



Framework for Modeling the Cognitive Process

*Spatial and Temporal Considerations
in a Signal-Based Approach*

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Command & Control (C2)



C1 - Command

C2 - Command, Control

C3 - Command, Control, Communications

C4 - Command, Control, Communications, Computers

C5 - Command, Control, Communications, Computers,

... Combat

... Coalition

... Consultation

... Collaboration

...

Command requires Cognition!



Definitions of “Cognition”



cog•ni•tion [*cognoscere* to know]: knowing, knowledge

Other (loose) definitions of cognition include:
awareness, thinking, reasoning, understanding,
mental processes (esp. high order), “of the mind”...



A “*Signal-Based*” Approach



- *Signal* is a generic term used for cognitive activity
- *Signal* use is modeled after pulses, oscillations in brain
- A *Signal* has frequency, phase, amplitude components
- A *Signal* exists in space and in time
- A *Signal* can be input, output, or internal activity
- A *Signal* can be data, information, knowledge, etc.
- A *Signal* can be abstract, conceptual, etc.
- A *Signal* can be formal, physical, symbolic, etc.

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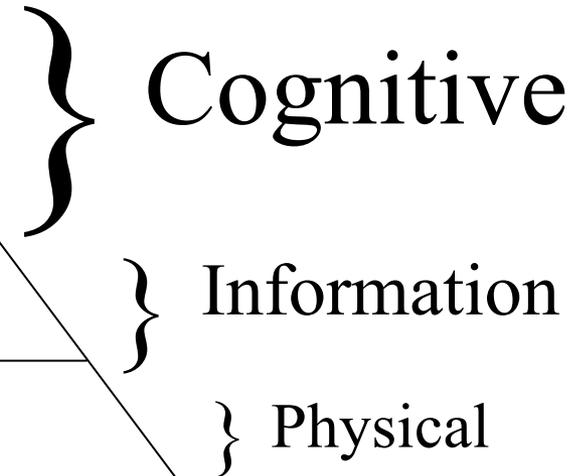
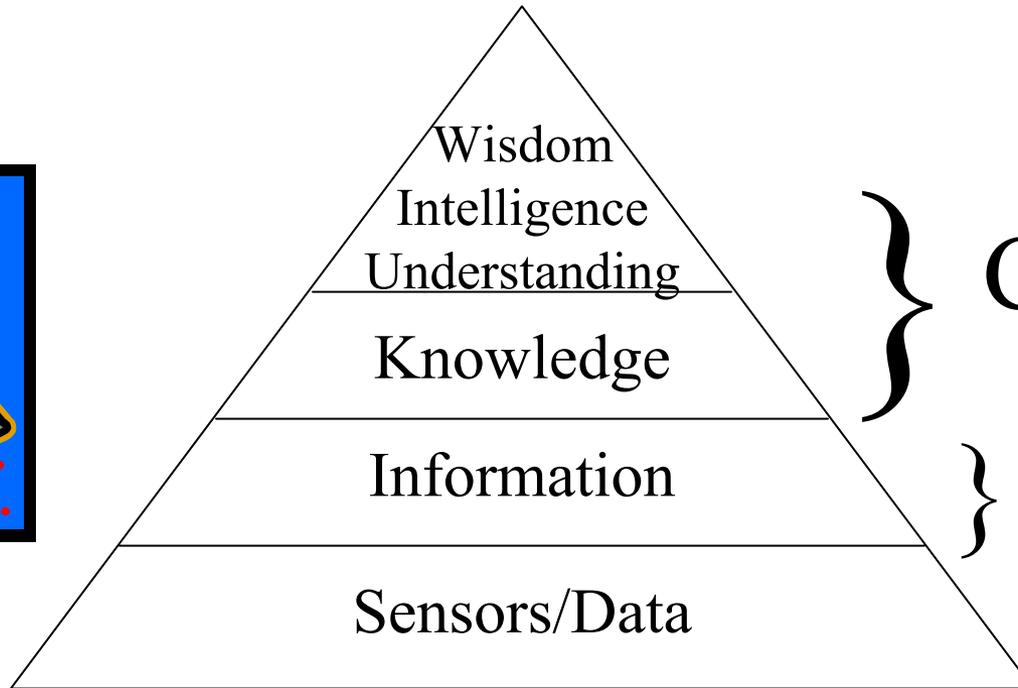
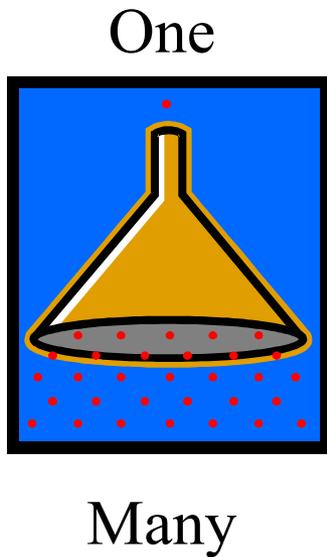
Descriptions of “Cognition”



