CCS3562 | CIS3582
MULTIMEDIA SYSTEMS

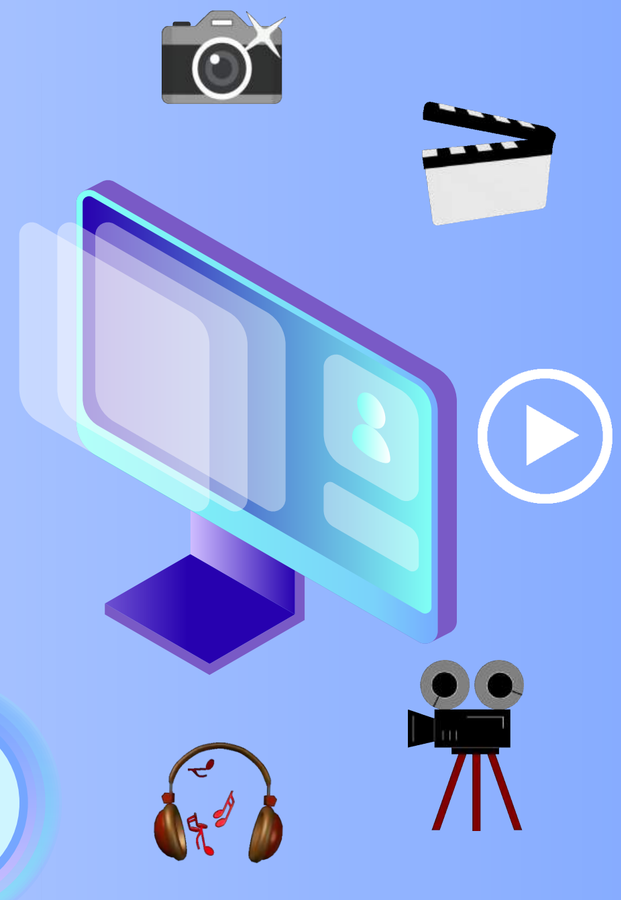
INTRODUCTION

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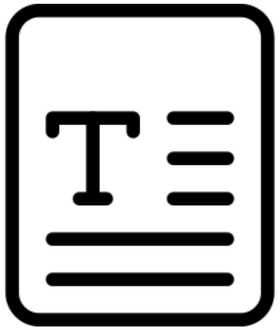


What is Multimedia?

- “Multimedia” has no strict definition.
- In our context, multimedia indicates the computer technology (multimedia computing) for more efficient communication by using different media types:
  - Text
  - Audio and speech
  - Images
  - Graphics
  - Video



What is Multimedia?



Text



Audio



Still Images



Animation

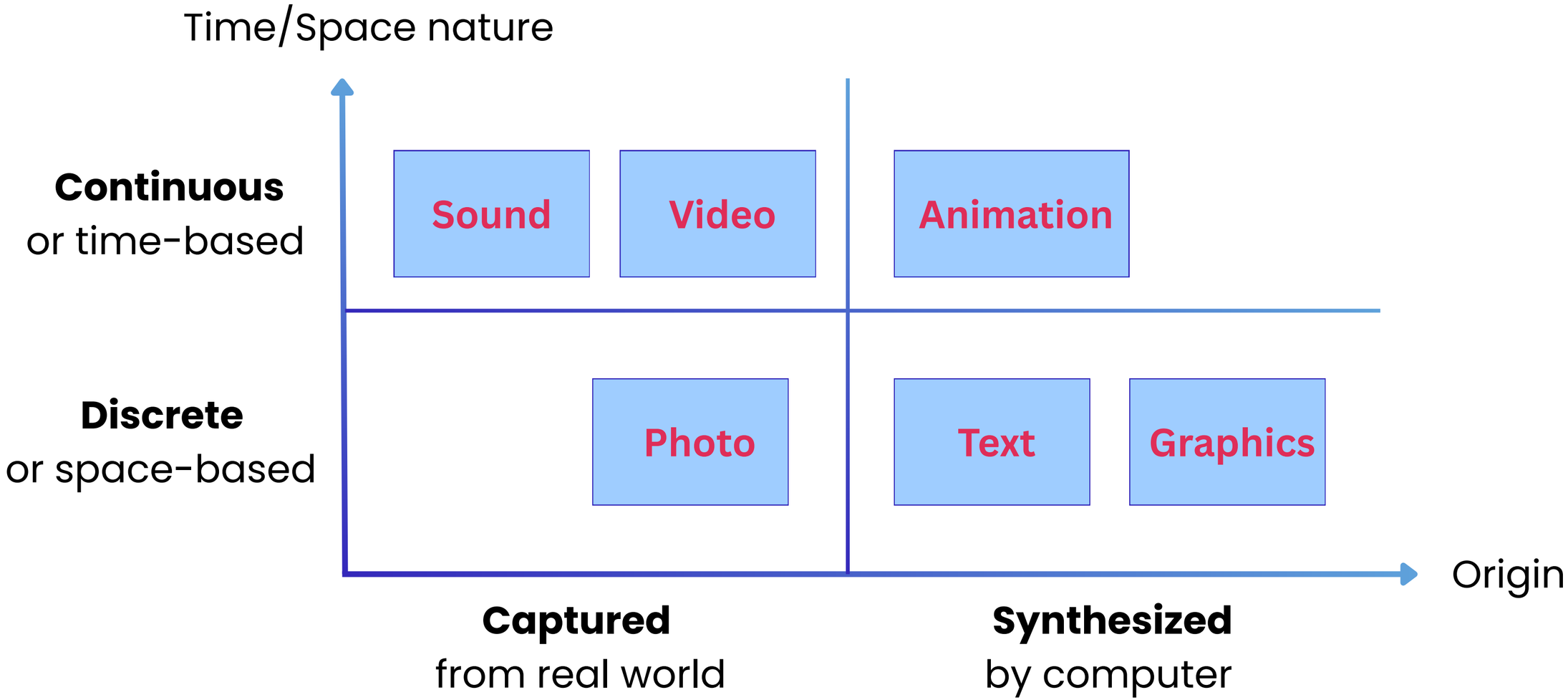


Video



Interactivity

Classification of media types



Captured Versus Synthesized Media

Captured media refers to information types captured from the real world (e.g. Still pictures, moving pictures, and sound).







Synthesized media refers to information types synthesized by the computers (e.g. Text, graphics and computer animation).









Discrete Versus Continuous Media

Discrete media

- Refers to media involving space dimension only (e.g. Still images, text and graphics).
- Discrete media is also referred to
    - static media
    - non-time-based media
    - non-temporal media
    - space-based media.

Continuous (time based)

- Media refers to time-based media (e.g. Sound, moving images, and animation).
- Continuous media is also referred to
    - dynamic media
    - time-based media
    - temporal media.

Classify the following media items based on their time/space nature (Continuous and Discrete) and the origin (Captured and Synthesized).

1. An animated text prepared for a presentation
2. A portrait, taken for preparing an ID card
3. A MIDI audio loop
4. A video clip extracted from a surveillance camera system
5. A vector graphic of a company logo
6. A photograph of a billboard which contains text
7. A non-animated 3D model in an interactive multimedia application
8. A sample-based midi audio clip.
9. A 3D model obtained using a 3D scanner
10. An audio recorded using a direct line-in cable from an electric guitar





Images

Challenges

- Is the image as high-quality as I need?
- Is the image efficiently stored and transmitted?
- Can the image be retrieved by its content?

A Simple Quiz

1. Define image resolution (Spatial Resolution).
2. Define image spectral Resolution.
3. Define temporal resolution.
4. Define Amplitude Resolution.

Videos

Challenges

- How are the temporal relations between the media represented?
- What do I need to stream video across the network?
- Are the different media synchronized?
- How can I describe a video retrieval request like a query?

What is a Multimedia System?

