Kuliah 5

Dasar Multimedia

Indrabayu
Lab. Multimedia Signal Processing and Wireless

Representasi Data Multimedia

- Topik yang dibahas (akan dibahas sampai akhir kuliah)
  - Digital Audio
  - Sampling/Digitisation
  - Compression (Basic)
  - Graphics/Image Formats
  - Digital Video (Basic)

Dasar Audio Digital

- Application of Digital Audio -- Selected Examples
- Digitization of Sound
- Digitizing Audio
- Computer Manipulation of Sound
- Sample Rates and Bit Size
- Nyquist's Sampling Theorem
- Implications of Sample Rate and Bit Size, has been discussed previusly
- Typical Audio Formats
- Delivering Audio over a Network

Application of Digital Audio

- **Music Production**
  - Hard Disk Recording
  - Sound Synthesis
  - Samplers
  - Effects Processing
- **Video**
  - Audio Important Element: Music and Effects
- **Web**
  - Many uses on Web
    - Spice up Web Pages
    - Listen to Cds
    - Listen to Web Radio

Proses sound digital

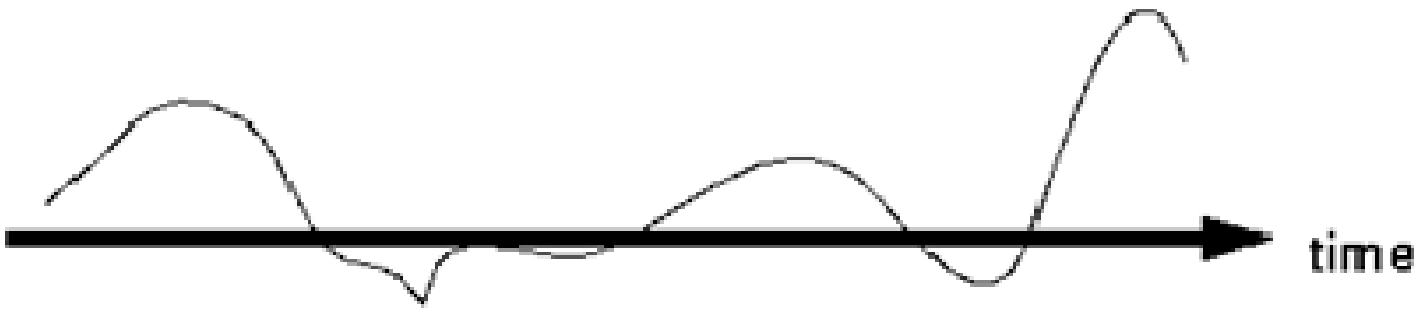
- Suara adalah???
  - Suara adalah gelombang kontinu yang merambat di udara
  - Gelombang terdiri atas beberapa tekanan. Sound is detected by measuring the pressure level at a location.
  - Gelambang suara mengalami beberapa proses dalam perambatannya (reflection, refraction, diffraction, etc.).

Macam2 sumber suara

- Sumber, Suara yang dibangkitkan
  - Tekanan udara berubah
  - ***Electrical*** -- Loud Speaker
  - ***Acoustic*** – Variasi Tekanan UDara
- Tujuan,
  - ***Electrical*** - Microphone menghasilkan sinyal listrik
  - ***Ears*** – merespon tekanan di udara menjadi suara

Suara harus di digitalkan

- Mikropon dan kamera video mengambil input analog



Digitalisasi

- To get audio or video into a computer, we have to *digitize* it (convert it into a stream of numbers) **Need to convert Analog-to-Digital** -- Specialised Hardware
- So, we have to understand *discrete sampling* (both time and voltage)
- *Sampling* - divide the horizontal axis (the time dimension) into discrete pieces. Uniform sampling is ubiquitous.
- *Quantization* - divide the vertical axis (signal strength) into pieces. Sometimes, a non-linear function is applied.
  - 8 bit quantization divides the vertical axis into 256 levels.
  - 16 bit gives you 65536 levels.

Manipulasi Data

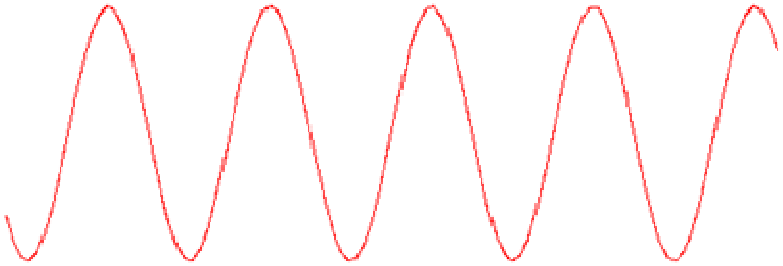
- Volume
- Cross-Fading
- Looping
- Echo/Reverb/Delay
- Filtering
- Signal Analysis

