

Chapter 04

Memory optimization and video processing

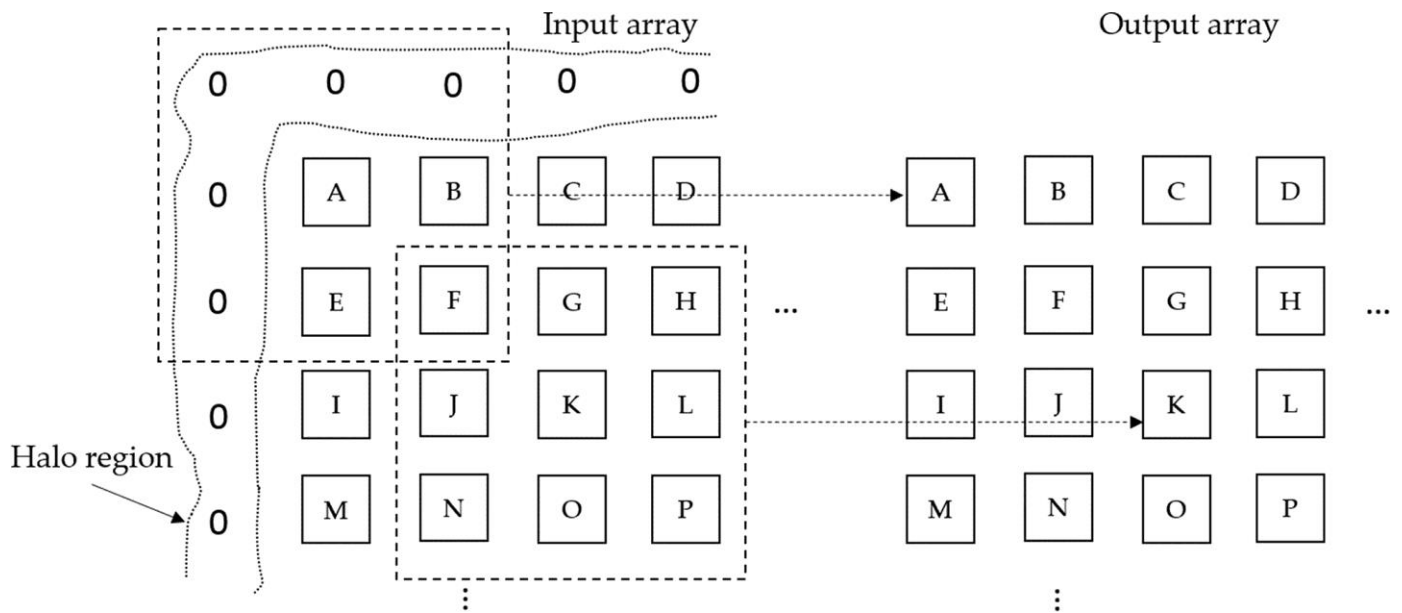


FIGURE 4.1 3 X 3 mean filter.

