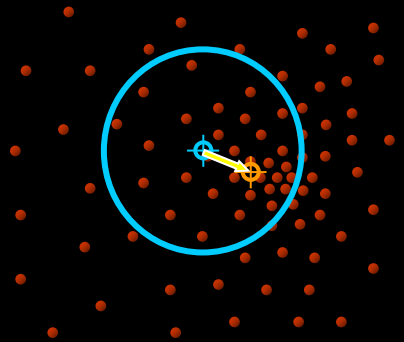
CS4495/6495
Introduction to Computer Vision

9A-L3 *Mean shift segmentation*

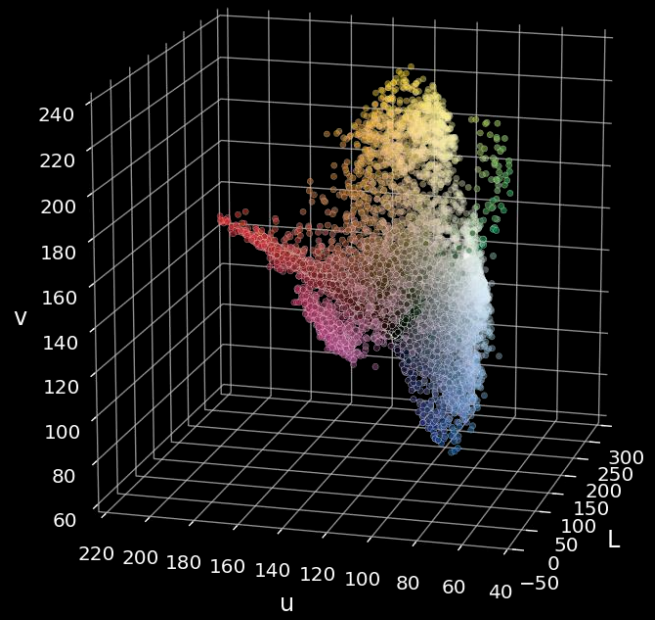


Slides originally by Y. Ukrainitz & B. Sarel

Mean shift algorithm

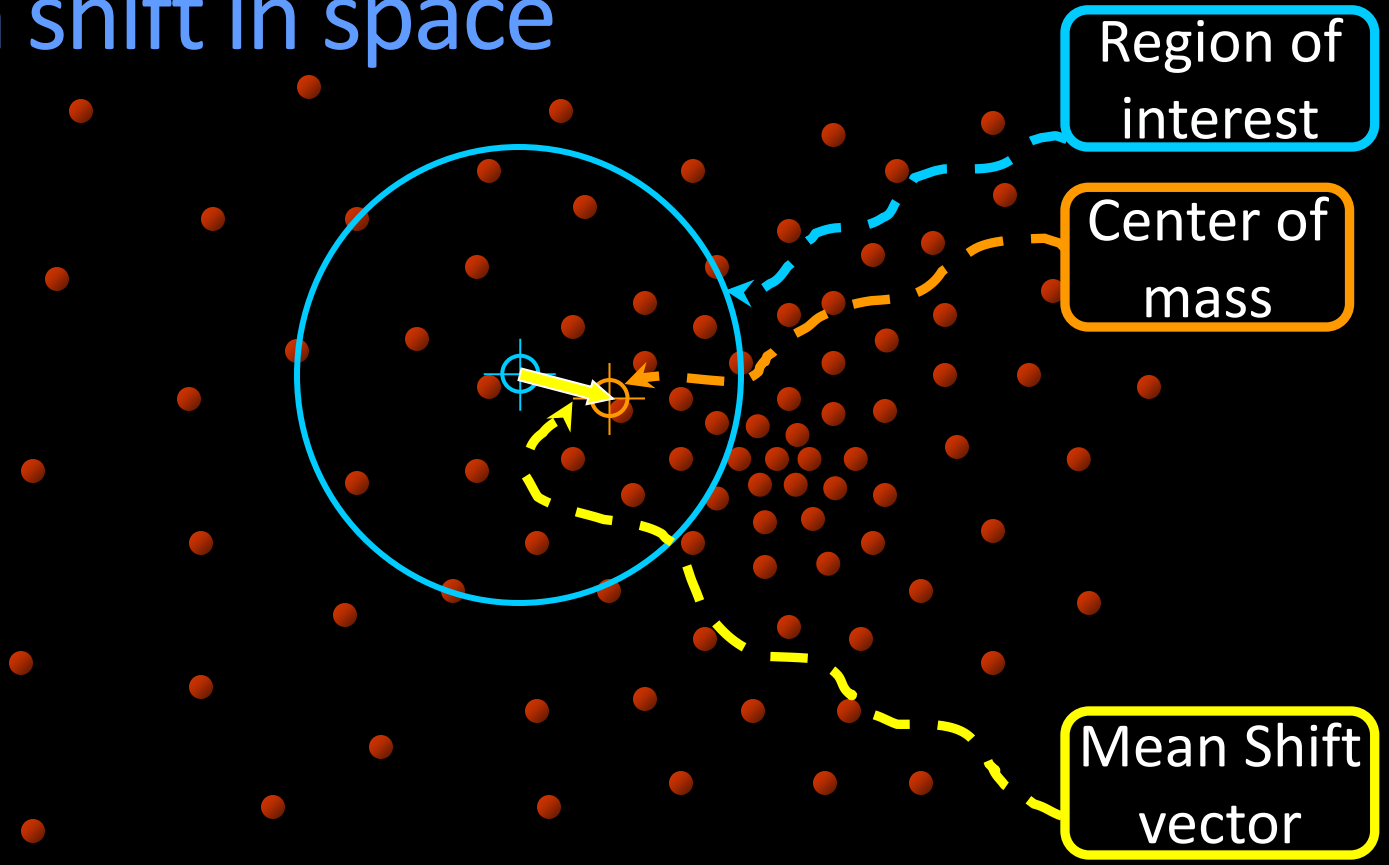
The mean shift algorithm seeks *modes* or local maxima of density in the feature space

