

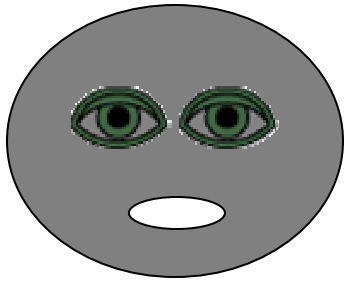
# Robot Vision: A Holistic View

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## Cognitive Vision



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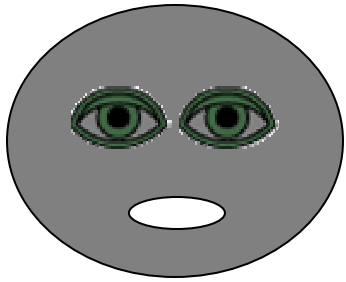
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# Introduction

- Cognitive vision is a new emerging sub-discipline in robot vision, which was testified by the first international workshop dedicated to it in May/June 2004.
- However, its scope was not well-defined in that workshop.



**Scope:** ( extracted from <http://www.cn.stir.ac.uk/ecovision-ws/> )

This workshop will bring together scientists in the field of biological motivated computer vision, visual neuroscience and computational neuroscience of vision. Its scope is trying to approach the problem of higher visual functions (e.g., active vision, visual attention, task-directed vision) by bridging the gap between early vision, visual perception, and cognition.

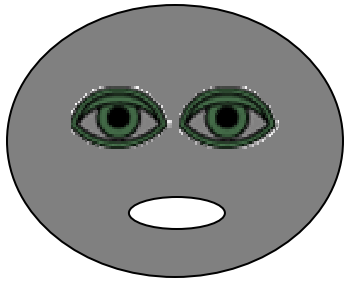
To this end we would like to invite participants from the different fields hoping to create an atmosphere which stimulates discussions at this most scenic location at the south tip of the Isle of Skye.

Send inquiries and comments to:  
<http://www.ntu.edu.sg/home/mmxie>

Cognitive Vision

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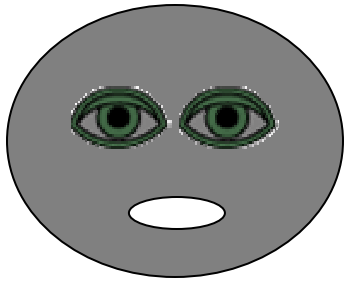
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# Introduction

- I would like to define Cognitive Vision as a discipline, which studies the aspect of “meaning” recognition from images or videos.
- Here, “meaning” of a scene or object refers to its properties, constraints and their evolutions in space and time.
- We know that vision is the window, through which a robot could sense and understand the meaning of an external world.
- We hope that vision could live up to this expectation, because:
  - The evolution of robots from automated machines to autonomous machines depend on the ability to sense and understand the meaning of an external world.
  - Therefore, a robot must possess a cognitive vision, in order to become intelligent and autonomous.
  - The following diagram shows the psycho-physical development of an organized body at various stages.