A system that involves:

- generation ➢ production/authoring tools
- representation ➢ compression and formats
- storage ➢ file system design
- transmission ➢ networking issues
- search and retrieval ➢ database management
- delivery ➢ server design, streaming

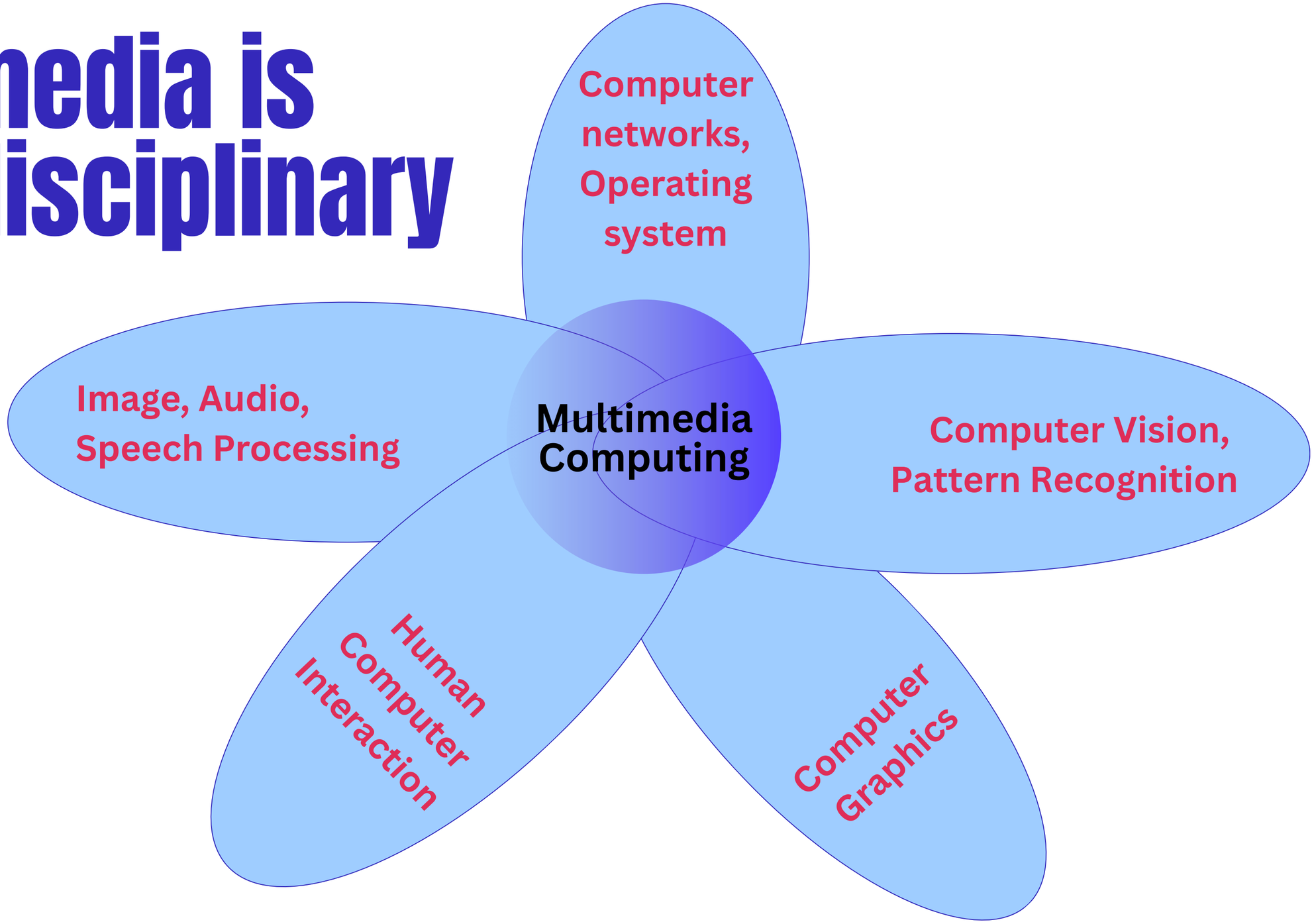
of multimedia information

Challenges of Multimedia Computing

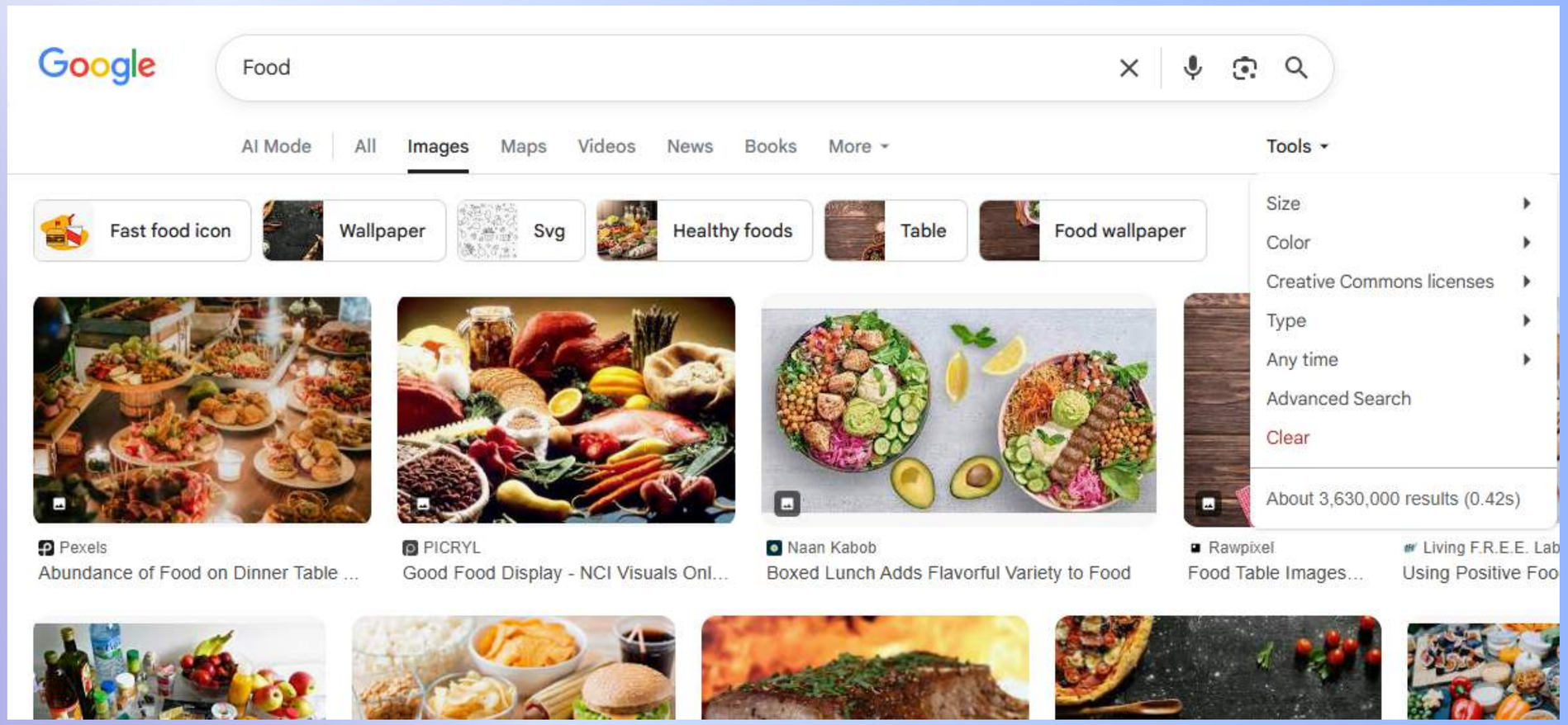
Developing a successful multimedia system is non-trivial.

- Continuous media types such as video need a lot of space to store and very high bandwidth to transmit.
- They also have tight timing constraints.
- Automatically analyzing, indexing and organizing information in audio, image and video is much harder than for text.
- Multimedia involves many different research areas and needs more complex and more efficient algorithms and hardware platforms.