Input image

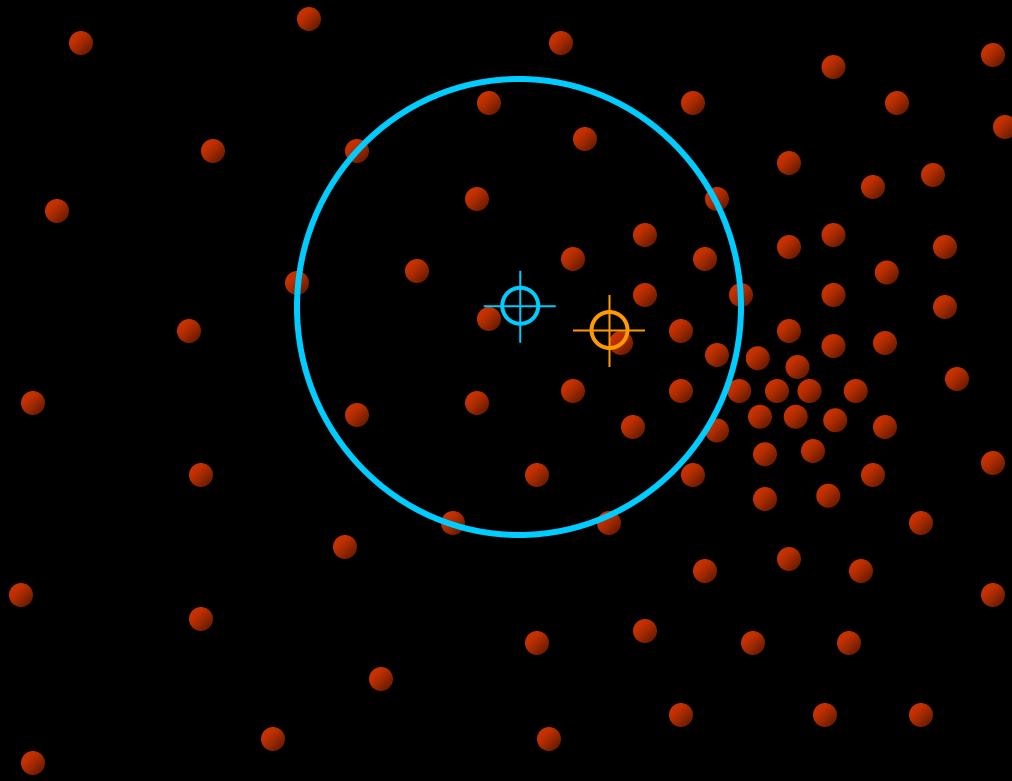


Feature space
(L*u*v* color values)

