VISCO: Bringing Visual Spatial Querying to Reality

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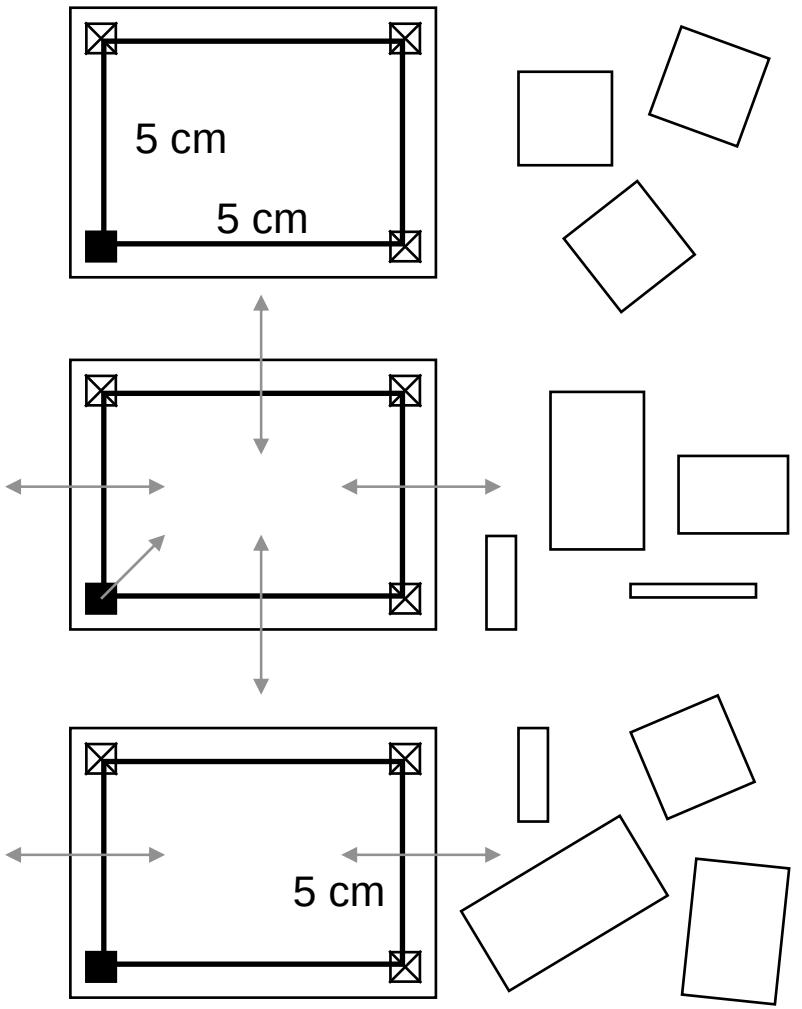
- The Visual Language VISCO
- The VISCO Prototype
  - Architecture
  - Graphical User Interface
  - Representing, Compiling and Executing Queries
    - Abstract Syntax Graph (ASG)
    - Optimizing Compiler (Petri Net Model)
- Example (Quicktime Movie)
- Conclusion

