Agenda for Today

- Generation and Output of Waves
- Quantization Issues of Voltage and Time
- Real-Time Issues: Blocks and Threads
- Noise Gate
- Limiter, Compressor

Generation and Output of Waves

- clips in javax.sound.sampled,
  playing clips
- sine waves with given frequency and
  amplitude by Math.sin
- sawtooth, square, and pulse waves
- generating broad-band noise
  with random numbers
- Note: All of this is neither efficient nor
  does it sound good. More on that later.
- reading sound files into clips

Quantization Issues of Voltage and Time

- Reducing the number of bits per sample leads to noise (strongly colored noise if the resulting number of bits is small).
- Using only every n-th sample to reduce the sampling frequency leads to aliasing: mirrored frequencies. Demo: spreadsheet
- Perfect reconstruction of a wave is possible and is only possible if it does not contain any frequencies $\geq f_s/2$. Shannon-Nyquist-Kotel'nikov
- Lab task: Experiment with reducing the number of bits and samples

Real-Time Issues: Blocks and Threads

- DSP-based or fully hardwired audio processing: compute sample per sample. PC: lots of things going on in other processes; always process a block (e.g., 1000) of samples and use buffers to keep the audio streaming
- latency: The larger the block size, the larger the delay between input and output.
- spawn a thread to separate audio processing from GUI etc.
- demo with thread, block-orientation in

Noise Gate

- Lab task: Write a Java program that streams sound file from the disk to the speaker and acts like a noise gate.
  This means: Low-level parts of the file are reduced to complete silence.
  How do you prevent that decaying tones are suddenly cut off?

Limiter, Compressor

- Lab task: Write a Java program that streams a sound file from the disk to the speaker and acts like a (infinite) limiter. This means: Whenever the level is above some threshold it is reduced to this threshold.
- Lab task: Let the user draw a curve representing the relationship between input and output levels (given in dB). For instance, a straight line with steepness 0.5 may be used to reduce (compress) the dynamics by half.