# Advanced Image Processing - Segmentation

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## Goal of segmentation

### Goal of segmentation

The goal of segmentation is to divide the image into disjunct areas so that the areas correspond to singular objects.
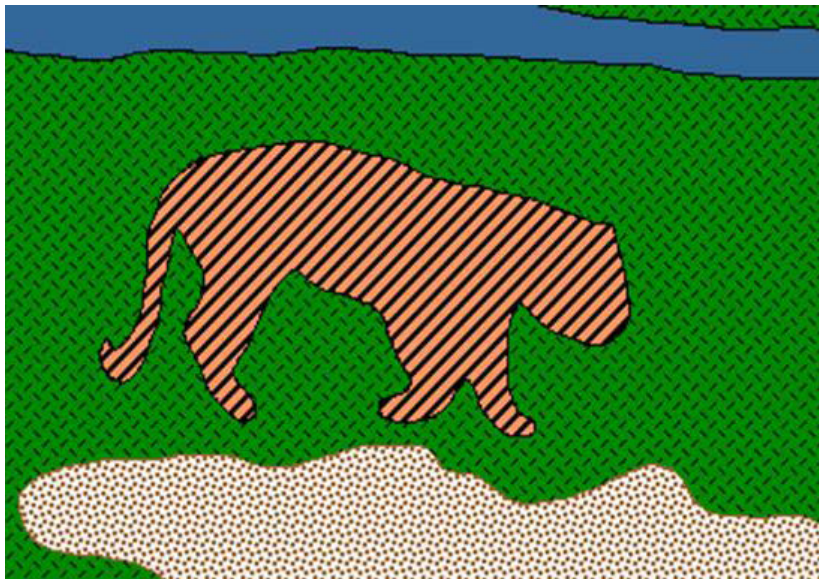
### Partial segmentation

It is not always necessary to segment the image into all objects. Sometimes a partial segmentation is sufficient. In that case only one or more objects can be segmented.

# Original Image

## Segmented Image
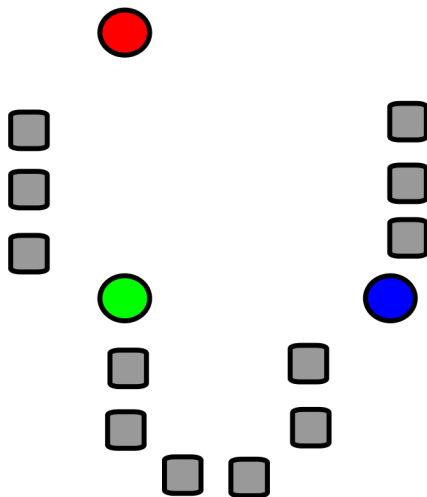
## k-means clustering

### k-means

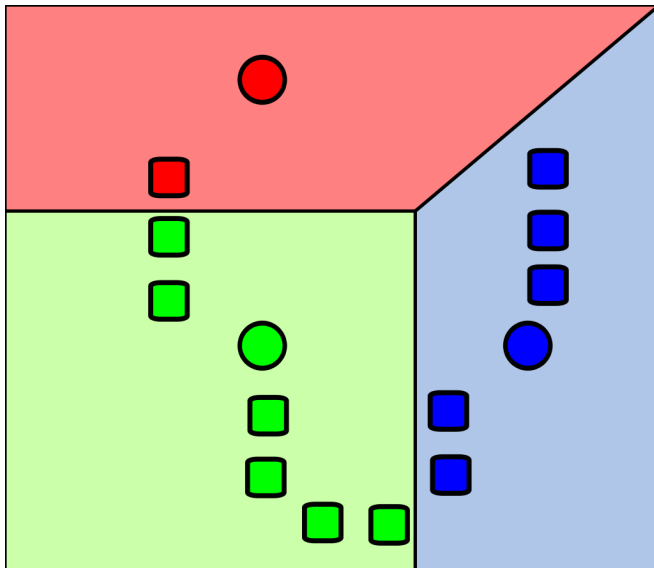k-means clustering is a method which clusters points into k groups

