



Special Module on Media Processing and Communication

Dayalbagh Educational Institute
(DEI)
Dayalbagh Agra

CSM011

Indian Institute of Technology Delhi
(IITD)
New Delhi

SIV864/SIV8064



Course Administration

Course web site

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Course Administration

Evaluation Components:

Exam (1 for IITD, 2 for DEI students)

Quiz (in class)

Assignments (small reading and implementation)

Project (small project with final presentation)



Course Outline

- ▶ Multimedia representation (Image/Video/Audio/Graphics)
- ▶ Multimedia compression
- ▶ Multimedia communication (Protocols TCP/RTP)
- ▶ Multimedia communication (QoS, Streaming)
- ▶ Special Topics



Multimedia

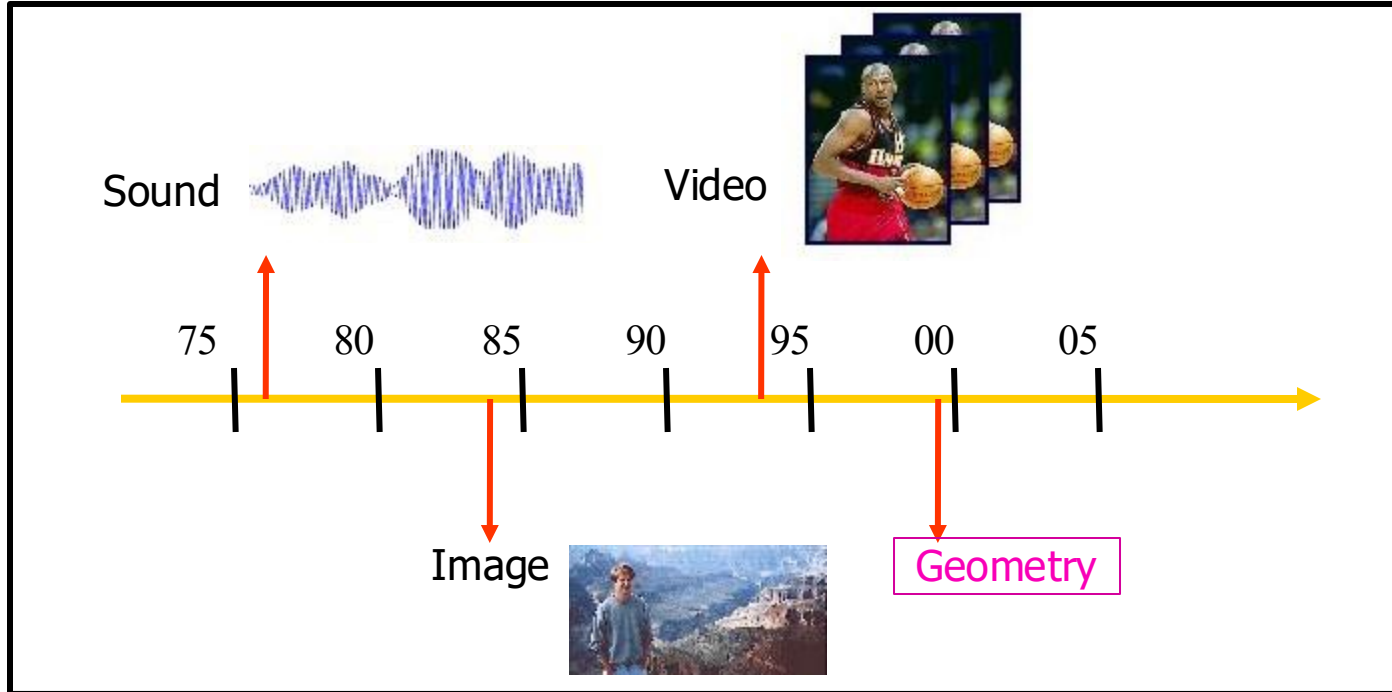
- Information can be in the form of Image/Video/Audio/Graphics in addition to Text
- Multiple Modalities
- Interactivity
- Applications:
 - Video conferencing
 - Tele-medicine
 - e-learning (Tele-learning)

