# Interaction and Exploration

# Interaction

- Interaction -- allow for direct manipulation of graphical representation of the data

- Response times
  - ➢ .1 sec - animation, visual continuity
  - ➢ 1 sec - conversation break
  - ➢ 10 sec - cognitive response

- 3 Transformations:
  - ➢ Data
    - Selecting cases to show
  - ➢ Visual
    - Selecting a different representation, UI controls for chart/graph/vis
  - ➢ View
    - Selecting the perspective, zoom, pan, ...

# Interaction Forms

- Selecting what you want to see
- Direct walk
  - Linkages between cases; Exploring one may lead to another
  - Example: Following hyperlinks on web pages
- Brushing
  - Selecting a case in one view generates highlighting the case in the other views
    - Selected data subsets may be highlighted, deleted, or masked
  - Applies when you have multiple views of the same data (scatteplots)
- Details-on-demand
  - May not be showing all the data due to scale problem
  - Expand set of data to show more details, perhaps individual cases
- Dynamic query
  - Gaining some qualitative idea of the database while moving towards a final solution
  - Most commonly used

# Database Query

- Conventional DB query language in house hunting:
  - ➢ **Select** house-address
    **From** BR-real-db
    **Where** price <= $200,000 **and**
    bathrooms = 2 **and**
    garage == 2 **and**
    bedrooms >= 3

- Query response:
  - ➢ 52 hits

    1040 Perkins Road, $150,000, 3 bedrooms, …

- Disadvantages:
  - ➢ Must learn language
  - ➢ Only shows exact matches
  - ➢ Too few and too many hits may occur
  - ➢ Reformulating a new query can be slow
  - ➢ No helpful context is shown

# Dynamic Query

- Concept was proposed by Williamson and Shneiderman (1992)
- Dynamic exploration
  - What if …..?
  - Formulating a problem concurrently with solving it
  - You may learn more about your problem as you explore
  - Want to understand a set of tradeoffs and choose some best compromise
- Specifying a query brings immediate display of results
  - Responsive interaction (< .1 sec) with data
- Constituents:
  - Visual representation of world of action including both the objects and actions
  - Rapid, incremental and reversible actions
  - Selection by pointing
  - Immediate and continuous display of results
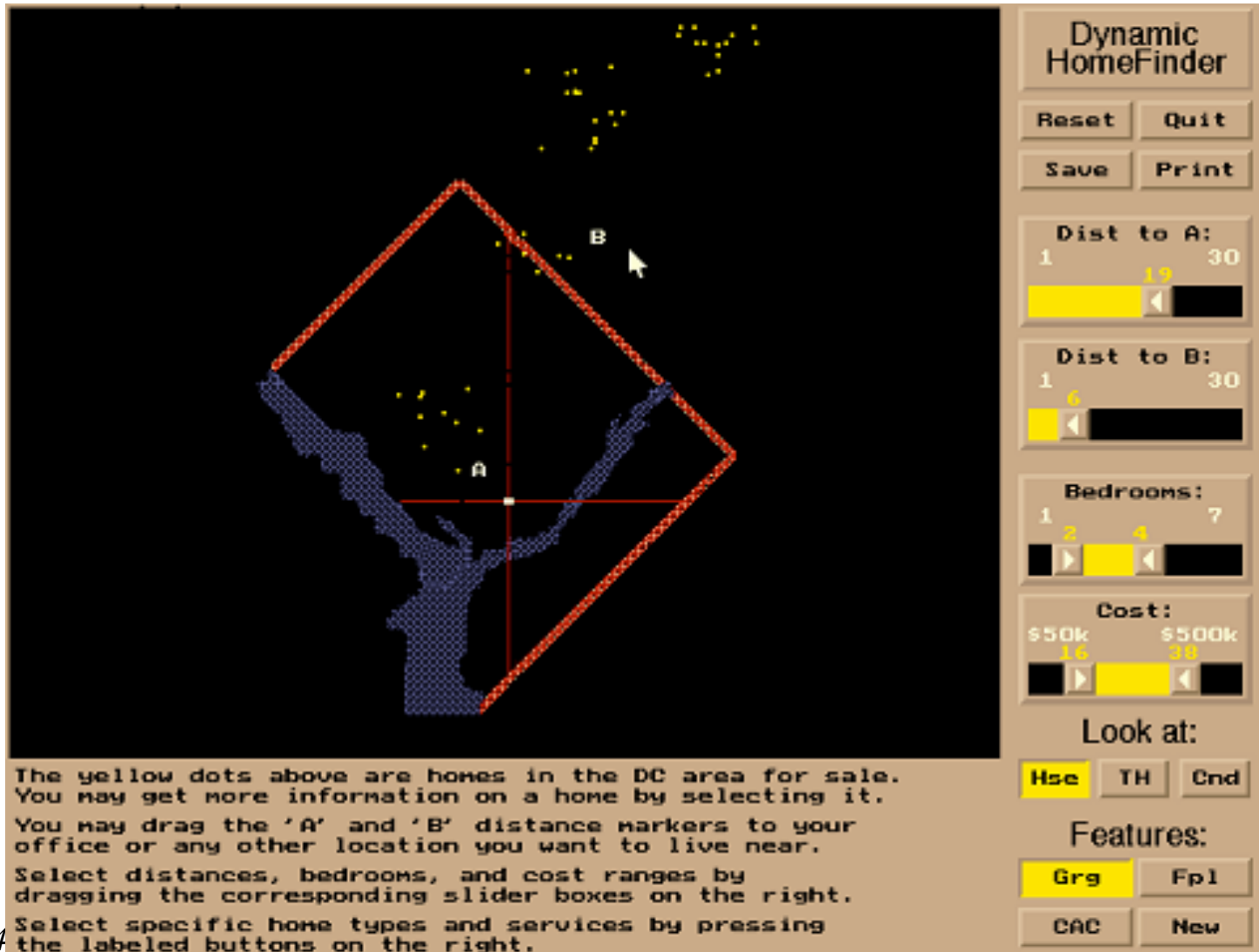
# Dynamic Homefinder
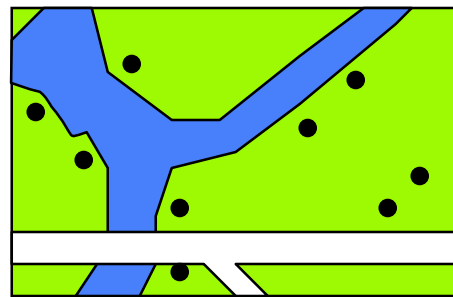


