Initial Plan

Medical image processing – lesions

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40 credits

Description

The incidence rates of melanoma skin cancer have been often steadily, but recently, rapidly increasing with a 140% increase since the early 90s (Cancer Research UK 2021). Early detection and identification of this cancer is vital for the survival of those who become afflicted with it – 100% of people diagnosed with melanoma skin cancer at its earliest stage will survive *at least* one year (Cancer Research UK 2021). Thankfully, there are visible indicators that can help to diagnose a skin lesion, even in its early stages. A lesion's size, shape, symmetry, colour, and texture can all be used to determine whether a particular lesion is in fact a malignant melanoma, or whether it is benign, or dysplastic ('dysplastic nevus' being a precursor lesion or 'warning sign' for malignant melanoma) (The Skin Cancer Foundation 2021). These visible indicators are also 'visible' to a computer, given the correct tools.

Initially spurred on purely by the prevalence of this cancer, automatic computerised identification of skin lesions became of interest to researchers all around the world, who saw the utility of computer vision and machine learning for this purpose and wished to streamline the process by which a concerned person can reach a medical diagnosis (Ganster et al. 2001). Today, researchers have slightly different motivations behind the progression of this technology. One such reason is that convolutional neural networks built for the purpose of lesion identification have been shown to match, and oftentimes *exceed* the performance of a human dermatologist (Tschandl et al. 2019). Another reason, more recently brought into the spotlight, is that this technology can help when and where there is limited physical access to healthcare. For instance, during the recent COVID-19 pandemic (Li et al. 2021), or simply in countries with insufficient higher-level education.

The primary aim for this project is to build a system to automatically classify images of skin lesions into 3 classes: malignant, benign, and dysplastic, based on the techniques described in 'Automated Melanoma Recognition' (Ganster et al. 2001). The system will use a combination of traditional computer vision segmentation methods such as adaptive thresholding to locate the region of interest within the image – the lesion. Then a variety of global and local features will be extracted that describe the segmented region (Kabbai et al. 2019). These features will be based on the ABCD(E) rule of dermoscopy (The Skin Cancer Foundation 2021), which provides the basis for a medical diagnosis by a dermatologist. Such features include asymmetry, colour, and diameter of the lesion. Finally, the system will have enough information to begin to classify the lesion in question.

During the process of building the classification system, there are also some secondary aims that would be beneficial to satisfy along the way – through testing and comparing different computer vision and machine learning methods at each stage of the system, the efficacy and efficiency of these stages will be evaluated. This will contribute to a deeper analysis of the problems at hand. To be able to draw meaningful conclusions for these secondary aims, some ground truths must be established.

The HAM10000 (Tschandl P 2018) dataset will be utilised for this project. The dataset from Harvard University provides over 10,000 images of pigmented skin lesions to help researchers construct machine learning models for the classification of lesions. The dataset includes a representative collection of a variety of lesions, as well as the ground truth for each case, and a curated set of binary lesion-segmentations, courtesy of Tschandl.

Aims and Objectives

Primary Aim – 22nd March:
To construct a lesion classifier using traditional computer vision methods.

Objectives:

- Image data will be extracted from the HAM10000 dataset.
- The images will be segmented to locate the region of interest.
- Segmented image regions will be described by their features.
- Each image will be classified as benign, dysplastic, or malignant.

Secondary Aim 1 – 18th February:
To investigate the best method(s) for segmenting dermatoscopic images of skin lesions.

Objectives:

- Data will be synthesised by way of visual examination to determine the proportion of correct segmentations in the training set.
- Data will be synthesised by way of an accuracy-loss function(s) to establish the accuracy of the segmentation compared to the ground truth – the curated segmentations.

Secondary Aim 2 – 5th April:
To analyse the strengths and weaknesses of traditional computer vision methods and deep learning methods.

