Mondrian

or

this is not a Toolkit

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Differences at Several Levels

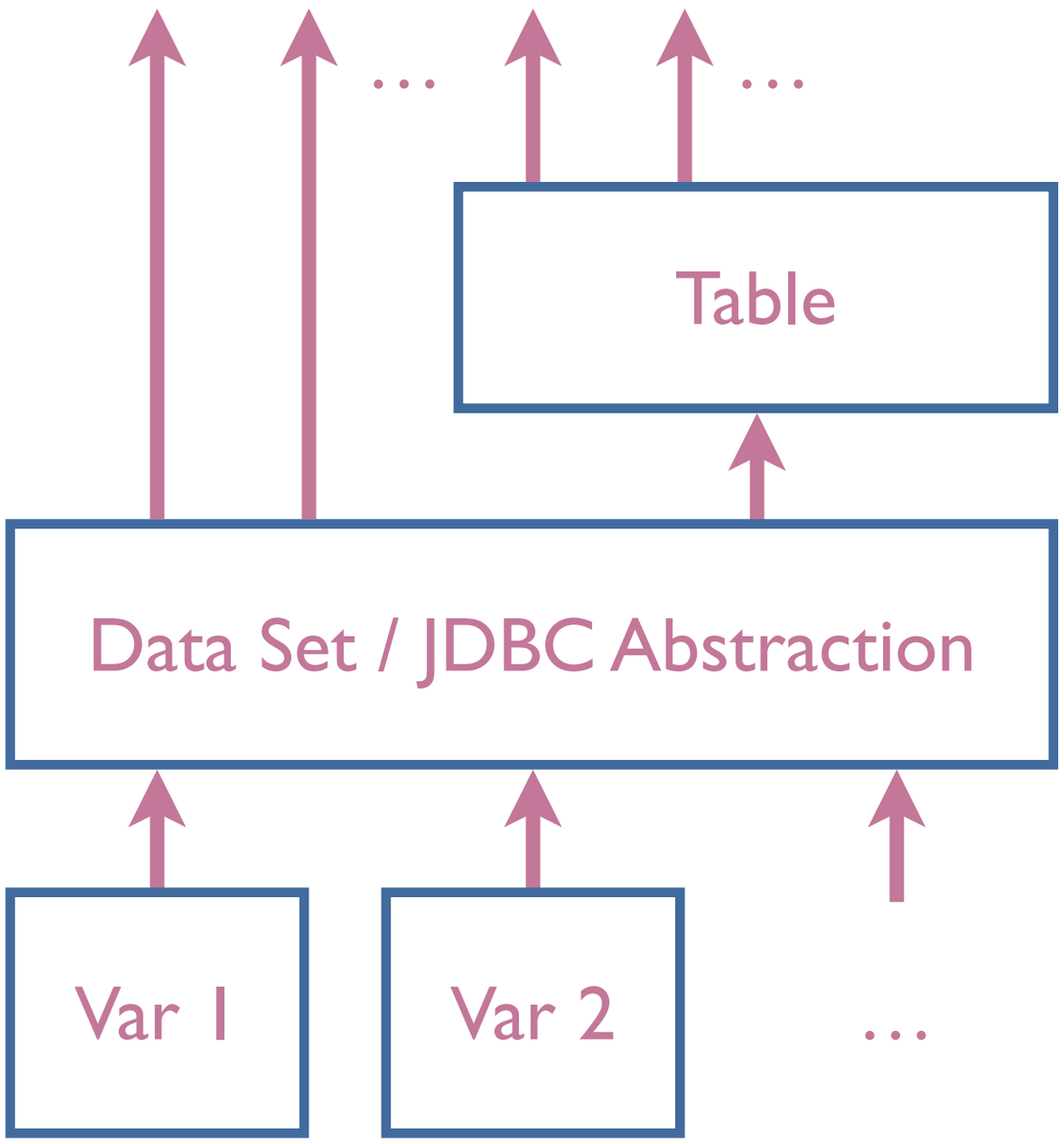
- **Motivation**
  The motivation for writing Mondrian was (in the end) to build a tool that can be used by anyone who needs graphical methods for EDA for (almost) arbitrary datasets, regardless of his/her computing skills.
- **Concept**
  Above motivation calls for a more or less closed and complete application with no configuration efforts and little learning efforts.
- **Technical**
  The software design for a closed application does not necessarily need “orthogonal” components that can be combined to build new visualizations.

