FACULDADE DE ENGENHARIA DA UNIVERSIDADE DO PORTO
MIEIC - 2019/2020

COMPUTER VISION

PROJECT Nº 2
Classification of chest CT scans

Summary

The broad goal of this project is to develop a system that can perform an automatic classification of chest CT scans. An example of an image acquired in a chest CT scan is shown in Figure 1. Note that the CT scan is acquired in various planes and therefore, for each CT scan, multiple images are acquired.

This project is associated with the LNDb grand challenge [https://lndb.grand-challenge.org/]. The challenge comprises a main challenge (classification of the CT scans) – and 3 sub-challenges (nodule detection, segmentation and classification).

The LNDb dataset contains 294 CT scans collected retrospectively at the Centro Hospitalar e Universitário de São João (CHUSJ) in Porto, Portugal between 2016 and 2018; it can be accessed online [https://tinyurl.com/VCOM1920-Project2]. Important information about the dataset is available in the challenge website [https://lndb.grand-challenge.org/Data/], please read it carefully.

More specifically, the scope of this project is related to sub-challenge C - Nodule Texture Characterization: given a list of nodule centroids, classify the nodules. Three texture classes will be considered following the classification in the Fleischner guidelines (illustrated in Figure 2): 1) Ground glass opacities (GGO), 2) Part solid nodules, 3) Solid nodules. Additional information about how this task is evaluated in the corresponding section of the evaluation page [https://lndb.grand-challenge.org/Evaluation/].

Figure 1 - Example of a slice of a chest CT scan

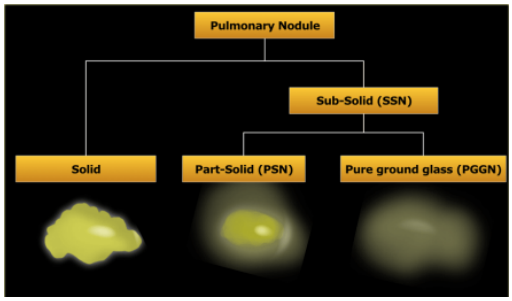

Figure 2 - Nodule classification
[source: https://radiologyassistant.nl/chest/fleischner-2017-guideline-for-pulmonary-nodules]

There is no restriction on how the system should be built.
Some approaches to create such a system include (but are not limited to):

- Feature detectors and descriptors (e.g. SIFT, color histograms) + classifier
- Dictionary-based representation (e.g. Bag of Visual Words) + classifier
- Deep learning methods (e.g. CNN)[1]

An objective evaluation of the system should be presented, based on relevant metrics. The grading will consider the following tasks, with associated weights:

- Main task (85%): implement and compare solutions in the scope of sub-challenge C
- Extra task (15%): implement at least one solution for one of the other sub-challenges

Note that the grading of the project will not be defined by the system's performance but rather by its complexity and adopted methodologies.

[1] Take into consideration that the training will take a significant amount of time if GPUs are not used.

Scientific Paper and Delivery

A short report must be elaborated in the format of a scientific paper (max. 3 pages), including:

- Brief introduction to the problem, including references about the state of the art;
- Description of the developed system;
- Possible additional specifications or improvements;
- Results of the system, using measures considered relevant;
- Discussion about the overall performance of the system and possible situations where it fails;
- Conclusions and future improvements.

The paper can be written in English or Portuguese and should be based on the model available in Moodle. The code, with meaningful comments, should be presented in annex.

The work must be submitted at the Computer Vision page, in the UP Moodle site, until the end of the day December 27, 2019.

Optional: consider participating in the (sub-)challenge and thus being able to compare the method's performance with implementations by other groups from around the world.

Bibliography

- Sampling Strategies for Bag-of-Features Image Classification. E. Nowak, F. Jurie, and B. Triggs. ECCV 2006.
- Imagenet classification with deep convolutional neural networks, A. Krizhevsky, I. Sutskever, and G. E. Hinton. *Advances in neural information processing systems*, pp. 1097-1105. 2012.
- Faster R-CNN: Towards real-time object detection with region proposal networks . S. Ren, K. He, R. Girshick, and J. Sun. In *Advances in neural information processing systems*, pp. 91-99. 2015.
- You only look once: Unified, real-time object detection. J. Redmon, D. Santosh, R . Girshick, and A. Farhadi.. In *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*, pp. 779-788. 2016.