Multimedia is Multidisciplinary



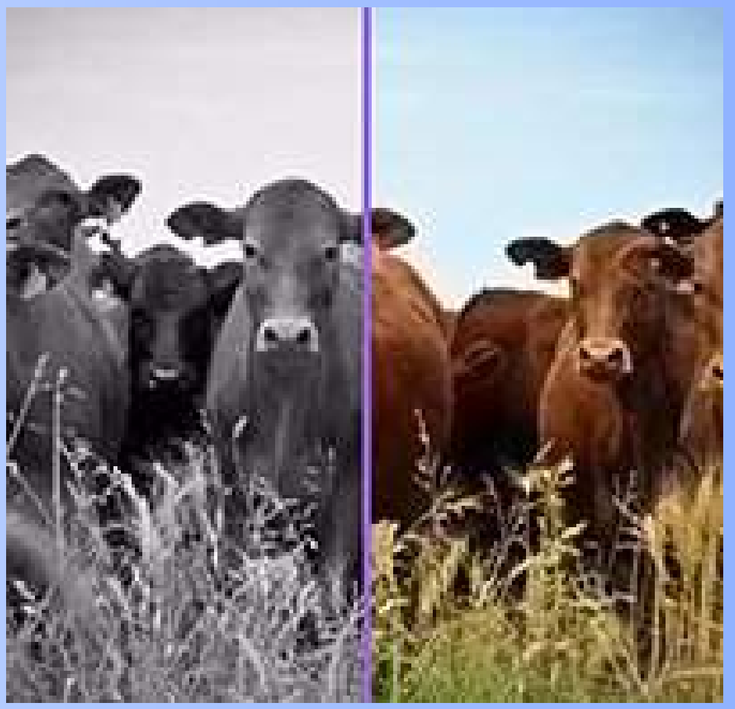
Example Multimedia Systems



Google Image

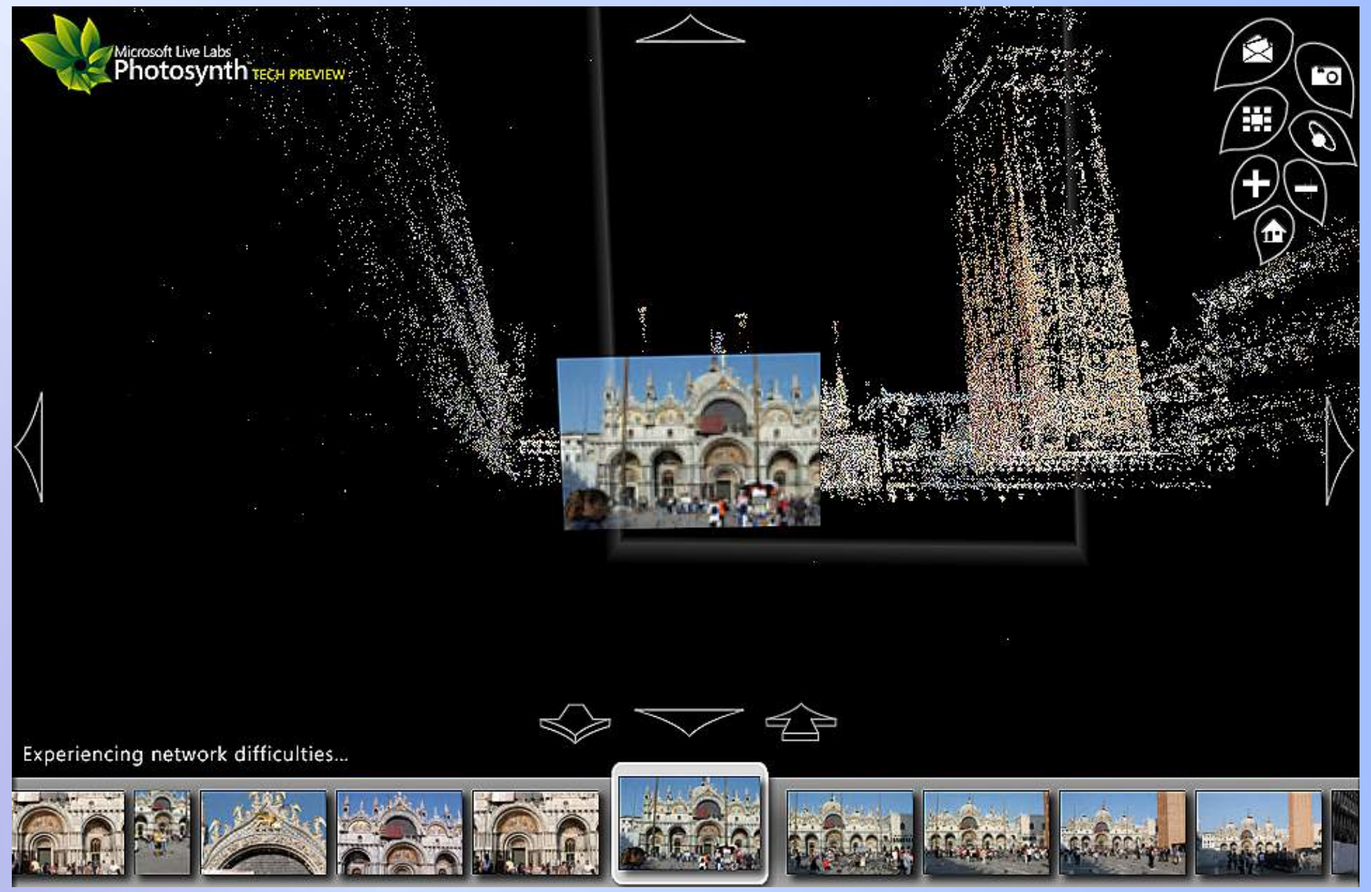
Example Multimedia Systems





https://demos.algorithmia.com/colorize-photos

Example Multimedia Systems



Photosynth of Microsoft Live Labs.

Multimedia Computing



Multimedia systems involve some basic enabling of techniques:

- Multimedia data representation and compression.
- Multimedia data processing and analysis.
- Transmitting multimedia data through communication networks.
- Multimedia database, indexing and retrieval.

Data Compression

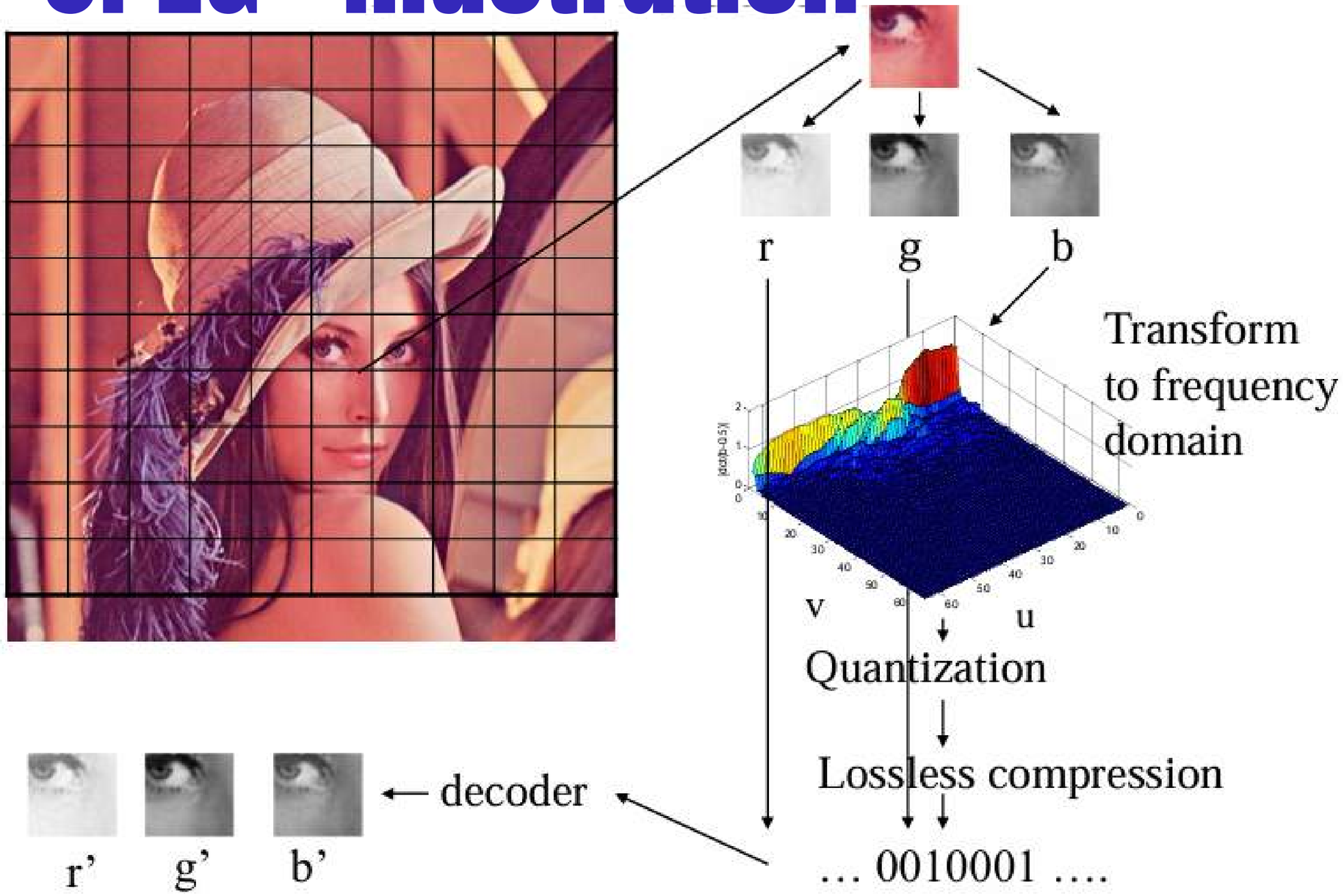


Raw image takes about 6M bytes
(without header information)