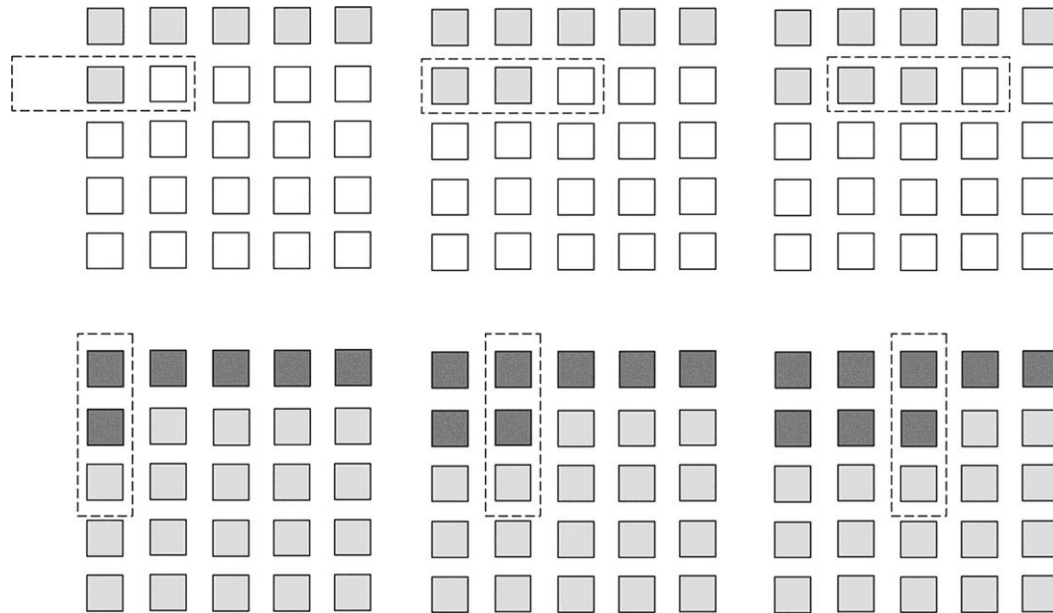


FIGURE 4.2 Row pass (top) and column pass (bottom) of a separable 3 X 3 2D filter.



FIGURE 4.3 2D Gaussian blur using 7 X 7 coefficient array sampled from normal distribution applied to the “Lena” image. Note the black line that borders the bottom and right edges, which is produced from the filter coefficients being multiplied against implicit zeros that exist beyond the boundaries of the image.



FIGURE 4.4 I_x (left), I_y (right) of Lena image using Sobel filter.



FIGURE 4.5 Norm of (I_x, I_y) of Lena image.



FIGURE 4.6 Sobel filter output (I_x , I_y , and edges) when image is prefiltered with Gaussian.

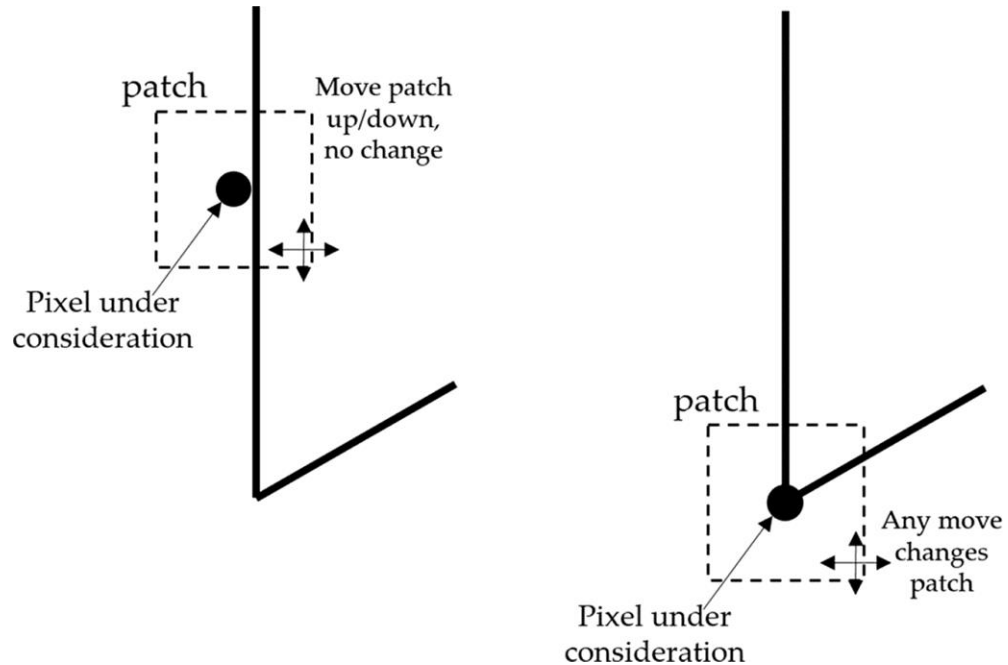


FIGURE 4.7 Two candidate pixels evaluated for their suitability as corners. The pixel on the left is near an edge and its corresponding patch would only change with a horizontal or diagonal movement. The pixel on the right is located on a corner, and its corresponding patch would change the patch significantly for any movement.

