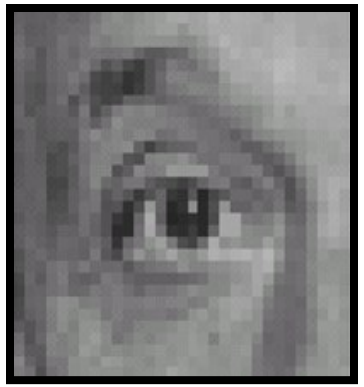
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	90	90	90	90	90	0	0
0	0	0	90	90	90	90	90	0	0
0	0	0	90	90	90	90	90	0	0
0	0	0	90	0	90	90	90	0	0
0	0	0	90	90	90	90	90	0	0
0	0	0	0	0	0	0	0	0	0
0	0	90	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0

G

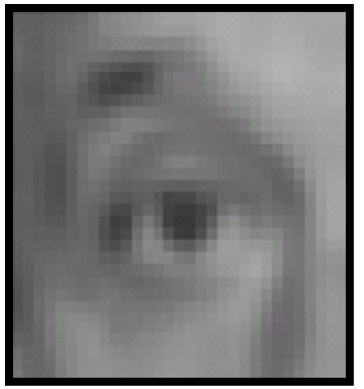
	0	10	20	30	30	30	20	10	
	0	20	40	60	60	60	40	20	
	0	30	60	90	90	90	60	30	
	0	30	50	80	80	90	60	30	
	0	30	50	80	80	90	60	30	
	0	20	30	50	50	60	40	20	
	10	20	30	30	30	30	20	10	
	10	10	10	0	0	0	0	0	

$\frac{1}{9}$

1	1	1
1	1	1
1	1	1



Original



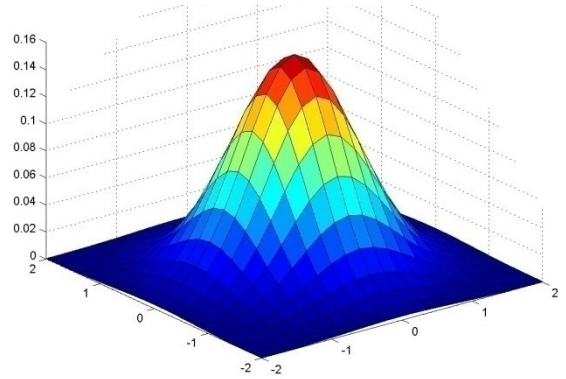
Blur (with a mean filter)

Gaussian filters

- A Gaussian kernel gives **less weight** to **pixels further** from the center of the window

0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	90	90	90	90	90	0	0
0	0	0	90	90	90	90	90	0	0
0	0	0	90	90	90	90	90	0	0
0	0	0	90	0	90	90	90	0	0
0	0	0	90	90	90	90	90	0	0
0	0	0	0	0	0	0	0	0	0
0	0	90	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0

$F[x, y]$



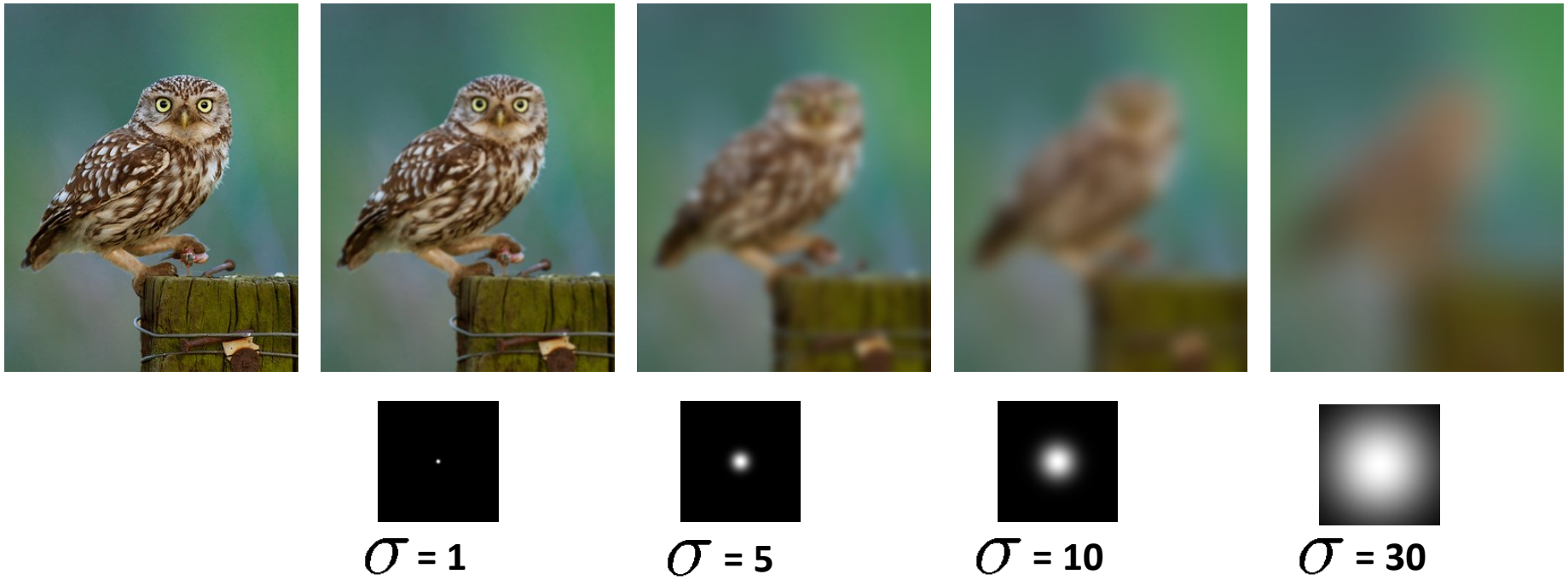
$$h(u, v) = \frac{1}{2\pi\sigma^2} e^{-\frac{u^2+v^2}{\sigma^2}}$$