Transformations

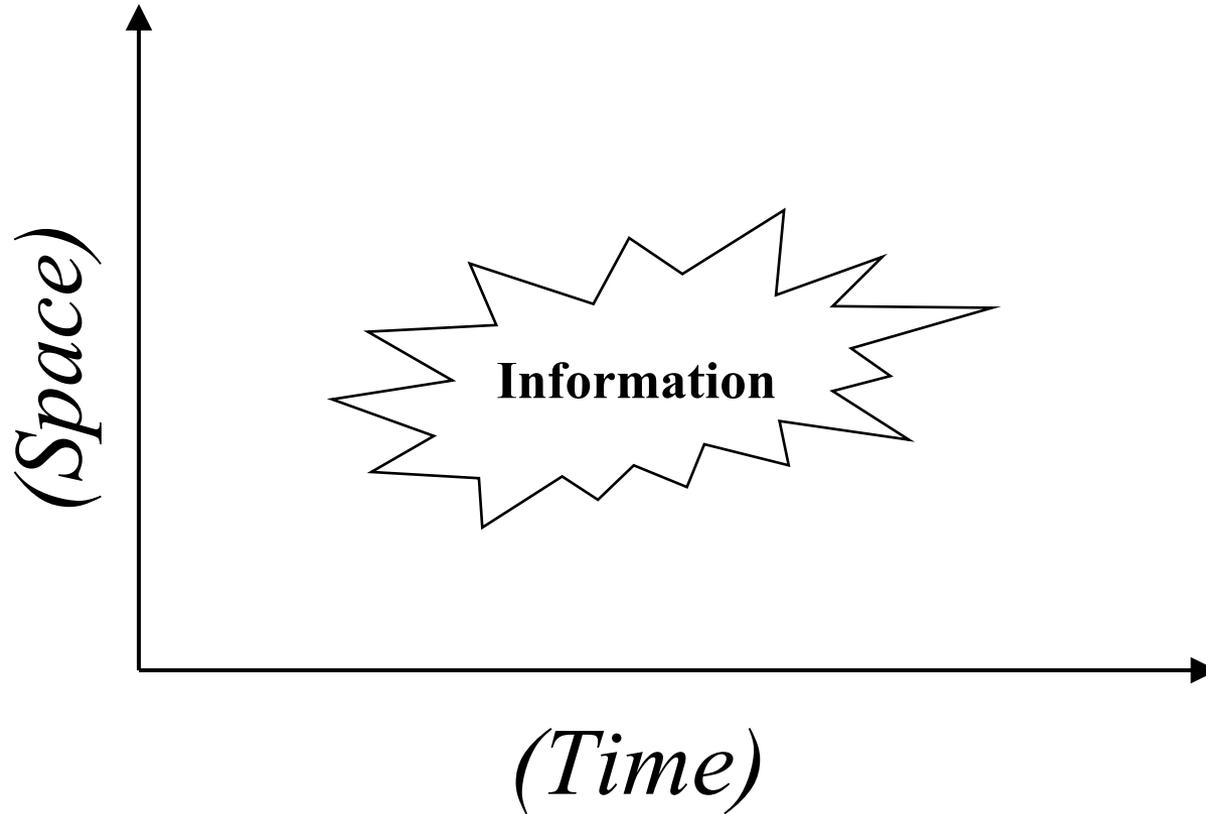
Pyramids

Domains



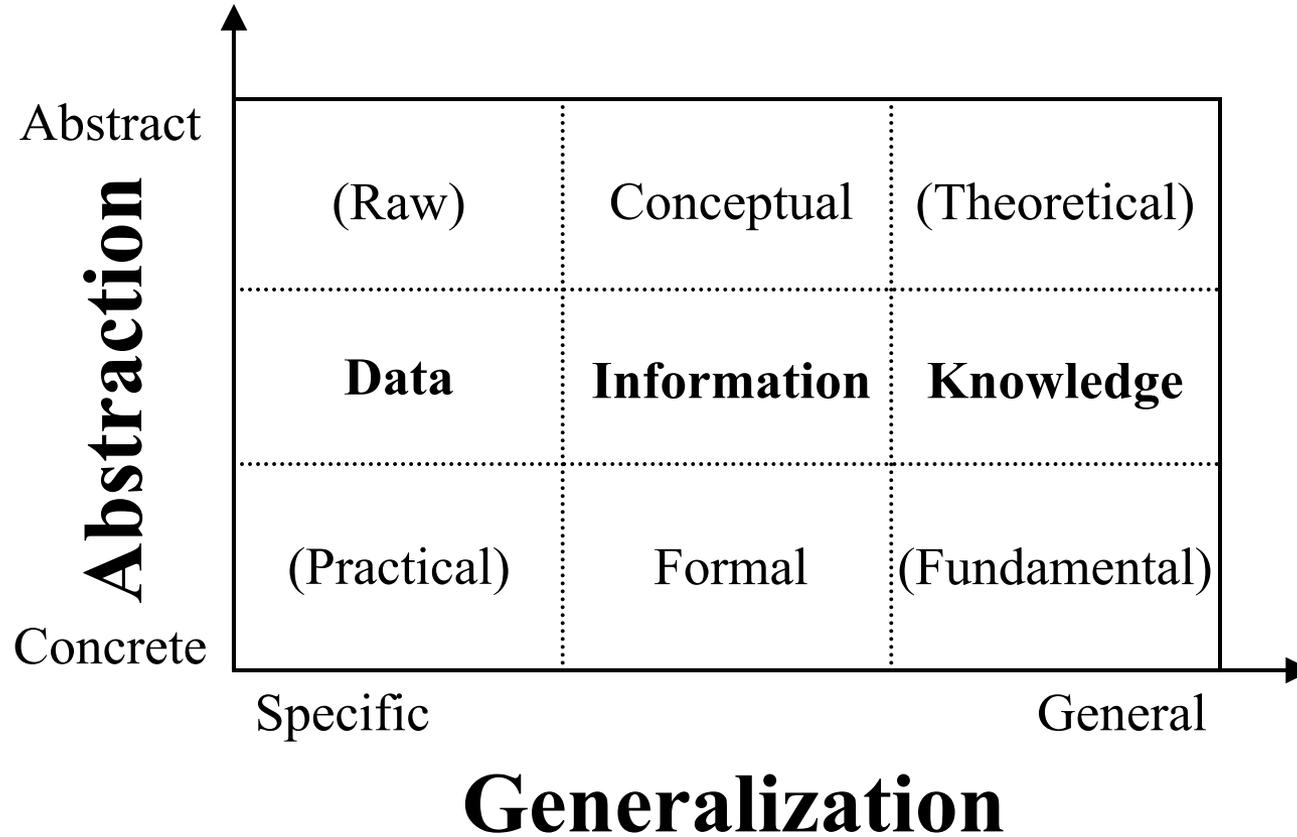


“Frame the Perspective”





