



Inference and Visualization

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“The purpose of computing is insight, not numbers” - R. Hamming, 1962

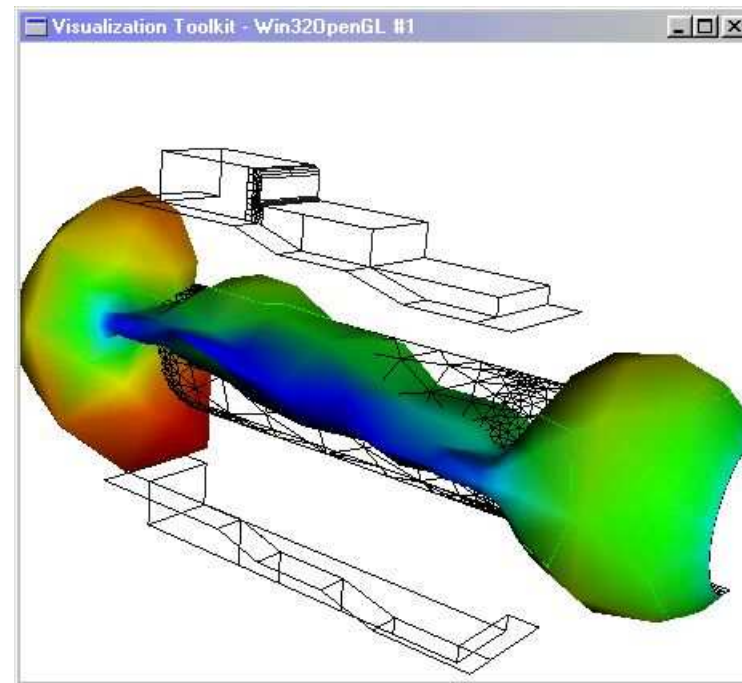
```
# vtk DataFile Version 1.0  
Plastic blow molding of car bumper  
ASCII
```

```
DATASET UNSTRUCTURED_GRID
```

```
POINTS 687 float
```

```
5 7 10  
5 7 10  
5 8 11.25  
5 8.25 11  
5 8 10  
5 7 11.25  
5 7.5 13  
5 8 12.5  
5 7 10.3125  
5 7 10.625  
5 7 10.9375  
5 7.38766 11.25
```

```
...
```