Price

No. of Bedrooms

Age

- Scales with adjustable sliding limits
- Adjustment of limits defines selection to be made from all houses from DB
- Result of selection immediately displayed by dots on the map

# Dynamic HomeFinder

Williamson, et al., 1992 [www.cs.umd.edu/hcil/pubs/products.html]
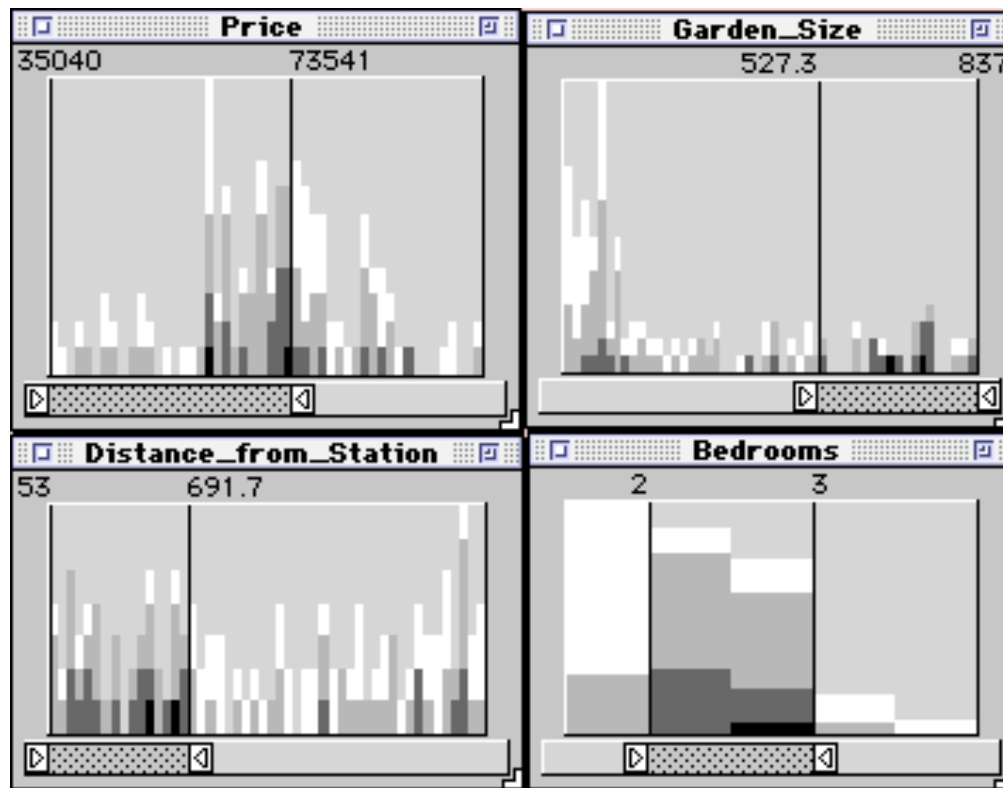
# Dynamic FilmFinder

- To find a film
  - Each colored spot identifies a film
  - Color represents type (comedy, horror, etc)
  - Horizontal positions indicate year and duration

