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

COMPUTER VISION

PROJECT Nº 2
Skin Lesion Analysis
(based on the ISIC Challenges)

Summary

The broad goal of this project is to develop a system that can perform an automatic classification of skin lesions from dermoscopic images. Dermoscopy is an imaging technique that eliminates the surface reflection of skin. By removing surface reflection, visualization of deeper levels of skin is enhanced[1]. An example of an image acquired in dermoscopy is shown in Figure 1. This project relies on the datasets provided by ISIC Challenges [https://www.isic-archive.com → Challenges].

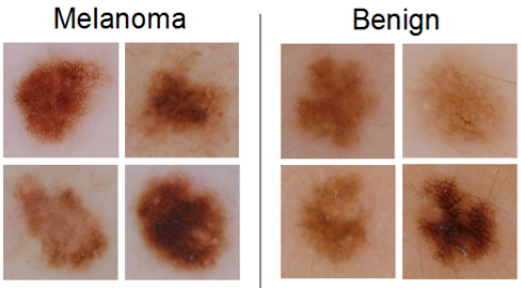

Figure 1 – Malignant/Benign image classification
[source: ISIC Challenge 2016]

The project will be divided into three tasks, with increasing difficulty and a different weight in the final grade:

- **Malignant/Benign image classification** (70%)
  The goal of this task is to implement and compare two or more methods/architectures that classify the lesions in dermoscopy images (as shown in Figure 1) as malignant or benign. The available training dataset contains 900 images, with an associated ground-truth label, and the test set contains 379 images. Note that the dataset is highly unbalanced. Some possible approaches include, but are not limited to:
  - Feature detectors and descriptors (e.g. SIFT, colour histograms) + classifier
  - Dictionary-based representation (e.g. Bag of Visual Words) + classifier
  - Deep learning methods (e.g. CNN)[2]

  Source: https://challenge.kitware.com/#phase/5667455bcad3a56fac786791

- **Multi-class image classification** (20%)
  This task focuses on implementing and evaluating one method/architecture to predict the type of disease present in dermoscopy images, considering the following 7 classes: Melanoma, Melanocytic nevus, Basal cell carcinoma, Actinic keratosis, Benign keratosis, Dermatofibroma, and Vascular lesion. The available training dataset contains 10015 images and, since no ground-truth labels are provided for the validation/test datasets, it should be adequately used for both training and testing. An adaptation of the (most successful) method applied in the first task should be considered for this task.

  Source: https://challenge2018.isic-archive.com/task3/

[1] Definition provided in the ISIC 2016 page.

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

- **Image semantic segmentation** (10%)
  The final task is related to semantic segmentation of clinical dermoscopic features on lesions (as shown in Figure 2). Two types of features are considered: globules and streaks. The training dataset consists of 807 images and 1614 binary masks (one for each feature, for each image); the test dataset consists of 334 lesion images, with the same format as the training data. A CNN-based approach should be used to address this task.

  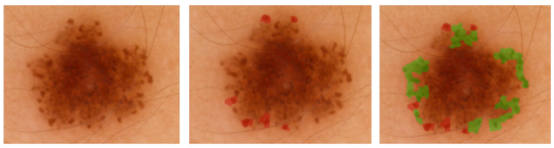

  Figure 2 – Semantic segmentation of clinical dermoscopic features on lesions: globules in red and streaks in green [source: ISIC Challenge 2016]

  Source: https://challenge.kitware.com/#phase/56fc26f7cad3a54f8bb80e4c

An objective evaluation should be presented for each task, based on relevant metrics. Note that the grading of the project will not be defined by the system's performance but rather by the correctness of the adopted methodologies.

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 methodology;
- Description of the datasets used for training and testing;
- Evaluation using metrics adequate for the specific problem;
- 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 (Moodle U.Porto) until the end of the day June 2, 2020.

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.