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In this recitation, we will see how to apply clustering techniques to segment images, with the main application being geared towards medical image segmentation.

At the end of this recitation, you will get a head start on how to cluster an MRI brain image by tissue substances and locate pathological anatomies.

Image segmentation is the process of partitioning digital images into regions, or segments, that share the same visual characteristics, such as color, intensity, or texture.

The segments should also be meaningful, as in they should correspond to particular surfaces, objects, or even parts of an object.

Think of having an image of a water pond, a mountain chain in the backdrop, and the sky.

Segmenting this image should ideally detect the three different objects and assign their corresponding pixels to three different regions.

In few words, the goal of image segmentation is to modify the representation of an image from pixel data into something meaningful to us and easier to analyze.

Image segmentation has a wide applicability.

A major practical application is in the field of medical imaging, where image segments often correspond to different tissues, organs, pathologies, or tumors.

Image segmentation helps locate these geometrically complex objects and measure their volume.

Another application is detecting instances of semantic objects such as humans, buildings, and others.

The two major domains that have seen much attention recently include face and pedestrian detection.

The main uses of facial detection, for instance, include the development of the auto-focus in digital cameras and face recognition commonly used in video surveillance.

Other important applications are fingerprint and iris recognition.

For instance, fingerprint recognition tries to identify print patterns, including aggregate characteristics of ridges and minutiae points.

In this recitation, we will look in particular at the medical imaging application.

Various methods have been proposed to segment images.

Clustering methods are used to group the points into clusters according to their characteristic features, for instance, intensity values.

These clusters are then mapped back to the original spatial domain to produce a segmentation of the image.

Another technique is edge detection, which is based on detecting discontinuities or boundaries.

For instance, in a gray-scale image, a boundary would correspond to an abrupt change in the gray level.

Instead of finding boundaries of regions in the image, there are other techniques called region growing methods, which start dividing the image into small regions.

Then, they sequentially merge these regions together if they are sufficiently similar.

In this recitation, our focus is on clustering methods.

In particular, we will review hierarchical and k-means clustering techniques and how to use them in R.

We will restrict ourselves to gray-scale images.

Our first example is a low-resolution flower image whose pixel intensity information is given the data set flower.csv.

Our second and major example involves two weighted MRI images of the brain.

One image corresponds to a healthy patient, and the other one corresponds to a patient with a tumor called oligodendroglioma.

The pixel intensity information of these two images are given in the data sets healthy and tumor.csv.

The last video will compare the use, pros, and cons of all the analytics tools that we have seen so far.

I hope that this will help you synthesize all that you've learned to give you an edge in the class competition that is coming up soon.