- Additional features
  - Sliders on right to specify attributes (title, actor, director)
  - A click on spot produces a pop-up box with details and a picture of actor/actress
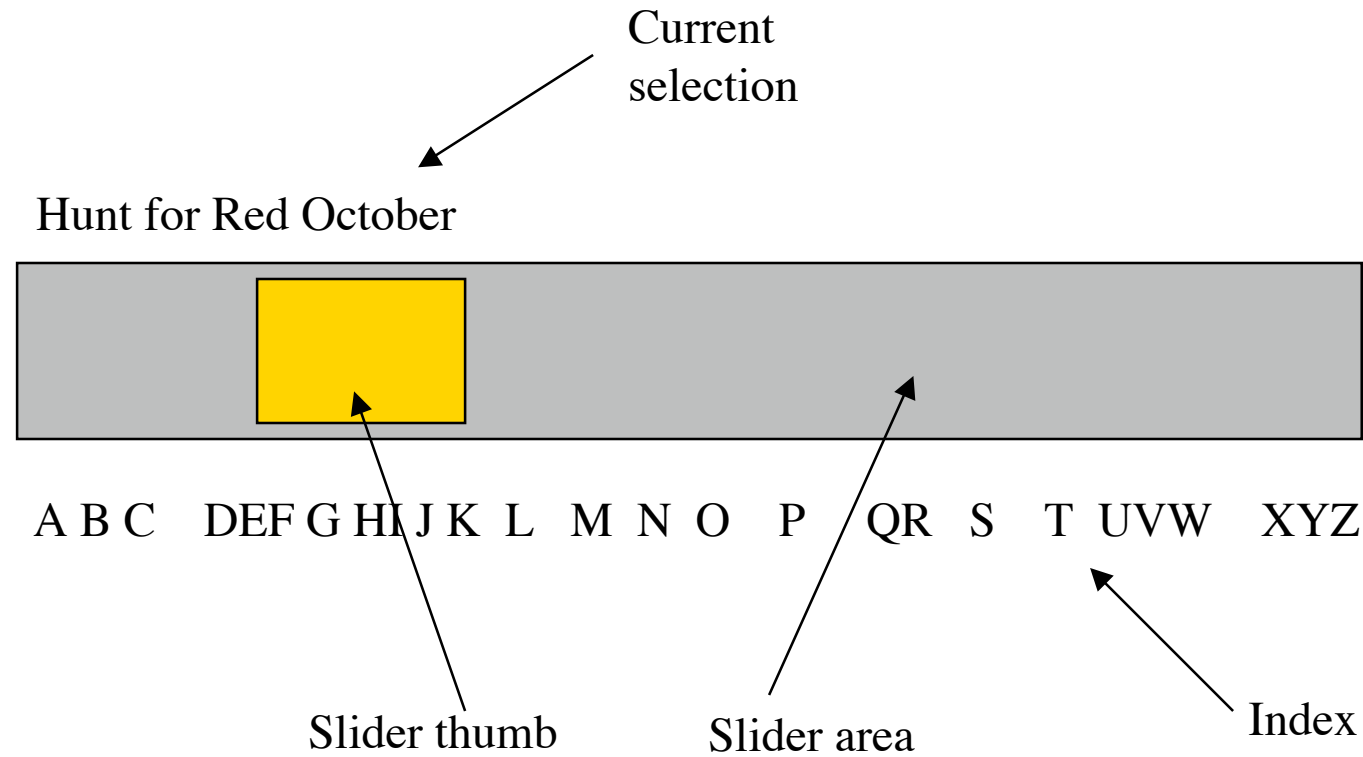
www.cs.umd.edu/hcil/pubs]
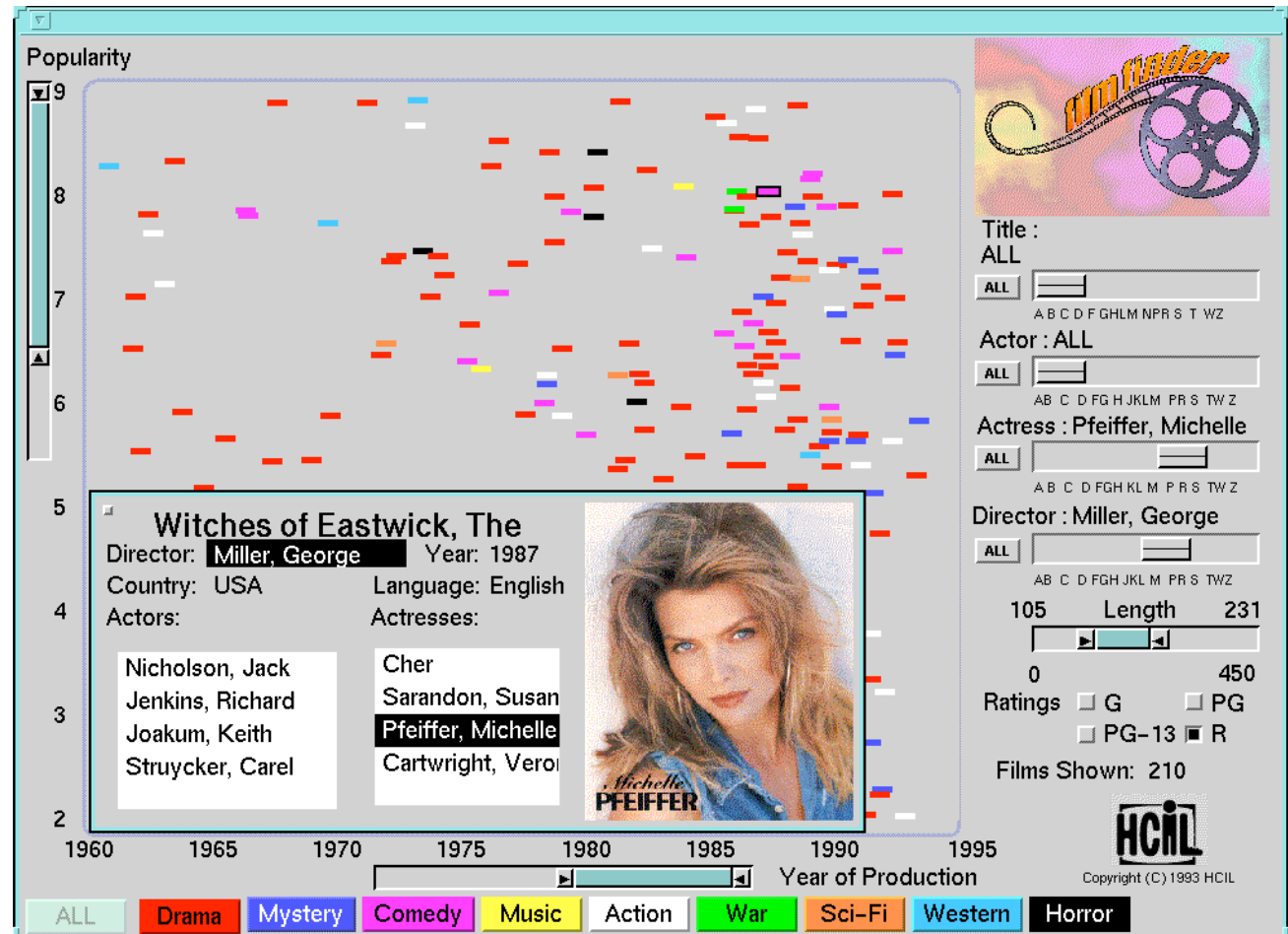
# Attribute Explorer