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Multimedia

Historical Perspective: Digital Media

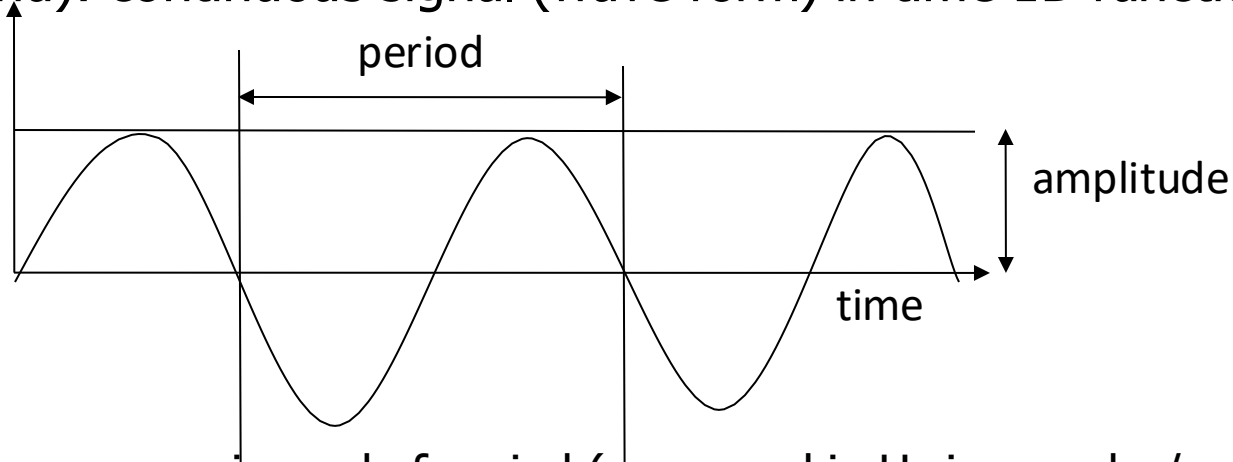




Audio

Digital Representation

Audio (Sound): continuous signal (wave form) in time 1D function $f(x)$



Frequency: reciprocal of period (measured in Hz i.e., cycles/sec)
relates to the **pitch** of sound

Amplitude: relates to the **loudness** of sound (measured in decibels –db)



