Module #6:
Taxonomy of User Interactions

Main Purposes of Interaction

1. Tell storyline (usually over time)
   - Time-based playback
   - Sequence of actions based playback

2. Allow user to explore data (visual analytics)
   - Zoom in on details
   - Create different views into data
   - Change/Filter values
   - Show connections between data (including to other datasets)

Shneiderman's Visualization Mantra

- Overview, zoom & filter, details on demand
- Overview, zoom & filter, details on demand
- Overview, zoom & filter, details on demand
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- Overview, zoom & filter, details on demand
- Overview, zoom & filter, details on demand
- Overview, zoom & filter, details on demand
- Overview, zoom & filter, details on demand

Shneiderman's Taxonomy of Information Visualization Tasks

1. **Overview**: see overall patterns, trends
2. **Zoom:** see a smaller subset of the data
3. **Filter:** see a subset based on values, etc.
4. **Detailed on demand:** see values of objects when interactively selected
5. **Relate:** see relationships, compare values
6. **History**: keep track of actions and insights
7. **Extract:** mark and capture data

Interaction Techniques

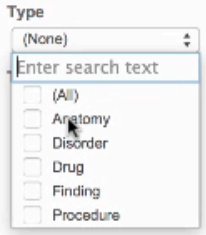
1. Filtering
2. Dynamic query
3. Selecting
4. Direct manipulation
5. Brushing
6. Details on demand
7. Zoom

FILTERING

Filtering

- Filtering
  - one of the basic interaction techniques often used in data visualization
  - used to limit the amount of displayed information through filter criteria

