> **Note**
>
> All documents forbidden. Answers are expected in French, unless you are more comfortable in English.
> Tous documents interdits. Réponses en français ou anglais.

1 Questions de cours

1.1 Caractéristiques d'images

- Cite the names of the major image file formats and their main differences. What is DICOM?

- Define sampling in numerical images. Define the image resolution.

1.2 Sensors

- What is a Bayer filter?

- Explain the principles of demosaicing.

1.3 Image processing

- Define the operation of histogram equalization.

- What is the difference with histogram stretching?

- From the mathematical definition of the derivative, explain the construction of the gradient operator, and then of the Laplacian.

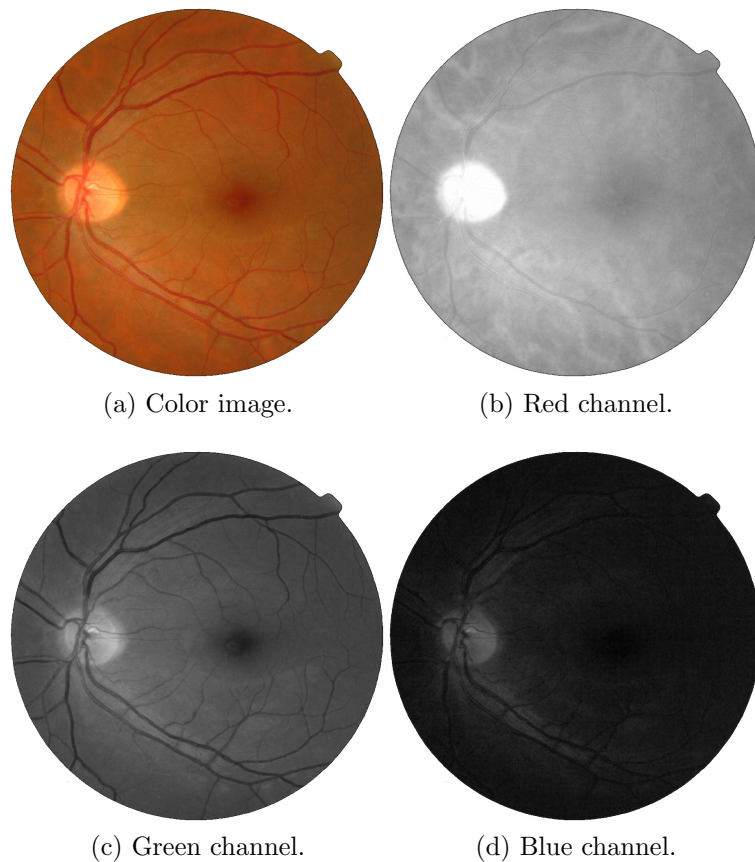- Cite some method for contours detection, and list their pros and cons.

(a) Color image.

(b) Red channel.

(c) Green channel.

(d) Blue channel.

Figure 1: Human retina.

2 Open question

The Fig. 1 shows a human retina (eye fundus). Propose a method for segmenting:

- the vessels,

- the optical nerve (bright disk).

Justify your choices. Indicate all elements that seem important and the way to deal with them. Look carefully at the shapes and intensities of objects you need to segment. For your record, ophthalmologists need to measure the diameter and the circularity of the optical nerve, as well as the length and the number of vessels (branches, tortuosity...).