All Kinds of Data

- **Structure Data vs. Unstructured Data**
  Classical datasets in statistics are simple rectangular data matrices with rows corresponding to observations (cases) and columns are the different variables (attributes) measured per observation.
- **Data on different Scales**
  Above all, the scale of a variable is important for its potential role in an analysis. Scales are:
  - nominal (alpha-numeric or numeric)
  - ordinal (alpha-numeric or numeric)
  - continuous
- **Dark Ages of Statistical Data Visualization**
  For a long time, data visualization in statistics did only handle numerical data (as classical statistics does) with all the problems.

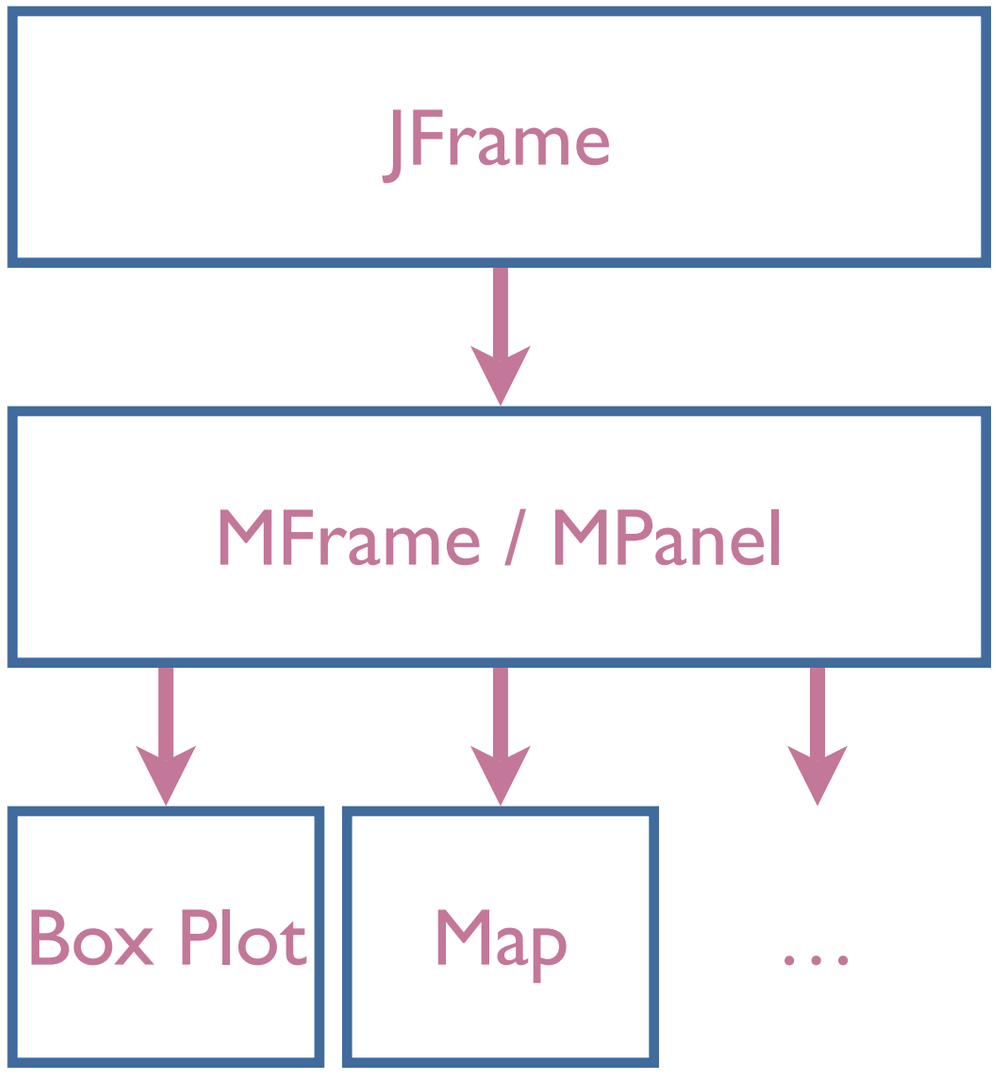
Data Handling in Mondrian

- Mondrian assumes that data sits either in datafiles or JDBC accessible databases and follows the strict rectangular layout. (datafiles may optionally point to a polygon description file)
- The dataset class handles all data requests (selection, color, …)
- Internally all columns of the data table are stored as variables
- The table class manages all (multivariate) categorical data



Graph Drawing Objects

- Of central importance in Mondrian are the mechanisms for selecting and highlighting data on case level
- The standard plot-canvas supports all that is needed for selections
- If coordinate systems are used, standard zooming can be used
- Each plot must implement the necessary methods to maintain the correct representation of a selection, color etc.