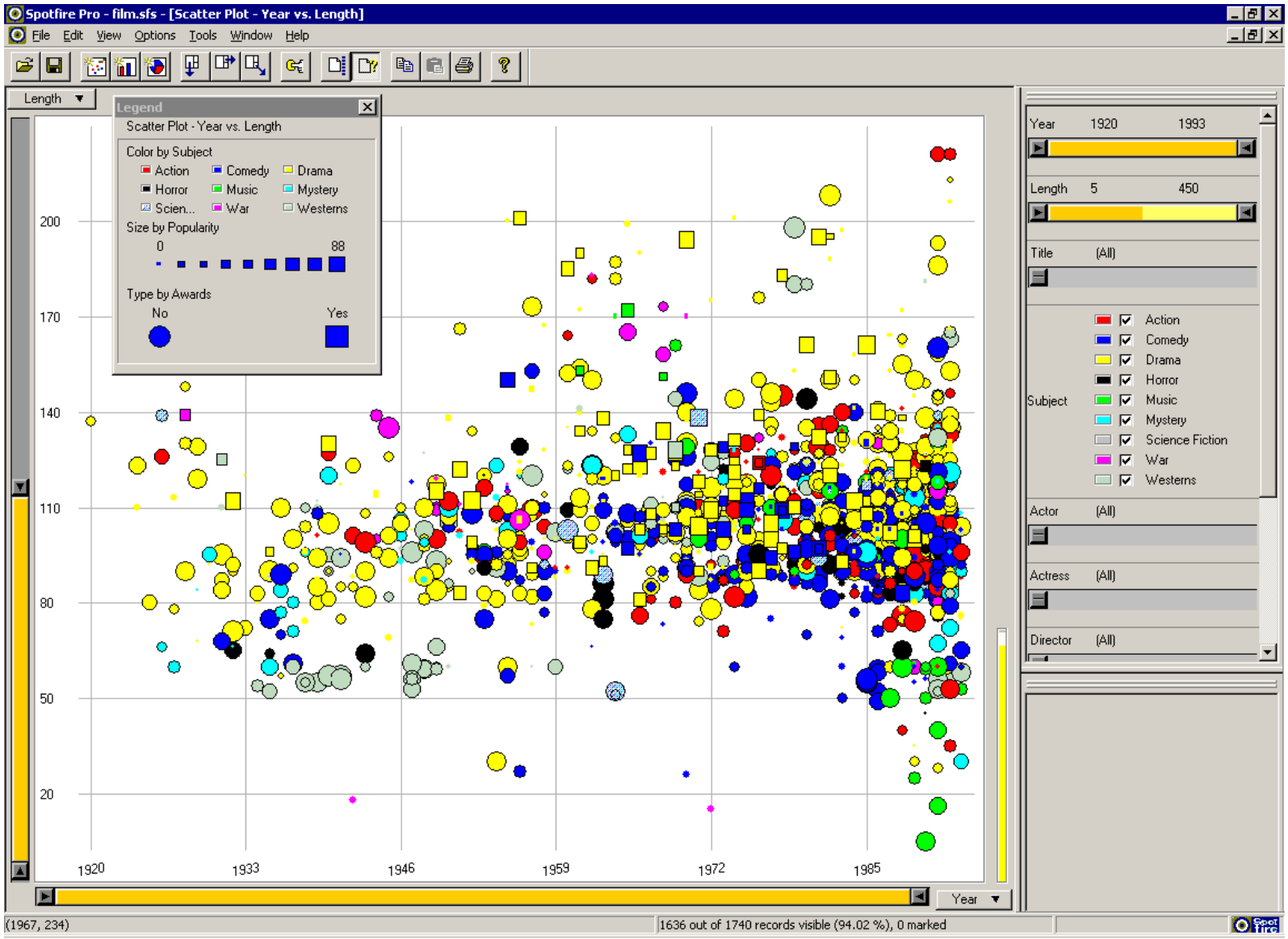
Filtering


Type
(None)
Enter search text
(All)
Anatomy
Disorder
Drug
Finding
Procedure

DYNAMIC QUERY

Dynamic Query

- Dynamic queries:
  - continuously update the data that is filtered from the database
  - users adjusts sliders or select buttons to form simple queries or to find patterns or exceptions
  - work instantly within a few milliseconds
  - applies the principles of direct manipulation to the database
  - allows beginners a faster entrance without having much practice