24k bytes with jpeg, Q=50

“JPEG” Illustration



Data Compression Topics

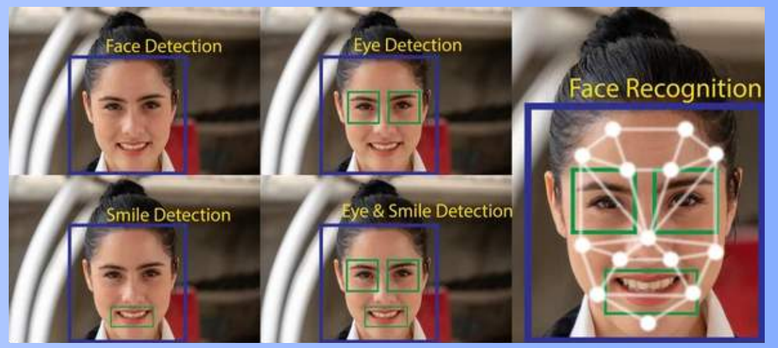
- Data Redundancy Types
- Content Measurement
- Compression Types
- Variable Length Coding
- Run Length Coding
- Hybrid techniques



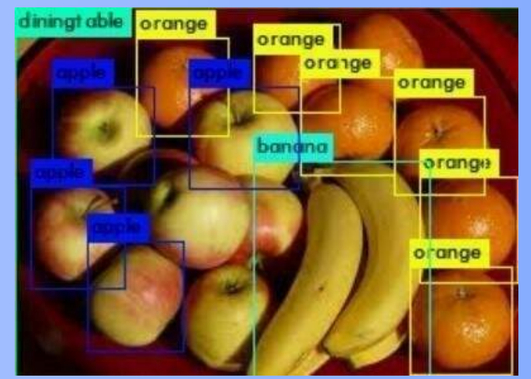
Media Processing and Analysis

• In applications such as digital library, automatic data analysis has to be done to extract semantic meanings from audios, images and videos.





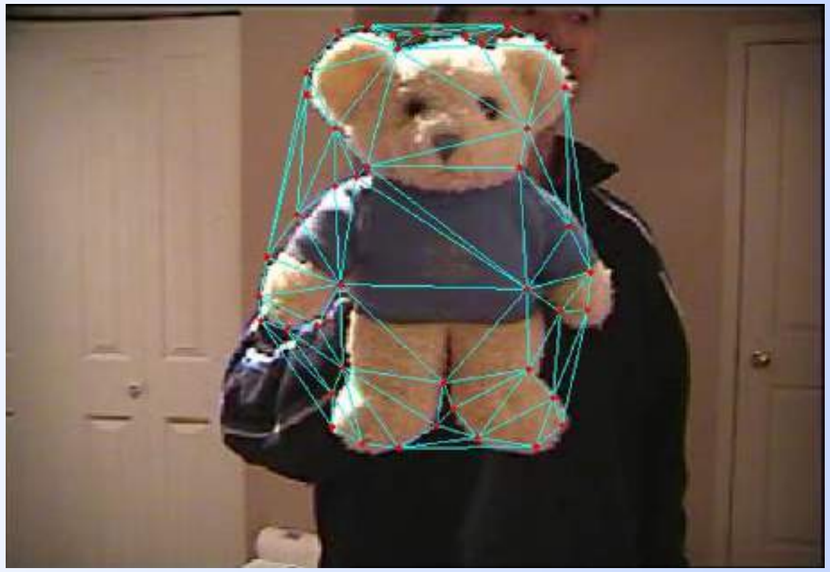
• Based on media processing methods such as
– object tracking (face, eyes),
– object recognition,
– gesture recognition, etc.,
we can build more effective human computer interfaces.