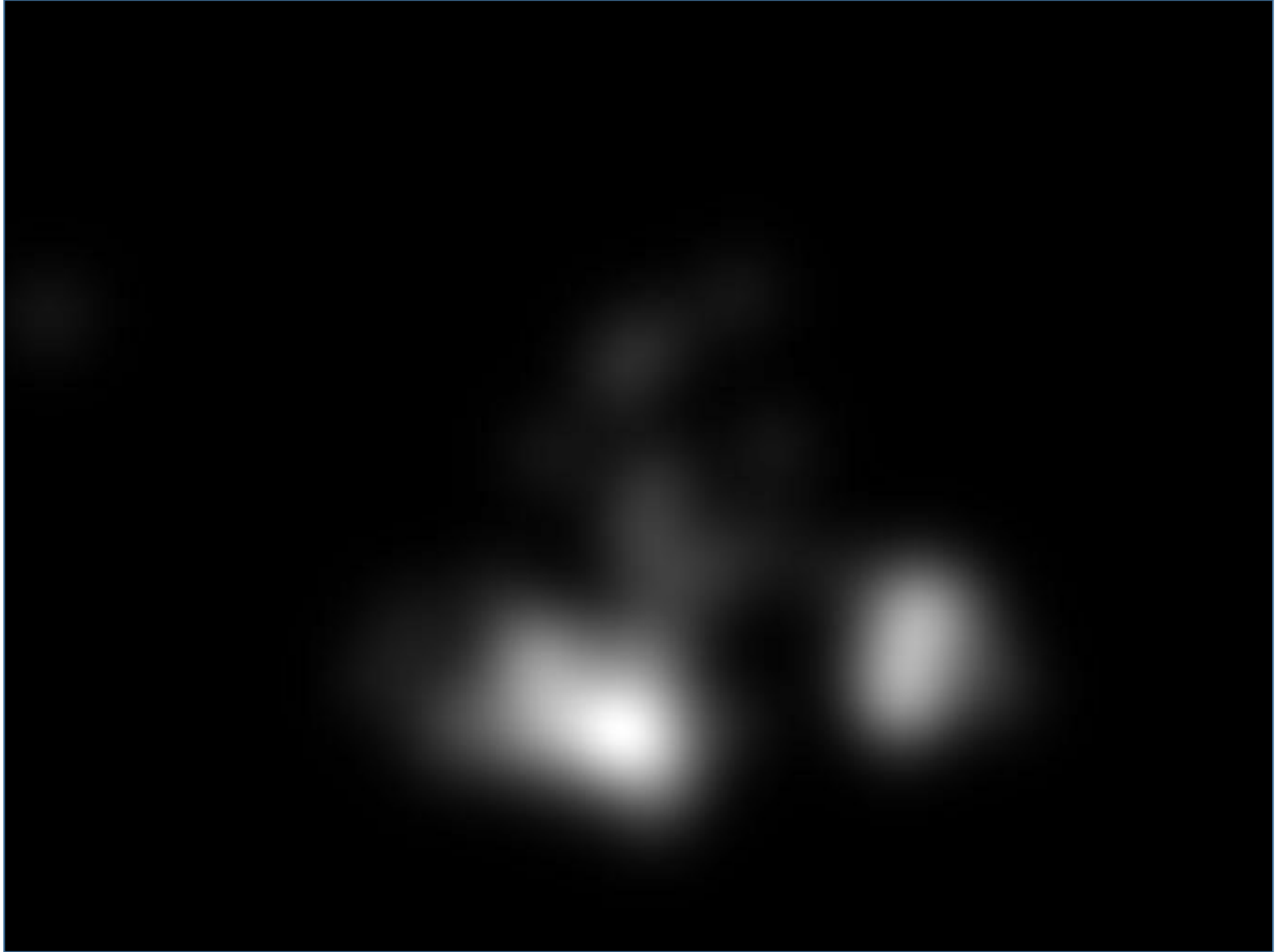
$\frac{1}{9}$

1	2	1
2	4	2
1	2	1