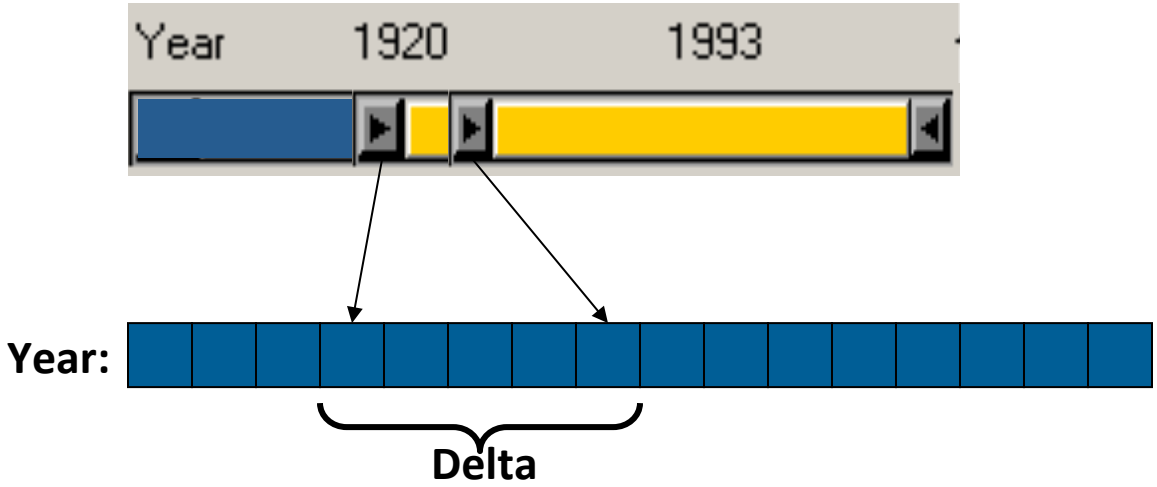

Spotfire Pro - film.sfs - [Scatter Plot - Year vs. Length]
File Edit View Options Tools Window Help
Length
Legend
Scatter Plot - Year vs. Length
Color by Subject
Action
Comedy
Drama
Horror
Music
Mystery
Scien...
War
Westerns
Size by Popularity
0
88
Type by Awards
No
Yes
200
170
140
110
80
50
20
1920
1933
1946
1959
1972
1985
Year
Year 1920 1993
Length 5 450
Title (All)
Subject
Action
Comedy
Drama
Horror
Music
Mystery
Science Fiction
War
Westerns
Actor (All)
Actress (All)
Director (All)
(1967, 234)
1636 out of 1740 records visible (94.02 %), 0 marked

Dynamic Query Algorithm

- Idea: incremental algorithm
  - only deal with data items that changed state
- When slider moves:
  - Calculate slider delta
  - Search in data structure for data items in the delta region
  - If slider moved inward (filter out):
    - Erase data items from visualization
  - Else slider moved outward (filter in):
    - Draw data items on visualization

Dynamic Query Algorithm

- Sorted array of the data for each slider

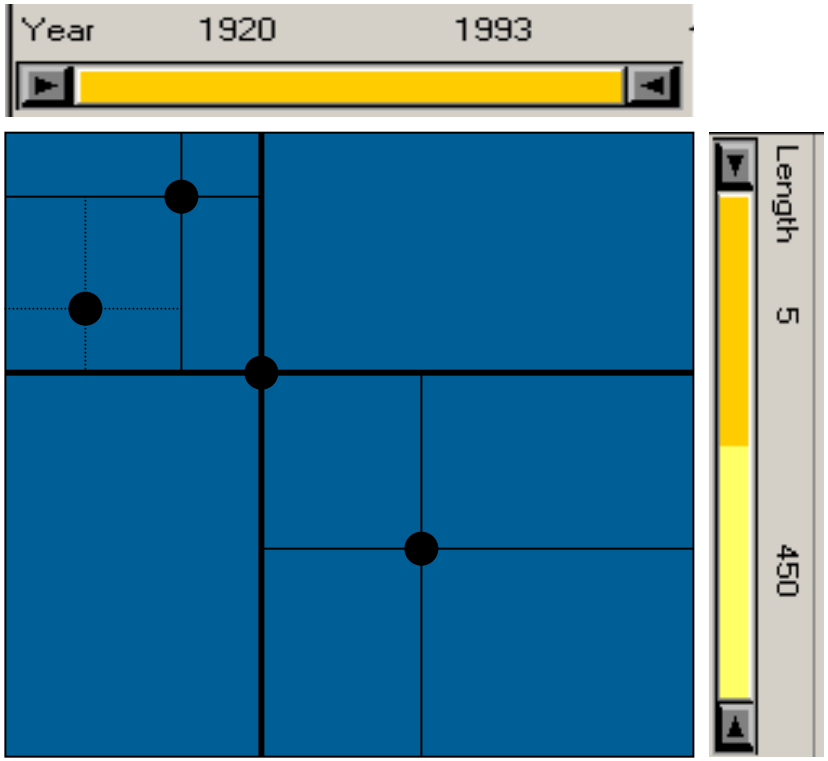


- Need counter for each data item = # sliders that filter it
  - Attribute Explorer visualizes these counters too!

