

## Modelling Languages: Concrete (Visual) Syntax

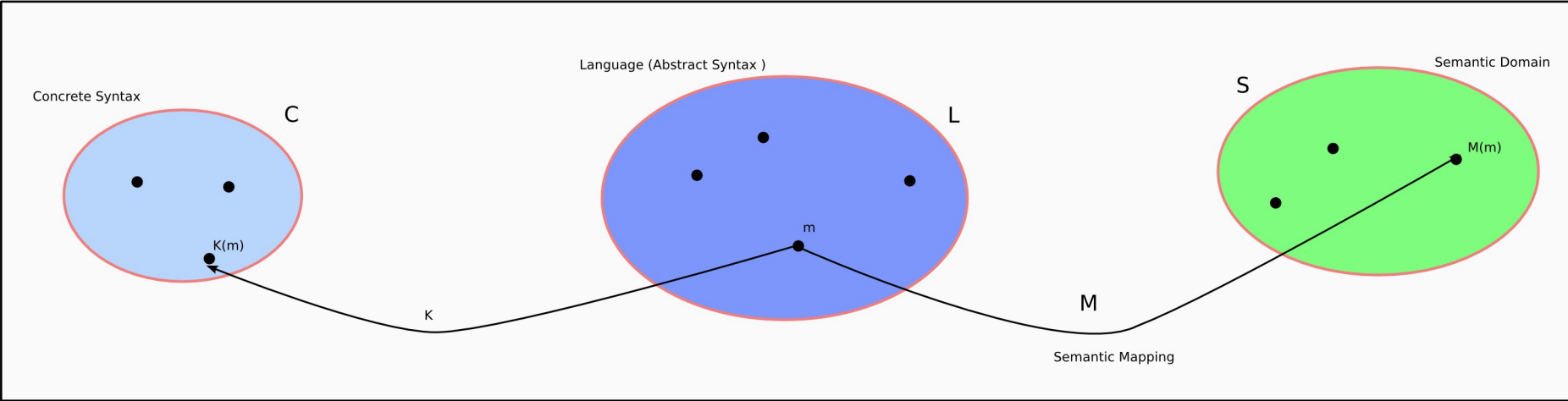


Hans Vangheluwe

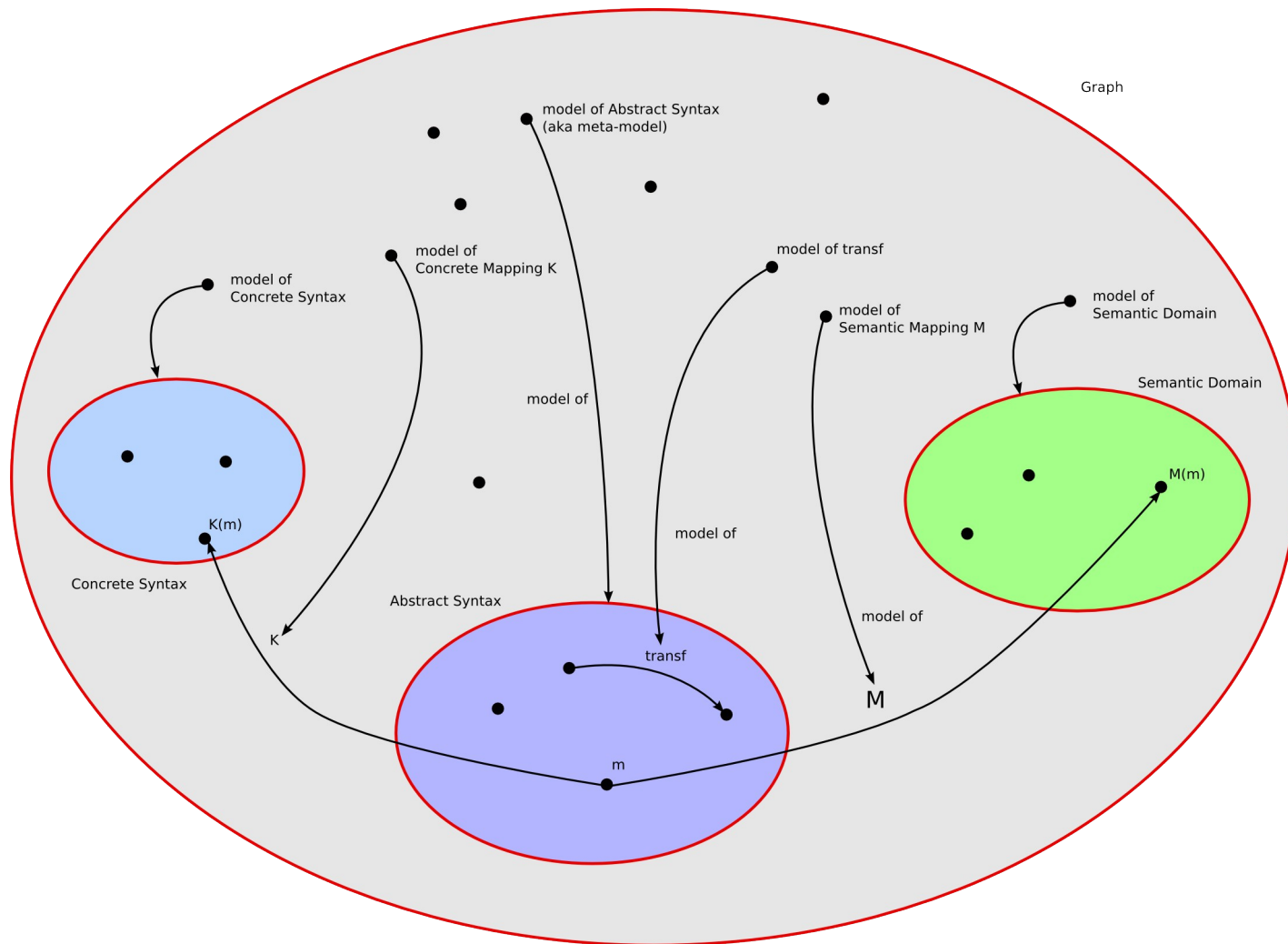
Santiago de Compostella  
4 September 2013

# Modelling Languages/Formalisms

Concrete Formalism F



# Explicit Modelling of Modelling Languages/Formalisms



## Textual Languages

“this sentence is very short”

- Individual **letters** in an **alphabet**
- Combined into **words**
- Combined in to **sentences** in a **language**
  
- Letters in words *specified* by **regular expressions**
- Words in a language *specified* by a **grammar**
  
- Symbols are combined by “is to the right of”

# The Spofax Language Workbench

Report TUD-SERG-2010-014a

## Rules for Declarative Specification of Languages and IDEs

Lennart C. L. Kats

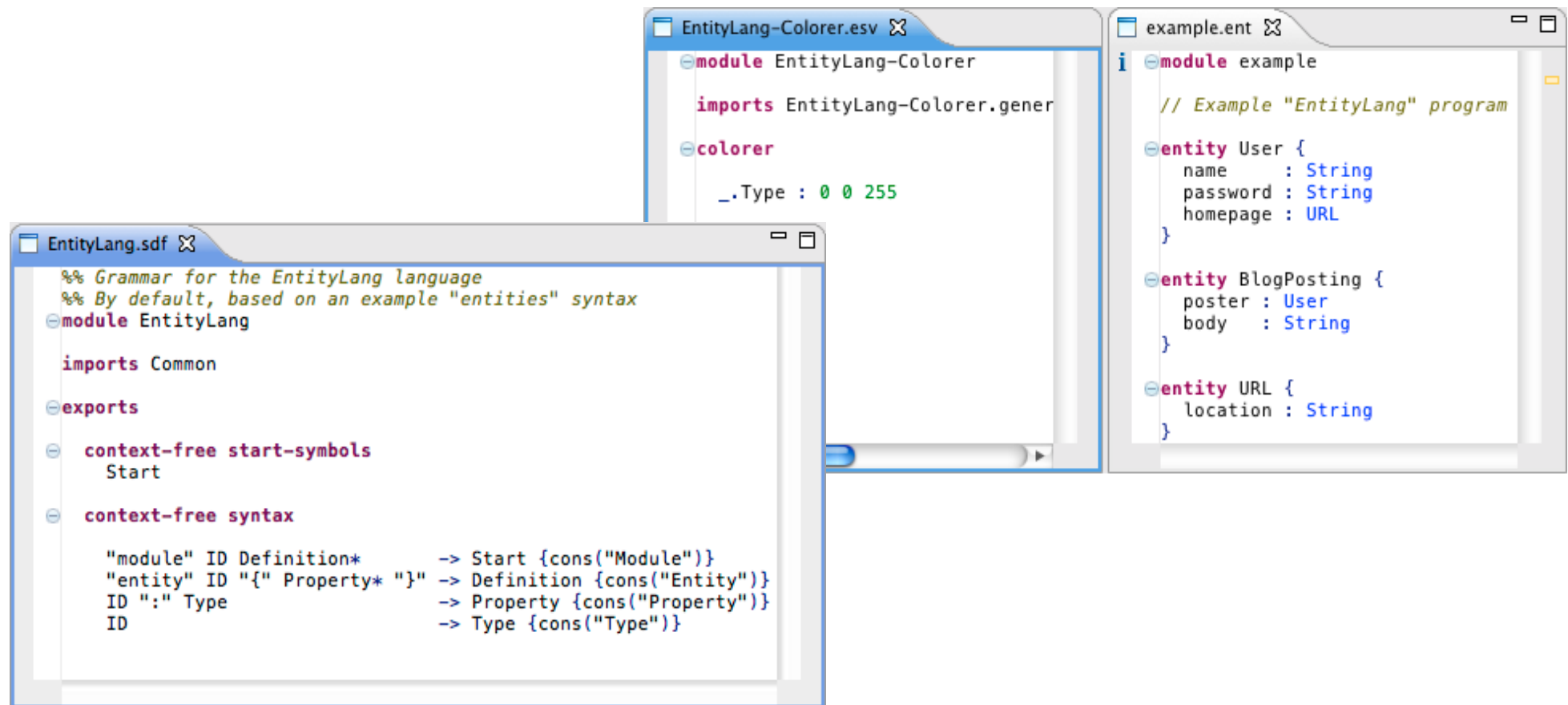
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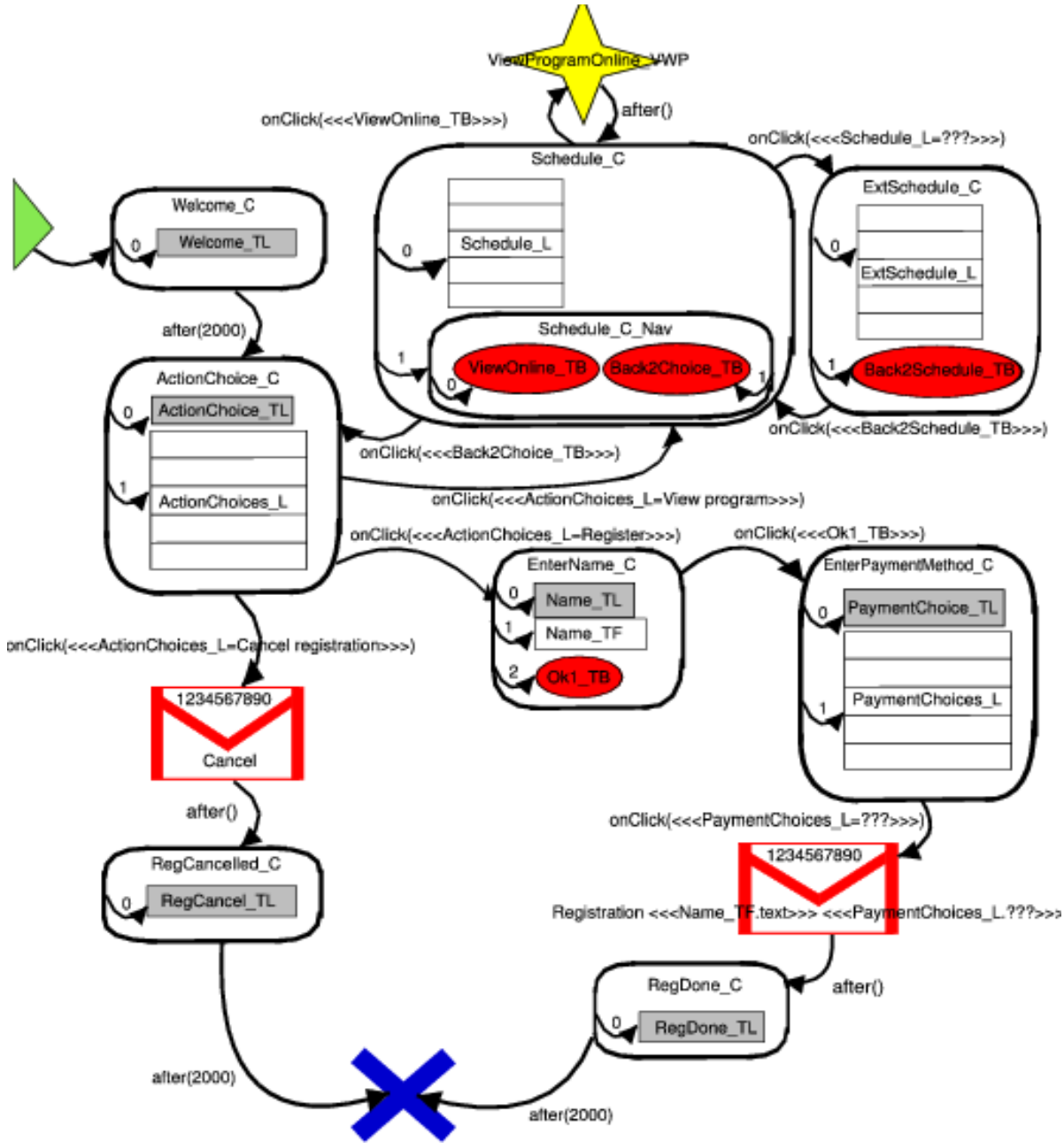
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*Journal of Visual Languages and Computing* (2002) **13**, 573–600

