Invoke Matlab and go to the ee171 directory under drive D. That is

```
  cd d:\ee171
```

Type ‘dir’ or ‘ls’ and determine that you have lpc.mdl, flanger.mdl, reverberation.mdl and lenna.mat, bird.mat and einstein.mat. Type ‘load lenna’, ‘load bird’ ‘load einstein’ and ‘load baboon’. Type ‘who’ or ‘whos’ and see that you have images lenna, bird, einstein and baboon. Type ‘imagesc(variable)’ or ‘image(variable)’. Type ‘colormap(gray)’ to convert the color to a gray level image.

(If you want yet more images to look at, you can type ‘load images’ and see that you have a number of images.)

1. 1-Dimension convolution

(a) Let signal \( f=[1 \ 2 \ 3 \ 4] \), filter \( h_1=[1 \ -1] \) and filter \( h_2=[1 \ 1] \). Calculate the convolution of \( f \) and \( h_1 \) and \( f \) and \( h_2 \) yourself and verify your answer with that obtained by Matlab. In Matlab convolution is obtained by using the command “conv(f,h1)”. You can type “help conv” to obtain more information about convolution. Also, commute the signal and the filters to see if the result changes.

Command list:

\[
\begin{align*}
f &= [1 \ 2 \ 3 \ 4]; \\
h_1 &= [1 \ -1]; \\
h_2 &= [1 \ 1]; \\
g_{11} &= \text{conv}(f,h_1) \\
g_{12} &= \text{conv}(f,h_2) \\
g_{21} &= \text{conv}(h_2,f)
\end{align*}
\]

Note that appending “;” at the end of the command does not show you the results of the command. Without it, it does.

2. 2-Dimension convolution

(a) Let \( f=bird \) (bird is a variable in your workspace).

(b) Design four filters as:

\[
\begin{align*}
h_1 &= \begin{bmatrix} 1 & -1 \\ 1 & -1 \end{bmatrix} \\
h_2 &= \begin{bmatrix} 1 & 1 \\ -1 & -1 \end{bmatrix} \\
h_3 &= \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix} \\
h_4 &= \begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}
\end{align*}
\]

(c) Use Matlab to convolve \( f \) and the four filters.

(d) Compare the original and convolved images.
Command list:

```
f=bird;
h1=[1 -1; 1 -1];
h2=[1 1; -1 -1];
h3=[1 -1; -1 1];
h4=[1 1; 1 1];
figure(1)   %active window #1
imagesc(f);
colormap(gray) %gray scale.
image(f)  %see which is better
figure(2)
g1=conv2(f,h1);   %convolve image f with filter h1
imagesc(g1)
colormap(gray) %gray scale
figure(3)
g2=conv2(f,h2);   %convolve image f with filter h2
imagesc(g2)
colormap(gray) %gray scale
figure(4)
g3=conv2(f,h3);   %convolve image f with filter h3
imagesc(g3)
colormap(gray) %gray scale
figure(5)
g4=conv2(f,h4);   %convolve image f with filter h4
imagesc(g4)
colormap(gray) %gray scale
```

Hand In: 1) Results of 1-D convolution.
2) Results of 2-D convolution (copies of before and after).
3) Very brief explanations of results.