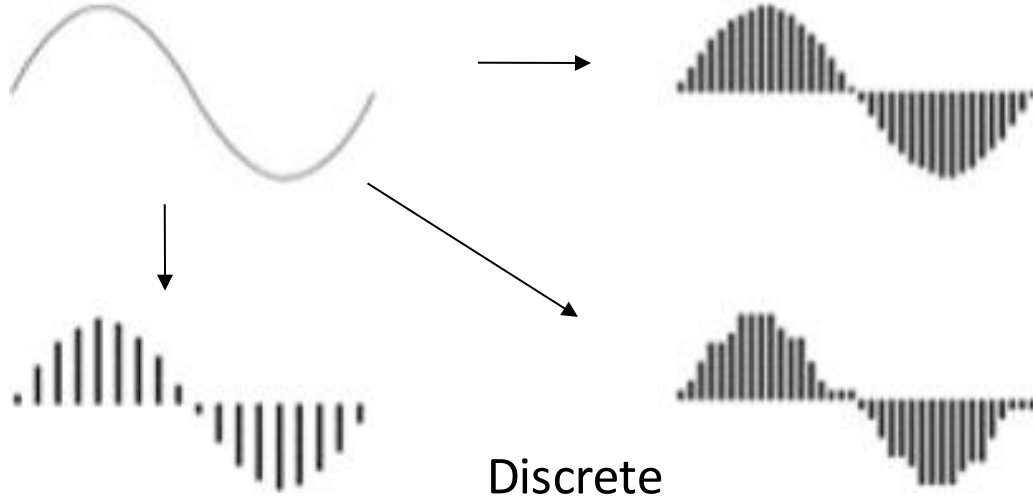
Audio



Digital Representation

Audio (Sound): continuous signal (wave form) in time 1D function $f(x)$

Continuous



Discrete



Audio



Digital Representation

1D function $f(x)$



Discretization Process

Discretization in x : Sampling

Discretization in f : Quantization



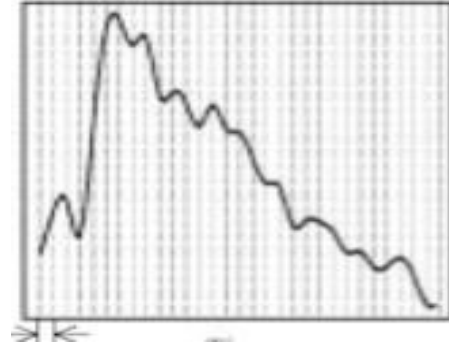
Audio



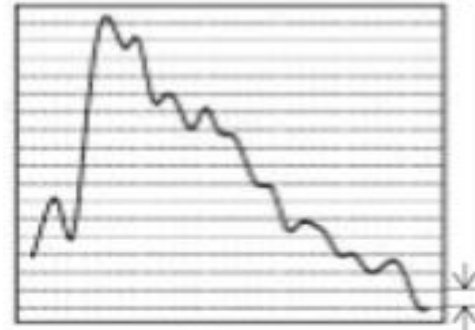
Sampling and Quantization



Sampling



Quantization





Audio

Sampling Rate

Rate at which the continuous wave is sampled (number of samples) measured in Hz

Telephone 8000 Hz, CD 44100 Hz

Quantization

Number of bits used to measure the amplitude



Audio

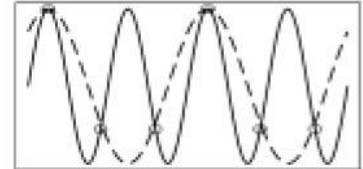
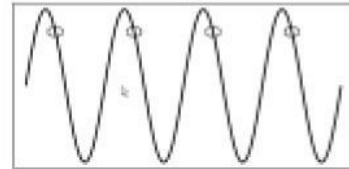


Effect of Sampling Rate and Quantization

Storage and fidelity

voice quality: 8KHz (sampling) 8 bit (quantization) 8Kbytes/s

Sampling rate if not adequate can result in error and the digital representation is not able to do a faithful reconstruction of the signal



Quantization determines the precision of a sample.



Audio

Audio Formats

- ▶ au (SUN file format)
- ▶ Wav (Wave)
- ▶ midi (Music Instrument Digital Interface file format)
- ▶ aiff (Audio Interchange File Format)
- ▶ riff (Resource Interchange File Format)
- ▶ wma (Windows Media Audio format)
- ▶ mp3 (MPEG Audio Layer 3)

Related areas: Speech Processing, Music Processing



Audio



Audio Tools

- ▶ Adobe Audition (formerly Cool Edit)
 - A powerful multi-track mix/edit tool
- ▶ Sound Forge
 - Sony audio editing software includes a powerful set of audio processes, tools, and effects for manipulating audio.
- ▶ Pro Tools
 - From Digidesign used by professionals in music production, TV and films



Image

- An image is a spatial representation of an object, a 2D or 3D scene.
- Abstractly, an image is a continuous function defining a rectangular region of a plane
 - intensity image - proportional to radiant energy received by a sensor/detector
- An image can be thought of as a function with resulting values of the light intensity at each point over a planar region.

2D function $f(x,y)$



Image

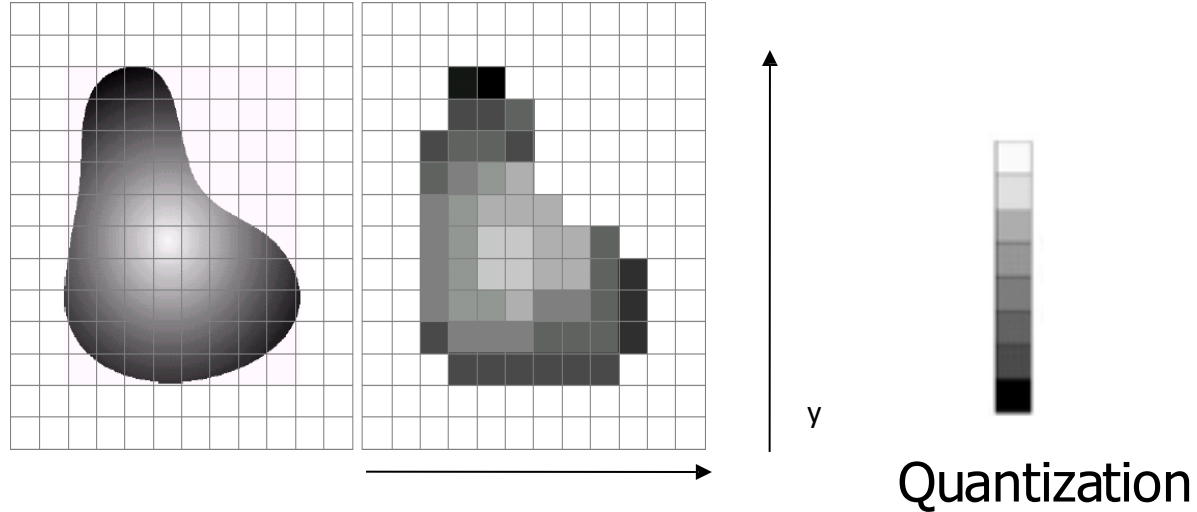
2D function $f(x,y)$

- Function (e.g. intensity) must be sampled at discrete intervals.
- Points at which an image is sampled are called picture elements or pixels.
- Resolution (spatial) specifies the number of pixels.
- Precision (Quantization) of the intensity (f) value is the number of bits per pixel
- A digital image can be represented by a matrix of numeric values each representing a quantized intensity value.