doi:10.1006/S1045-926X(02)00025-3 available online at <http://www.idealibrary.com> on **IDEAL**<sup>®</sup>

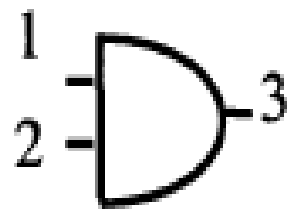
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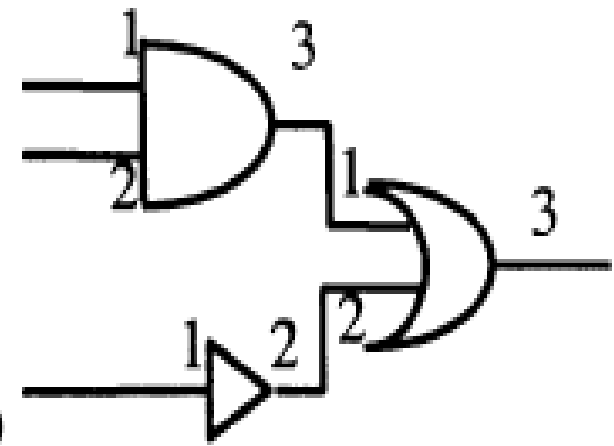
## A Classification Framework to Support the Design of Visual Languages

G. COSTAGLIOLA\*, A. DELUCIA†, S. OREFICE‡ AND G. POLESE\*

Plex



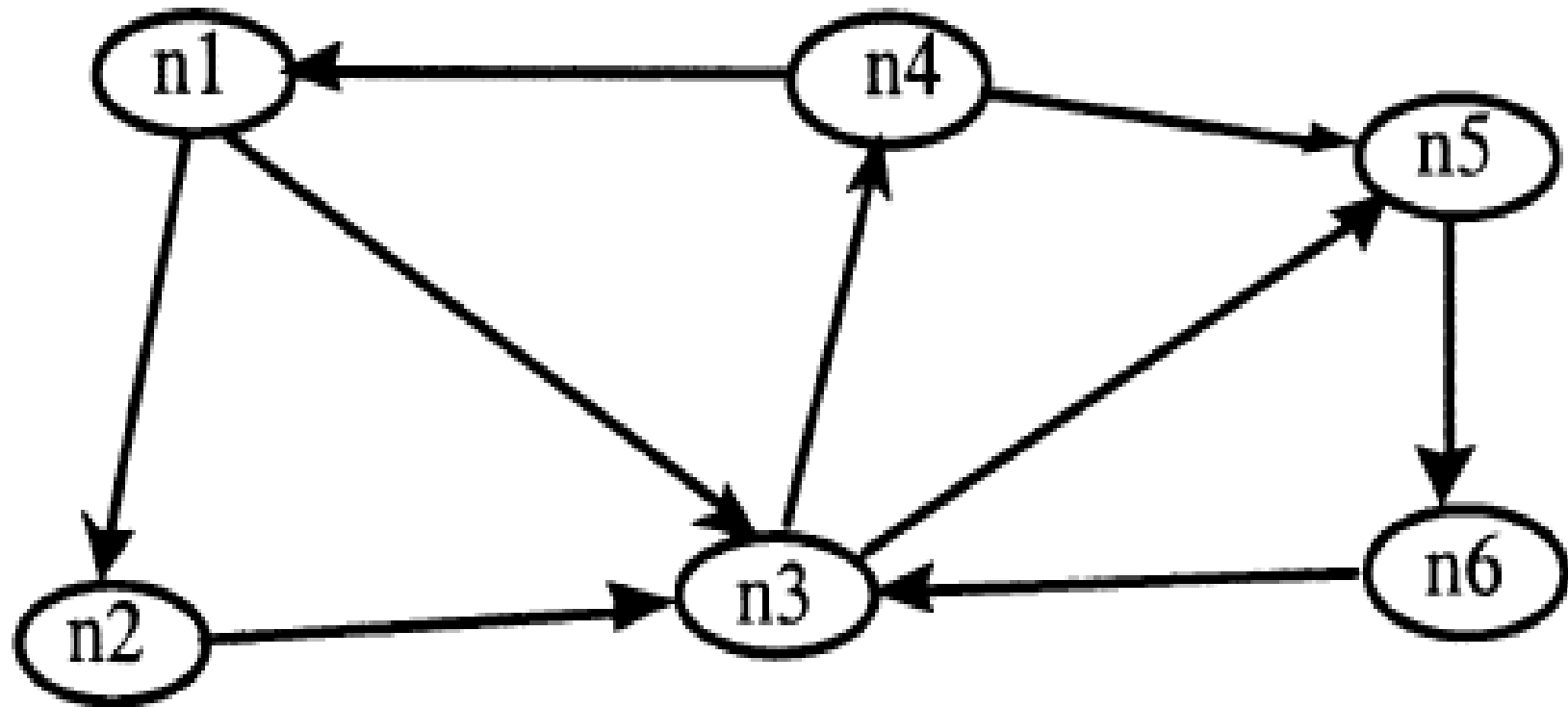
(a)



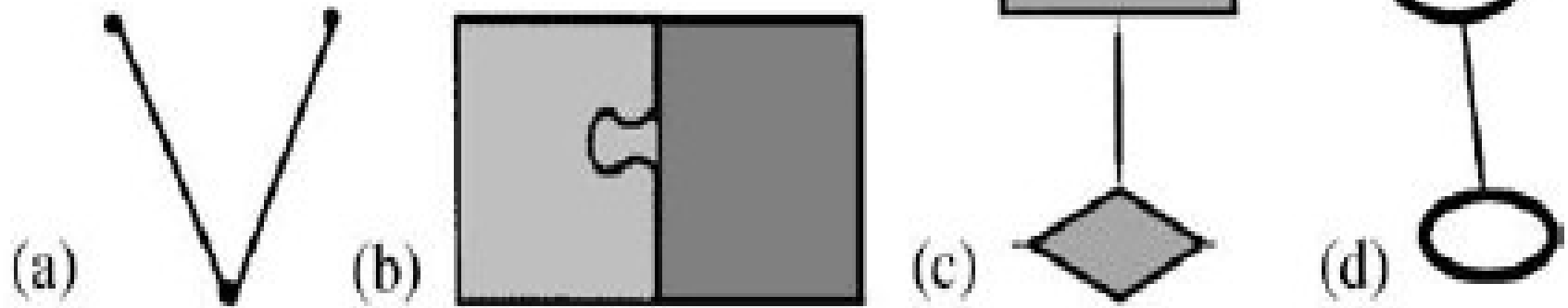
(b)



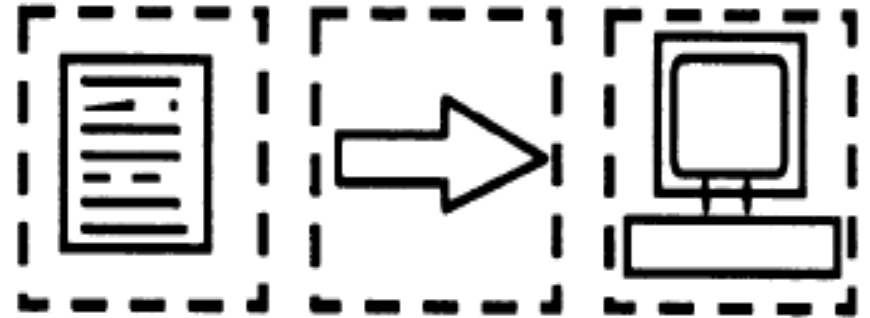
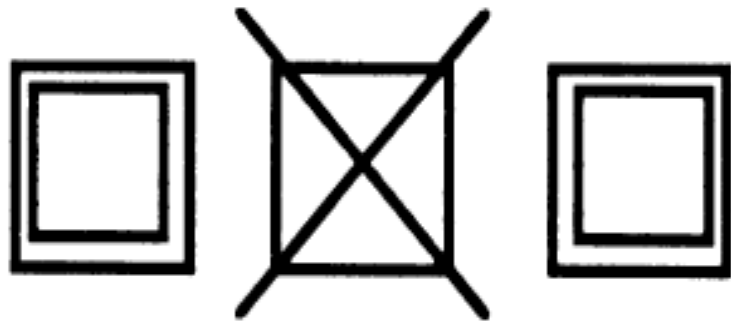
## Graph