Framework for Modeling Cognition

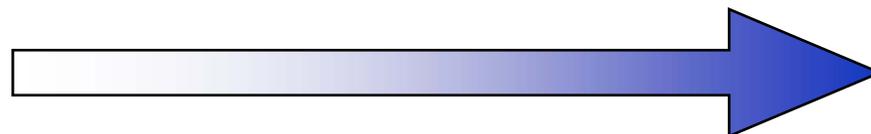
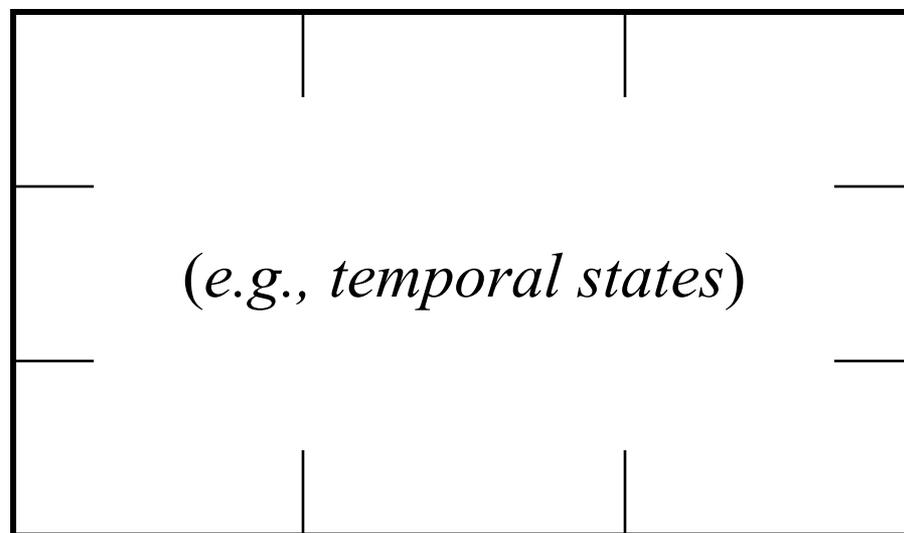




Describe Signals Changing in *Time*



(Horizontal Dimension in Framework)



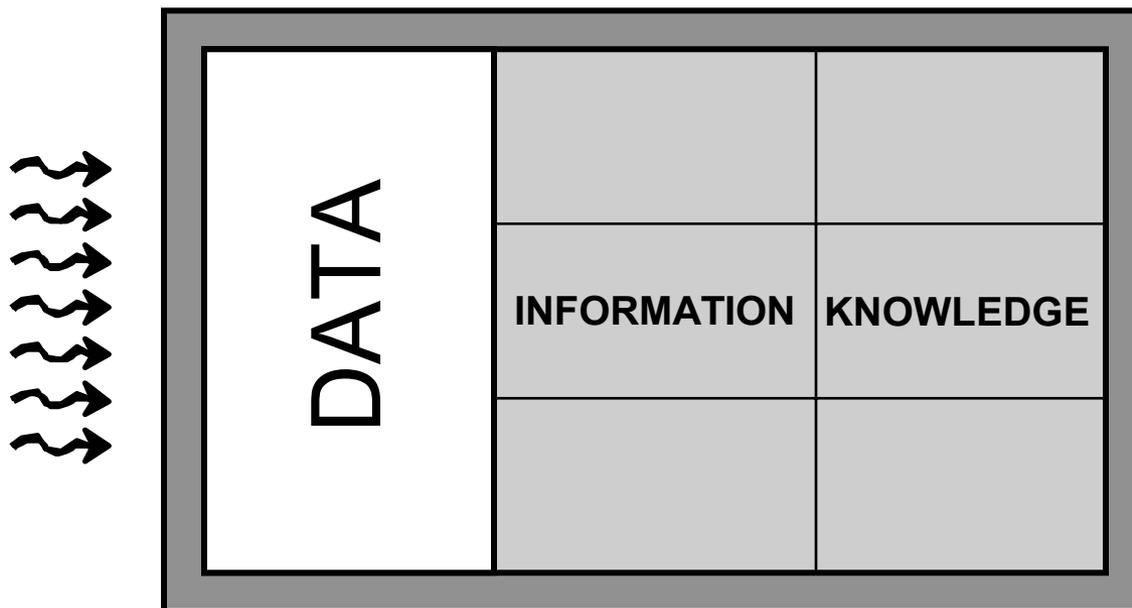
(Time)



“Data...”



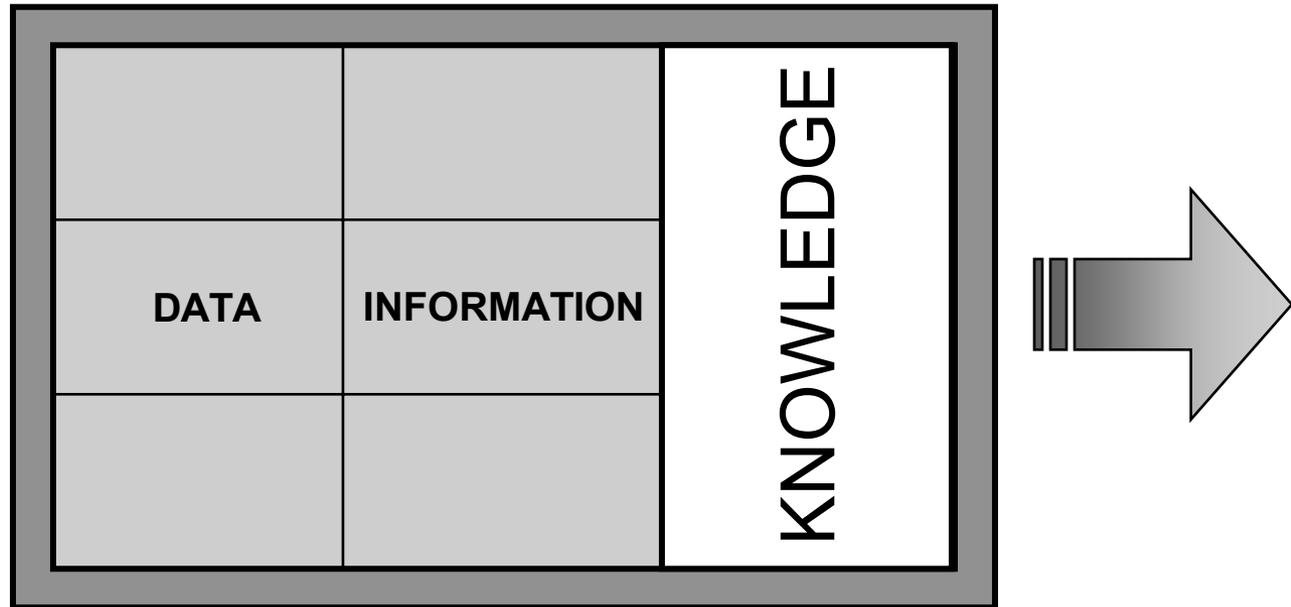
- represents the majority of input signals
- has the highest frequency/shortest period
- is the least organized type of signals





“Knowledge...”

