CS663: Digital Image Processing

Assignment 1, Question 1

(a) Image Shrinking

```
function [OutputImage] = myShrinkImageByFactorD(InputImage, d)
    % Take the file title and subsampling factor as the inputs and gives outputs the input image but subsampled by a factor of d
    myGetBlockElement = @(X) X(1,1);
    fun = @(block_struct) myGetBlockElement(block_struct.data);
    OutputImage = blockproc(InputImage, [d, d], fun, 'UseParallel', 1);
end
```

Code Explanation: The function *myShrinkImagebyFactorD* takes *inputImage* as a single channel 8 bit image and returns *outputImage* i.e. a single channel 8 bit image with scaled dimensions. We take a block of size d X d and then take the first element of (1,1) pixel intensity of the block. These values for each d X d block are concatenated using *blockproc* to form an image of size *(sizeX / d, sizeY / d)* where *(sizeX, sizeY)* are the dimensions of the original image.

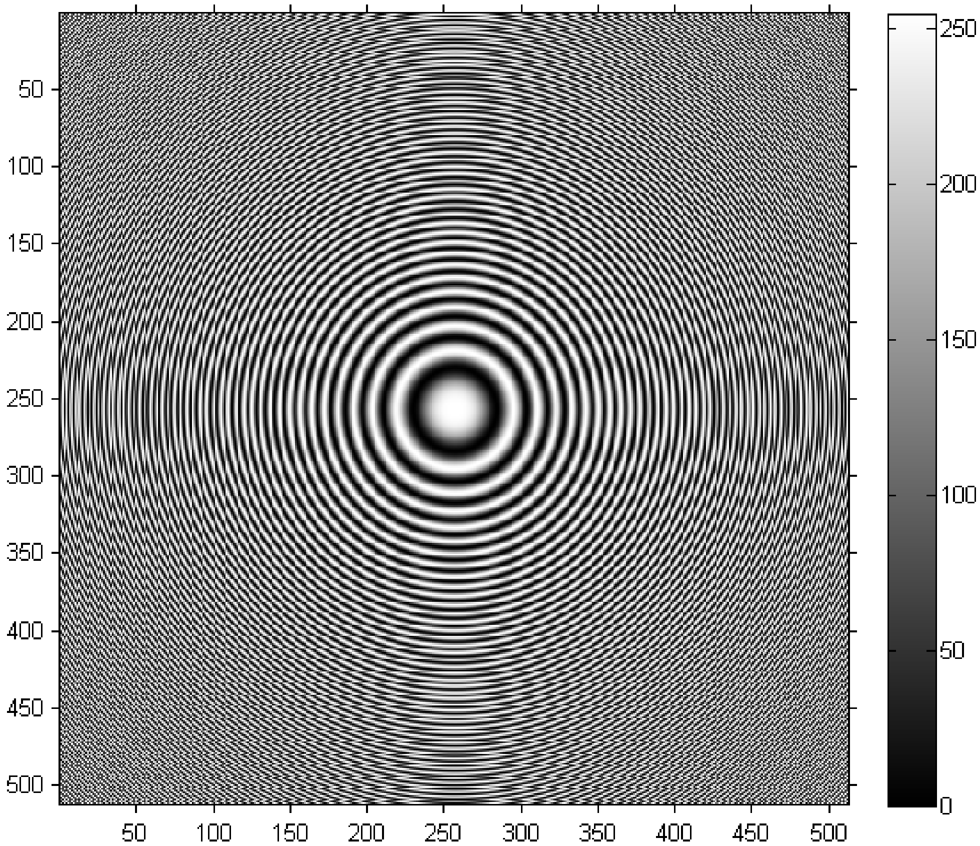

Figure. Original Image Concentric Circles

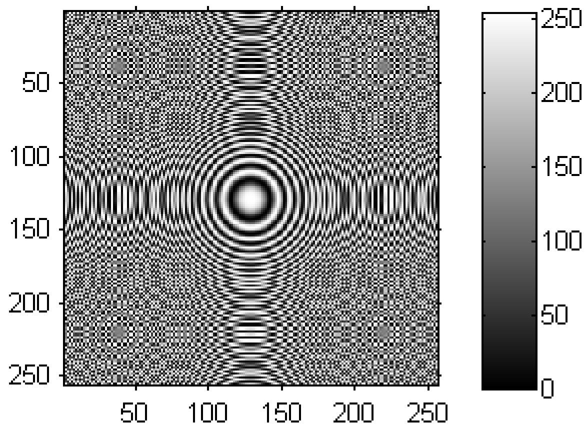

Figure. Concentric Circles, subsampled by factor of 2

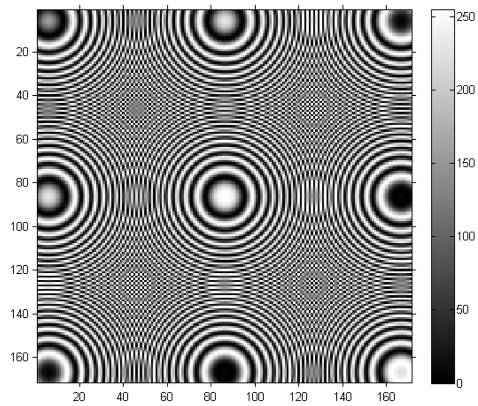

Figure. Concentric Circles, subsampled by factor of 3

(b) Bilinear Interpolation

```
function outputImage = myBilinearInterpolation(inputImage)
   [R,C] = size(inputImage);
   Rnew = 3*R - 2;
   Cnew = 2*C - 1;

   sR = R ./ Rnew;
   sC = C ./ Cnew;

   outputImage = zeros(Rnew, Cnew, 'uint8');
```

```
    for rp = 2:Rnew-1
        for cp = 2:Cnew-1
            rF = rp .* sR;
            cF = cp .* sC;
            r = max(1, floor(rF));
            c = max(1, floor(cF));
            dR = rF - r;
            dC = cF - c;

