Pressing Vision Problems in Intelligent Sketch Understanding Systems

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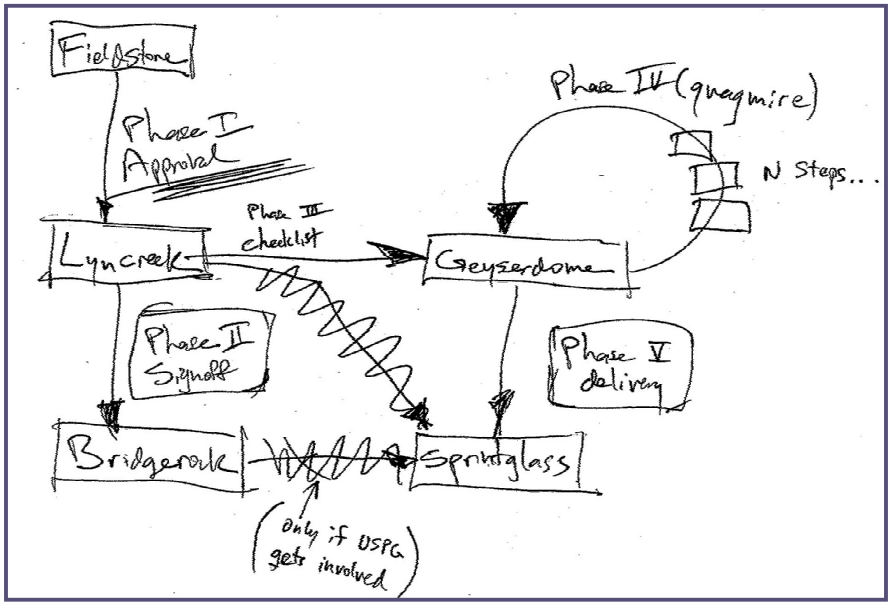
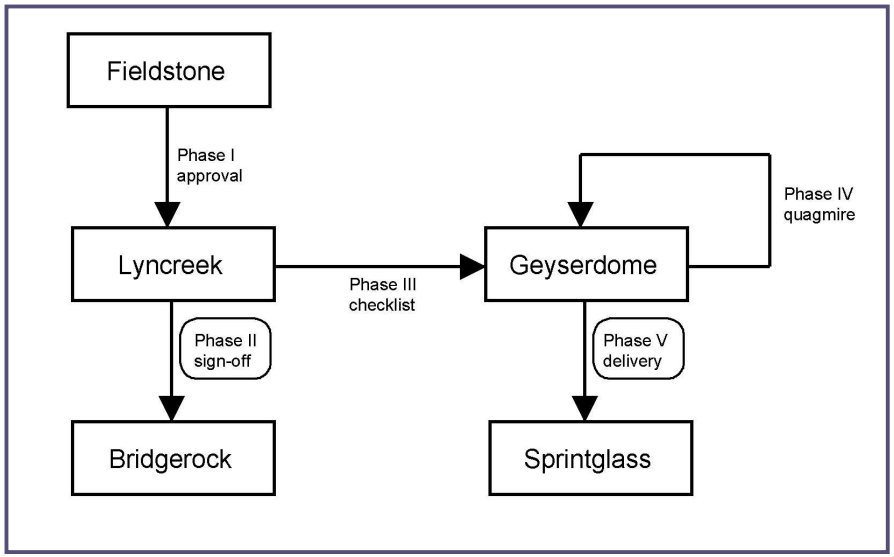
Image Domain: Document Images





Formal, Rough

Text, Graphics

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Applications Around Rough Documents

- Transcription
  - handwritten text to ASCII
  - sketches to CAD models
- Sorting
- Excerpting
- Annotating and cross-linking
- Editing
- Indexing and retrieving

ScanScribe
Document Image Editor

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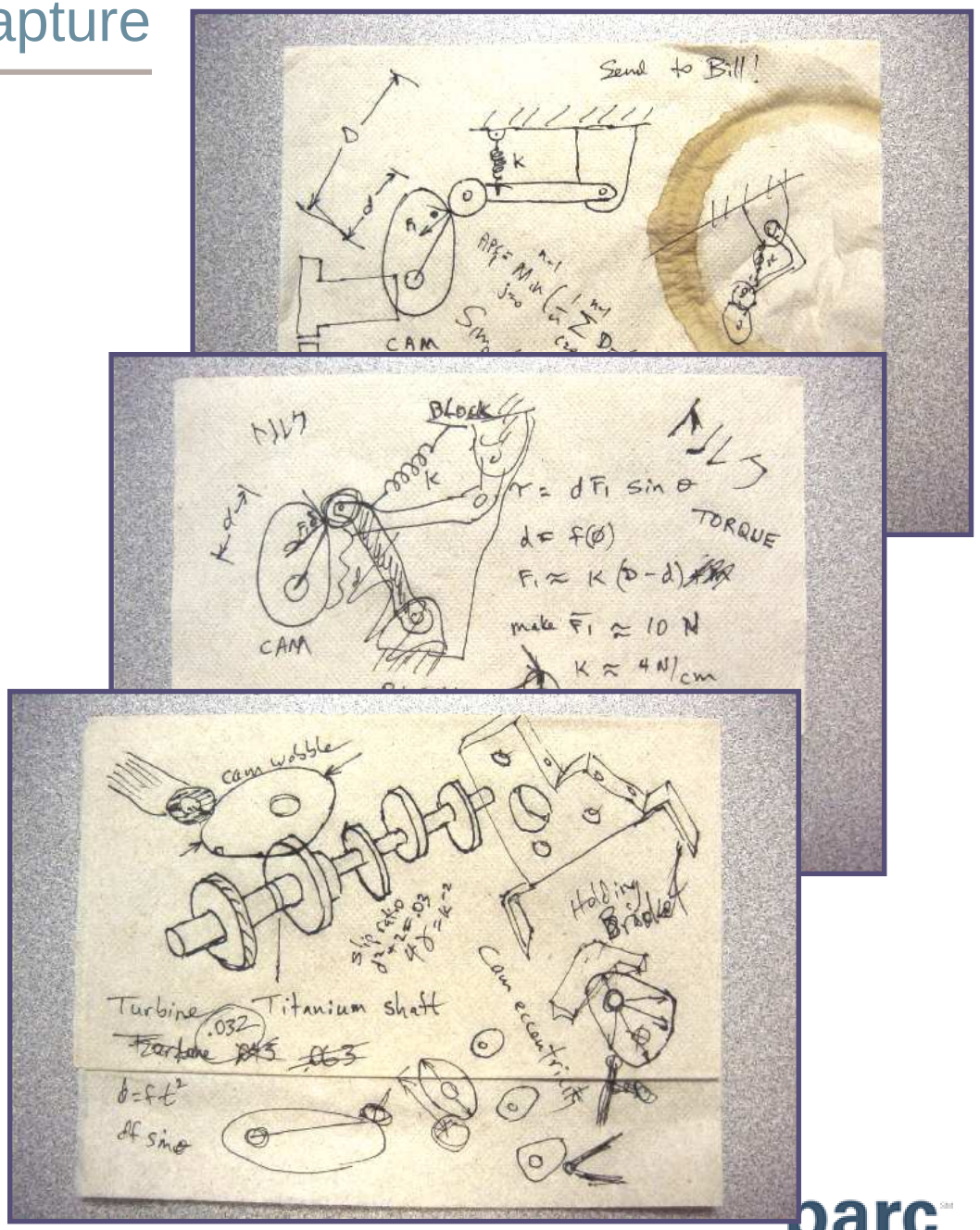
Ubiquitous casual image capture