- O(delta)

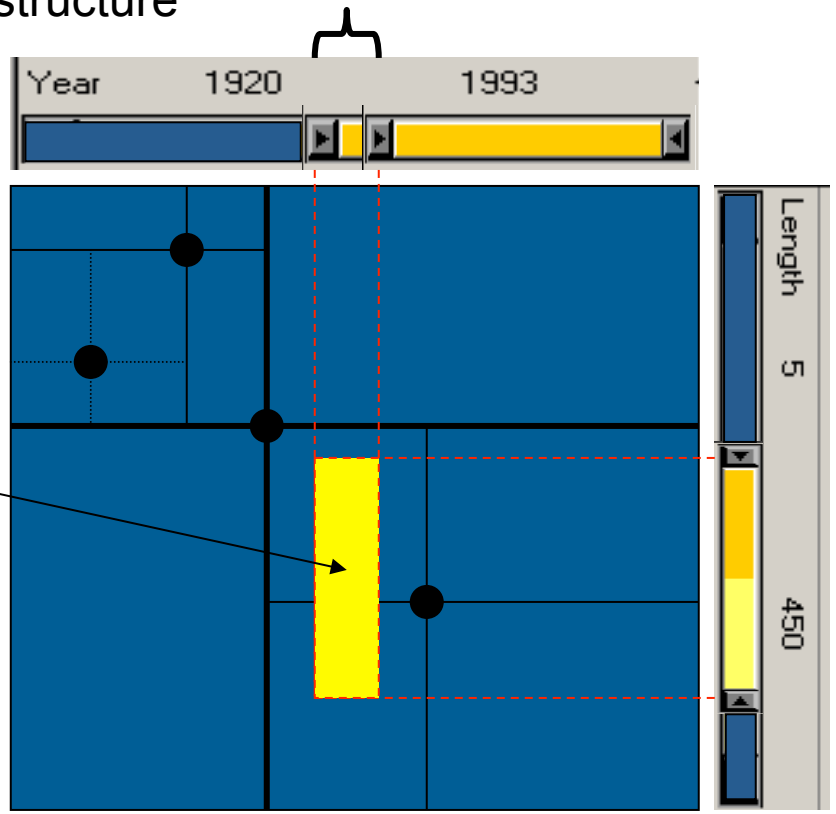
Dynamic Query Algorithm

- Multi-dimensional data structure
  - E.g.: K-d tree, quad-tree, …
  - Recursively split space, store in tree structure
  - Enables fast range search, O()



Dynamic Query Algorithm

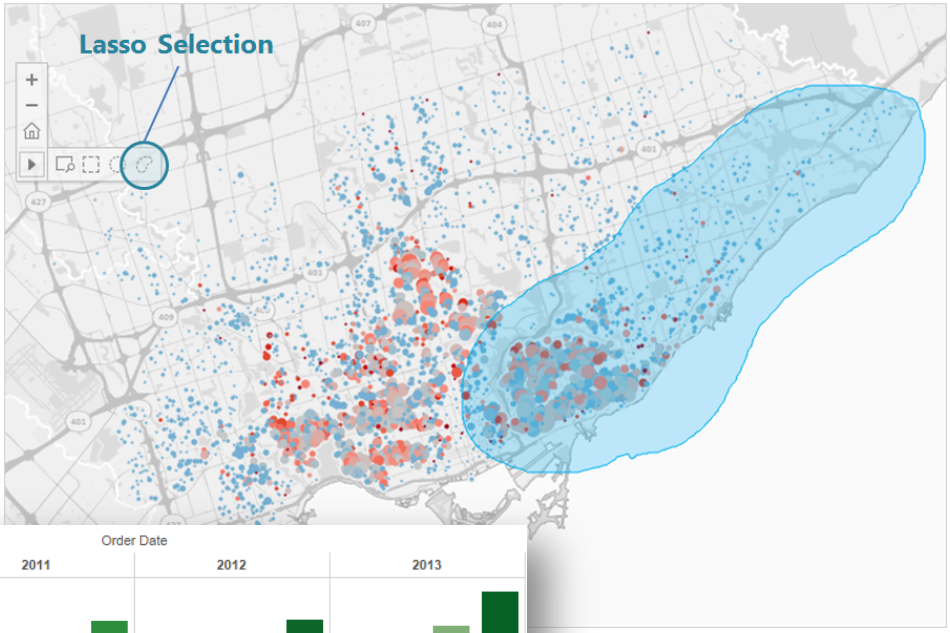
- Multi-dimensional data structure
  - E.g.: K-d tree, quad-tree, …
  - Recursively split space, store in tree structure
  - Enables fast range search, O(logn)