Image

2D function $f(x,y)$



Sampling: Discretization in x and y



Image



Effect of spatial resolution



1024



512



256



128



64



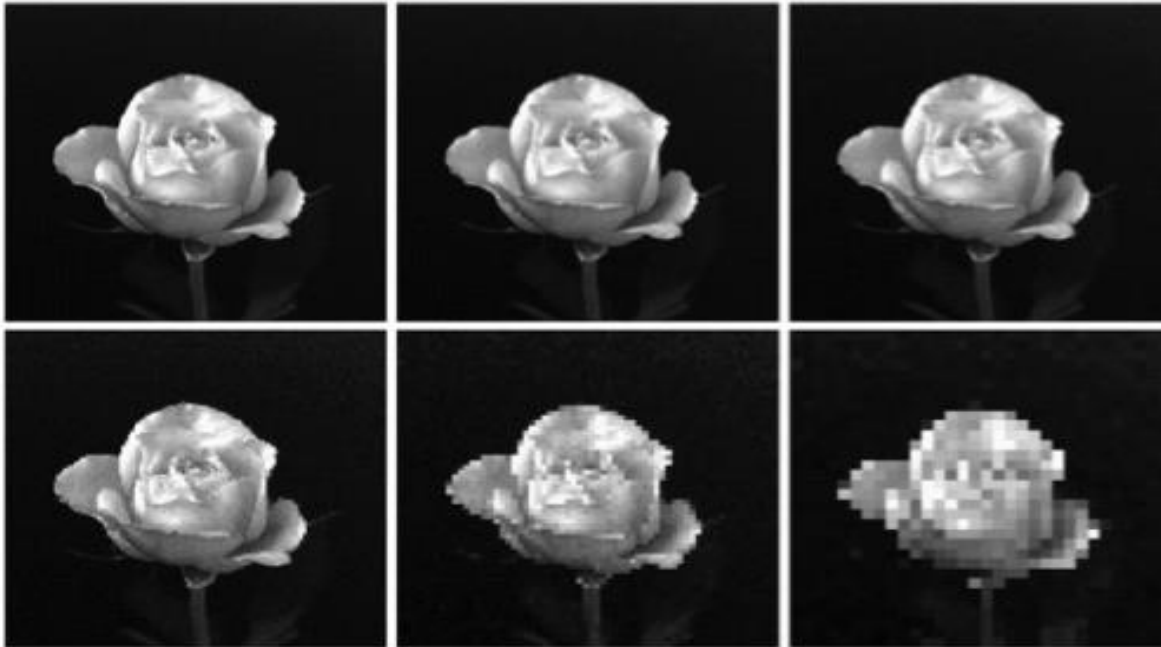
32



Image



Effect of spatial resolution

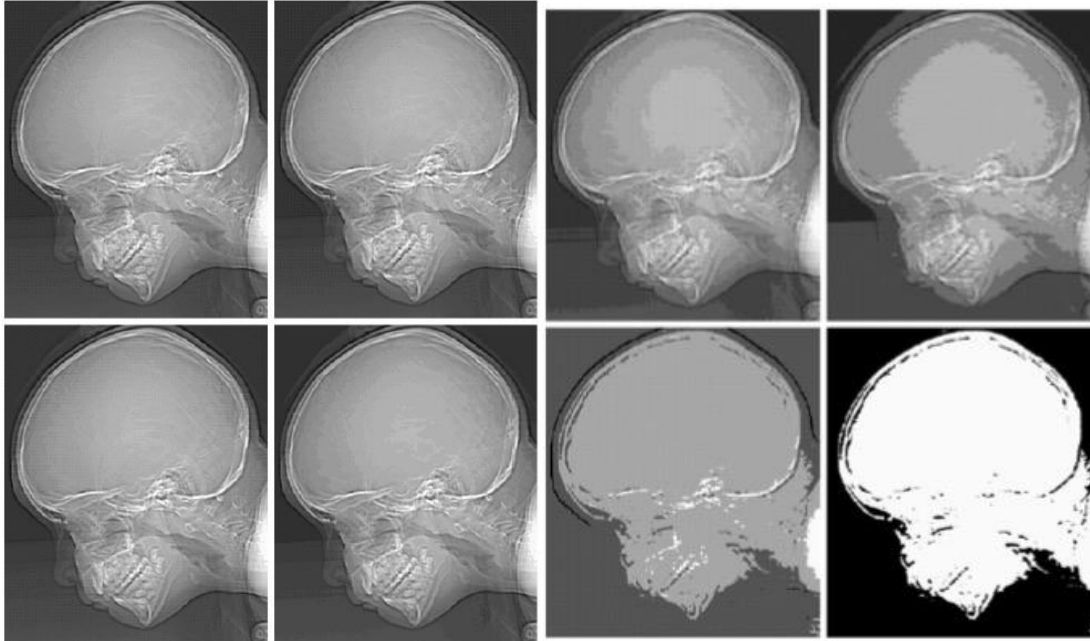




Image



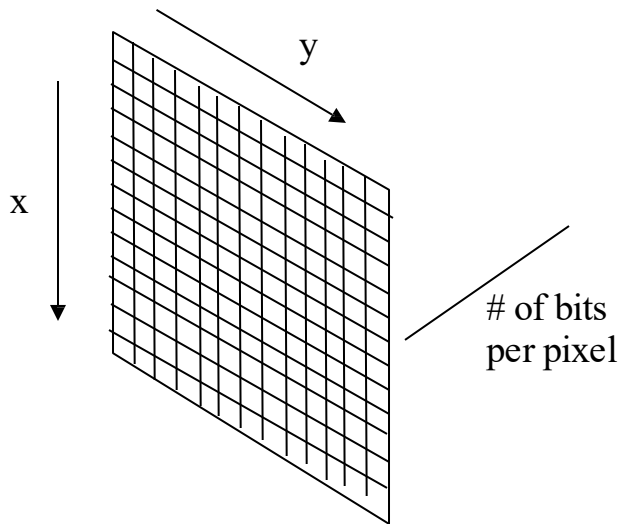
Effect of quantization (no of bits per pixel)





Image

Spatial resolution and quantization level determine the size of the image



Gray scale (monochrome) image
with 8 bit pixel

$256 \times 256 \times 8$ bits = 256×256 bytes