- is the most organized type of signals
- has the lowest frequency/longest period
- represents the majority of output signals

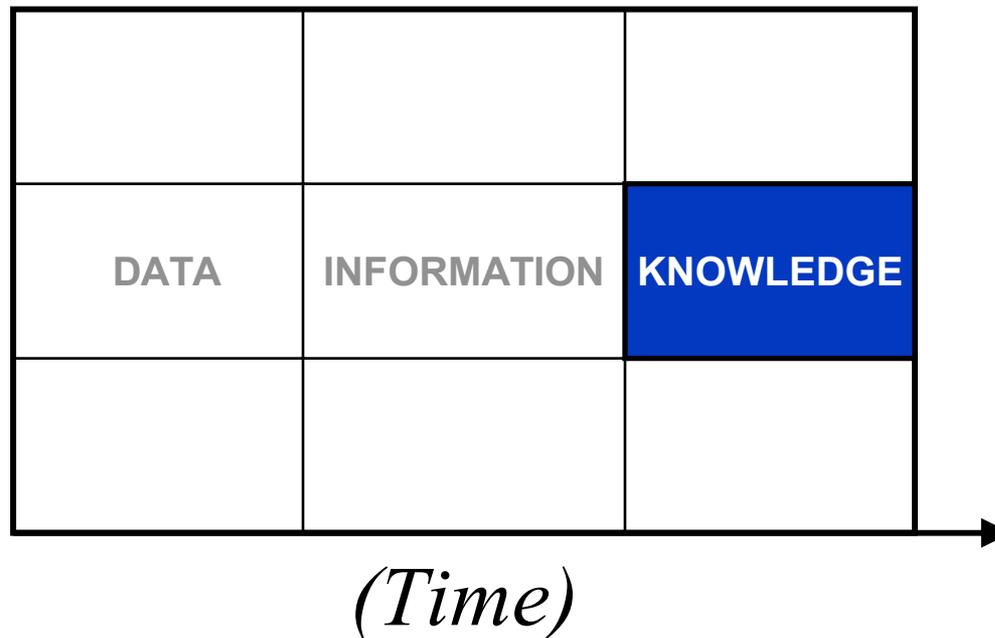




The Essence of Generalization



- Produces *Knowledge*
- Many signals transformed into fewer ones
- *Time* abstracted out of signals

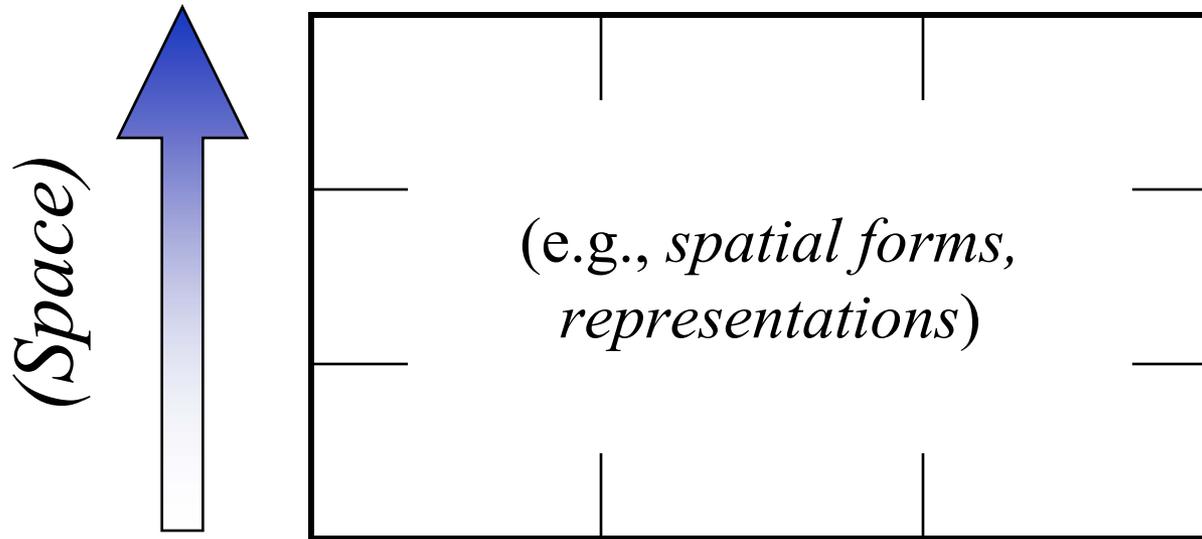




Describe Signals Changing in *Space*



(Vertical Dimension in Framework)

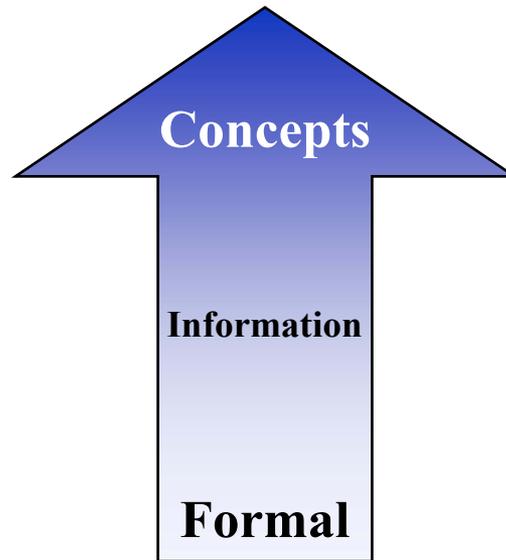




What Happens to Mental Signals in *Space*?