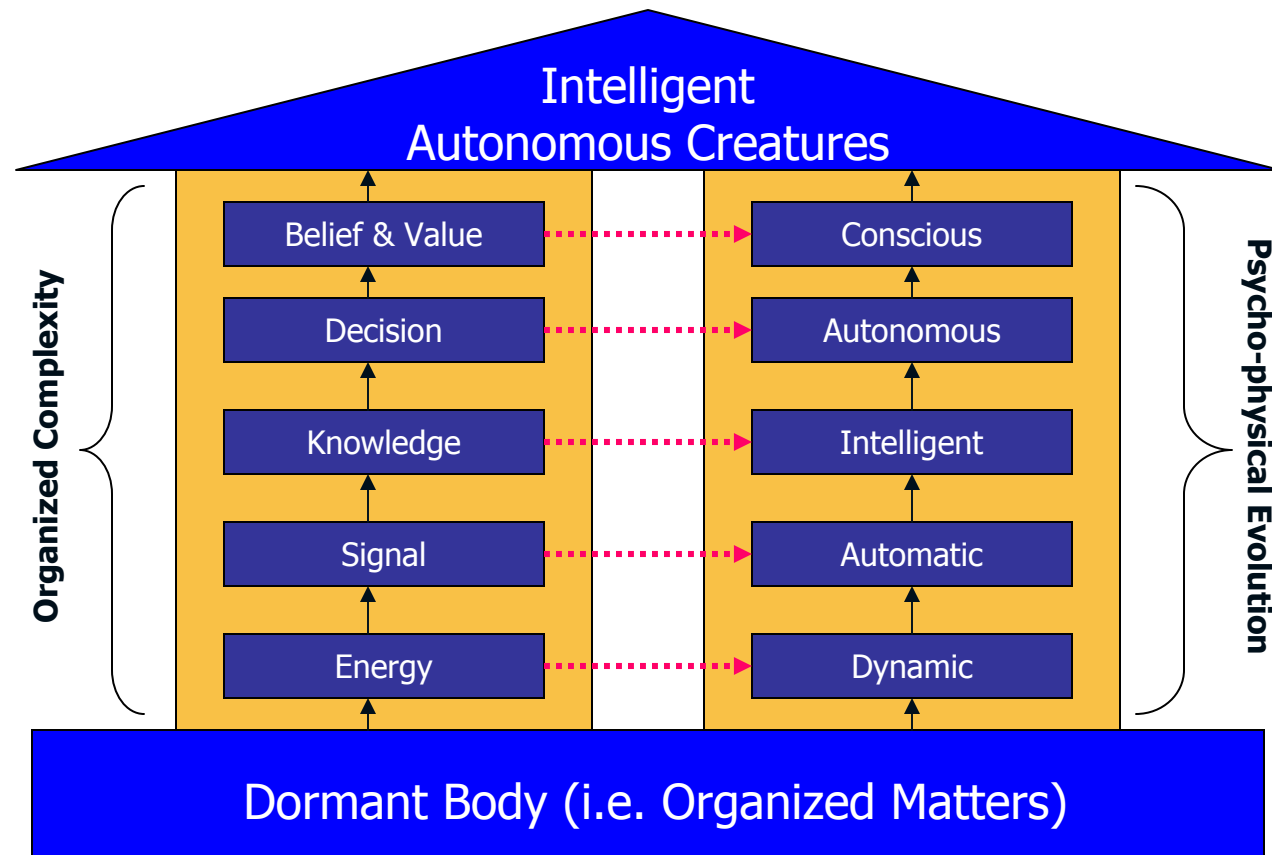
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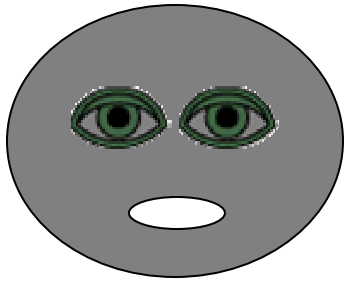
Robots of tomorrow should become intelligent and autonomous creatures.

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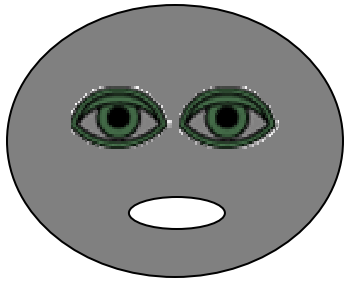


