

Audio- / Videosignalverarbeitung Advanced Digital Signal Processing Digital Signal Processing 2

Seminar 2
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Homework assignment

1. Use two audio signals

a) Read in an audio file

➤ Same signal as in Homework 1 (**use only 1 channel with voice**)

➤ Save it to binary file “original_audio.bin”

b) Read in **another audio file** with voice (which was not used before and has max length – 3 **sec**)

2. Scalar quantizer

a) Implement a uniform mid-tread quantizer with $M=16$ levels (corresponding to 4 bits)

b) Apply it to the signal from **1a** and plot the decoded (de-quantized) signal together with original

c) Save encoded (quantized) signal to binary file “coded_uniform_q_signal.bin”

➤ Use the implementation from Homework 1

Homework assignment

3. Vector Quantizer

- a) Implement a vector quantizer (VQ) with dimension $N=2$ and $M=16^2=256$ code vectors (again corresponding to 4 bits per dimension)

Training stage (Training)

- a) Train the VQ using the LBG algorithm on the training set (with signal from **1b**)
- b) Plot codebook (**red stars**) with 2D training signal **1b** (**blue dots**) and “voronoi regions” (**green**)
- c) Save your training set to “*codebook.bin*” file
- d) Save your “voronoi regions” to “*voronoi_regions.bin*”

Encoding stage (Encoder)

- a) Plot codebook (**red stars**) with 2D signal **1a** (**blue dots**) and “voronoi regions” (**green**)
- b) Encode the signal **1a** with training set from “*codebook.bin*”
- c) Save indices to “*coded_vq_signal.bin*”

Homework assignment

3. Vector Quantizer

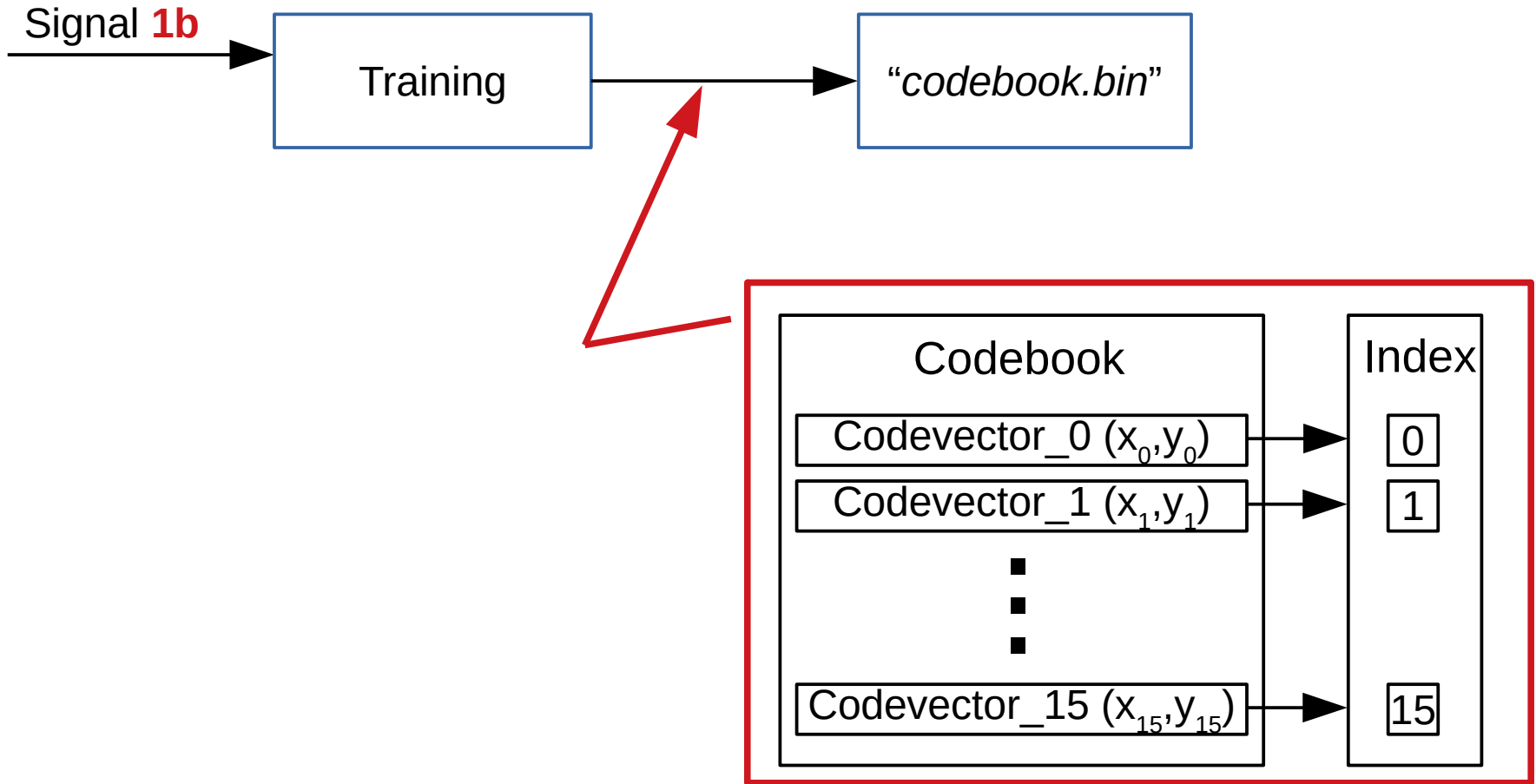
Decoding stage (Decoder)

