Taipei Tech Digital Image Processing Final   2023/01/09

(Only one A4 document notes can be opened for this final!!)

1. (15%) (a) What is the result of the center pixel value through an arithmetic mean, geometric mean, harmonic mean, and median filters (calculate the result of new pixel intensity values);

100	100	100
100	(1)	100
100	100	100

1	1	1
1	(100)	1
1	1	1

(b)What is a contra-harmonic mean filter? How to set up the Q value (order of the filter) to solve the previous two matrices (pepper noise and salt noise)? (c) How to restore an image degraded by period noises?

Chinese: (a)請計算上圖中心圈選的像素經過 arithmetic mean、geometric mean、harmonic mean、median 濾波器的復原結果的數值為何? (b) 何謂 contra-harmonic mean 濾波器，如何設定 Q 值以解決上述兩種胡椒鹽雜訊的干擾? (c) 如何處理被週期性雜訊(Periodic Noise)干擾的影像?

2. (20%)(a) If an image ($f(x,y)$:the original image) was degraded by the motion blurring function ($h(x,y)$: blurring function) and an additional additive Gaussian noise ($n(x,y)$: Gaussian noise function), how to write the degradation model in a mathematics equation? (b) **What are criterion differences** for evaluating image restoration processes and image enhancement? (c) If an image was blurred due to motion blurring effects in the direction of 45 degrees, how you create the mathematical model for such blurring effects? (d) What is a pseudo-inverse filter? Design the filter in frequency domain by mathematics equation. (e) What is a homomorphic filter?

Chinese: (a)如果一張影像 $f(x,y)$ 因為移動造成衰減($h(x,y)$: 模糊函數)，再遭受到外加高斯雜訊(n(x,y))干，用數學式子描述汙染模型; (b) 如何 g 使用不同方法評量影像增強技術和影像復原技術的優劣? (c) 若一張因照相機 **45** 度角移動而產生模糊效應，如何產生此模糊效應之數學模型? (d) 甚麼是 Pseudo-inverse filter? 請在頻域設計該濾波器的數學模型 (e) 何謂同態濾波器(homomorphic Filter)?

3. (20%) (a) How to perform color histogram equalization for a color image? Write the flow diagram and explain. (b) How to transform an RGB image to its corresponding CMYK color model? (c) What is a pseudo coloring filter, can you name an example?

Chinese: (a) 如何對一張彩色影像進行 Histogram Equalization 之影像增強技術?請說明。
(b) 說明如何將一張 RGB 彩色空間的彩色影像轉換至 CMYK 彩色空間? (c)甚麼是 pseudo coloring filter? 請舉一範例說明。

4. (15%) (a) Constructing the Huffman Code Tree and Code Table. Numbers of appearance count for each symbol are: Y:12, E:15, S:7, A:40, B:2, F:4, P:20; (b) If the received code is "0110010100000101000100", what is the decoded words? (c) What are the average code length (bits) for the Huffman coding technique?

Chinese: (a)建立下列字母相對的 Huffman Code Tree 及 Code Table；經統計後，各字母出現的次數分別如下：Y:12 次，E：15 次，S：7 次，A：40 次，B：2 次，F：4 次，P：20 次; (b)若接收到所編譯

的碼為" 0110010100000101000100"，請問經解碼後的字母為何？(c)經 Huffman Code 壓縮後的平均字碼長度是多少 bits?

5. (15%) (a) How many different type of data redundancy? What are them? (b) how to evaluate the "randomness" of an image? Write the formula! (c) Using arithmetic encoding technique to encode the string of " *aiea!*", what is the coded result?

Chinese: (a) 說明資料冗餘性有哪幾種類別？(b) 如何評估一張影像內容分布的隨機性？公式為何?(c) 使用算數編碼(arithmetic encoding)進行 *aiea!* 的編碼數值為何？

Symbol	Probability	Range
a	.2	[0, 0.2)
e	.3	[0.2, 0.5)
i	.1	[0.5, 0.6)
o	.2	[0.6, 0.8)
u	.1	[0.8, 0.9)
!	.1	[0.9, 1.0)

6. (15%) (a) Which module causes the loss of data in JPEG compression, and what are the purpose (type of redundancy) for such a module? (b) The first two continuing sub-images (after DCT transformation and divided by a standard quantization matrix) are shown in the following matrices. Please transform them into JPEG binary strings according to the standard look-up table.

Chinese: (a) JPEG 壓縮過程中，哪一個步驟造成失真效應？因為解決哪一類的資料冗餘性? (b)若下列範例為一張影像在進行 JPEG 壓縮過程時的第一及第二張子影像，已經完成 DCT 轉換及量化處理後的兩個連續 8X8 子影像，此影像為灰階影像(只要參考 Luminance DC/AC 等相關表格)，試問這二張子影像的相對 JPEG 壓縮代碼應為何？

20	6	0 ...
4	8	
0...		

24	6	-6	0 ...
4	0	2	
8	0	0	
5	0	0	
0...			