- Show all the data, use different displays for different variables
- Use brushing so that interaction with one view highlights selections in others
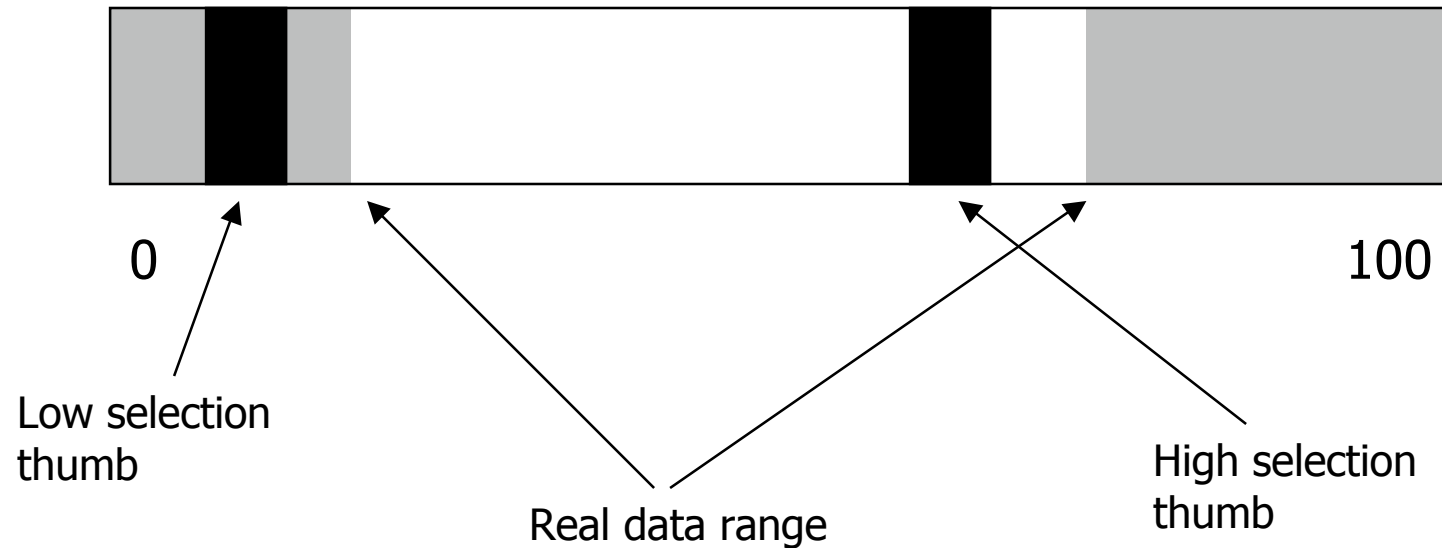
# Alphaslider

Current
selection

Hunt for Red October

A B C  DEF G HI J K L  M N O  P  QR  S  T UVW  XYZ

Slider thumb          Slider area          Index

- First proposed by Osada et al., 1993
- You scan rapidly through, and select items from, lists of alphabetic data
- A mouse click on slider causes thumb to move and the selected text
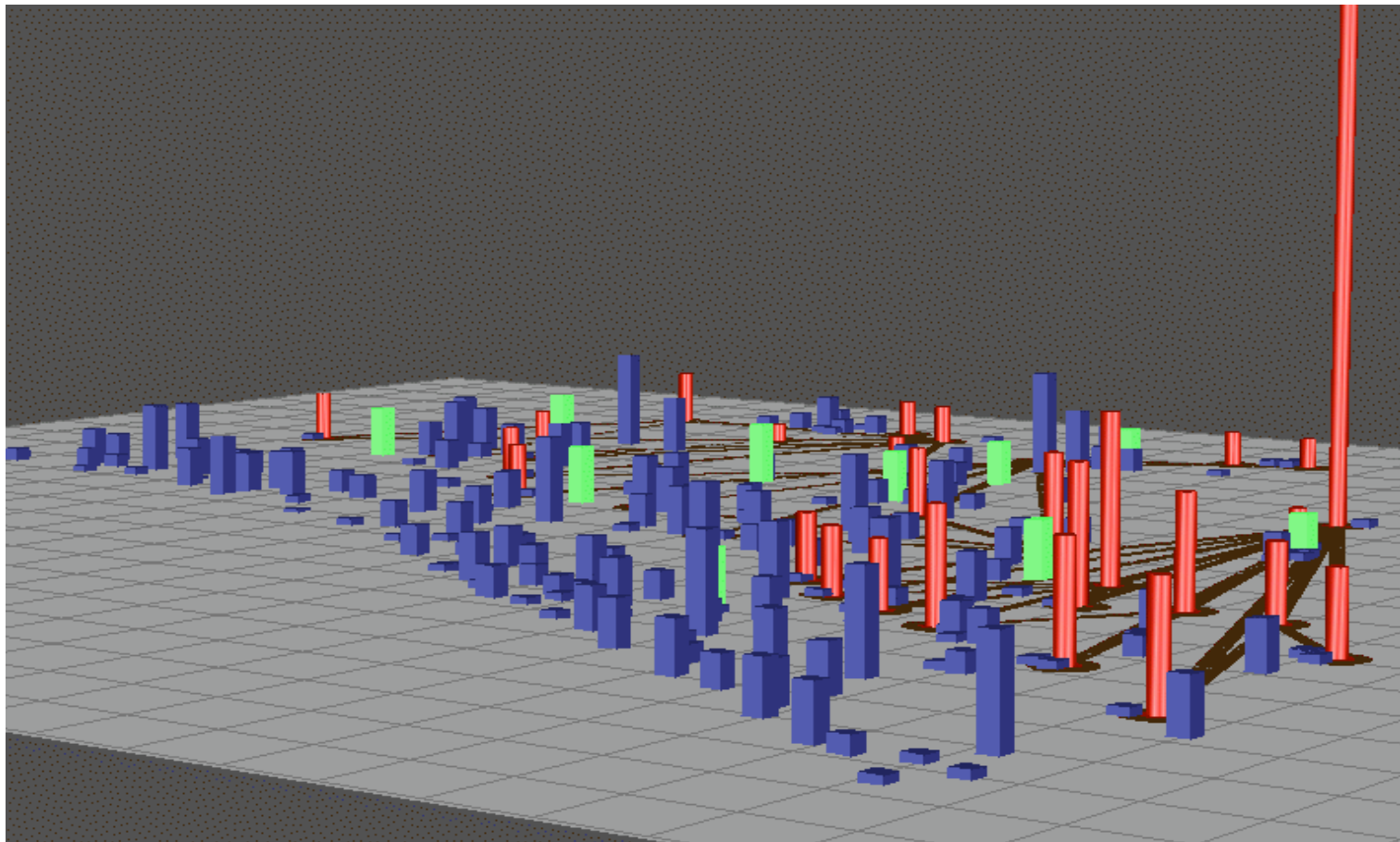item to appear

