Final Project – Bag of Words with Template matching for image Classification

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Task 1

- Implement a function for template matching by yourself. You may compare your results to built-in functions. However, you need to implement your own template matching function. Use the visual words as templates. Normalized cross-correlation (NCC) can be used for computing the similarity between the template and the respective window of the image.

- Assume the location with the highest value for NCC to be the best t for the respective template.

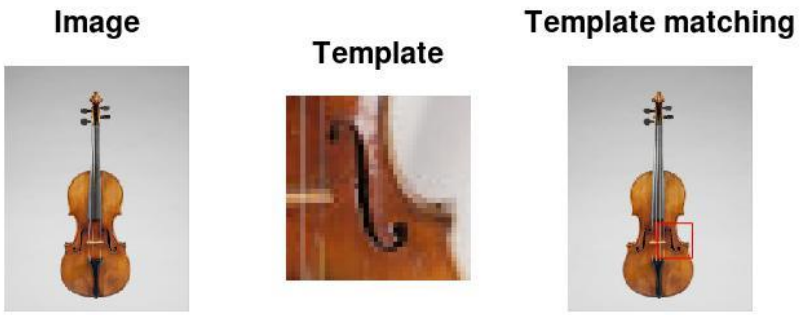

Figure 1. Template matching result

- Investigate in how far different scales affect the results.

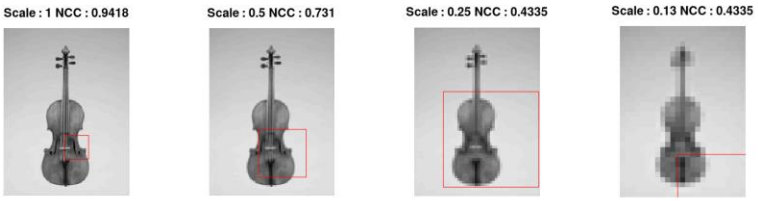

Figure 2. Template matching with different scales

Template matching is an algorithm where the scale and appearance are meaningful in the detection of an object. Therefore, changing scales affect directly the outcome of the NCC, and it is possible to select the best scale of the template

- Plot four exemplary results, where the template is successfully found. Indicate the position by a proper bounding box.

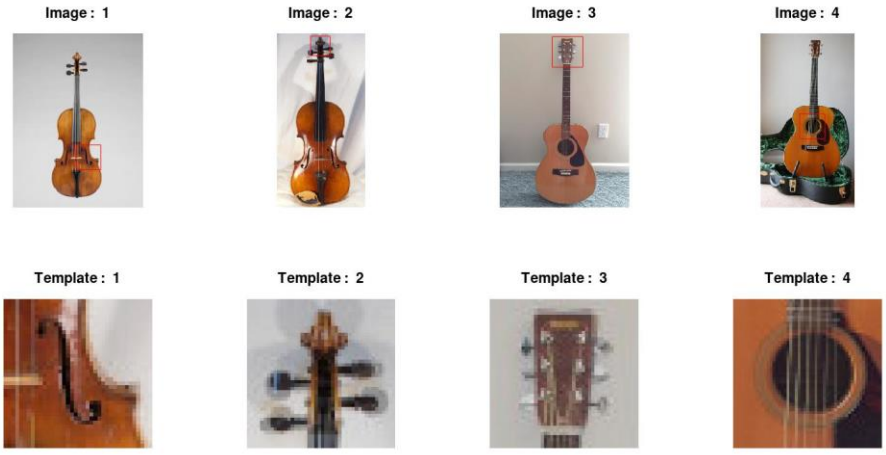

Figure 3. Template matching with different templates

Task 2

- The implementation of template matching from Task 1 will be used in order to compute, how strongly a visual word is associated with an image. The strength of the association will be measured by the highest present NCC value for the image (over multiple scales). Write a function, that returns a feature vector for an image. The feature vector has 6 values according to the 6 visual words, each representing the highest NCC for the respective word.

