Resampling

○ Changing the resolution of the image

○ It might seem simple but it causes issues that has to be dealt with

○ Also resampling creates an interesting way to examine an image, from the most detailed form to broad shape of it

Aliasing

○ Aliasing occurs when the sampling rate is lower than twice the frequency of the components of the image

○ It is very similar to aliasing in 1D signals

○ When aliasing occurs it creates features that are simply not there

○ In 2D images, aliasing can be explained easily by moire patterns

○ Solution to aliasing is applying low pass filters to reduce the high frequency components from the image

○ Sharp edges and corners are high frequency components in an image, and applying low pass filter will blur the image

○ This step should be performed before or during the re-sampling

○ Different interpolation methods are applied during resampling to prevent aliasing to occur

○ Interpolation is determining missing values in general

○ In image processing interpolation is used in resampling to find all pixels of the destination image using the source as the pixels in the destination image are all unknown

Nearest neighbor interpolation

○ Simplest interpolation method

○ Considers the value of a single pixel

○ Causes aliasing

$$O_{x,y} = I_{x\frac{ow}{iw}, y\frac{oh}{ih}}$$

where I is the input, O is the output image, (ow, oh) is the size of the output image and (iw, ih) is the size of the input image

Bilinear interpolation

○ Slightly more complicated interpolation method

○ Considers 4 values around the destination pixel

○ Reduces aliasing artifacts

○ May cause blurring

○ One dimensional case is simple

$$f = x - \left\lfloor x\frac{os}{is} \right\rfloor$$

$$O_x = (1-f)I_{\left\lfloor x\frac{os}{is}\right\rfloor} + fI_{\left\lceil x\frac{os}{is}\right\rceil}$$

○ Two dimensional case is the square of the operation, requiring 4 coefficients rather than 2

Bicubic interpolation

○ Very complicated

○ Reduces the amount of blurring

○ Performs overshooting to achieve sharper result

○ Considers 16 pixels around the value to be determined