
Representational Issues for Behavioral Systems

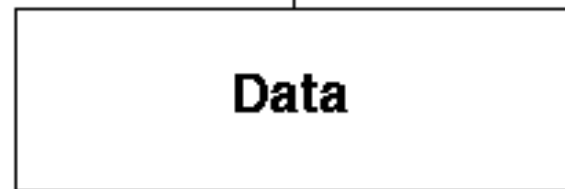
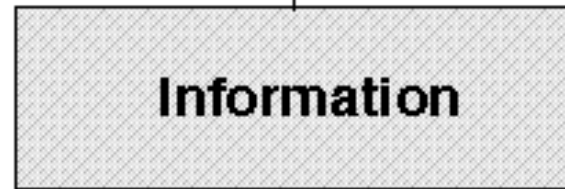
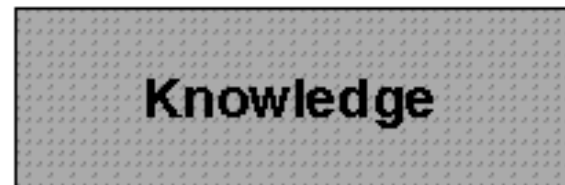
Behavior-based Robotics Course

Objectives

- Define knowledge
- Understand qualities of knowledge representation
- Identify types of knowledge useful for behavior-based systems
- Study several specific strategies

Basis of Knowledge

Volume

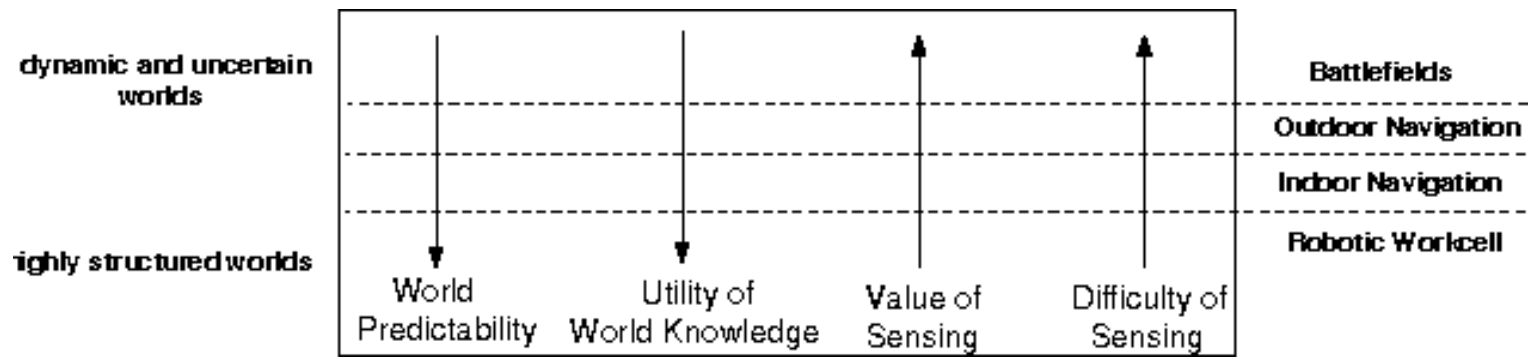


Organization

Definitions of Knowledge

- Information in context, organized so that it can be readily applied ...
- Understanding, awareness, or familiarity acquired through education or experience
- Physical structures which have correlations with aspects of the environment and thus have a predictive power for the system

Tradeoffs for Knowledge Use



Knowledge representations

- **Explicit:** symbolic, discrete, manipulable knowledge representations typical of traditional AI
- **Implicit:** Knowledge that is non-explicit but reconstructible and can be made explicit through procedural usage
- **Tacit:** Knowledge embedded within the system that existing processes cannot reconstruct

