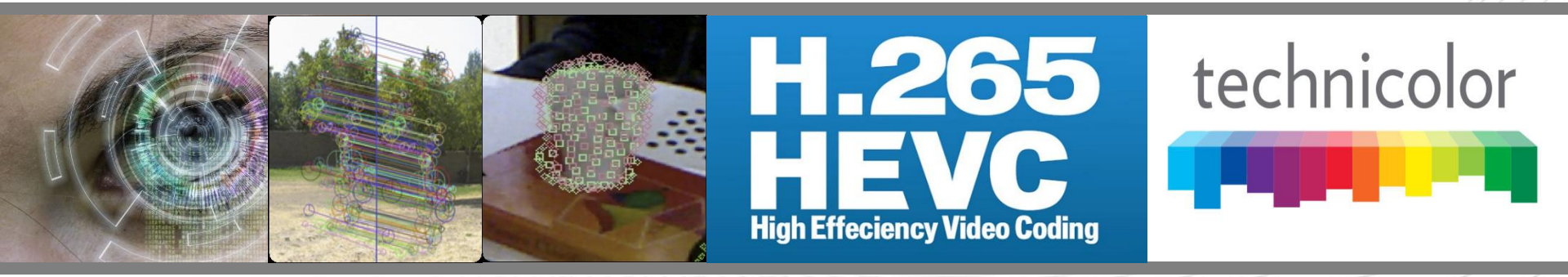
VICL
Visual Information Computing Lab

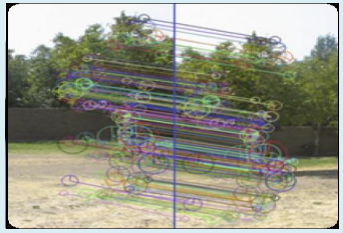
# Advanced Multimedia Signal Processing (#1: Introduction)

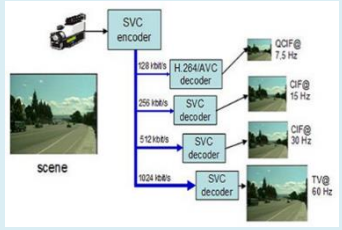



2017. Spring

Prof. Byung-Gyu Kim

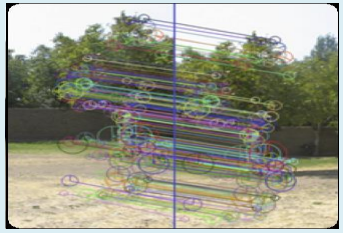
Dept. of IT Engineering, Soomyung Women's University

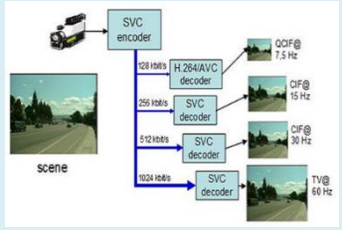



# Contents

- Introduction to this lecture
- What is “Multimedia”?
- Why We Need Data Compression?




# Contents

- **Introduction to this lecture**
- **What is “Multimedia”?**
- **Why We Need Data Compression?**

# Introduction to this lecture (1)

❖ Info. of advisory professor (담당 교수)

- Name: Byung-Gyu Kim (김병규)
- Office: Saehim Building Room No. 102
- Phone : 2077-7293, (Portable: 010-5037-3452)
- E-mail: bg.kim@ieee.org, bg.kim@sm.ac.kr
- Available office time :
  - Tues./Thurs. 12:40-14:00, Wed. 10:00-11:20

❖ Website for this class

- VICL homepage (http://vicl.sookmyung.ac.kr)
  - "Advanced IT Programming" board

# Introduction to this lecture (2)

❖ What will we talk about in this lecture?

- What is multimedia (basic concept)?
- **Video signal processing**
- **Basic Video Coding (Compression) concepts** and **techniques**
- **Video coding standards from H.261 to H.265** (H.26x family)

❖ Aims:

- Understanding what is a concept of video signal processing.
- Learning various kinds of video signal processing.
- Getting a sense of basic video processing and compression schemes.
- Obtaining a skill to design your own study or research project if you have an interest on video processing (coding) field.

# Introduction to this lecture (3)

❖ The detailed course of this lecture

- Tutorial lectures
  - Video processing techniques
  - Detailed modules for video compression (coding)
  - Some signal transforms for video compression
  - If possible, the advanced techniques (H.265 video) will be discussed shortly.
- Term projects
  - Proposal
    - Some topics about video coding will be given in middle of semester.
  - Final presentation
    - Final reports of your topics should be submitted and presented.

