Can Mental Images be Realistically Represented in Computer Arrays?

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June 12, 2012

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Models of Mental Imagery

- historical
  - picturesque view
  - homunculus
  - from introspection
- structural description view (*Z. Pylyshyn*)
  - any information is of propositional form
  - so is thinking in form of images
  - mental images = epiphenomenal
- pictorial view (*S. Kosslyn*)
  - mental images connected to perception
  - 2D quasi-pictorial representations of real objects in a visual buffer

Experiments

Experiment 1 – Rotation

- subjects were asked to rotate objects in their mind
- rotation time $\propto$ rotation angle
- supports pictorialism

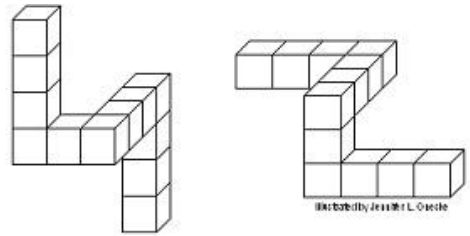

Figure 1: Based on Shepard & Metzlar's 'Mental Rotation Task'

Figure: objects to be rotated, by Jennifer Oneske for Wikipedia

Experiment 2 – Scanning

- subjects were shown objects in different heights, looked from above
- asked to scan a mental image of the setup with a mental dot
- scanning time $\propto$ height difference
- depth may not be ignored

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Marr's and Nishihara's 2.5D-Arrays

- visual perception per: edges, corners, pictorial properties
- procedure:

1. primal sketch: array of symbols for "surface patches"
   - take into account position of pictorial properties
2. 2.5D-sketch by computation of two pictures: depth and orientation
3. final 2.5D-sketch:
   - array; cells contain symbols with surface patch properties
4. shape recognition via a connection to a hierarchical 3D model data structure

Marr's and Nishihara's 2.5D-Arrays

final 2.5D-sketch

- array; cells contain symbols with surface patch properties

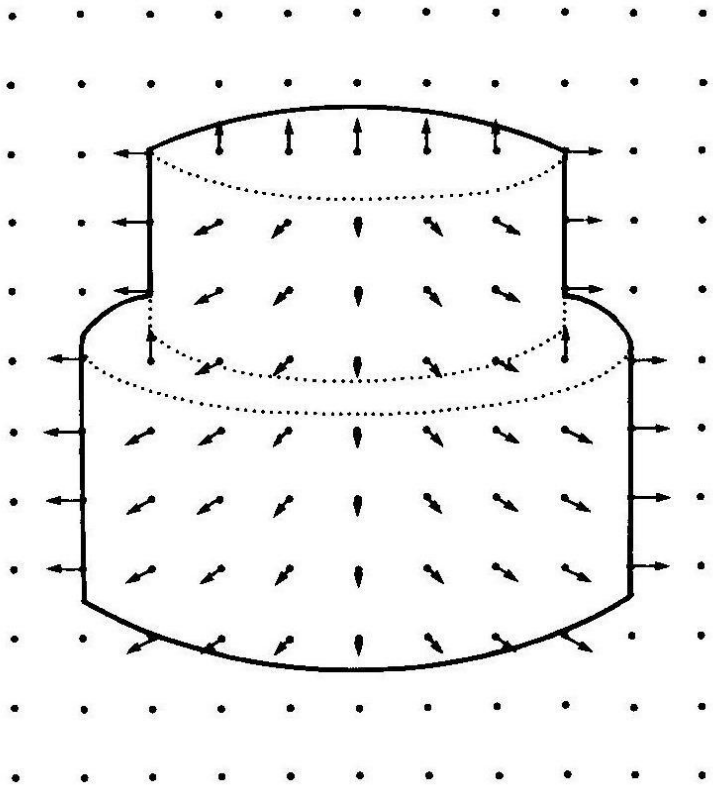

Figure: 2.5D-sketch, from "The Imagery Debate", Michael Tye

Tye's 2.5D-Arrays

- mental image represented by 2.5D-array with "caption" (interpretation)
- visual buffer:
  - every cell in array represents surface patch
  - cells may be empty/only contain color information
- generation: reverse to visual process
  - gather information from hierarchical structured long-term memory
  - construct surface patches pattern/array
  - write it into visual buffer

Discussion & Consequences for AI

- Can mental images really be represented in the proposed arrays?
- Do you think a "mental image device" can help AI thinking (i.e. adaptive problem solving)?
- Do you think "mental imagery" in the sense of pictures is superior to other methods of imagination?