Mean shift in space



Mean shift in space

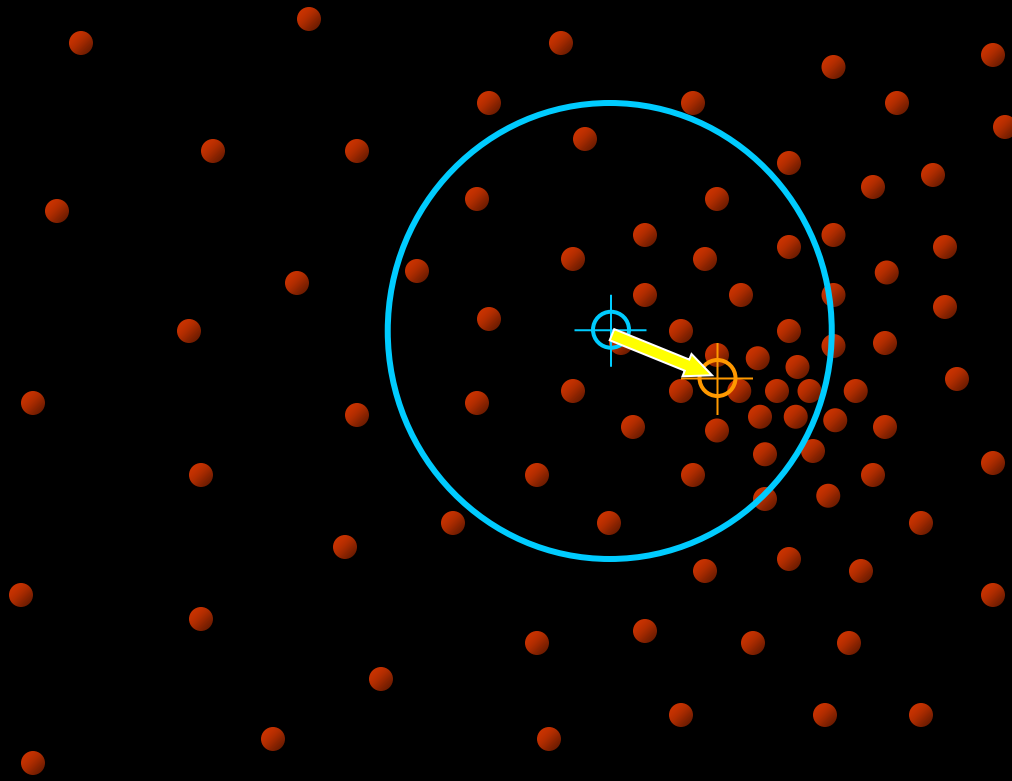


Region of interest

Center of mass

Mean Shift vector

Mean shift in space



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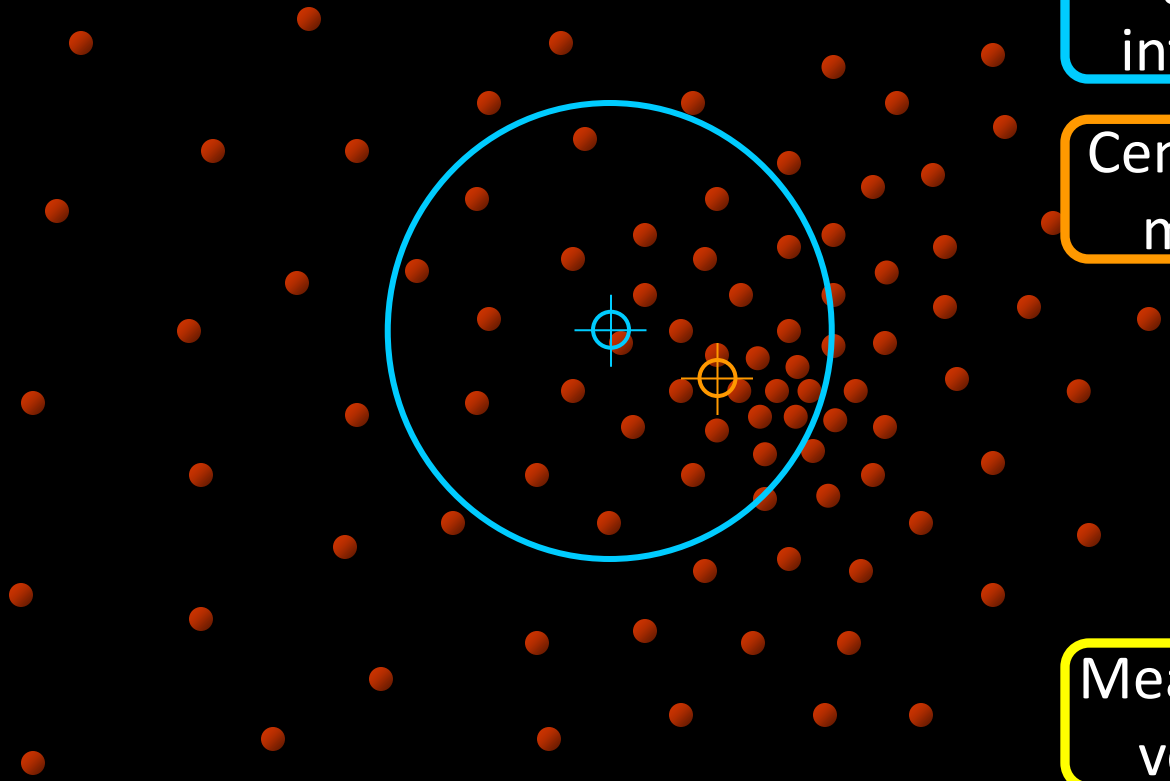
Mean shift in space