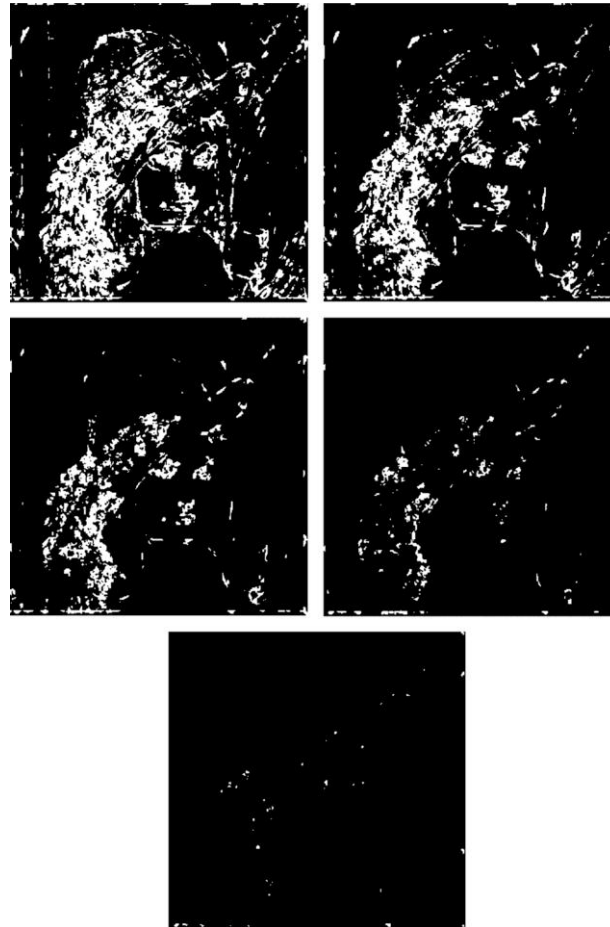
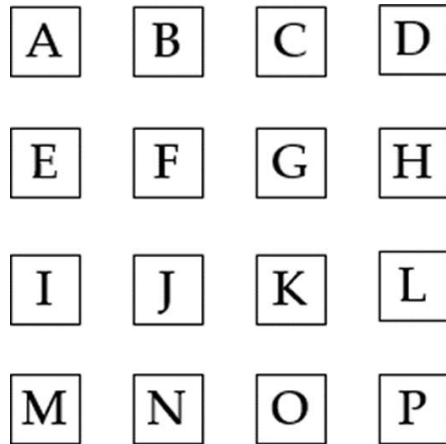
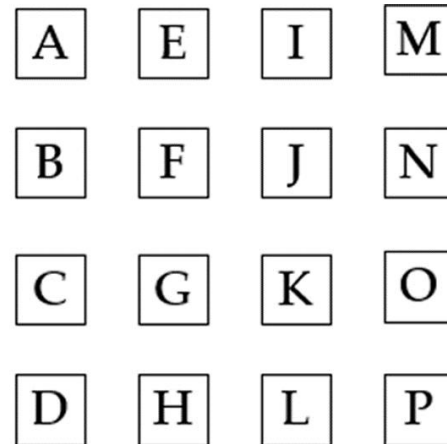


FIGURE 4.8 Corners in Lena image using threshold values = [1e6 1e7 1e8 1e9 1e10].



Row major order



Column major order

FIGURE 4.9 4 X 4 arrays collapsed using row-major and column-major order. Row-major order stores the elements across each row in consecutive memory locations, while column-major order stores the elements across each column in consecutive memory locations. In this figure, consecutive letters represent consecutive memory addresses.