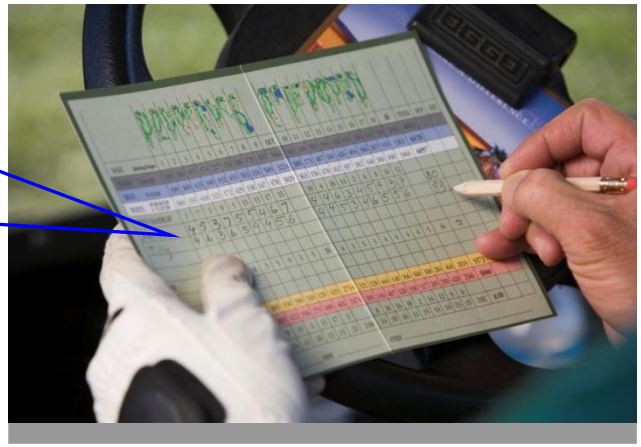
# Introduction to this lecture (4)

- The final achievements of this course (end of this semester)
  - To understand video processing and coding concept.
  - To provide useful information for each personal study.
  - To make use of some concepts for your own research.
  - If possible, get enough experience for video processing and coding.

# Introduction to this lecture (5)

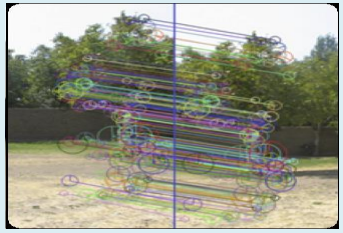
- The Evaluation of this lecture
  - Basic rule:

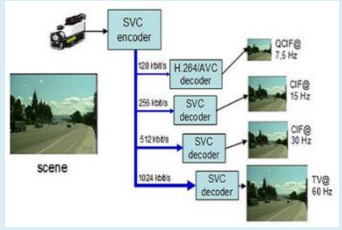
| | |
|---|---|
| Midterm Exam. | : 30% |
| Presentation skill | : 10% |
| Attendance | : 10% |
| Homework | : 10% |
| Course Project | : 40% |



# Introduction to this lecture (6)

- The Textbook and lecture materials
  - Summarized PPT.
  - Textbook: “H.264 and MPEG-4 video compression” (by Iain E. G. Richardson, Wiley, 2003)