## Connection Types

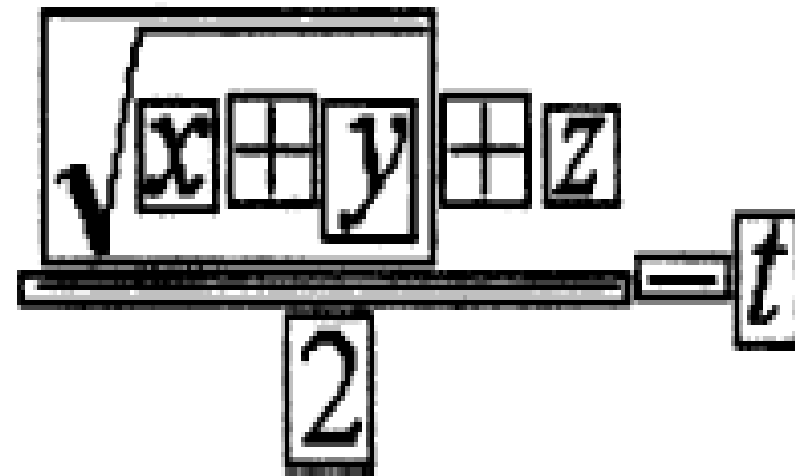


# Iconic

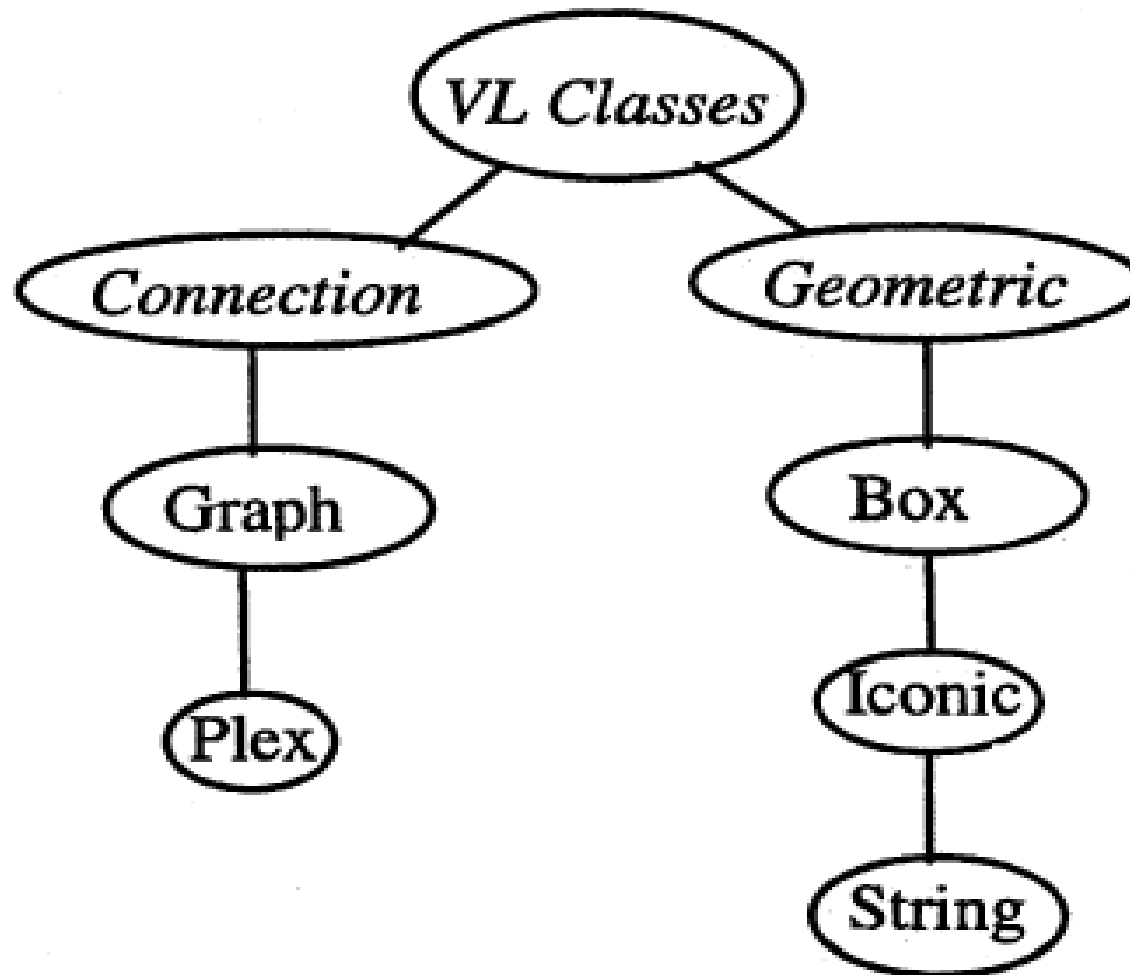


Box


$$\frac{\sqrt{x+y+z}}{2} = t$$



## Visual Language Classes



# Hybrid Languages

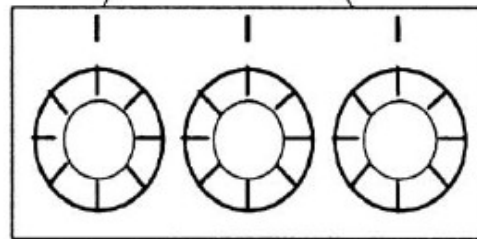
		JAN 97			
SUN		5	12	19	26
MON		A1 A3 <sup>6</sup>	13	20	27
TUE		7	14	A4 <sup>21</sup>	28
WED	1	A2 8	15	22	29
THU	2	A3 A4 <sup>9</sup>	16	23	30
FRI	A1 A2 3	10	17	24	31
SAT	4		18	25	

