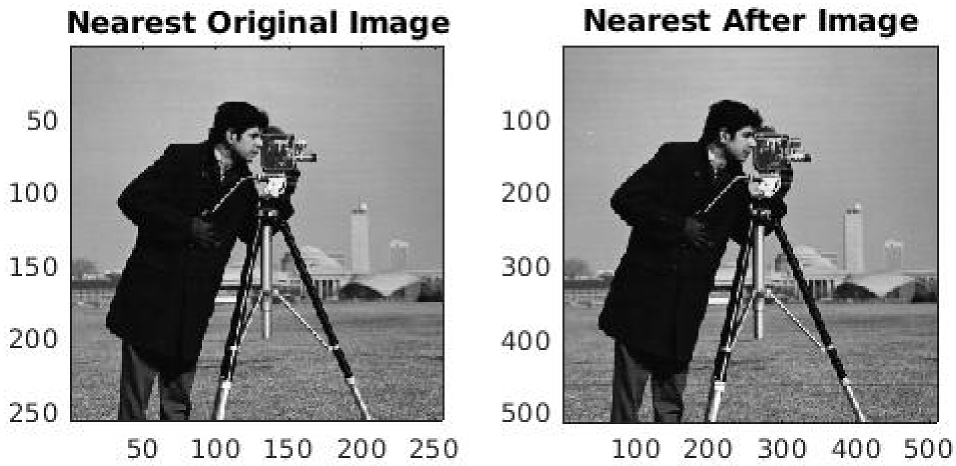
Q1:

A. Nearest Neighbour Interpolation:

In new figure, for filling (i,j) the nearest x co-ordinate from old one will be int (i/X) and nearest y co-ordinate will be int (j/X).

Algorithm:

```
for i=0:o_row-1
      for j=0:o_col-1
            New[i+1][j+1]=Old[int(i/X)+1,int(j/X)+1] //since in
matlab co-ordiantes of matrix start from (1,1) not (0,0) we have to
increase co-ordinates by 1.
```

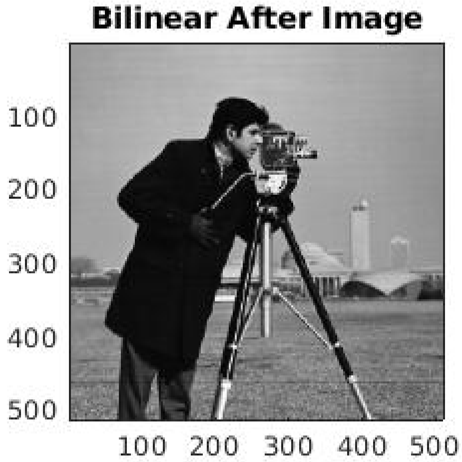


B. Bilinear Interpolation:

Algorithm:

```
      Input:irows*icols
      Resize-factor:X
      orows=irows*X
      ocols=icols*X
      for r’ in 1 to orows
            rf=r’/X
      for c’ in 1 to ocols
            cf=c’/X
//    for each rf find floor(rf)
      r=floor(rf)
      c=floor(cf)
      delr=rf-r and delc= cf-c
      for all output(r’,c’)=Input(r,c)*(1-delr)*(1-delc)
                              +Input(r+1,c)*delr*(1-delc)
      +Input(r,c+1)*(1-delr)*delc+Input(r+1,c+1)*delr*delc
```

because (r’,c’) is nearer to these 4 co-ordinates and dependent on these 4 as by distances delr, delc.



Q2:

Given M = [-1 -2 -1; 0 0 0; 1 2 1]

Edge: The places where the changes takes place after filtering or doing some change is called edge

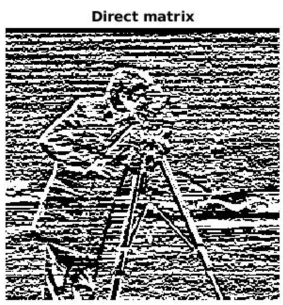
The given filter detects the HORIZONTAL edges in the image. Because as the sum of elements in the filter equal to zero. Where there is a uniform Intensity,the value at that pixel becomes zero and where there is non-uniform intensity , the value at that pixel will be close to white.

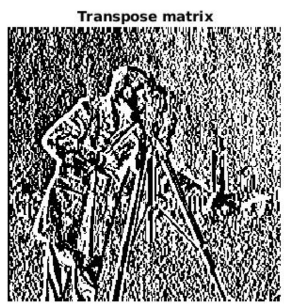
M’=[-1 0 1;-2 0 2;-1 0 1]

The transpose filter now have VERTICAL edges in the image.

Here also sum of elements in the filter is zero.

And remaining is same as above.





If we add both the results we can see the edges clearly in the image in both direction.

Q3.

Image_size = WxHxchannels
Filter_size = FxFxchannels and total of N filters given
S is stepsize and Z is zeropadding

a)

After Zero padding size => (W+2*Z)x(H+2*Z)xchannels
Also,

a*S + F = W + 2*Z
a = floor((W+2*Z-F)/S) where a is const;

Similarly

b*S + F = H + 2*Z
b = floor((H+2*Z-F)/S) where b is const;

After first filter dimensions => (a+1)x(b+1)xchannels

for width
W' = floor((W+2*Z)/S-F/S+1)
W' = floor((W+2*Z)/S + 1-(F/S))
let
A = 1-(F/S)
W' = floor((W+2*Z)/S)+A
Now for the same 2^{nd} filter

W'' = floor(W'/S)+A
W'' = ((W+2*Z)/S + A)/S + A
W'' = $(W+2*Z)/S^2 + A/S + A$

Similary then After the n^{th} filter applied
$W^n = (W+2*Z)/S^n + A/S^{n-1} + A/S^{n-2} + \ldots\ldots + A$
Which is in GP sequence
$W^n = (W+2*Z)/S^n + (A/S^{n-1})*((S^n-1)/(S-1))$

$\mathbf{W^n = floor((W+2*Z)/S^n + (A/S^{n-1})*((S^n-1)/(S-1)))}$

where A = 1-(F/S)

Similarly for the Height also

$\mathbf{H^n = floor((H+2*Z)/S^n + (A/S^{n-1})*((S^n-1)/(S-1)))}$

where A = 1-(F/S)

The no.of channels remain same throught the process

there fore

the final output dimensions are

$\mathbf{W^n \times H^n \times channels}$

b)

Multiplications:

inp-size (W+2*Z)x(H+2*Z)xchannels {After padding}
“
“ ==> {W’*H’*(F*F)*channels} mulplications
“
“
After 1st Fil W’xH’xchannels
“
“==> {W”*H”*(F*F)*channels} multiplications
“
After 2nd Fil W”xH”xchannels
“
“
“==> {W^n*H^{n*}(F*F)*channels} multiplications
“
“
After nth Fil W^nxH^nxchannels

==>

Total No.of multiplications are
=(W’*H’ + W”*H” + ... + W^n*H^n)*(F*F)*channels

Similarly

Total No.of Additions are
=(W’*H’ + W”*H” + ... + W^n*H^n)*(F*F-1)*channels

Q5.The matrix obtained from given condition is

M=[1 2 1;0 0 0;-1 -2 -1]

In this sum of the elements in filter is zero. Therefore,where there is uniform density the value at that pixel becomes zero and where there is non uniform density it is almost white.

Here we identifies Horizontal edges.

And in the transpose M’=[1 0 -1;2 0 -2;1 0 -1] each row is zero. Here we can see Vertical edges and all remaining is same as above.