Color image (R, G, B) each color channel
pixel is 8 bit

$256 \times 256 \times 24$ bits = $256 \times 256 \times 3$ bytes



Image

Image Formats

- ▶ bmp (Bit Mapped format)
- ▶ gif (Graphics Interchange File Format)
- ▶ tiff (Tagged Image File Format)
- ▶ jpeg (Joint Photographic Experts Group)



Image



Image Tools

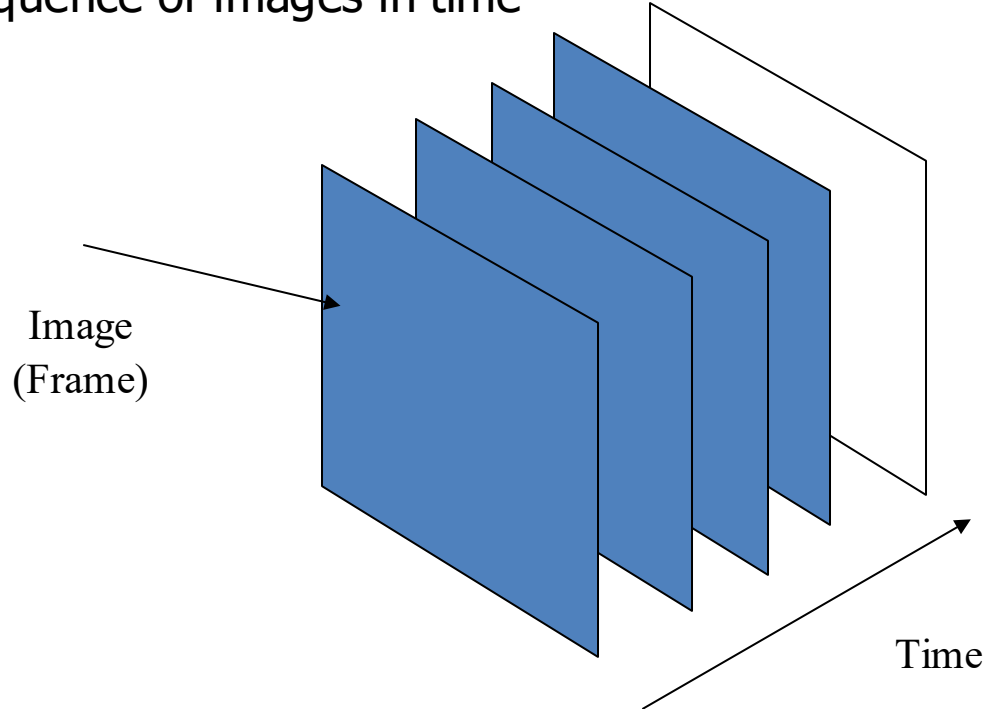
- ▶ Adobe Illustrator
 - A powerful publishing tool from Adobe
- ▶ Adobe Photoshop
 - Image processing and manipulation tool
- ▶ Number of public domain image processing tools are available



