Project themes, October 2019

I. Medical image recognition

1. Perform binary classification in order to distinguish HCC from the cirrhotic parenchyma on which HCC had evolved, based on textural parameters, such as those derived from the GLCM matrix and also edge based statistics. Compare the performances of the Support Vector Machines (SVM) and Multilayer Perceptron (MLP) classifiers, configured in optimum manner, using metrics such as the accuracy (recognition rate) metric, sensitivity (True Positive Rate), specificity (True Negative Rate), Area under the ROC curve (AuC). (1-2 pers)
   http://web.pdx.edu/~jduh/courses/Archive/geog481w07/Students/Hayes_GreyScaleCoOccurrenceMatrix.pdf
   http://users.utcluj.ro/~dmitrea/Pagina_persDM/prez_texture_analysis.ppt
   https://www.cs.cornell.edu/courses/cs578/2003fa/performance_measures.pdf

2. Perform binary classification in order to distinguish HCC from the hemangioma benign liver tumour, based on first order statistics of the grey levels, computed on rectangular regions of interest: the arithmetic mean, the standard deviation, the maximum and minimum value, the histogram skewness and kurthosis, the autocorrelation index. Provide these values at the inputs of the following classifiers: the Naïve Bayes classifier and the AdaBoost + C4.5 classifier. Find the best configuration of each classifier, in order to achieve maximum performance. Compare the classification performances of these classifiers, using the following metrics: accuracy (recognition rate), sensitivity (True Positive Rate), specificity (True Negative Rate), Area under the ROC curve (AuC) (1-2 pers)
   https://www.csee.umbc.edu/~caban1/Fall2010/CMSC691//Schedule_files/Docs/08-ImageStatistics.pdf
   https://www.cs.cornell.edu/courses/cs578/2003fa/performance_measures.pdf
   https://www.researchgate.net/publication/285737882_GLCM_textural_features_for_Brain_Tumor_Classification

3. Malignant tumour recognition within ultrasound images using deep learning techniques (2 pers).
   https://www.hindawi.com/journals/cmmm/2016/6215085/

4. Detect the contour of the malignant/benign tumour structures, using the Hough transform, or another image processing method. (1-2 pers). *Optional:* Differentiate between the malignant and benign liver tumours, based on the contour shape.
   https://www.slideserve.com/naida/hough-transform-a-preliminary-study
   https://www.researchgate.net/publication/245745293_Computational_Techniques_for_the_Support_of_Breast_Tumor_Diagnosis_on_Ultrasound_Images

5. Detect the contour of the malignant/benign tumour structures using active contour models (“snakes”). (2-3 pers)
   http://web.cs.ucla.edu/~dt/papers/ap08/chapter8-revised.pdf
   http://people.ee.ethz.ch/~cattin/MIA-ETH/pdf/MIA-09-DeformableModels.pdf

6. Employ clustering (grouping) methods in order to perform the segmentation of the tumour and vessel structures within computer tomographic (CT) images (2-3 pers).
   http://www.fernandolobo.info/dm/slides/fuzzy-c-means.pdf
   http://people.brunel.ac.uk/~eesthhm/FINAL_VERSION.pdf

7. Perform tumour segmentation within ultrasound images using Convolutional Neural Networks (CNN). (2 pers)
   https://arxiv.org/pdf/1505.04597.pdf)

8. Perform supervised binary classification in order to detect polyps and telangiectasia within endoscopic images using colour features (R, G, B histograms) and textural features (the Gray Level Cooccurrence Matrix – GLCM), computed on rectangular regions of interest, provided at the input the k-nn and Support Vector Machines (SVM) classifiers. Compare the results obtained with these two classifiers (1-2 pers).
   https://pdfs.semanticscholar.org/ed0f/a5dade7fdd730c48650dd20df0620997fa9e.pdf
   https://www.researchgate.net/publication/285737882_GLCM_textural_features_for_Brain_Tumor_Classification

II. Recognition for other types of images

9. Human face recognition. Image recognition based on colour, shape and textural features in combination with a binary classifier.
   Compare the performances of several binary classifiers, using the following metrics: accuracy (recognition rate), sensitivity (True Positive Rate), specificity (True Negative Rate), Area under the ROC curve (AuC) (1-2 pers)
   http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.46.5826
   https://www.cs.cornell.edu/courses/cs578/2003fa/performance_measures.pdf

10. Face expression recognition and identification of the facial regions containing relevant information, in order to monitor the emotional states. (2 pers). Compute specific features in order to characterize the shape of the facial elements, then provide them to binary classifiers. Assess the performances of these classifiers using the following metrics: accuracy (recognition rate), sensitivity (True Positive Rate), specificity (True Negative Rate), Area under the ROC curve (AuC).
    https://www.researchgate.net/profile/Allen_Hanson/publication/24391234_Feature_Selection_Using_Adaboost_for_Face_Expression_Recognition/links/00b7d51717373e1498000000/Feature-Selection-Using-Adaboost-for-Face-Expression-Recognition.pdf
    https://www.cs.cornell.edu/courses/cs578/2003fa/performance_measures.pdf

11. Static hand gesture recognition (1-2 pers)
    http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.165.1575&rep=rep1&type=pdf

12. World object recognition, independently on illumination and orientation, based on specific features.(1-2 pers)
    http://wearables.cc.gatech.edu/paper_of_week/viola01rapid.pdf

13. Satellite image recognition. Compute textural features (e.g. GLCM) in order to distinguish urban areas from other types of areas within satellite images. Provide the features at the input of an AdaBoost classifier. Assess the classification accuracy (1 pers).
    https://www.researchgate.net/publication/333353216_The_Comparison_of_Different_Methods_of_Texture_Analysis_for_Their_Efficacy_for_Land_Use_Classification_in_Satellite_Imagery

14. Satellite image segmentation using Convolutional Neural Networks (CNN). Employ CNN in order to detect different types of area, such as water, forest, urban areas from satellite images. Assess the classification accuracy.
    https://www.fruct.org/publications/abstract22/files/Khr.pdf
    https://www.eea.europa.eu/data-and-maps/data/urban-atlas