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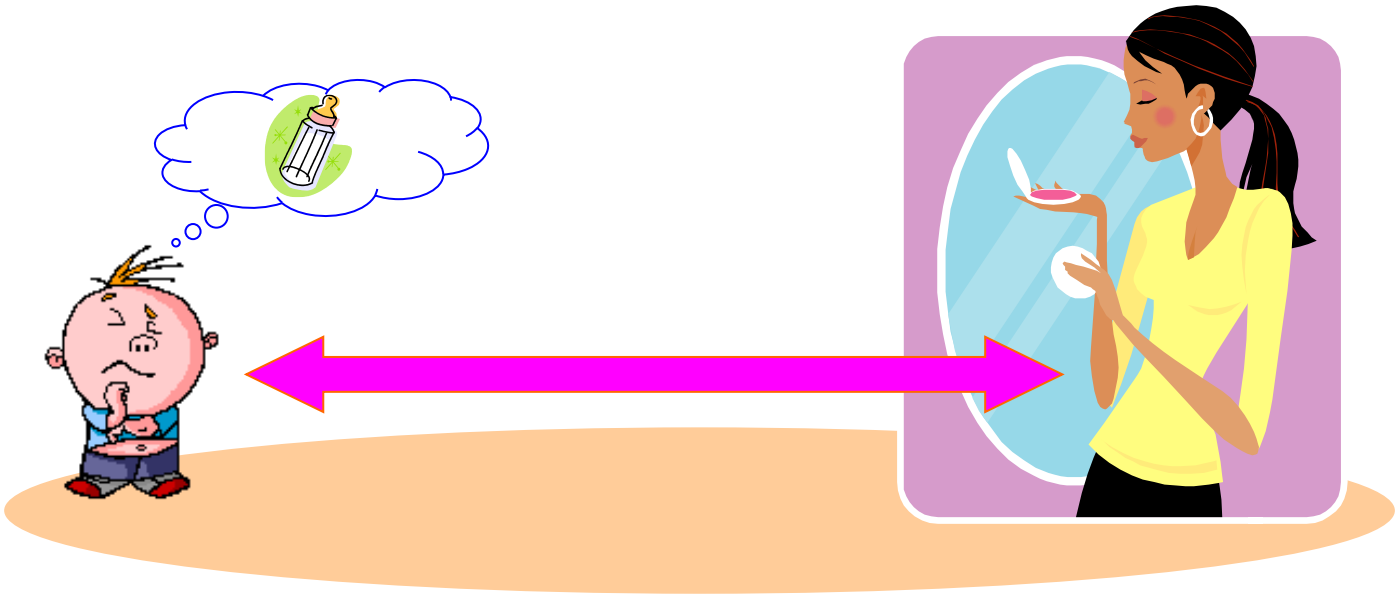
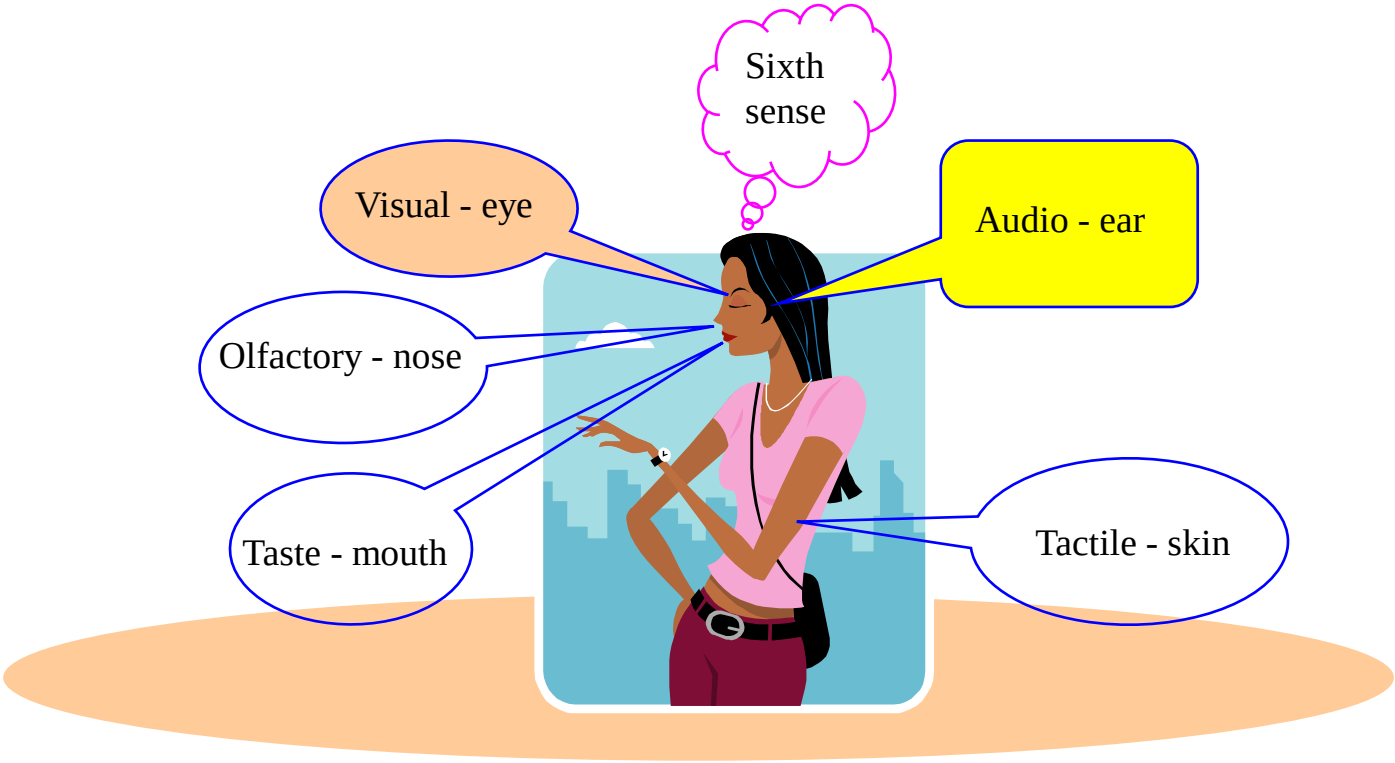
# What is “Multimedia”? (1)

- Multi-Media
  - What is “Media”?
    - Media is a tool for exchanging people’s mind/thought and information, between people.



# What is “Multimedia”? (2)

- What kinds of “Media”?
  - Most of system that have been studying/developing are imitators based on the senses of human being.
- What kinds of the senses of human being?