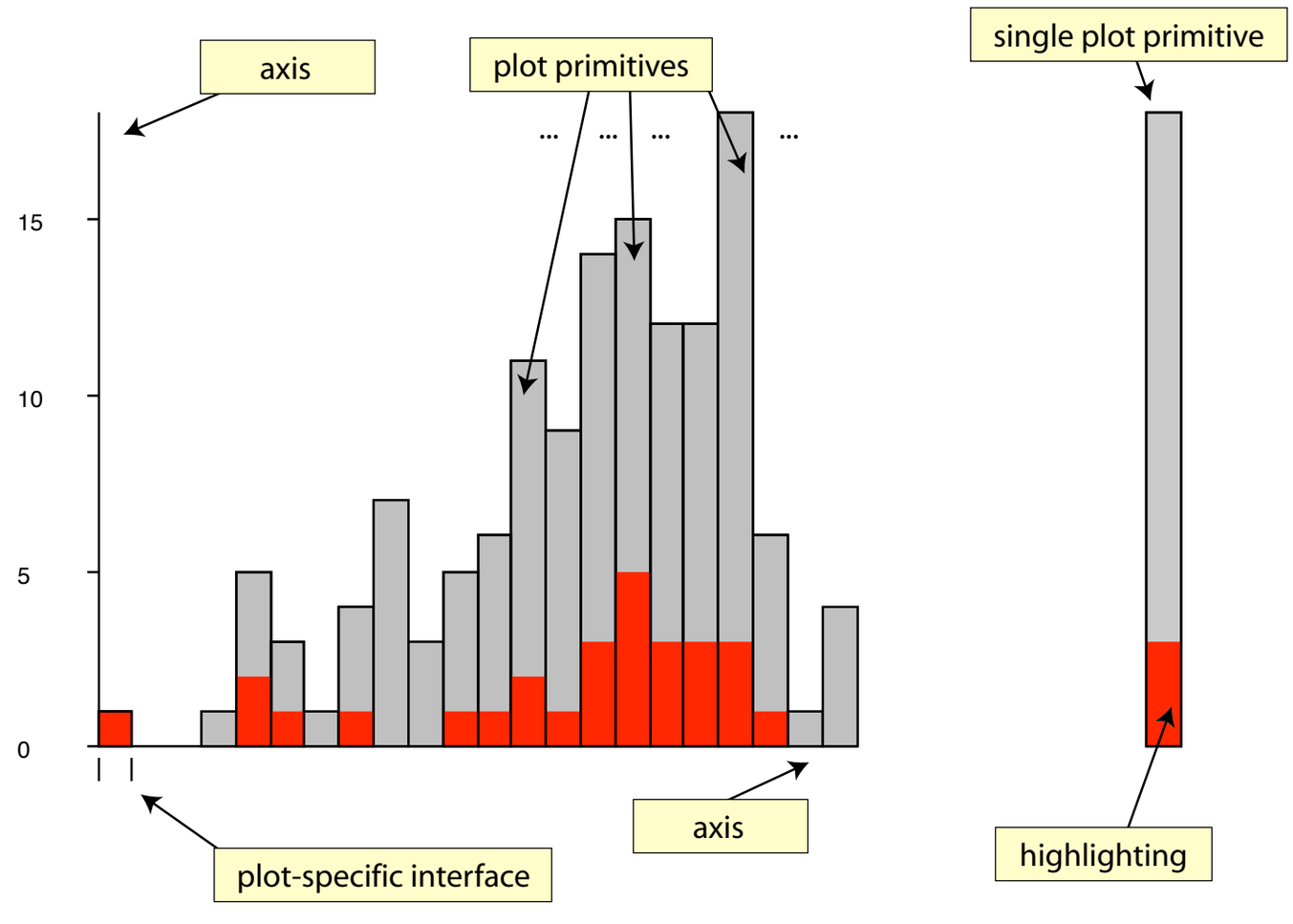


Plot Primitives

- **Points**
  Points, like in scatterplots, are **NO** objects and have a 1:1 correspondence to some columns of a single row in the data matrix.
- **Polylines**
  Analogous to points, polylines are the multivariate incarnation of a point, i.e., they correspond 1:1 to a row in the data matrix.
- **Rectangles**
  Rectangles are objects that correspond to either a single row of a table or a group of rows of a table and gather many cases.
- **Polygones**
  Polygones, as in maps, are a generalization of rectangles and link to a group of cases in the dataset, less strict as a table.

