

# Digital Audio - 1

## Media type Digital audio Representation

Sampling frequency

Sample size and quantization

Number of channels (tracks)

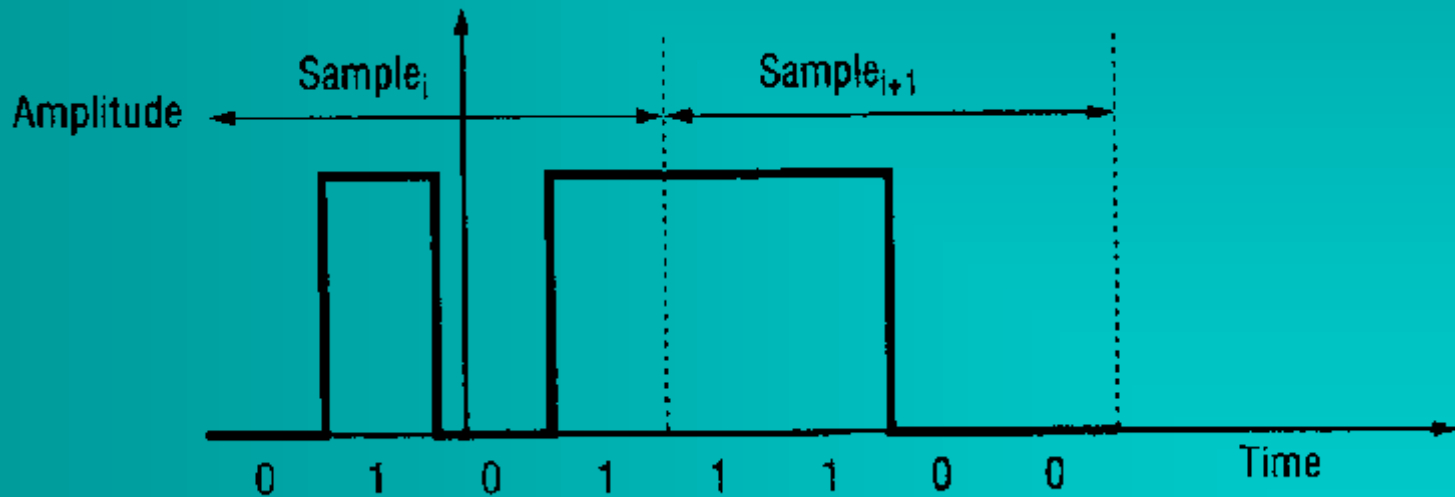
Interleaving

Negative samples

Encoding

# Encoding - 1

## ■ PCM - *Pulse Code Modulation*



# Encoding - 2

- *ADPCM - Adaptive Delta Pulse Code Modulation*
  - encodes differences between samples
  - used in CD-I and DVI
  - compression rates 4:1 to 2:1
  - standardized as G.721
- *A-law/ $\mu$ -law*
  - telephony

# Digital Audio Formats

|  | <b>CD audio</b> | <b>DAT</b> | <b>G.721</b> | <b>A-law/ <math>\mu</math>-law</b> |
|--|-----------------|------------|--------------|------------------------------------|
| <b>Sampling rate (kHz)</b>                                   | 44.1            | 48         | 8            | 8                                  |
| <b>Sample size (bits)</b>                                    | 16              | 16         | 16/4         | 8                                  |
| <b>Quantization</b>  | Linear          | Linear     | Linear       | Log                                |
| <b>Number of channels</b>                                    | 2               | 2          | 1            | 1                                  |
| <b>Data rate per channel<br/>(<math>10^3</math> bit/sec)</b> | 705             | 768        | 32           | 64                                 |
| <b>Encoding</b>  | PCM             | PCM        | ADPCM        | PCM                                |
| <b>Quality</b>   | Very high       | Very high  | Moderate     | Telephone                          |

# Digital Audio - 2

## Operations

Storage

Retrieval

Editing

Effects and filtering

Conversion

# Digital Audio Effects & Filtering

- **Delay** - adds echoing and reverberation
- **Equalization** - modifies various frequency bands
- **Normalization** - scaling peak amplitudes
- **Noise reduction** - removes background hum or hiss

# Digital Audio Effects & Filtering

- **Time compression/expansion** - Segment duration is changed without changing pitch
- **Pitch shifting** - pitch is changed without altering duration
- **Stereoization** - A single track is split into two stereo tracks
- **Acoustic environments** - ‘signatures’ of particular environments are applied.

# Music

**Media type Music**

**Representation**

Operational versus symbolic

MIDI

SMDL

**Operations**

Playback and synthesis

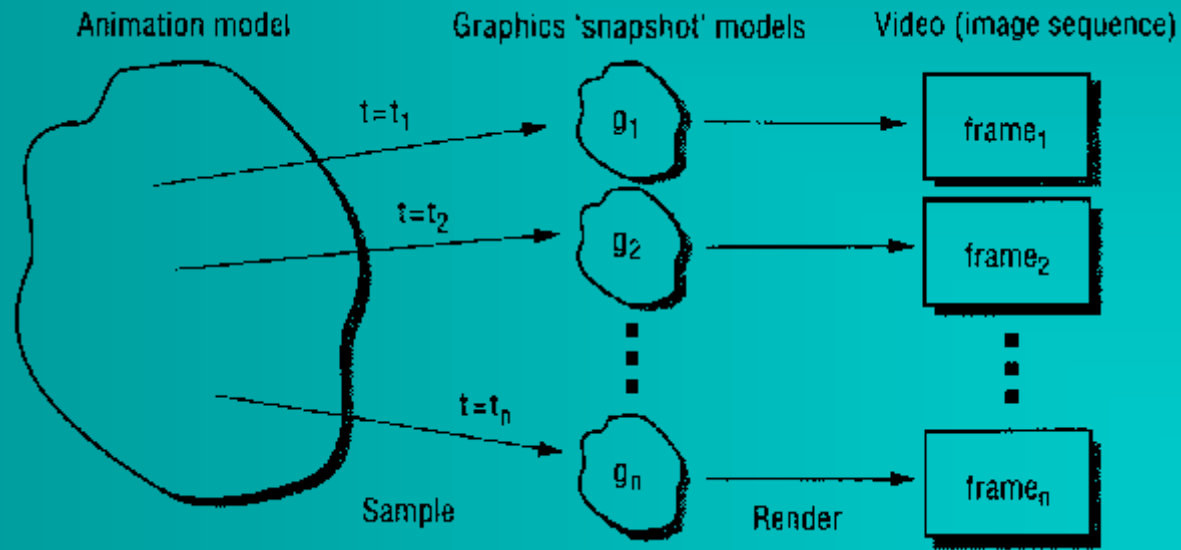
Timing

Editing and composition



# Animation

The depiction of objects as they vary over time.



# Animation - 1

**Media type Animation**

**Representation**

Cel models

Scene-based models

Event-based models

Key frames

Articulated objects & hierarchical models

Scripting & procedural models

Physically based & empirical models

# Animation - 2

## Operations

Graphics operations

Motion and parameter control

Rendering

Playback

# Other Media Types

- Extended Images
  - Virtual reality (QuickTime-VR)
- Digital Ink
  - Penbased (Newton)
- Speech
  - Recognition
  - Encoding
  - Synthesis