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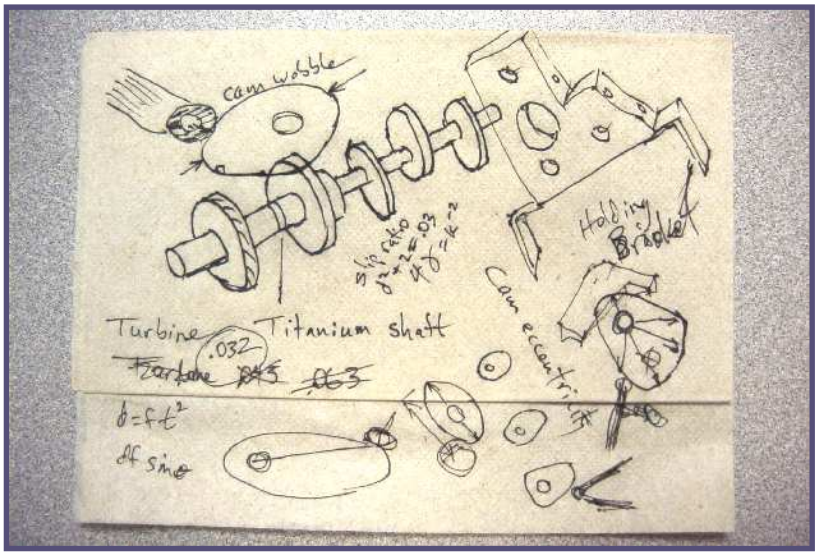
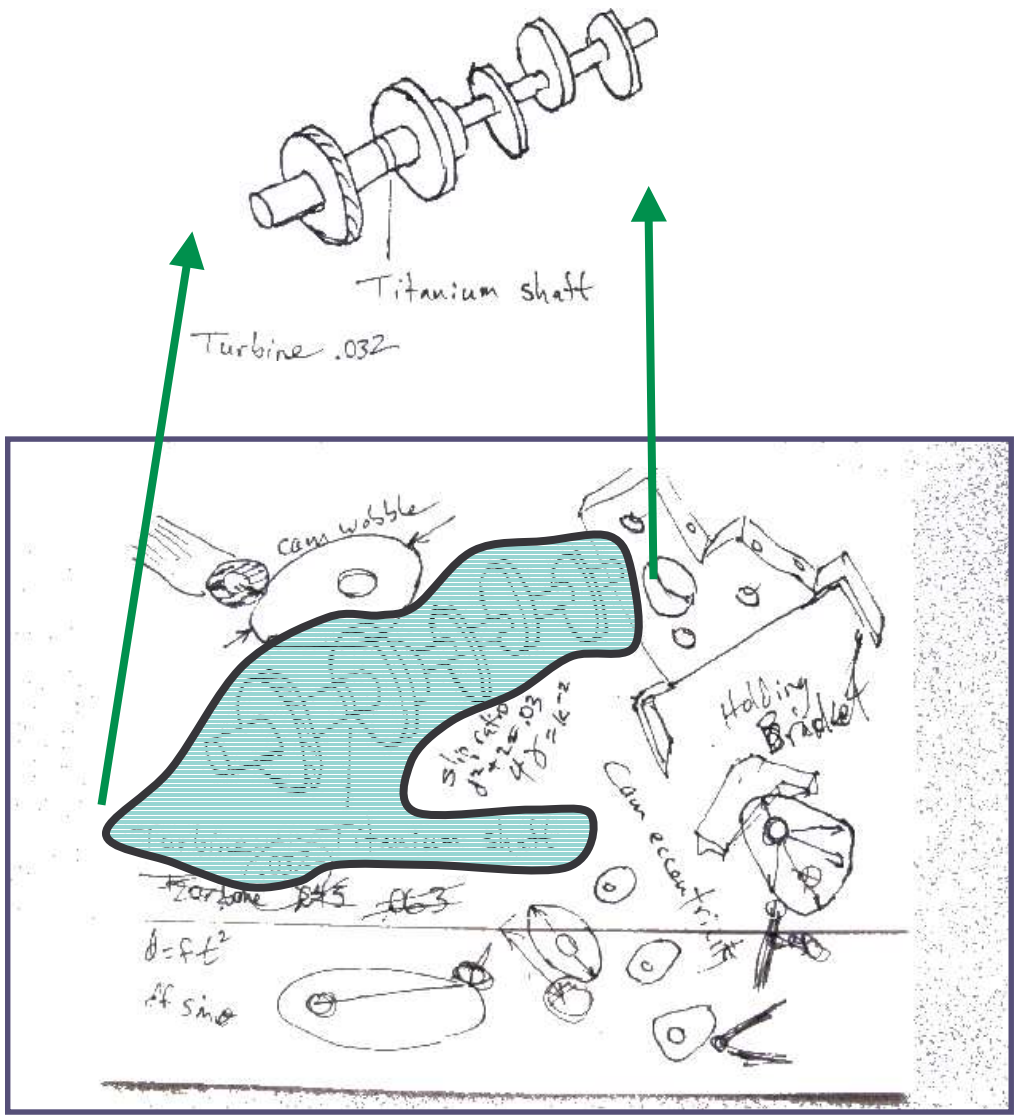
Perceptually-Supported Selection



Perceptual Image Processing
(foreground/background)



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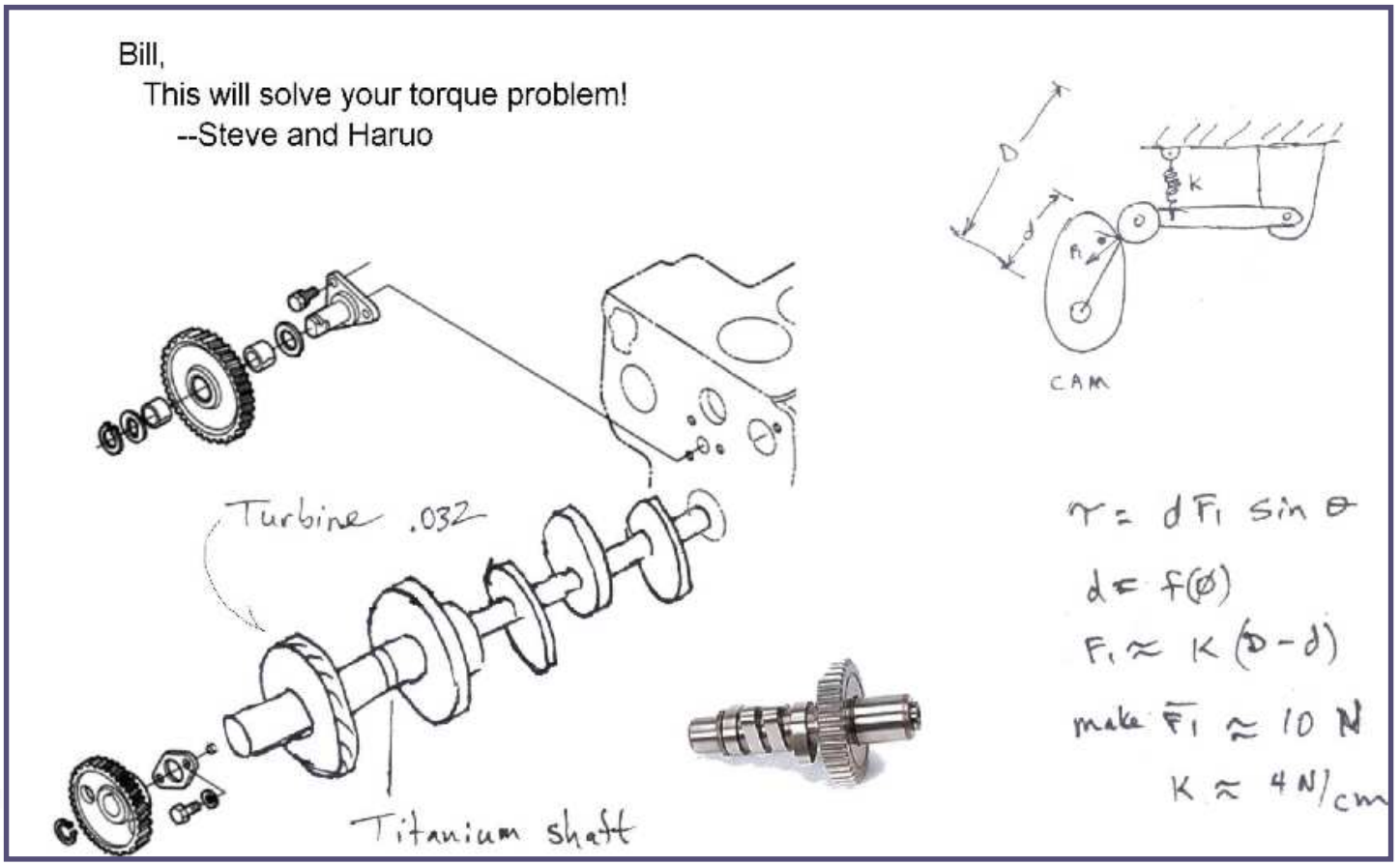
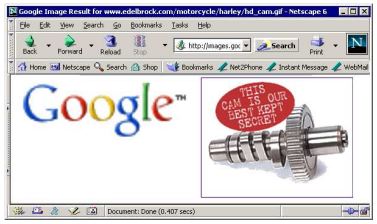
Application: Perceptually-supported Image Editing