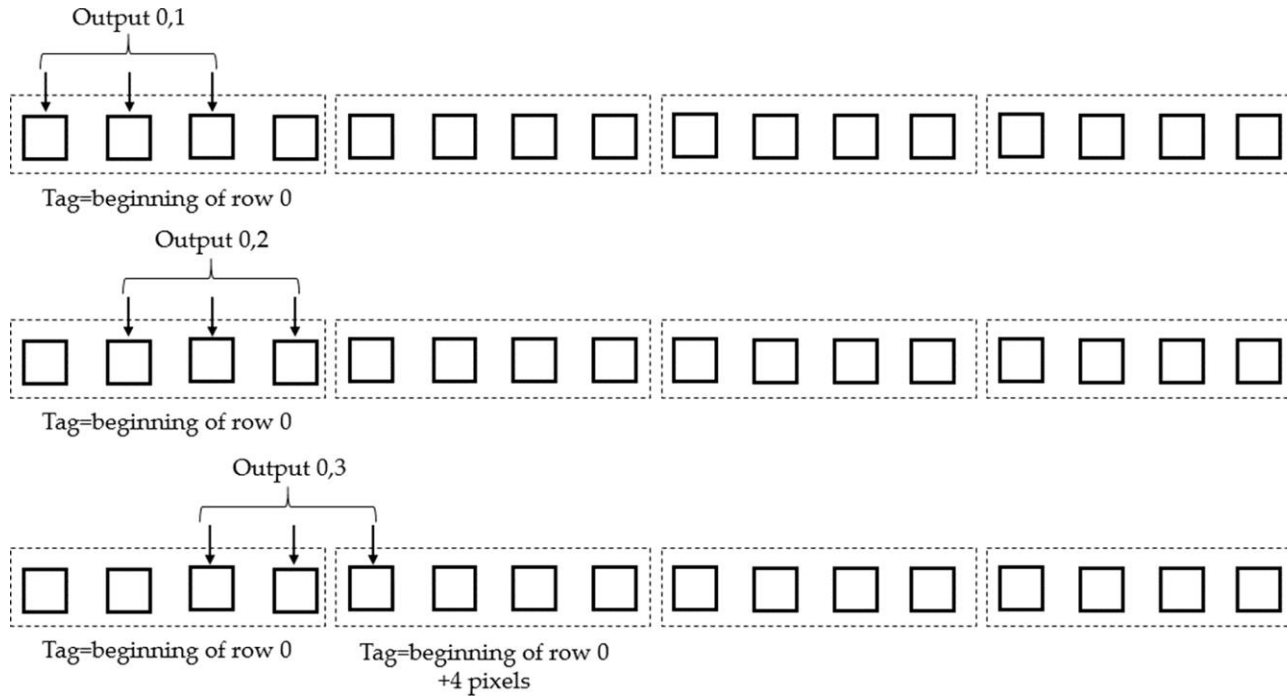


FIGURE 4.10 Runtime behavior of a 3-tap 1D row filter.