VISCO: Vivid Spatial Constellations

Basic Key Concepts

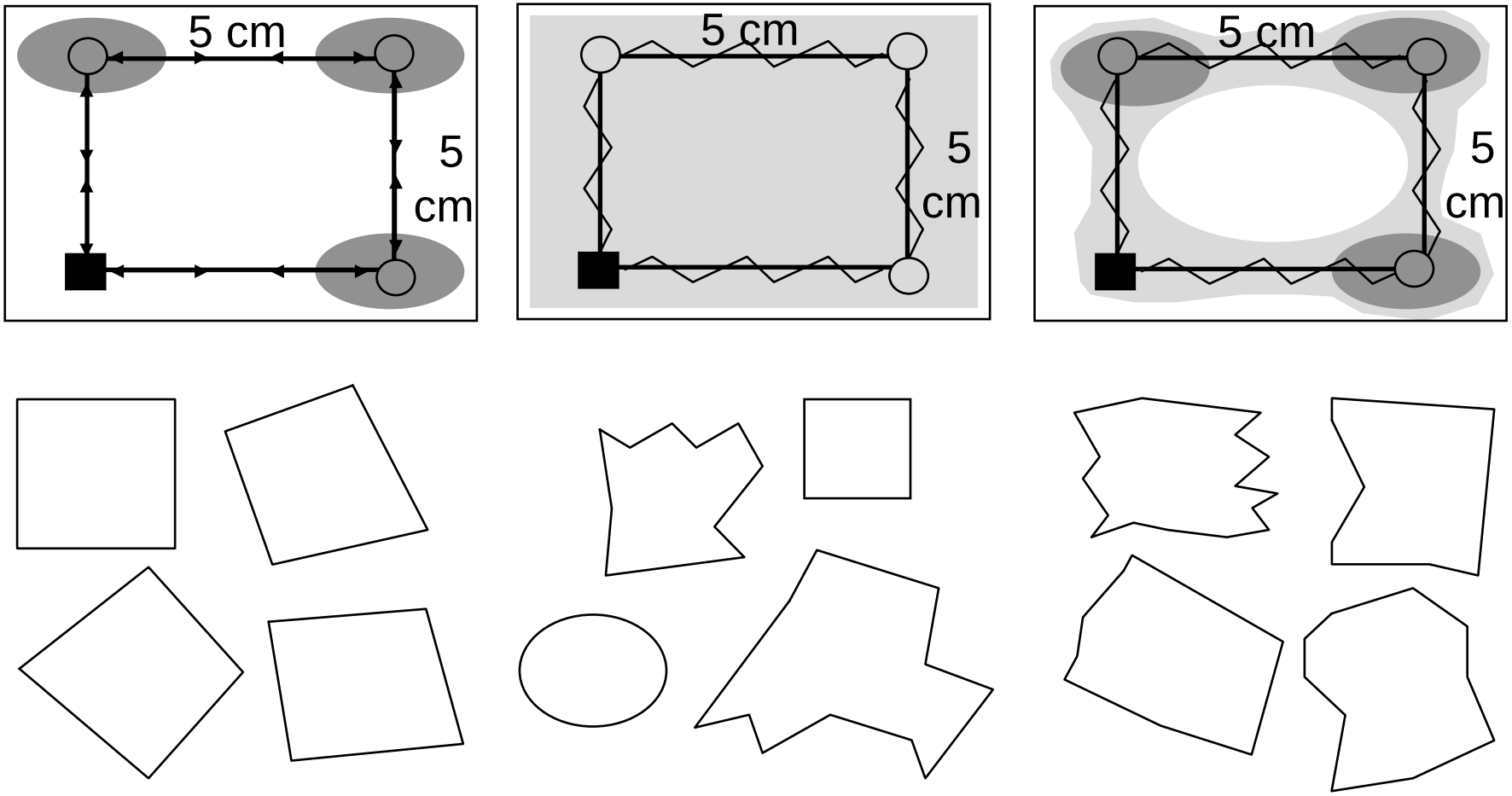
- Represent constellations (aggregates) of geometric objects
  - Describe classes of pictures through pictures, represent spatial aspects *directly*
    - adequacy, consistency, transparency
  - Extensions
    - VSQL: retrieve from spatial DB
  - Geometric objects
    - Transformable agggregates with local coordinate system, polygons & polylines, segments, points
  - Guidance of interpretation of visual aspects present in a VISCO definition
    - Physical metaphors
    - Meta objects
  - Expressive: metric, geometric and topologic relationships / constraints
    - inside / contains, disjoint, intersects

