Question 1:

* *Explain the concept of interpolation in general. Explain ’bilinear’ and ’bicubic’ interpolation in detail. Explanations should be your own work, otherwise you may lose points. Provide proper references, AVOID PLAGIARISM:*

“Interpolation is the process of calculating the intermediate values

of a continuous event from available discrete samples. It is practiced extensively in digital image processing to magnify or reduce images and to correct spatial distortions”([Microsoft Word - my\_paper\_2.docx](https://arxiv.org/pdf/2009.09622)). There are multiple techniques possible for this. In our assignment bilinear and bicubic interpolation will be utilized. Bilinear interpolation utilizes the closest 2x2 of the unknown pixel to calculate the pixel value using the weighted average. Bicubic interpolation takes it to the next level by considering the closest 4x4 neighbors instead of 2x2. Since these 16 pixels differ in distance to the target pixel, closer pixels are given a higher weight in the calculation([Understanding Digital Image Interpolation](https://www.cambridgeincolour.com/tutorials/image-interpolation.htm)). Due to considering more pixels in the calculation bicubic interpolation yields higher results however it also requires more computational power([Microsoft Word - my\_paper\_2.docx](https://arxiv.org/pdf/2009.09622)).

* *Comment on your findings. Based on your results compare bilinear and bicubic interpolation. Discuss whether any of the interpolation algorithms are superior to the other. Justify your reasoning based on your knowledge from the lectures and your findings from the previous step.*

To measure the quality of the interpolation methods MSE(Mean Squared Error) was utilized. However as for MSE the images needed to be of the same size we needed to change or the original image or our output image. First we utilized cropping to reduce the size of our output to the size of the original. However this didn’t yield the desired result this was probably due to the output image still having some black padding on the edges of the image. Therefore we opted for adding a padding to the original image to increase it to the size of the output image. Due to the added padding, along with the pixels at those locations in the output image being the same color, does not introduce additional error in the MSE calculation. Using cropping the MSE of the first image was …. for bilinear and …. for bicubic. For the second image it was …. for bilinear and … for bicubic. Using padding the MSE of the first image was …. for bilinear and …. for bicubic. For the second image it was …. for bilinear and … for bicubic.

* *Is mean squared error a good distance measure in this case. Discuss what other measures can we use.*

Due to being fast to compute MSE provides a good baseline. However there are also limitations namely it assumes pixel independence and ignores spatial relationships, which can provide problem for image processing. Moreover MSE measures the absolute difference between pixels rather than the structural difference which is more similar to the human visual system([5131-Article Text-8194-1-10-20190710.pdf](file:///C:\Users\casca\Downloads\5131-Article%20Text-8194-1-10-20190710.pdf)). Therefore if the image is shifted one pixel MSE would be really high while humans probably wouldn’t even noticed. Therefore other techniques like SSIM and PSNR could be utilized. **Explain SSIM and PSNR**

Question 2:

* *The given images are relatively easy. Discuss different scenarios where we can or cannot use this solution to classify images. Hint: Analyse the different channels in HSI and RGB channels. Can we differentiate all of the colors or objects easily*

Question 3:

* *Explain image subtraction. Provide proper references, AVOID PLAGIARISM!*

Image subtraction calculates the difference between all pairs of corresponding pixels of two images. The primary use case of subtraction is highlighting the difference between the two images. If there is no change between the image the difference will be zero or close to zero depending on noise and lighting ([digital\_image\_processing.pdf](file:///C:\Users\casca\Downloads\digital_image_processing.pdf)). To obtain only the meaningful change in the image thresholding can be utilized. Thresholding converts an image into a binary image based on their intensity values. For this you need to select an threshold value which acts as a boundary between the two classes.

* *Discuss your findings*