Tracking Object by Image Matching

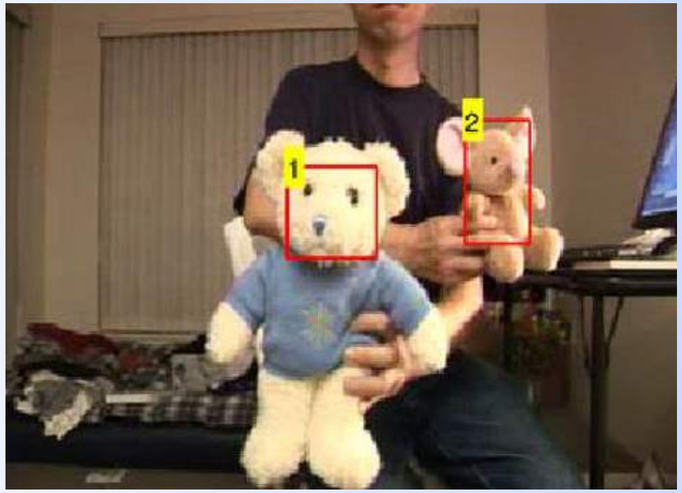




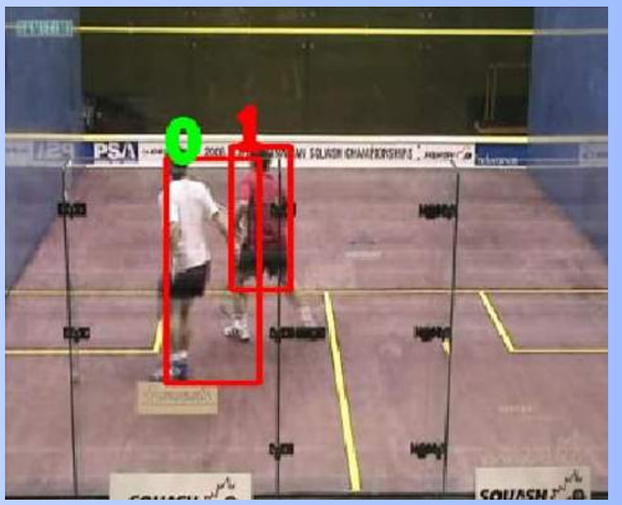




Multiple Object Tracking



Toys



Squash

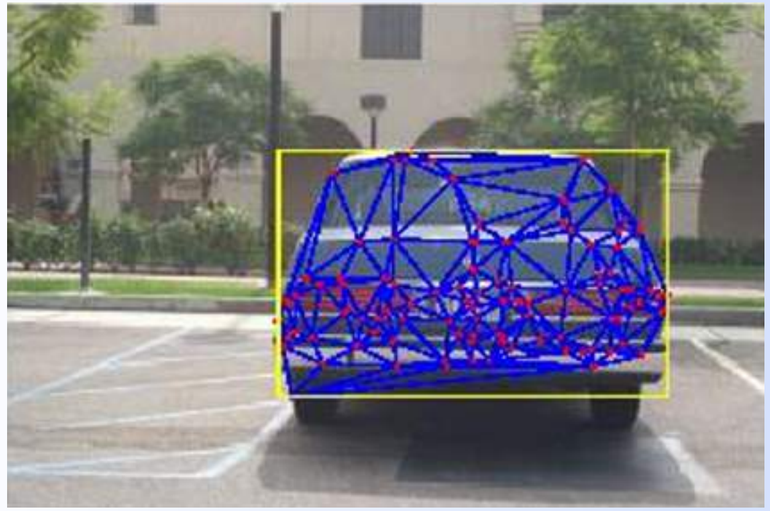


Lab



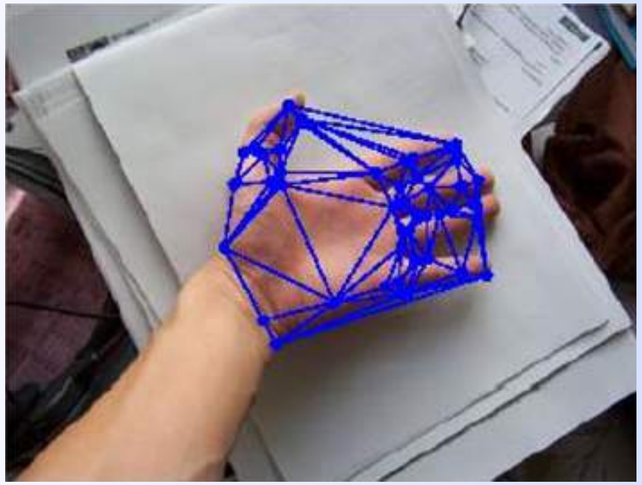
Double Squash

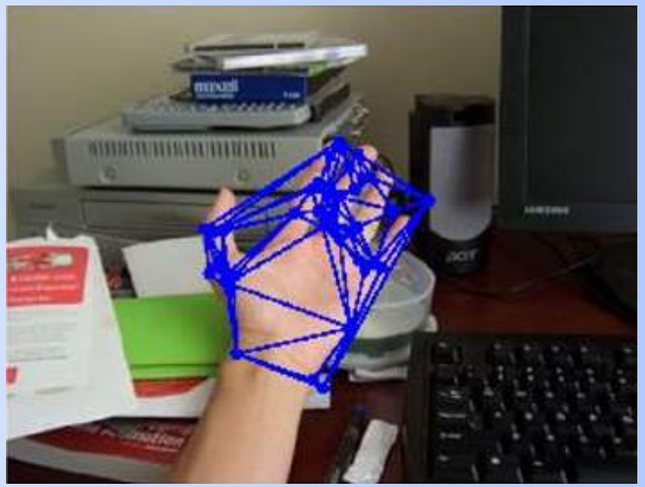
Finding Objects in Clutter

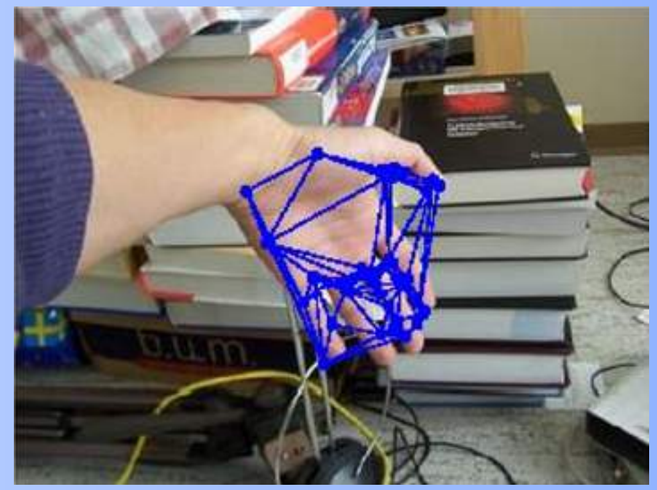












