Biological Vision and Applications
Module 01-02: Stages of Human Vision

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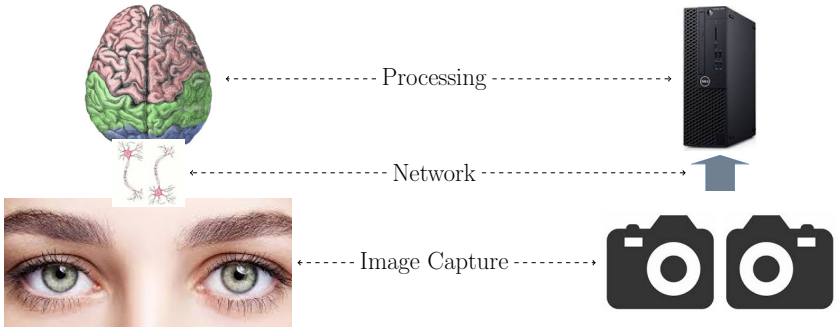
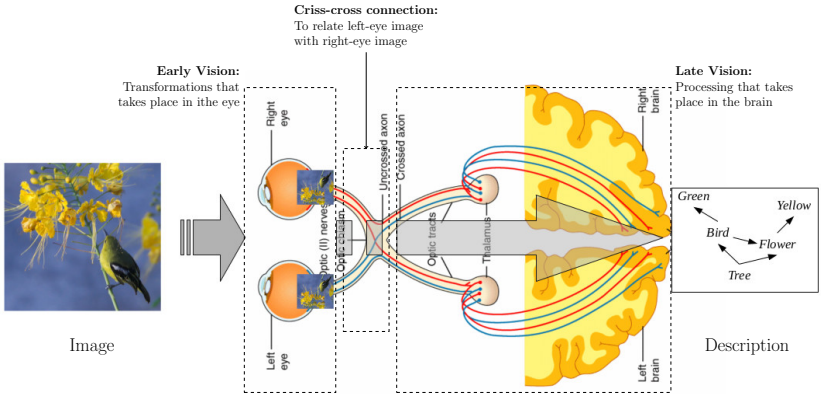
A Simplistic Analogy



... But, there is much more to it

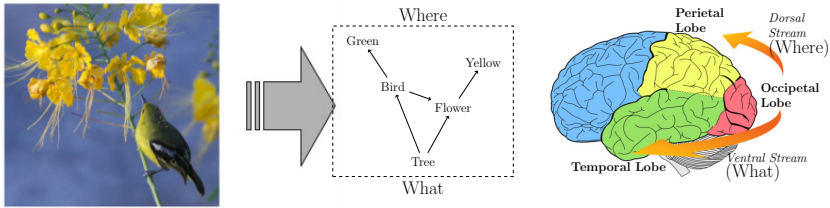
Overview of Human Vision System

Early Vision and Late Vision



Ventral and Dorsal Streams

Answering "What" and "Where"



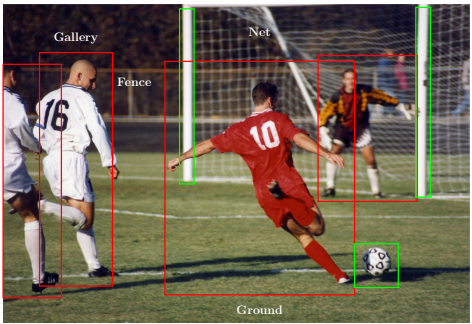
- Ventral Stream is responsible for answering "What"
- Dorsal Stream is responsible for answering "Where"

What is "Vision"?