# What is “Multimedia”? (3)

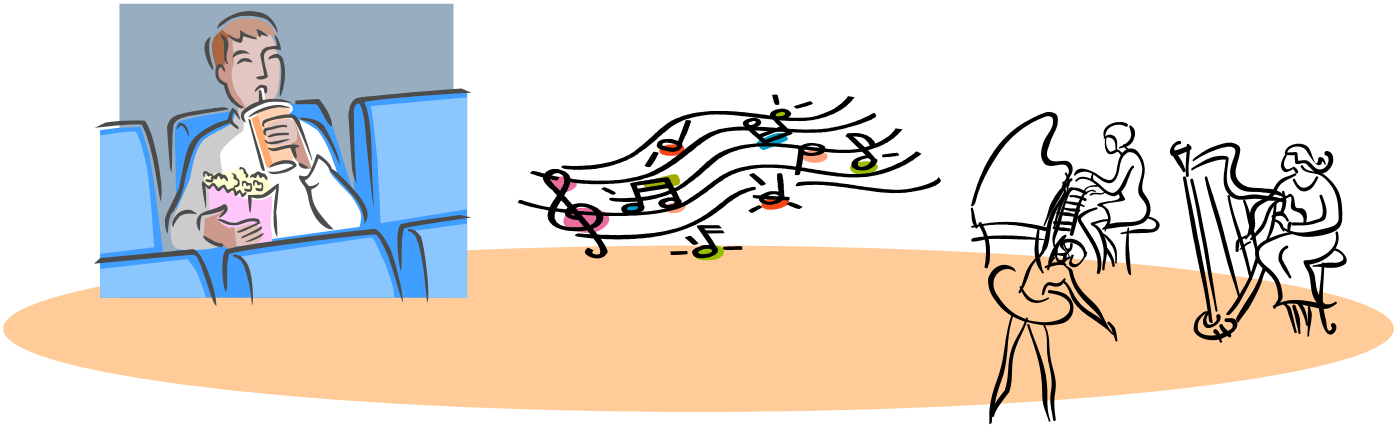
❖ Sensors of Human Body

- Audio
- Visual
- Taste
- Olfactory
- Tactile

Audio perception model

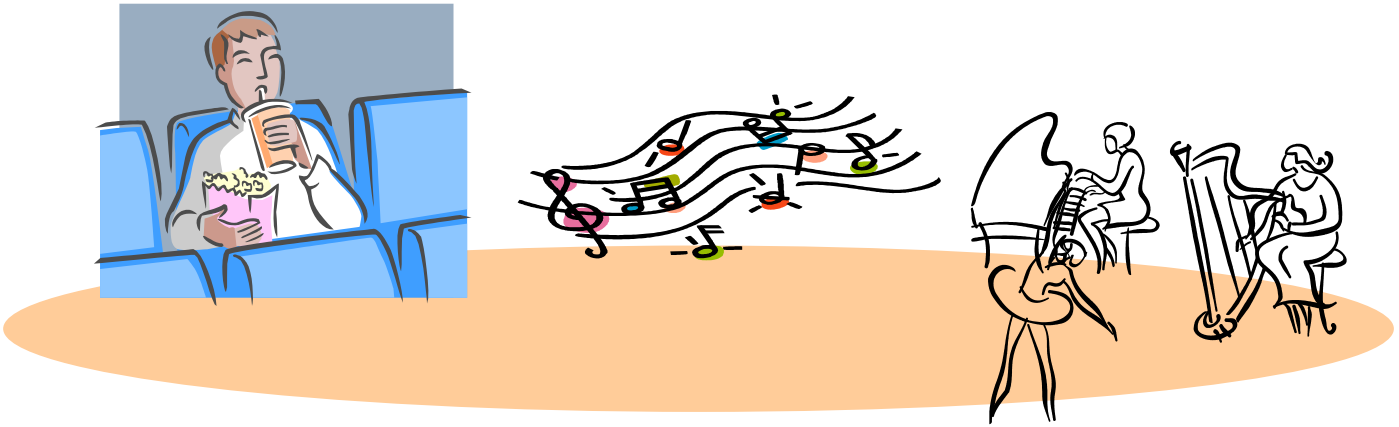
Visual perception model

Biological signal processing/transportation



# What is “Multimedia”? (4)

- Multi-Media
  - Multiple media, not separated.
    - Containing more than two different  media types
    - Text, speech, music, audio, image, graphics, video, and many more….
    - Giving the useful and additional information by the given media.