Some Quadrilaterals

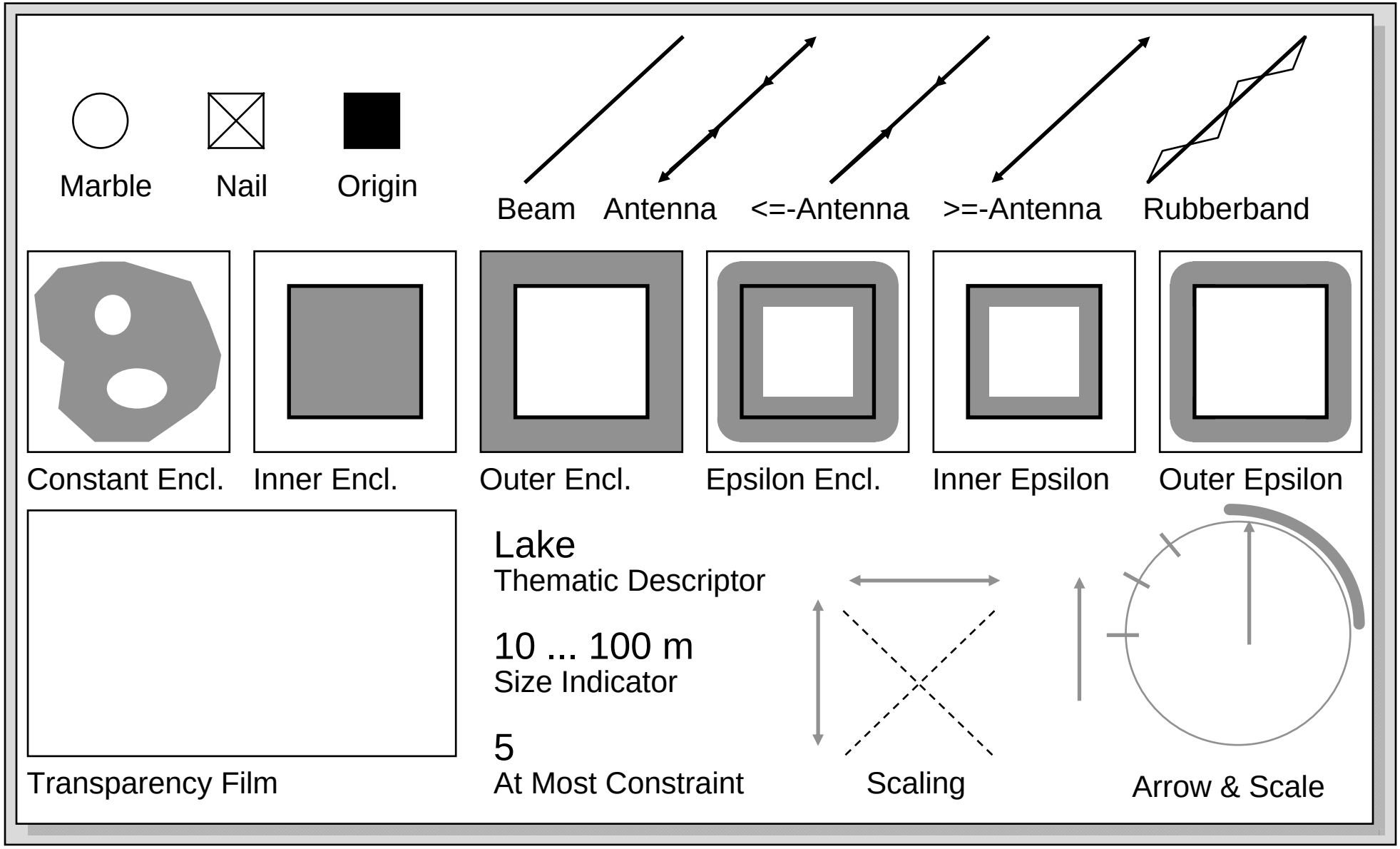


VISCO: Concrete Shape, Arbitrary Shape, Vague Shape

Degree of Vagueness can be seen (“Mental Animation”)



VISCO: Overview of Language Elements (Incomplete)