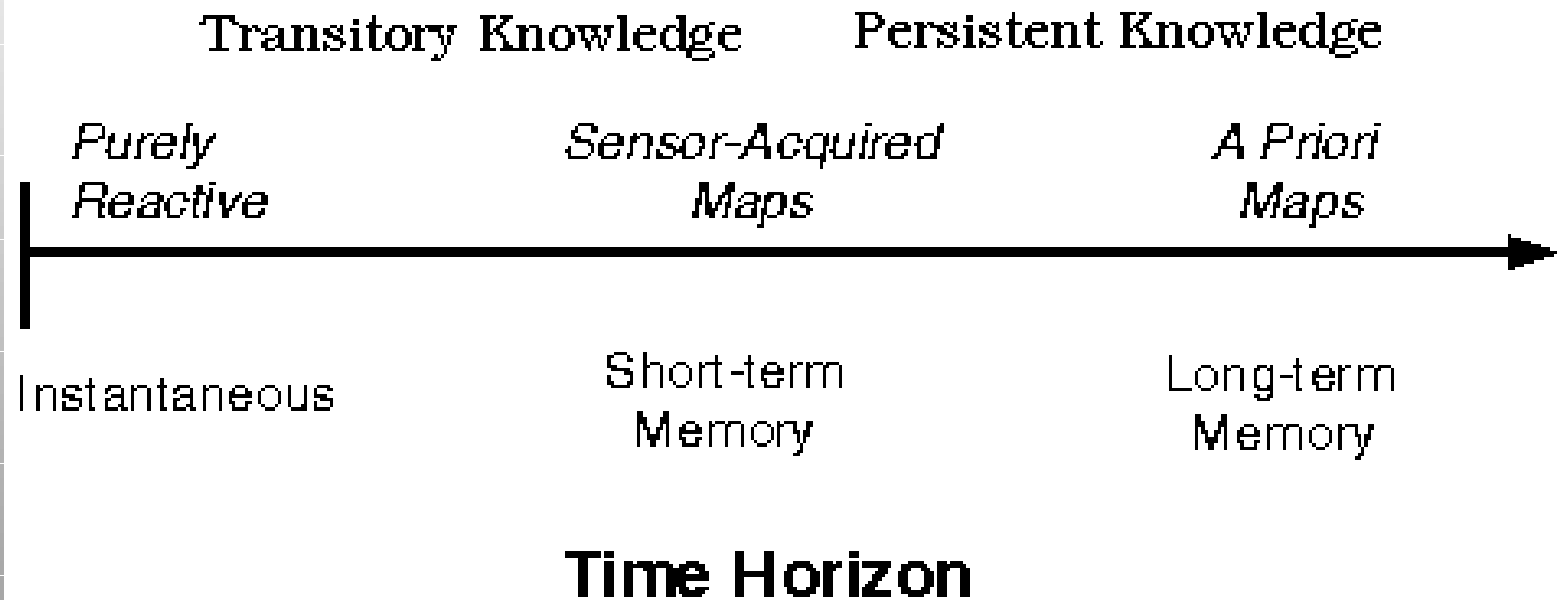
Types of knowledge

- Spatial world knowledge
- Object knowledge
- Perceptual knowledge
- Behavioral knowledge
- Ego knowledge
- Intentional knowledge

Qualities

- quantitative/metric or qualitative/relational
- persistent or transitory (STM / LTM)
- symbolic or subsymbolic

