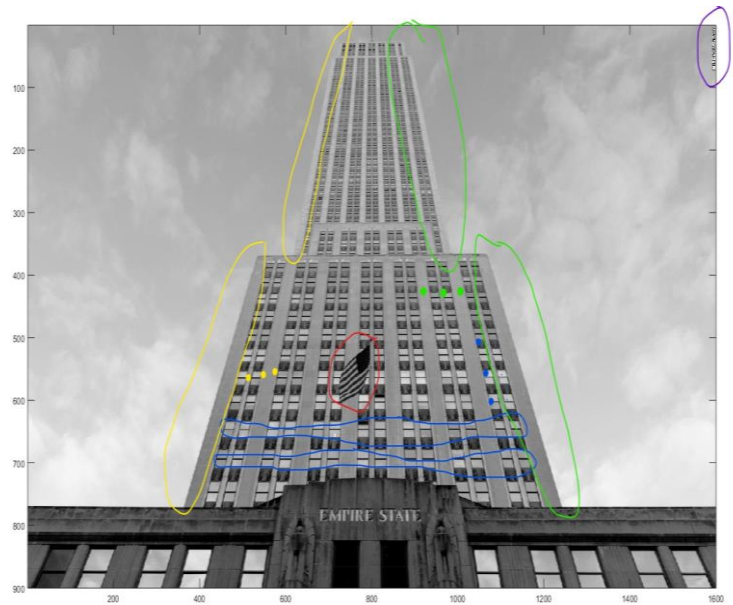
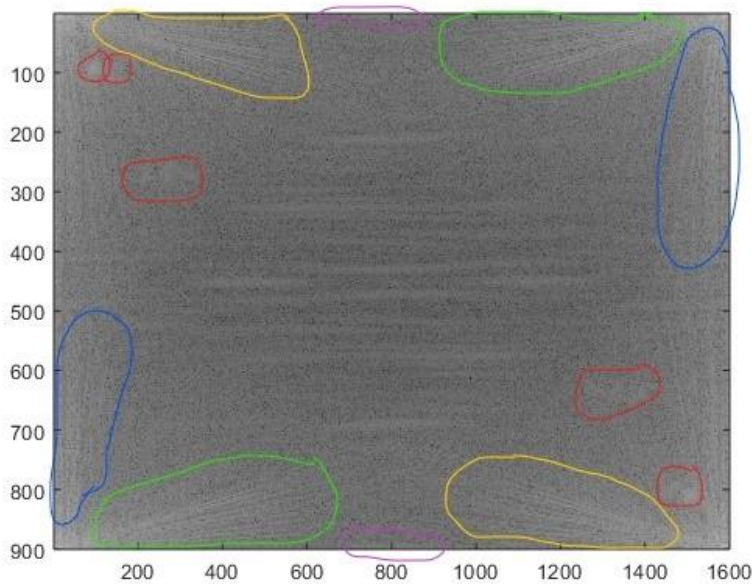


