# Lab 3: Image segmentation

In this exercise, you must design and conduct an image segmentation experiment. You can use and extend the k-means clustering code used in the exercises, or you are welcome to use any other tools or methods you find suitable. Based on your experiment, you must write and hand in a small lab report. You must work independently in groups as assigned on DTU Learn.

In the notebook exercises we have used k-means to cluster image pixels based only on their color. You are most welcome to add additional features to improve the clustering algorithm. Additional features could be the x- and y-coordinates of the pixels, the distance to the image center, the standard deviation of the pixel's neighboring colors, or anything else you can think of.

Once you have segmented the image using k-means, you can use the clusters to post-process the image. For example, you can erase clusters that correspond to parts of the image background to "clip out" a foreground object, or you can modify of some of the clusters for example to change the color of an object in the image.

## Develop an idea

You must come up with an idea and formulate a research question. For your inspiration, you could consider the following ideas:

1. How well can we change the color of a foreground object in an image. Can we do it so well, that a human subject cannot tell which is the original an which is the modified image?
2. By manually removing a distracting background, can we achieve better image recognition performance (on multiple images of some object, say a banana)?
3. Can we apply these techniques to video?

Come up with your own idea, perhaps inspired by the ideas above, and formulate your idea so that you can put it to the test.

## Experimental design

You should then design an experiment where you define exactly how you will approach your idea, and how you will measure the outcome. As always, you should consider how to statistically evaluate the results and estimate an appropriate sample size etc. Ideally, the experiment should be designed so carefully that others would be able to reproduce the experiment and get the same result except for statistical variation.

## Carry out the experiment

Now, you are ready to carry out your experiment. Follow your protocol carefully and record the results. If something goes wrong or you realize there is an issue with your experimental design, you might need to go back to the previous step and modify your design.

## Write up your report

Finally, you must write up a small lab report, following the template we have given you. The report must be exactly 1 page long, and you must hand it in as a pdf file.

## Purpose and intended learning objectives

**Expectations:** I expect that you completely understand the k-means clustering algorithm and how it is implemented in the code.

**Learning objectives:** The primary objective of this lab is to gain experience with programming your own AI algorithms. Furthermore, as always you should practice your statistical skills by estimating sample sizes and computing confidence intervals where it makes sense.