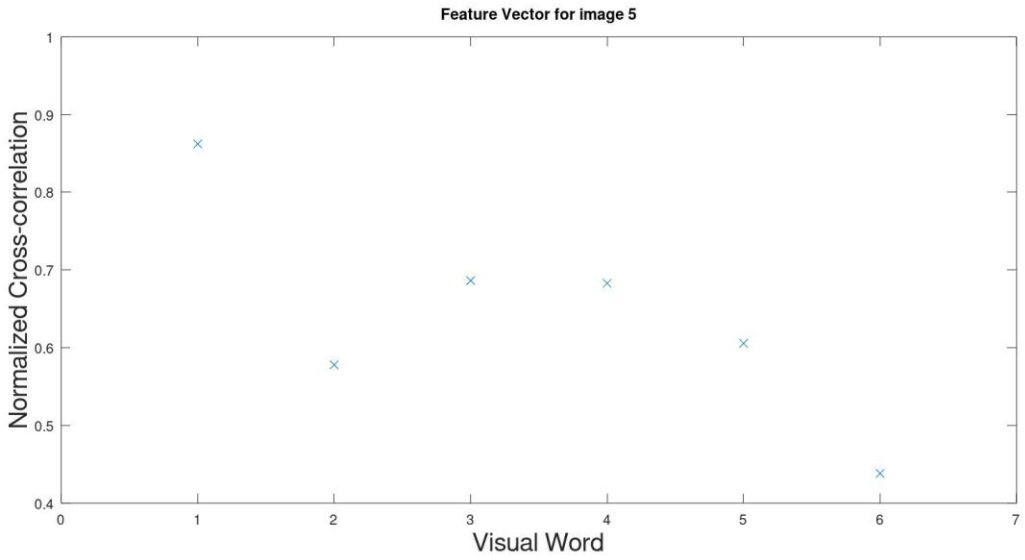

Figure 4. Feature vector image 5.

- Compute the feature vectors for all 6 images. Plot the feature vectors in a figure, where the x-axis represents the index of the visual word and the y-axis the value for NCC. Images 1, 2, and 5 represent the violin and images 3, 4, and 6 the guitar class.

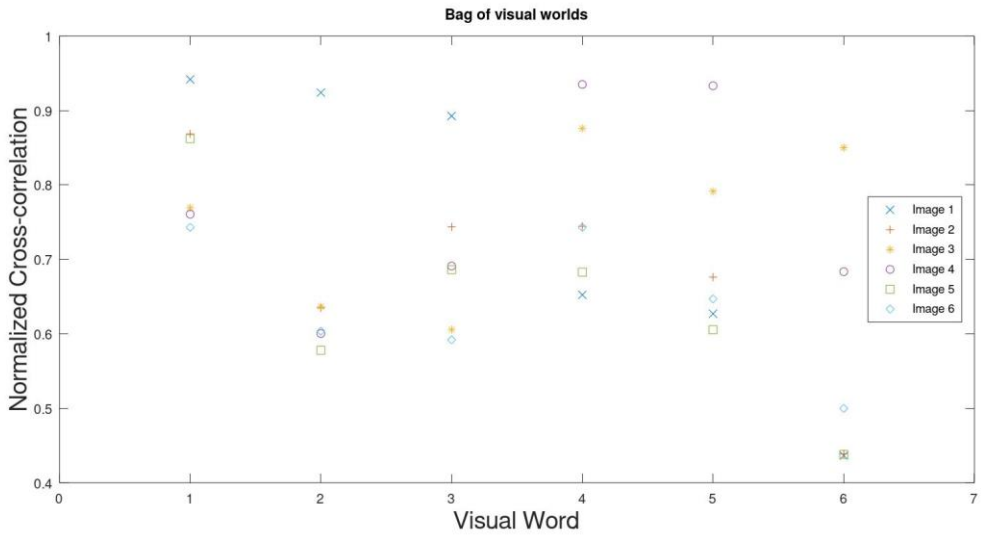

Figure 5. Feature vector for all images

- In order to classify the test images based on the computed feature vectors, k-nearest neighbors (kNN) will be used. Implement the kNN algorithm by yourself. Use k = 3 and apply a simple majority voting procedure
- Use images 1 to 4 as training samples and run the kNN on the two test images 5 and 6. Plot the results showing the predicted class (e.g. in the plot's title).

Figure 6. Classification with bag of visual words