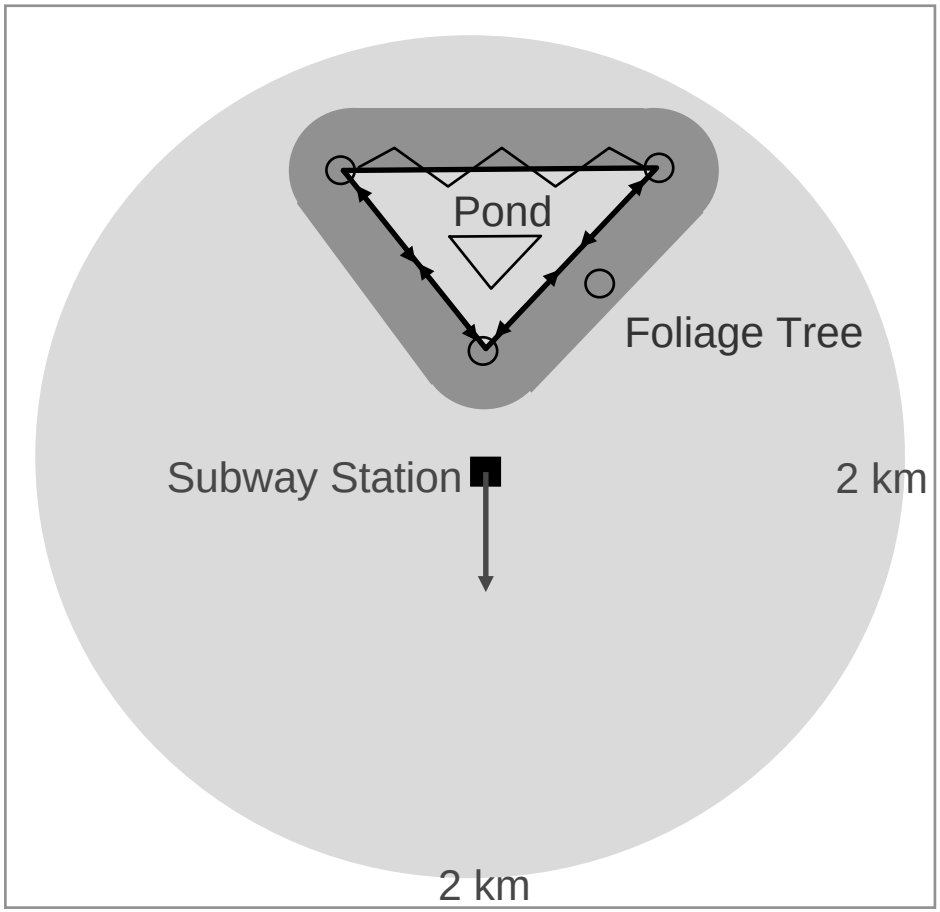
Example Query: How to Find a BBQ Place with VISCO

Requirements for BBQ Place

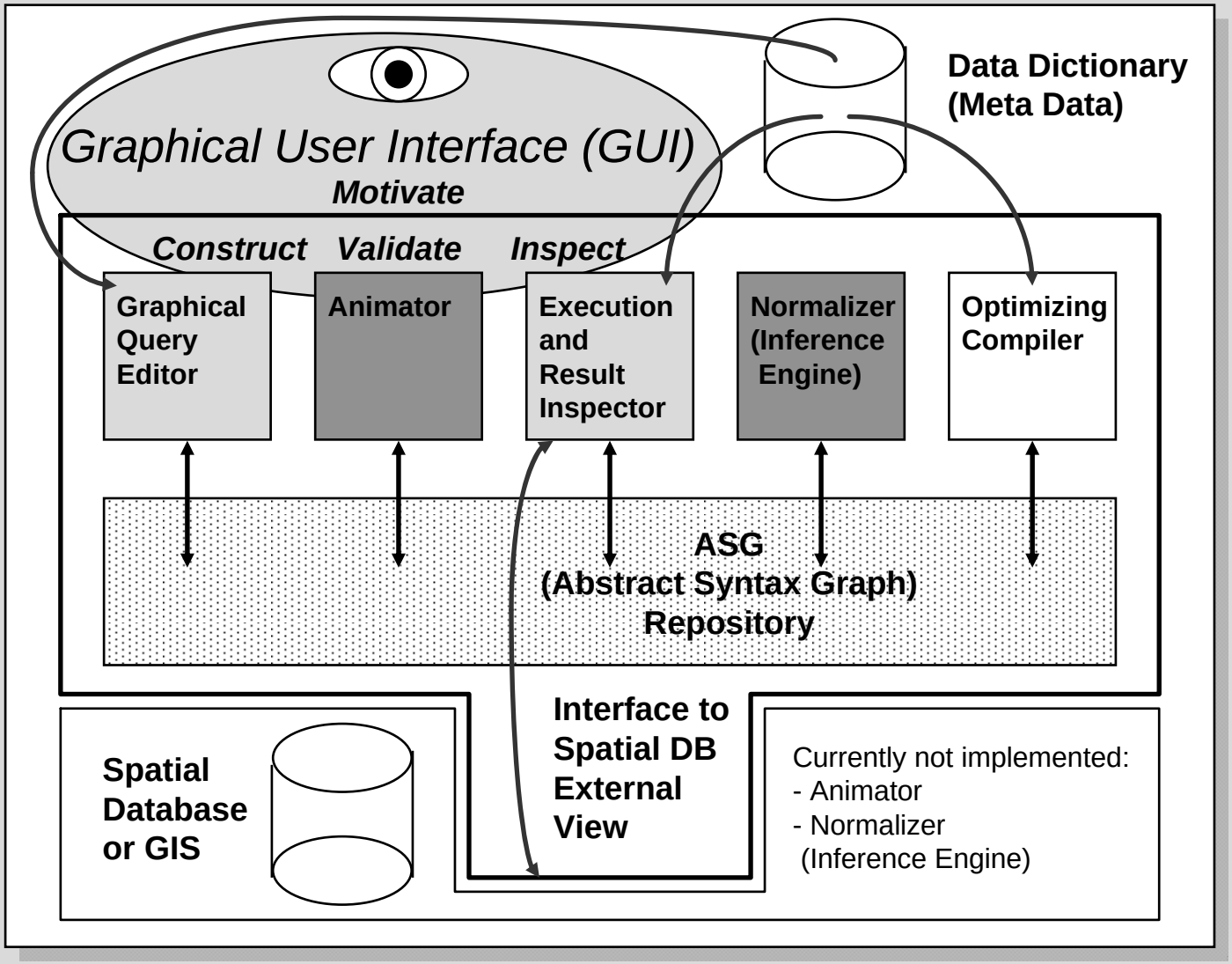
- If you don't own a car, it must be in the vicinity of a subway station, we don't want to walk much more than approx. 800 meters
- We would like to sit at a pond
- If it is a hot or rainy day, it would be good if there were some trees to protect us
- However, only foliage trees are suitable