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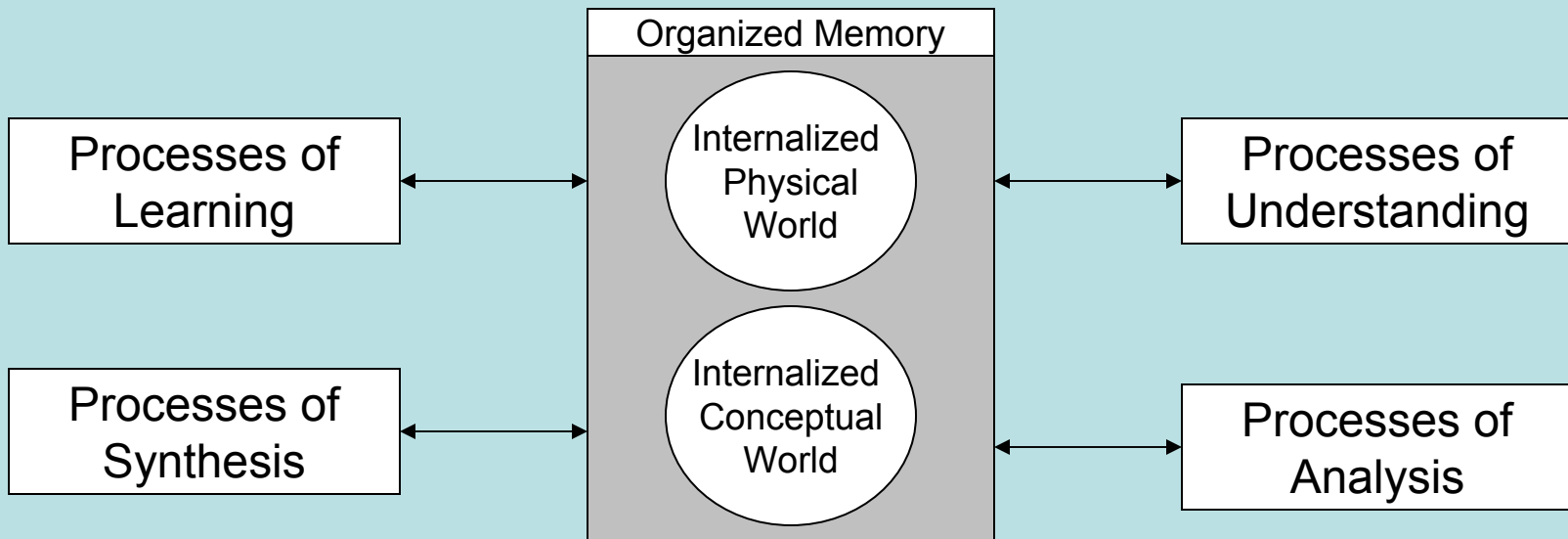
- It will be an exciting journey for a robot to evolve and become an intelligent and autonomous creature of human.
- However, despite many attempts, no significant progress has been made toward the ultimate goal of robot vision, that is: to understand the meaning from images or videos.
- There are, at least, two reasons behind this stagnation:
  - First of all, the importance of “mental architecture for vision” is overlooked.
  - Although there are a lot of recent works on the so-called “content-based” video/image processing, understanding, or retrieval, there is no questioning about what should be the fundamentals.
- We believe that an organized complexity implies not only organized body, but also organized memory, in which all mental processes (e.g. learning, analysis and synthesis) act, or interact.

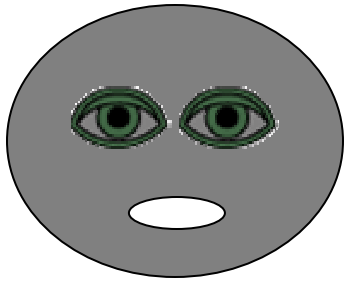


# Future Challenge

An organized complexity must have an organized memory

## A Robot's Mental World





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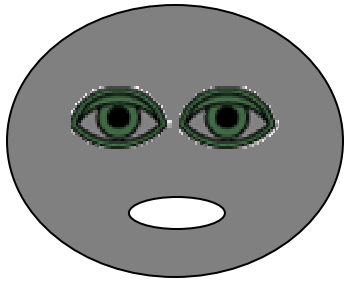
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- Secondly, robot learning is mistakenly considered as being equivalent to machine learning.
- In its traditional sense, machine learning studies techniques or algorithms, which discern “regularities” or “irregularities” in data (including images or videos as in the application of visual surveillance).
- However, I consider that robot learning is a sub-discipline in robotics, which studies the innate principles or solutions, which enable robots to discern meanings from sensory data as a result of interaction between robots and an environment.
- In general, learning invokes modeling, optimization and representation.
- But, at the cognitive level, learning must consider knowledge model.
- And, in robotics, learning must be active, and involve interaction in order to form a “learning loop”.