# CA4007 Image Processing Assignment

Kyrylo Khaletskyy – 15363521

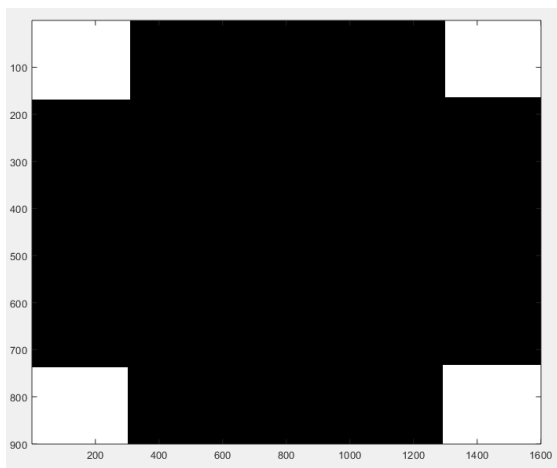
Ben Kelly – 15337716

## Image & Mask:



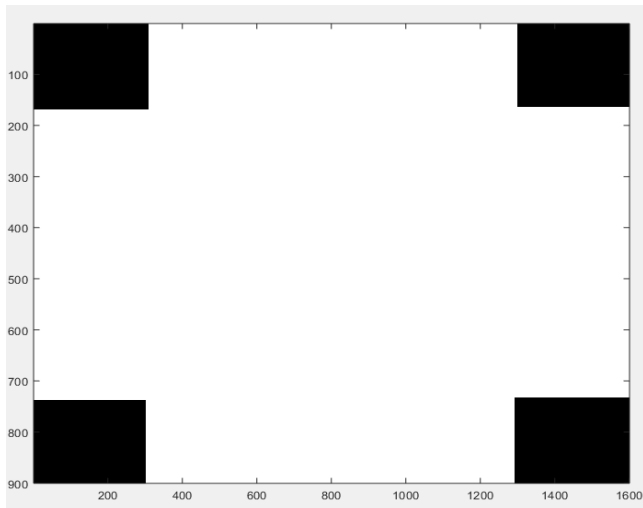
The Fourier transform on the left shows the different parts of the image and what they correlate to the on the right image, more in detail analysis is mentioned below, along with references to the same colours shown above. The Fourier transform of the image correlates to orthogonally to the features in the original image. The convergence of the edges of the building plays a role in the directional replication of some of the features in the FT. Relational to the point of the empire image, i.e. looking up from the base of the building.

## Low Pass Filter:

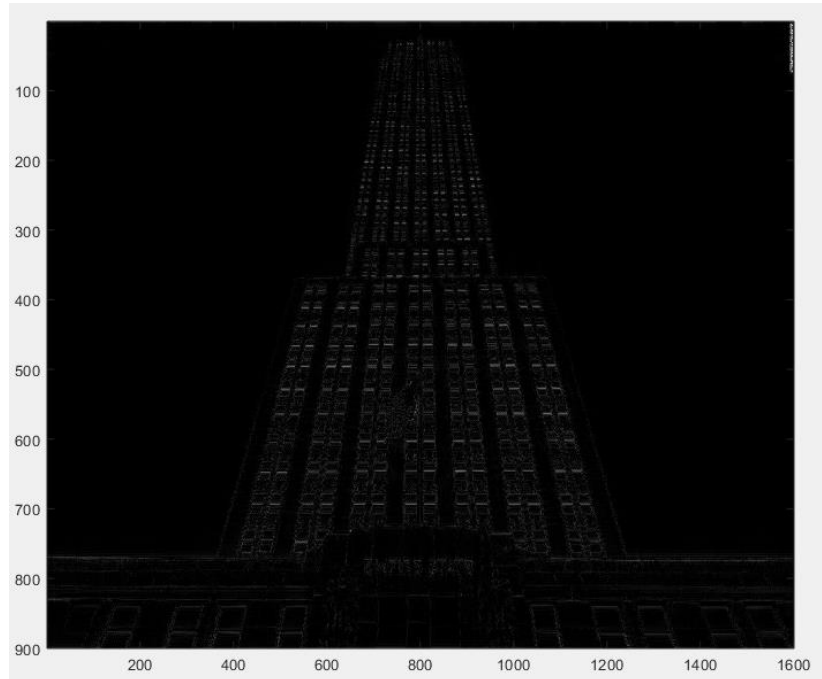


The mask shown above is a low pass filter, as the majority of the details is located in the 4 corners, when you run the image through the following mask you remove what is known as "aliasing". While the image becomes more "blurry" it also makes it less pixilated. The frequencies in the corners are the low frequencies. The high frequencies are closer to the centre of the Fourier Transform. Small points, details and edges have all been softened.

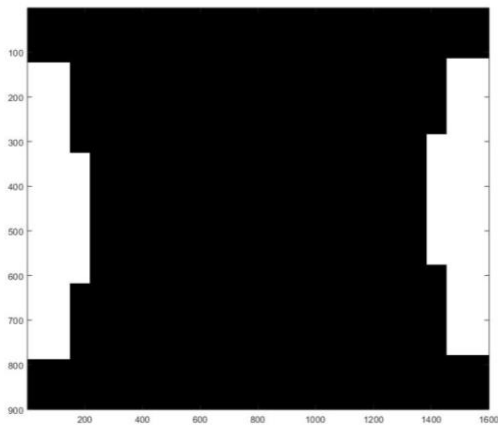
## High Pass Filter:



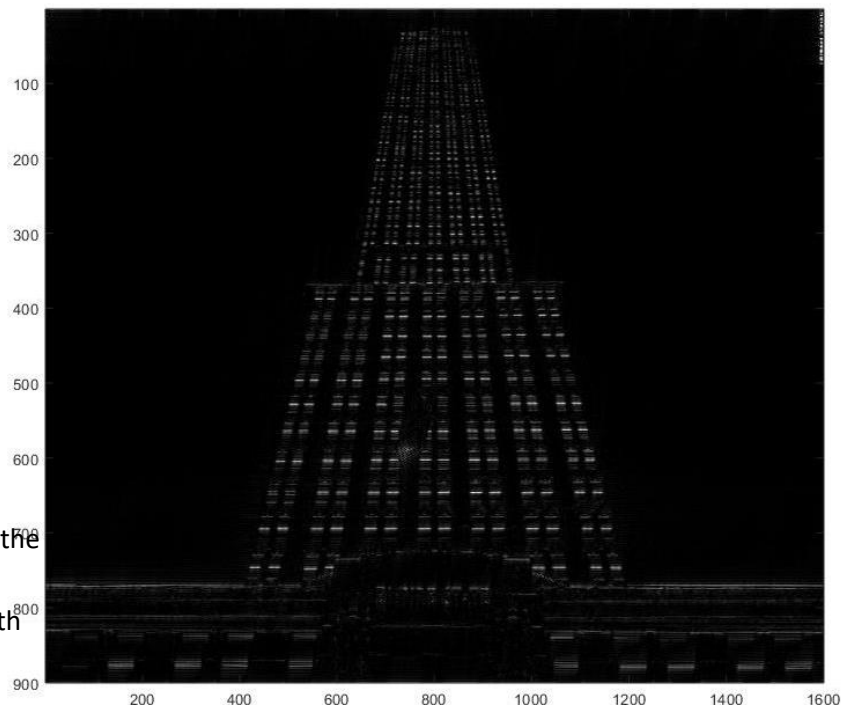
To get the high pass we just run 1-mask from the previous mask. While the low pass filter softens edges, the high pass filter removes the content of the image and we can see that only the edges are retained. The slowly varying parts of the image are being blocked out. This is useful for edge detection in image recognition.



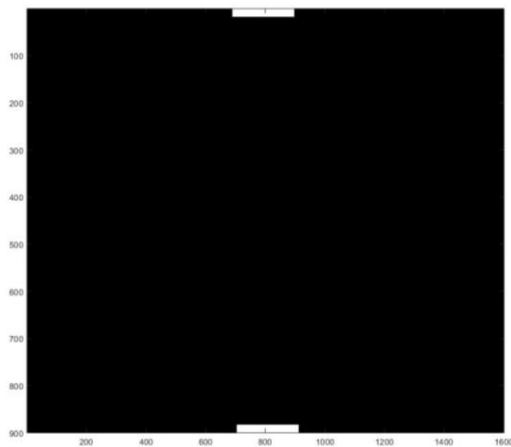
## Horizontal Lines:



The horizontal lines are contained within this Mask. **BLUE** Interestingly the horizontal edges of the Letters in 'EMPIRE STATE' can be seen here also. Sampling & replication are present here again with The horizontal lines of the windows. They are Displayed perpendicularly in the FT which shifts Them diagonally towards the centre as the horizontal lines of the building are not truly horizontal because the epicure is taken at an angle everything is shifted.