# Rangeslider



0                                                                                                    100

Low selection
thumb

Real data range

High selection
thumb

- Adjustment of low and/or high thumbs defines two limits on selection t

# Selective Display Manipulation (SDM)

Geographic location of a supply distribution network for a relief
Effort in a large crisis from SMD [Chuah et al., 1995]



Cylinders:
supply centers

Rectangular bars:
shelters

Dark lines:
routes between
supply centers

# Limitation of Static Visualization

- Unable to focus on different object sets with context
  - ➤ Too much information to be displayed in detail at once

- Clutter and object occlusion (too many data)

- Objects are dwarfed in the scale for the entire dataset

- Classify sets of objects
  - ➤ Original versus updated objects

- Difficult to compare quantities which are not spatially contiguous
  - ➤ Objects are at different distances from the user

# SDM Features and Components

- Selective:
  - ➢ User control in selecting an object set, selecting interactive techniques
- Dynamic:
  - ➢ Interactions occur in real-time and interactive animation is used in response to an user's action
- Manipulation:
  - ➢ Users can move objects and transform their appearance to perform different tasks

- SDM Components
  - ➢ Object-centered selection
    - Clicking on objects
  - ➢ Dynamic and flexible operations
    - Manipulate object set parameters through object handles (no menus)
  - ➢ Object constraints and feedback techniques
    - Context persistence, set-wide operations

# SDM Handles
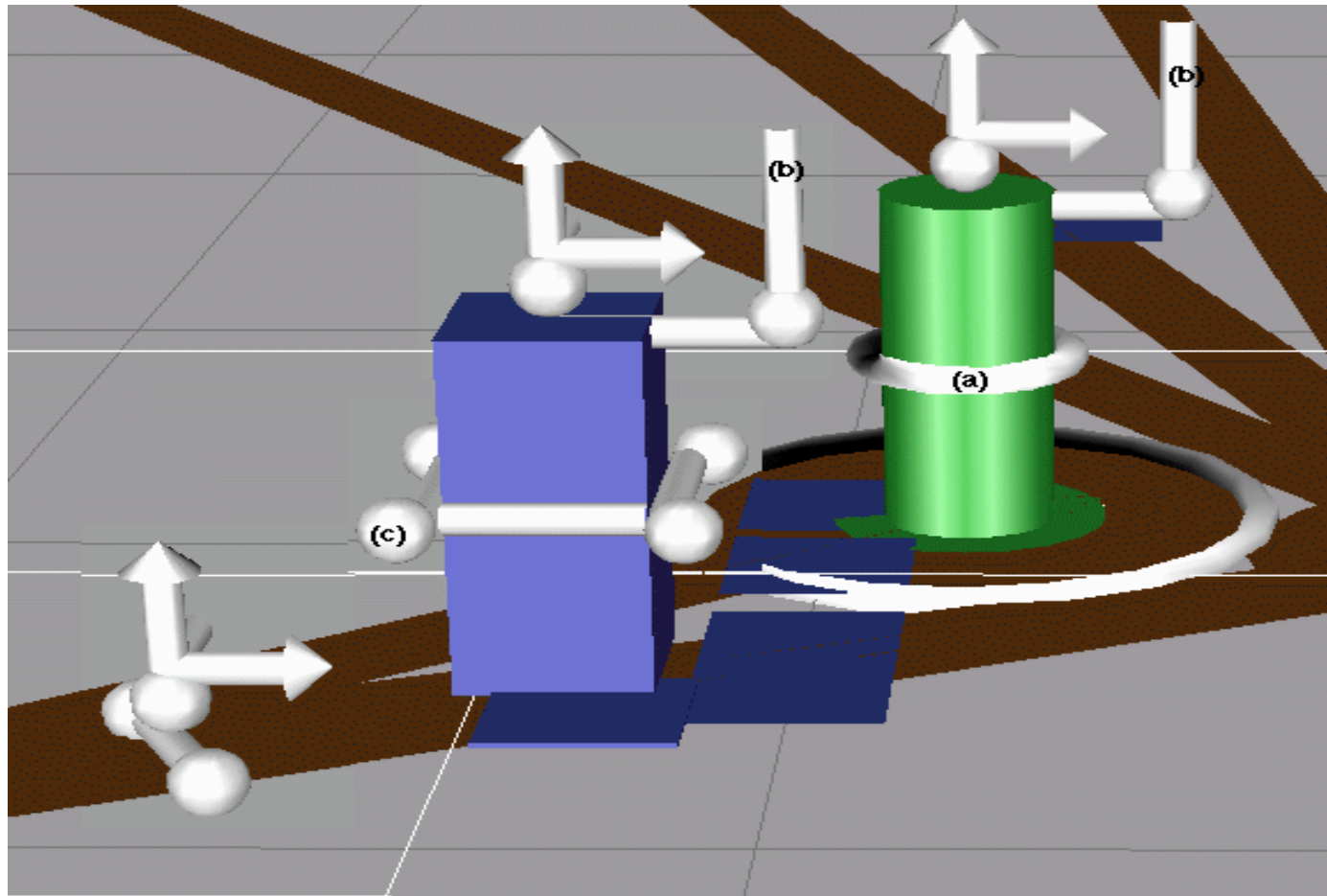


Part a controls the radius of cylindrical object, part b controls the height
of the object, and the part c controls the width of the bar.
Arrows enable users to shift the objects in 3D space.