Scan Scribe





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ScanScribe demo

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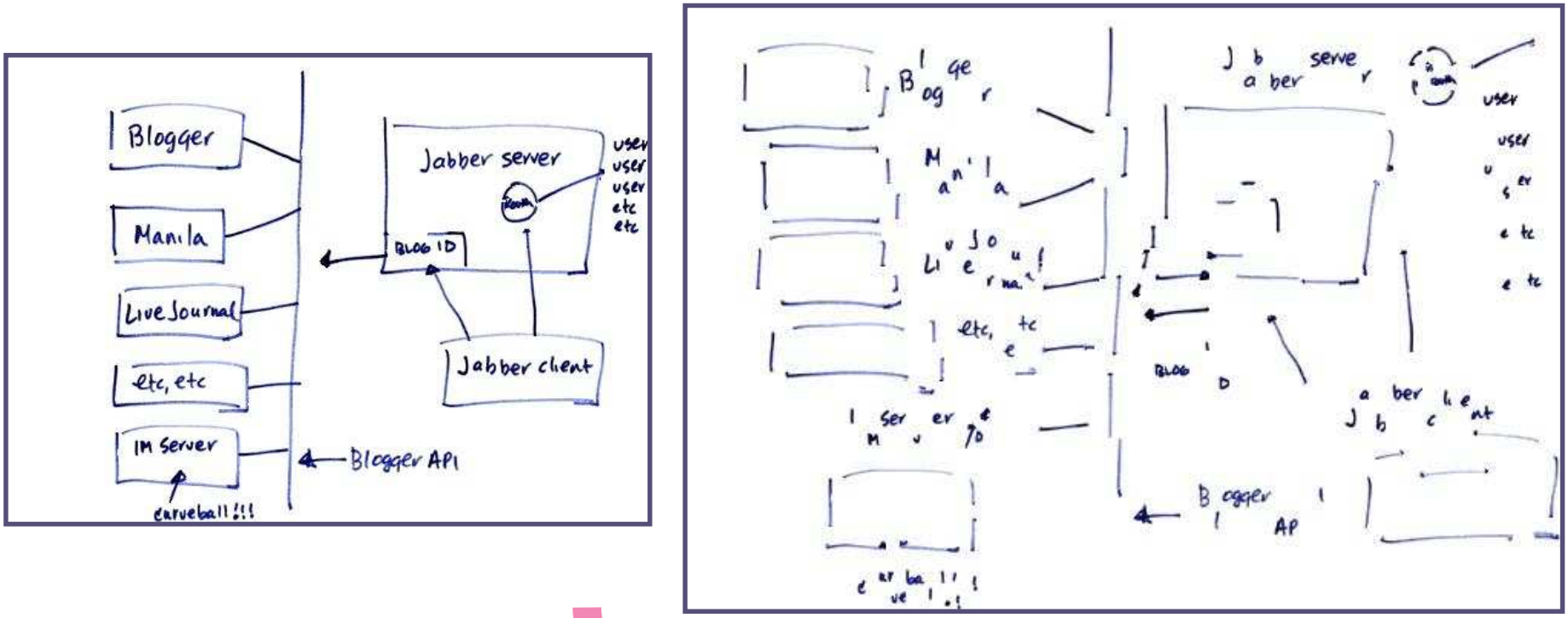
Approach to Identifying Visual Structure

1. Decompose image into atomic fragments

2. Form links among spatially related fragments
   → Data Graph

3. Search for globally salient or matching structure
   - curvilinear alignment
   - closed paths
   - structural models

Fragmentation into Atomic Primitives



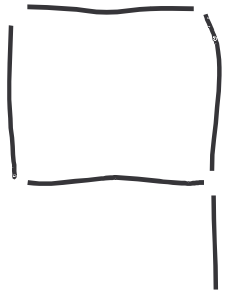
Fragmentation

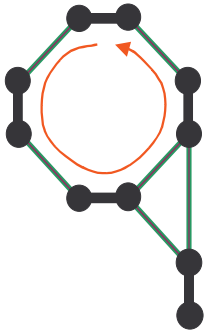
Perceptual Organization:

Identifying Perceptually Closed Paths

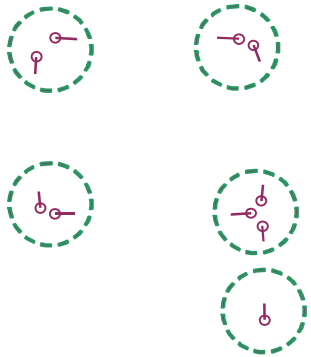
Approach: Graph search

Nodes: curvilinear segments





Links: end proximity+ relations

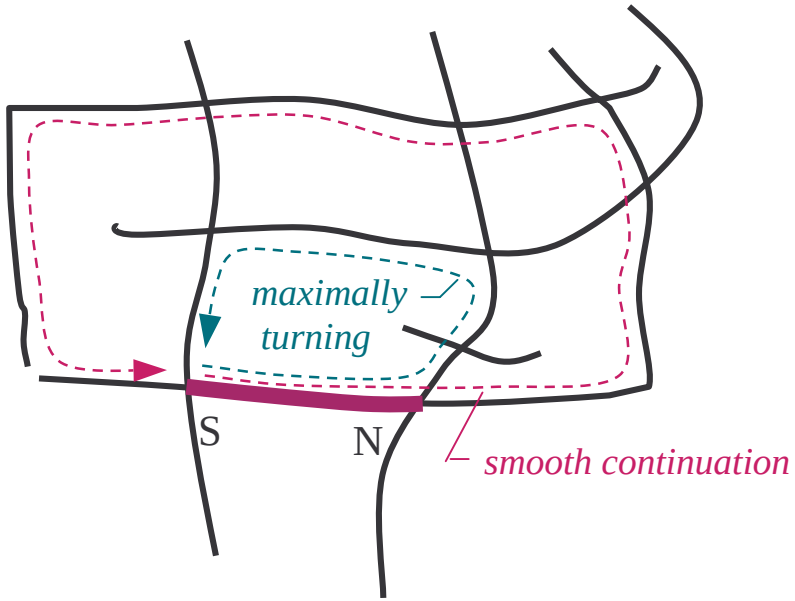


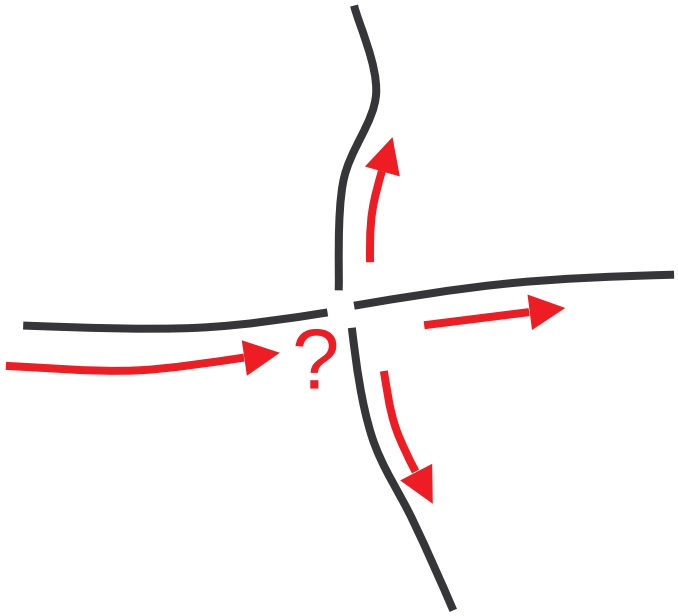
Data Graph

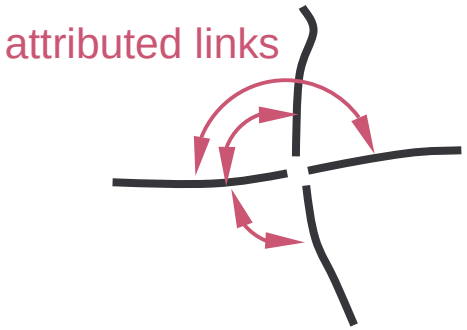
Solution: paths in the data graph satisfying local and global goodness criteria.

Perceptually Closed Paths:

Insights for Tracing Algorithm







I. Two kinds of closed paths $\Rightarrow$
Two kinds of local junction preference.

II. Bidirectional search
-- exploits local junction preferences
-- helps best-first search overcome garden paths

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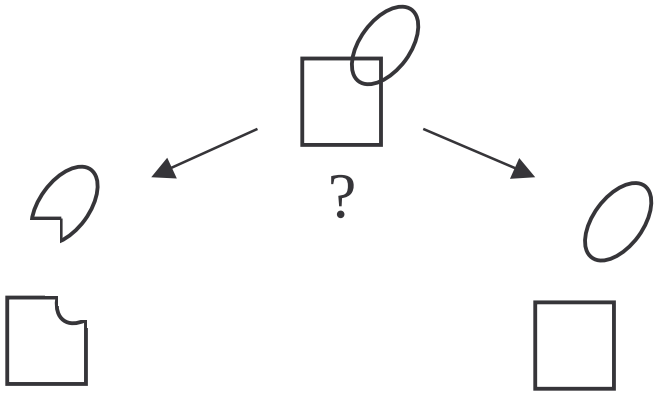
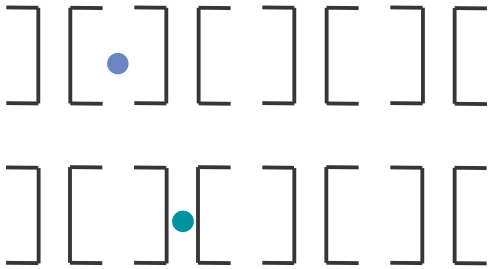
Wanted: Practical, Efficient, Effective Algorithms for the Gestalt Laws



Smooth Continuation



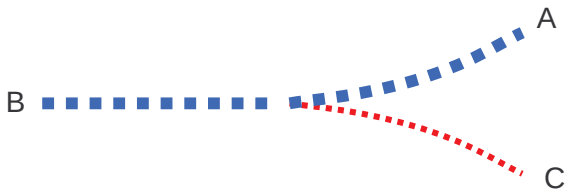
Closure

Symmetry

Although algorithms
are empirically more
top level, the level of
Me gustaria aprovechar
saludarlos y darles la
information de interes

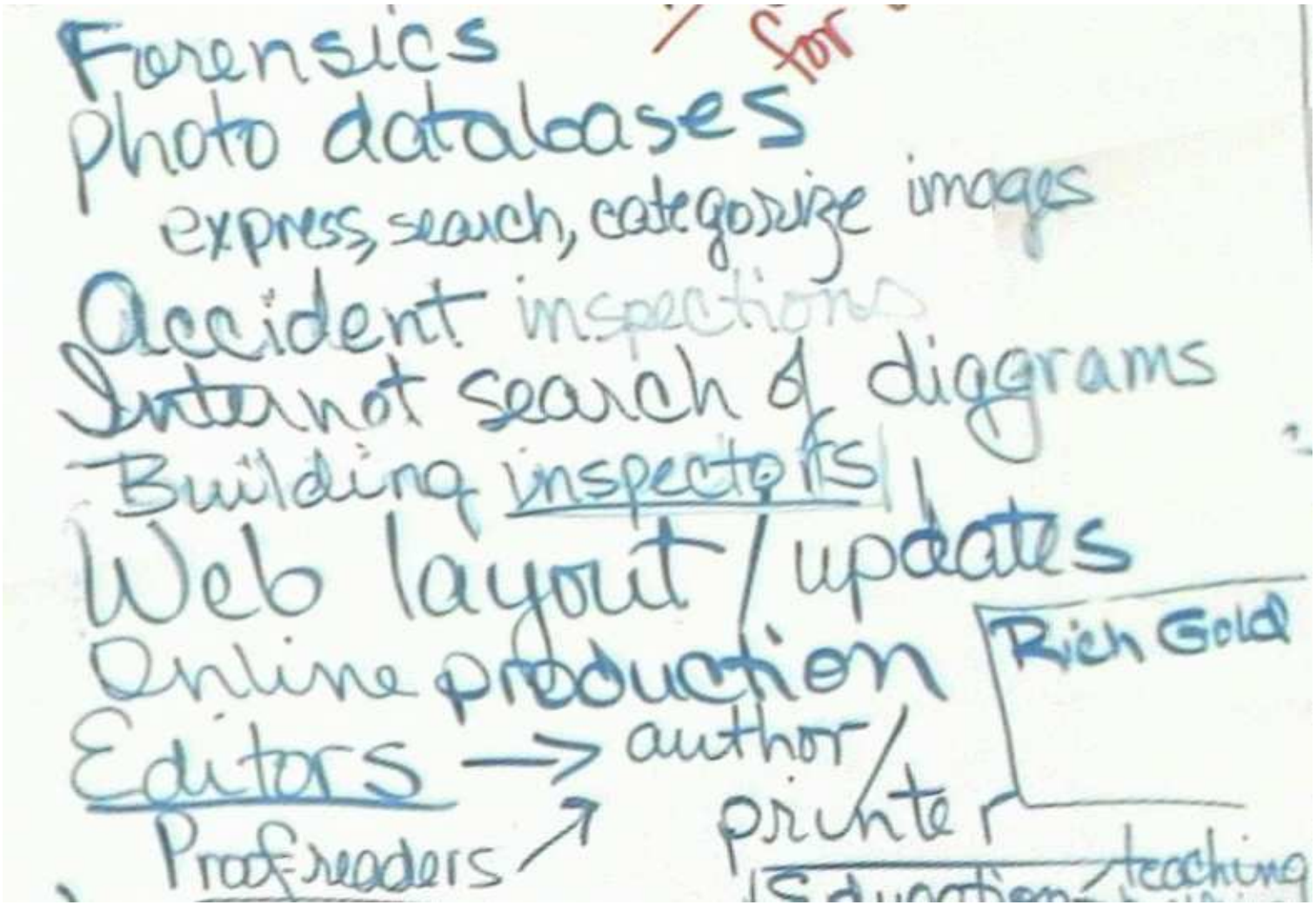
and mechanisms
accessible, it is the
computational theory
esta oportunidad para
bienvenida a ofrecer
en espanol, Nicaragua

