Exercise set 4: Segmentation and recognition

Bonus submission deadline: 14.04.2021 23:59

The exercises marked with **BONUS** should be returned in Moodle by the submission deadline. Successfully solving it will give you bonus points to boost your final grade. During the exercise session, the solution of the exercises will be discussed.

Exercise 1: Otsu method (BONUS)

Image thresholding is a simple image segmentation technique, which has applications e.g. in medical image processing and saliency detection. Given a grayscale image, thresholding will set to black all pixels which have intensity below a given threshold T and to white all pixels with intensity above a given threshold. In this exercise you will have to implement Otsu's algorithm to automatically compute the threshold T. You should return the matlab function `T = otsu_thresholding(I)`, which takes as input a grayscale image I and computes the threshold T. You can assume that I is a 8-bit image, i.e. the intensity values are in the range $0 - 255$. Here is a highlight of Otsu's algorithm. Given a candidate threshold t, you will classify as class 1 all pixels with intensity $\geq t$ and as class 0 all pixels with intensity $< t$. Now we define the following quantities

- $\omega_0(t)$: probability of class 0 at threshold t, i.e. number of pixels with intensity $< t$ divided by total number of pixels in the image
- $\omega_1(t)$: probability of class 1, analog definition
- $\sigma_0^2(t)$: variance of class 0, i.e. the variance of all intensity values $< t$ in the image
- $\sigma_1^2(t)$: variance of class 1, i.e. the variance of all intensity values $\geq t$ in the image
- $\sigma_w^2(t) = \omega_0(t)\sigma_0^2(t) + \omega_1(t)\sigma_1^2(t)$: intra-class variance

Otsu algorithm computes the intra-class variance for all values $t \in 0 \dots 255$ and chooses the one that leads to the smallest intra-class variance.
Your task is to implement Otsu algorithm in the file `otsu_thresholding.m`. When you are done, you can test your function running the script `ex1.m`
Hint: To avoid problems with empty lists, you may want to iterate from $I_{min} + 1 : I_{max}$, where I_{min}, I_{max} are the minimum and maximum intensity

values in the picture.
Note! Don't even think of copying the Matlab code in the wikipedia article! The code there uses a different approach than what you are asked to do here :D (it maximises the inter-class variance while here you are asked to minimise the intra-class variance).

Exercise 2: Object detection with YOLO network

Nothing to do here, the TA will go through an example of how to perform object classification with YOLO network. You can open the example by running the following command in your matlab prompt.
`openExample('deeplearning_shared/ObjectDetectionUsingYOLOV2DeepLearningExample')`

Exercise 3: Object detection with Faster R-CNN

Nothing to do here, the TA will go through an example of how to perform object classification with Faster R-CNN. You can open the example by running the following command in your matlab prompt.
`openExample('deeplearning_shared/DeepLearningFasterRCNNObjectDetectionExample')`