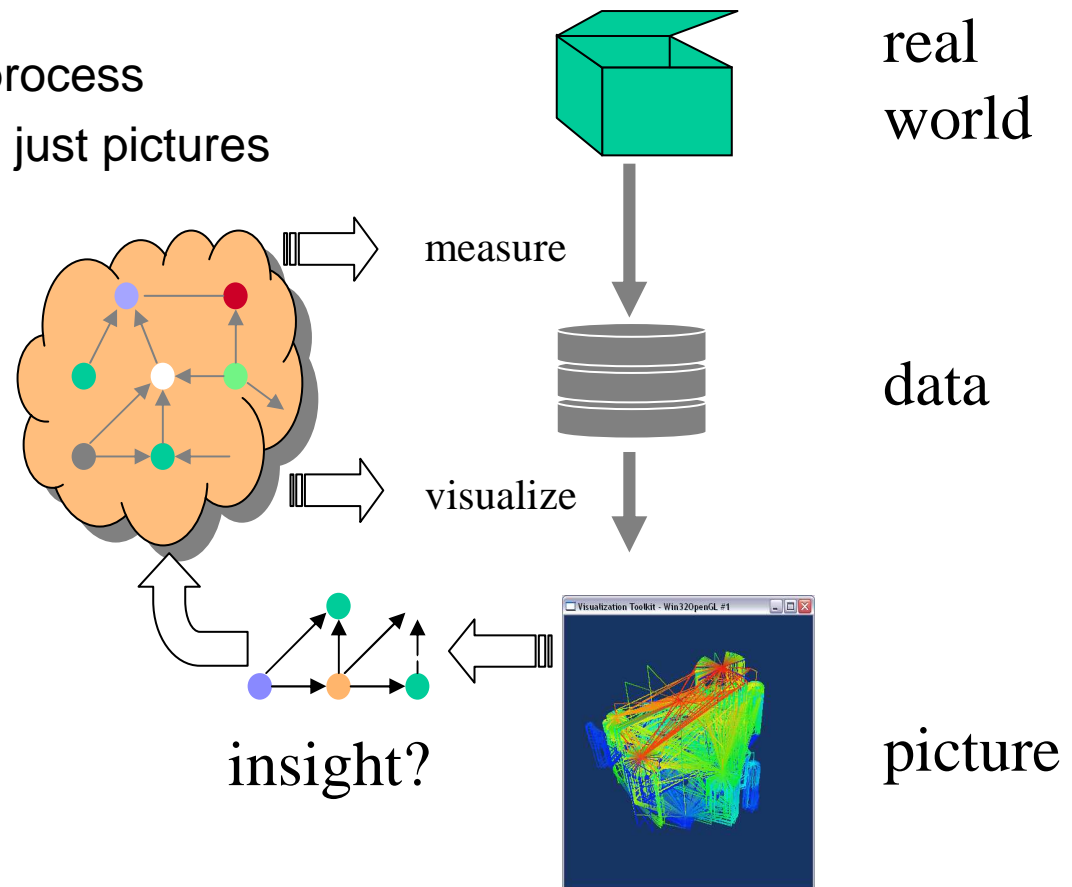




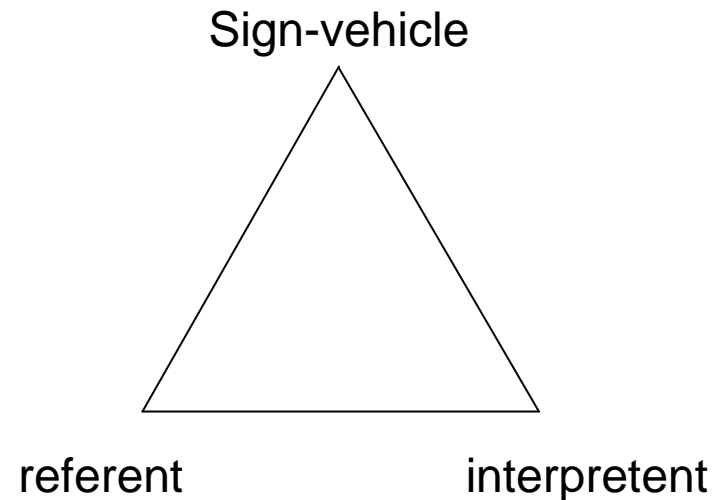
What is Visualization?

- Qualitatively different goals [Bergeron, 1993]
 - descriptive: see what I can explain!
 - analytic: do I see what I can explain?
 - exploratory: can I explain what I see?
- Shift workload between computational and cognitive systems
 - different representations of problem/knowledge
 - different capabilities for processing
 - operations in system A “easier” than in system B
- Want framework to understand ‘work’ in neutral terms
 - inference systems one possibility
 - different modes, and different “systems”

- Visualization
 - is part of a larger process
 - relies on more than just pictures
 - requires iteration



- Perceptual
 - Ware et al.
 - Interrante
- Cognition and task
 - Casner
 - Pinker
 - Glasgow
 - Feiner & Zhou
- Semiotics
 - Peirce
 - Bertin
 - MacEachren