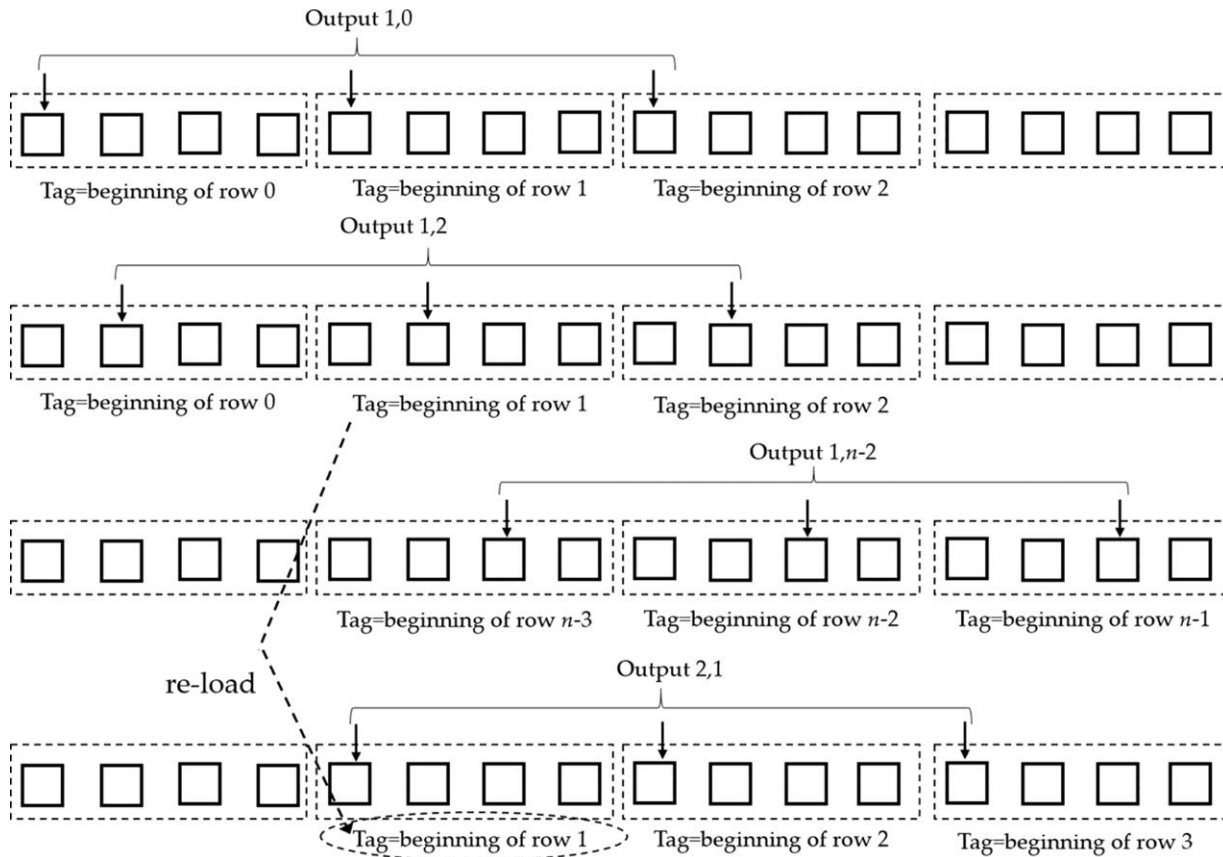


FIGURE 4.11 Runtime behavior of a 3-tap 1D column filter.

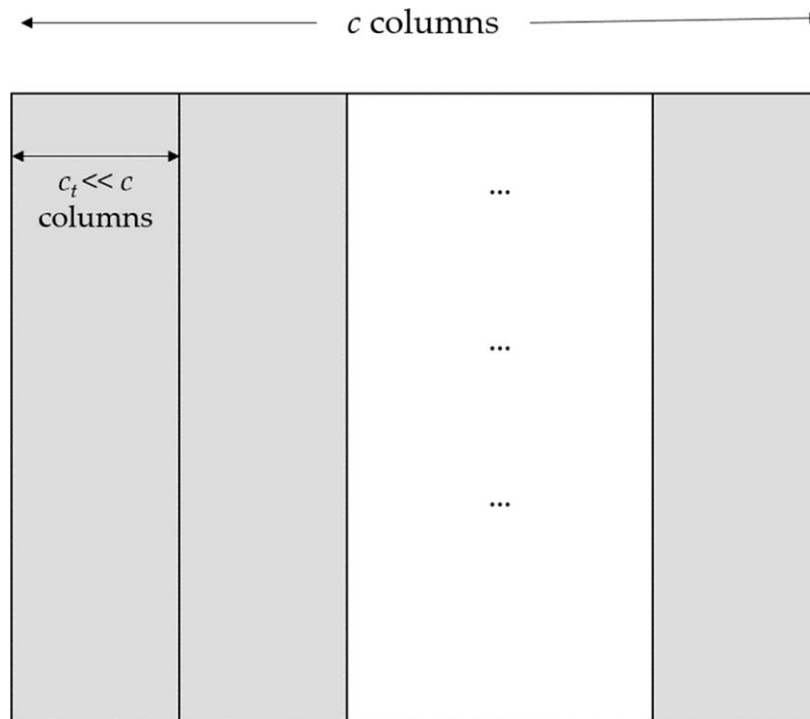


FIGURE 4.12 Subdividing an image into vertical strips.

