Feedback — Quiz #4

Help Center

You submitted this quiz on **Mon 9 Feb 2015 4:54 PM IST**. You got a score of **7.00** out of **7.00**.

Question 1

Compute the variance of the uniform noise distribution function $(b > a)$:

$$p(z) = \begin{cases} \frac{1}{b-a} & \text{for } a \leq z \leq b \\ 0 & \text{otherwise} \end{cases}$$

Your Answer		Score	Explanation
$\frac{a+b}{2}$			
0			
$\frac{(a+b)^2}{2}$			
$\frac{(b-a)^2}{12}$	✔	1.00	
Total		1.00 / 1.00	

Question Explanation

Simply use the definition of variance. Check here if you want to refresh the definitions.

Question 2

What is the probability distribution function of salt-and-pepper noise?

Your Answer	Score	Explanation
$p(z) = \begin{cases} P_a & \text{for } z = a \\ 0 & \text{otherwise} \end{cases}$		

$p(z) = \begin{cases} P_a & \text{for } z = a \\ P_b & \text{for } z = b \\ 0 & \text{otherwise} \end{cases}$	✔	1.00
$p(z) = \text{constant}$		
$p(z) = e^{-z}$		
Total		1.00 / 1.00

Question Explanation

Remember that we need a probability to create salt (white) and a probability to create pepper (black). $p(z) = \text{constant}$ is constant noise; $p(z) = e^{-z}$ is exponential; $p(z) = \begin{cases} P_a & \text{for } z = a \\ 0 & \text{otherwise} \end{cases}$ is only salt or pepper but not both.

Question 3

Consider a constant image (a single pixel value in the whole image). Assume we add Gaussian noise to the image. How many Gaussian functions (distributions) will appear in the histogram of the noisy image?

Your Answer		Score	Explanation
Two			
None			
One	✔	1.00	
Three			
Total		1.00 / 1.00	

Question Explanation

The original histogram is a delta function, and then we obtain one Gaussian around it.

Question 4

Consider a constant image (a single pixel value in the whole image), not white nor black. Assume we add salt-and-pepper noise to the image. How many delta functions (distributions) will appear in the histogram of the noisy image?

Your Answer		Score	Explanation
Two			
None			
One			
Three	✔	1.00	
Total		1.00 / 1.00	

Question Explanation

We have a delta for the original pixel values, and one for salt (white) and then one for pepper (black).

Question 5

What filter would you apply to restore an image corrupted by additive Gaussian noise and motion blur if your goal is to minimize the expected mean squared error between the original image and the restored one?

Your Answer		Score	Explanation
Wiener filter	✔	1.00	
Local average filter			
Median filter			
No filter can restore Gaussian additive noise			
Total		1.00 / 1.00	

Question Explanation

This is the exact definition of Wiener filter.

Question 6

Do you consider you understand the difference between image enhancement and image restoration? There is no wrong answer here.

Your Answer		Score	Explanation
Yes	✔	0.00	
No			
Total		0.00 / 0.00	

Question Explanation

In image restoration we expect that by having information about the degradation process, we can recover the original image. In image enhancement, the goal is simply to make the image more appropriate for a given task. For example, we can still apply histogram equalization to a clean and sharp image, though there is no need to apply any restoration technique to it.

Question 7

Consider we have an image composed of three constant flat regions. In other words, every line looks like $\cdots ccccdddd \cdots, eeee \cdots$, where c is a given gray value, d another, and e yet another. Assume $c > d$ and $e > d$. We want to compress the image and select to apply a simple predictor such that the current value is predicted as equal to the previous one just to its left (ignore boundary pixels). The prediction error is better modeled as

Your Answer	Score	Explanation
There will be no prediction error		
Gaussian		

Exponential		
Salt and pepper	✔	1.00
Total		1.00 / 1.00

Question Explanation

We only have error at the boundaries, when moving from c to d and from d to e.

Question 8

Assume we have the same image as in the previous question, and we add to it Gaussian noise with zero mean. Assume we apply the same type of prediction. The prediction error is now better modeled by

Your Answer		Score	Explanation
Two Gaussian modes			
A constant distribution			
A single Gaussian mode			
Three Gaussian modes	✔	1.00	
Total		1.00 / 1.00	

Question Explanation

When we move in a constant region, the prediction error is Gaussian with zero mean. When the do one of the jumps, we get a Gaussian, now centered at $d - c$ or $e - d$. We then get 3 Gaussian modes

Question 9

(Optional programming exercises)

- Add Gaussian and salt-and-pepper noise with different parameters to an image of your choice. Evaluate what levels of noise you consider still acceptable for visual inspection of the image.

- Apply median filter to the images you obtained above. Change the window size of the filter and evaluate its relationship with the noise levels.
- Practice with Wiener filtering. Consider for example a Gaussian blurring (so you know exactly the H function) and play with different values of K for different types and levels of noise.
- Compare the results of non-local-means from the previous week (use for example the implementation in www.ipol.im) with those of Wiener filtering.
- Blur an image applying local averaging (select different block sizes and use both overlapping and not overlapping blocks). Apply to it non-local means. Observe if it helps to make the image better. Could you design a restoration algorithm, for blurry images, that uses the same concepts as non-local-means?
- Make multiple (N) copies of the same image (e.g., N=10). To each copy, apply a random rotation and add some random Gaussian noise (you can test different noise levels). Using a registration function like imregister in Matlab, register the N images back (use the first image as reference, so register the other N-1 to it), and then average them. Observe if you manage to estimate the correct rotation angles and if you manage to reduce the noise. Note: Registration means that you are aligning the images again, see for example http://www.mathworks.com /help/images/ref/imregister.html or http://en.wikipedia.org/wiki/Image_registration
- Apply JPEG compression to an image, with high levels of compression such that the artifacts are noticeable. Can you apply any of the techniques learned so far to enhance the image, for example, reduce the artifacts or the blocking effects? Try as many techniques as you can and have time to do.
- Apply any image predictor as those we learned in Week 2. Plot the histogram of the prediction error. Try to fit a function to it to learn what type of distribution best first the prediction error.

Your Answer	**Score**	**Explanation**
Total	0.00 / 0.00	