# Feedback Mechanisms

- For indicating which objects have been altered, how they have been altered, how they can be returned to their home positions

- Identifies the selected set
  - <span style="color:red">Paint differently</span>
- Maintain scene context
  - <span style="color:red">Each data object has two representations: body and shell</span>
  - <span style="color:red">Object shells are left behind when the object bodies are moved</span>
- Maintain temporal continuity
  - <span style="color:red">Interactive animation</span>
- Maintain the relationship between the selected set and the environment
  - <span style="color:red">Ratio axes technique: scale difference between selected set and rest</span>
- Home mechanism
  - <span style="color:red">To return objects back to their home positions</span>
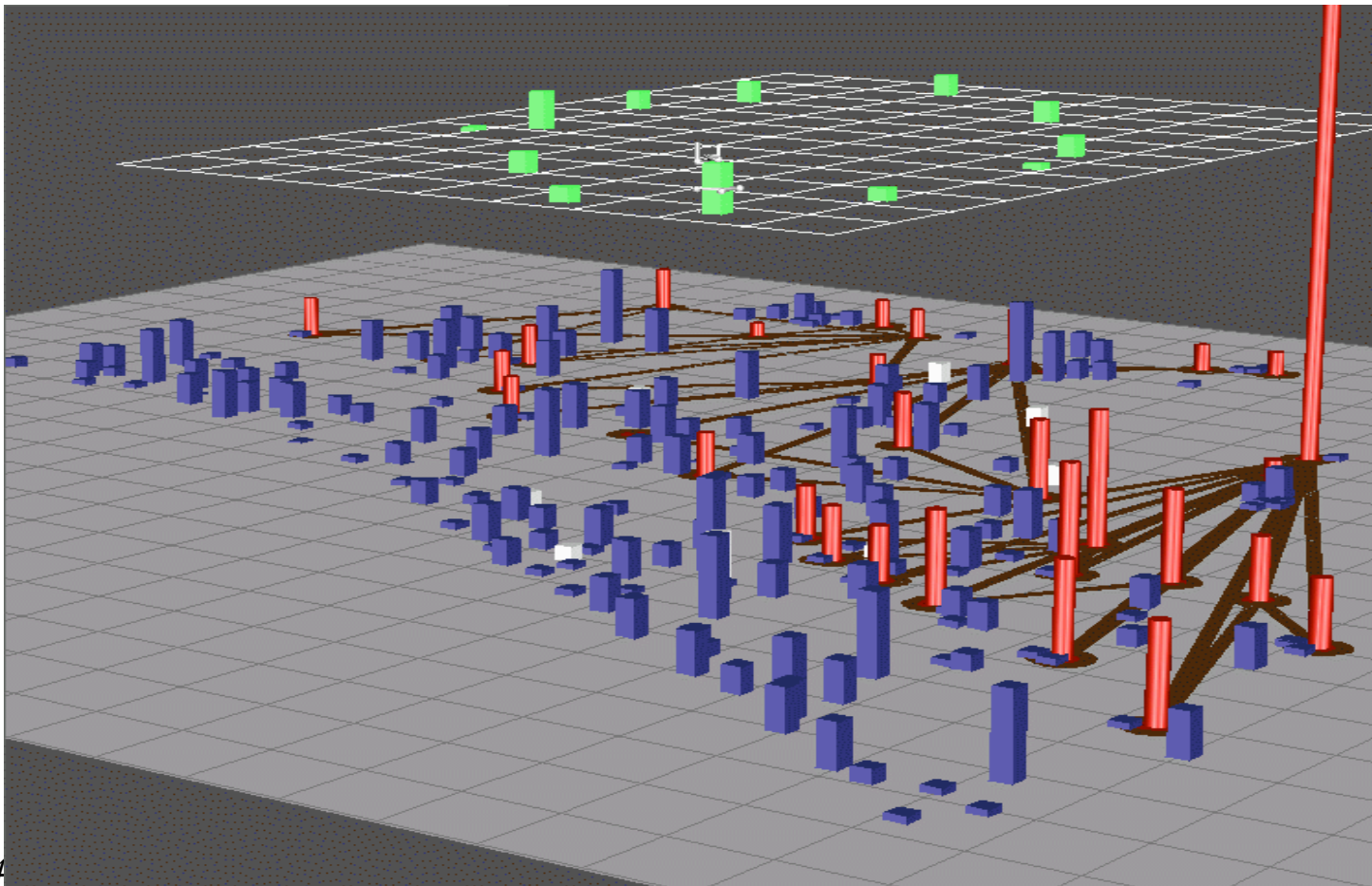
# Maintain context: Body and Shell