Proximity

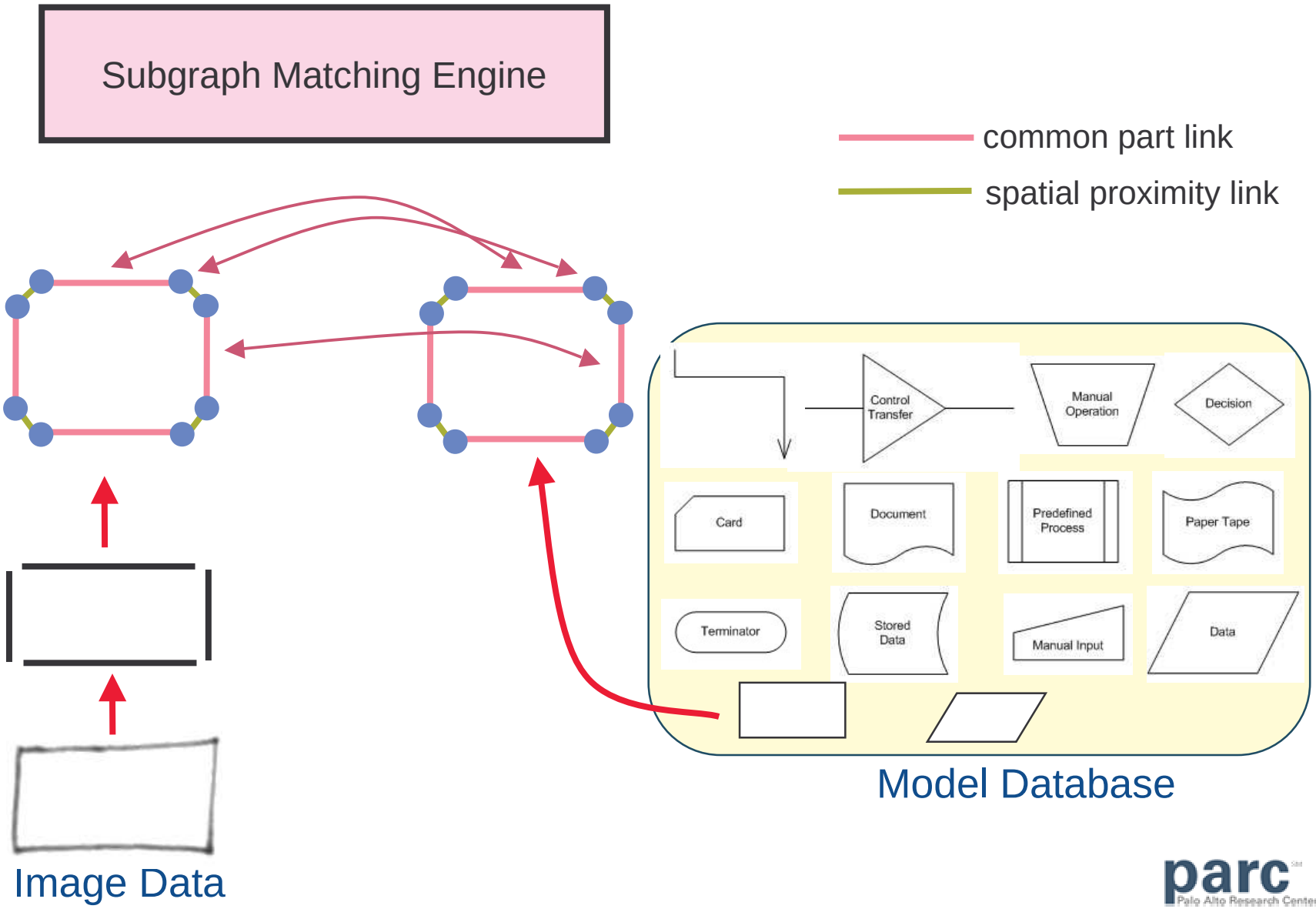


Feature Similarity

A Difficult But Not Atypical Example



Shape Recognition by Graph Matching



Mismatched Data and Model Parts

Subgraph Matching Engine

common part link

spatial proximity link

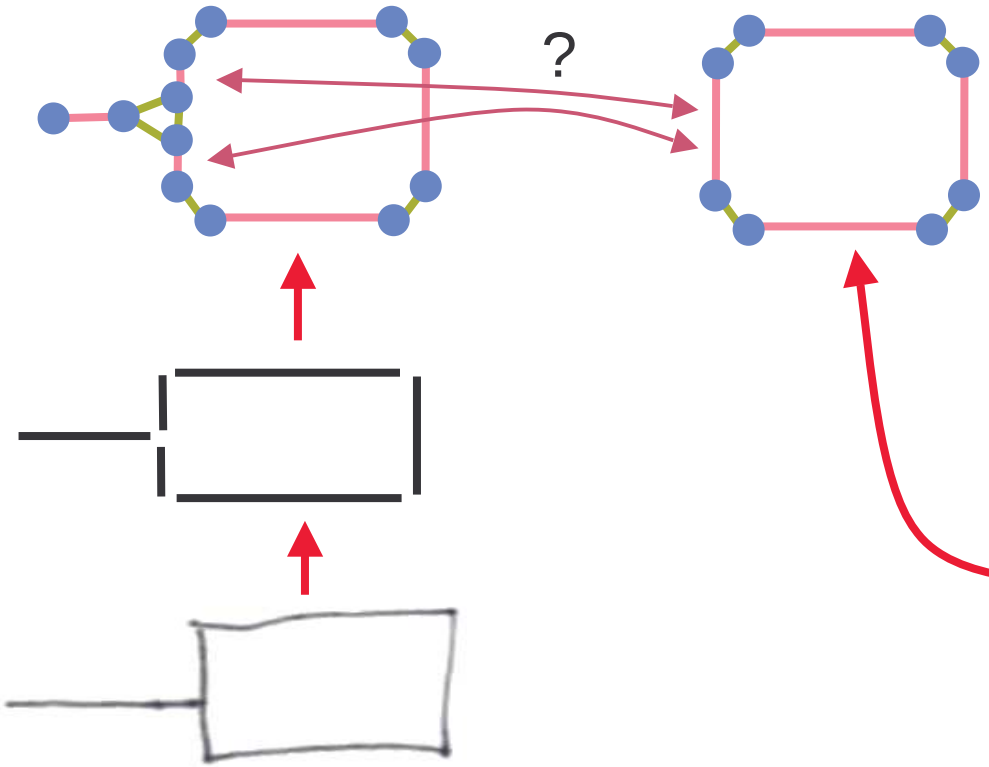
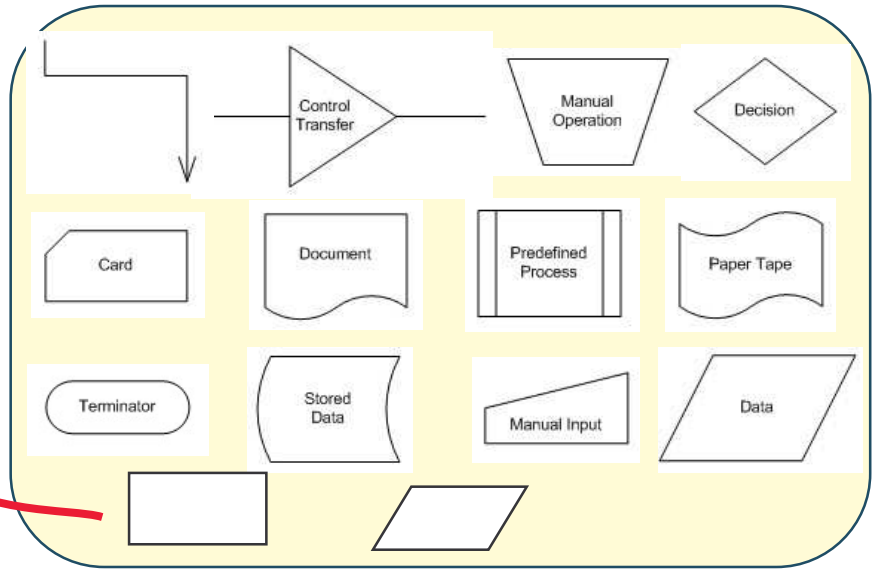