POLICY TIER

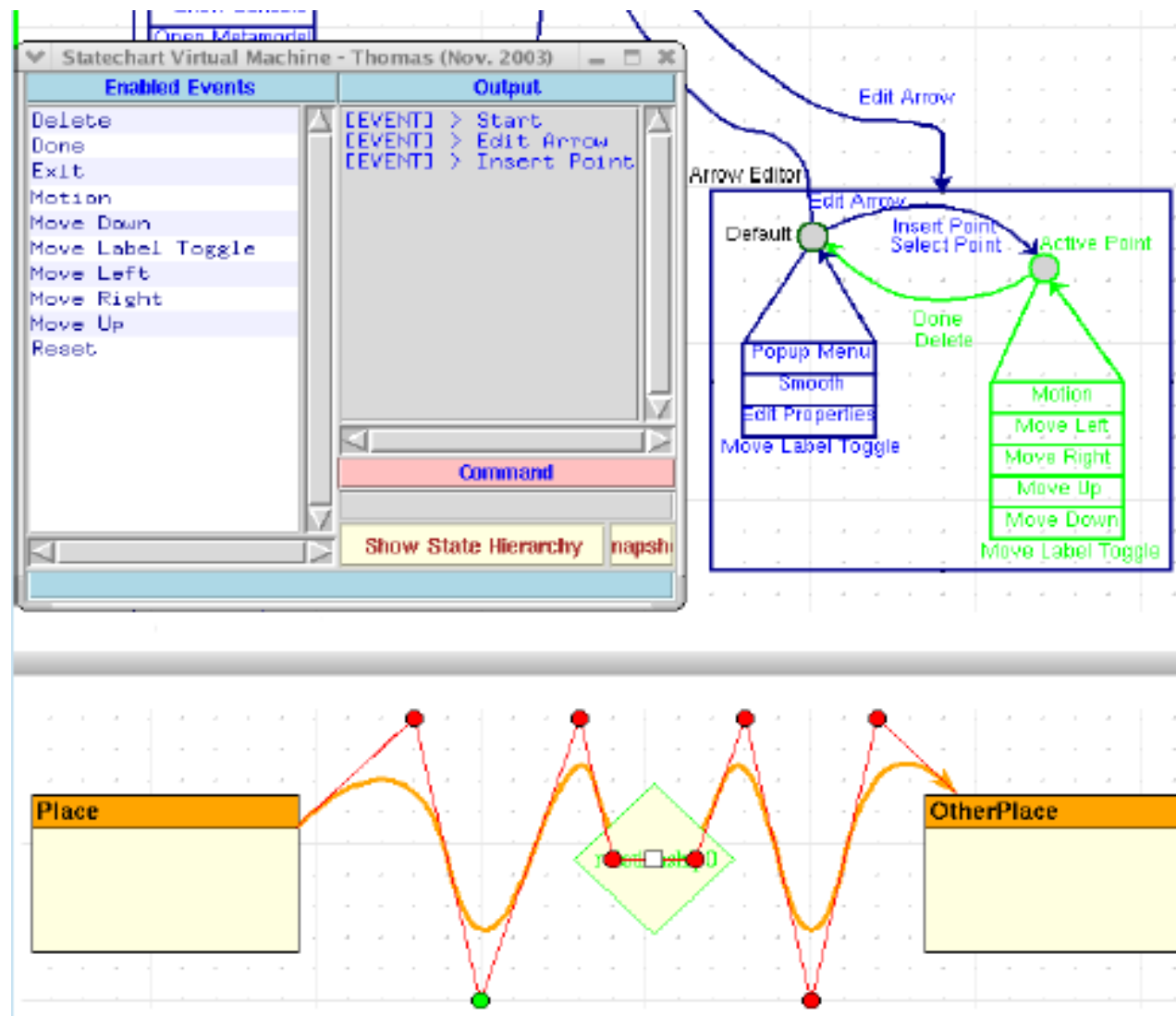
CALENDAR-FORM METAPHOR

DEFINITION TIER

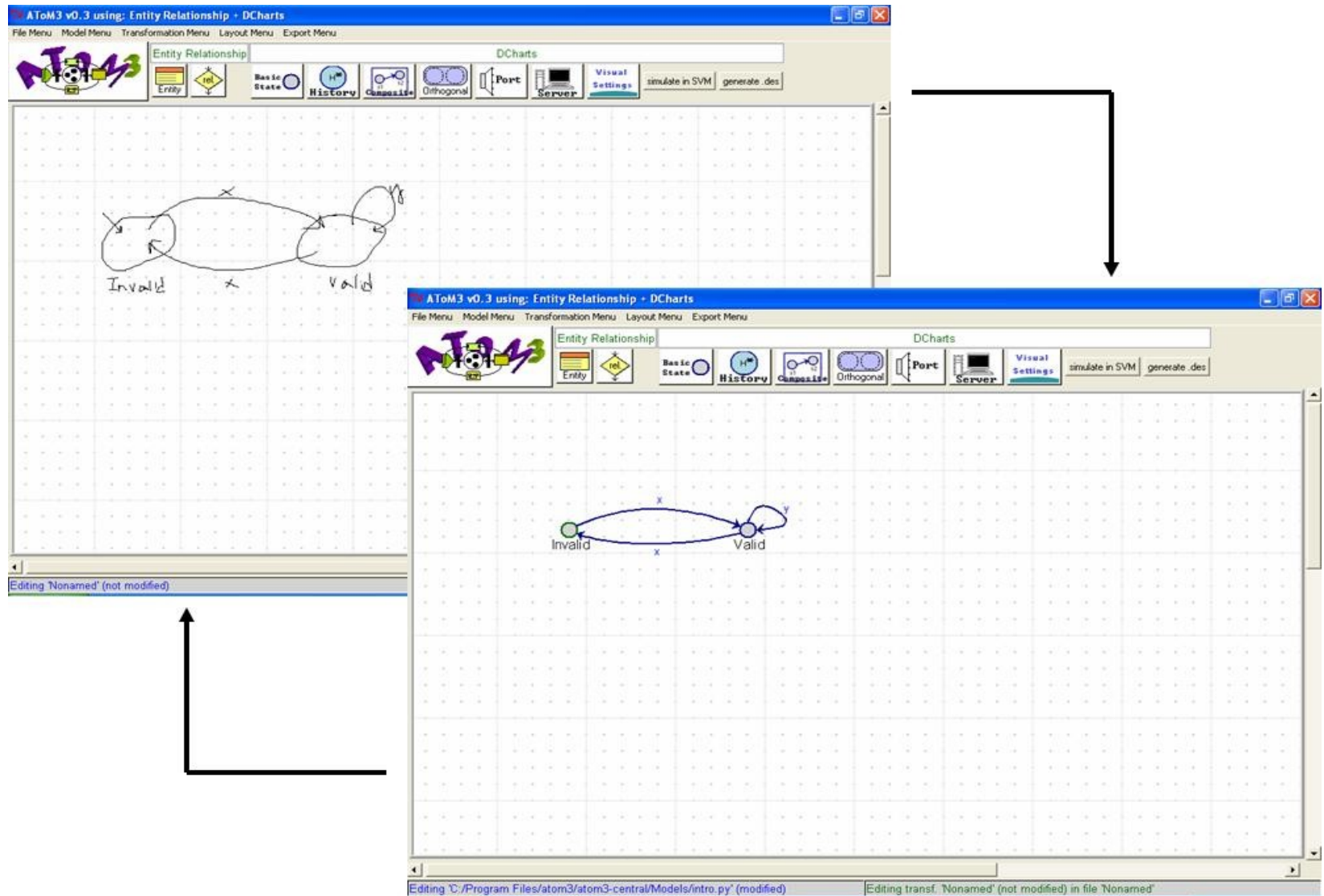
COMBINATION LOCK METAPHOR



# Syntax-directed Visual Editors: model behaviour




# Syntax-directed Visual Editors: freehand (early stages of multi-domain project)





# Different Media: Gestural Interaction, Sound, ...






**gestureworks**  
*true multitouch for Flash and Flex*

Gestures included in the open source gesture library


  

## MULTITOUCH GESTURES


**Tap Gestures**




**Rotate Gestures**




**Scale Gestures**




**Scroll Gestures**




**Hold Gestures**




**Swipe Gestures**




**Drag Gestures**




**Split Gestures**




**Flick Gestures**



**3D Gestures**



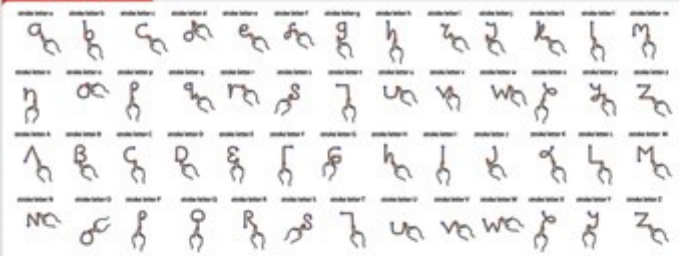
**Anchor Gestures**




  

## STROKE GESTURES


**Letter Strokes**



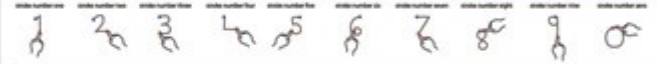
**Greek Symbol Strokes**




Stroke Gesture Direction:



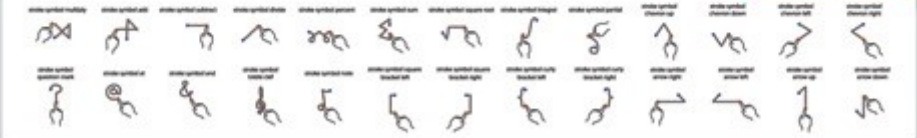
**Number Strokes**



**Shape Strokes**




**Symbol Strokes**



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Gestures for Windows and the Gestures for Mac OS X.

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# The “Physics” of Notations: Towards a Scientific Basis for Constructing Visual Notations in Software Engineering

Daniel L. Moody, *Member, IEEE*

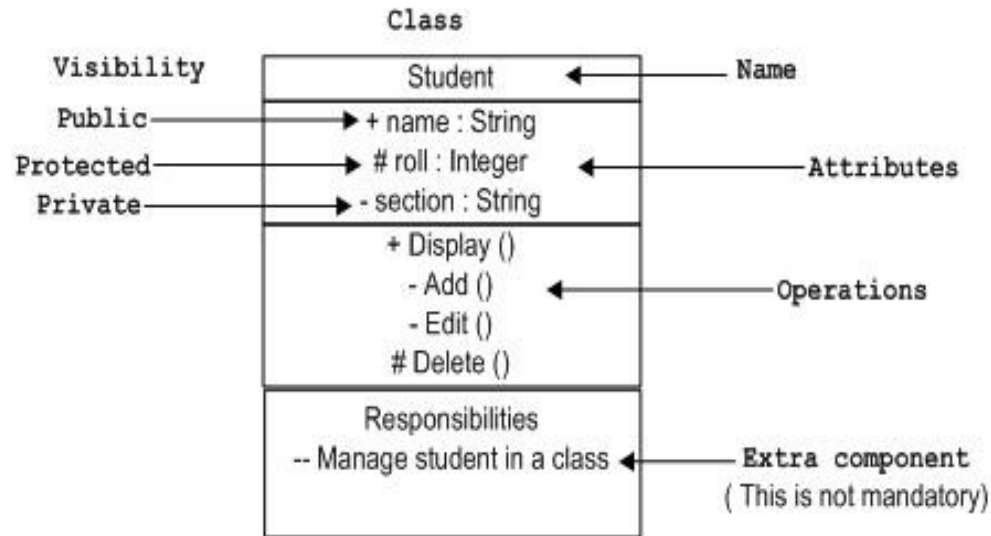
## Introduction

- Visual notations pre-date textual ones
- Visual notations are important for Modelling and Software Engineering
- Humans are excellent pattern recognizers
- Need cognitively efficient and effective notations.  
Cognitive effectiveness = speed, ease and accuracy with which a representation can be processed by the human mind

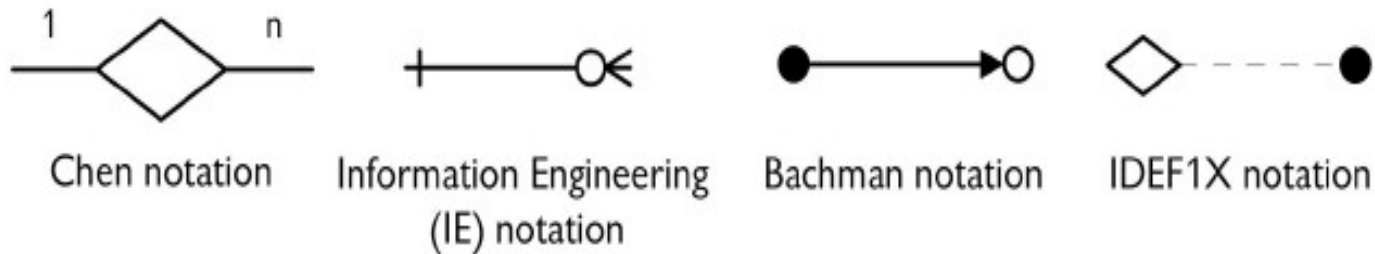


## Introduction/Rationale

Visual notations are often introduced without underlying theory or rationale

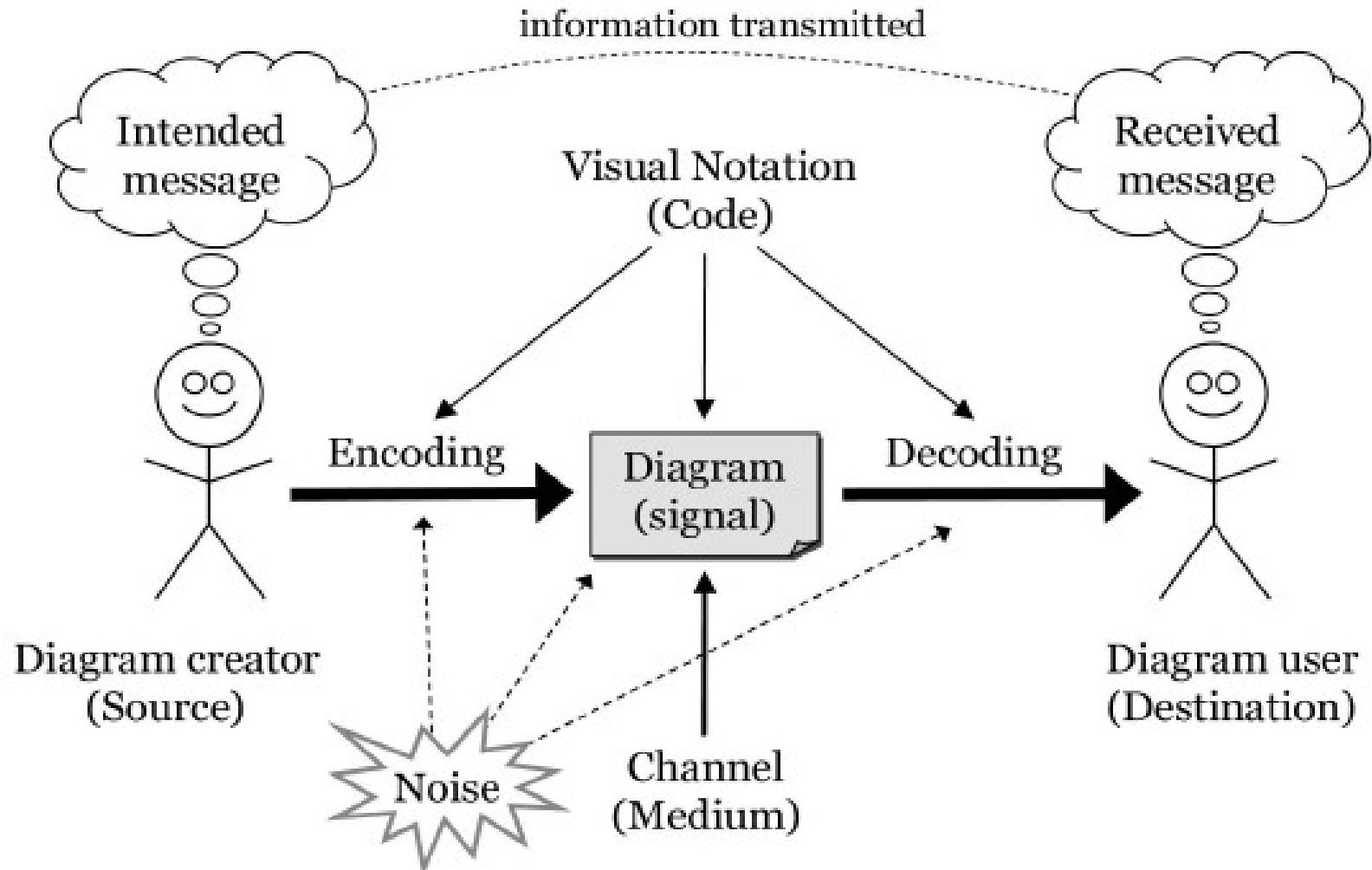


Many visual notations for same concepts.