Few Signals, Formless, Abstract



Many Signals, Formal, Concrete

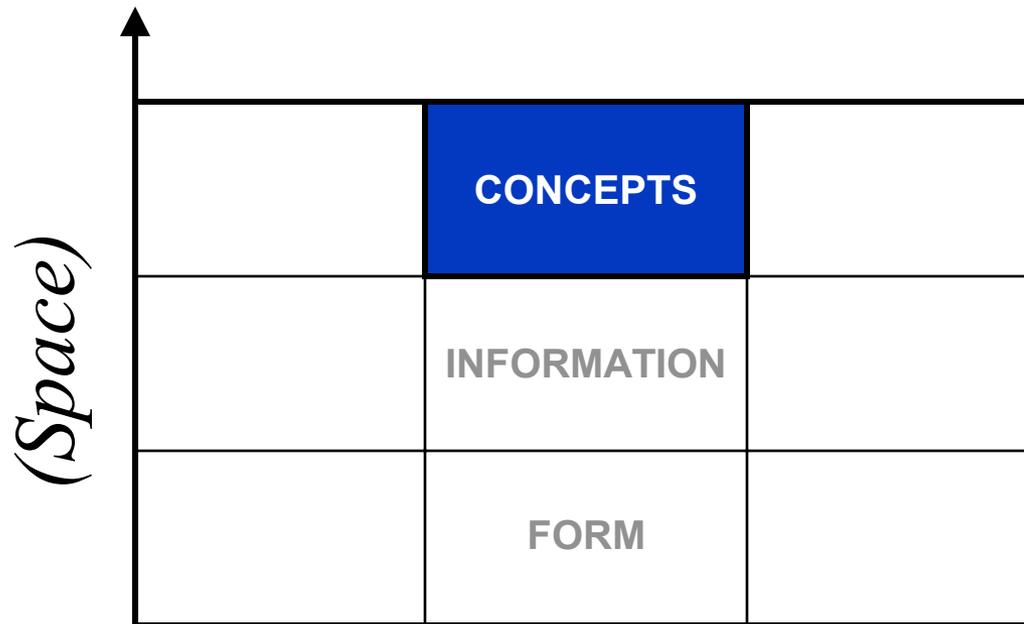
Humans *Abstract...*



The Essence of Abstraction



- Produces *Concepts*
- Many signals transformed into fewer ones
- *Form* abstracted out of signals

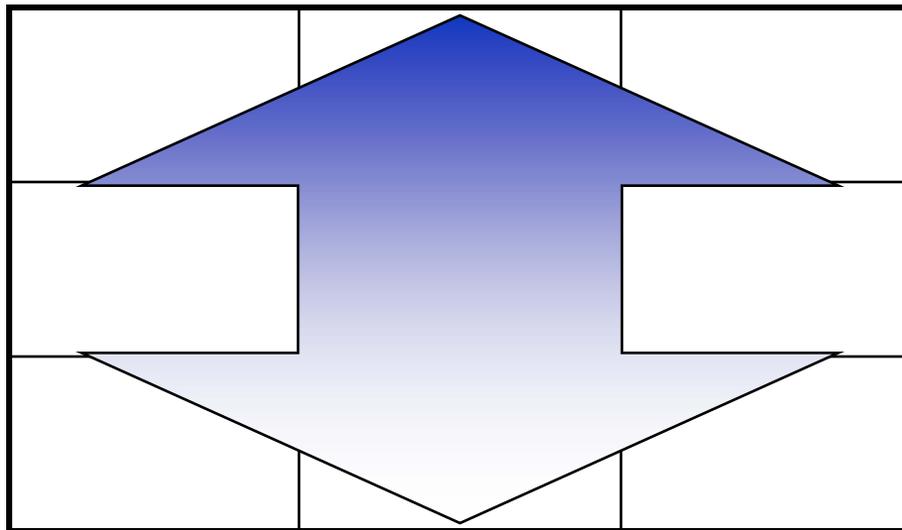




Abstraction: Two Opposing Forms



Abstract, conceptual, informal, apparent, complex, combined, notional, seeming, cognitive, ideal, intangible; *“mental” model of reality ...*



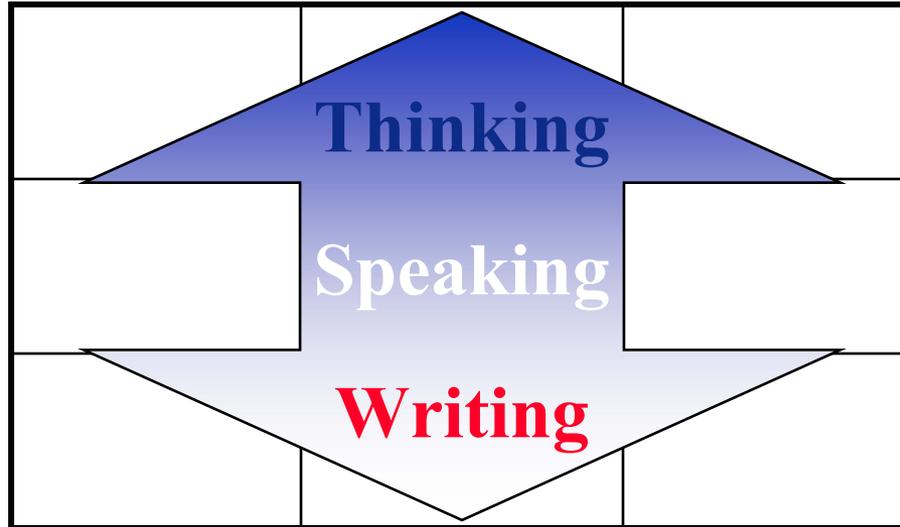
Formal, concrete, certain, absolute, fundamental, simple, basic, primitive, practical, principle, factual, sensory, machine-like; *“physical” model of reality ...*



Example of Abstraction

(Representation Across Multiple Levels)

Abstract, Conceptual ... (“*Mental*”)



Formal, Concrete ... (“*Physical*”)



