Feedback — Quiz #3

Help Center

You submitted this quiz on **Mon 2 Feb 2015 7:57 PM IST**. You got a score of **10.00** out of **10.00**.

Question 1

Consider that the maximum value of an image I_1 is M and its minimum is m (with M different than m). An intensity transform that maps the image I_1 onto I_2 such that the maximal value of I_2 is L and the minimal is 0 is:

Your Answer		Score	Explanation
$\frac{I_1}{M-m} \cdot L$			
Such transform does not exist.			
$\frac{L}{M-m} \cdot I_1$			
$\frac{I_1-m}{M-m} \cdot L$	✔	1.00	
Total		1.00 / 1.00	

Question Explanation

The correct answer is $\frac{I_1-m}{M-m} \cdot L$.

We see that if $I_1 = M$ then the fraction becomes 1 and the value is mapped to L. If $I_1 = m$, then the fraction is zero and so is the mapped valued. All other values for I_1 will lead to fractions in the interval $[0, 1]$ and as such the values of I_2 are in the interval $[0, L]$.

Question 2

Why global discrete histogram equalization does not, in general, yield a flat (uniform) histogram?

Your Answer		Score	Explanation
Because the histogram equalization mathematical derivation doesn’t exist for discrete signals.			
Because in global histogram equalization, all pixels with the same value are mapped to the same value.	✔	1.00	
Because images are in color.			
Actually, global discrete histogram equalization always yields flat histograms by definition.			
Total		1.00 / 1.00	

Question Explanation

Since we cannot split pixels of the same value to be mapped to different ones, complete flat histograms are not achievable in general. All pixels having the same value in the original image are mapped to the same value after global equalization.

Question 3

Discrete histogram equalization is an invertible operation, meaning we can recover the original image from the equalized one by inverting the operation, since:

Your Answer		Score	Explanation
Images have unique histograms			
Pixels with different values are mapped to pixels with different values.			
Actually, histogram equalization is in general non-invertible.	✔	1.00	
There is a unique histogram equalization formula per image.			
Total		1.00 / 1.00	

Question Explanation

In global histogram equalization, it can happen that pixels with different values in the original image are mapped to the same value, and therefore the operation is not invertible.

Question 4

Given an image with only 2 pixels and 3 possible values for each one. Determine the number of possible different images and the number of possible different histograms

Your Answer		Score	Explanation
9 images and 6 histograms	✔	1.00	
6 images and 9 histograms.			
6 images and 6 histograms.			
9 images and 9 histograms.			
Total		1.00 / 1.00	

Question Explanation

Each pixel can have any of the 3 possible values, and therefore there are $3 \times 3 = 9$ possible images. On the other hand, since the order does not matter for the histograms, there are only 6 possible different histograms, e.g., considering the possible values as $0, 1, 2$, the images 01 and 10 have the same histogram

Question 5

Which integer x number minimizes $\sum_{i=1}^{i=99} |x - i|$?

Your Answer		Score	Explanation
51			
50	✔	1.00	

49	
50.5	
Total	1.00 / 1.00

Question Explanation

Remember that the median minimizes such functional.

Question 6

Applying a 3×3 averaging filter to an image a large (infinity) number of times is

Your Answer		Score	Explanation
Equivalent to replacing all the pixel values by 0.			
Equivalent to replacing all the pixel values by the average of the values in the original image.		1.00	
The same as applying it a single time.			
The same as applying a median filter.			
Total		1.00 / 1.00	

Question Explanation

As discussed in the video, this leads to a constant value. It is also equivalent to applying an averaging operation with an increasing kernel, until the kernel has “infinity” support and then we obtain the average of all pixel values. As an extra exercise, experiment this writing a simple program in your computer.

Question 7

Which integer x number minimizes $\sum_{i=1}^{i=3} |x - i|^2$?

Your Answer		Score	Explanation
2	✔	1.00	
1			
4			
3			
Total		1.00 / 1.00	

Question Explanation

Remember that the average minimizes this function.