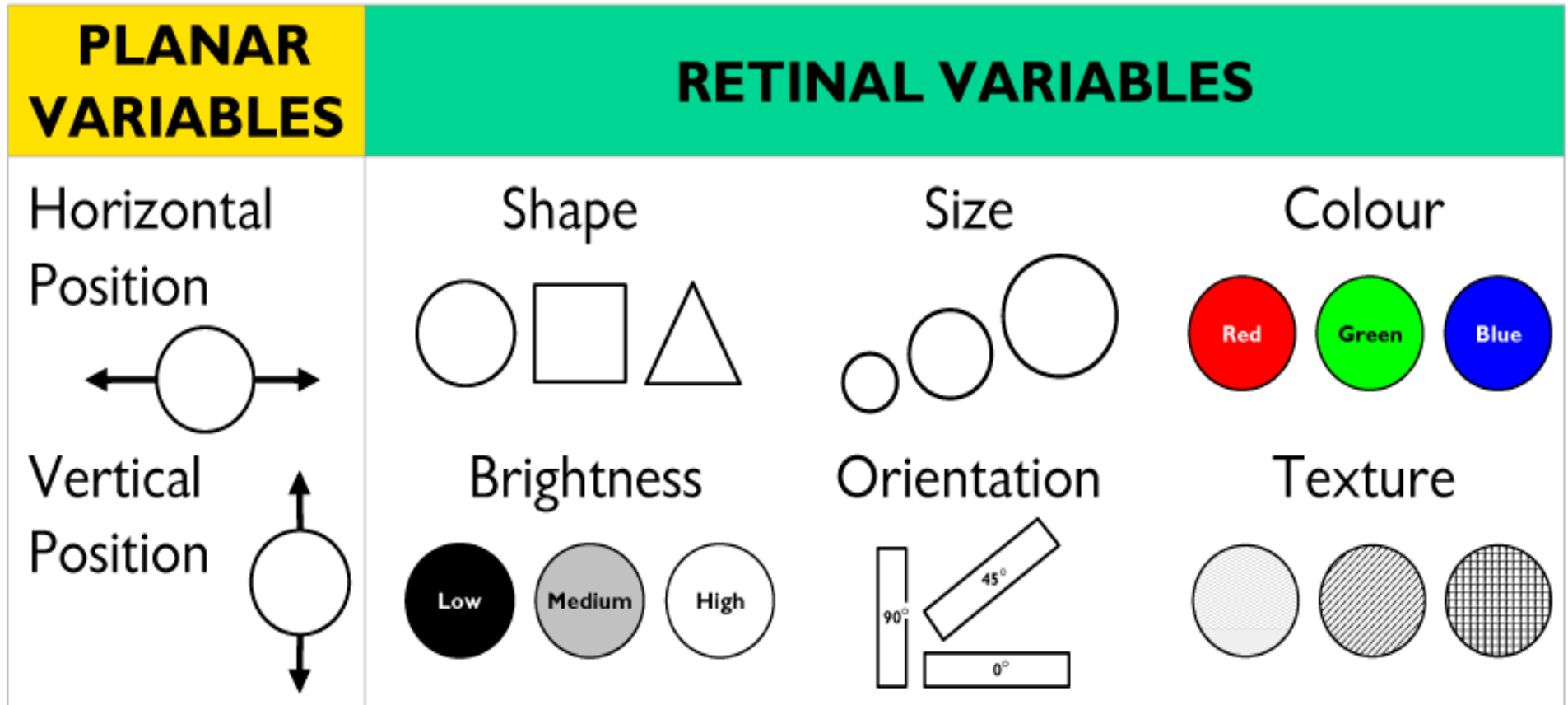


No rigorous way to compare effectiveness and hence no clear design goal.