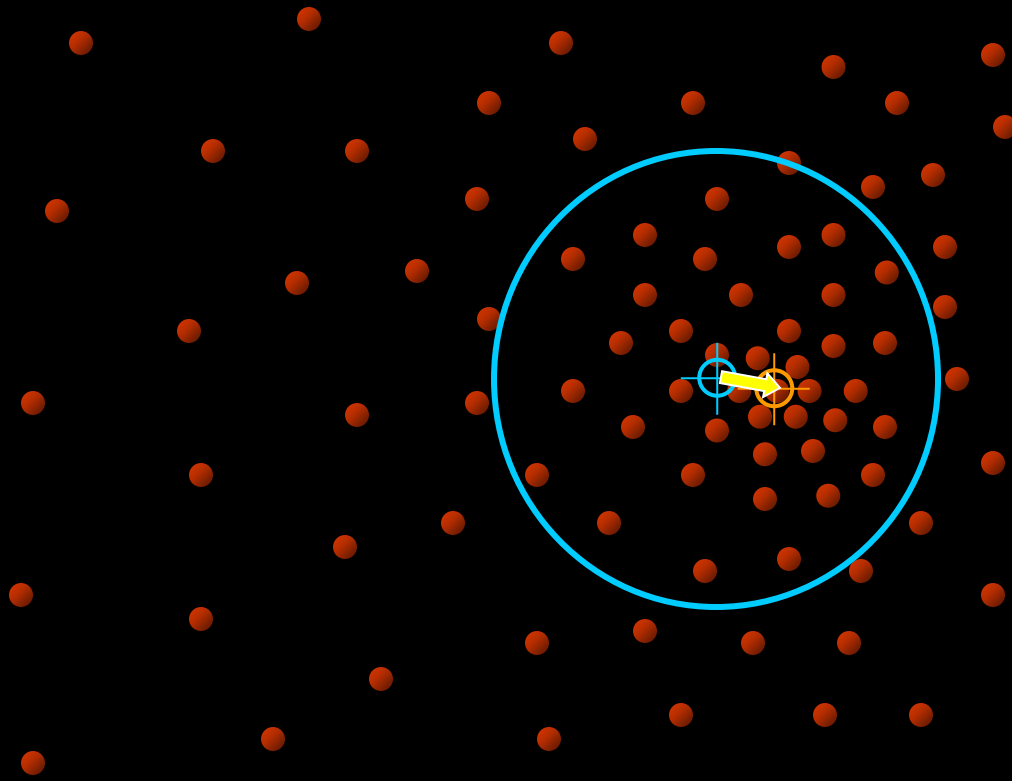


Region of interest

Center of mass

Mean Shift vector

Mean shift in space



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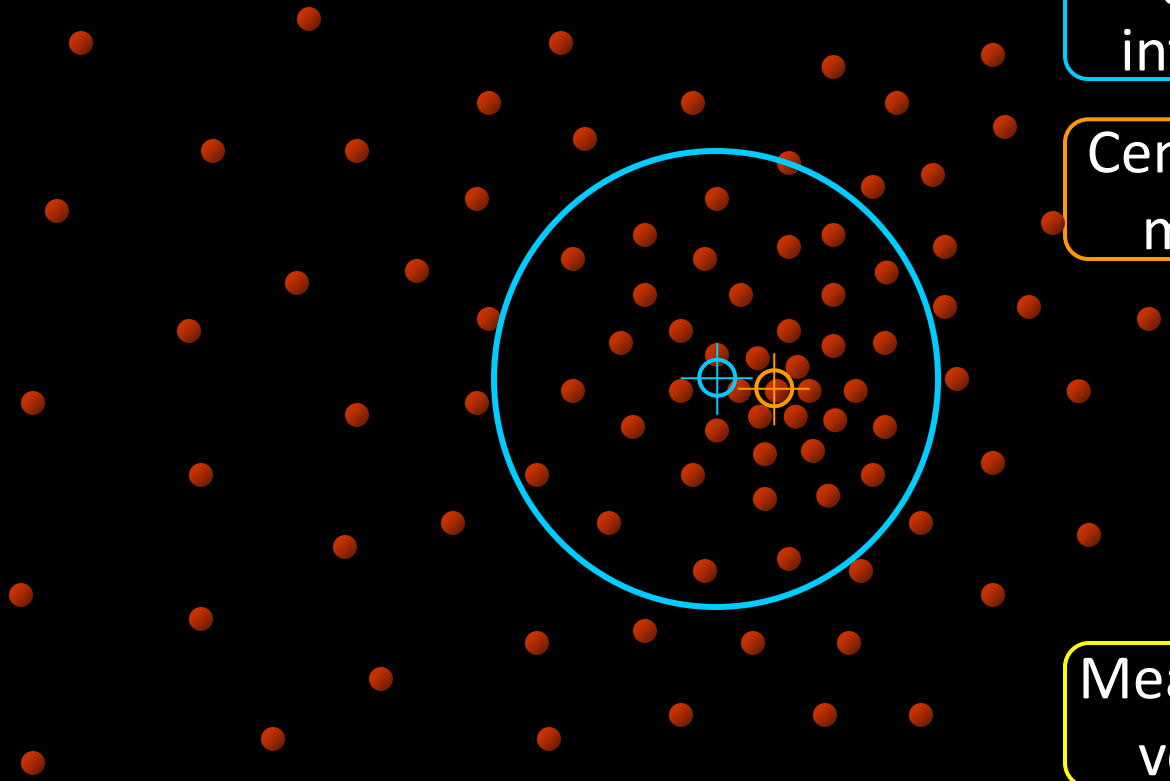
Mean Shift vector