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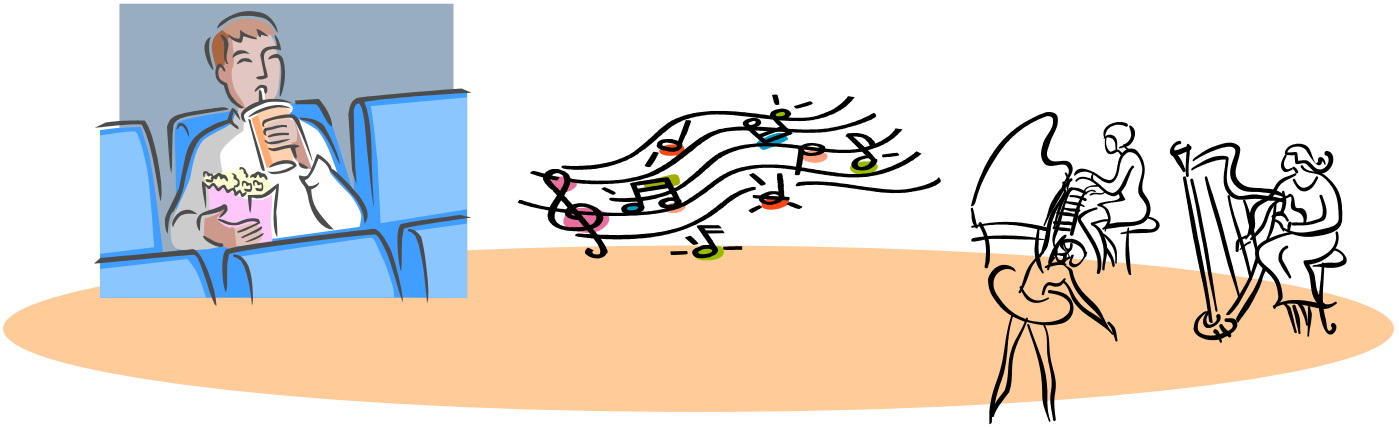
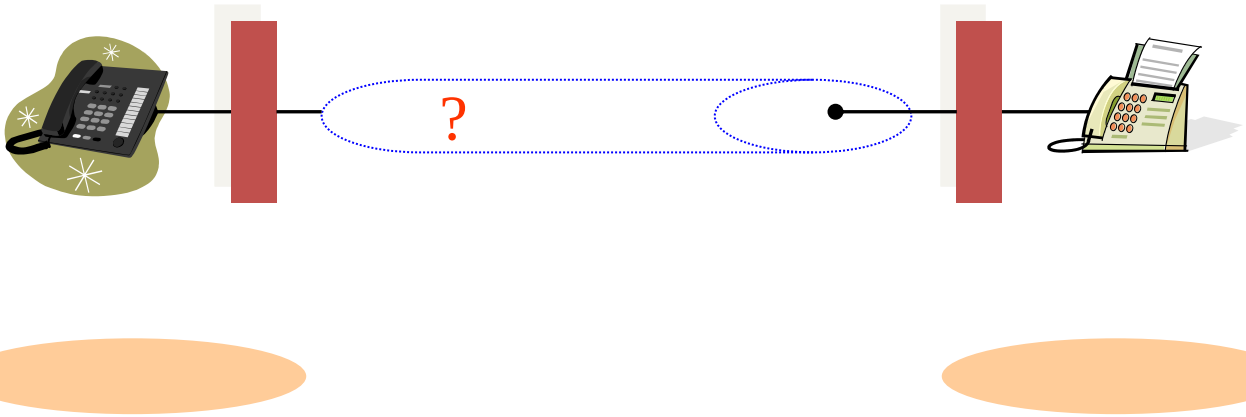


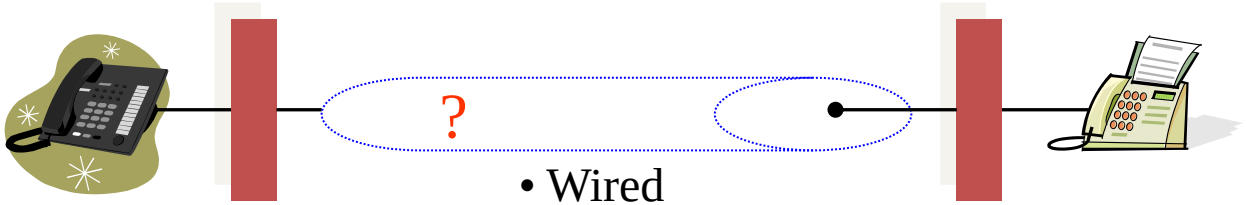
# Some Useful Definitions (1)