Time horizon for knowledge



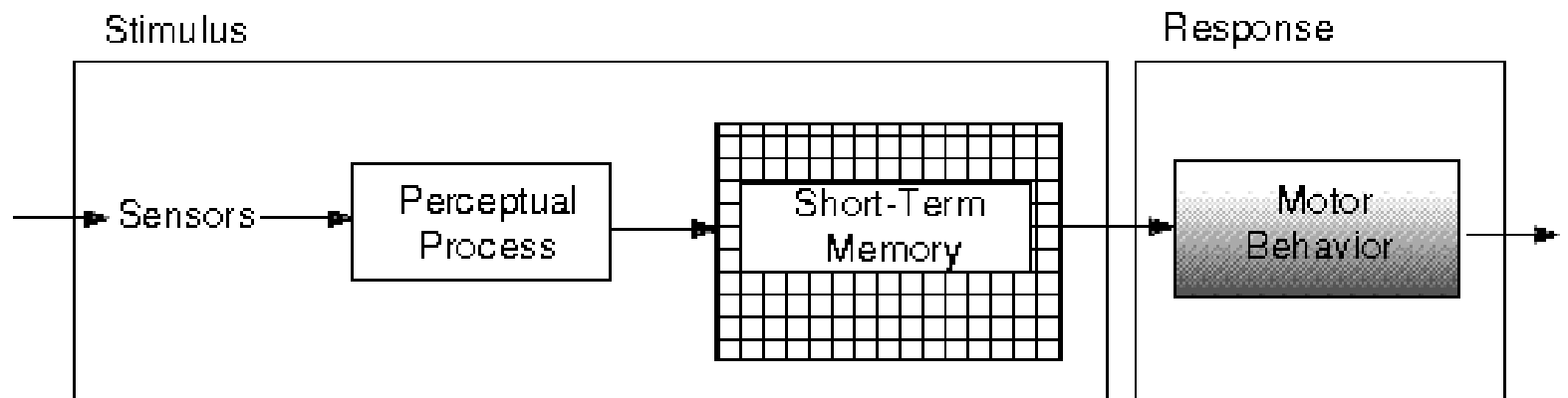
Cognitive maps

- animal navigation
- appear vector based
- support a wide range of behaviors
- evidence for geometric module in rat hippocampus

Knowledge Representations in behavior-based systems

- Short-term behavioral memory: action-oriented knowledge representation
- Sensor-derived long-term cognitive maps
- A priori map-derived representations

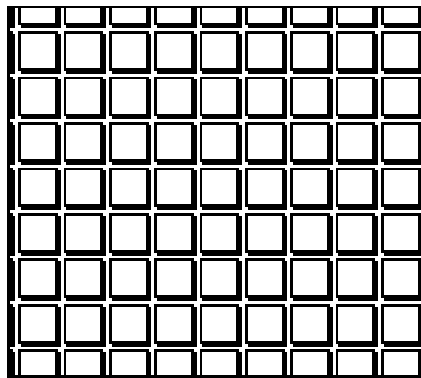
Short-term behavioral memory



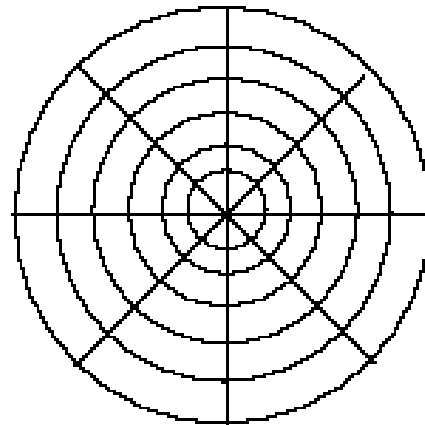
Grid representations

Vary in:

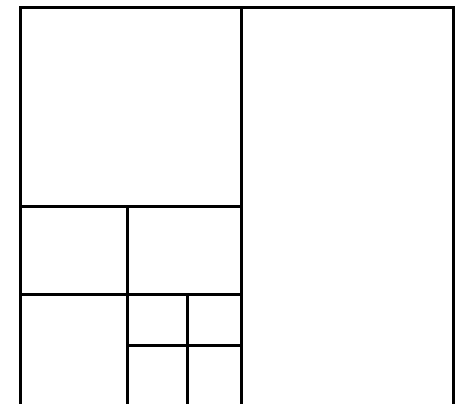
- resolution (area)
- shape
- uniformity (quadtrees)



(A)

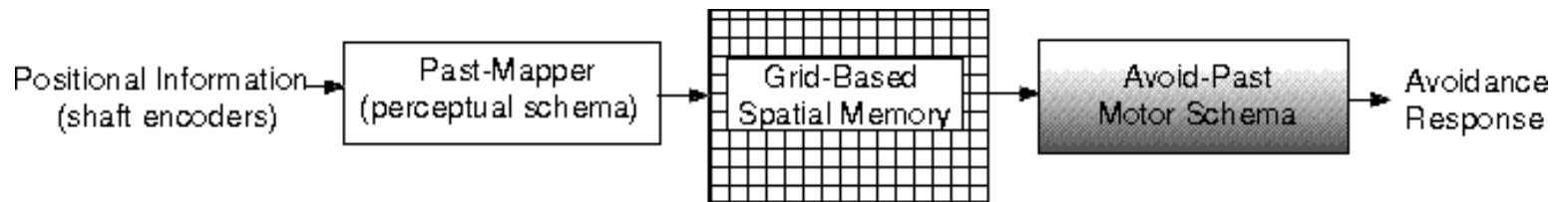


(B)