Question 8

Consider a row of pixels with values 1, 1, 1, 1, 5, 1, 1, 1, 1. When we apply an average and a median filter of size 3, the output values of the 5th pixel starting from the left are

Your Answer		Score	Explanation
9/3 and 1 respectively			
5 and 1 respectively			
7/3 and 1, respectively.	✔	1.00	
1 for both operations			
Total		1.00 / 1.00	

Question Explanation

Also note how the median filter gets rid of this pointwise noise.

Question 9

Consider a row of pixels with values 1, 1, 1, 1, 5, 5, 5, 5, 5, 5. When we apply an average and a median filter of size 3, the output values of the 5th pixel starting from the left are

Your Answer		Score	Explanation
11/3 and 5, respectively	✔	1.00	
7/3 and 1 respectively			
5 for both operations			
1 and 5, respectively			
Total		1.00 / 1.00	

Question Explanation

Also note how the median filter preserves the edge but the average does not.

Question 10

Consider an image denoising operation T, and write $T(I)$ the application of T to the image I.

Your Answer		Score	Explanation
If T is the non-local means algorithm, then $T(T(I)) = T(I)$.			
None of the above statements is correct.	✔	1.00	
If T is the non-local means algorithm, then $T^n(I) = average(I)$, where T^n stands for applying T an infinite number of times and $average(I)$ is the pixel average of the image I.			
If T is the non-local means algorithm, then there is no image for which $T(I) = I$.			
Total		1.00 / 1.00	

Question Explanation

Note that:

- If T is the non-local means algorithm, then $T(T(I)) = T(I)$.
  This is not correct because even the neighborhood will be different after a single non-local means application.
- If T is the non-local means algorithm, then $T^\infty(I) = \text{average}(I)$, where T^∞ stands for applying T an infinite number of times and $\text{average}(I)$ is the pixel average of the image I.
  This is not correct, since this is a property of the standard average filter but not necessarily of non-local means.
- If T is the non-local means algorithm, then there is no image for which $T(I) = I$.
  This is not correct, e.g., the equality is valid for any constant image.

Question 11

(Optional programming exercises)

- Implement a histogram equalization function. If using Matlab, compare your implementation with Matlab's built-in function.
- Implement a median filter. Add different levels and types of noise to an image and experiment with different sizes of support for the median filter. As before, compare your implementation with Matlab's.
- Implement the non-local means algorithm. Try different window sizes. Add different levels of noise and see the influence of it in the need for larger or smaller neighborhoods. (Such block operations are easy when using Matlab, see for example the function at http://www.mathworks.com/help/images/ref/blockproc.html). Compare your results with those available in IPOL as demonstrated in the video lectures.
- Consider an image and add to it random noise. Repeat this N times, for different values of N, and add the resulting images. What do you observe?
- Implement the basic color edge detector. What happens when the 3 channels are equal?
- Take a video and do frame-by-frame histogram equalization and run the resulting video. Now consider a group of frames as a large image and do histogram equalization for all of them at once. What looks better? See this example on how to read and handle videos in Matlab:

```
xyloObj = VideoReader('xylophone.mp4');

nFrames = xyloObj.NumberOfFrames;
vidHeight = xyloObj.Height;
vidWidth = xyloObj.Width;

% Preallocate movie structure.
mov(1:nFrames) = struct('cdata', zeros(vidHeight, vidWidth, 3, 'uint8'),
 'colormap', []);
```

```
% Read one frame at a time.
for k = 1 : nFrames
    im = read(xyloObj, k);

    % here we process the image im

    mov(k).cdata = im;
end

% Size a figure based on the video's width and height.
hf = figure;
set(hf, 'position', [150 150 vidWidth vidHeight])

% Play back the movie once at the video's frame rate.
movie(hf, mov, 1, xyloObj.FrameRate);
```

- Take a video and do frame-by-frame non-local means denoising. Repeat but now using a group of frames as a large image. This allows you for example to find more matching blocks (since you are searching across frames). Compare the results. What happens if now you use 3D spatio-temporal blocks, e.g., $5 \times 5 \times 3$ blocks and consider the group of frames as a 3D image? Try this and compare with previous results.
- Search for “camouflage artist liu bolin.” Do you think you can use the tools you are learning to detect him?

Your Answer	Score	Explanation
Total	0.00 / 0.00	