Image Data



Model Database

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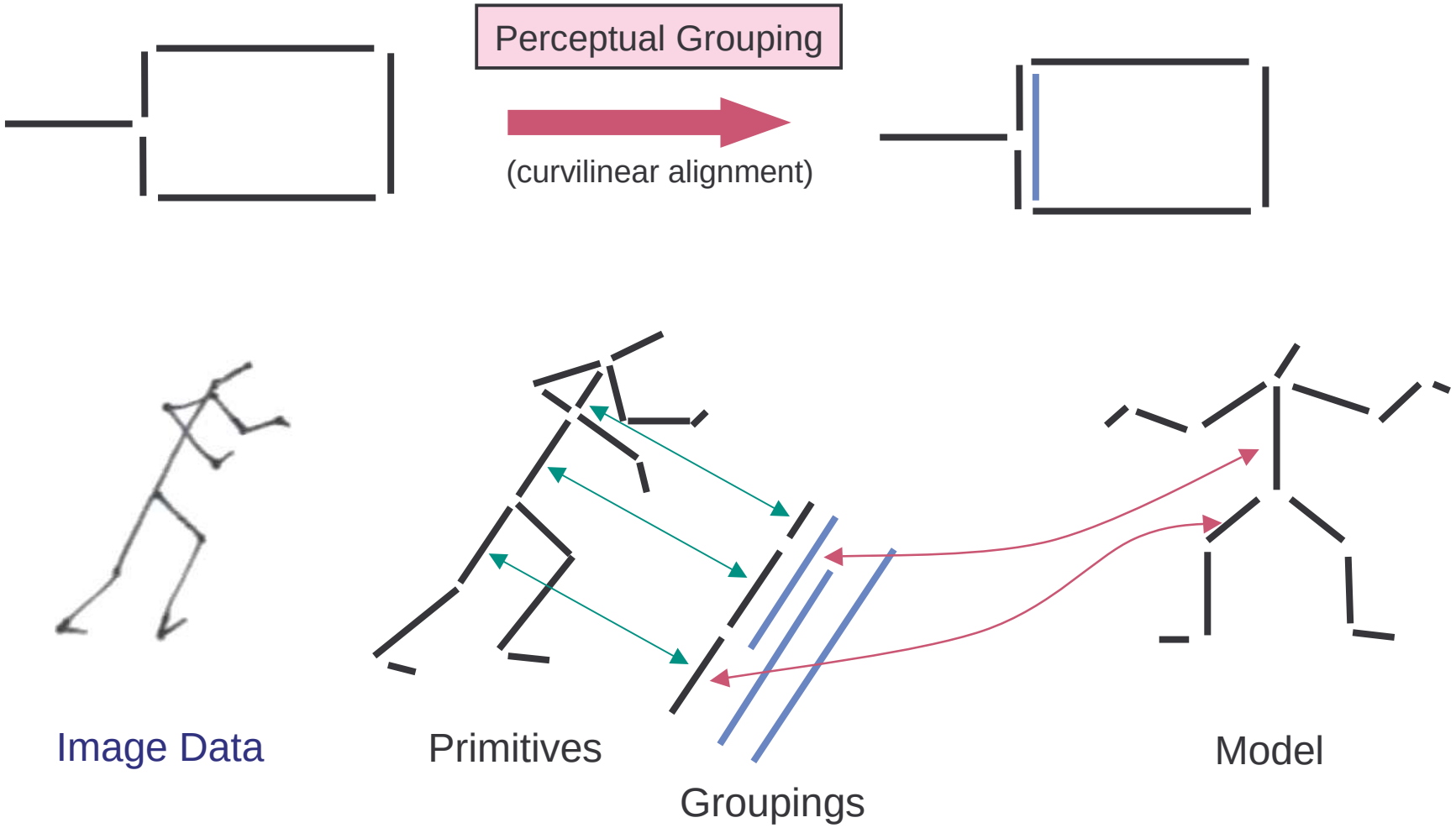
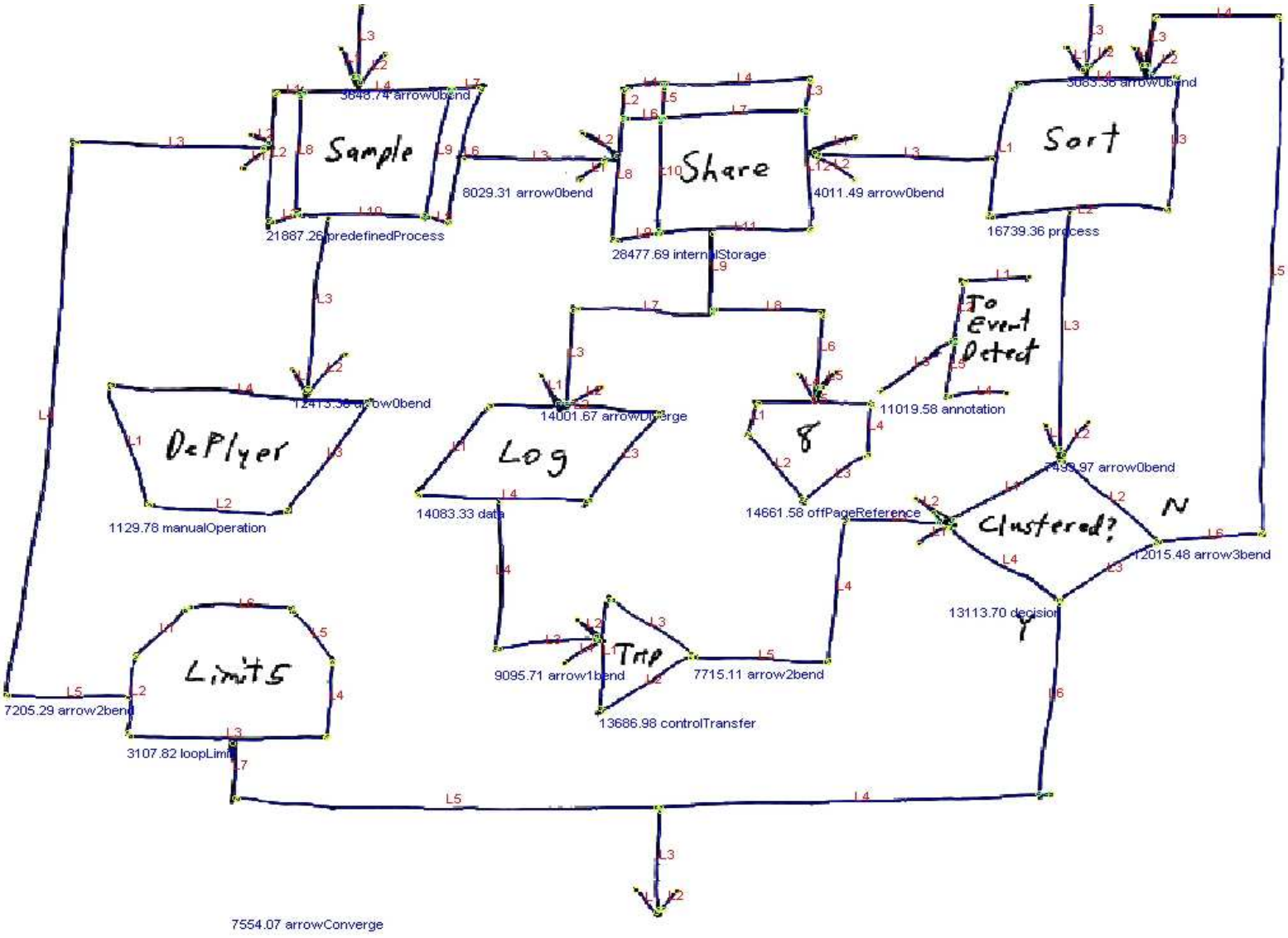
Perceptual Grouping to Simplify Model Matching