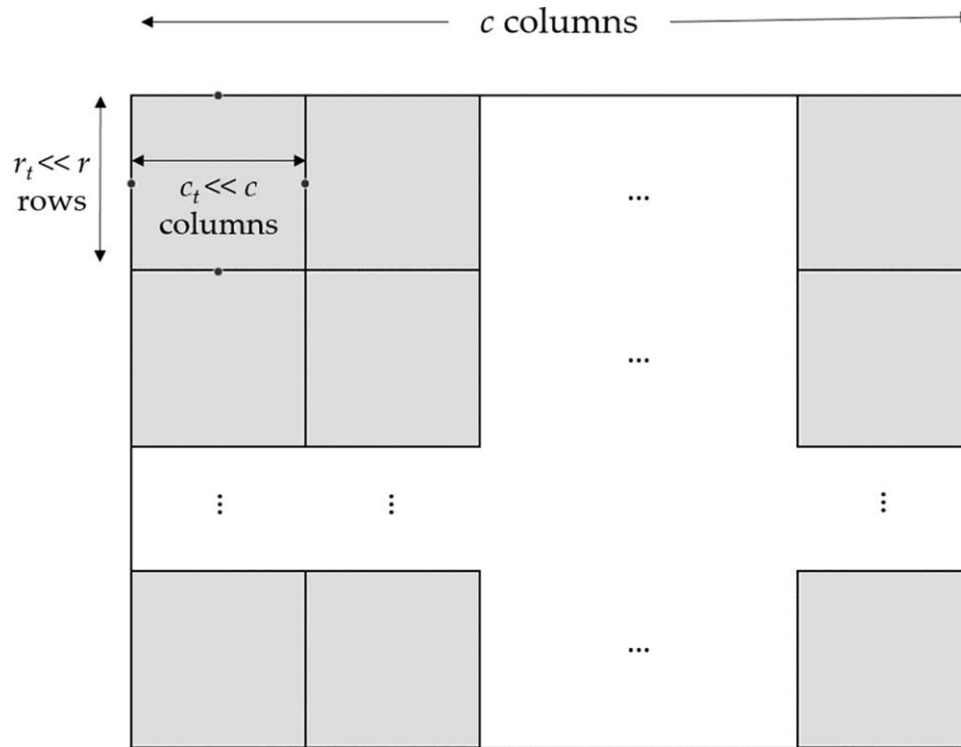


FIGURE 4.13 Subdividing the image into rectangular sub-images.

