You want to solve the problem of counting and visually estimate the weight of newborn fishes in a fish breeding facility. You have built a system (Fig. 1) in which the camera is able to capture all the newborn fishes going through a water slide (a video frame is shown in Fig. 2). Assuming that the fishes do not overlap and they all have a dark color, while the background has a homogeneous light color, analyze the video frame shown in Fig. 2, in order to count the number of fishes and estimate their weight according to Eq. 1

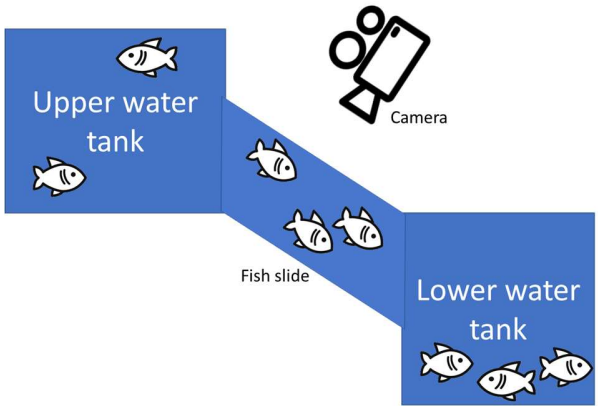


*Figure 1: Image aquisition system*

*Figure 2: Video Frame*

Eq. 1: $$mass\ [g] = 8 + 0.02 \times area\ [pixel] - 0.05 \times perimeter\ [pixel]$$

Write a MATLAB script able to perform the following steps:

a) Read the 8-bit grayscale image (stored in the file *'video_frame.png'*) and visualize it.
b) Obtain a binary image using a threshold value of 100 (fishes must appear as white) and visualize the result.
c) Obtain a label image of connected components of the binary image (*hint: use the default 8-connectivity and remember that label 0 will be assigned to the background*).
d) Initialize the fish counter to zero and for each label in the label image (excluding the background) perform the following operations:
    I. Obtain a binary image specific to the considered label.
    II. Calculate the fish area (count the number of white pixels) and check if the area is greater than 100 (in order to exclude spurious white regions not related to any fish). Perform the following steps only if the previous condition is satisfied:
        i. Increase the fish counter by one.
        ii. Using a 3x3 8-connectivity structuring element, extract the boundary of the fish binary image and obtain the perimeter binary image.
        iii. Calculate the fish perimeter by counting the number of white pixels in the perimeter binary image.
        iv. Calculate the fish mass with Eq. 1

```
clc
close all
clear all

%a)
I=imread('video_frame.png');
figure
imshow(I)

%b)
I_bw = I<100;
figure
imshow(I_bw)


%c)
L = bwlabel(I_bw);

%d)
min_area = 100;
count = 0;
for k=1:max(L(:))

    %d.1)
    mask = (L==k);

    %d.2)
    area = sum(mask(:));
    if(area>min_area)

        %d.2.i)
        count = count+1;

        %d.2.ii)
        B = strel('arbitrary', [1 1 1; 1 1 1; 1 1 1]);
        I_per = mask - imerode(mask, B);

        %d.2.iii)
        per = sum(I_per(:));

        %d.2.iv)
        mass = 0.02*area - 0.05*per + 8;

    end

end
```