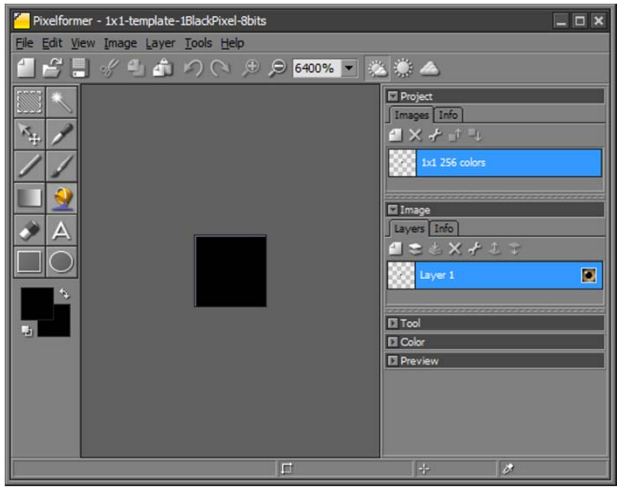
Object Tracking, Template Matching, Region-of-Interest (ROI) Search



Above, is a 50x10 image with one black pixel located at (10,5). The right shows a 1x1 template which a single black pixel. Object tracking is the task of sliding a $(n \times m)$ template across a $(N \times M)$ image and comparing their pixel values.

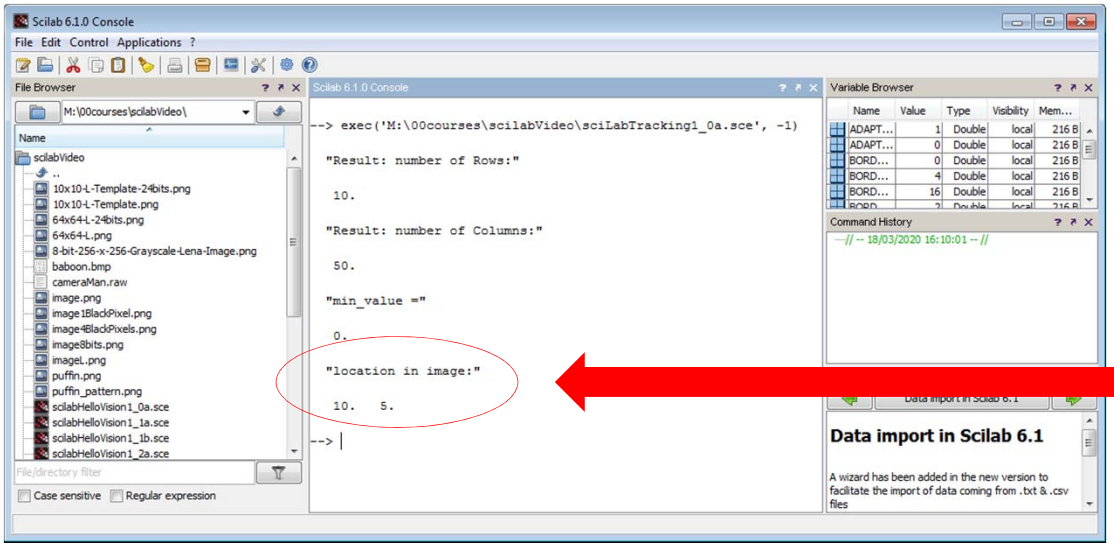
The above example is a sanity check; the 1x1 template T will move thru the 50x10 image I = 500 pixels. Similarity measure is a value that reflects the pixel value comparison between an image and template. The sum-of-squared distances (SSD) is the computationally easiest similarity measure:

$$\sum_{[i,j] \in R} \big(I(i,j) - T(i,j)\big)^2$$

In SSD, 0 means a perfect match where as the larger the value, the less of a match.

