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## Exercise 4: Image classification - Part 1

### Introduction

In this exercise, we will perform image classification using regions/superpixels as spatial support. Please use the Jupyter Notebook provided to complete this exercise.

### Info

All parts in the code that require your input for completion are marked with flag “#TODO”.

### Tasks

#### 1 Setup

Open the file `ex4.ipynb` (available on Moodle) using Jupyter.

#### 2 Extract regions and their features

- 2.1 Download the dataset
- 2.2 For each image in the dataset, compute regions and their features using the function implemented in the previous exercise

#### 3 Create a training dataset

- 3.1 Read the images from the training set and compute the ideal label for each superpixel (the label that has the largest intersection with each region)
- 3.2 Create an array of targets (ground truth), per region, that joins the targets of all the training images
- 3.3 Create an array of features that joins the features of all the training images

#### 4 Normalize features

- 4.1 Normalize features by subtracting the mean and dividing by the standard deviation

#### 5 Train Random Forest classifier

- 5.1 Create a Random Forest classifier, using the library `sklearn`
- 5.2 Use the function `fit` to train the classifier with the normalized features and targets

#### 6 Predict classification map

For each image in the test set

- 6.1 Load features
- 6.2 Predict labels by region
- 6.3 Predict labels for each pixel
- 6.4 Save the predictions on disk

#### 7 Visualize predictions

- 7.1 Visualize one of the classification predictions saved on disk, using the function `display_label_image` defined in the Jupyter Notebook
- 7.2 Visualize the ground truth label map that corresponds to the classification prediction that you selected to plot

**8 Answer the following question**

**Q** Comparing the prediction and the ground truth, which types of errors do you find in the predictions?