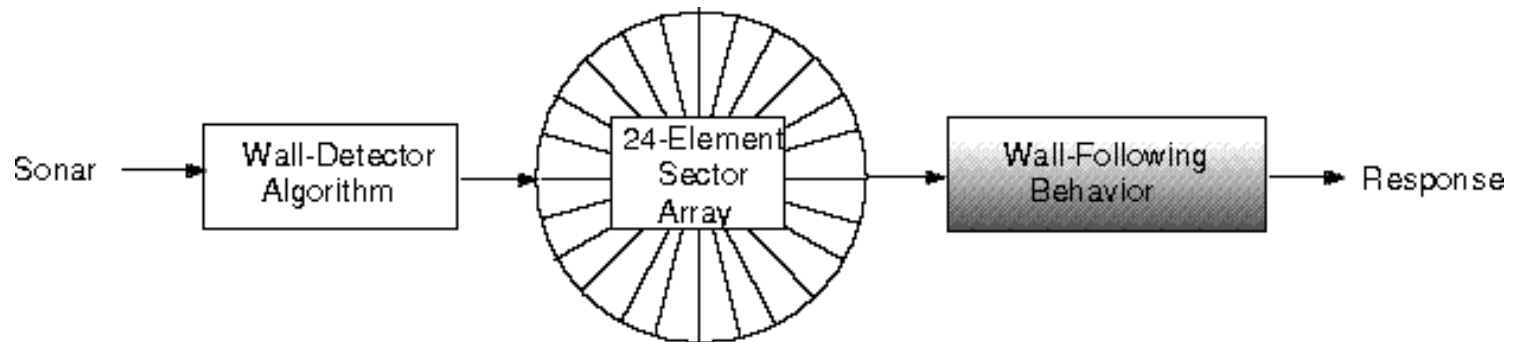


(C)

Behavioral memory examples (1)