Video



Video is a sequence of images in time





Video



Discretization

Image (Frame) discretization

+

Sampling in time

frame rate (frames per second fps)

Bandwidth requirement = image size in bytes x frame rate

NTSC (National Television Systems Committee)

30 frames/second

PAL(Phase Alternating Line)

25 frames/second



Video



Video Editing Tools

- ▶ Adobe Premiere
 - Video and audio are arranged in tracks –superimposition of tracks
 - Built-in filters, transitions and motions
- ▶ Adobe After Effects
 - Special effects for lighting, shadows, motion blurring
- ▶ Final Cut Pro: from Apple

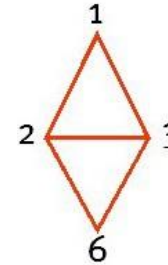
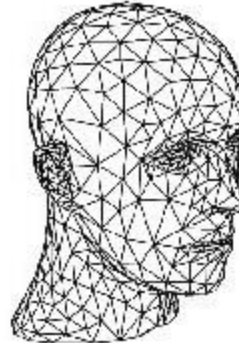
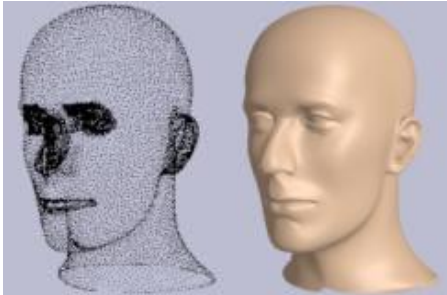