Distinguish explicit and implicit composite objects!

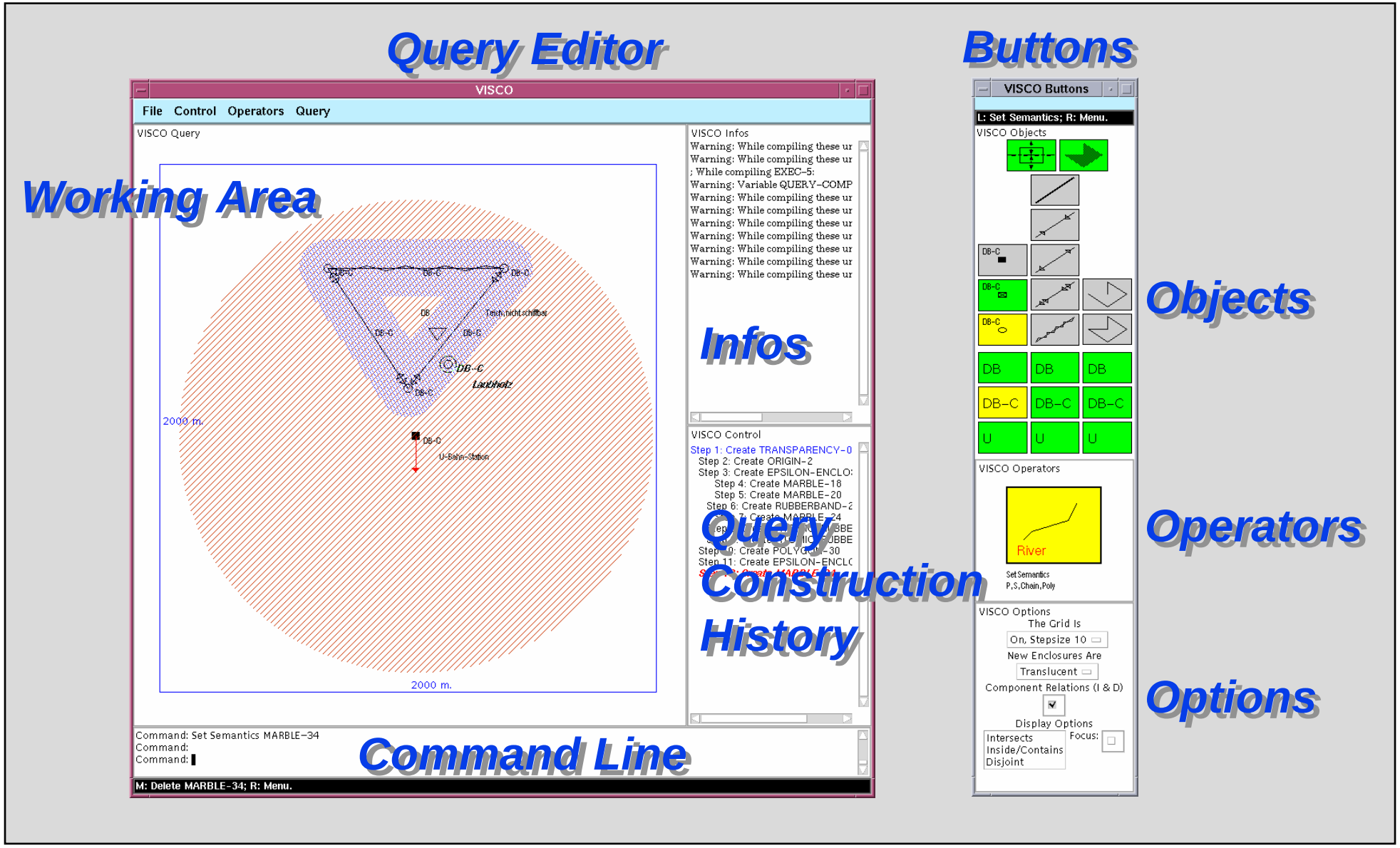
VISCO Query



The VISCO Prototype: Logical Architecture



VISCO GUI: The Graphical Query Editor

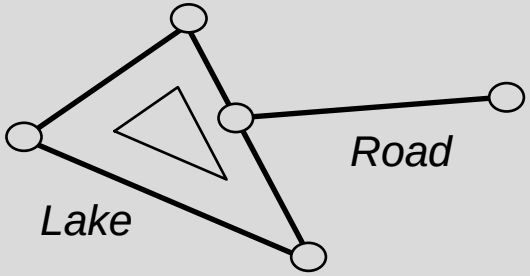


Representing Queries

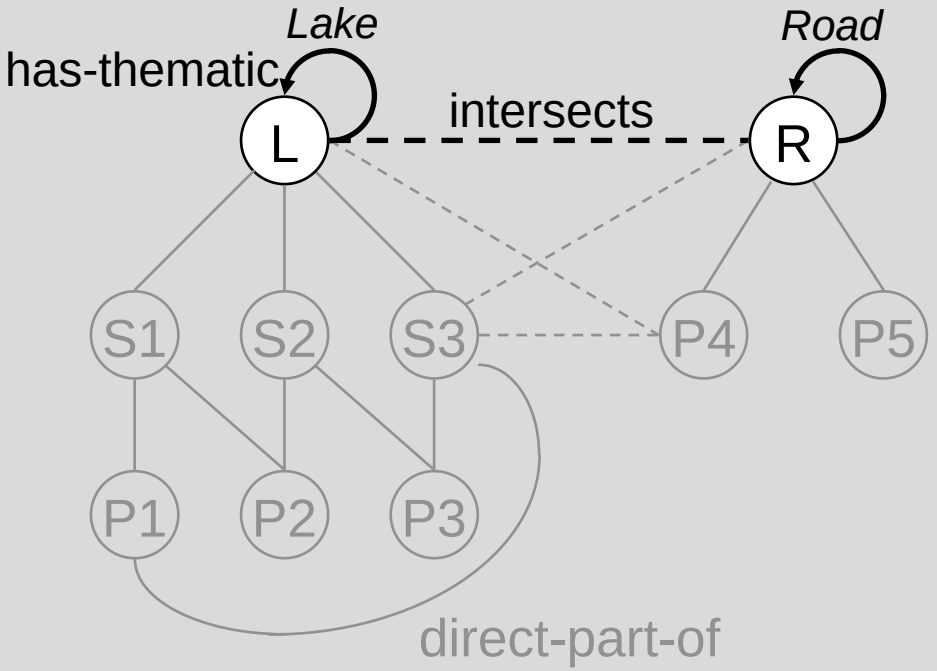
Abstract Syntax Graph (ASG)

- Directed multi-hypergraph with attributed edges
  - Properties (unary)
    - *“has-thematic(x)”*
  - Edges (binary)
    - *“direct-part-of(p,l)”*
  - Hyperedges (tenary, ...)
    - *“intersection-point-of (p,l1,l2)”*
- ASG maintained by operator applications provided by the repository module
  - Preconditions
- Graphical query editor maps user’s interactions to internal ASG operator applications
  - History of operator applications