Mean shift in space



Region of interest

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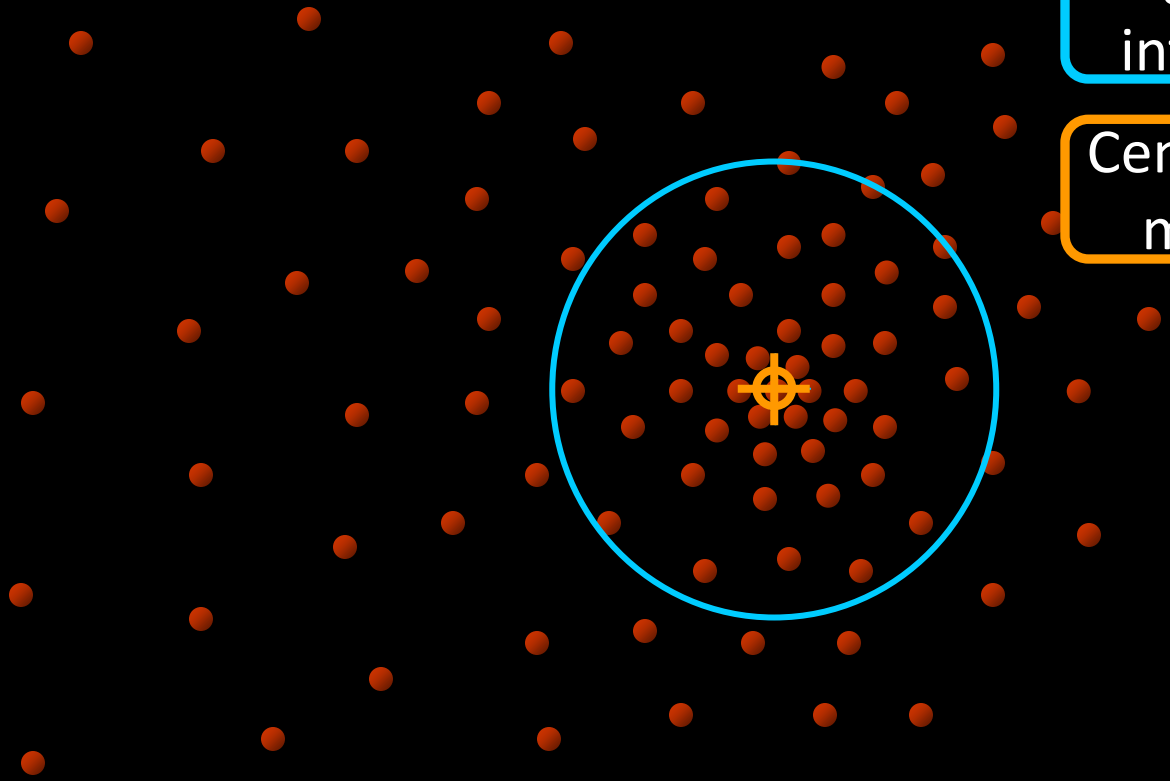
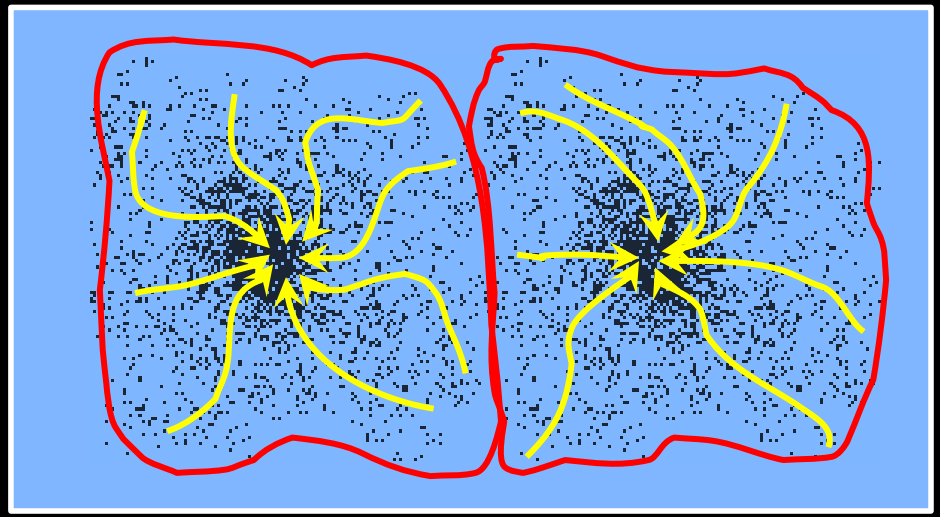
Mean Shift vector