### Postup

- In the given vector space place k random centroids
- For each point in the space determine the closest centroid
- Move the centroids so that they are now in the center of their corresponding poitns
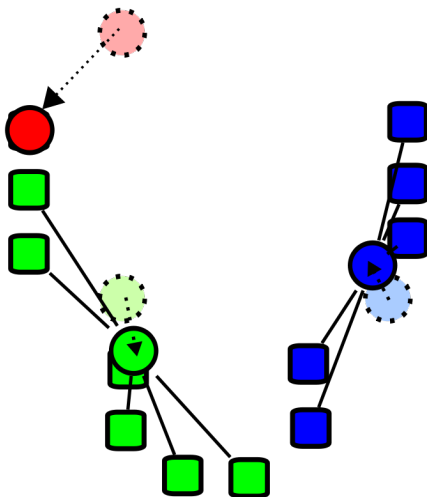- Repeat step 2 and 3 until the centroids no longer move
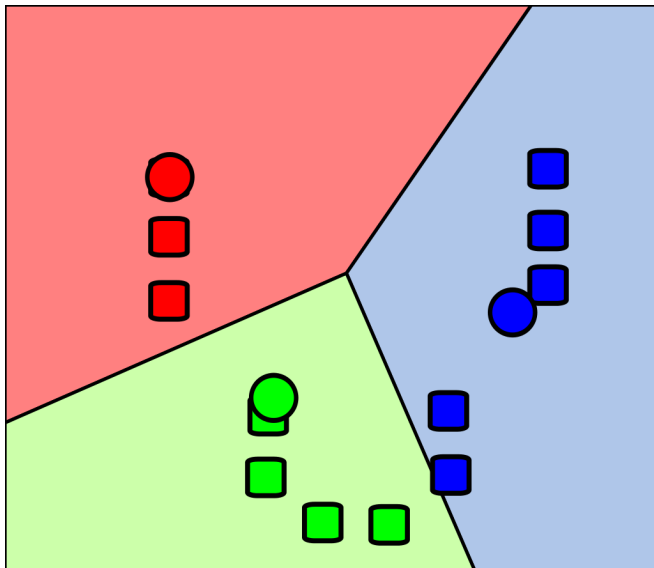
# k-means

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## k-means in matlab

### kmeans

kmeans(A, k) - for A matrix with n rows, each of which is one vector in our vector space return a vector of size n with values 1 to k according to the cluster to which each vector corresponds.

### Vectors for image segmentation

For images we can segment the pixels. The vector space can be represented with color and position of the images.

## k-means in matlab

### Exercise

Use k-means for zatisie. Use Lab color space for segmentation.

### Exercise

Add x and y coordinates to the vector space. Do not forget to normalize the components.

### meshgrid

[X, Y] = meshgrid(1:c,1:r) - creates two matrices of size $r \times c$. X contains the x coordinates and Y contains the y coordinates.

# Graph Cut

### Graph Cut

Graph Cut is a method that uses user input to segment the foreground. User selects a few pixels as the foreground and some as background.

### Algorithm

A graph containing all pixels is constructed. Each pixel is connected to its neighbors with a weight that corresponds to the pixel similarity. There are two additional nodes in the graph representing the foreground and the background. These are connected to the pixels with a probability based on a distribution of colors selected by the user. In the final step the algorithm cuts a graph so that it minimizes energy, which is calculated using the weights of edges in the graph.

# Graph Cut

### Matlab

You can use Graph Cut in matlab. Look for image segmenter in the APP context menu.

## Color-based Segmentation

### Using user input

We can also use user input to pick a color in the image and segment pixels based on their distance to the color in some colospace. We can then threshold the distance image to obtain the segmentation.

### Pixel position

We can also use user input position of the object to also use the spatial information as we did with the k-means clustering.

### Exercise

Try to use this approach to segment the apples or the orange in the image zatisie. Try different color spaces. Try it without spatial information and with it. Use smoothing and morphological operations to refine the segmentation.