- Network
  - Layered/electrical devices to give and take information between end users (systems).
    - Channel
    - Bandwidth



# Some Useful Definitions (2)

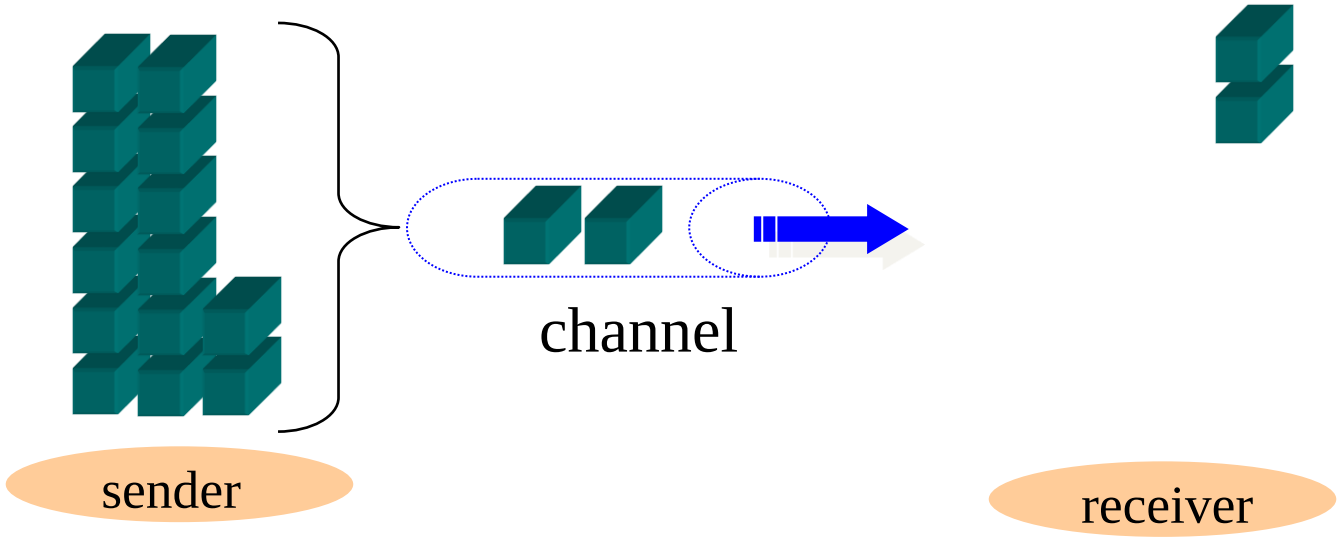
- Channel:
  - Physical path between end systems (users).
    - Different characteristics as kind of medium.
      - Copper wire vs. Optical fiber.
      - Wired vs. wireless.

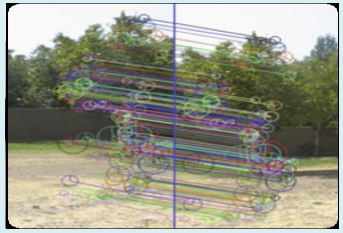


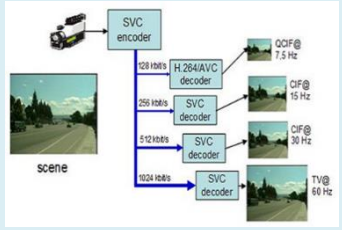

- Wired
- Wireless

# Some Useful Definitions (3)

- Bandwidth:
  - Transmission capacity of data for the given time.
    - Bits/second (bps)
      - 1 bit = 0 or 1
      - 1 byte = 8 bits, 1 K bits = 1024 bits, 1 M bits = 1024 K bits



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# Why We Need Data Compression? (0)