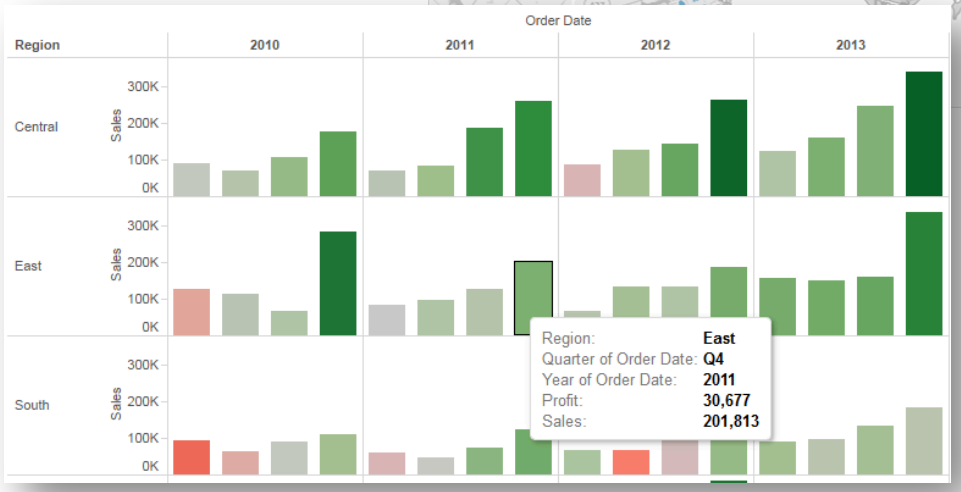


SELECTING

Basic Interaction Techniques

- Selecting
  - Mouse click
  - Mouseover / hover / tooltip
  - Lasso / drag
- Rearrange
  - Move
  - Sort
  - Delete