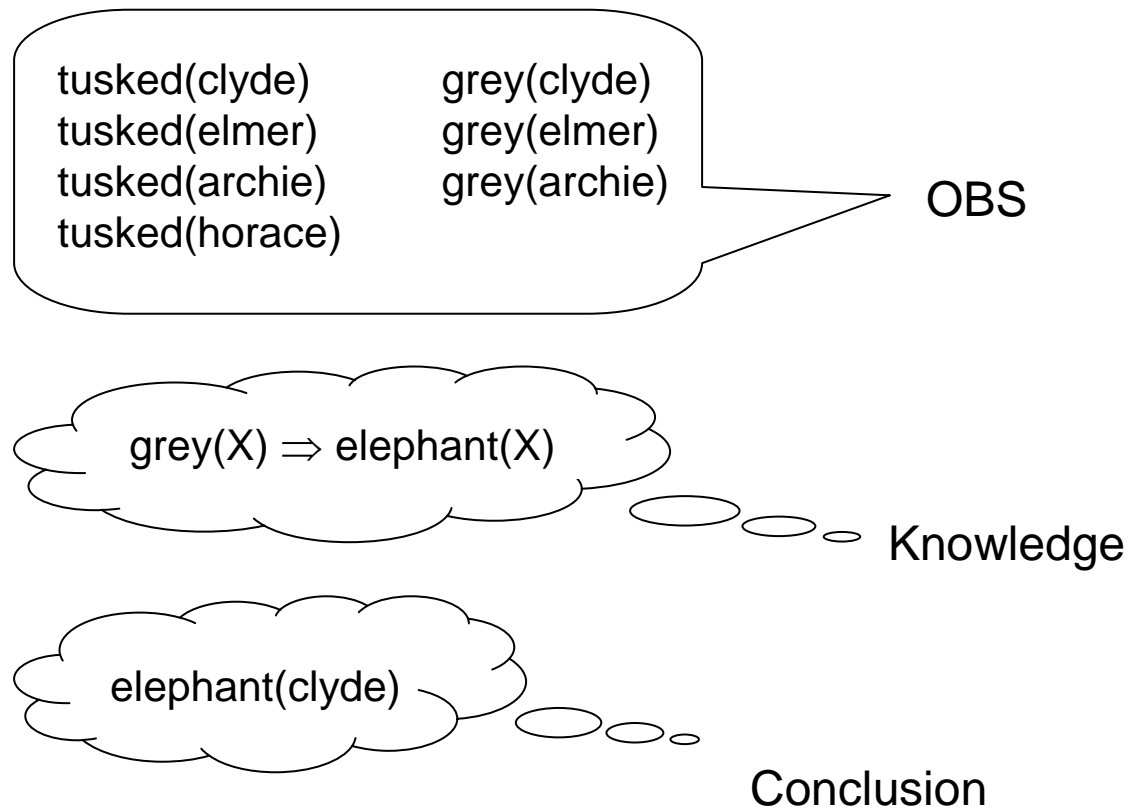


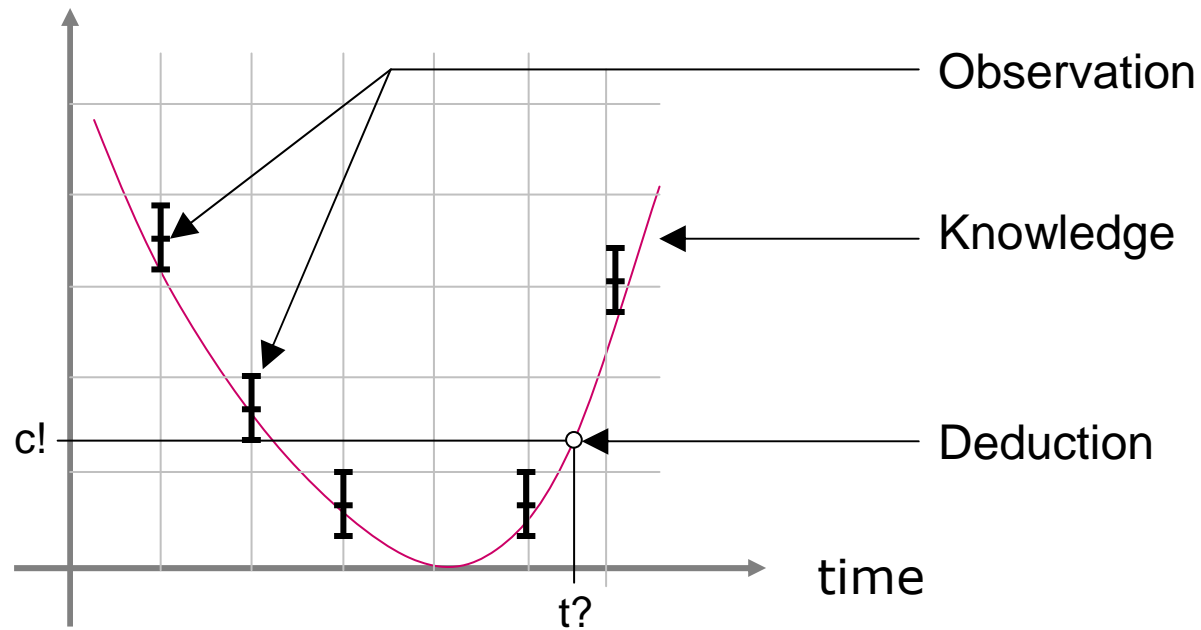
- Is there a common thread?