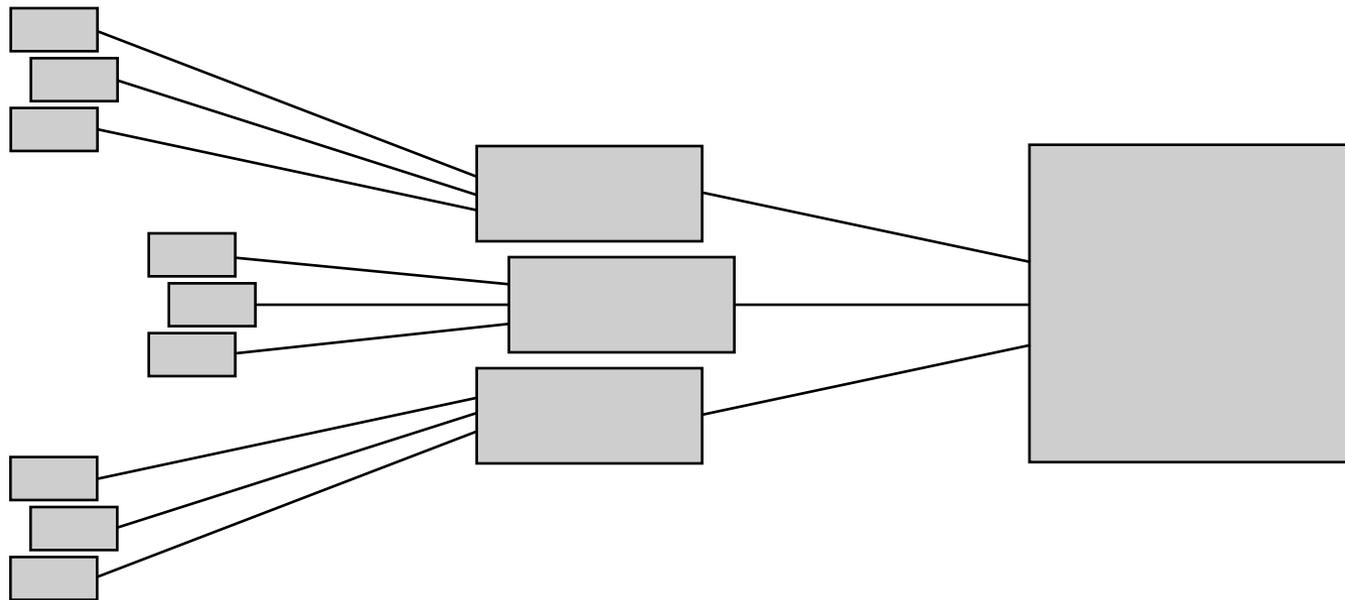
Some Basic Signal Properties...



(Spatial and Temporal Considerations)