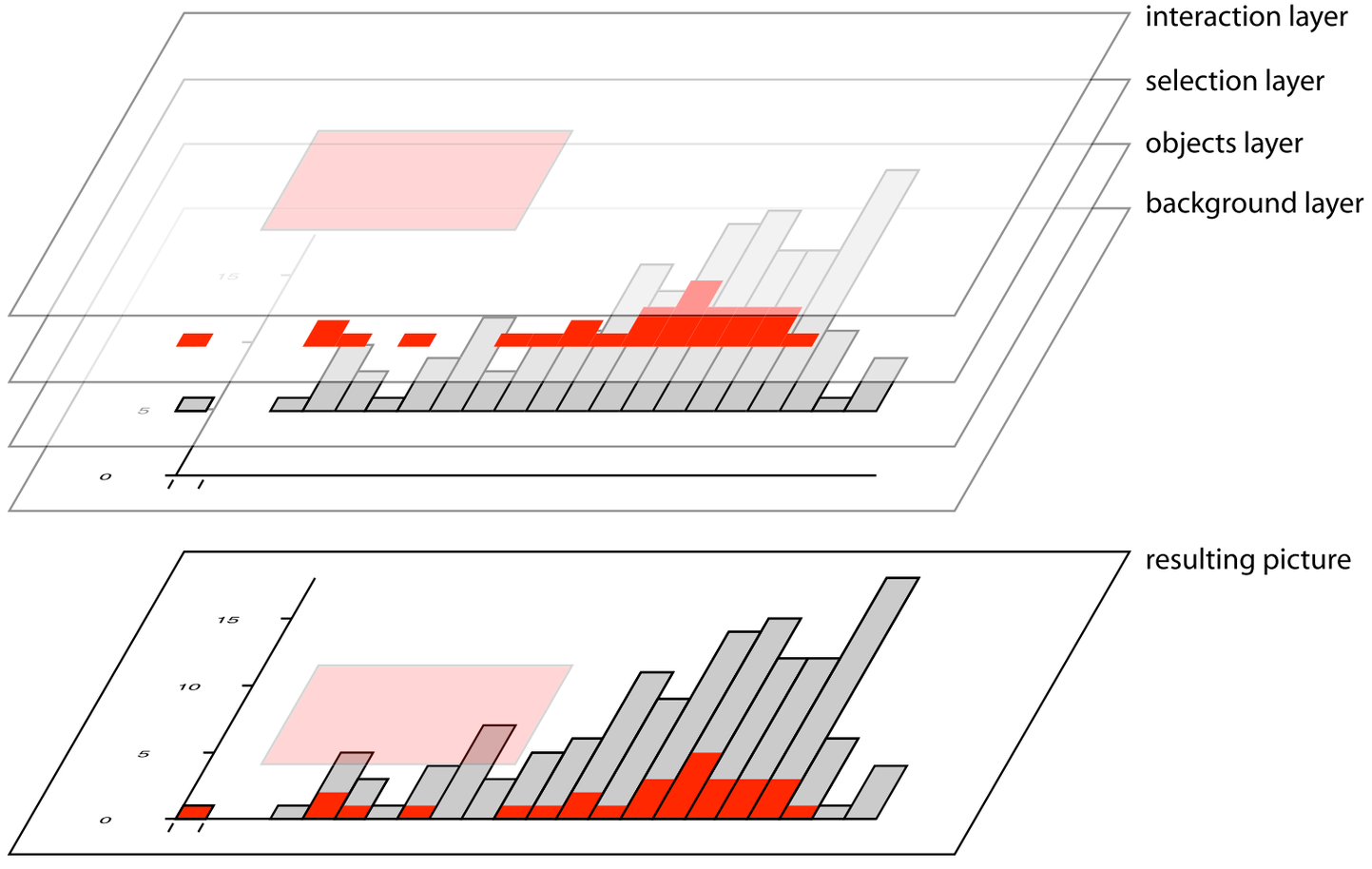
Decomposing a Graphic

- In an object-oriented programming environment/language, an effective definition of the graphical objects is key.
- Typical Objects
  - plot primitives
    - points
    - lines
    - boxes
  - axes
  - plot specifics
- Example: Histogram
  - primitives: boxes
  - axes
    - x: range
    - y: count or probability