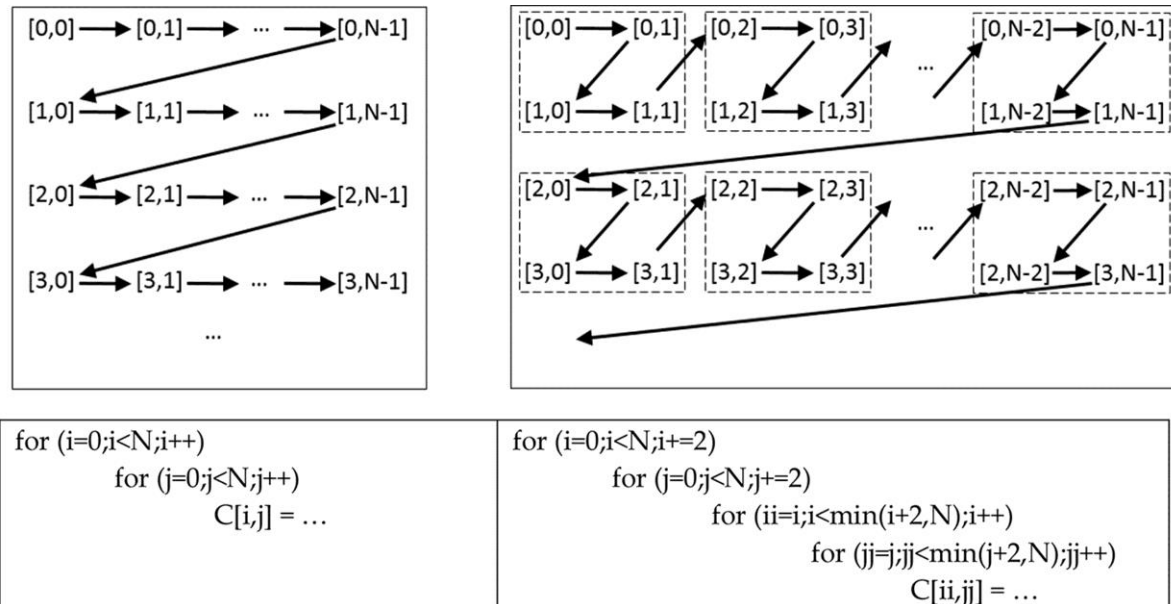


FIGURE 4.14 Nontiled and tiled access pattern.

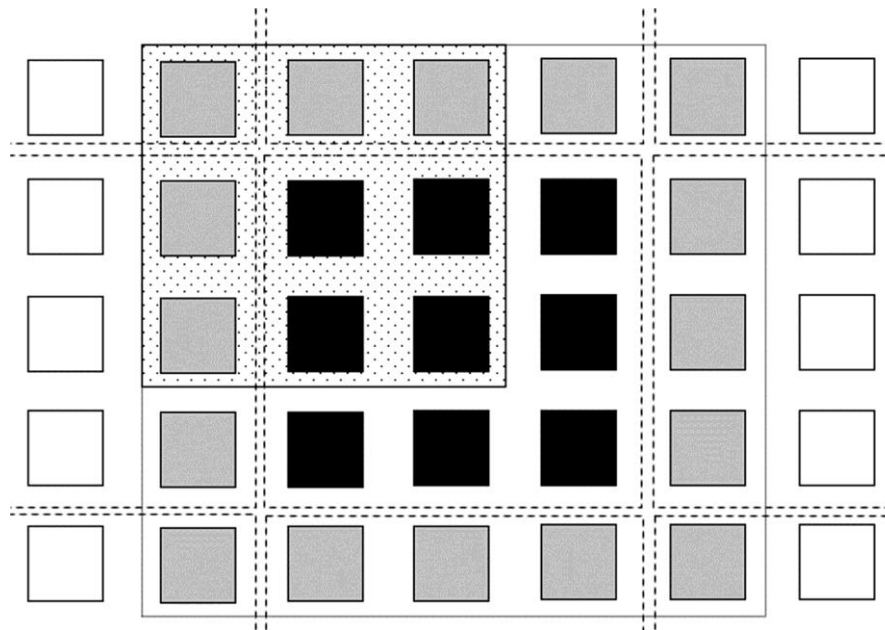


FIGURE 4.15 The output pixels of a 3 X 3 filter using a 3 X 3 tile are colored black. The dashed lines show the tile boundaries with respect to the output pixels for each tile. The gray pixels represent the halo region of the center tile. The patterned box covers the input pixels for tile output location (0,0).