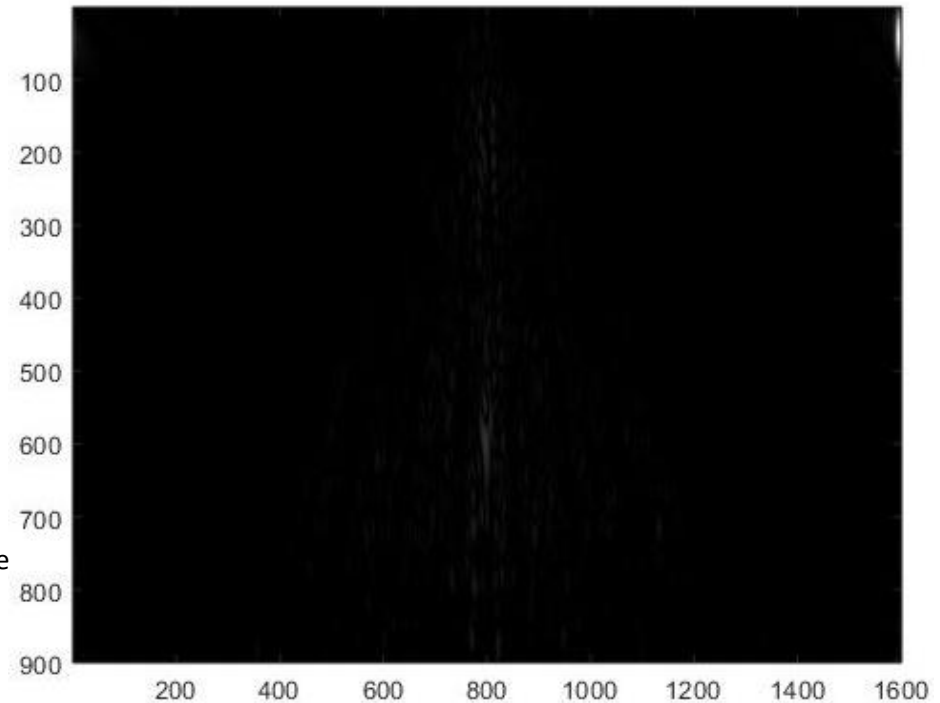


### Text Top Right of image:

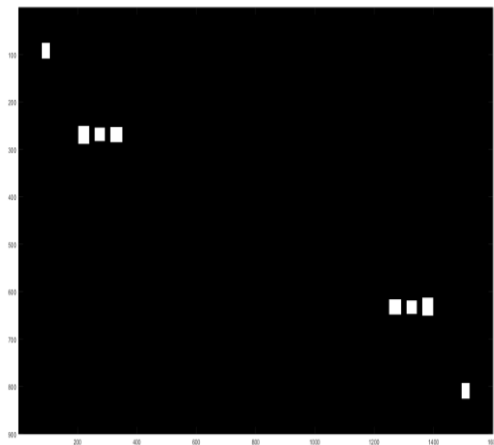


The mask shown above correlates to the **PURPLE** mark on the Fourier of the image shown at the beginning of the document. this small variation in the Fourier outlines the text on the image found in the top

Right hand corner. This relates to the watermark in the top right of the empire image. This is just a single instance as there is nothing special about this watermark. Shown in the image on the right above can be seen the white mark relating to the watermark in the original image.



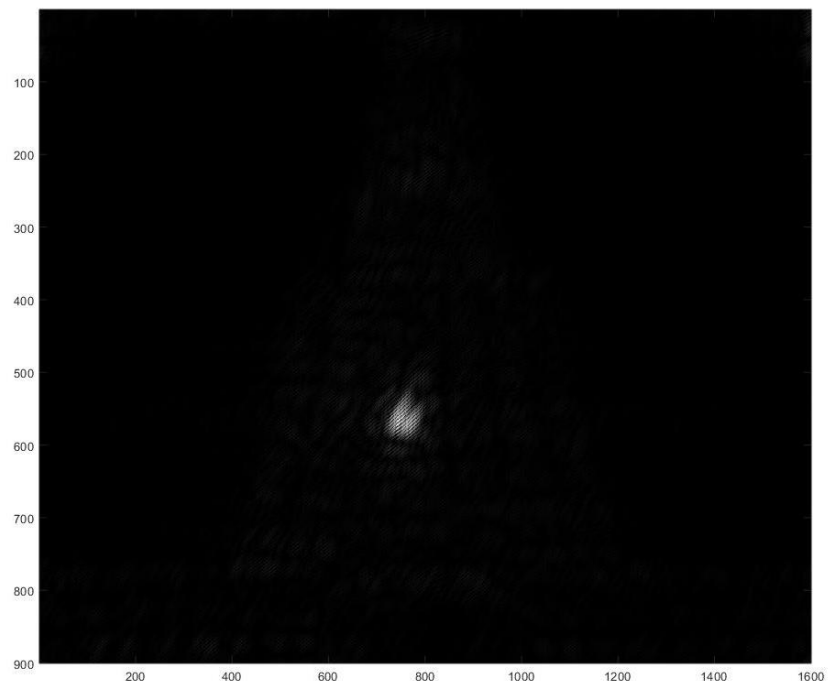
### Flag:



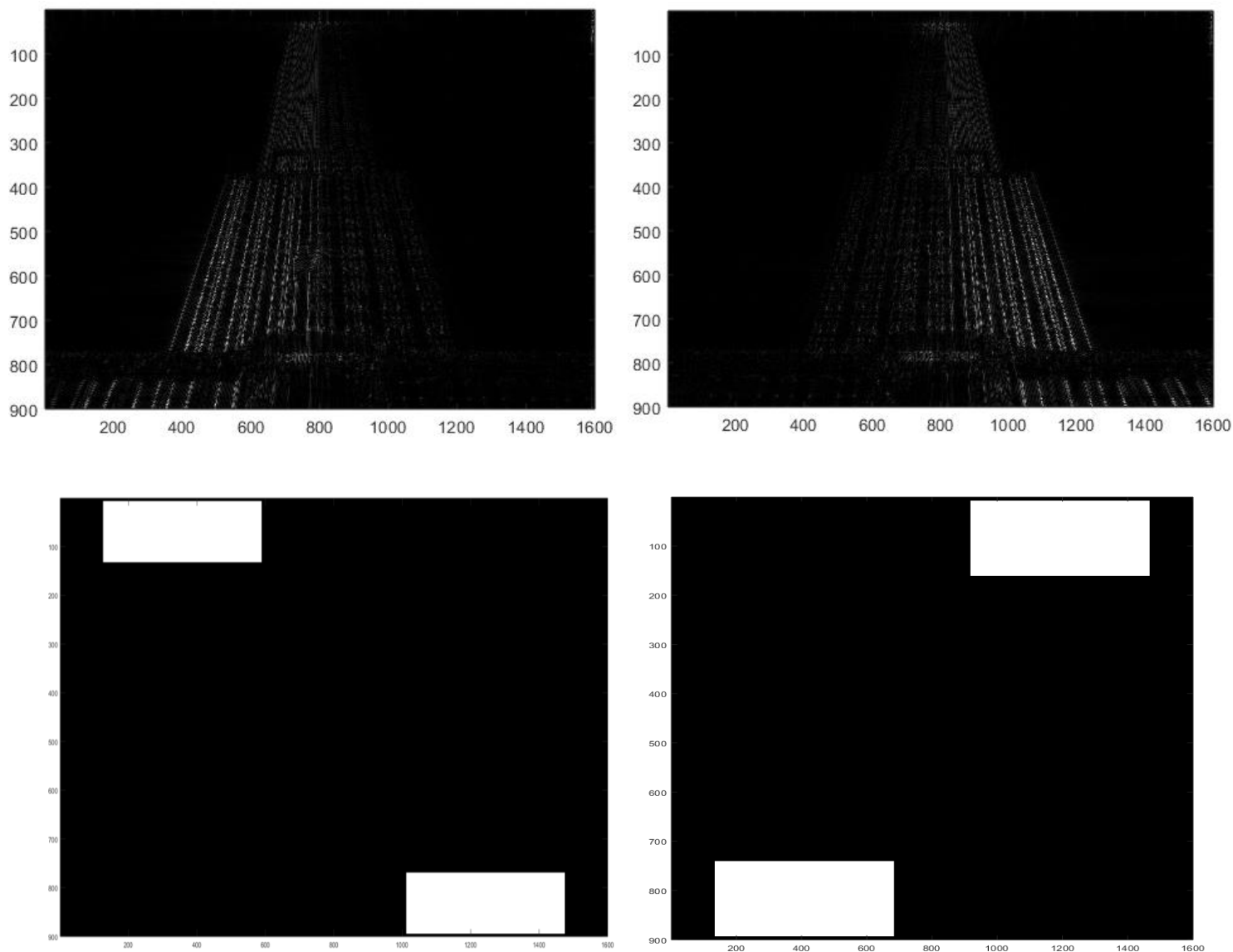
The flag is an interesting item highlighted in **RED**.

The Lines on the flag cause replication in the FT.

This Sampling is seen best with the diagonally formation of blobs in the FT. As the lines are somewhat diagonal in the flag they are perpendicular to that in the FT creating a diagonal sample as seen with the mask. Along with it we can see any other lines which travel in a south-west direction. The blobs themselves are relatively the same size, this is due to our perspective of the flag, all points on the flag are equally distant from us. If the flag was moving away from us the blobs would get smaller.



## Vertical Edges:



The vertical edges on the left hand side here are the **YELLOW** Highlights in the main image. They are displayed as diagonal lines perpendicular to the vertical edges in the empire picture but as the image is not perfectly vertical, i.e. it is moving away from us this explains why the lines are diagonal and not horizontal This is called shifting. Also there is replication in the FT because there are multiple vertical edges of each of which is sampled in the edges of the windows. The same can be said for the right hand side **GREEN**. Interestingly, the text of 'EMPIRE STATE' is contained slightly within this mask. The vertical lines of the letters can be seen in the image on the right as a result of this. The same examples of sampling and replication of the perpendicular lines in the FT can be observed on this side also.