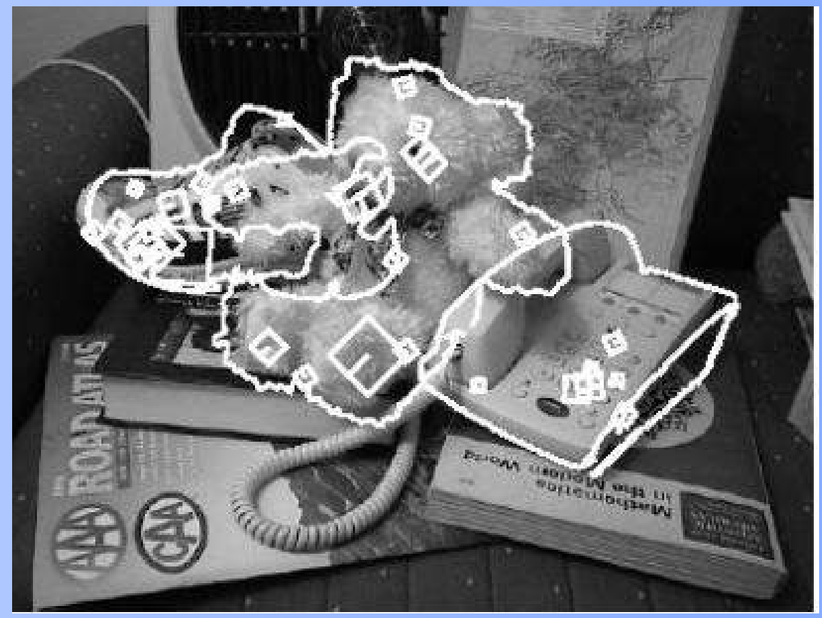
Object Recognition





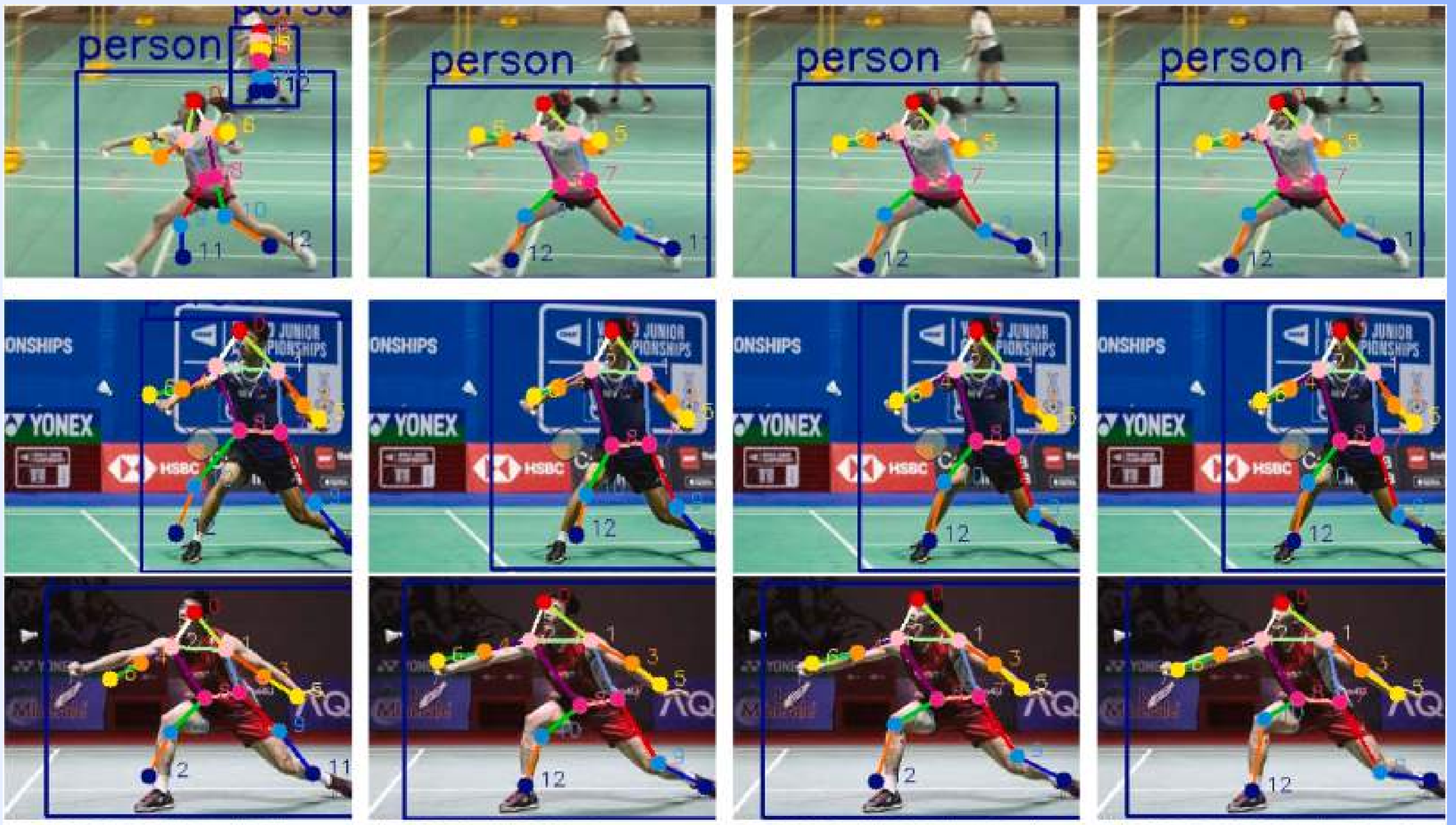






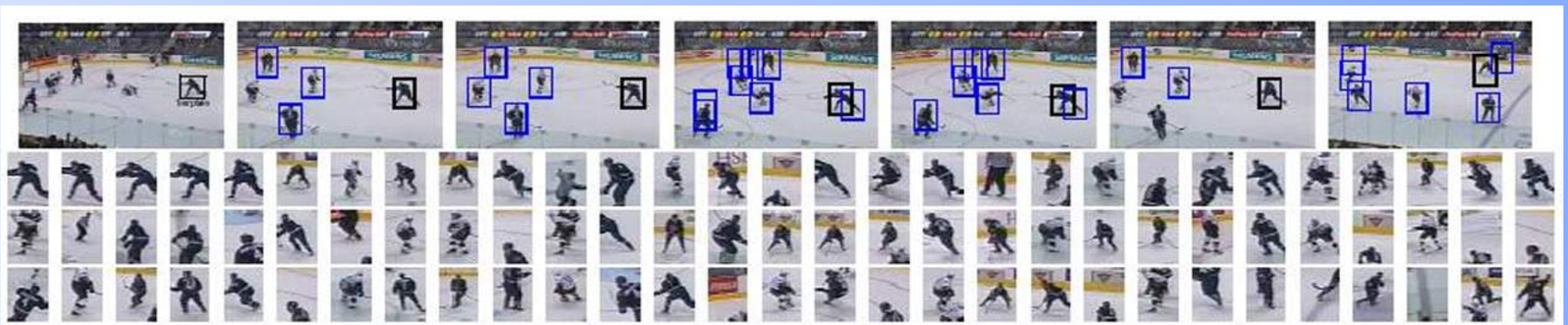
David G. Lowe, "Object recognition from local scale-invariant features," ICCV99

Posture Detection in Images

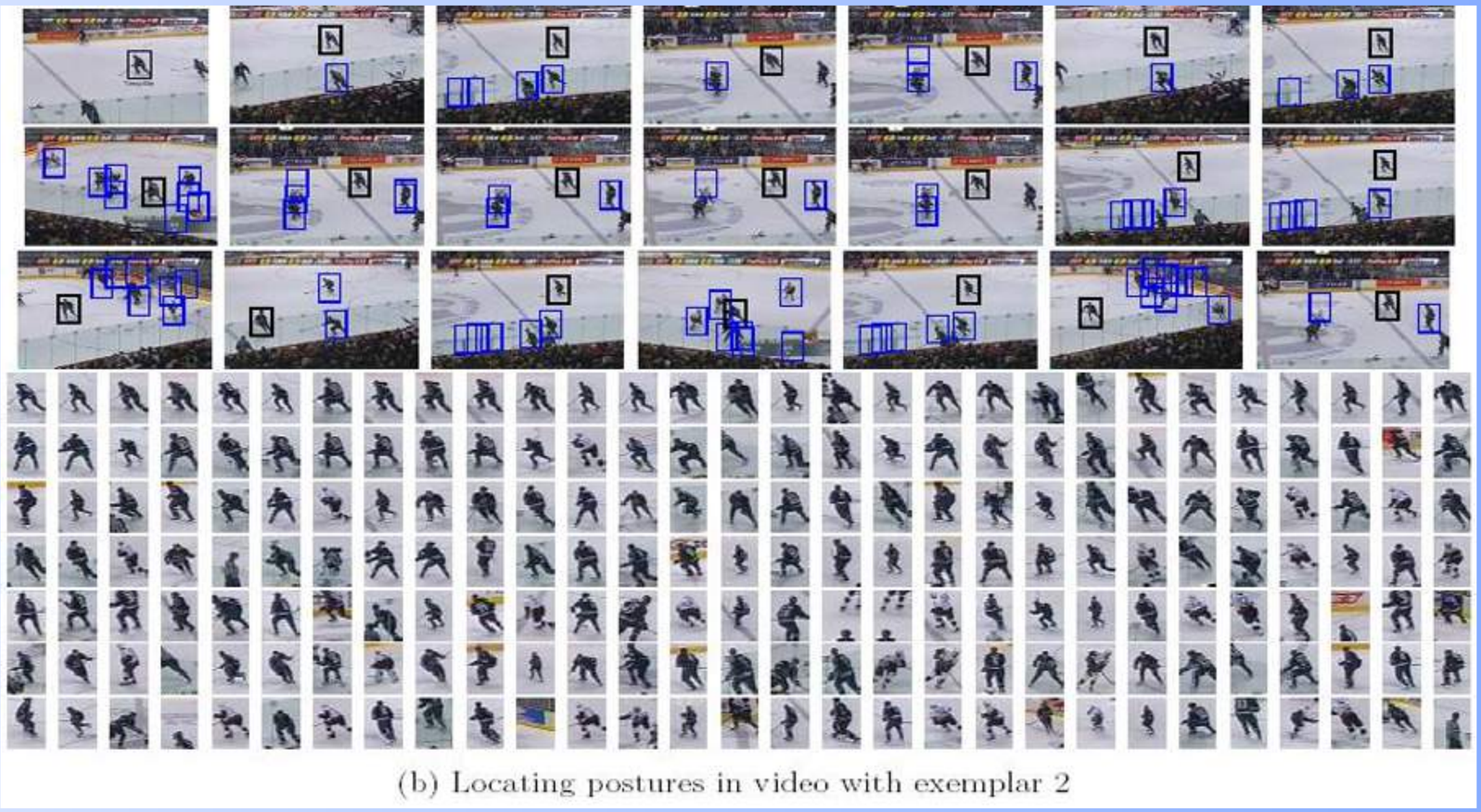


(a) YOLOv8(CSPDarkNet) (b) YOLOv8(HGNet) (c) YOLOv8(HGNet)+ACmix (d) YOLOv8(HGNet)+ACmix+FocalModulation