Visual Language Recognition Result



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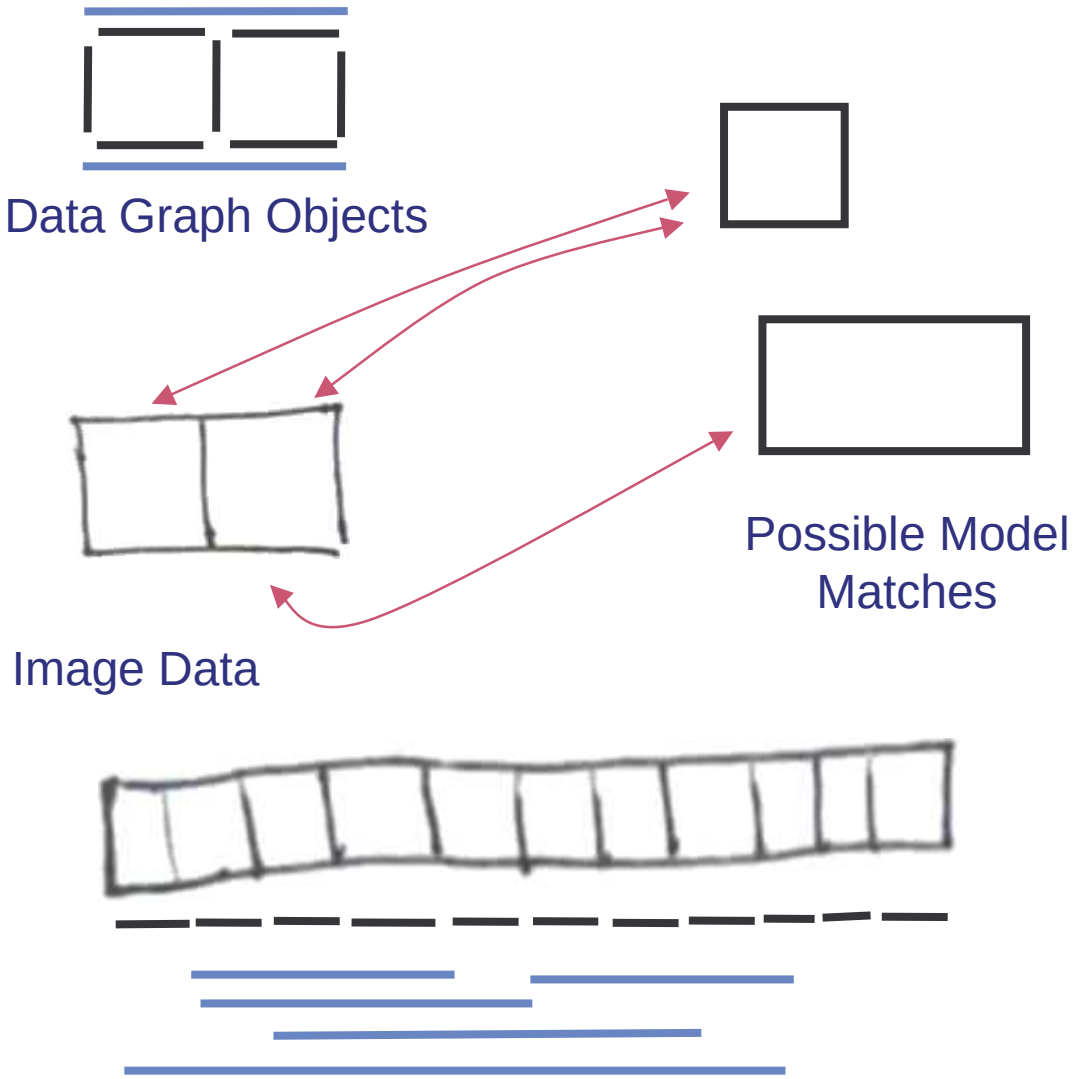
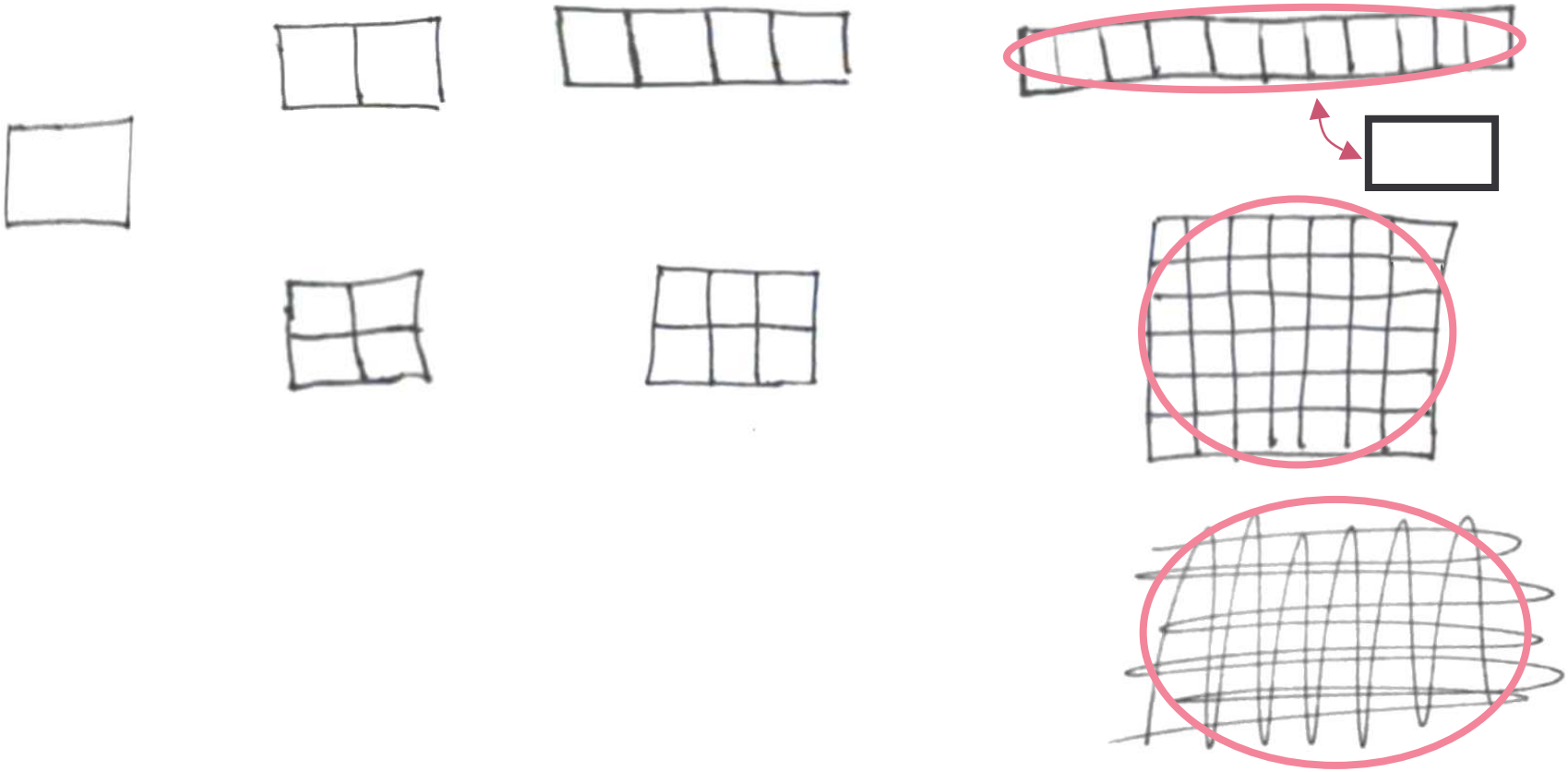
Overlapping Model Matches