Simplified Query



Simplified ASG

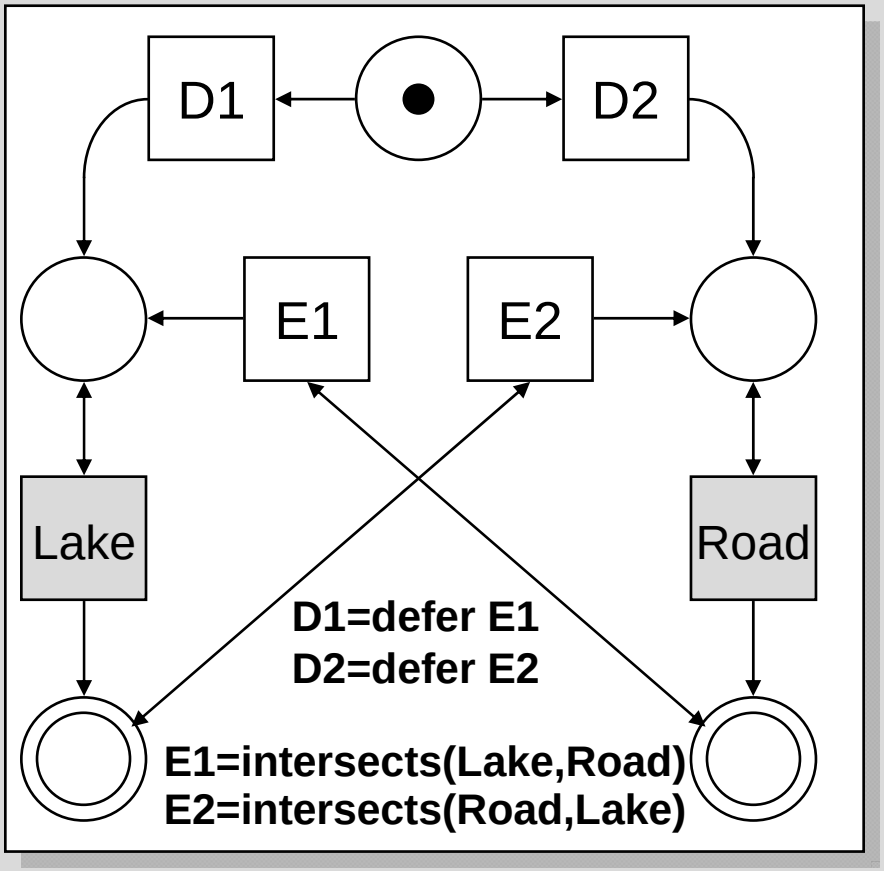


Compiling & Executing Queries

Plan Generation

- Use ASG to construct an execution plan
  - Order of sequence of node processing (currently, simple Backtracking)
  - Binary inverse constraints: multiple plans become possible, potentially ***n!***
  - Optimizer: find best plan by valuation
- Query objects
  - Searchable, use indexing, especially spatial indexing
- Universal objects
  - Must be constructed (components or operator arguments already instantiated)
- Geometric objects & enclosures
  - Spatial selection possible
    - e.g. use R-Tree

Compiler: Petri Net Model



Possible Plans:
D1 - ***Lake*** - E2 - ***Road***
D2 - ***Road*** - E1 - ***Lake***

Current State of Work, Conclusion & Future Work

- VISCO prototype places additional restrictions on the (query) language VISCO
  - E.g., transformations must be uniquely determinable
    - E.g., for an universal arbitrary scalable and rotatable transparency film at least 3 non-collinear instantiatable nails are needed
- Optimizer: use more knowledge
  - Much more heuristics need to be included
  - Exploit database statistics as well as properties of spatial relations
- Missing components / modules
  - Animator
  - Normalizer / Inference Engine
    - Derive additional constraints only implicitly present, make them available for the compiler; query subsumption, reuse of query results (refine); query normalization
  - Use a “real” GIS / spatial DB
- VISCO GUI
  - Currently, too abstract for end users
  - Not evaluated yet
- However, the usefulness of the visual language VISCO has been proven