- Significant community in diagrammatic reasoning
 - how to design effective diagrams
 - role of diagrams in mediating cognition
 - what makes a diagram usable?
- Generalization to role of external representations, e.g.
 - Tversky
 - Scaife and Rogers (Sussex)
 - Erika Rogers (Atlanta)
- Common thread: how do pictures affect judgement
- But what is judgement?

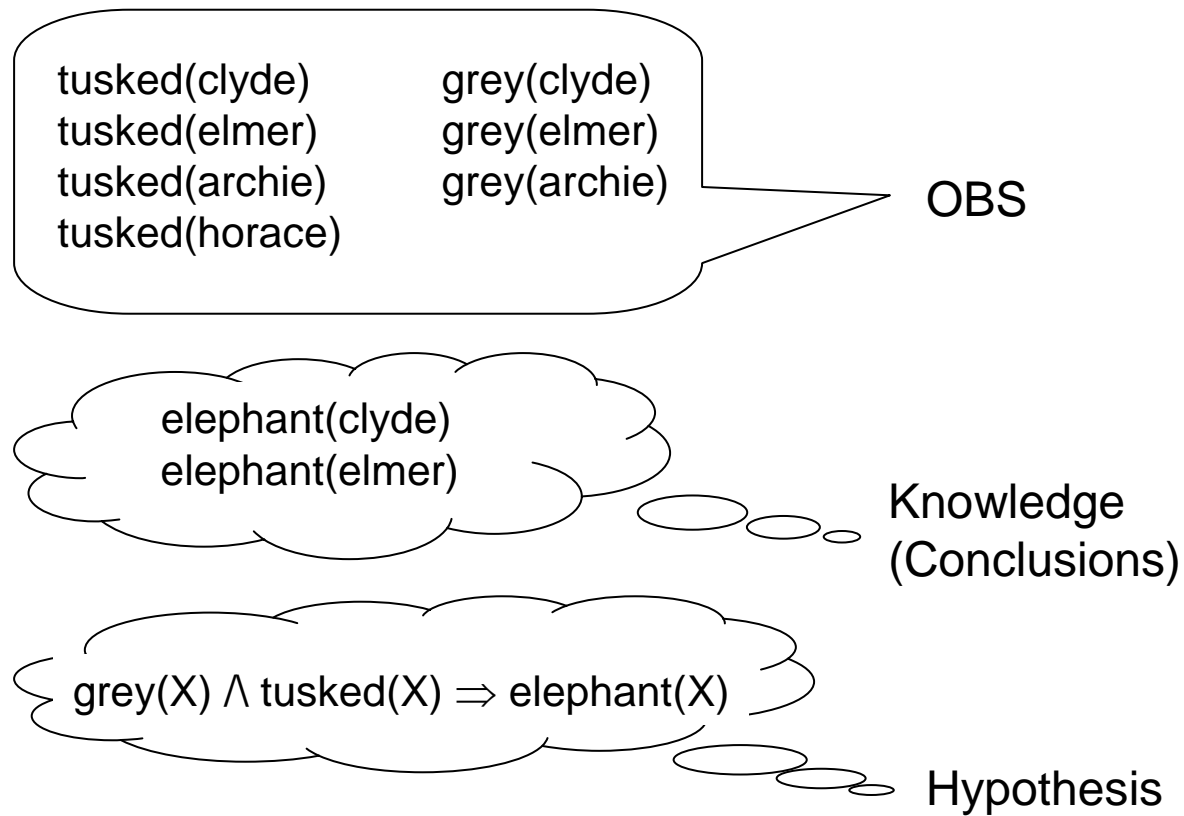
- know rules, given a question
- calculate an answer