Objectives:

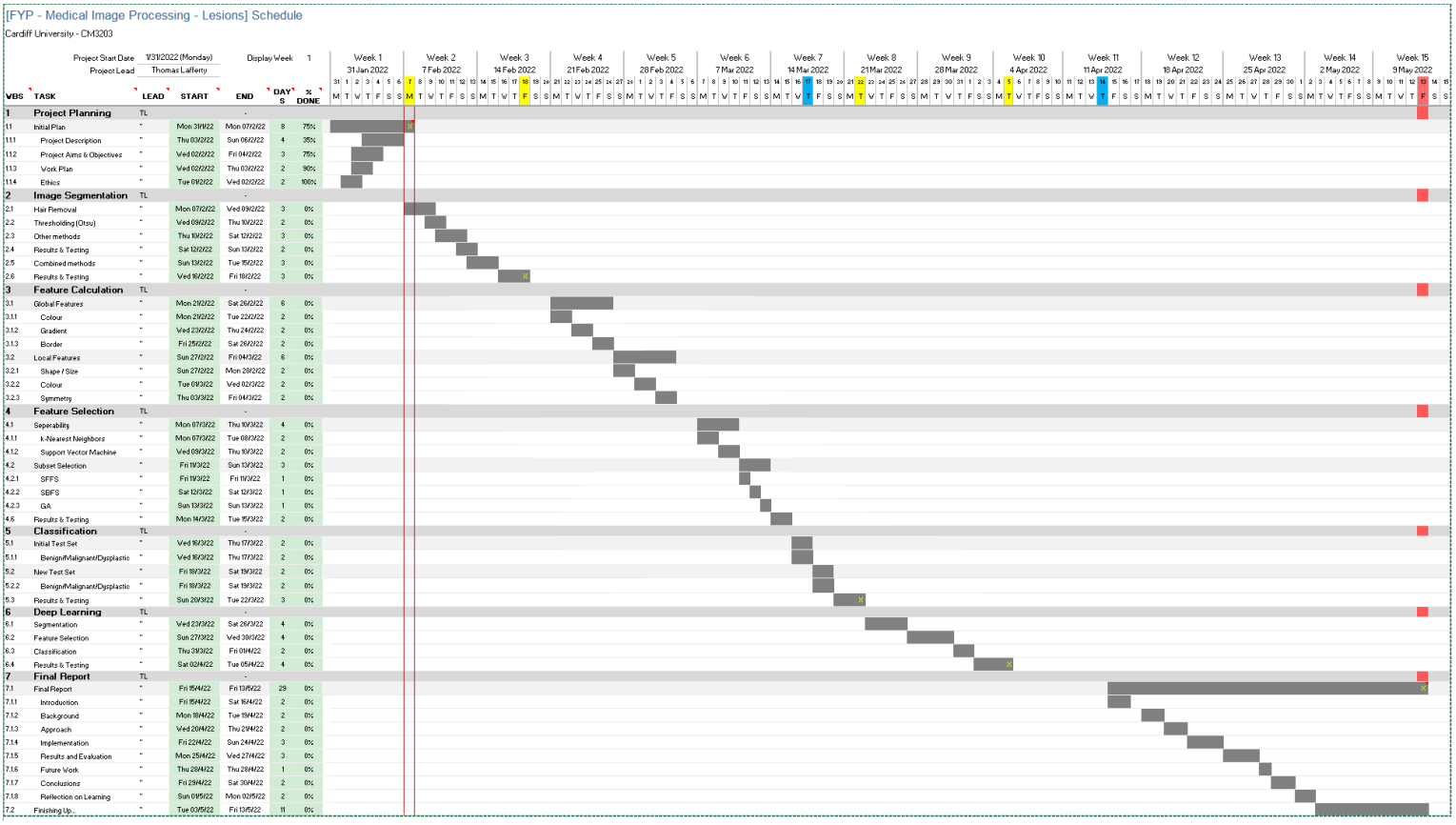
- Data will be synthesised by measuring suitable model evaluation and classification metrics such as sensitivity and specificity.

Work Plan

Final report submission: 13th May (red)

Scheduled review meetings: 11th March & 14th April (blue)

As shown below –



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