  - plot specifics
    - origin and width control



Example of Plot Layout

- 4 layers can be defined to group the different plot components
  - Interaction layer
  - Selection layer
  - Object layer
  - Background layer



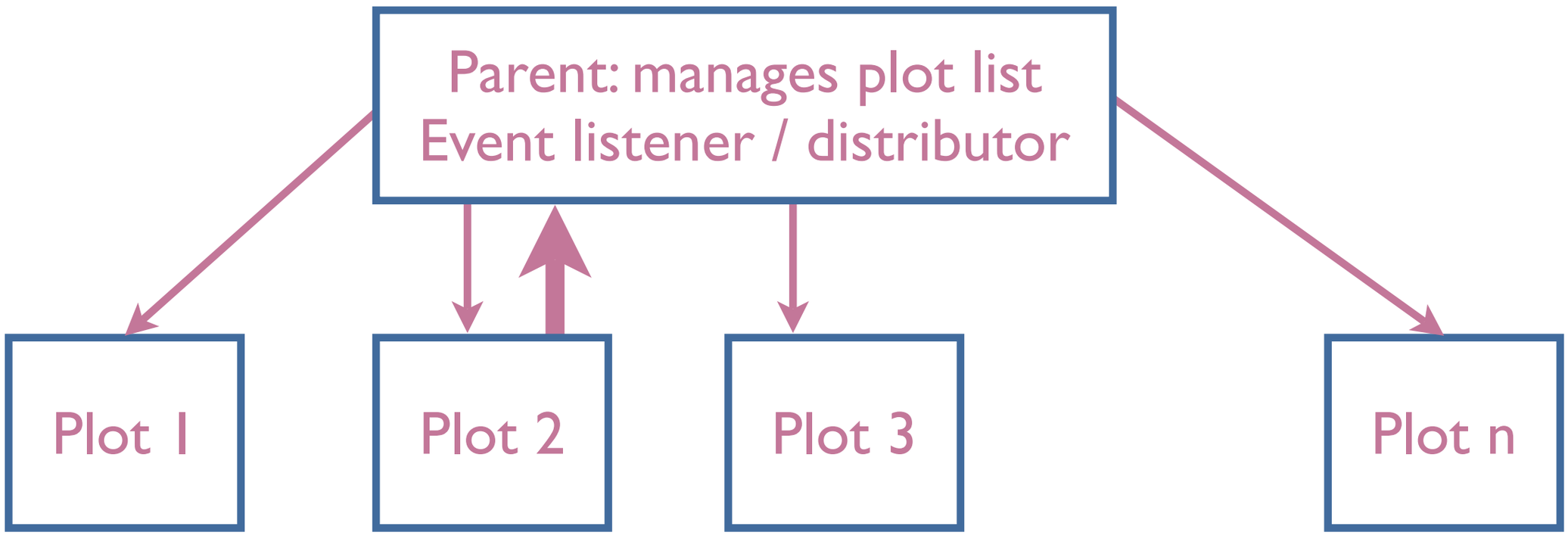
- The layers are defined according to their update frequencies from least frequent update to most frequent update, i.e.