            outputImage(rp,cp) = uint8(inputImage(r,c).*(1-dR).*(1-dC) + inputImage(r+1,c).*(dR).*(1-dC) + inputImage(r,c+1).*(1-dR).*(dC) + inputImage(r+1,c+1).*(dR).*(dC));
        end
    end
end
```

Code Explanation: The function *myBilinearInterpolation* takes *inputImage* as a single channel 8 bit image and returns *outputImage* i.e. a single channel 8 bit image with dimensions as [3R-2, 2C-1] where R and C are the rows and columns of the original image. For each pixel (i', j') in the output image, intensity x is calculated as linear combination of the intensities at closest adjacent points i.e. towards upper left and right corner and lower left and right corner. The indices start from 2 and go up to max index – 1 because we need to accommodate the nearby pixel values.

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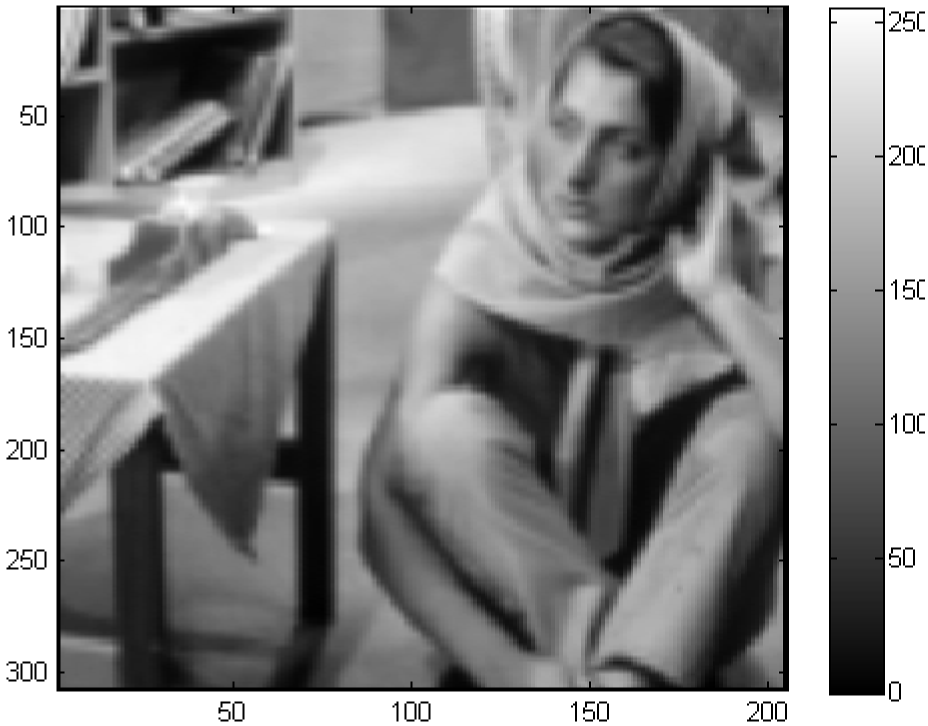

(c) Nearest Neighbour Interpolation

```
function outputImage = myNearestNeighborInterpolation(inputImage)
    [R,C] = size(inputImage);
```

```
    Rnew = 3*R - 2;
    Cnew = 2*C - 1;

    sR = R ./ Rnew;
    sC = C ./ Cnew;

    outputImage = zeros(Rnew, Cnew, 'uint8');

    for rp = 2:Rnew-1
        for cp = 2:Cnew-1
            rF = rp .* sR;
            cF = cp .* sC;
            r = max(1, floor(rF));
            c = max(1, floor(cF));

            outputImage(rp,cp) = uint8(inputImage(r,c));
        end
    end
end
```

Code Explanation: The function *myNearestNeighbourInterpolation* takes *inputImage* as a single channel 8 bit image and returns *outputImage* i.e. a single channel 8 bit image with dimensions as [3R-2, 2C-1] where R and C are the rows and columns of the original image. For each pixel (i', j') in the output image, intensity x is calculated as the intensity of the pixel closest to it in the original image.