Graphics



Geometry Data: Meshes

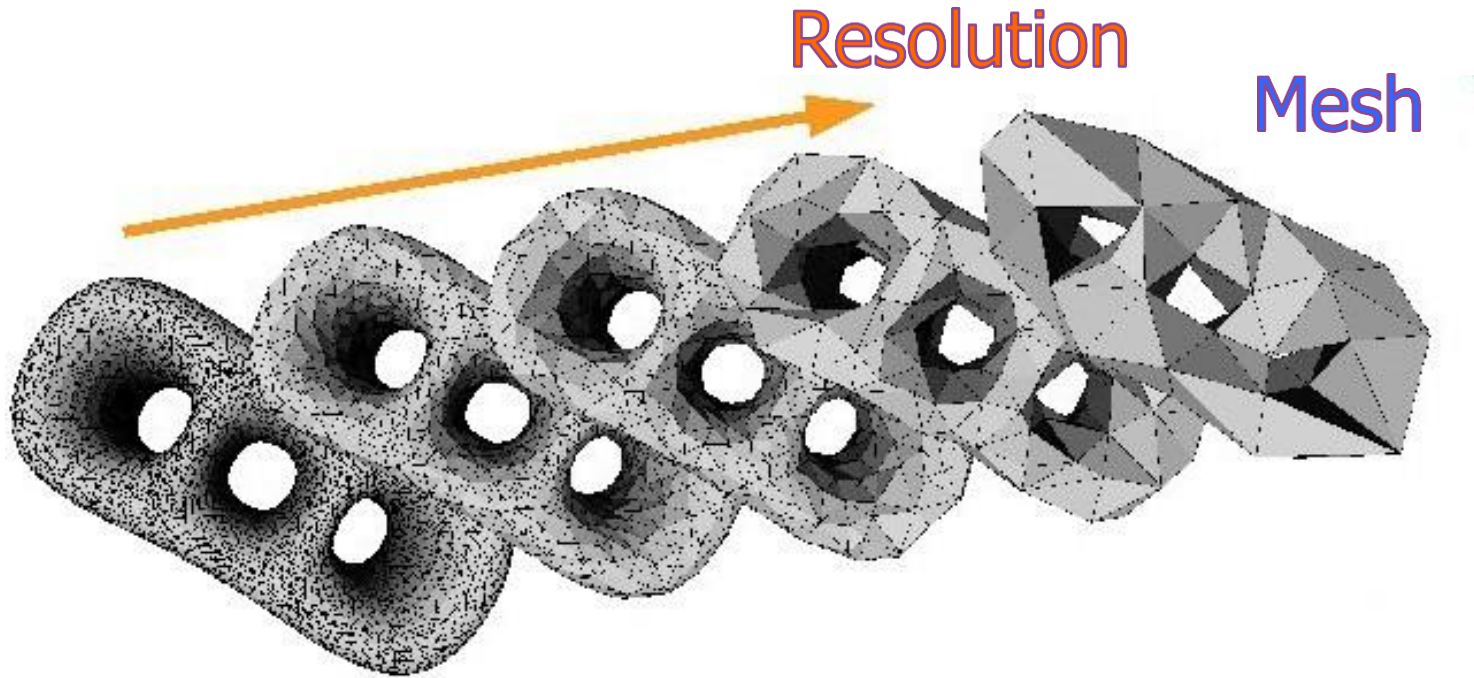
- Points
- Connectivity



x_1	y_1	z_1
x_2	y_2	z_2
x_3	y_3	z_3
$\vdots$		
1	2	3
1	2	6
$\vdots$		



Graphics





Graphics



Graphics Tools

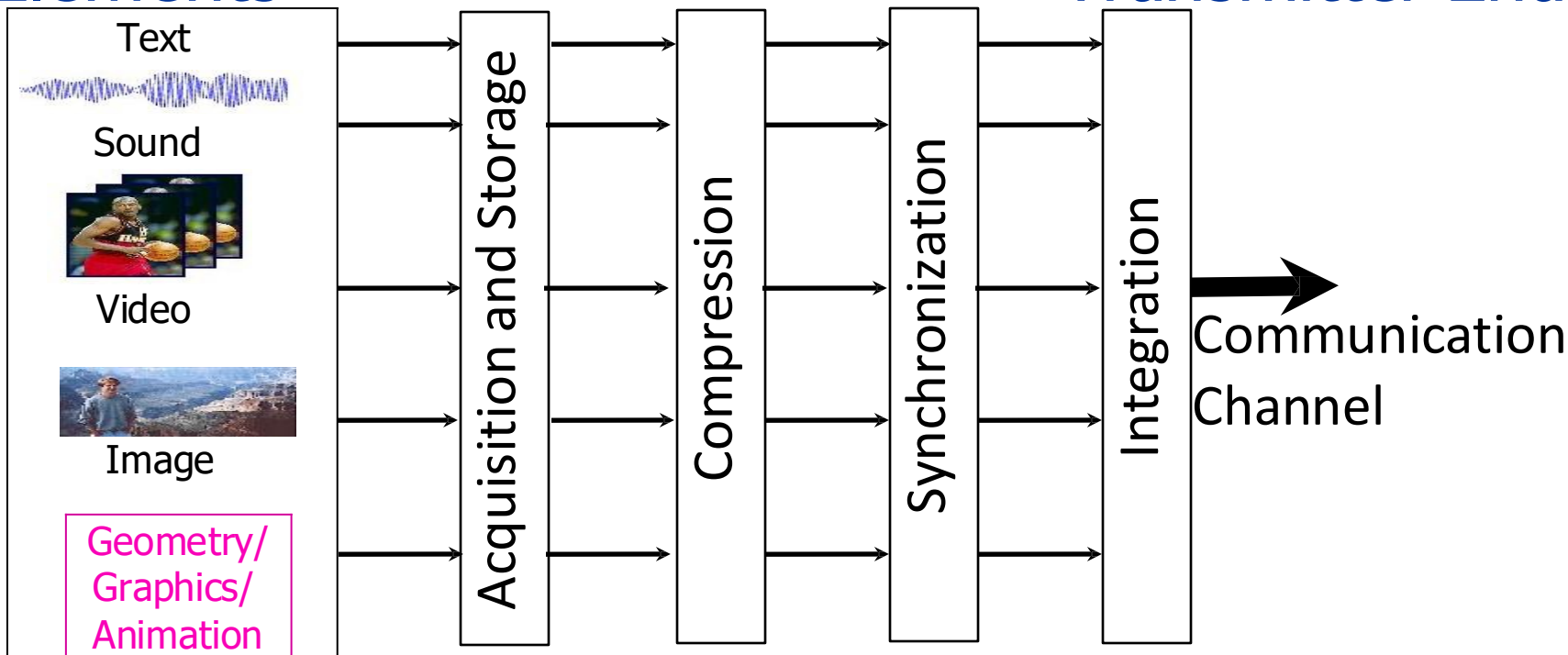
- ▶ 3ds Max (from Autodesk Media and Entertainment)
 - 3D graphics application software (formerly 3D Studio Max)
- ▶ Maya (from Autodesk Media and Entertainment)
 - High end graphics software (originally from Alias Research)
- ▶ Application Program Interface (API)
 - OpenGL
 - DirectX
 - Java3D