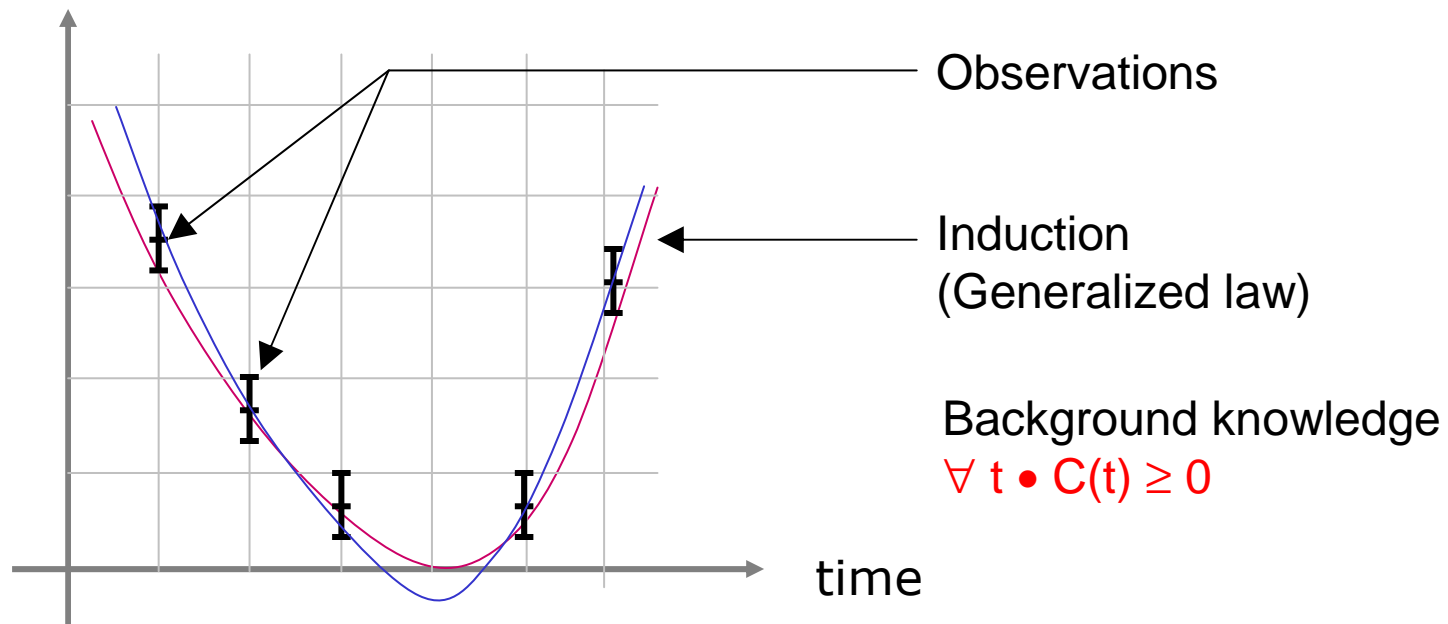




- perceptual system – parallel search, exploring region
- inference “mechanism” depends on representation system
- presentation / confirmation

- explains (and generalizes) *event* of observing instance
- does not explain the *instance*





- interpolation
- new knowledge may invalidate conclusion
- knowledge filters rules