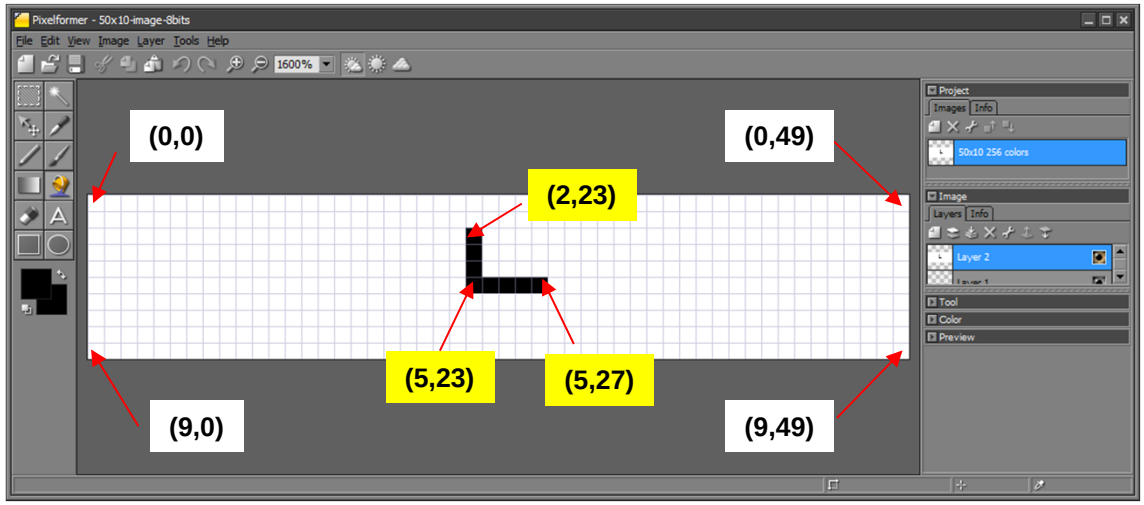
```
// FILE: sciLabTracking1_0a.sce
// DATE: 03/18/20 16:02
// AUTH: P.Oh
// VERS: 1_0a: SSD tracking of 1x1 black pixel template thru a 50x10 image
// DESC: Goal: Find object in an image.

scicv_Init();
img = imread("M:\00courses\scilabVideo\image1BlackPixel.png");
img_template = imread("template1BlackPixel.png");
img_result = matchTemplate(img, img_template, CV_TM_SQDIFF); // 0 = match

disp("Result: number of Rows:");
disp(Mat_rows_get(img_result));
disp("Result: number of Columns:");
disp(Mat_cols_get(img_result));
/* uncomment if wish to all values
disp("img_result: entire");
disp(img_result(:,:));
*/
[min_value, max_value, min_value_loc, max_value_loc] = minMaxLoc(img_result)
disp("min_value =");
disp(min_value);
disp("location in image:")
disp(min_value_loc);

delete_Mat(img);
delete_Mat(img_template);
delete_Mat(img_result);
```

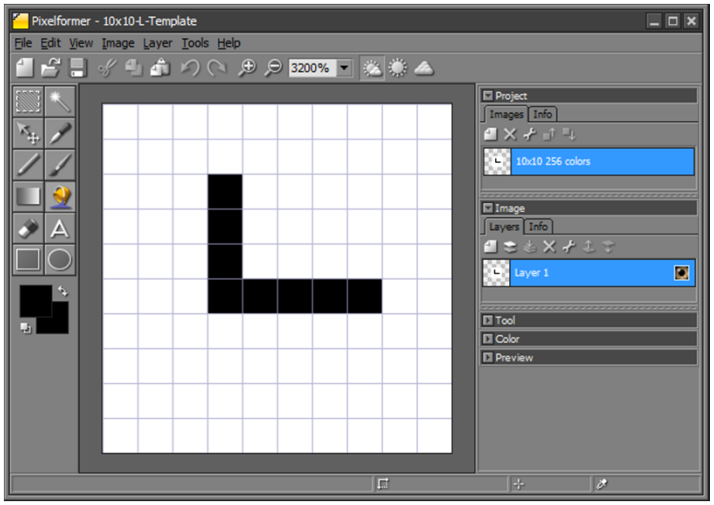
Scilab's `matchTemplate` function's SSD similarity measure is called `CV_TM_SQDIFF`.