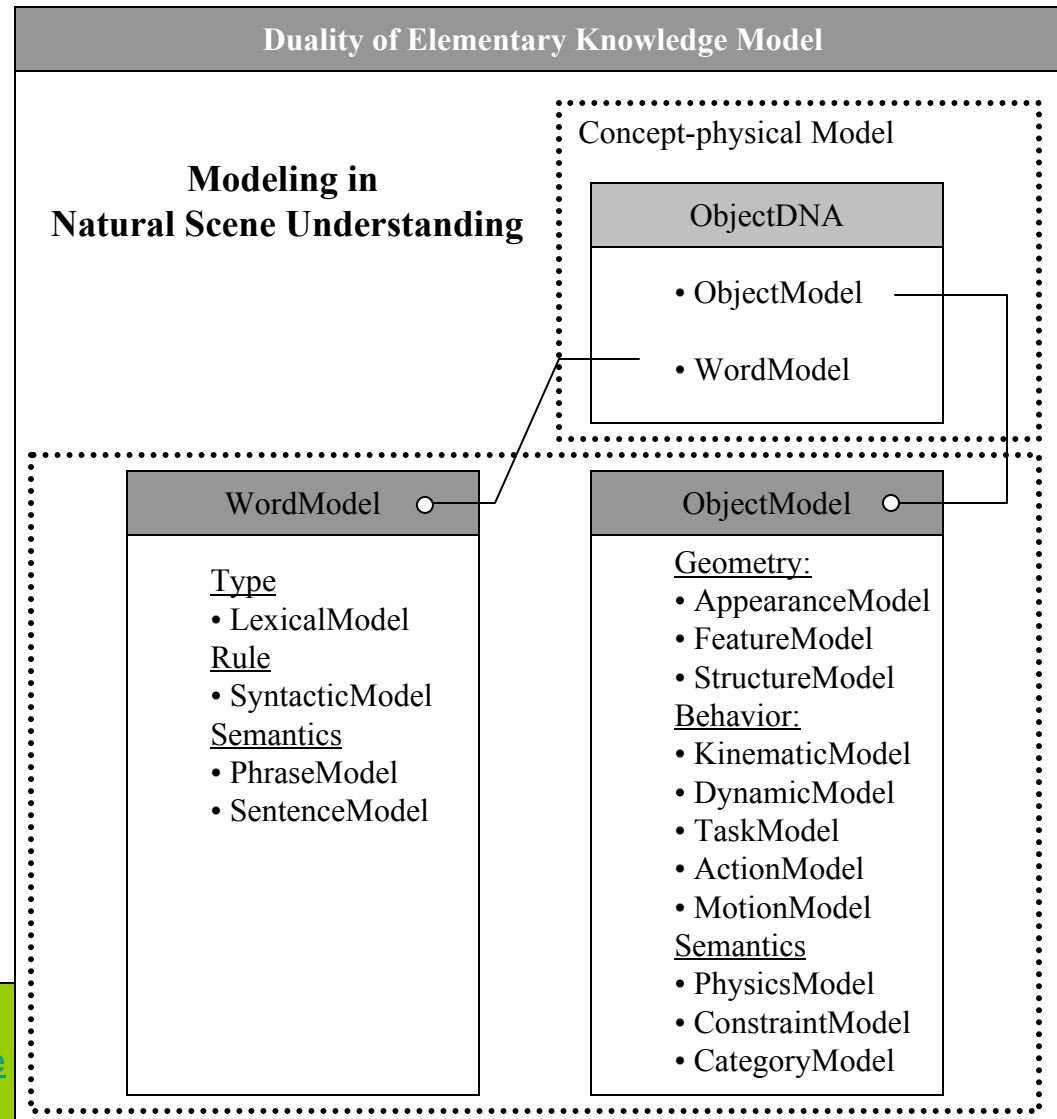
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Robot learning at cognitive level must use a knowledge model