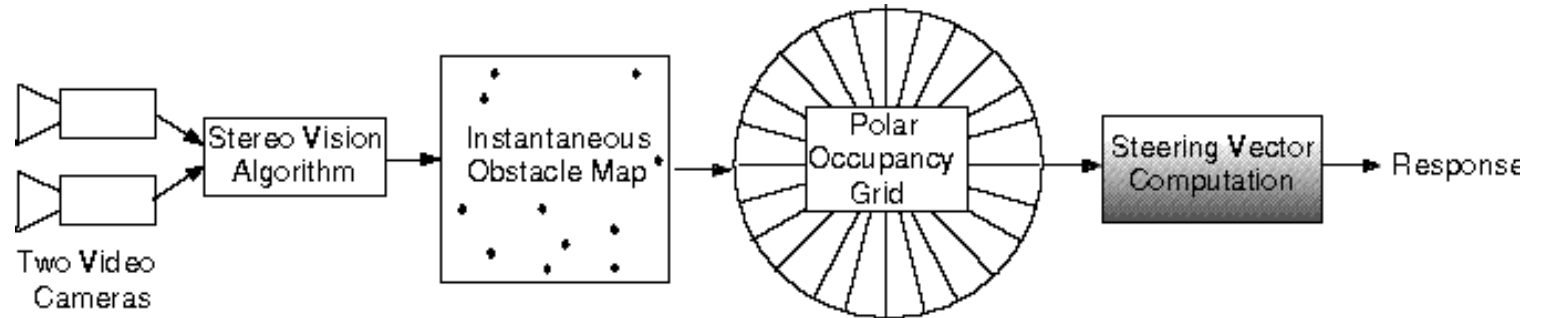


Avoid-past

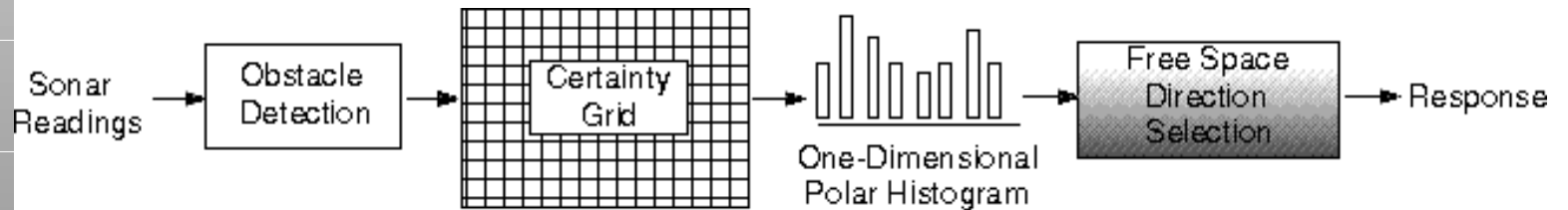


Wall memory

Behavioral memory examples (2)



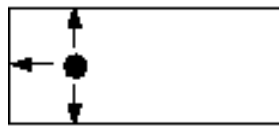
IOM



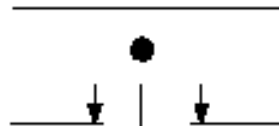
Vector Field Histogram

Qualitative navigation

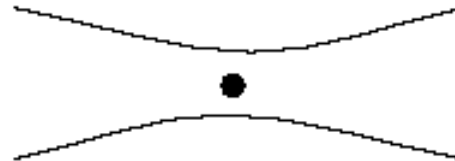
Distinctive regions



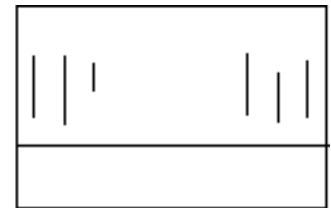
(A)



(B)