Dealing with Multiple Objects

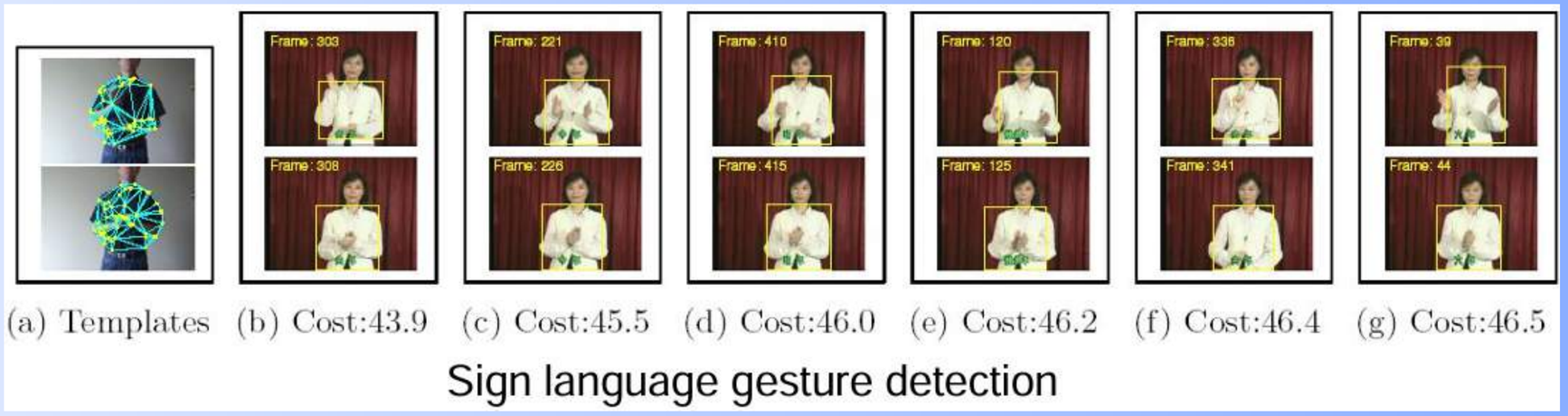


(a) Locating shooting posture in video with exemplar 1

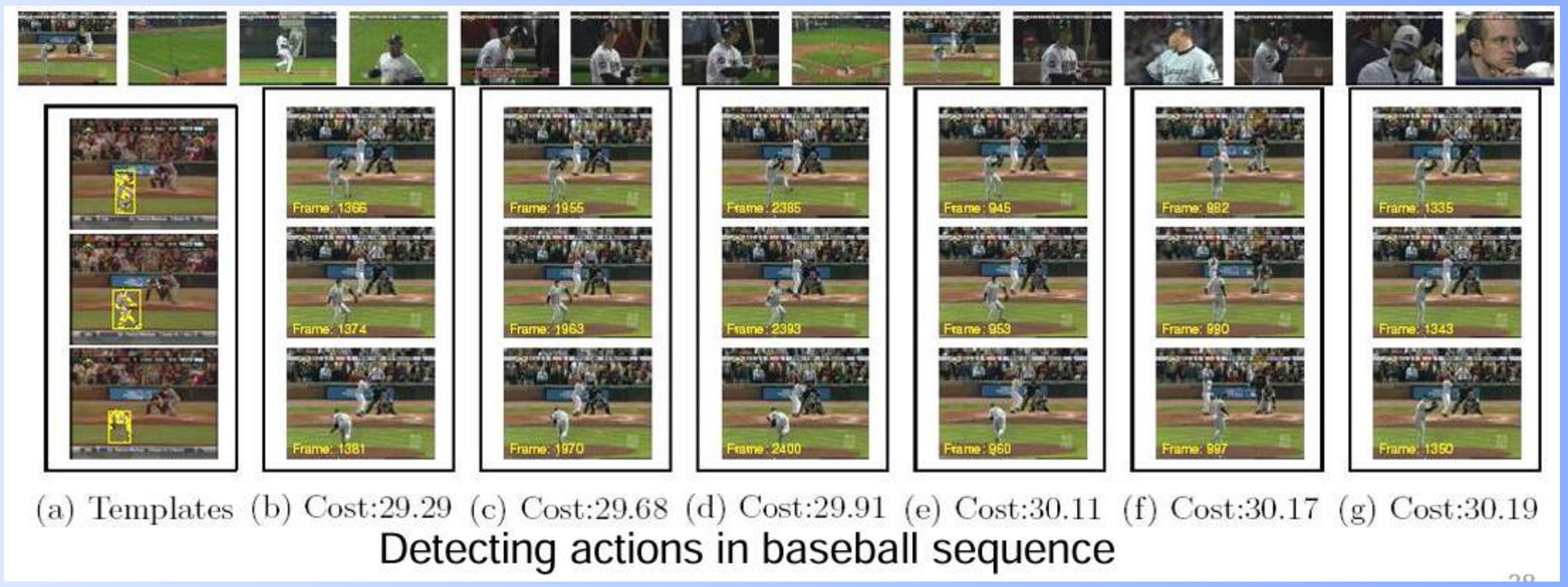


(b) Locating postures in video with exemplar 2

Action Detection



Sign language gesture detection

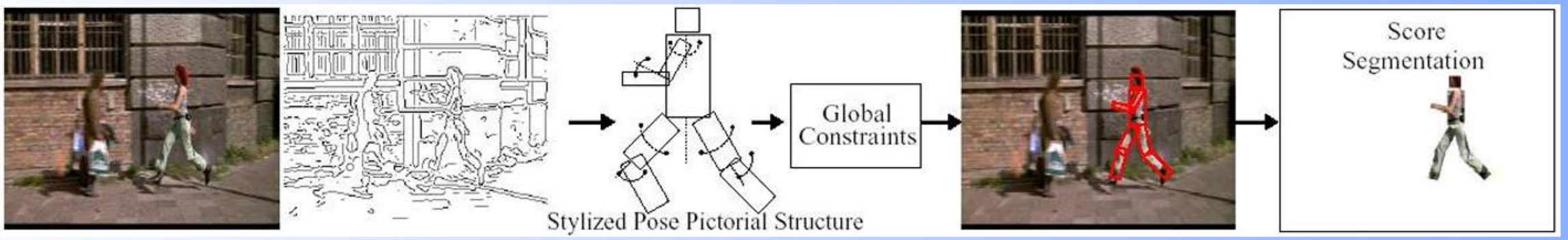


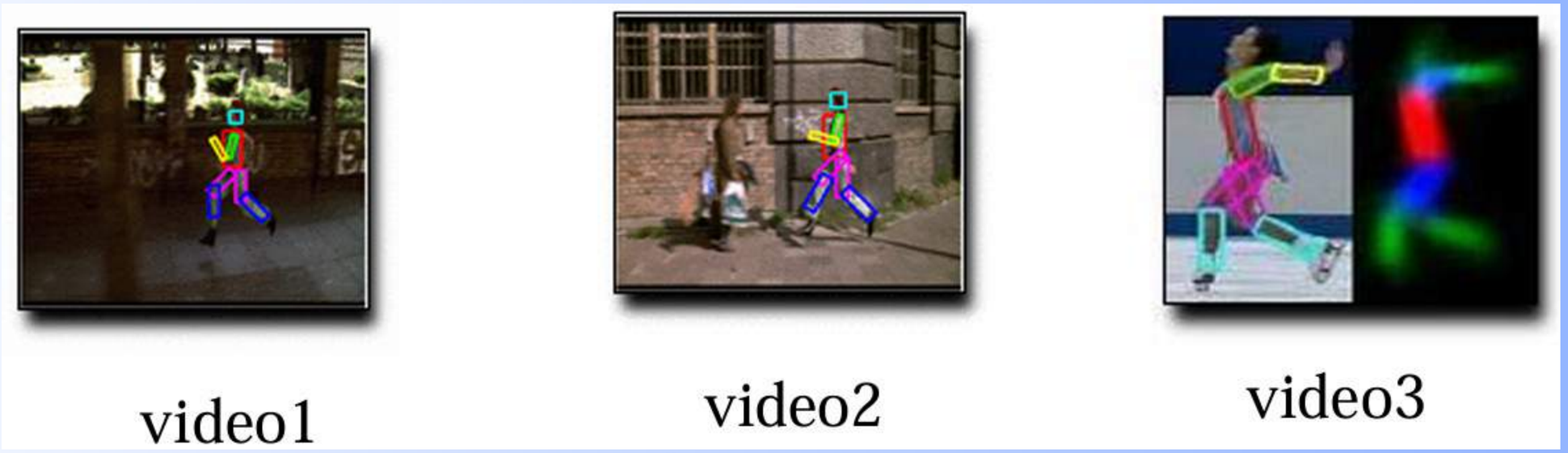
Detecting actions in baseball sequence

Finding Action Clusters in Image



Action Recognition





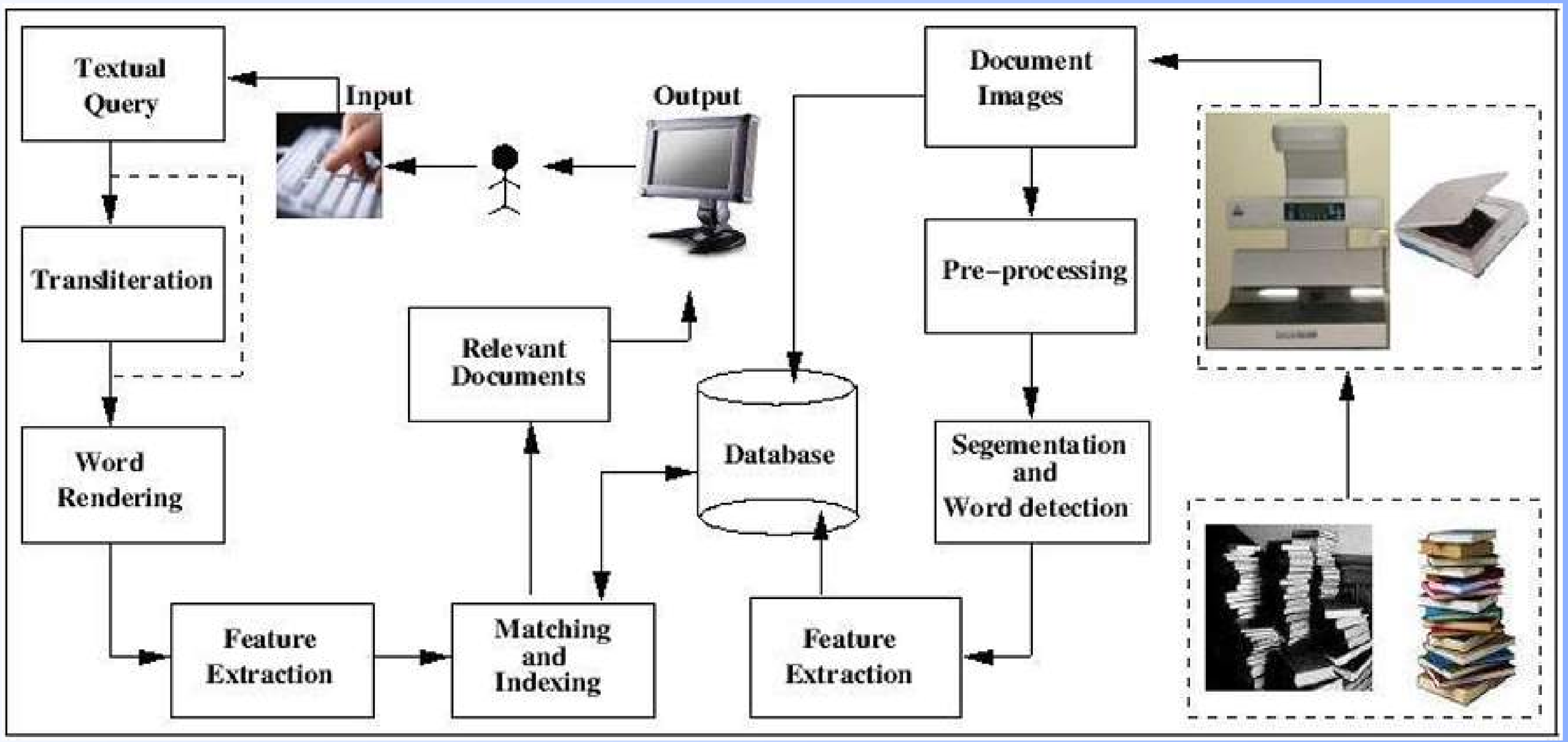
Ramanan, D., Forsyth, D. A., Zisserman, A. "Strike a Pose: Tracking People by Finding Stylized Poses." Computer Vision and Pattern Recognition (CVPR), San Diego, CA, June 2005.