Mean shift in space



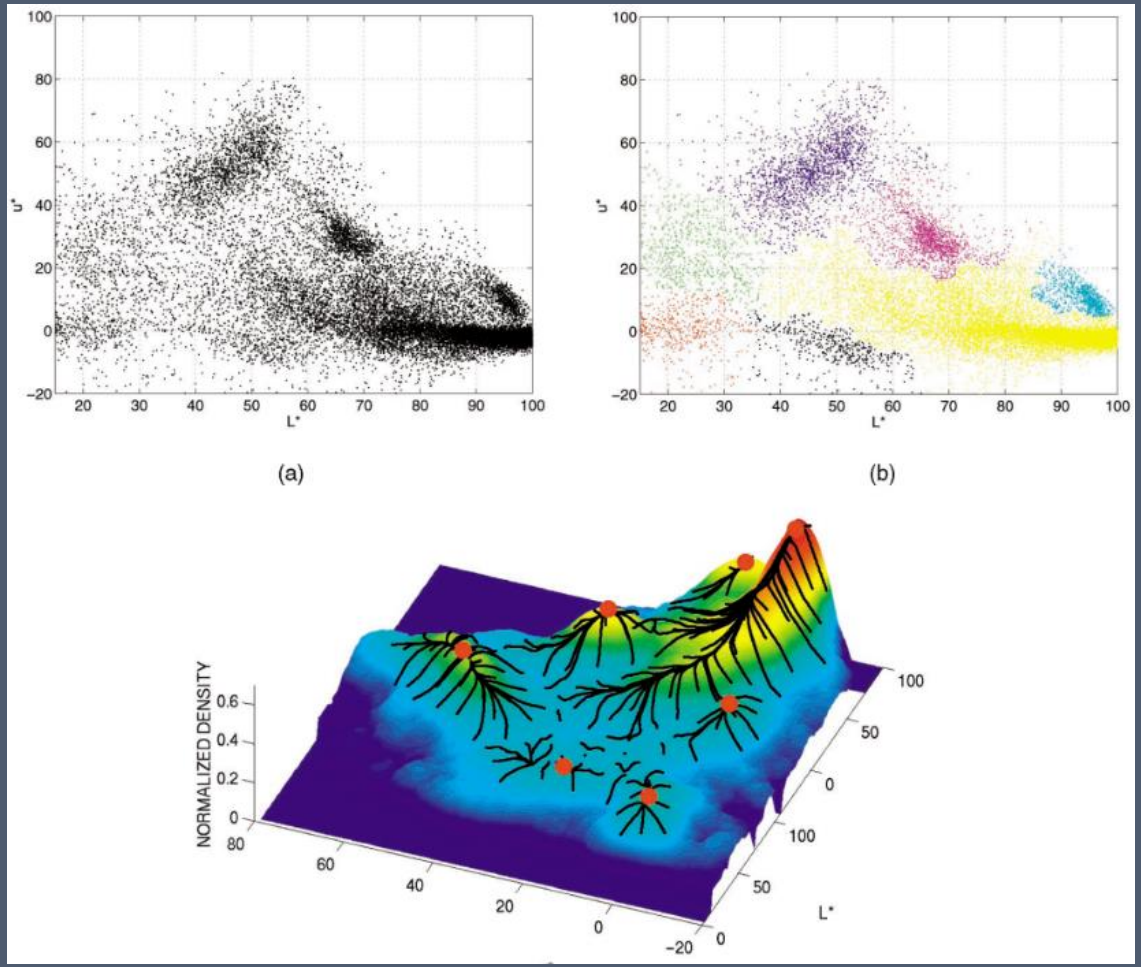
Mean shift clustering

- Cluster: all data points in the *attraction basin* of a mode
- Attraction basin: the region for which all trajectories lead to the same mode

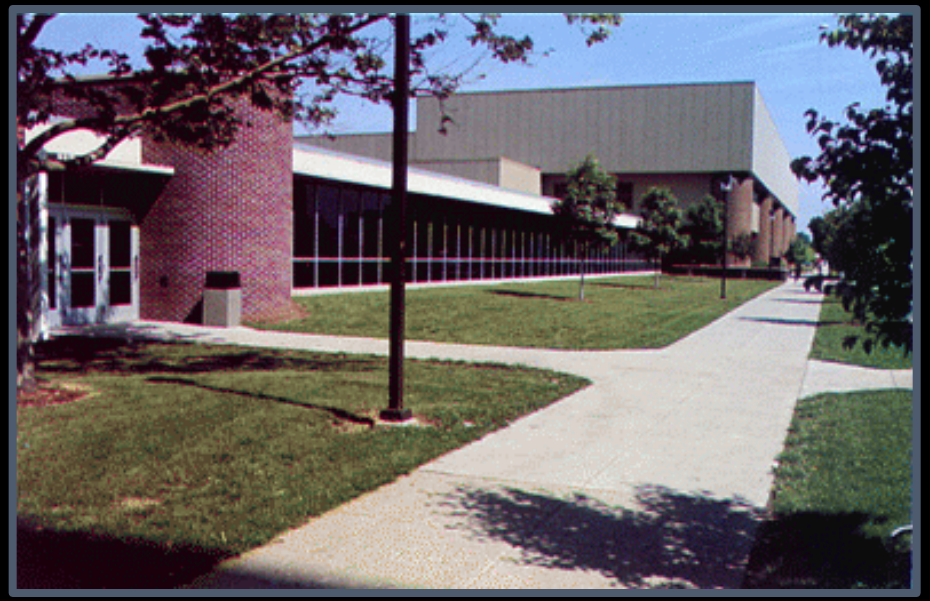


Mean shift clustering/segmentation

- Find features (color, gradients, texture, etc.)
- Initialize windows at individual feature points (pixels)
- Perform mean shift for each window (pixel) until convergence
- Merge windows (pixels) that end up near the same “peak” or mode


u*
L*
(a)
(b)
NORMALIZED DENSITY
0.6
0.4
0.2
0
80
60
40
20
0
−20
100
50
0
100
50
0
L*

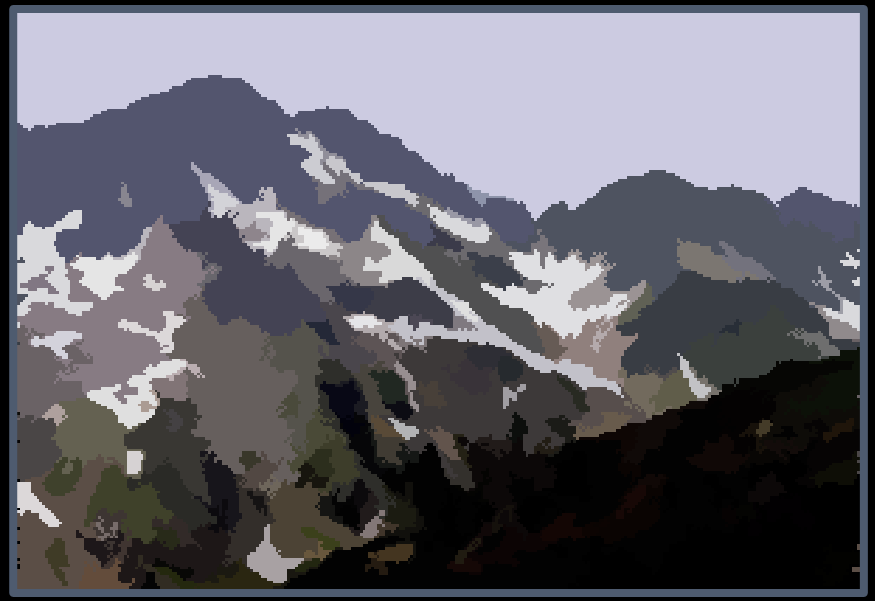
Mean shift segmentation results



Dorin Comaniciu & Peter Meer, PAMI 2002

Mean shift segmentation results

Mean shift segmentation results



Dorin Comaniciu & Peter Meer, PAMI 2002

Mean shift

Pros:

- Automatically finds basins of attraction
- One parameter choice (window size)
- Does not assume (image) shape on clusters
- Generic technique
- Find multiple modes

Mean shift

Cons:

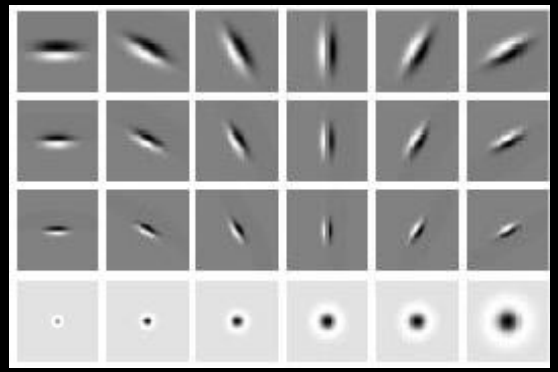
- Selection of window size
- Does not scale well with dimension of feature space

Segmentation as clustering

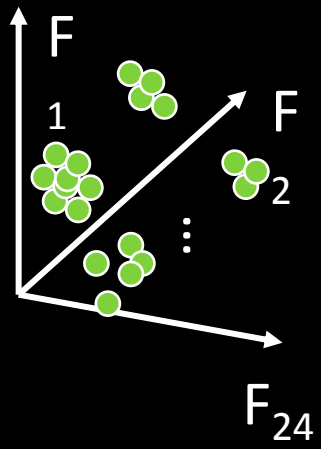
Color, brightness, position alone are not enough to distinguish all regions…

Segmentation as clustering

Grouping pixels based on texture similarity



Filter bank of
24 filters



- Feature space: Filter bank responses (e.g., 24D)

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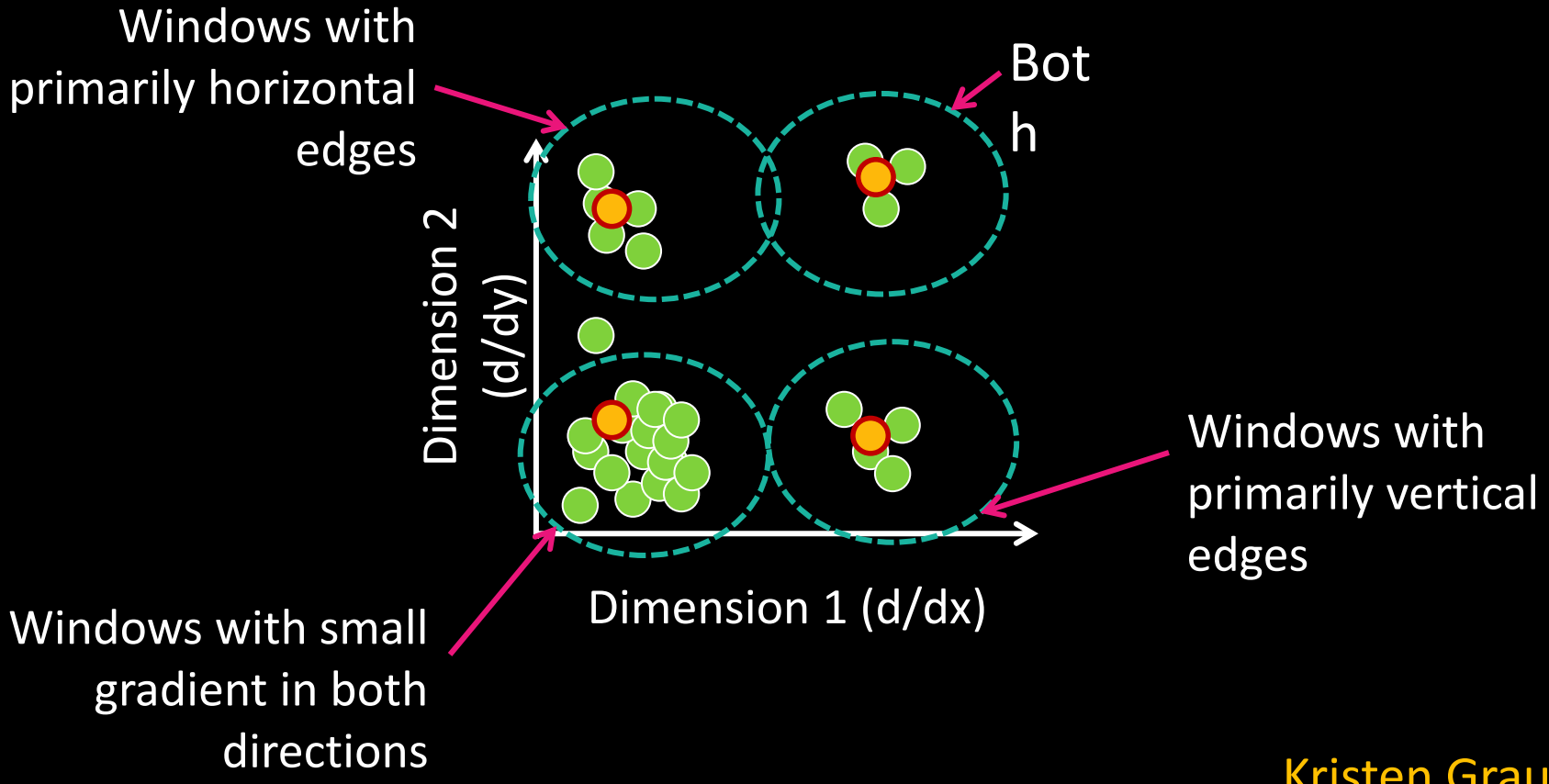
Texture representation example