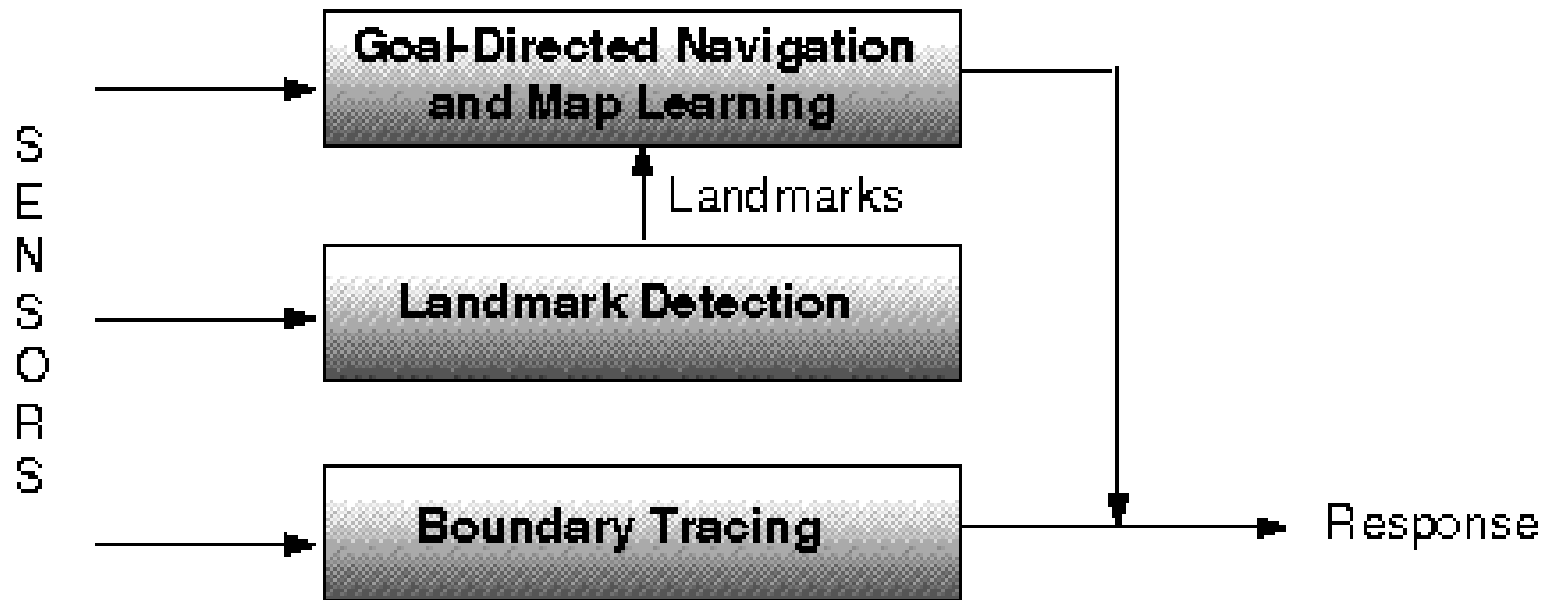


(C)



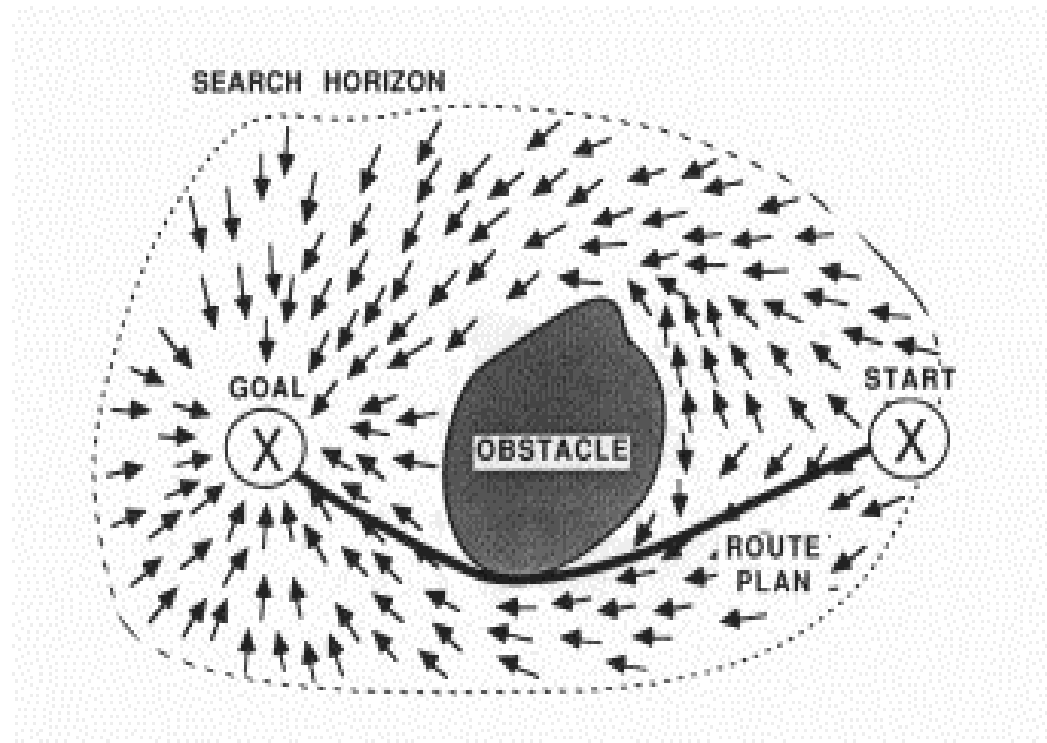
(D)

