

**Aim:**

We've to implement a 3X3 convolution, using the Gaussian blur on the image provided using the semi-systolic and the fully systolic array.

**Modules Provided:**

We've been provided with the UART code and the MATLAB script and we use the MATLAB to control the UART on the PC side.

**Modules created:**

1. Scanning Window (**scanner.v**)  
We use a 3X3 scanning window to scan the original image and give out a pixel to the systolic array at the rate of one/clock cycle. Doing that, we output 9 pixels of the original image in 9 clock cycles in the form of a 3X3 image. The scanning window then moves horizontally towards right to the next set of 9 pixels. Once the window is done scanning the image horizontally, it moves down vertically one row and continues the scanning thereof. This way the whole image is scanned.
2. Systolic Array  
We make two systolic array, the semi-systolic (**sys\_full.v**) and the fully systolic array (**systolic.v**). Both the arrays receive the pixels from the scanning window. In the semi-systolic array, we multiply the pixels with the weight and the addition of the array elements is done at the last cycle giving out the resultant pixel.  
Whereas, in the fully systolic array, the multiplication and the addition operations happen in the same block and the result of the array element is passed to the next array element in each cycle. At the end on nice cycles, we receive the resultant pixel.
3. Output Matrix (**OutMx.v**)  
It is used to store all the resultant pixels obtained from the systolic array operation and creates a matrix of the convoluted pixels. These pixels are then given as an input to the data send block one at a time which then works as specified.

**Result:**

We obtain the blurred image of the input image as the output from the FPGA. Hence, the convolution/Gaussian blur has been performed and the lab has been successfully implemented.