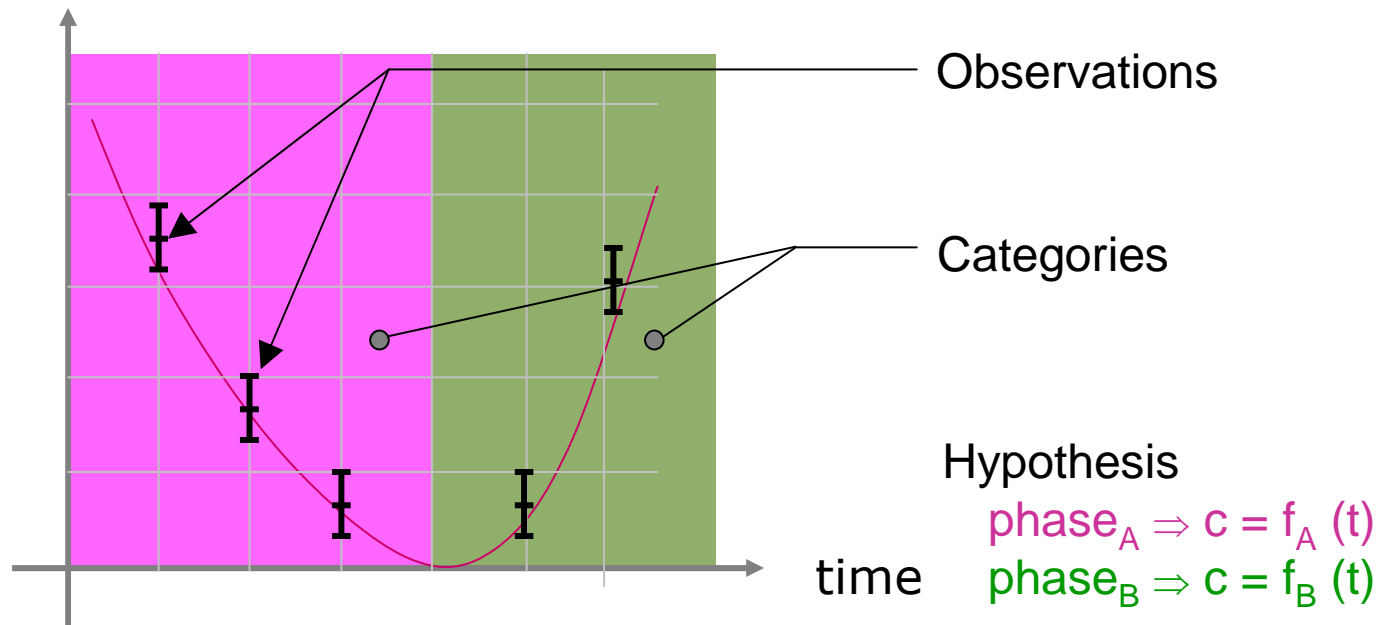
- reasoning to “best hypothesis”
- various notions of “best” - “final causality” is pragmatic

tusked(clyde)	grey(clyde)	
tusked(elmer)	grey(elmer)	
tusked(archie)	grey(archie)	swims(archie)
tusked(horace)		swims(horace)

Observations

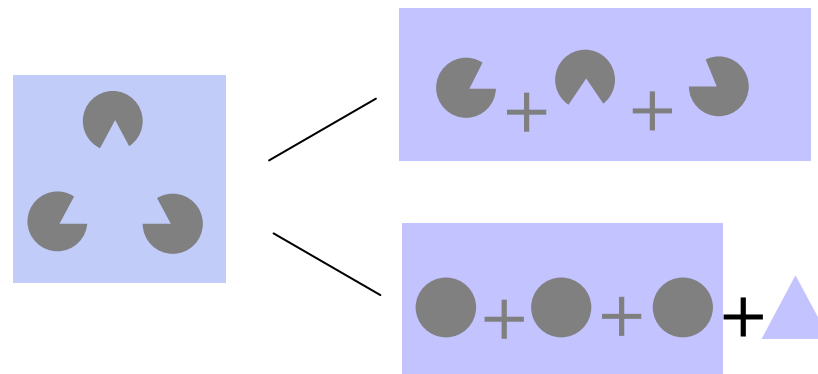
$\text{elephant}(X) \Rightarrow \text{tusked}(X) \wedge \neg \text{swims}(X)$	
$\text{walrus}(X) \Rightarrow \text{tusked}(X) \wedge \text{swims}(X)$	
elephant(clyde)	walrus(archie)
elephant(elmer)	walrus(horace)

Hypothesis
(explains observations)

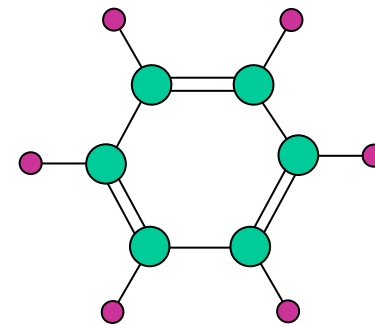
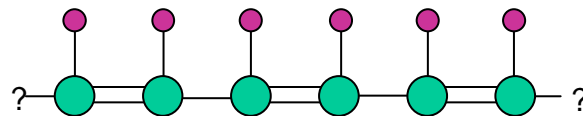


- categorization
- hypothesis explains membership of categories.
- basis for further experimentation (deduction to test, induction to generalize)

- e.g. abduction with object-space representation
- in bottom-up processing: explanation