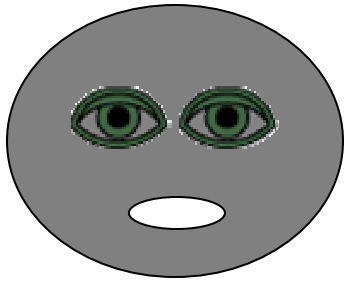
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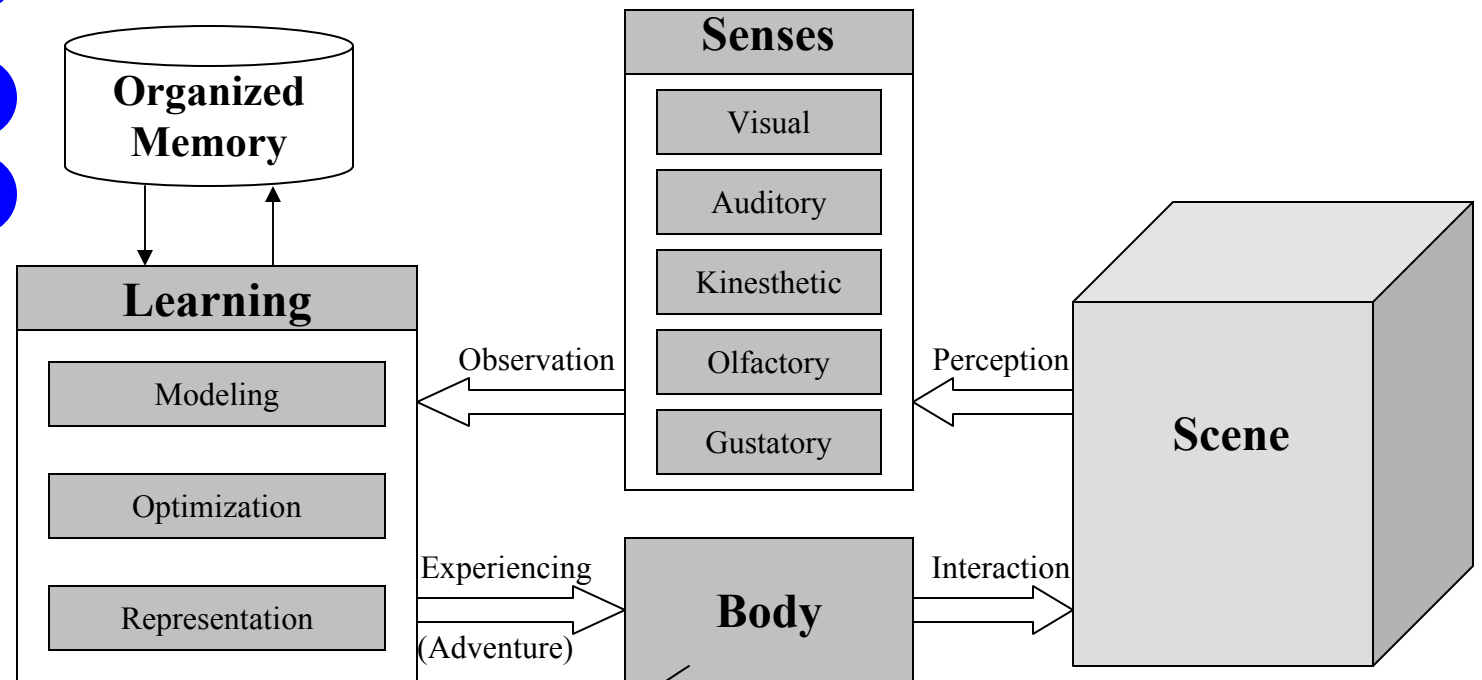
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Learning must be “active”, and involves interaction in a “learning loop”.