Audio Processing

- Audio Coding
- Speech recognition
- Speech synthesis
- Speaker verification/recognition
- Audio effects



Indexing Structure

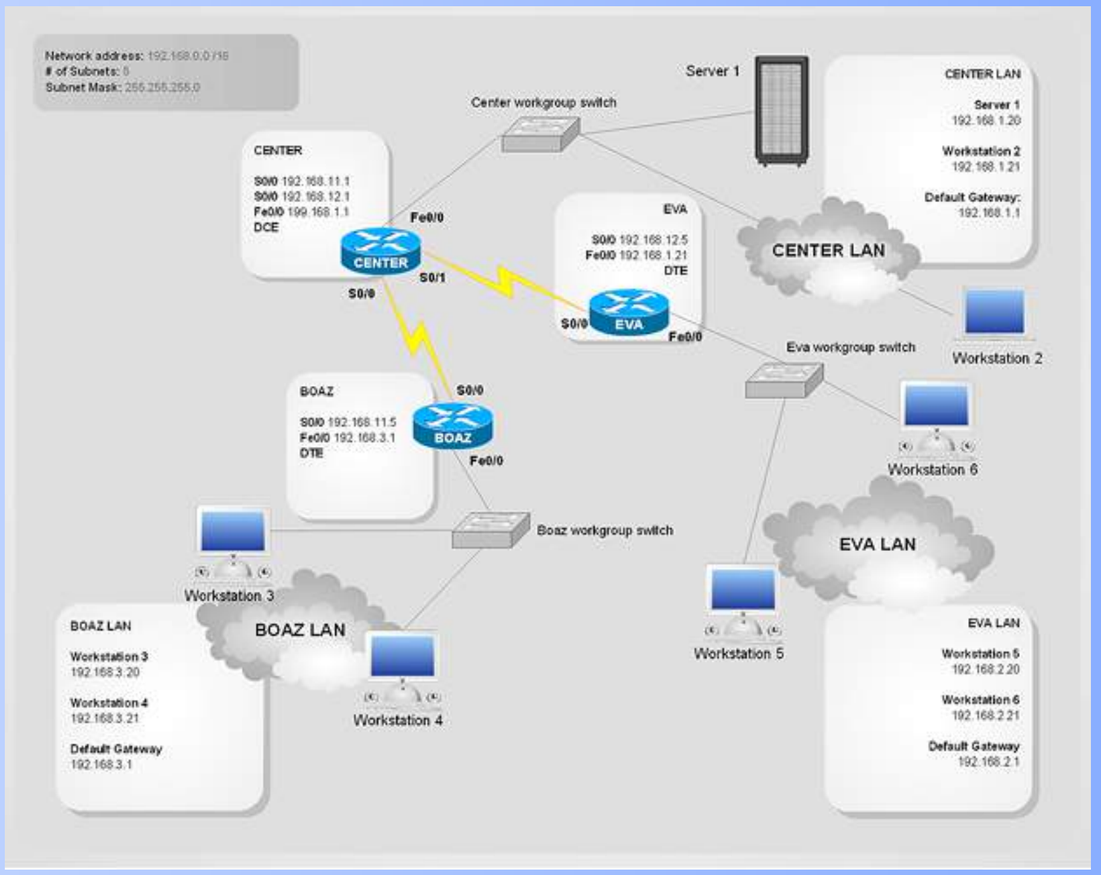


Multimedia Database and Indexing

- Multimedia database has to deal with large media files.
- Multimedia data needs new data structures, indexing and searching methods.
- Content based multimedia retrieval is still an ongoing research topic.

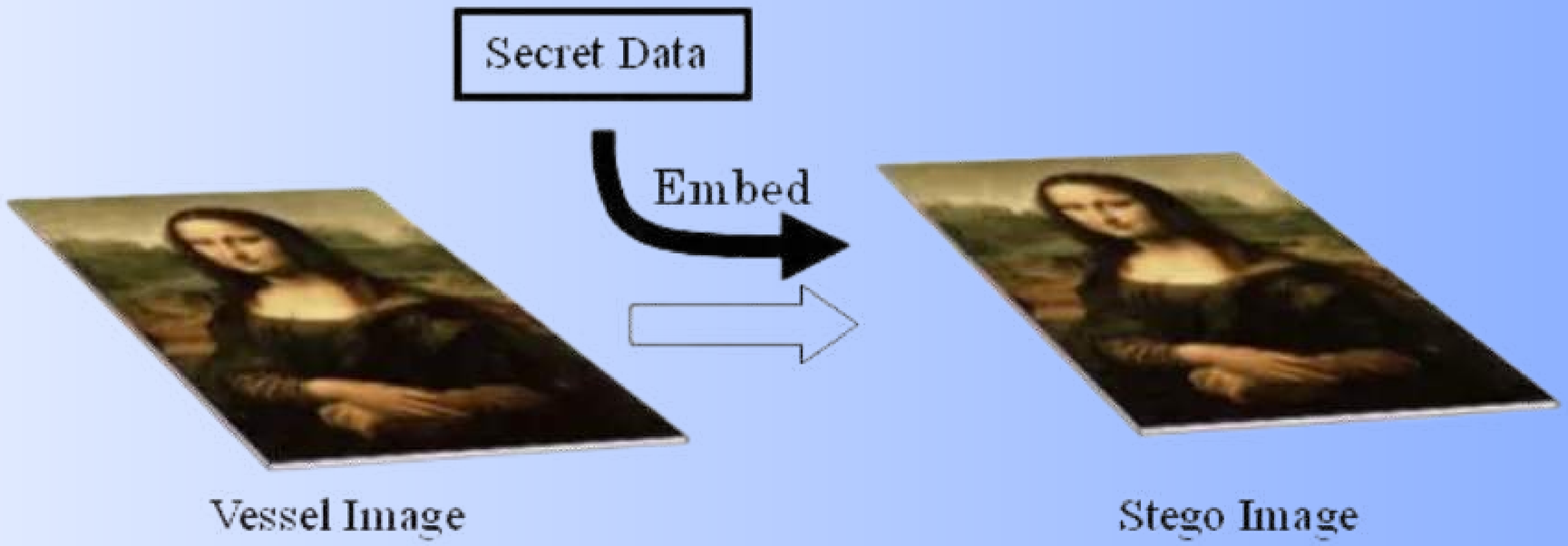
Media Delivery

- Transmitting multimedia data across the network is another topic in multimedia computing.
- There are different issues when we transmit video and audio through packet network.
  - Quality of service.
  - Synchronization.
  - Error and congestion control.
  - Session setup
  - Protocols



Watermarking Techniques & Security

- Why watermark media elements?
- Steganography:
  - Image
  - Video
  - Audio



Multimedia Server Architectures

- Multimedia Networking overview
- Media processing engines
- Supported standards and specifications