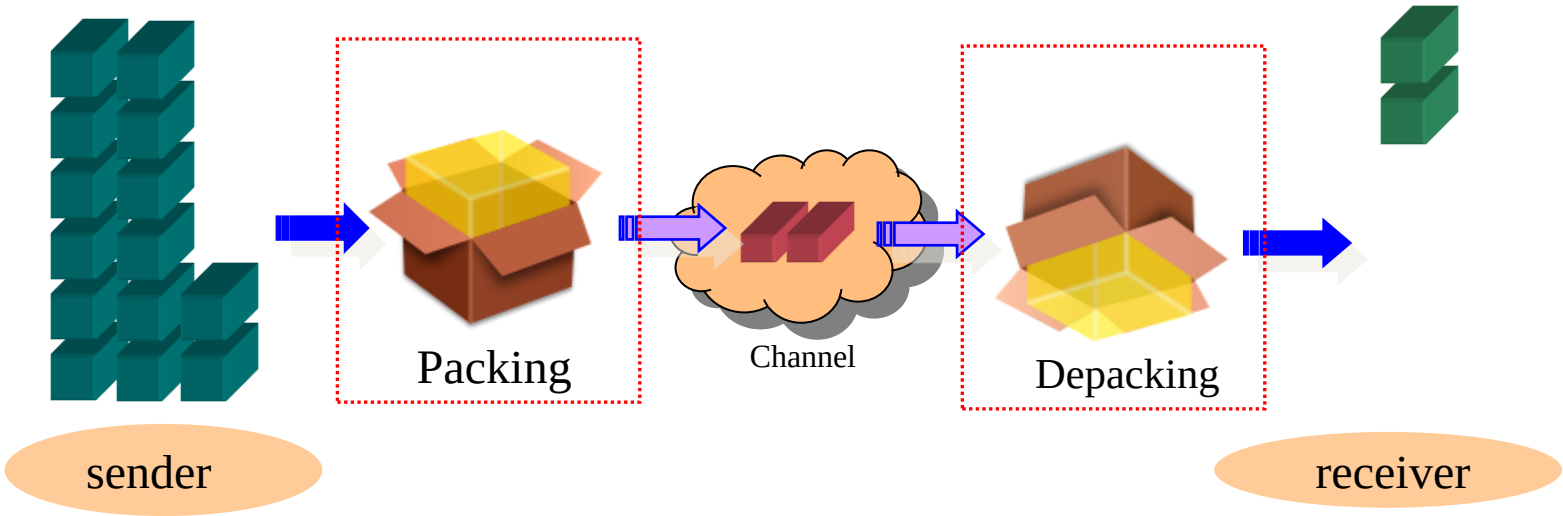
- In aspect of data communication, all signals are delivered through channels such as Phone line, copper, optical fiber and air (Physical path).
  - Problem:
    - **Bandwidth/sec. is always limited (not infinite).**
    - But people want to send or receive the desired data faster and faster.
    - **Data storage** aspect:
      - Modern data processing applications require storage of large volumes of data.
      - Compressing a file to half of its original size is equivalent to doubling the capacity of the storage medium.

# Why We Need Data Compression? (1)

| Multimedia Data | Size/Duration | Bits/Pixel or Bits/Sample | Uncompressed Size (B for bytes) | Transmission Bandwidth (b for bits) | Transmission Time (using a 28.8K Modem) |
|---|---|---|---|---|---|
| A page of text | 11" x 8.5" | Varying resolution | 4-8 KB | 32-64 Kb/page | 1.1 - 2.2 sec |
| Telephone quality speech | 10 sec | 8 bps | 80 KB | 64 Kb/sec | 22.2 sec |
| Grayscale Image | 512 x 512 | 8 bpp | 262 KB | 2.1 Mb/image | 1 min 13 sec |
| Color Image | 512 x 512 | 24 bpp | 786 KB | 6.29 Mb/image | 3 min 39 sec |
| Medical Image | 2048 x 1680 | 12 bpp | 5.16 MB | 41.3 Mb/image | 23 min 54 sec |
| SHD Image | 2048 x 2048 | 24 bpp | 12.58 MB | 100 Mb/image | 58 min 15 sec |
| Full-motion Video | 640 x 480, 1 min (30 frames/sec) | 24 bpp | 1.66 GB | 221 Mb/sec | 5 days 8 hrs |

# Why We Need Data Compression? (2)

- People want to see or get more information at the given network condition (limited bandwidth).
  - Better quality of service in terms of real-time.
  - More data and faster, more information.
  - Need to modify or process the original data.