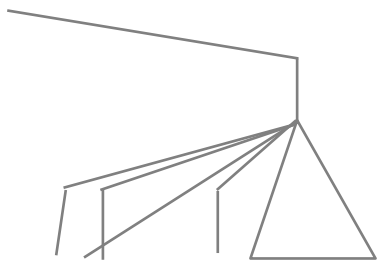
- in top-down processing: synthesis / imagery



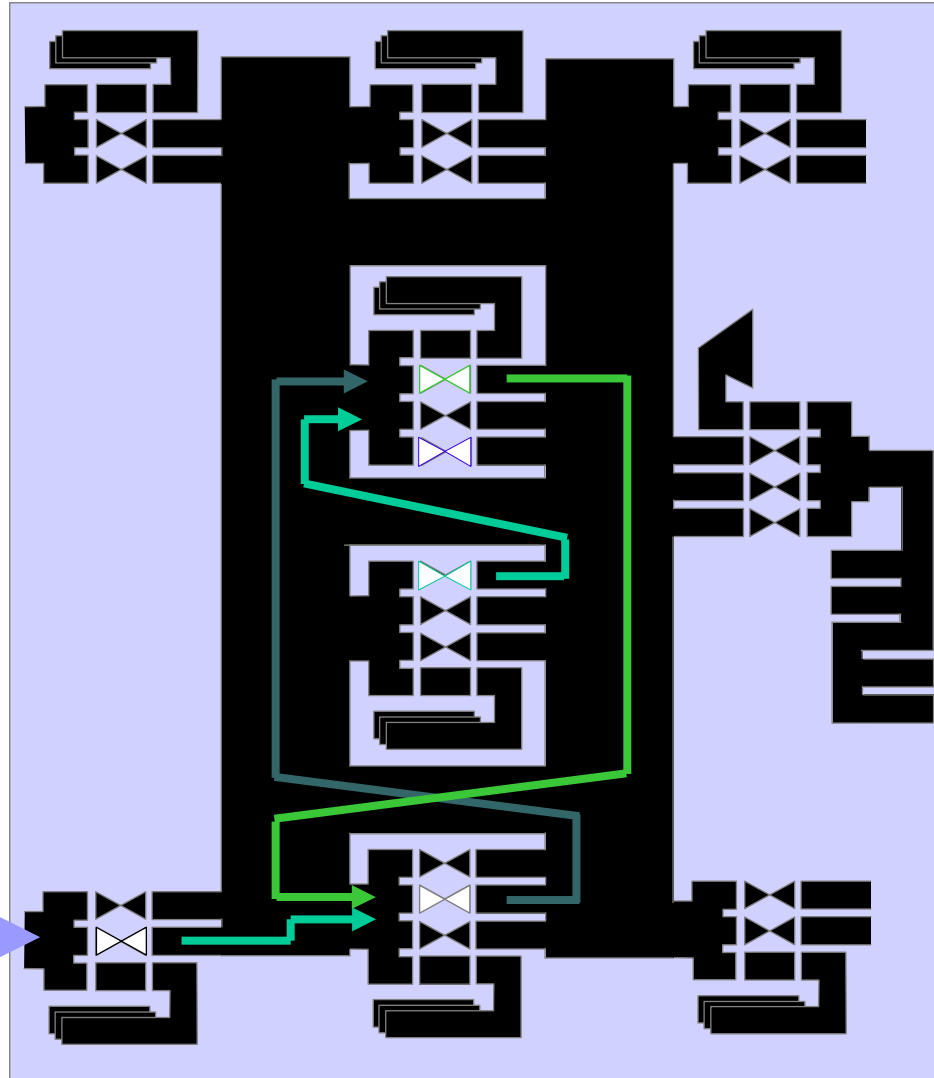
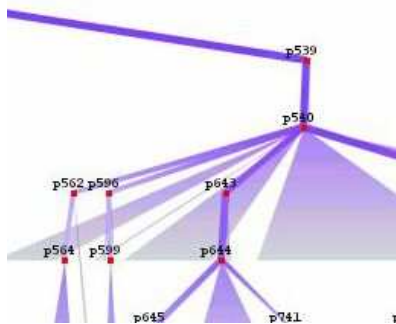


