

# Assignment 5

Basic Image Processing Algorithms  
Fall 2016

# Assignments

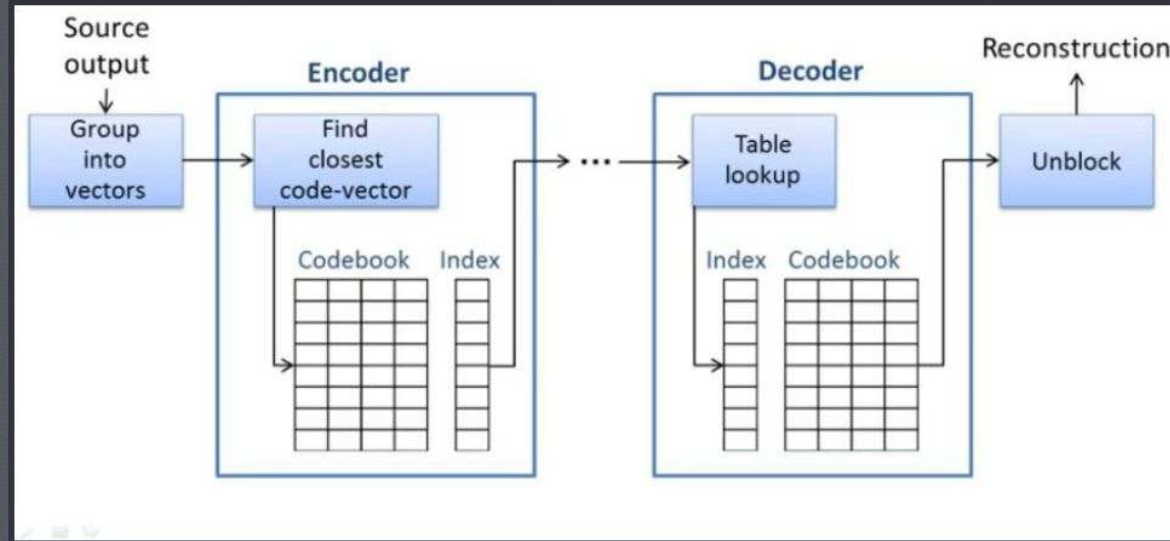
- assignment-points:
  - required minimum level: **50 points**
  - necessary condition to Offered Final Grade: **80 points**
- Assignment3:
  - will be published today,
  - **20 points**,
  - deadline **23:59, 08/December/2016** (Thursday midnight)
- Assignment4:
  - will be published today,
  - **40 points**,
  - deadline **18:00, 15/December/2016** (Thursday evening)
- Assignment5:
  - will be published tomorrow (Friday),
  - **10 points**,
  - deadline **23:59, 11/December/2016** (Sunday evening)
- Assignment6:
  - will be published Sunday (04/12/2016),
  - **30** (or 40) points,
  - deadline **18:00, 15/December/2016** (Thursday evening)

# Assignment 5: Image-compression with codebook

- the maximum score of this assignment: **10 points**
- deadline: **23:59, 11/December/2016 (Sunday evening)**
- please send to: [bipa2016fall@gmail.com](mailto:bipa2016fall@gmail.com)  
with the subject: **ASSIGNMENT5**

# Vector Quantization

- The input image is divided into small blocks, which are coded using a look-up table:



- The parameters of the codebook defines the compression rate.

Source: Fundamentals of Digital Image and Video Processing lectures by Aggelos K. Katsaggelos

# Exercise

Try to realize a simple image-compressing mechanism, on the basis of a codebook:

1. take regular parts of a grayscale image (eg. with 8x8 sized, non-overlapping blocks; the remaining rows at the bottom and the remaining columns on the right-hand side can be thrown away)
2. after vectorization, put them in a big data-matrix:
  - a. the size of the data-matrix will be 64xN, where
    - i. the 64 rows mean the vectorized grayscale intensities inside one block (64=8x8),
    - ii. and N is the number of blocks
3. cluster your datamatrix with k-means (use `v1_kmeans`, [http://www.vlfeat.org/matlab/v1\\_kmeans.html](http://www.vlfeat.org/matlab/v1_kmeans.html) ,  
`[centers, assignment_vector] = v1_kmeans(datamatrix, numcenters);` )
4. every column in the data-matrix should match one of the *centers* (returned by k-means)
5. rebuild your image with the matched center-vectors, instead of the original parts
6. try with different block-sizes (eg. 4x4, 8x8 16x16) and with different number of clusters (eg. 10, 25, 50)

# Exercise

Divide your code into two functions and a script:

- **encoder function**

- should realize the compression itself
- parameters:
  - *input1*: image matrix
  - *input2*: block side length (eg. 8 in the case of blocks 8x8)
  - *input3*: cluster number
  - *output1*: computed codebook (*centers* matrix returned by `v1_kmeans`)
  - *output2*: index vector (*assignment vector* returned by `v1_kmeans`)
  - *output3*: number of rows of the coded image (the cropped one)
  - *output4*: number of columns of the coded image (the cropped one)
- (things to place here: cropping the image to the appropriate size; defining blocks on the image (please read the blocks in row-wise order), from which you can build your *datamatrix* to be clusterized; calling `v1_kmeans`)

# Exercise

Divide your code into two functions and a script:

- **decoder function**

- should realize the compression itself
- parameters:
  - *input1*: codebook
  - *input2*: index vector
  - *input3*: number of rows of the image to be reconstructed
  - *input4*: number of columns of the image to be reconstructed
  - *output*: the reconstructed/decoded image
- (things to place here: constructing an array here as the output image; filling it from blocks to blocks as horizontal tile-series, where the content of the squared tiles should come from the codebook and the index vector)

# Exercise

Divide your code into two functions and a script:

- **script**
  - load the image *AlfredoBorba\_TuscanLandscape.jpg*
  - call your encoder function with different *block sizes* (4x4, 8x8, 16x16) and with different cluster numbers (10, 25, 50), and try to decode the original content on the basis of the generated codebook and index vector

Test examples:

- please download test pack form here:  
[http://users.itk.ppke.hu/~kolmi/bipa/assignment5\\_test\\_pack.zip](http://users.itk.ppke.hu/~kolmi/bipa/assignment5_test_pack.zip)
- to test your **encoder** function: please use the script `assignment5_test1.m`
- to test your **decoder** function: please use the script `assignment5_test2.m`

blocksize:4\*4, clusternum:10



blocksize:4\*4, clusternum:25



blocksize:4\*4, clusternum:50



blocksize:8\*8, clusternum:10



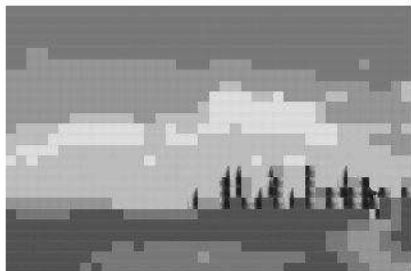
blocksize:8\*8, clusternum:25



blocksize:8\*8, clusternum:50



blocksize:16\*16, clusternum:10



blocksize:16\*16, clusternum:25



blocksize:16\*16, clusternum:50