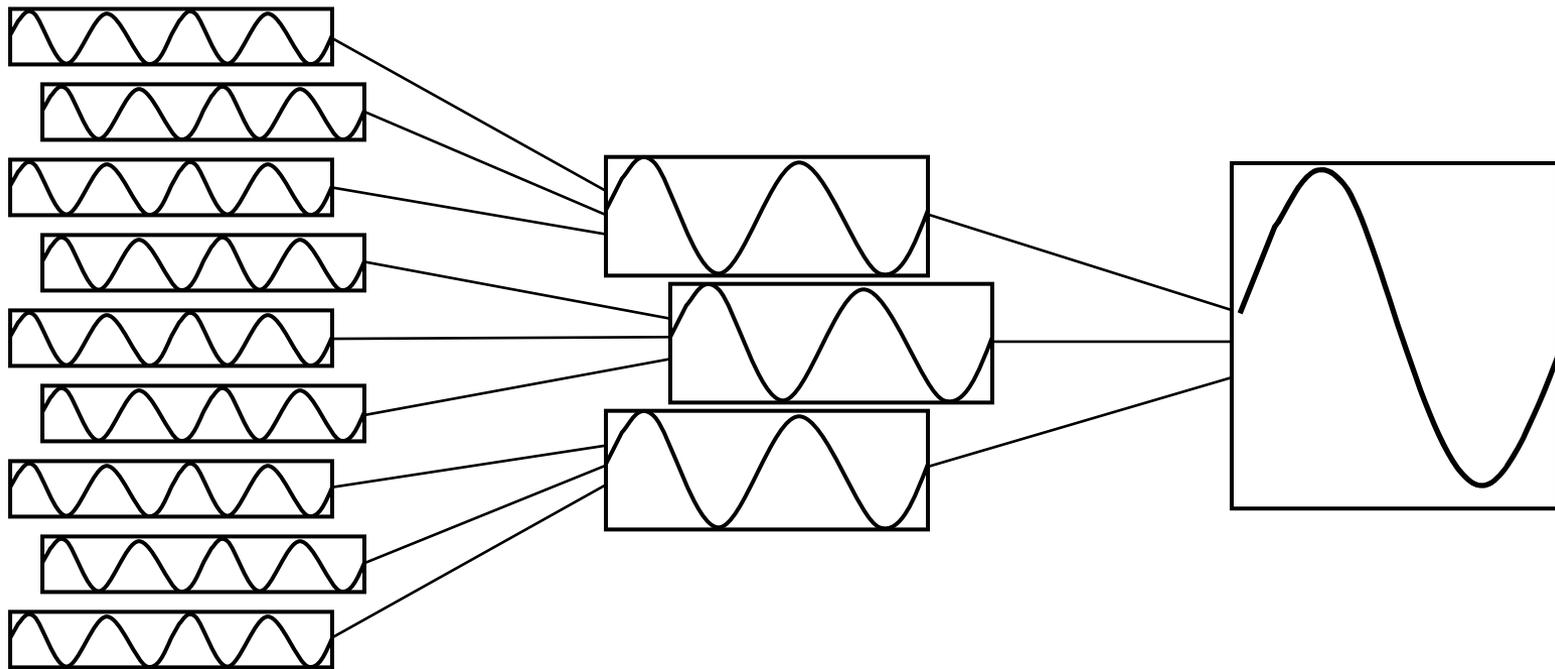


Signal Scaling



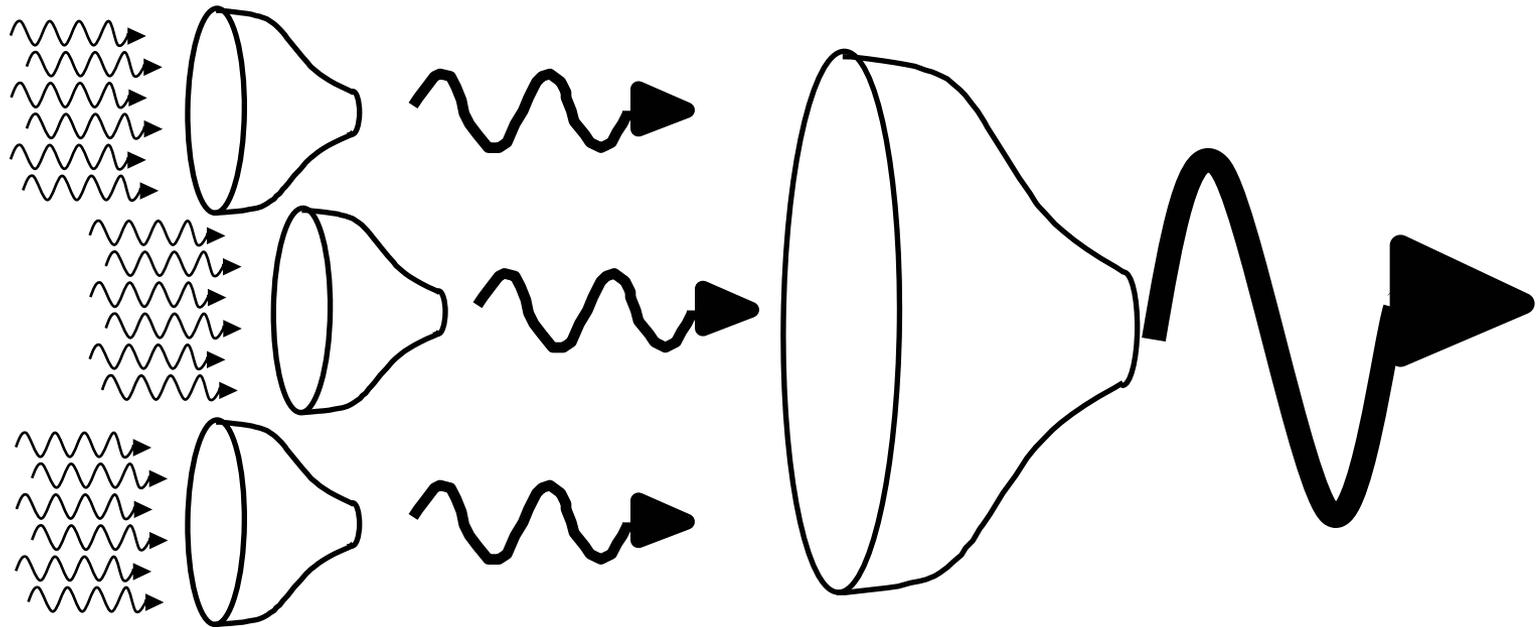


Signal Coupling





Signal Filtering

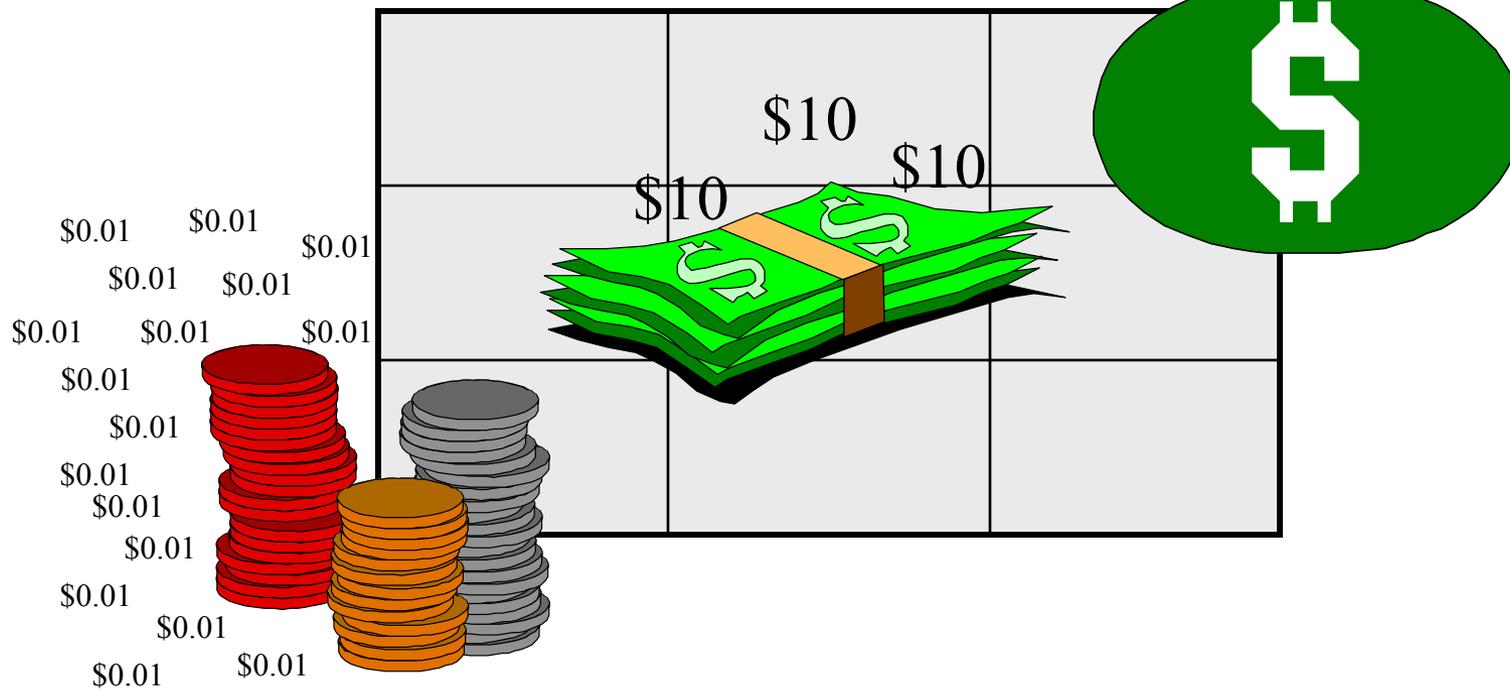




Signal Significance



\$1,000,000

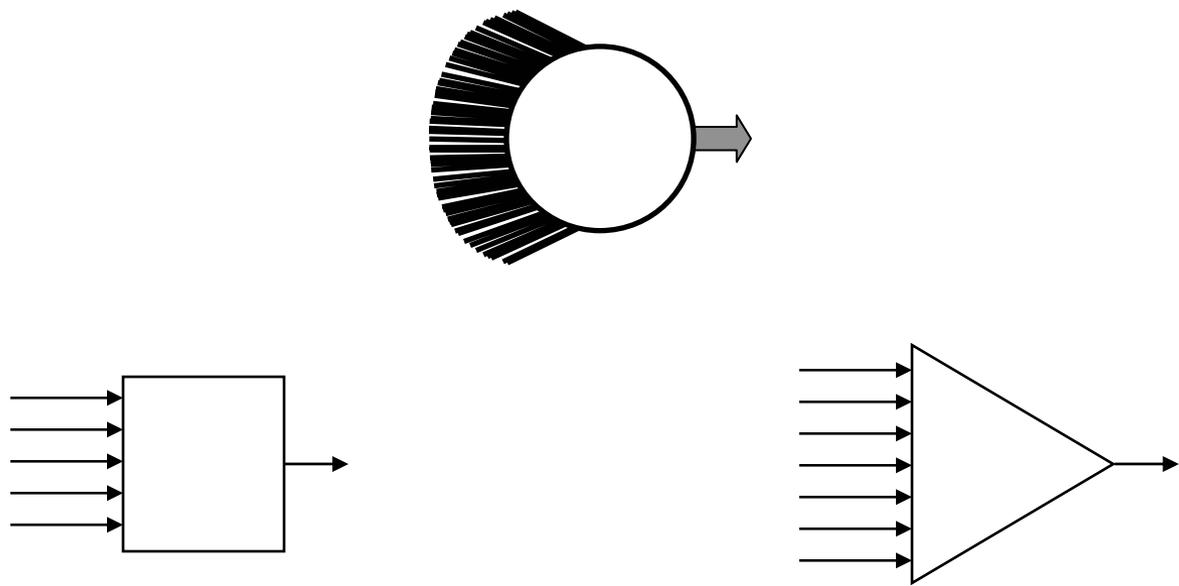




A Main Point of the *Process*



- Signals proceed from “**many to one**”...

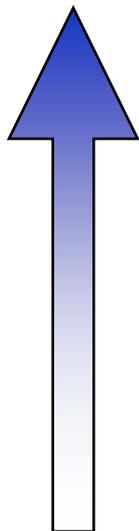


