**高等數位影像處理**

**作業#2**

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| **1** | |
| Figure | |
| lena256\_blur\_1.raw | lena256\_blur\_2.raw |
| MSE against lena256.raw: 0.95  PSNR against lena256.raw: 48.351 | |
| Discussion | |
| 從MSE可以得出兩張照片的像素質均方誤差很低，再由PSNR(大於30dB)更可以得出兩張照片的差異是人眼很難察覺的。 | |

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| **2(1)** | |
| Figure | |
| lena128\_to\_256\_nearest\_neighbor.png | lena128\_to\_256\_bilinear.png |
| MSE against lena256.raw: 101.649  PSNR against lena256.raw: 28.060  Execution time: 4ms | MSE against lena256.raw: 86.254  PSNR against lena256.raw: 28.773  Execution time: 3ms |
| lena128\_to\_512\_nearest\_neighbor.png | lena128\_to\_512\_bilinear.png |
| MSE against lena512.raw: 172.788  PSNR against lena512.raw: 25.756  Execution time: 14ms | MSE against lena512.raw: 122.800  PSNR against lena512.raw: 27.239  Execution time: 14ms |
| Discussion | |
| 由MSE及PSNR的比較，可以看出使用bilinear放大優於nearest neighbor，且nearest neighbor可以明顯看到棋盤效應，bilinear則是有些模糊效果。  再由執行時間可以看出當影像越大計算時間越久，而兩種演算法之間的計算時間差異不大。 | |

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| **2(2)** | |
| Figure | |
| lena512\_to\_256\_nearest\_neighbor.png | lena512\_to\_256\_bilinear.png |
| MSE against lena256.raw: 44.809  PSNR against lena256.raw: 31.617  Execution time: 3ms | MSE against lena256.raw: 13.056  PSNR against lena256.raw: 36.973  Execution time: 3ms |
| lena512\_to\_128\_nearest\_neighbor.png | lena512\_to\_128\_bilinear.png |
| MSE against lena128.raw: 104.640  PSNR against lena128.raw: 27.934  Execution time: 1ms | MSE against lena128.raw: 81.330  PSNR against lena128.raw: 29.028  Execution time: 1ms |

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| lena512\_blur\_to\_256\_nearest\_neighbor.png | lena512\_blur\_to\_256\_bilinear.png |
| MSE against lena256.raw: 31.636  PSNR against lena256.raw: 33.129  Execution time: 4ms | MSE against lena256.raw: 12.646  PSNR against lena256.raw: 37.111  Execution time: 3ms |
| lena512\_blur\_to\_128\_nearest\_neighbor.png | lena512\_blur\_to\_128\_nearest\_neighbor.png |
| MSE against lena128.raw: 76.111  PSNR against lena128.raw: 29.316  Execution time: 1ms | MSE against lena128.raw: 63.373  PSNR against lena128.raw: 30.112  Execution time: 1ms |
| Discussion | |
| 由MSE及PSNR的比較，可以看出使用bilinear縮小優於nearest neighbor，且nearest neighbor可以明顯看到棋盤效應，bilinear則是有些模糊效果。  觀察是否有先做模糊再縮小，可以發現效果更優於沒有先模糊(雖然肉眼觀察不出來)。  再由執行時間可以看出當影像越小計算時間越快，而兩種演算法之間的計算時間差異不大。 | |

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| **2(3)** | |
| Figure | |
| duck500x710\_bilinear.png | duck500x710\_bicubic.png |
| Discussion | |
| bilinear使用周圍2x2，4個鄰居做垂直、水平的線性內插，bicubic使用周圍4x4，16個鄰居來做內插，內插的算式比較複雜，按距離的遠近有不同的權重。  個人偏好使用bicubic演算法放大，因為取了16個鄰居來做內插，品質相對更好，圖片中可以明顯看到bicubic保留了更多紋理細節，bilinear反而使影像變模糊了，不適合用於細節觀察。 | |

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| **3** | |
| Figure | |
| lena256\_binarization.png | baboon256\_binarization.png |
| MSE against lena256: 8493.905  PSNR against lena256: 8.840 | MSE against baboon25: 9678.369  PSNR against baboon256: 8.273 |
| Discussion | |
| 量化灰階解析度的影像會很明顯失去影像中大面積的紋理特徵，因為能使用的顏色變少了，但也可以節省儲存空間。  本題將8bit影像量化為1bit(二值化)影像，原先需要256x256x8，二值化影像則只需要256x256x1的空間，節省率為 100% x (8 - 1) / 8 = 87.5%。 | |

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| **4** | |
| Figure | |
| D4\_search\_path.png | D4\_shortest\_path.png |
| D8\_ search \_path.png | D8\_shortest\_path.png |
| Dm\_search\_path.png | Dm\_shortest\_path.png |
| Discussion | |
| 本題使用廣度優先搜尋法( Breadth-first Search)演算法。從圖的某一pixel開始走訪，接著走訪該pixel相鄰且可以走且未走過的pixel，由走訪過的pixel繼續進行先廣後深的搜尋，直到找到目的pixel。  左圖為搜尋的路徑過程，其中pixel值代表從起點至該點的步數。  右圖為搜尋結果的最短路徑。 | |