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

Seminar 1

WS 2019/2020

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Organization

- Thursday (even weeks), 13:00-14:30pm (K 2032)
- Thursday (odd weeks), 09:00-10:30pm (K 2002A)

General information (1)

a) Homework assignments:

- Every two weeks (5-6 in total)
  - Solve with **Python**
  - Can be done in groups of **max 3** people
  - Show and explain your solution in seminars
    - You can show a homework **only** during the seminar
    - Bring your laptop if it is possible, otherwise an USB stick
    - **Submission via email is not possible**

General information (2)

b) Quiz

- Weekly
- Test related to the latest content of the lecture
- Sign in at moodle2 (https://moodle2.tu-ilmenau.de/)
- Pass the Quiz until the next lecture
- **Deadlines** will be announced in moodle

General information (3)

- The homework points account for 30% of the final grade. The exam accounts for the other 70%.
- Real example:
  - With the 98% for seminars and a good grade in the exam you get 1.0
  - With the 0% for seminars and still a good grade in the exam you would get 2.7
- Gained points will only be added after passing the exam

Final_grade = 0.3(0.25*Quizzes+0.75*HWs)+0.7*Exam*

General information (4)

Rules:

- Play back audio using Python (verification)
- Use of functions
- Delayed submission without justified reason = -20% from your grade
- Every next attempt = -10% from your grade

Python

- **Python**
  - Open source
  - Pre-installed in Linux (easy to install extra libraries → Linux is better)
  - Installation for Windows (original): https://www.python.org/downloads/
  - Installation for Windows (all in one): https://python-xy.github.io/downloads.html

- **Python tutorial:** https://docs.python.org/3/tutorial/

Homework assignment (1/3)

1. Generate 2 different signals
   a) Triangular wave
   b) Sinusoidal wave
      - normalized frequency of 0.1
      - $freq_{norm} = \frac{f}{f_s}$, where f - frequency of the signal and f_s-sampling frequency
      - Range = -1 to 1
   c) Use `Track48.wav` audio signal from our *Moodle* page
      - For reading a file into Python use library *scipy.io.wavfile*
      - For playing it back – *pyaudio* (beware of types of variables: *string* ↔ *int*)

   → Play it back

   → Plot original audio signal (one channel) and 25 dB under the full range in one plot

   → What is the difference between full and under full range signals?

Homework assignment (2/3)

2. Quantize and reconstruct `*.wav` audio signal
   - Uniform quantization with 8 bit accuracy
     - Implement Mid-tread and Mid-rise quantizers
     - Calculate the quantization error for both of them
     - Which one is better and why?
   - μ-law quantization with 8 bit accuracy
     - $y = sign(x) \cdot \frac{\ln(1+255 \cdot |\frac{x}{A}|)}{\ln(1+255)}$
     - $x = sign(y) \cdot \frac{(256^{|y|}-1)}{255} \cdot A$
   - → Plot and listen to the quantized signal
   - → Compare results of uniform and μ-law quantization (plot on top of each other in one plot)
   - → **For all the plots: Title, axis names, lables, legend**

Homework assignment (3/3)

3. Determine SNR for all the signals. SNR should be calculated in dB.

$$SNR = 10 * \log_{10}\left(\frac{Signal\ Energy}{Quantization\ Error\ Energy}\right)$$

→ What stands out when comparing the SNRs of the sinusoidal and the triangular wave?

→ Please, use *subplot()* for making the plots