

# Symbolic approach to affordances in SGOMS



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**Affordances in Vision for Cognitive Robotics**

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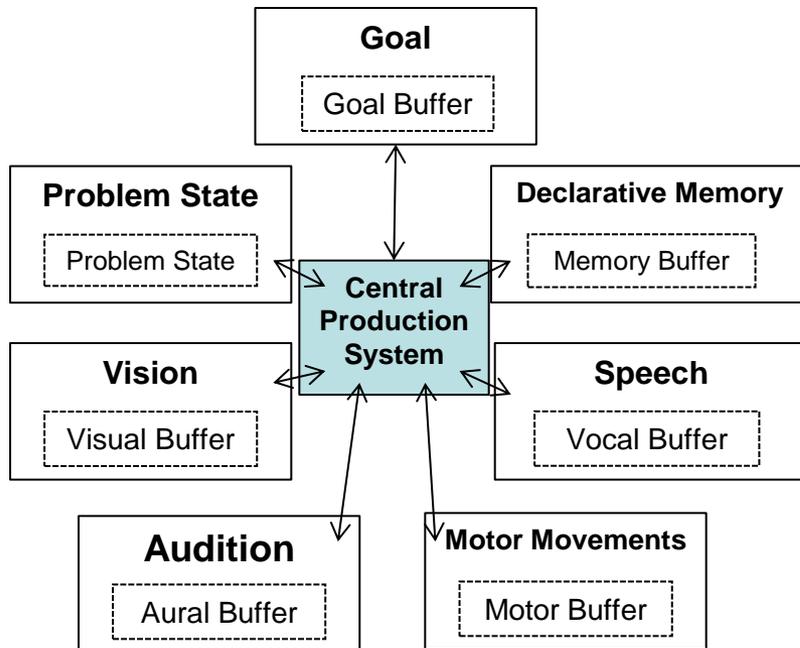


## ■ **Goals**

- | Symbolic approach
- | Geometric Affordances

## ■ **Order**

- | My research
  - *ACT-R & SGOMS*
  - *Symbolic approach example: plane model*
- | Aperture passage affordance research
  - *Summary of psychology research*
  - *Geometric Affordances*



## ■ ACT-R

| Hybrid Architecture

- *Symbolic & subsymbolic*

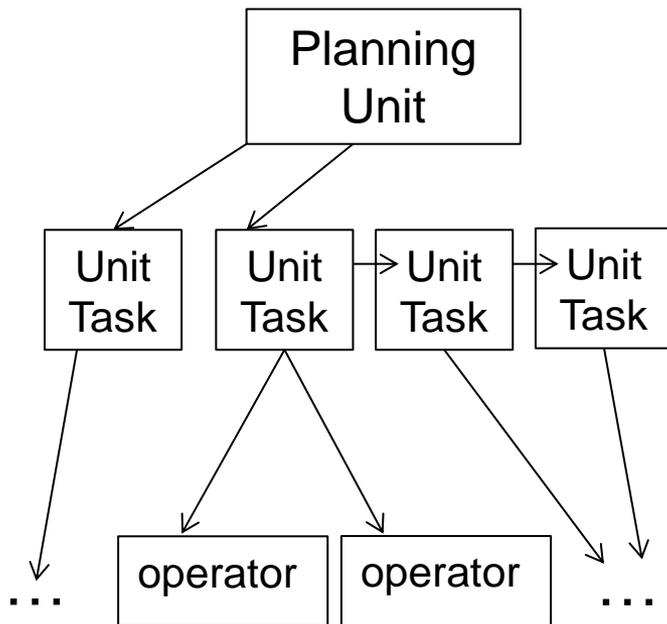
| Ex: Declarative memory

- *Stores “chunks” of information*
- *Retrieval times are calculated*
- *Memories decay over time*

| Predictions of human behavior

- *Reaction times*
  - Memory recall
  - Eye scanning
  - Motor movement

## ■ SGOMS



| Hierarchical framework for control

| Modelling complex tasks

| Planning Unit

- *Collection of one or more unit tasks*
- *Stored in declarative memory*
- *Supports task switching*

| Unit tasks

- *Collection of one or more operator*
- *Stored as procedural memory (productions)*
- *Supports brief interruptions*

| Operator

- *Single, simple action*
- *Implemented with productions*
- *Memory recalls, vision requests, motor actions*

- “semi-expected” left-handed veer
- Retinal Flow used for steering control [1]
- Successive screen shots to simulate retinal flow





## ■ Symbolized

| as “left” or “right” [2],[3]

- *Counter-steer in opposite direction (i.e., chose appropriate unit task)*

| As “normal” or “extreme” [3]

- *Choice to counter-steer or abort procedure (i.e., new planning unit)*

## ■ Counter-steer

| Linear increase in rudder (steering) pressure

| Until “left” or “right” movement no longer in buffer

## ■ Symbols

| Provide context

| Are the affordances available appropriate for present task?

- **Warren & Whang (1987) [4]**
  - | Method: Participants walking through apertures
    - *Rotating shoulders as needed*
  - | Conclusion:
    - *Eye-height modulates shoulder rotation & aperture passage*
- **Fath & Fajen (2011) [5]**
  - | Conclusions:
    - *Eye-height, head-sway, stride-length are “calibrated” to aperture passability*
- **Direct perception**
  - | Perceived in body-scaled units: e.g. eye-height/shoulder width ratio
- **Others: [6]-[10]**
  - | Conclusions:
    - *Groups of people, people carrying objects, ducking under apertures (including when wearing a helmet or blocks on feet)*

- **A class of affordances: Geometric**
  - | Eye-height, head-sway, etc. provide geometric information
- **Cognitive mechanism**
  - | Compare geometric properties of environment
  - | Retrieve a body posture using ACT-R declarative memory
- **Simulation Similar to Warren & Whang [4]**
  - | Warren & Whang
    - *Humanoid robot*
      - Shoulder rotations
      - Controlled by ACT-R
    - *A “matched” body posture to choose the appropriate unit task (SGOMS)*
  - | Change in body posture consequence of goals & context (affordances that are presented)

- **Python ACT-R** [11]
  - | Geometric comparison module
- **MORSE** [12]
  - | Modular Open Robot Simulator Engine
  - | Robotics simulator (Blender, Python)
  - | 3D environment for ACT-R
  - | “Semantic” camera
    - *Extract geometric properties between “objects”*
    - *Currently low-level vision is of lesser interest*



- **Thank you**
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