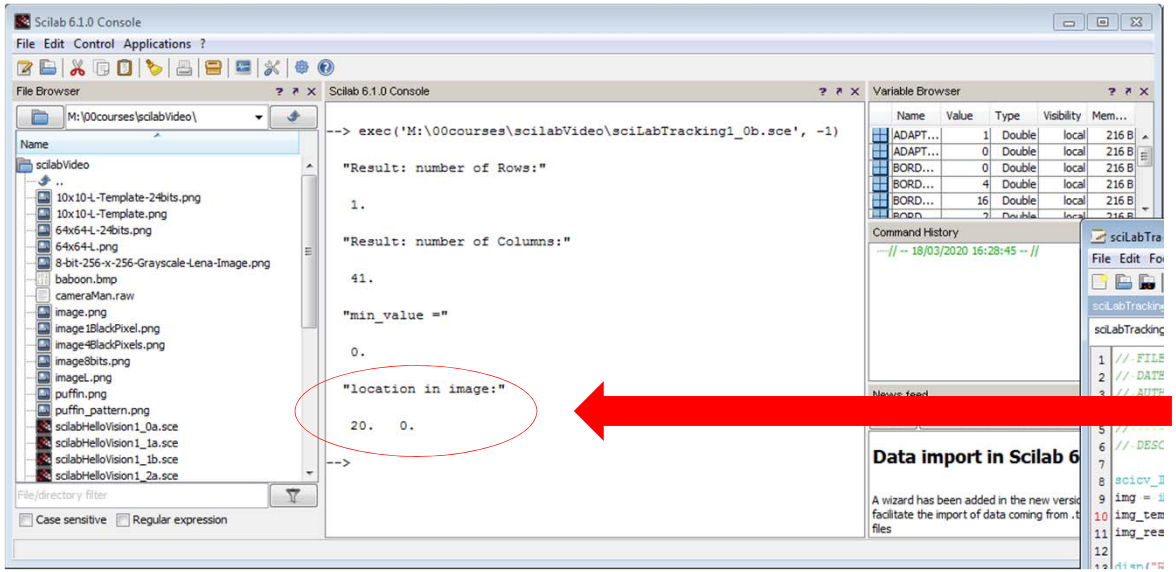
As seen in previous 50x10 image file, Scilab successfully reports the row, column position of (10,5)

A more interesting case





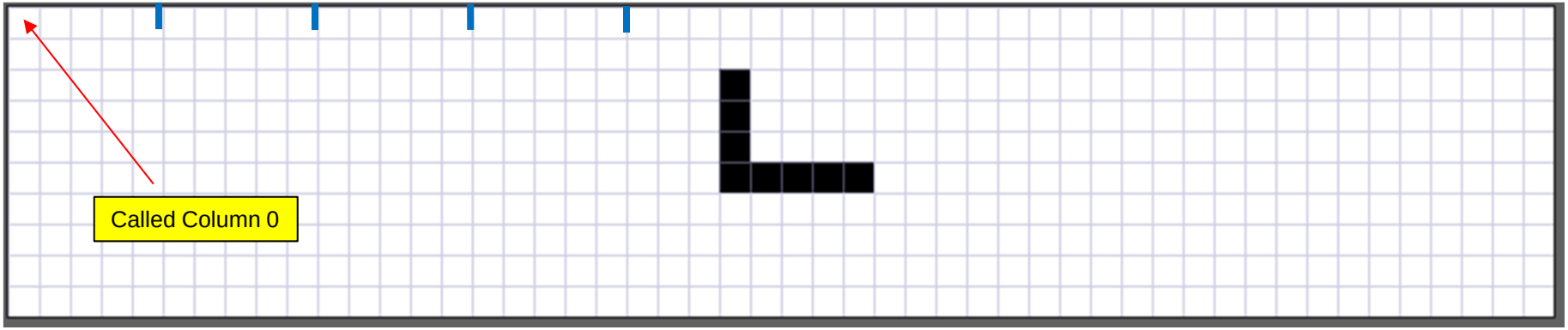
In this example, the 50x10 image has 8 black pixels that form an L-shaped object. The 10x10 template (right) also has the same object. Again, this template slides across the image, column-by-column (left to right) and then row-by-row (top to bottom).