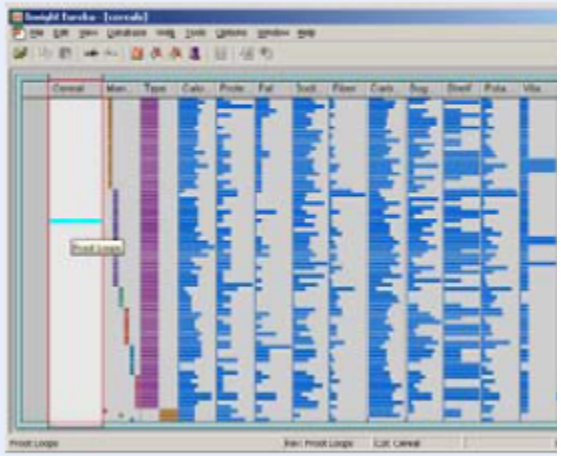




Selecting

Pop-up tooltips

Hovering mouse cursor brings up details of item



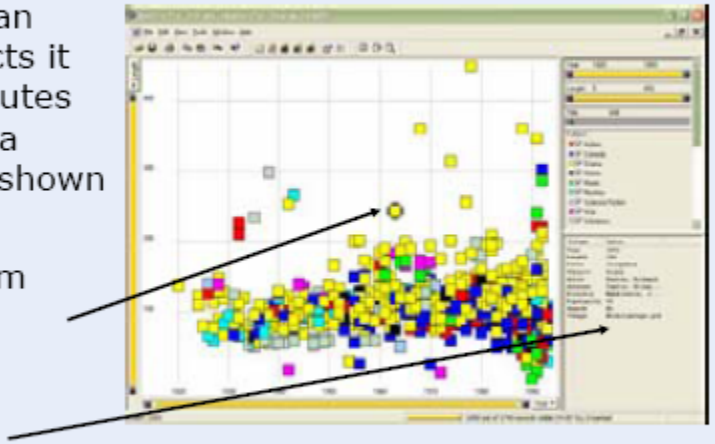
Slide adapted from John Stasko

Mouse Selection

Clicking on an item selects it and attributes of the data point are shown

Selected item

Attributes

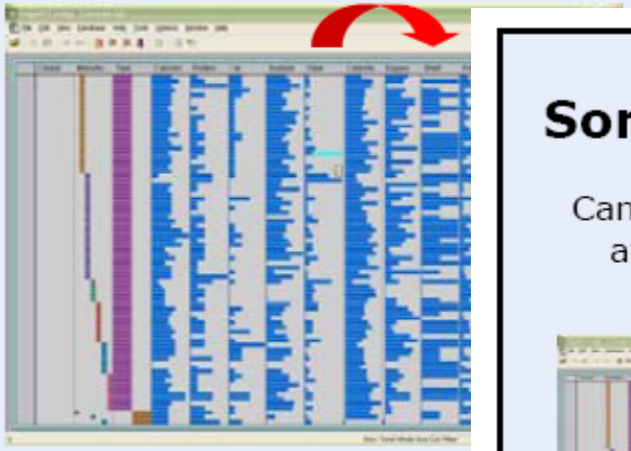


Slide adapted from John Stasko

Selecting

Rearrange

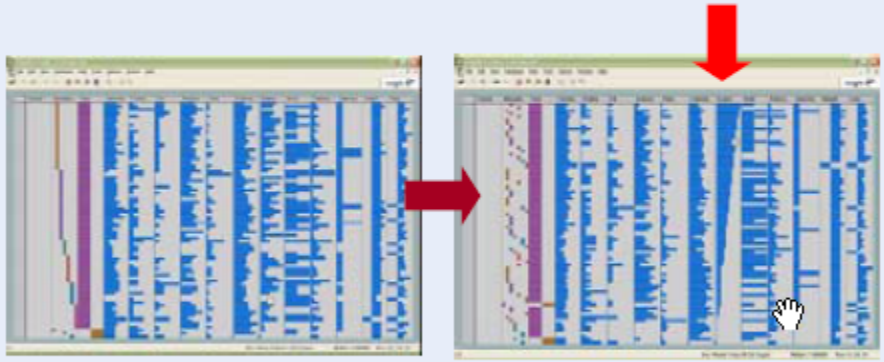
In TableLens you can move columns (attributes) left and right