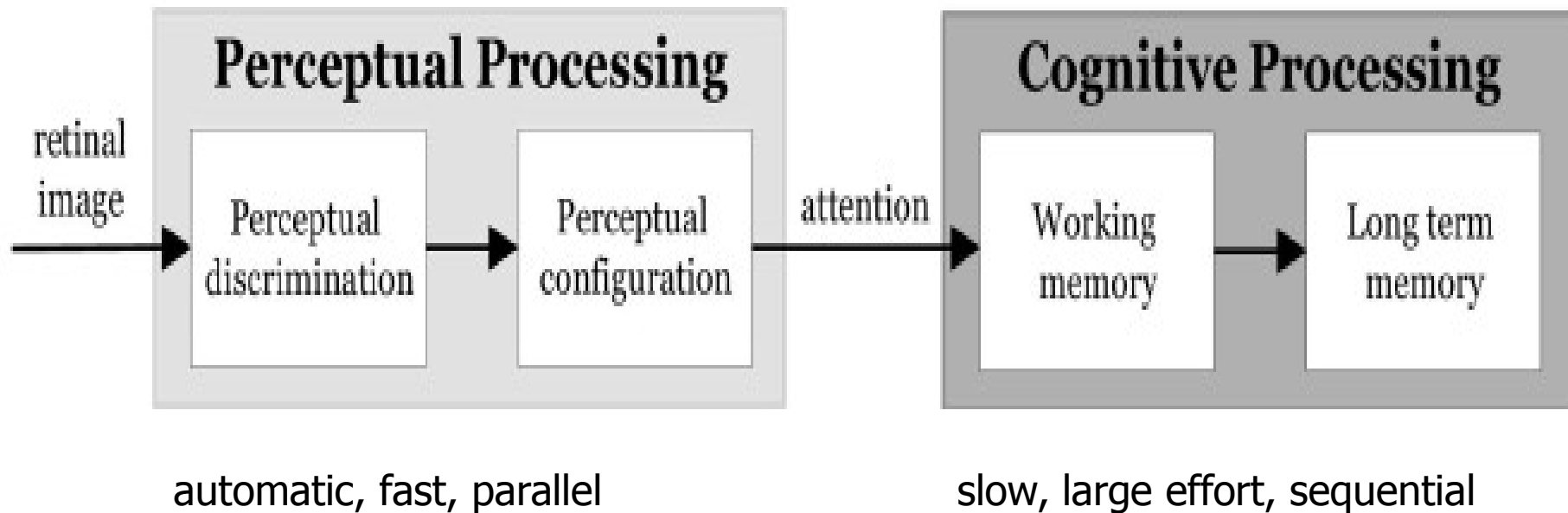
## Communication Theory



Encoding: 8 visual variables to (graphically) encode information

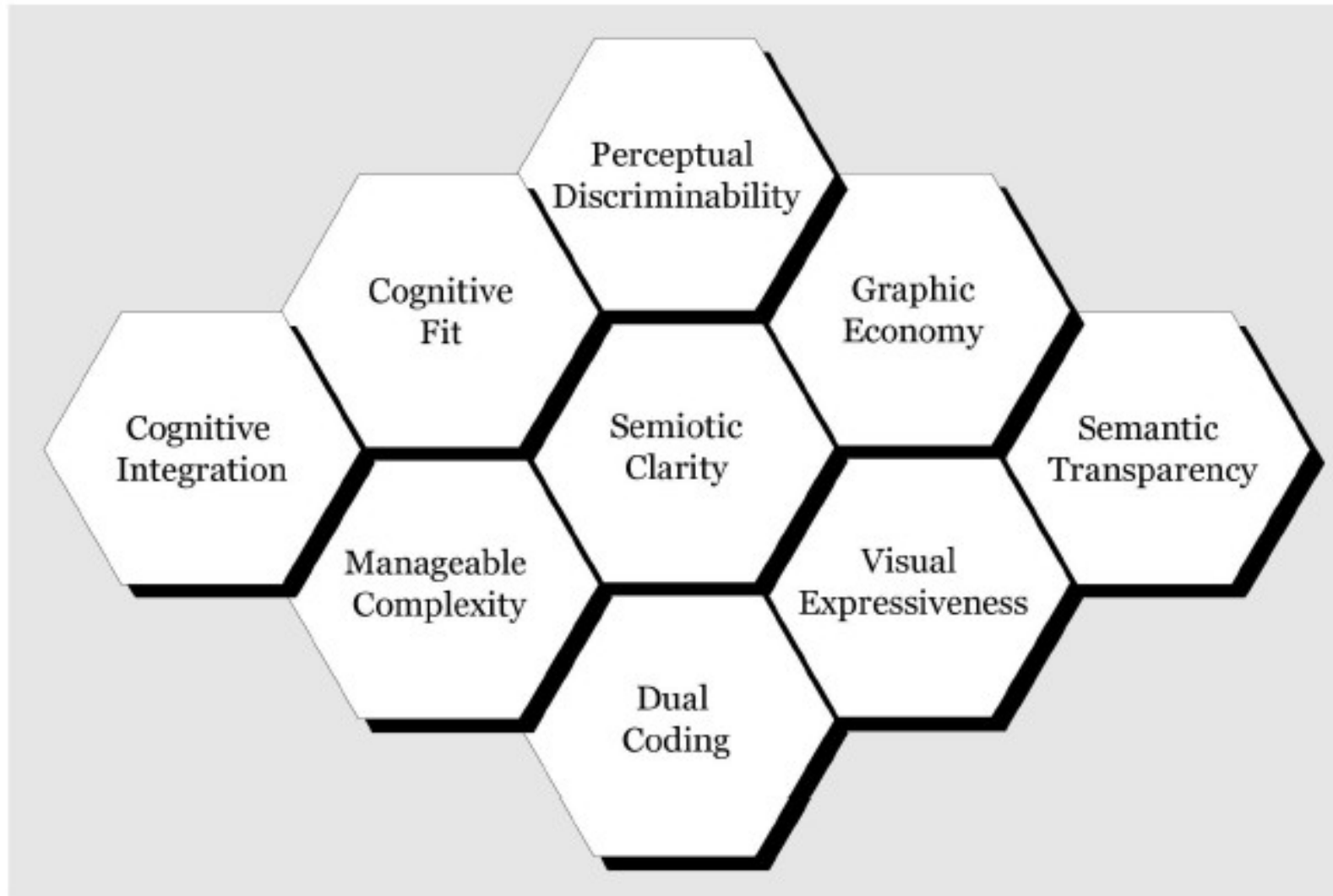


## Decoding



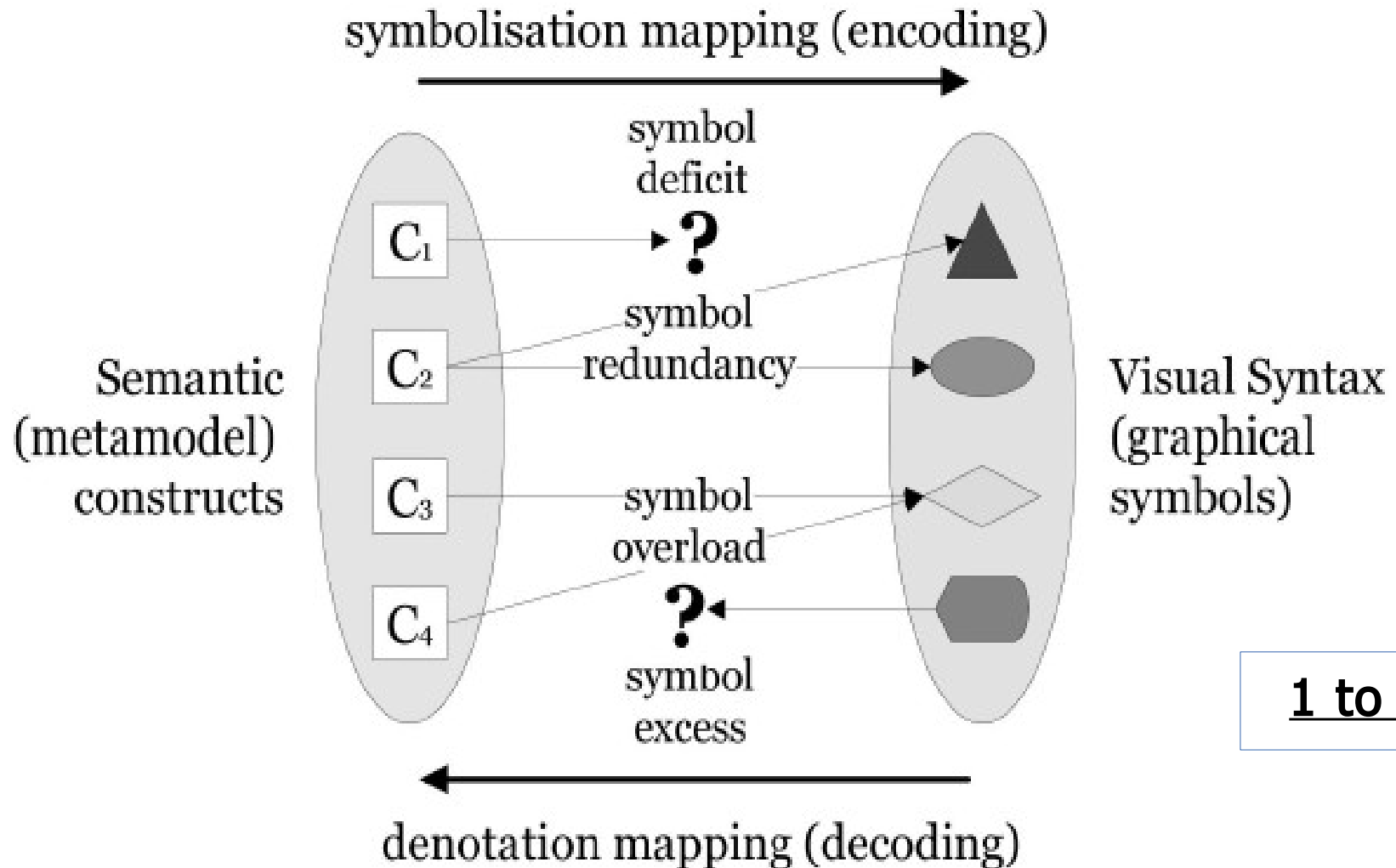
Appropriate notations » offload some of the burden from cognitive to perceptual

## Principles for Designing Efficient and Effective Visual Notations

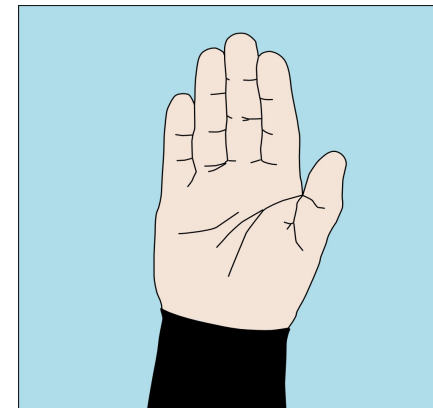
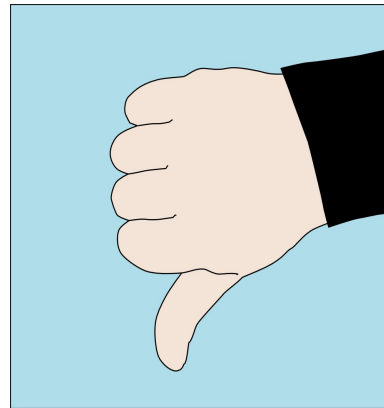
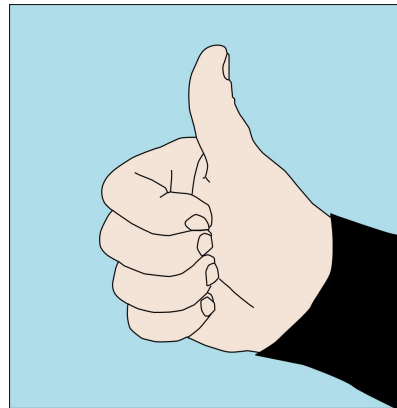
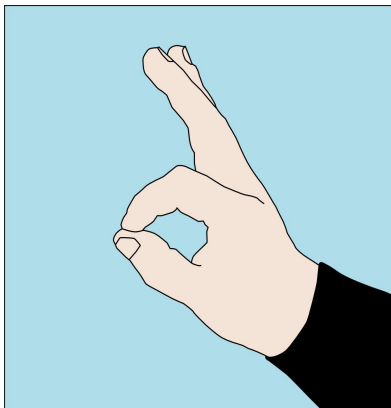
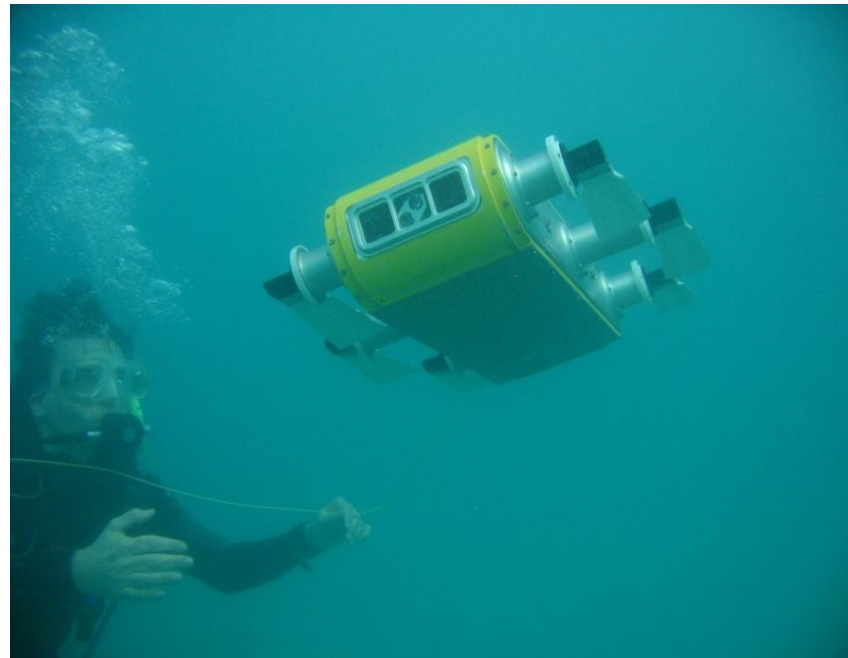




Semiotic Clarity (semiotics = study of signs and sign processes)



## Perceptual Discriminability



## Perceptual Discriminability

should be easy to **distinguish** visual symbols

ability to distinguish is determined by **visual distance**  
larger visual distance » faster, more accurate recognition

- number of visual variables on which they differ and the size of the differences
- shape is the main visual variable



## Perceptual Discriminability

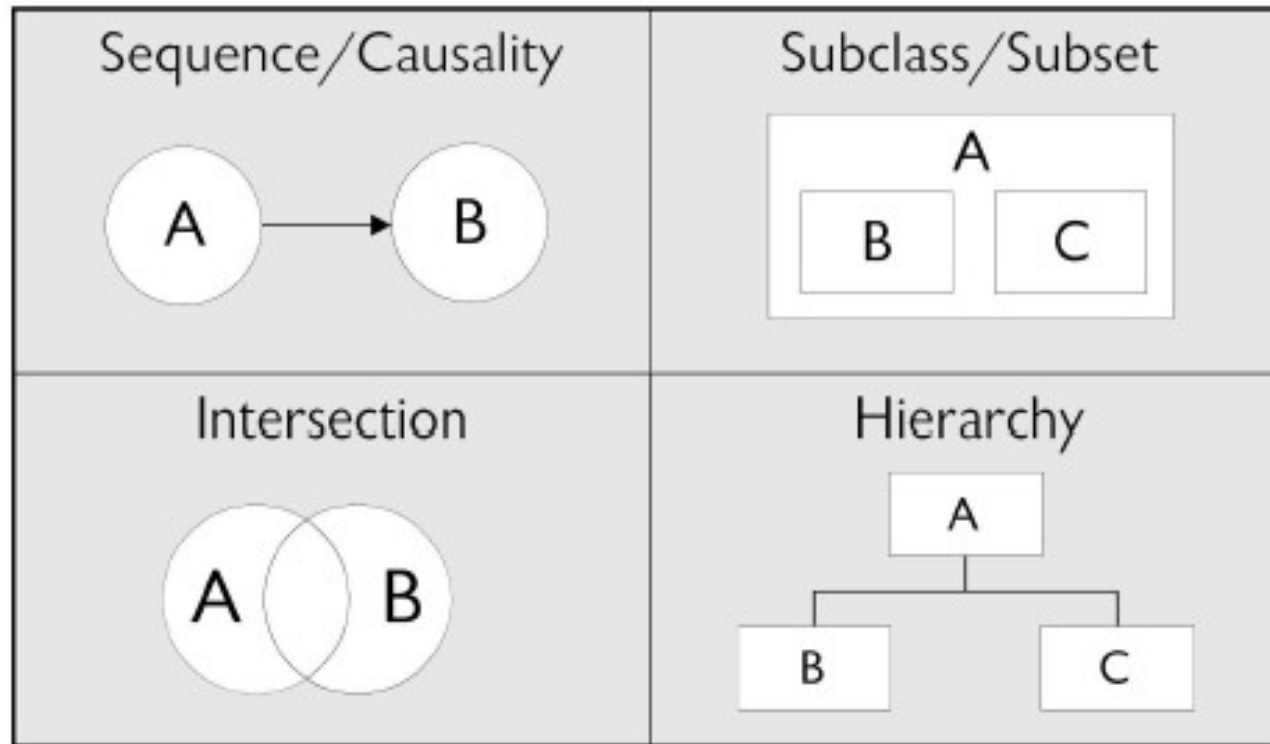
Software Engineering notations mostly look rectangle variants