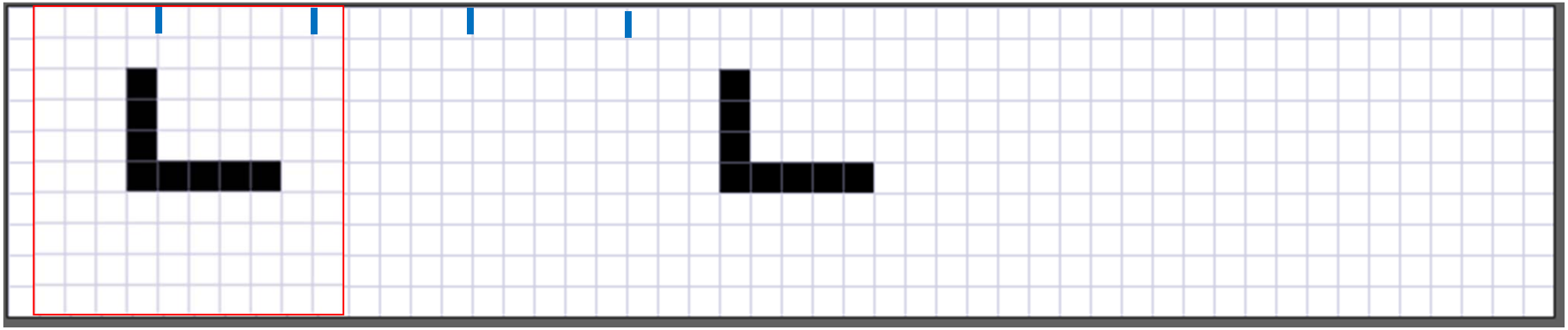
See **`sciLabTracking1_0b.sce`**

Scilab reports there's 1 row, 41 columns and location is (20,0)!