Slide adapted from John Stasko

Sorting

Can sort data with respect to a particular attribute in Table Lens

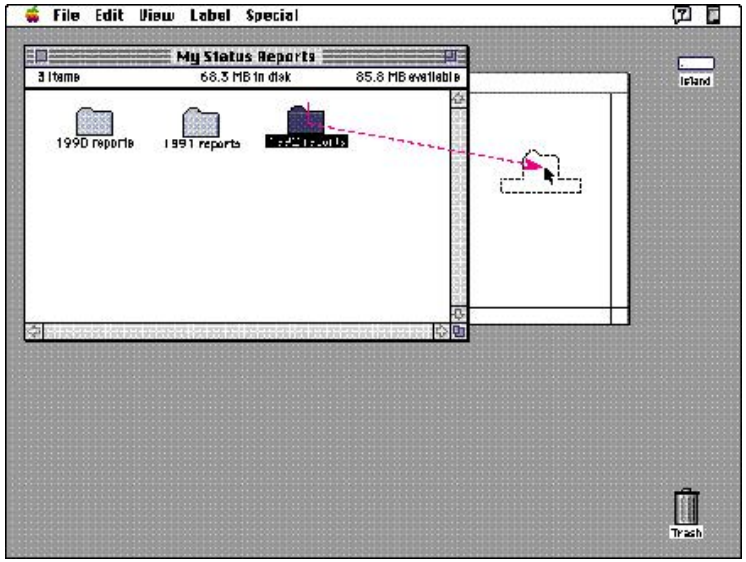


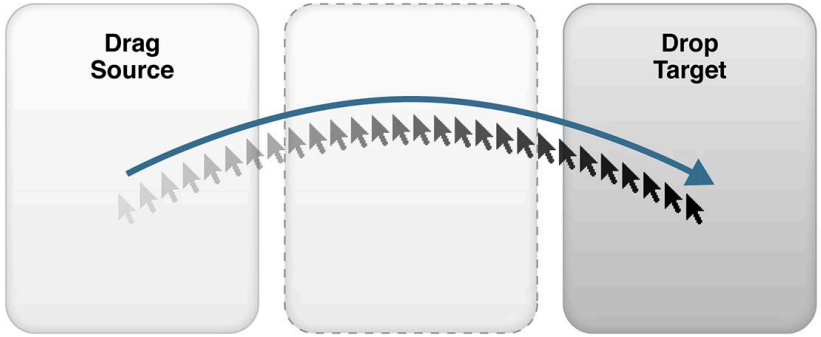
Slide adapted from John Stasko

DIRECT MANIPULATION

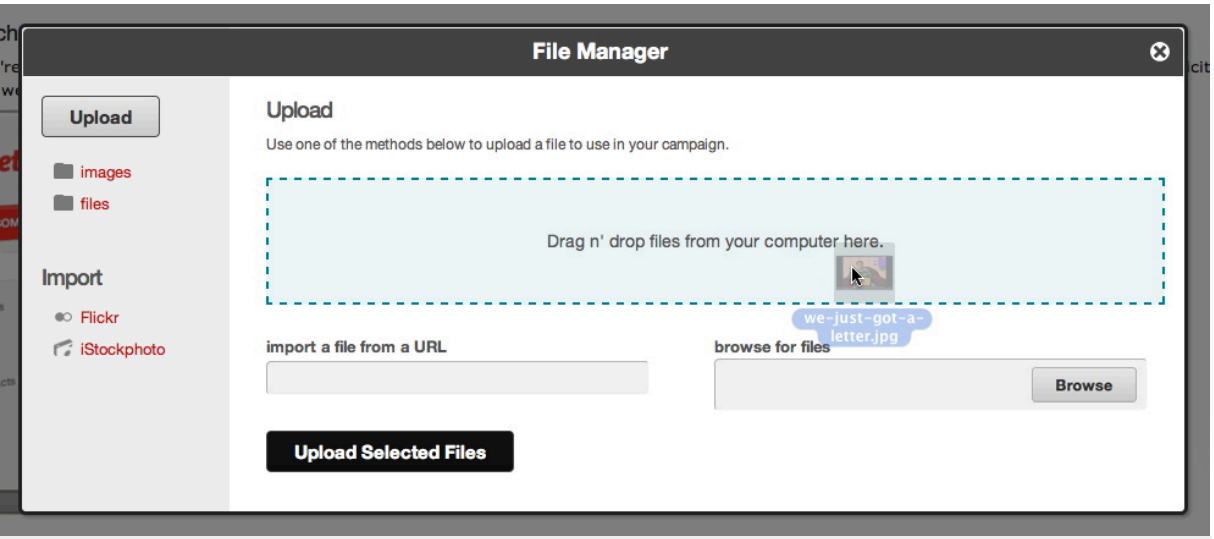
Direct Manipulation

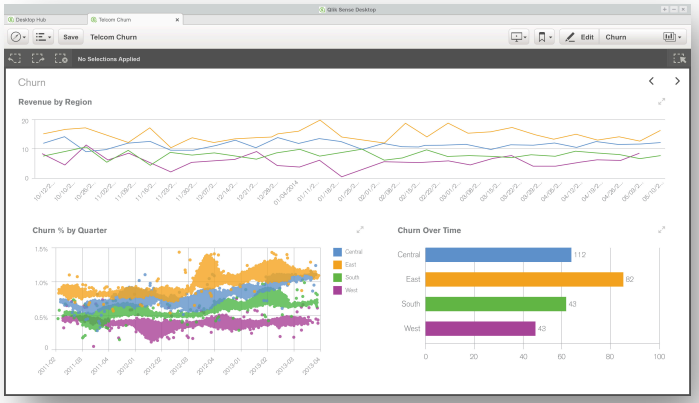
- Direct manipulation
  - allows people to feel that they are directly controlling the objects represented by the computer.