Use redundant visual encoding to increase distance (e.g., textual + visual)

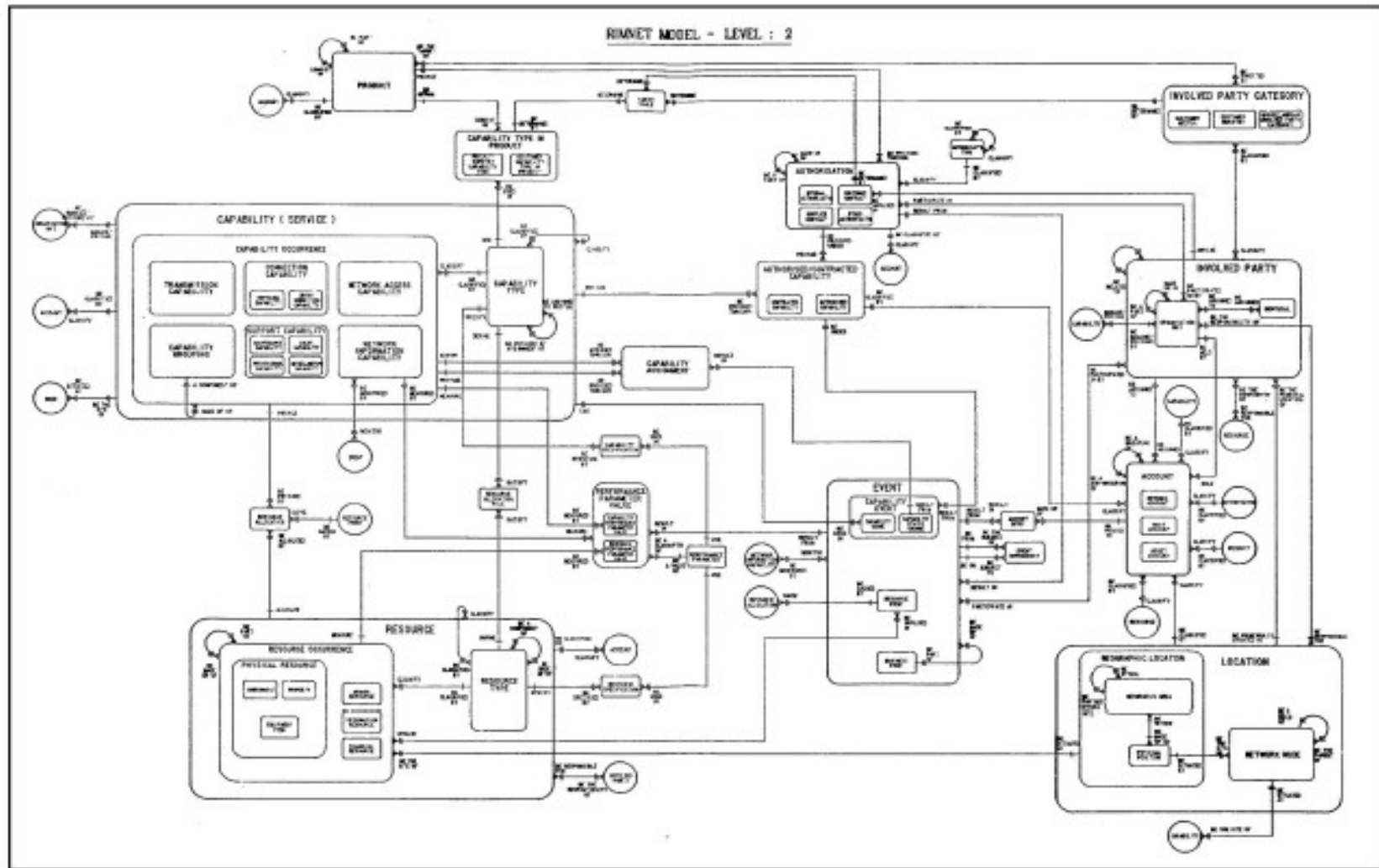




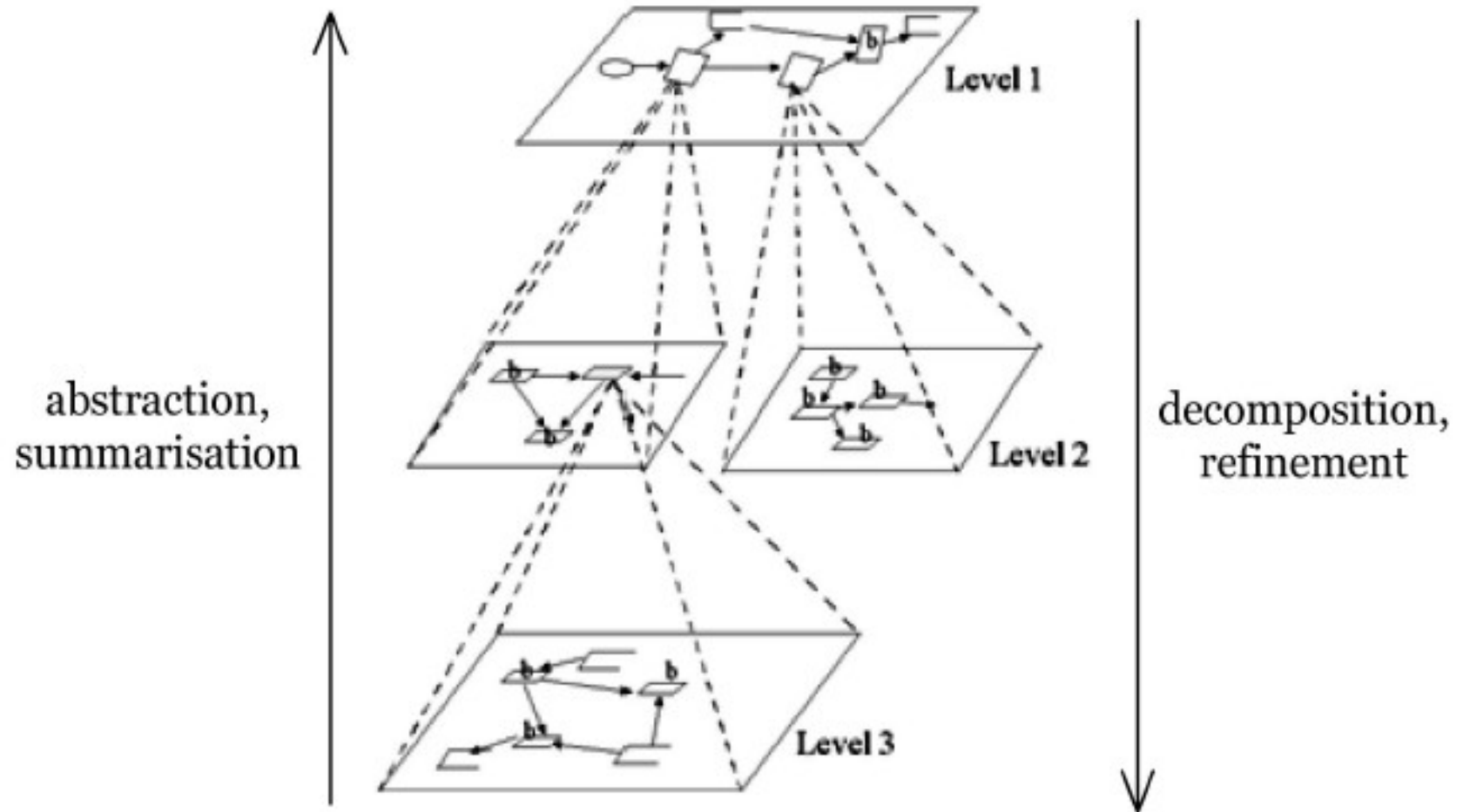
## Semantic Transparency



# Complexity management (# diagram of element » cognitive overload)

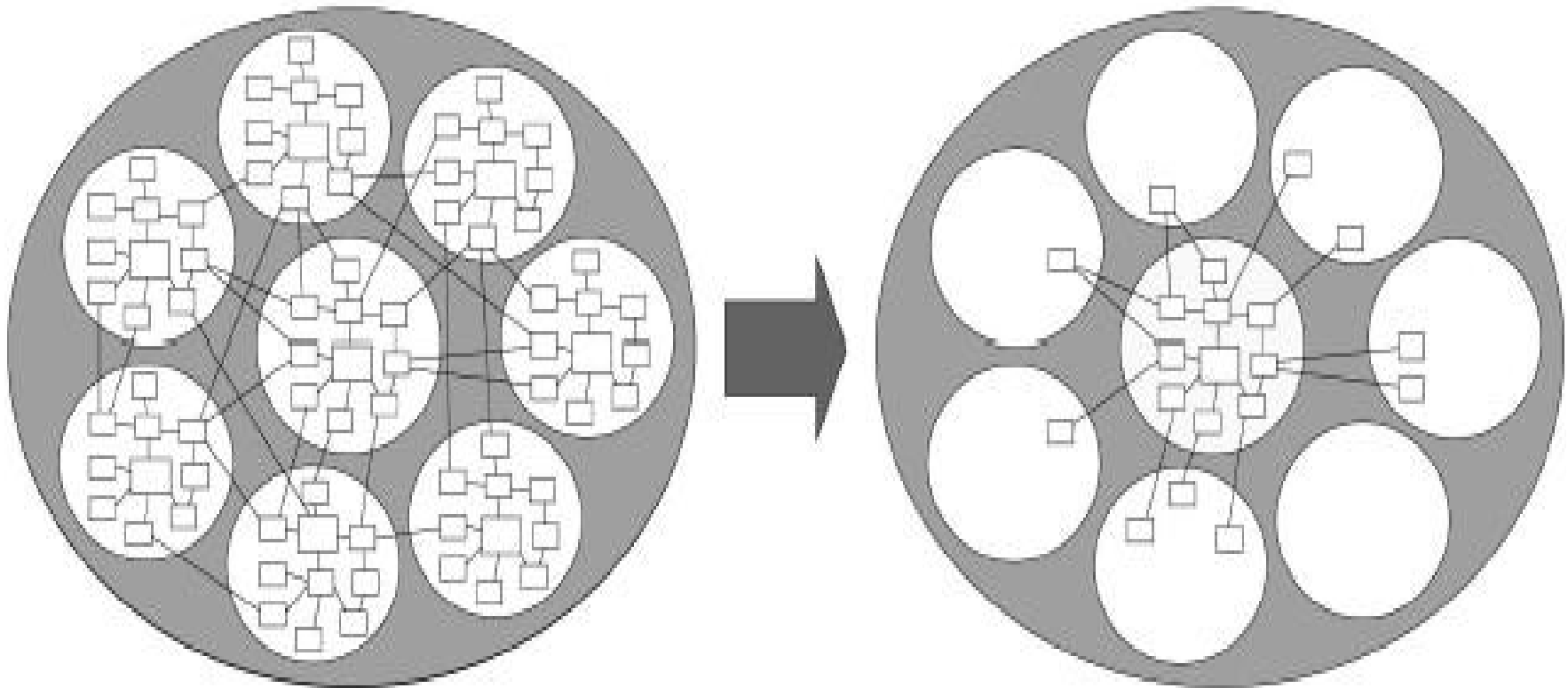


## Modularization/Hierarchy





## Cognitive Integration (different notations)

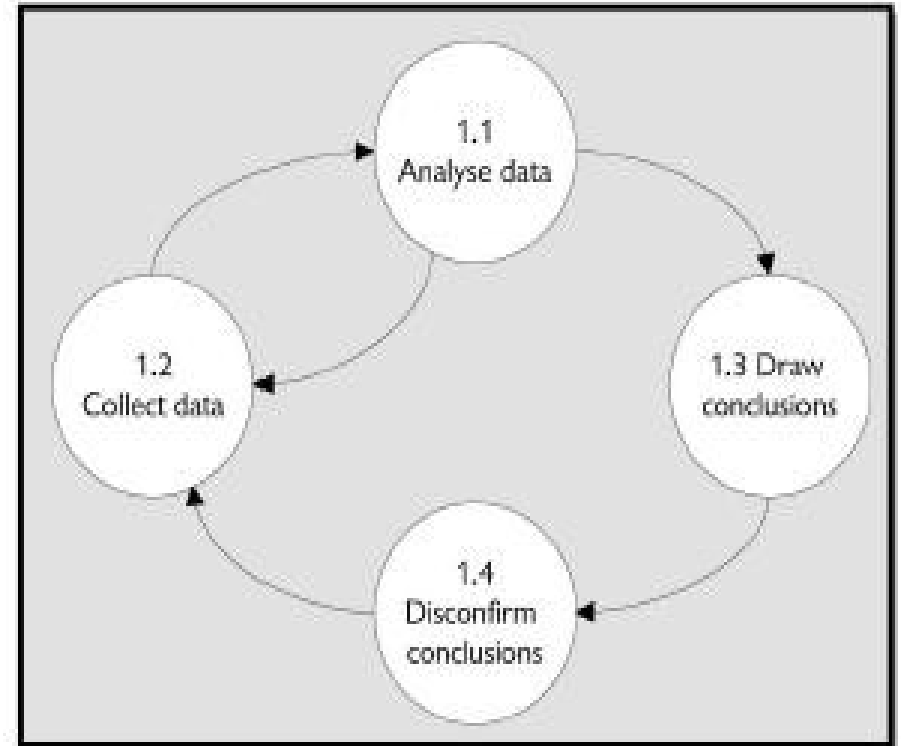
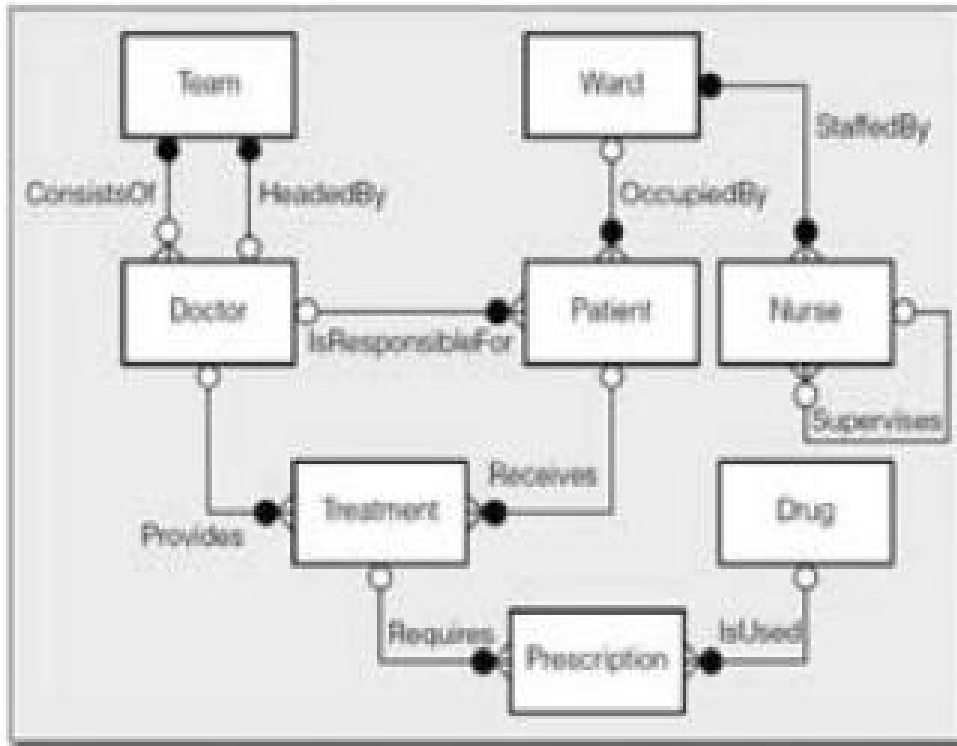


- Conceptual integration (coherent mental model)
- Enable navigation and transition between notations

## Visual Expressiveness

Number of visual variables used (UML, mostly shape, no colour)

8 degrees of visual freedom (0 = non-visual – 8 = visually saturated)



## Visual Expressiveness

Different visual variables have **different capacity** to encode information

Variable	Power	Capacity
Horizontal position (x)	Interval	10-15
Vertical position (y)	Interval	10-15
Size	Interval	20
Brightness	Ordinal	6-7
Colour	Nominal	7-10
Texture	Nominal	2-5
Shape	Nominal	Unlimited
Orientation	Nominal	4