# Why We Need Data Compression? (3)

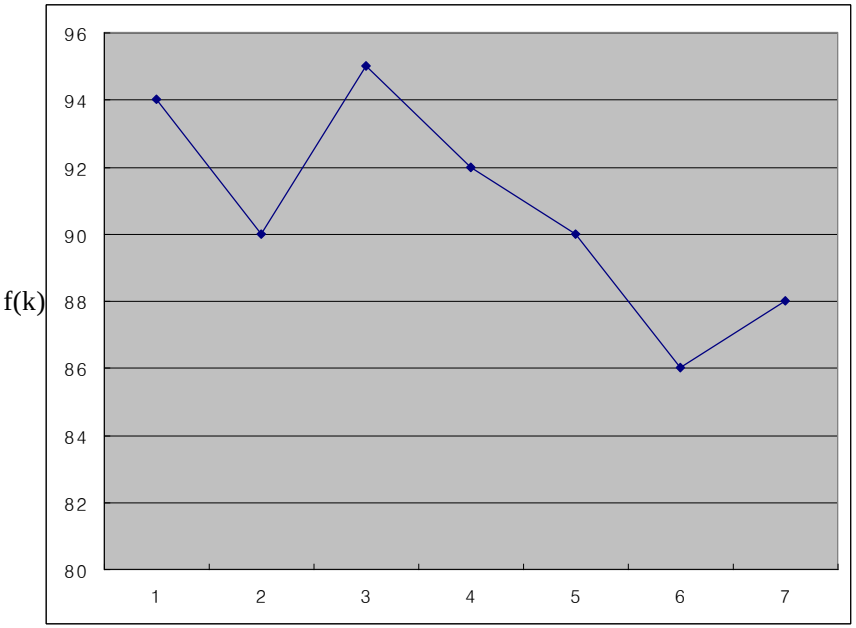
- Data Compression Techniques
  - Text and documents
    - Zip (WinZip, AlZip), TAR, ARJ, and so on.
  - Voice (Speech) and music signals
    - Wave, MP3, AAC, AC-3, AMR, OGG
  - Still images
    - JPEG, JPEG 2000, MJPEG
  - Videos (moving)
    - H.26x series and MPEG-1, MPEG-2, MPEG-4, WMV, DIVIX

# Data Compression: Motivation (1)

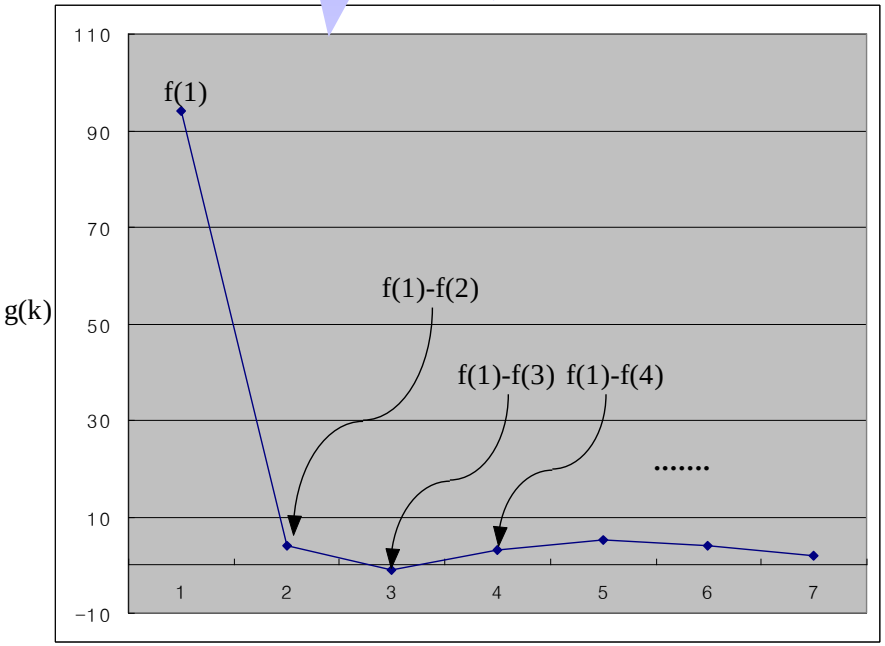
- How to reduce the original image data?
  - Most data (successive in terms of time) from nature has redundancy (correlation).
    - There is more data than the actual information contained in the data.
    - Squeezing out the excess data (information) amounts to compression.
    - However, un-squeezing is necessary to be able to figure out what the data means.

# Data Compression: Motivation (2)

❖ Let's see a simple example…!!!




Signal differencing between samples (data)



# Data Compression: Motivation (3)

- What form of data redundancy (correlation) in the original image data?
  - Very high correlation between neighboring pixels (data) within small area (block).
  - Remove statistical redundancy from data.
  - Encode common values with short codes, uncommon values with longer codes. ⇒ **Huffman Code**

# Summary of Todays' Lecture..!!!

- Introduction of this lecture
- What is "Multimedia"?
- Some Useful Definitions
  - Network
  - Channel
  - Bandwidth
- Why We Need Data Compression?
- Data Compression
  - How to (Basic concept)?

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# Thank you for your attention.!!!

## QnA

http://vicl.sookmyung.ac.kr