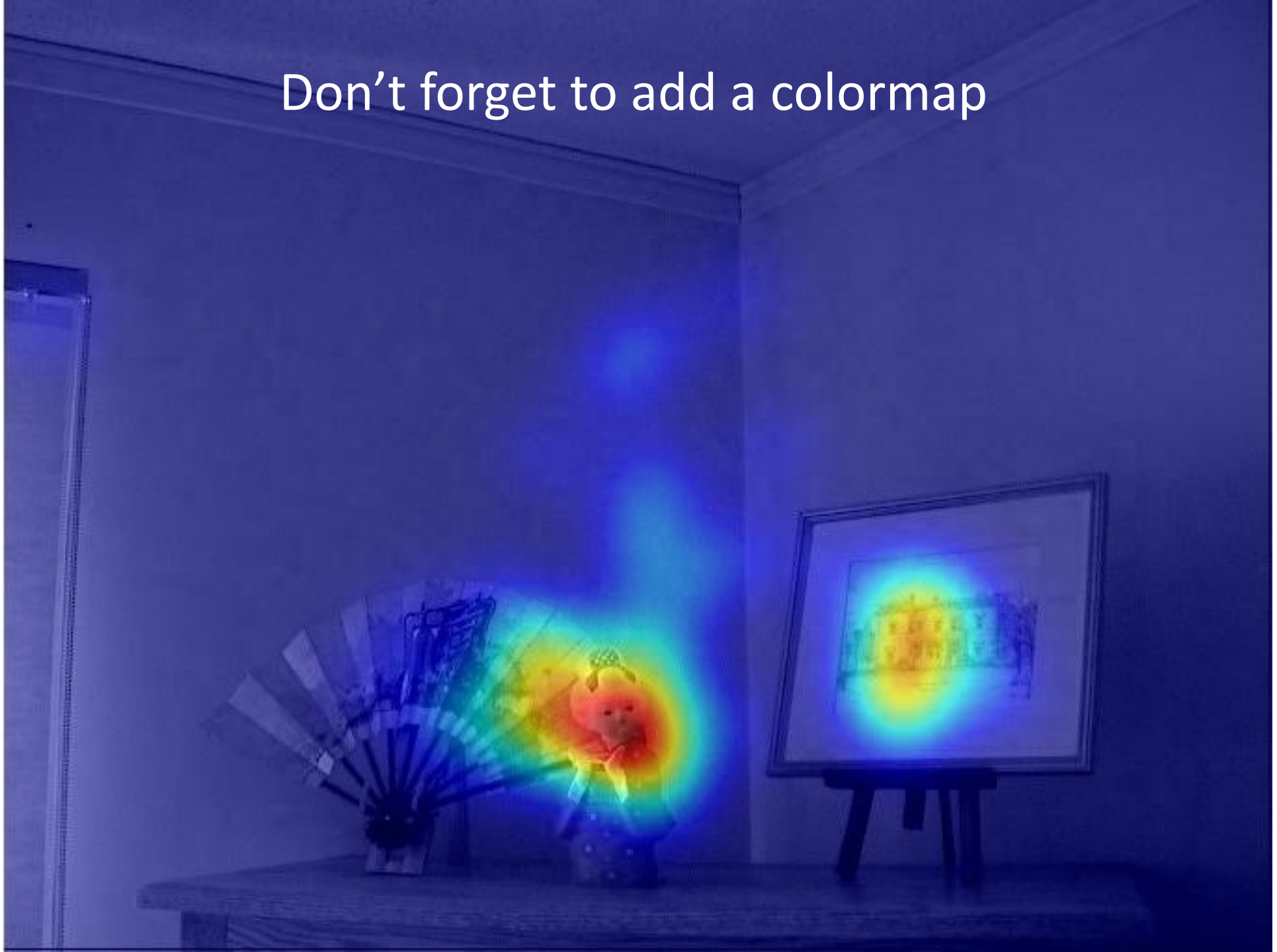
$H[u, v]$

Gaussian filters





Don’t forget to add a colormap



Q&A