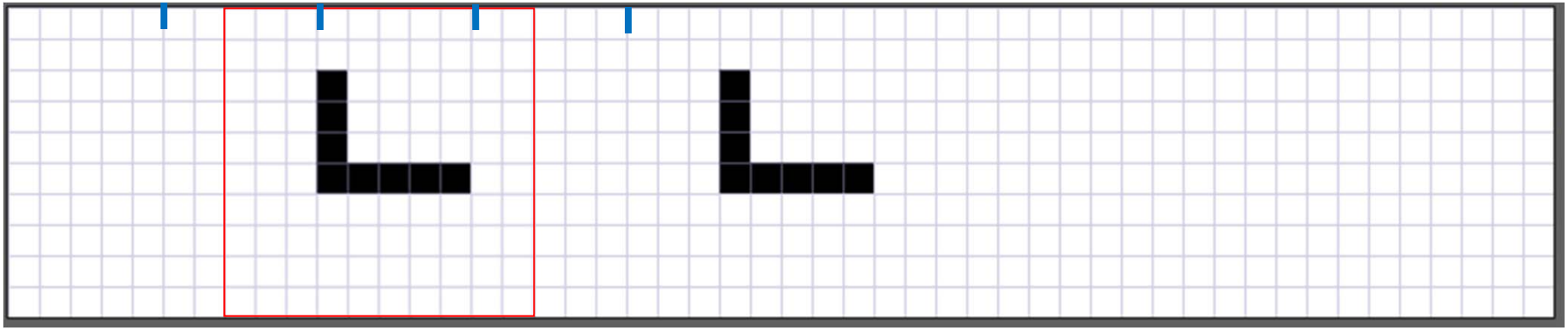
(1) Before sliding



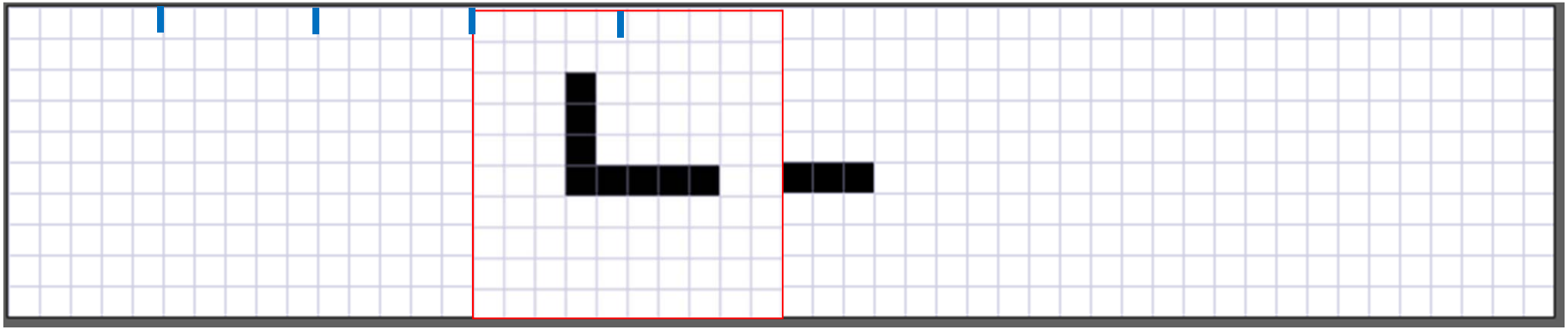
(2) Slide 1 column to right



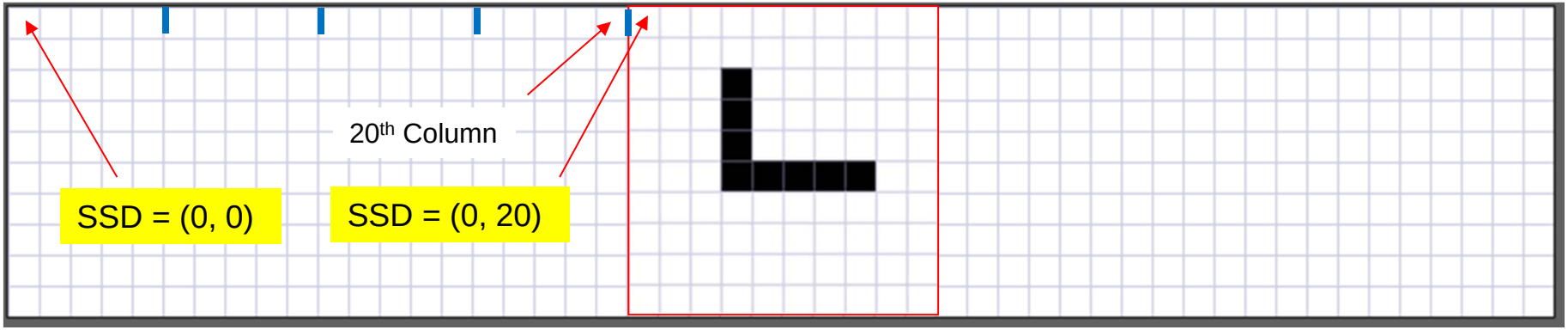
(3) Slide 7 columns to right



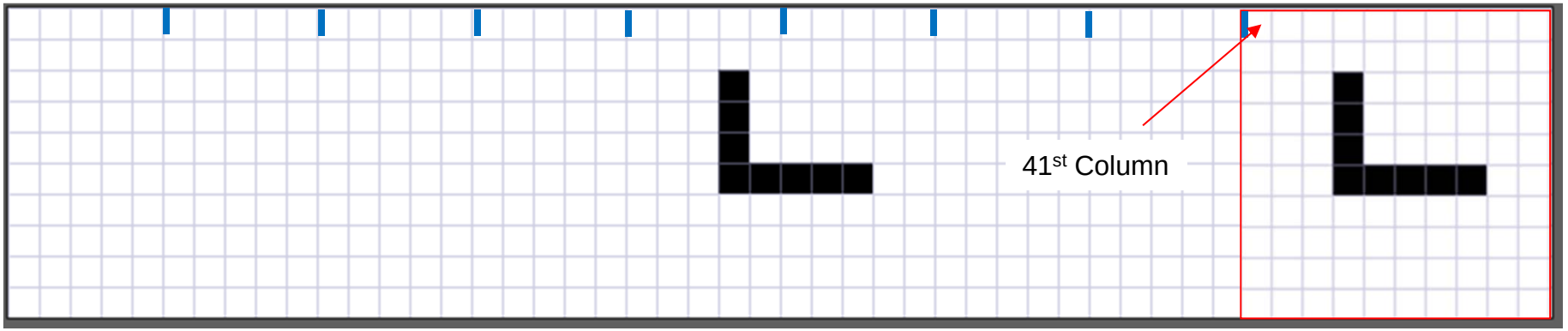
(4) Slide 15 columns to right – there's slight overlap



(5) Slide 20 columns to right – perfect overlap



(6) Slide 20 columns to right – perfect overlap



Thus, we see why there's only 1 row: both template and image has 10 rows (the template doesn't need to slide down).

We see why the match is at column 21: the 10x10 template fits perfectly over the image as shown in (5) above; The SSD value at (0, 20) is zero.

We also see why there the SSD size has 41 columns as shown in (6)

Thus, SSD result is not a 50x10 image but rather a similarity measure. It's the starting column in the image where the template fits over it.