- a) Decode (reconstruct) the signal from “*coded_vq_signal.bin*”
- b) plot the decoded (de-quantized) signal together with original

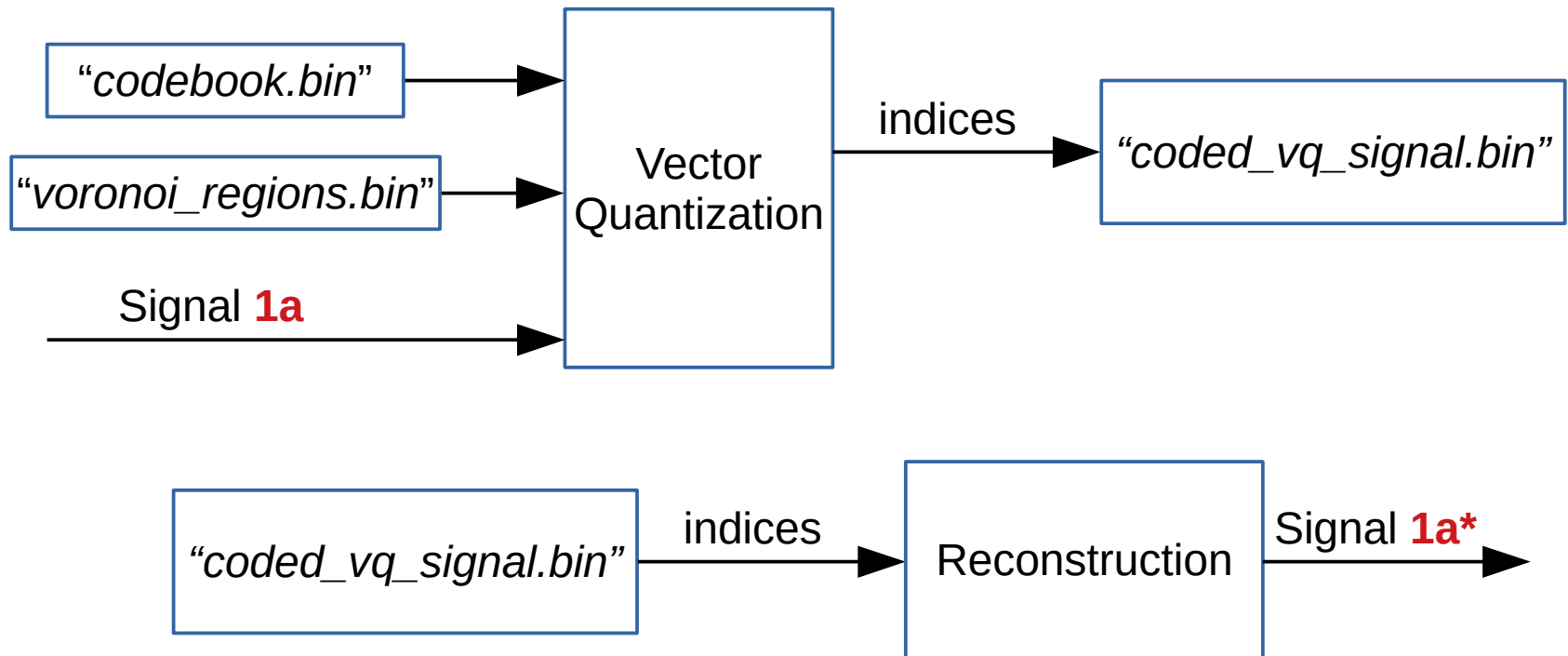
Homework assignment

- **Training, Encoder and Decoder – 3 different functions**
- Calculate and print out the quantization error for **Uniform** and **VQ**.
- Print out the file sizes for *“original_audio.bin”*, *“coded_uniform_q_signal.bin”* and *“coded_vq_signal.bin”*
- Plot **original** and reconstructed signals from **Uniform** and **VQ** on top of each other to compare.
- **Legend on the plot is required.**
- Useful link: <https://www.youtube.com/watch?v=trEDVj9M6Ng>

Homework assignment (Training)



Homework assignment (Encoder / Decoder)



Homework assignment (Encoder / Decoder)