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Texture features

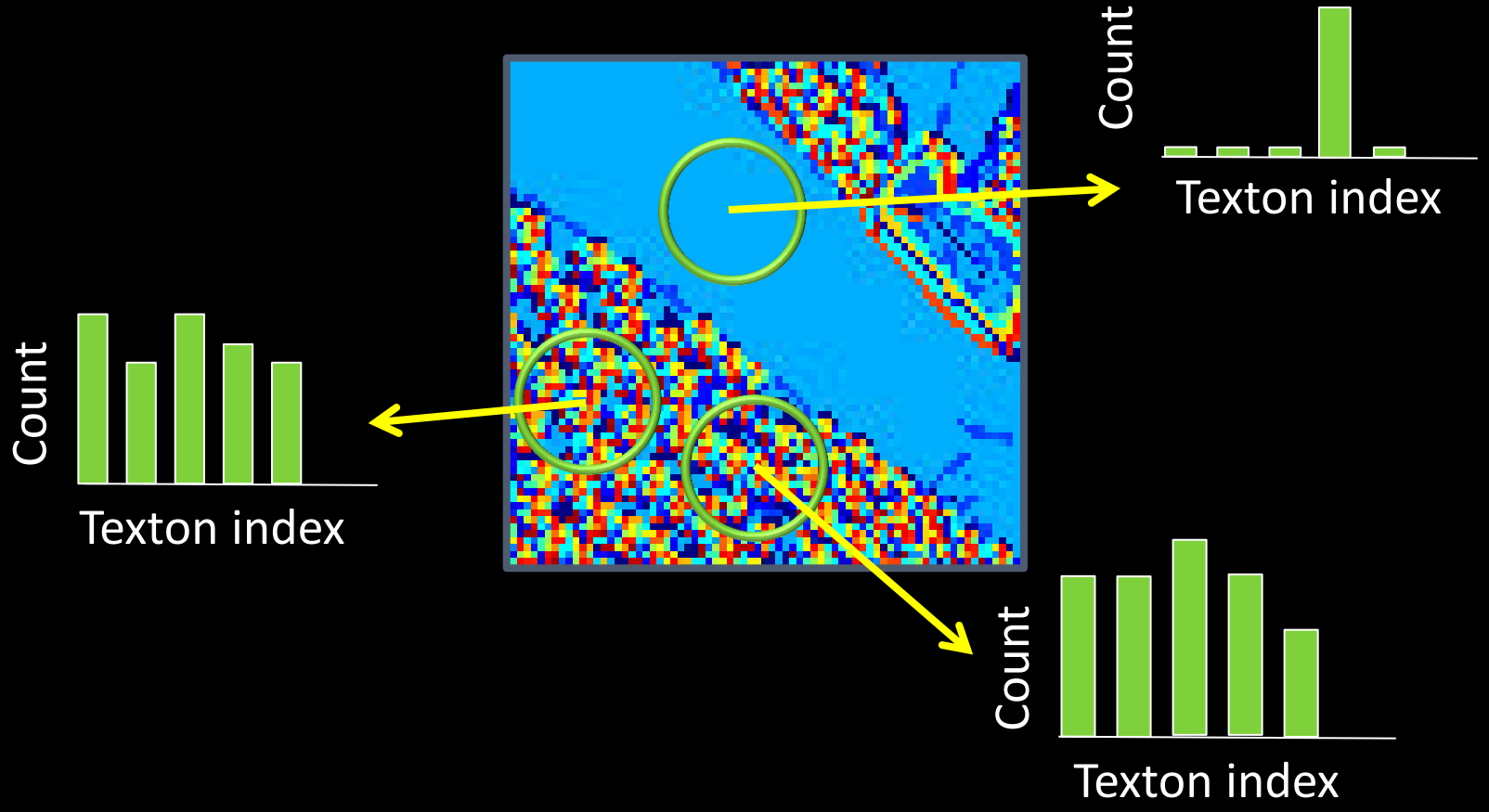
- Find “textons” by clustering vectors of filter bank outputs
- Describe texture in a window based on its *texton histogram*

Image

Texton map

Malik, Belongie, Leung and Shi. IJCV 2001.

Adapted from Lana Lazebnik



Malik, Belongie, Leung and Shi. IJCV 2001.

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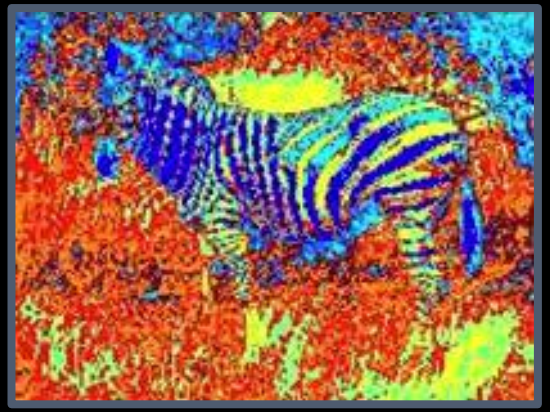
Image segmentation example

Texture-based regions



Color-based regions

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