Sampling dan kuantisasi

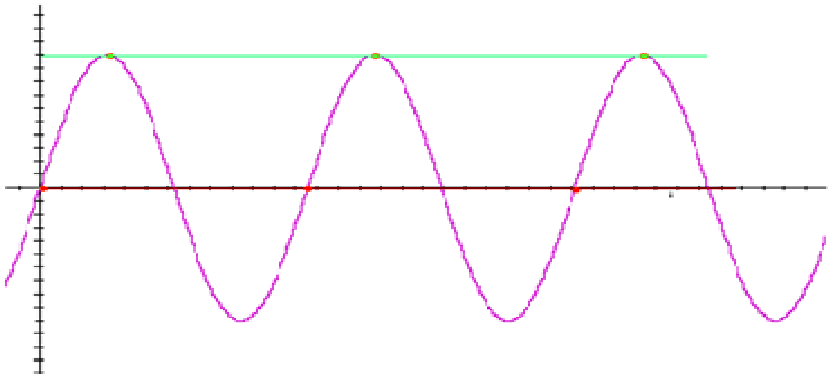
- **8 Bit Value**
  - (0-255)
- **16 Bit Value**
  - (Integer) (0-65535)

- How many Samples to take?
- **11.025 KHz**
  - -- Speech (Telephone 8KHz)
- **22.05 KHz**
  - -- Low Grade Audio
    (WWW Audio, AM Radio)
- **44.1 KHz**
  - -- CD Quality