Wanted: A Coherent Comprehensive Account of The Shape/Texture Continuum



Shape Realm

Texture Realm

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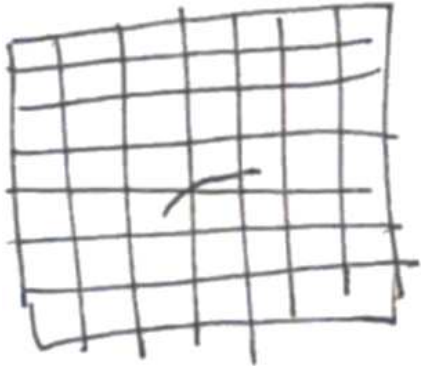
About The Shape/Texture Continuum

Odd-Man-Out phenomena

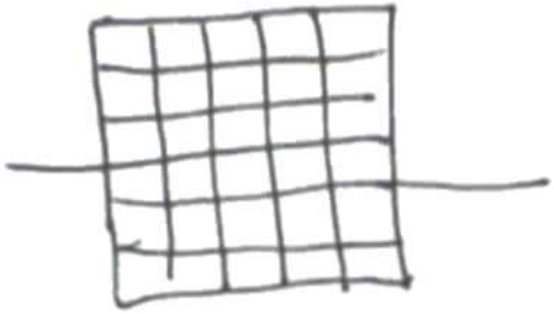


Curve texture and region texture

Scale and window of view

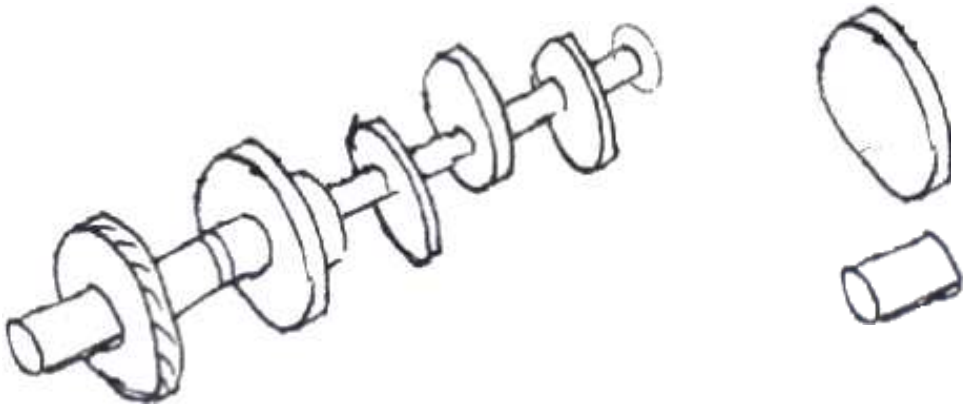
Spatial focus

Layer decomposition

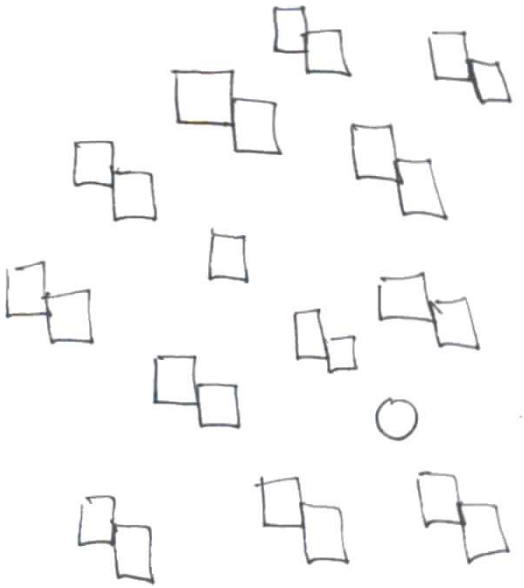


Interaction of “texture” processes *and* articulated “grouping” processes

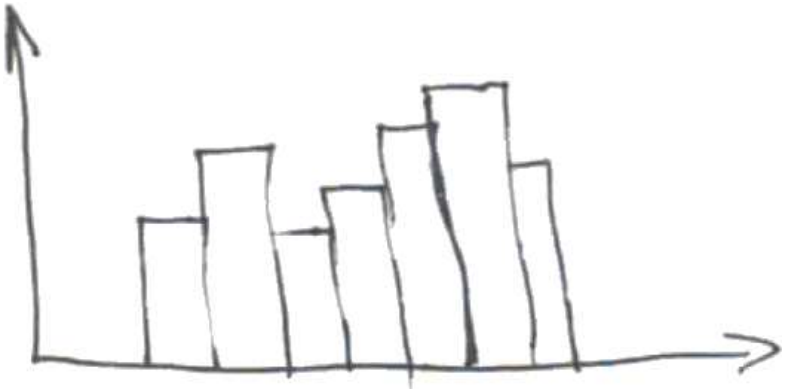
Wanted: A Comprehensive Modeling Ontology



Compositional models



Transient Models



Shared Parts

Statistics of co-occurance

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Conclusion

- The sketch/graphics image domain distills fundamental problems in Computational Vision
  - Perceptual Organization
  - The Shape/Texture Continuum
  - Modeling Ontology

- Practical Application in Perceptually Supported Image Editing
  - The *ScanScribe* document image editor