Cognitive levels of meaning

obj



vis



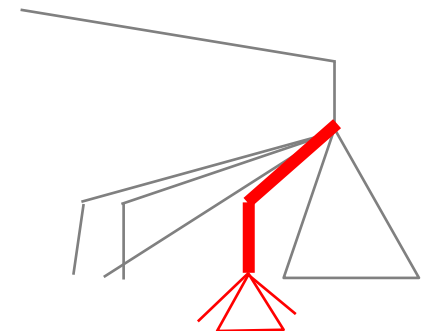
prop

node p540
+-[parent]- p539
+-[children] - [many]

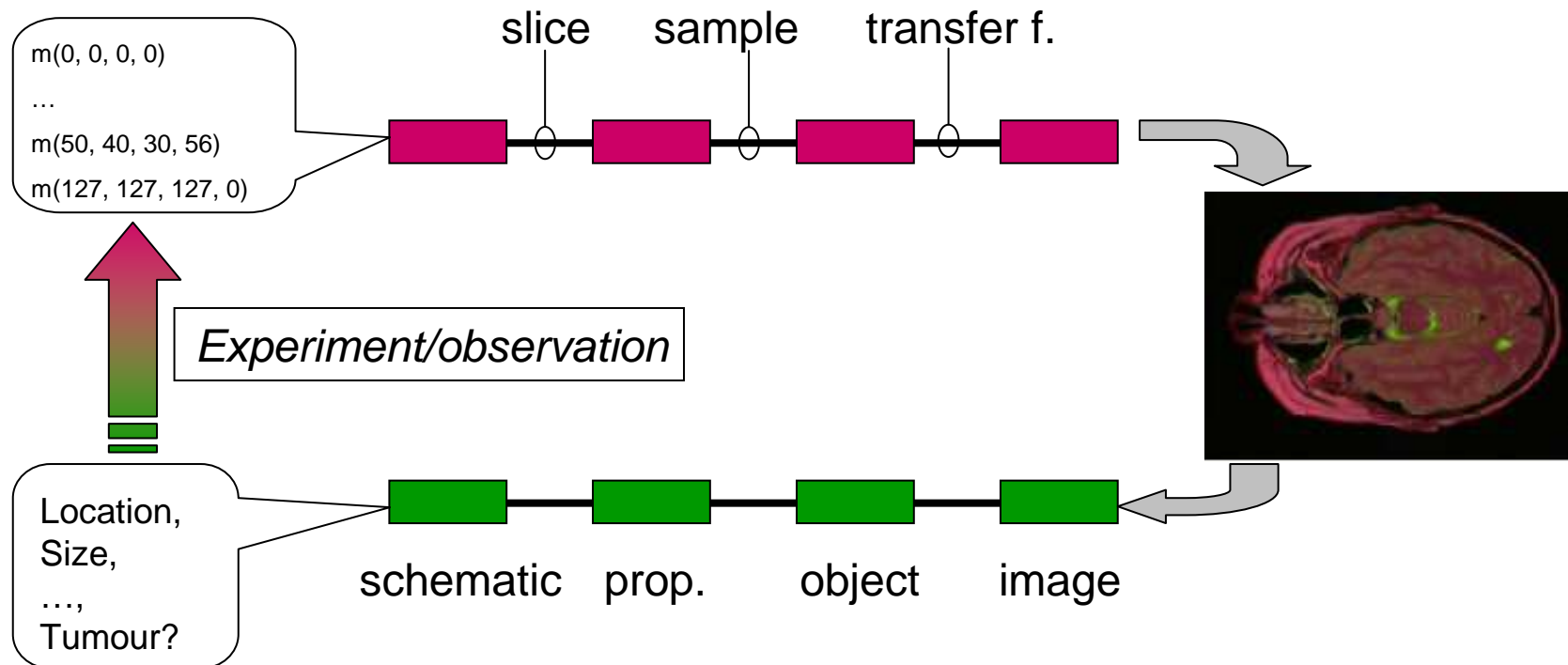
PIP

node p741?
parent = "down"
...

prop-obj



- series of inference steps
- inferences within different systems of representation
- *inference not limited to propositional systems*





Tentative conclusions

- As a conceptual tool ...
 - Language for understanding Bergeron's high-level goals
 - Goal-oriented taxonomy
 - Unification of techniques (clustering vs colour-mapping)
- As an engineering tool ...
 - Brookes' vision of IA + AI
 - Visual analytics: logic as common language for data and process
- ?