Toto

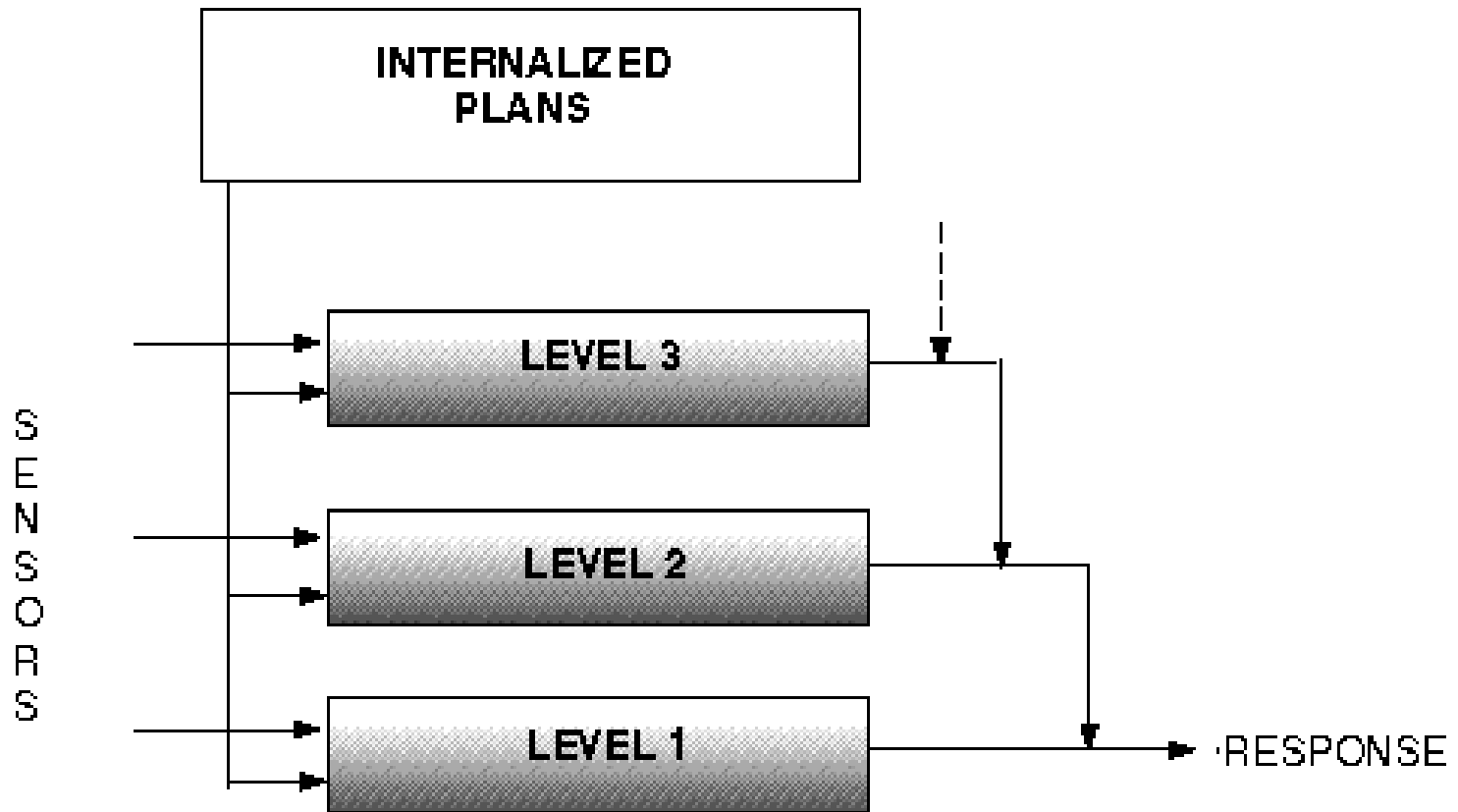


A priori maps

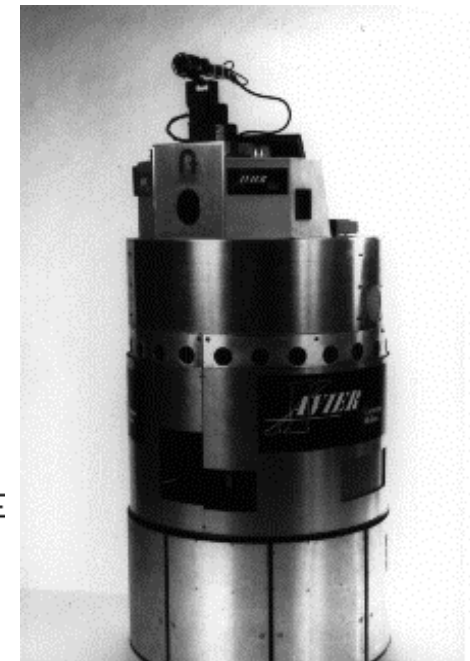
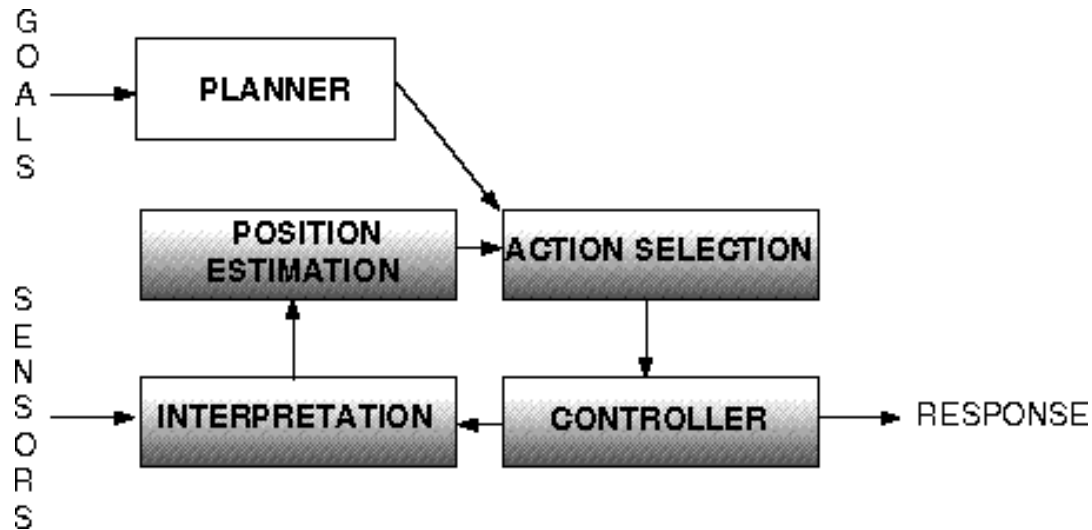
Internalized plans