Multimedia Communication

Elements

Transmitter End

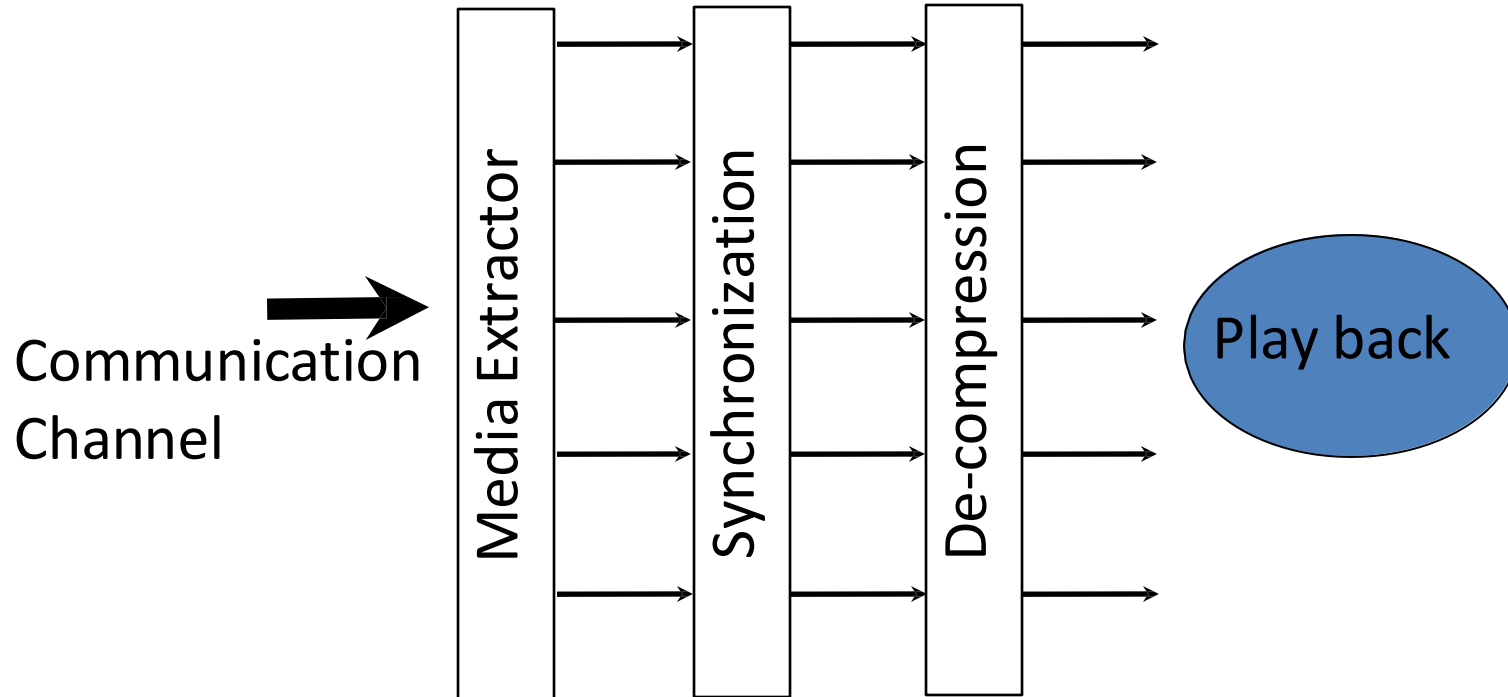




Multimedia Communication

Elements

Receiver End





Multimedia Communication

Some Challenges

- ▶ Bandwidth capacity of the communication channel
- ▶ Real-time processing
- ▶ Synchronization (inter-media)
- ▶ Continuity (intra-media)
- ▶ End-to-end delay