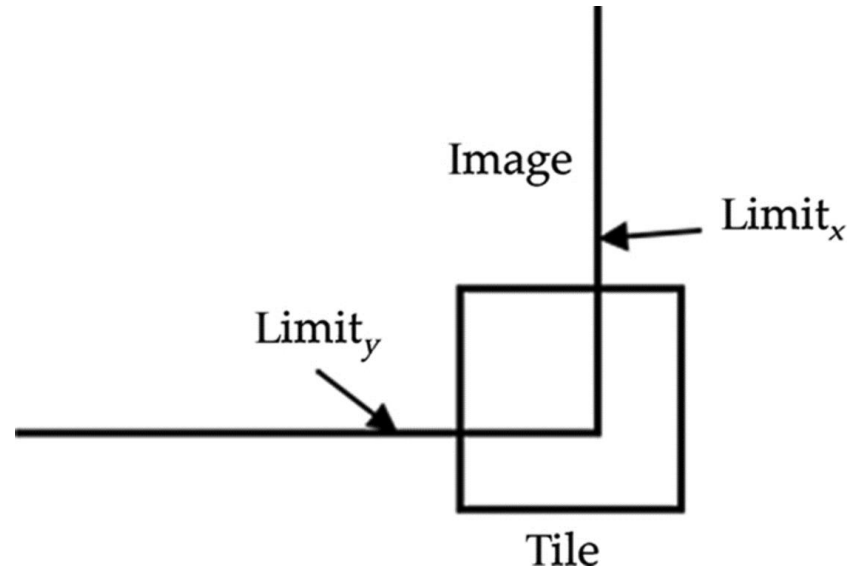


FIGURE 4.16 Boundary tile.

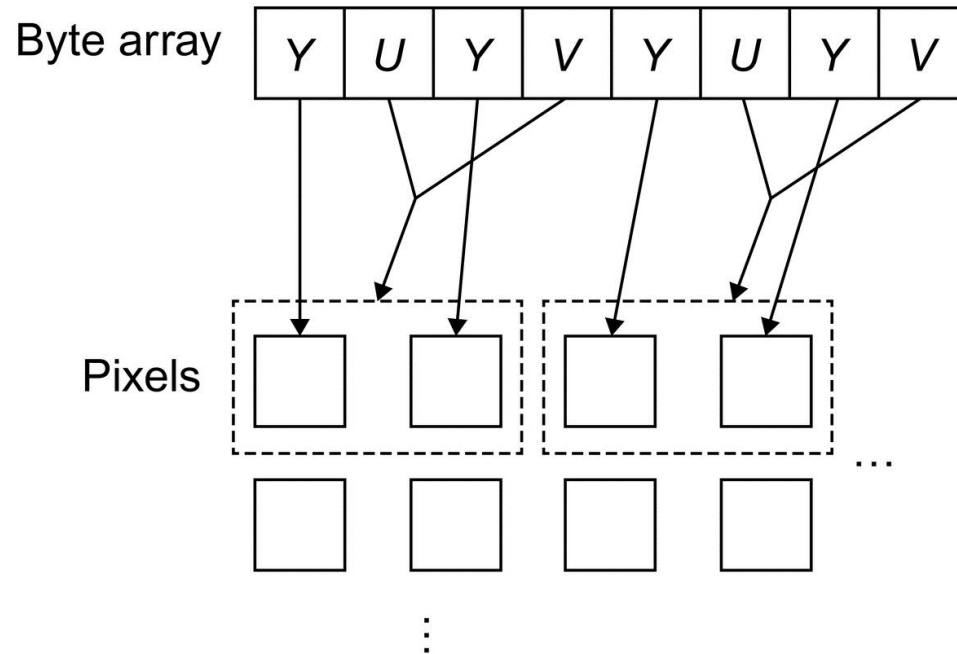


FIGURE 4.17 In *YUYV* format, a *Y* value is stored for each pixel and a (*U*, *V*) value is stored for each pair of pixel values horizontally.



FIGURE 4.18 Cache miss rate and CPI for 2D Sobel edge detection filter for a range of square tile sizes, from 8 X 8 pixels to 352 X 352 pixels, and without tiling. This performance includes the function that converts and buffers each frame and the function that writes the frame buffer. Cache miss rate roughly correlates with average CPI. The highest-performing tile was 8 X 8, which provided a speedup of 1.7 in miss rate as compared to the nontiled version.