Objects on focus are moved to the front
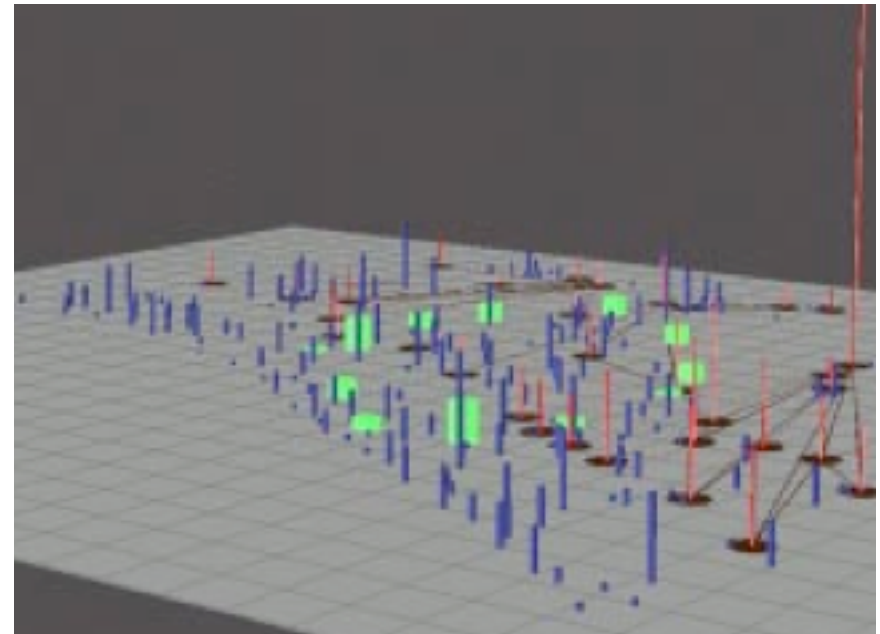Context is still maintained because object shells (shown in white)
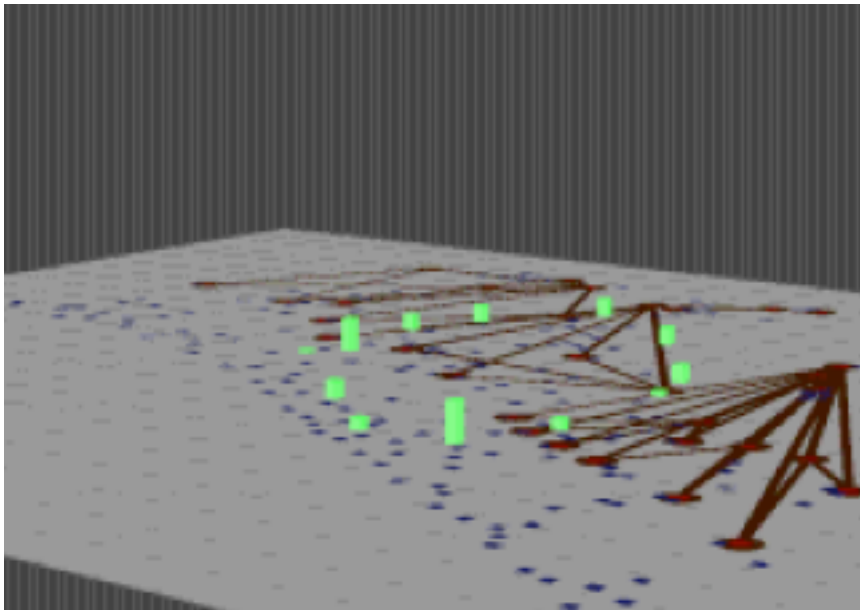are left behind
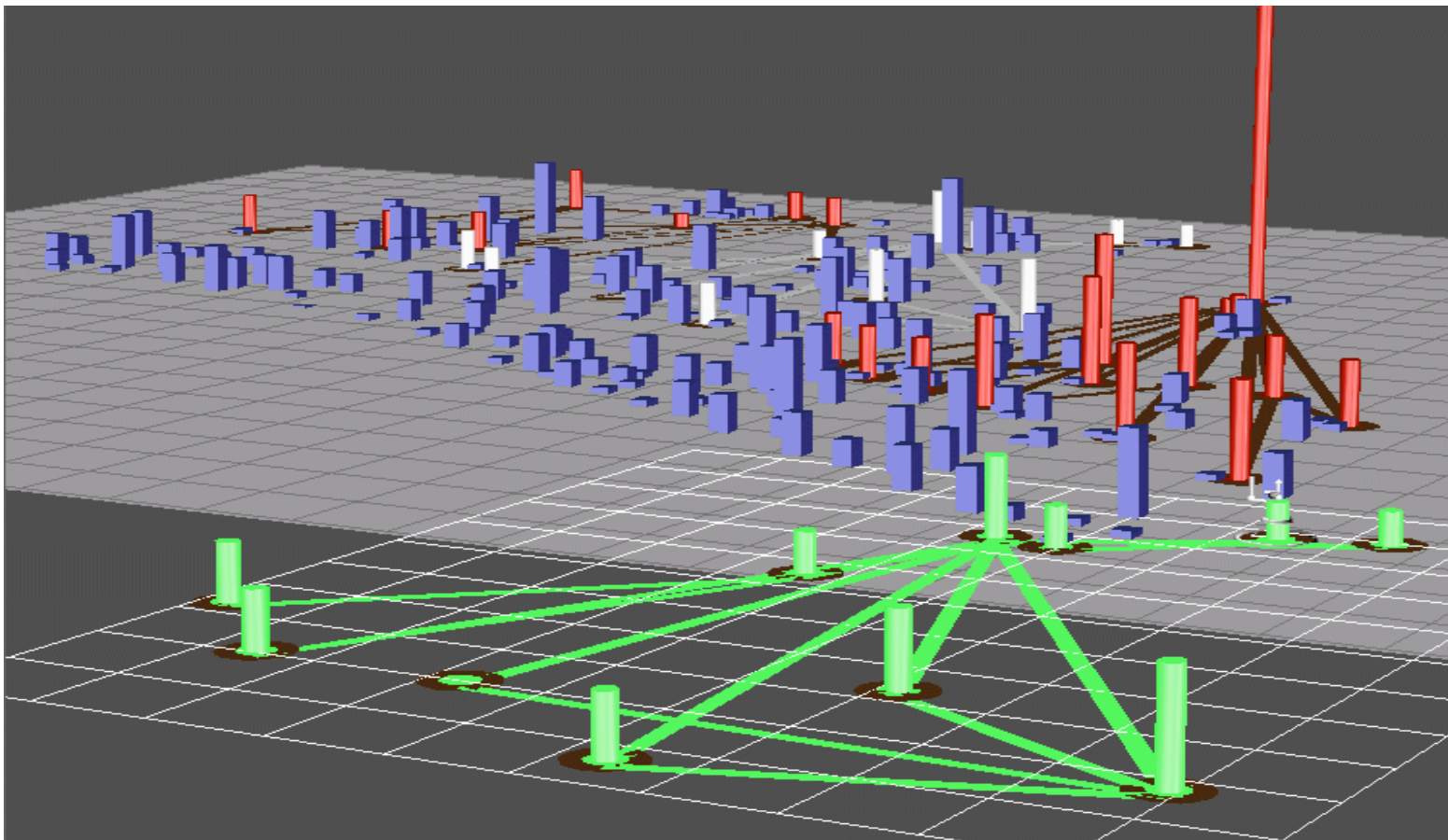
# View Occluded Object