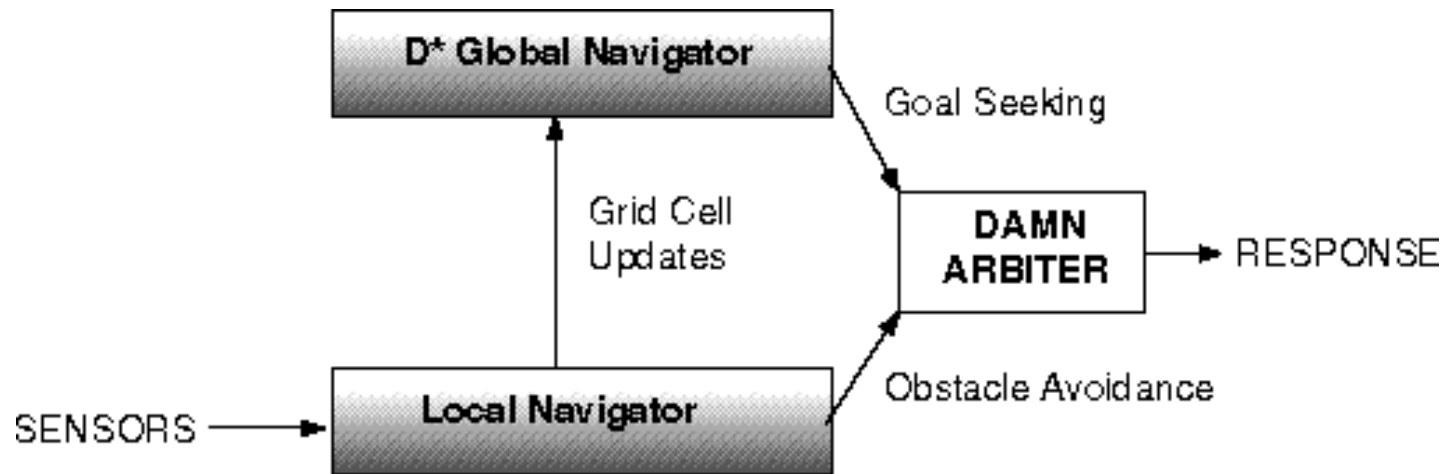
Behavioral controller using internalized plans



Action-selection control architecture



D*



Perceptual representations

function-based