  - an object on the screen remains visible while a user performs physical actions on the object.
  - when the user performs operations on the object, the impact of those operations on the object is immediately visible.

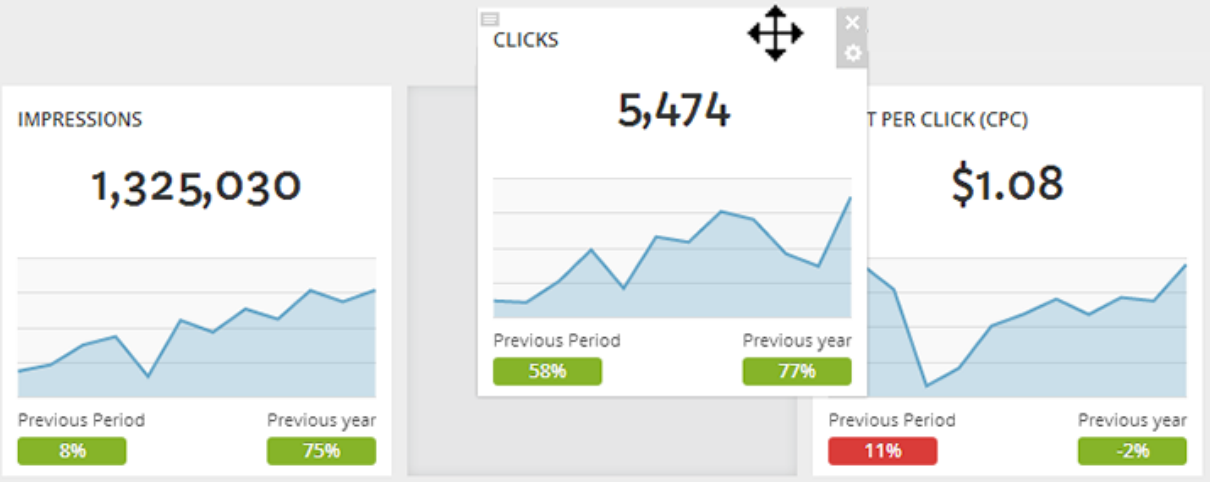


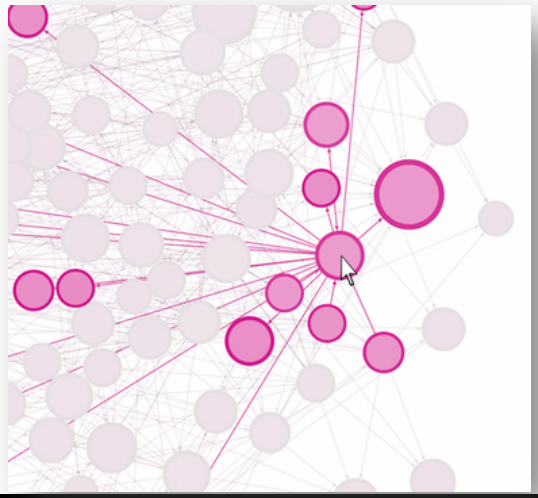


Direct Manipulation









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