- Raising reference for one class (green bars) of item allows that
  class to be examined more easily
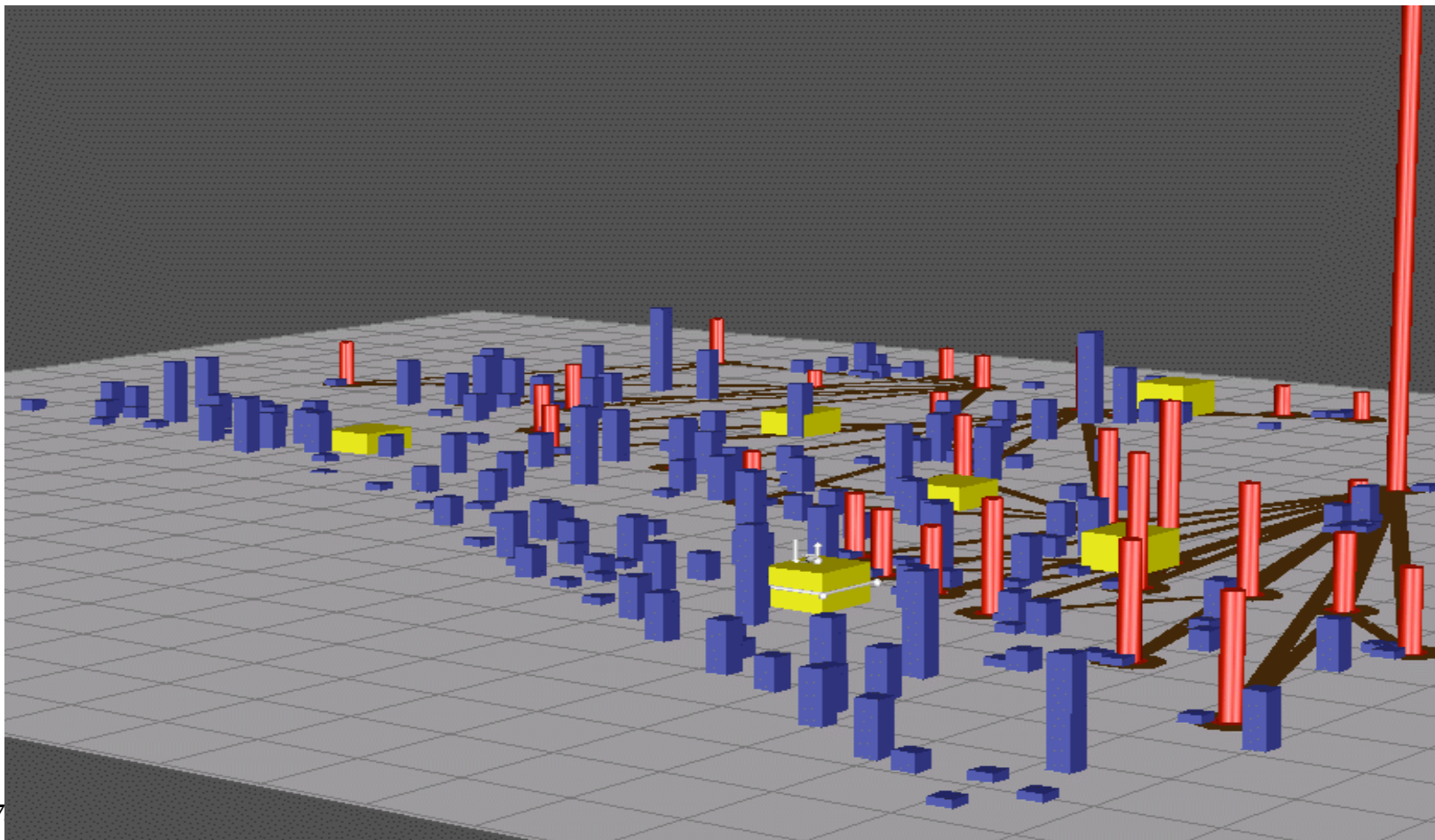
# Scaling Objects

- Objects other than selected are scaled to have zero height or to be very thin

# Interactively Augmenting

Interactively classify subset of objects as new information is
discovered about them

e.g., increase widths of some shelters and color them yellow

# Comparisons

Comparing the patterns, widths, and heights of objects by drawing a line of reference in the scene plane

e.g, two sets of objects made for height comparisons in Figure below.