Biological Vision and Applications
Module 01-01: About Biological Vision

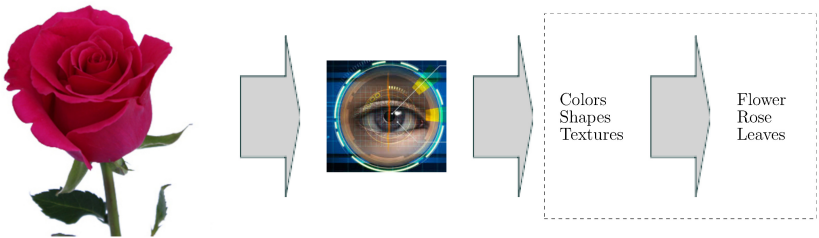
Hiranmay Ghosh

Vision

- Five sense organs to experience the world:
  - Eyes provide maximum information
- Vision is the process that transforms raw images to information
- This course is about study of principles of biological (human) vision
  - With an ulterior motive of applying them to computer vision system

What does Human Vision System do?

Transforming visual signals to information



Image

Description

... This looks trivial !!

What does Human Vision System do? (contd.)

A more complex example

- Determines structural composition of the scene in 3D
- Visual search – where is my cat?

What does Human Vision System do? (contd.)

A still more complex example

- **Identification**
  - Four players
  - Ball, Goalpost
  - Net, gallery, ...
- **Interpretation**
  - Football game
  - Free kick
- **Prediction**
  - Goal score?
- **Action Selection**
  - Cheer?

... Intuitive and instantaneous for humans. Extremely difficult for computers.

What all are involved?

- Signal processing (raw visual signals)
- Cognition capability
  - Mental focus (decide what is important)
  - Knowledge and experience (for interpretation)

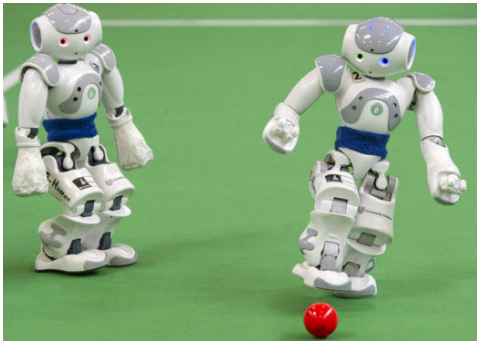
Goal of computer vision

- Simulate human vision system
  - ... Today's CV is far from achieving that
- How to bridge the gap?
  - Study principles of biological vision
  - Create mathematical models for those principles
  - Encode the mathematical models on computers (write programs)
  - Apply those programs for computer vision applications

What are the issues ?

- Too much of data to be handled
  - A HD video camera (1280×780) at 30 fps generates about 90 MB of data per sec.
- Interpreting visual data is ambiguous
  - A red circular object may be a cricket ball or a tomato
  - No two roses are exactly identical!
- Human mind does it intuitively!
  - Data reduction: What to ignore and what to use?
  - Knowledge-based interpretation: Context, knowledge and experience
- Interpretation is subjective

Situated Computer Vision System



- Visual task depends on environment and history
- To be done in real time – followed by action
- Eternal cycle of sensing and action

Layers of Interpretation

Food
Health
Elation

STOP!
Danger

Bharatnatyam
Joy & Freedom

Cognition

Yellow long things
Bananas

Red circle
Traffic signal

Human figure
Outstretched limbs
Blue dress

Perception

Visual signal

Quiz

Quiz 01-01

End of Module 01-01