Nyquist

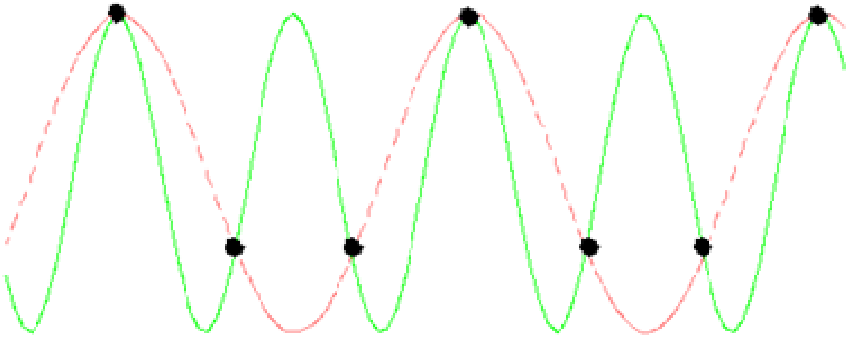


- Sampling 1 time per cycle

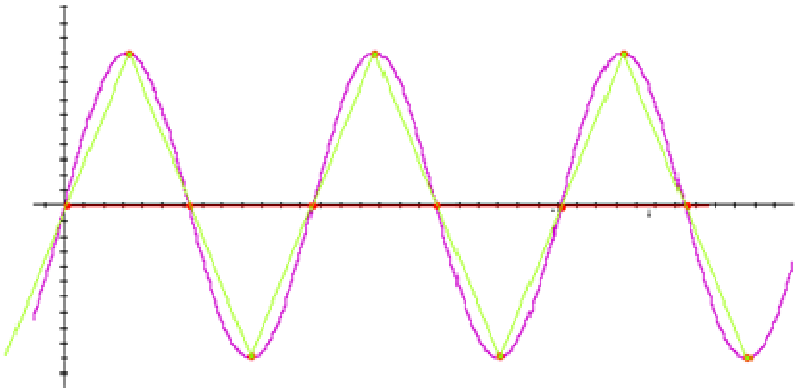


sampling

- Sampling 1,5 time /sec

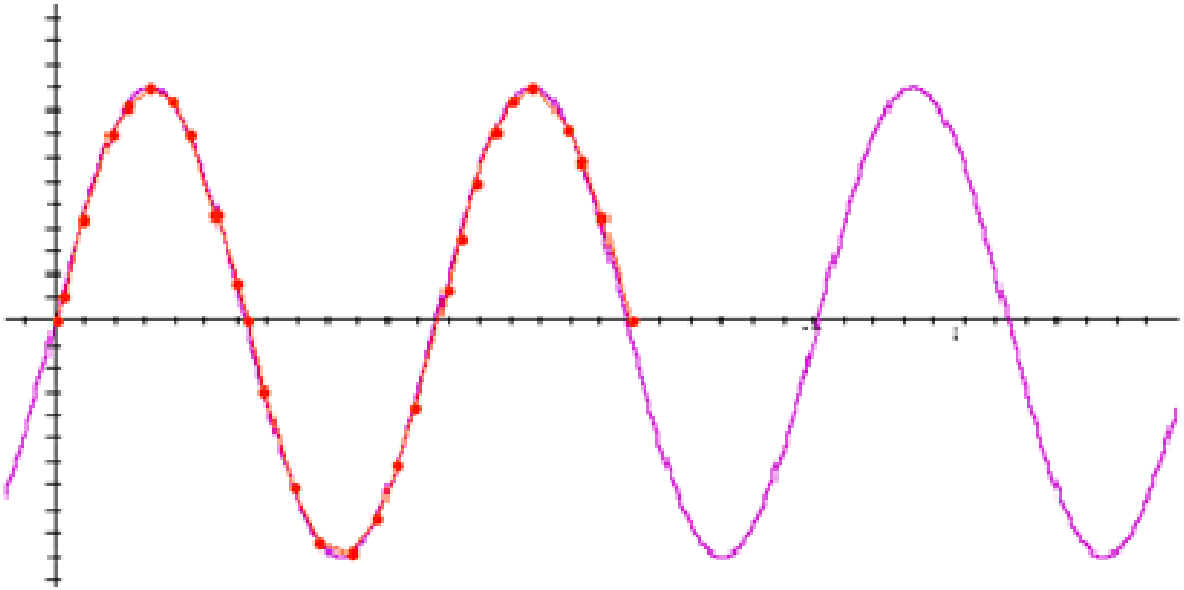


- Sampling 2 time /sec



sampling

- Sampling many times per sec



Implikasi sampling dan kuantisasi

- **Kualitas Audio**
  - Telinga tdk merespon gelombang/suara linear
  - Decibel (**dB**) adalah skala logaritmik untuk mengukur suara.
  - Penambahan 1 bit menaikkan gain sebesar 6 dB
  - 16-Bit memiliki signal-to-noise ratio sebesar 96 dB
  - 8-bit memiliki signal-to-noise ratio sebesar 48 dB
  - Penambahan 6 dB meningkatkan suara dua kali lipat

SNR

- Logarithmic representation approximates *perceptual uniformity*

$$SNR = 10 \log \frac{V_{signal}^2}{V_{noise}^2} = 20 \log \frac{V_{signal}}{V_{noise}}$$

Pengaruh Ukuran Data

- Fidelity VS Storage

File Type	*44.1 KHz*	*22.05 KHz*	*11.025 KHz*
16 Bit Stereo	10.1 Mb	5.05 Mb	2.52 Mb
16 Bit Mono	5.05 Mb	2.52 Mb	1.26 Mb
8 Bit Mono	2.52 Mb	1.26 Mb	630 Kb

Memory Required for 1 Minute of Digital Audio

Audio Quality vs data rate

- Quality Sample Rate Bits per Mono/ Data Rate Frequency (KHz) Sample Stereo (Uncompressed) Band

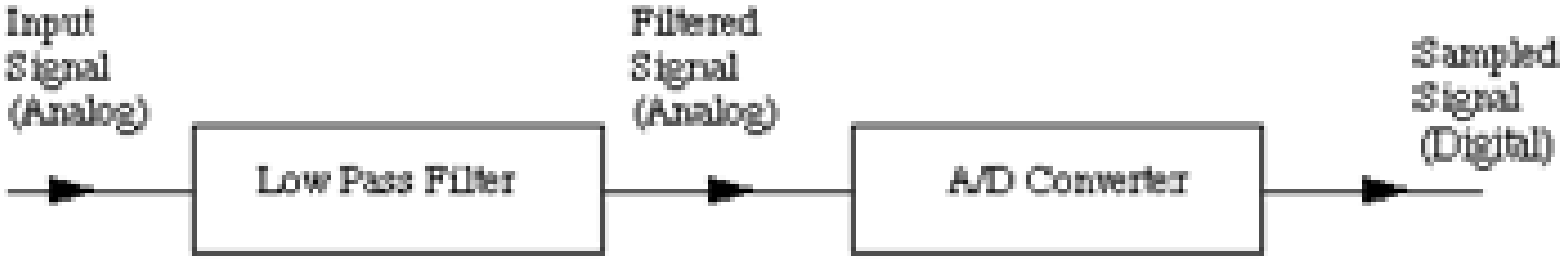
Quality	Sample Rate (KHz)	Bits per Sample	Mono/ Stereo	Data Rate (uncompressed) (kB/sec)	Frequency Band (KHz)
Telephone	8	8	Mono	8	0.200-3.4
AM Radio	11.025	8	Mono	11.0	0.1-5.5
FM Radio	22.05	16	Stereo	88.2	0.02-11
CD	44.1	16	Stereo	176.4	0.005-20
DAT	48	16	Stereo	192.0	0.005-20
DVD Audio	192 (max)	24 (max)	6 channels	1,200.0 (max)	0-96 (max)

Audio Demo

File Type	File Size (all mono)
44KHz 16 bit	3.5 Mb
44KHz 8-bit	1.3 Mb
22 KHz 16-bit	740 Kb
22KHz 8-Bit	424 Kb
11KHz 8-bit	120 K

Practical Implications of Nyquist Sampling Theory

- Harus melewati low pass filter sebelum sampling



- Berikan alasan kenapa CD audio disampling pada frek 44 KHz?

Selesai