1 – NEURAL NETWORKS AND CONVOLUTIONAL NEURAL NETWORKS

1.1 Explain what is an epoch and the batch size in the training process of a neural network. In particular, give an example on how these relate to the number of examples in the training dataset and to each other.

1.2 Consider a Convolutional Neural Network similar to the AlexNet architecture. Give an interpretation of what is being trained in the first layers (convolution) and in the last layers (fully connected).

1.3 Comment the following sentence: "It is possible to replace the fully connected layers of a convolutional neural network (CNN) by another classifier, for instance SVM".

1.4 Consider that in a given convolutional layer of a CNN, five 3x3 filters with stride 2 are applied to a 11x11x30 input. What is the shape of the output tensor? Justify your answer.

2 – OBJECT DETECTION AND SEGMENTATION WITH CNNs

2.1 Consider the following statement "The Faster R-CNN model can be 10x faster than the R-CNN model.". Why is this difference possible?

2.2 One of the most popular object detection models based on deep learning is YOLO, which stands for "You Only Look Once". Explain why this name is adequate and, in particular, why this is a differentiating factor from other models like Faster R-CNN.

2.3 Suppose you were asked to develop a system to automatically segment individual blood cells in microscopy images (example in the image below). Note that segmenting cell vs. background pixels is not enough. What CNN-based method would be a good choice for this system? Justify your answer.
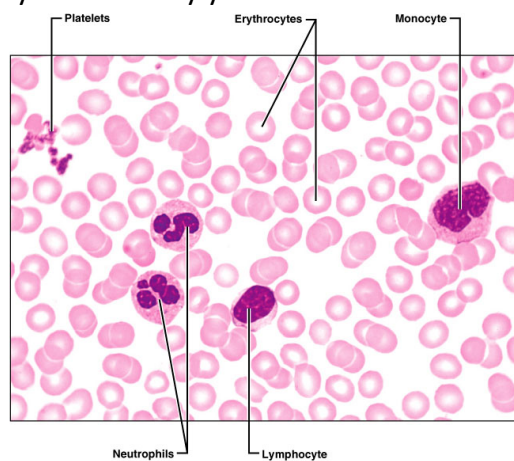
3 – GENERATIVE ADVERSARIAL NETWORKS

3.1 One of the main difficulties in many computer vision problems is related to the class imbalance of the dataset. Could a GAN be used as strategy to tackle this problem? If yes, how?

3.2 Explain why the cycle consistency loss is important in the training process of Cycle-Consistent Adversarial Networks (Cycle GANs).

4 – MOTION

4.1 Comment the following sentence: "The optical flow is not always a correct estimate of the motion". Present an example that illustrates this.

4.2 What is the aperture problem and how does it affect motion estimation?