- **Recognition and localization**
  - Four players, Ball, Goal post
  - Net, viewers' gallery, fence ...
- **Semantic interpretation**
  - Football game
  - Free kick
- **Prediction**
  - Possible goal score

Perception

Identify objects, locations: What and where



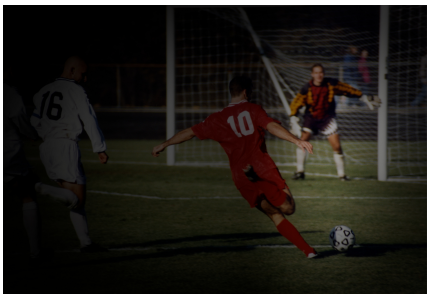
- Foreground and background
- **What ?**
  - Four Players, Ball, Goal Posts
  - Net, Fence, Gallery, Ground ...
- **Where ?**
  - Relative positions
  - Geometric organization

What is perception

- Interpretation of the sensory data - signal processing
- Some assertions made about the environment
- From signals to semantic representation
  - Results in data reduction
- Different viewers can make different assertions about the same scene
  - Depending on viewpoint, signal noise, sensory capabilities, etc.
- May be correct, partially correct, or incorrect
  - There can be “illusions”

Attention

Decide what is important



- We never look at the whole picture
  - We look at selective places for understanding the scene
- Lots of information gets filtered out before entering cognitive system
- Visual semantics is conveyed by very small regions of a picture

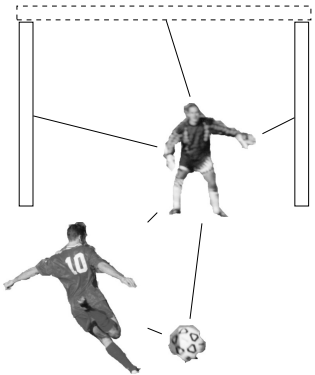
What is attention

- Selective filtering of the sensory data
  - Deciding what is important
- Results in data reduction
- Depends on context, user intention, task at hand
- Can result in change blindness
  - Adversarial attempt to “divert” attention

Edpuzzle assignment

Cognition

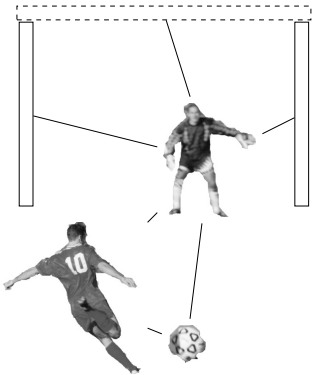
What do you "infer" from this picture ?



- Focus on a few things and interactions
- Draw inferences:
  - It is a football game
  - It is a free-kick
  - The goal-keeper is ready to defend
- How do you make these inferences?
  - Knowledge of football and other games
  - Experience of this game, reputation of the players ...

Prediction

What do you "predict" ?



- What will be the likely trajectory of the ball?
- What will be the goal-keeper's reaction?
- What is the probability of a goal score?
- How do you make these inferences?
  - Knowledge of football and other games
  - Experience of this game, reputation of the players ...

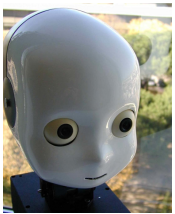
What is cognition

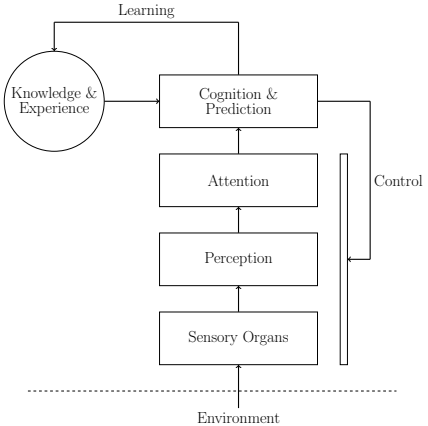
- Experiential interpretation of the filtered percept
- Cognition is subjective, depending on
  - Intentional state of the observer
  - Background knowledge, context, experience, etc.
- Can fill-in the missing percept / correct erroneous perceptions
- Cognition includes prediction (past and future)

In summary ...

- **Perception:**
  - Acquisition of new information about the environment through the sensors
  - Sensory signals to symbolic representation
- **Attention:**
  - Selective filtering of percept (decide what to filter)
  - Depends on user task, intention, context, etc.
- **Cognition:**
  - Experiential interpretation of filtered sensory data
  - Inferencing about the (past / present / future) state of the world

Simplified process model for Vision System





Quiz

Quiz 01-02

End of Module 01-02