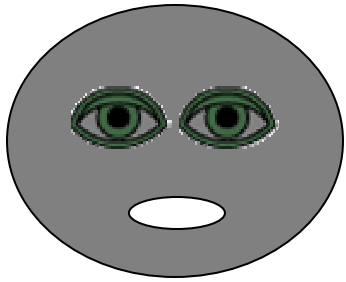
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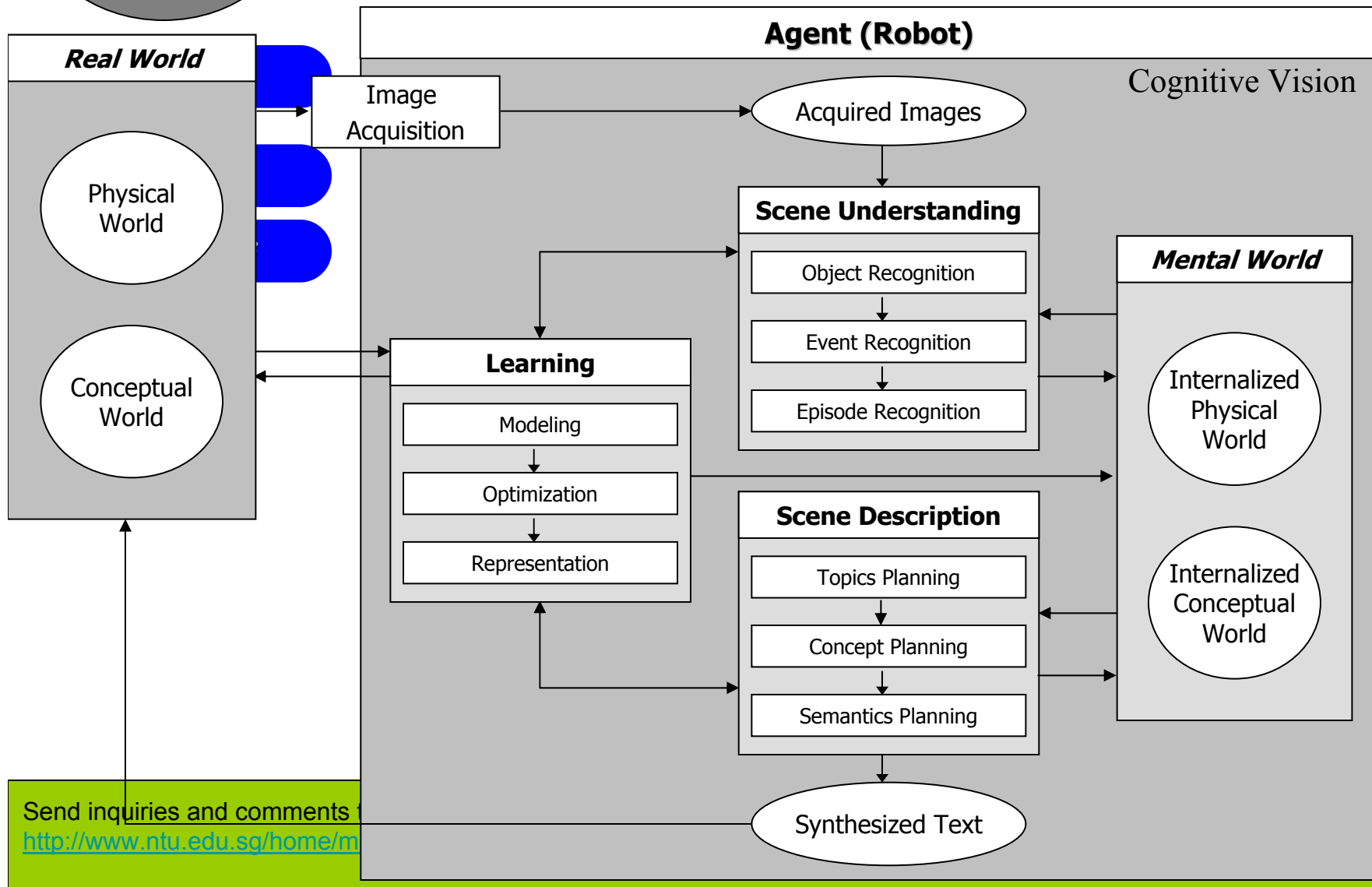


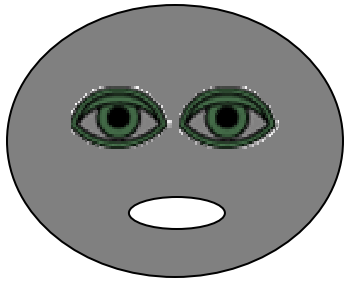
To design a robot body suitable for “active” learning!



# Future Challenge

A cognitive vision must have its own framework.





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# End of Cognitive Vision