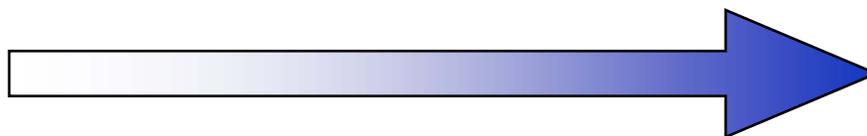


Cognition Involves the Ability to:



Abstract

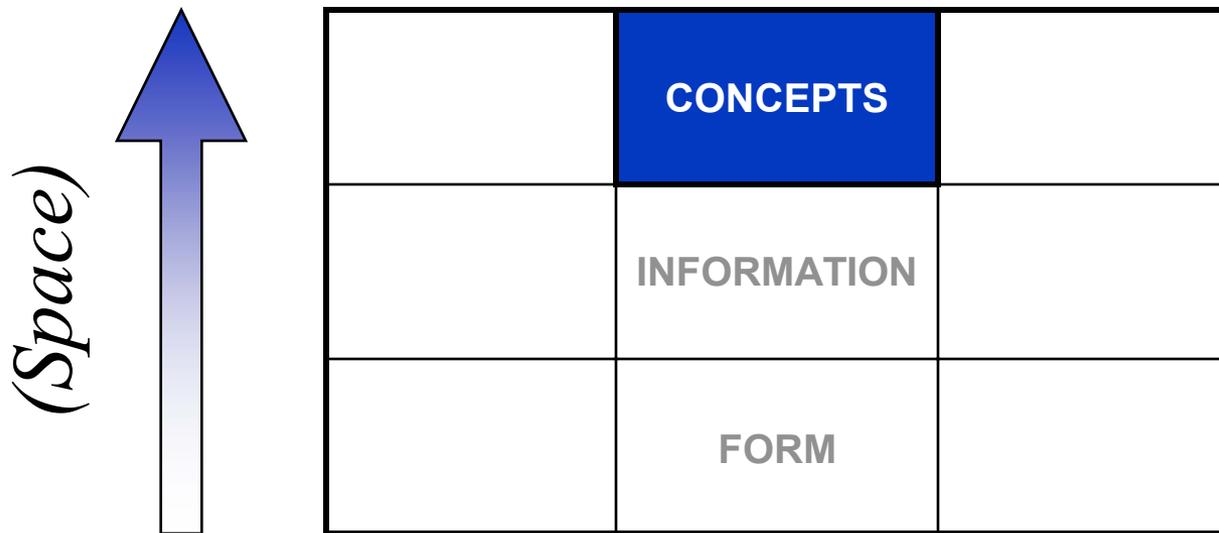




Generalize



Essence of Abstraction

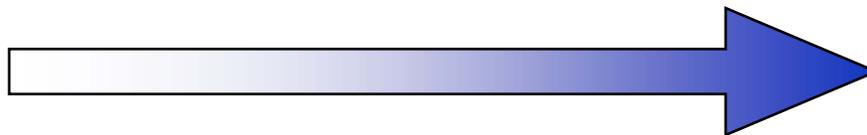




Essence of Generalization



DATA	INFORMATION	KNOWLEDGE



(Time)



Conclusion



*This conceptual framework,
while relatively simple,
has potentially far-reaching
effects in the domain of
modeling cognition.*