## Dual Encoding

Combine **Textual** and **Visual**

**Supplement** rather than duplicate (e.g., cardinality values)  
**Reinforce** meaning

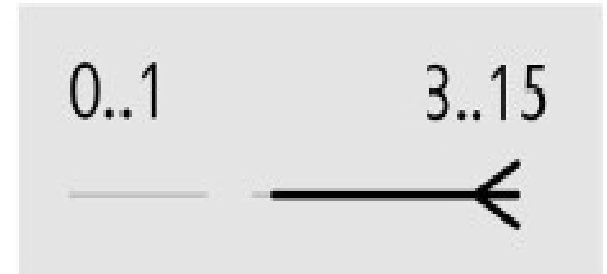
Graphical encoding



Textual encoding



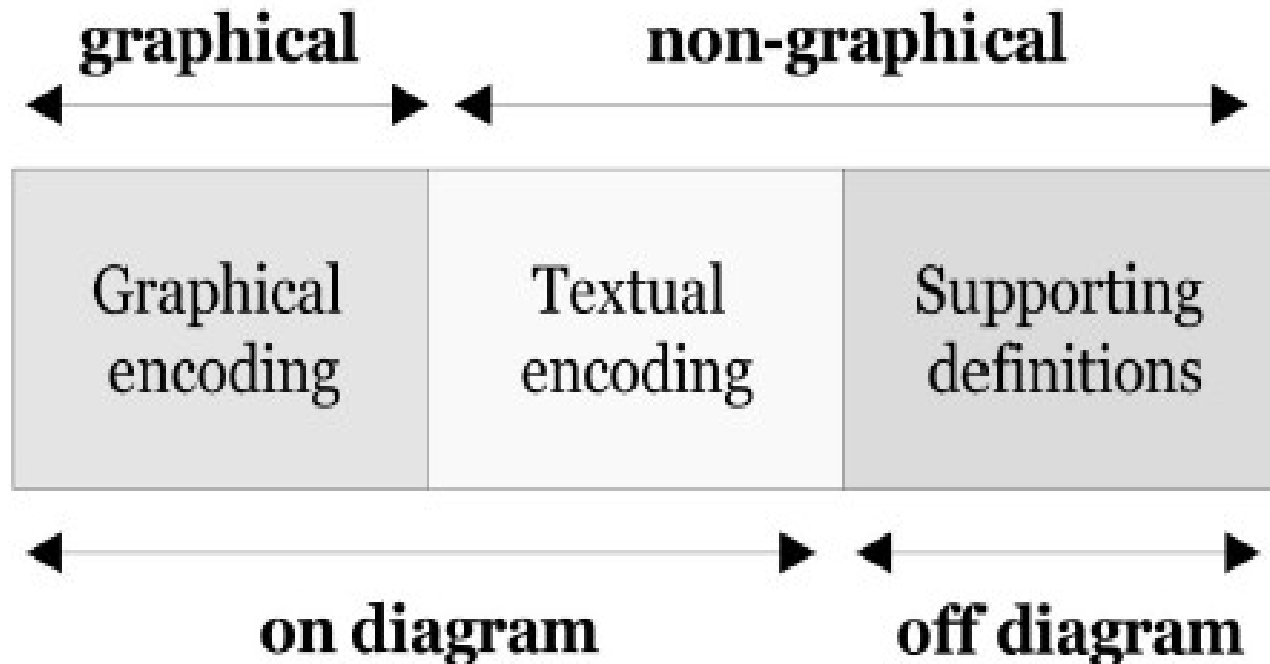
Dual coding  
(graphics+ text)



## Graphic Economy

- Not too many symbols. If many, provide legend
- Limit on human discrimination capability (6 levels per variable)
- Upper limit on graphic complexity

How?



## Cognitive Fit

Adapt choice of visual notation to

- Task
- Audience novices and experts

Representation medium

## Interactions among principles

	Semiotic Clarity	Perceptual Discriminability	Semantic Transparency	Complexity Management	Cognitive Integration	Visual Expressiveness	Dual Coding	Graphic Economy	Cognitive Fit
Semiotic Clarity							±		
Perceptual Discriminability						+		+	
Semantic Transparency		+						±	
Complexity Management							-	+	
Cognitive Integration	-			+			-		
Visual Expressiveness		+					+	±	
Dual Coding								+	
Graphic Economy		+		+		-		+	
Cognitive Fit									