  interaction ➢ selection/highlighting ➢ objects ➢ axes (background)

- Very important to speed up drawing times!

Interactions: Events

- Apart from JAVA's standard events, Mondrian implements two application specific events:
  - Selection Event
  - DataChanged Event
- Event distribution
  (e.g. plot 2 changes the selection state)



Interactions: Conventions

- There is a tight and consistent mapping of interactions
  - **Selections**
    - click and drag ➢ create a selection rectangle / brush
    - click on selection rectangle handle ➢ resize this selection
    - popup-trigger on selection rectangles ➢ alter this selection
  - **Queries**
    - <alt>-mouse over coordinate system ➢ orientation query
    - <control>-mouse over objects ➢ query
    - <shift>-<control>-mouse over objects ➢ extended query
  - **Alterations**
    - meta-click and drag ➢ zoom in/out (middle click on Windows)
    - popup-trigger on background ➢ get/change plot options
    - alt-click and drag ➢ reorder objects
    - page-up /-down ➢ cycle through views
    - arrows up/down and left/right ➢ increase/decrease plot parameters

Animation free Zone

- In InfoVis, animation is almost a must;
  in statistics, animation will significantly reduce your credibility.
- Animations usually show a transition from one state to another
  - different layouts (mainly for graphs)
  - different scales (zoom operations; maps etc.)
  - different plot parameters (e.g., smoothing parameters)
- Animations help to preserve the context, which might be lost if the change happen too abruptly.
- Transitions should be avoided if the intermediate states are not meaningful.
- The only obligatory animation in statistical graphics can be found in 3-d rotating plots

What does it take to build a new Plot?

- Data handling: ✓
- Define new plot object
  - Derive new class from MPanel
  - [Aggregate data, and/or calculate statistics]
  - Define the paint() method using
    - coordinate system
    - plot primitives
  - Define selection methods
  - [Define custom interactions]
- Housekeeping
  - Add plot to the plot menu
  - Define variable constraints for the plot
- All coding has to be done in JAVA

Size Matters!

- Unlike classical statistical graphics tools, Mondrian takes care of large datasets, i.e., dataset with > 1.000.000 observations
- There are some standard techniques to cope with massive data
  - alpha-blending to cure overplotting
  - different forms of zooming (names may vary)
    - standard
    - logical (change representation of objects)
    - censored zooming (only focus on the fringes)
    - quantum zooming (only zoom in on the highlights)
    - …
  - automatic sorting options
  - automatic permutations
- Above all, make sure the plot is still working with large amounts of data; regarding rendering speed AND interpretability.

Summary

- The main difference between Mondrian and (other) InfoVis tool-kits is probably the difference between building a visualization tool and implementing domain specific concepts and strategies.
- Structured data (as in graphs) directly constitutes the features within a dataset. If we assume to have randomness following a specific distribution, we might observe the features in the data only indirectly.
- Having “only” multivariate data of just a few structural different types of distributions, there is no need to create new graphical representations “by the minute”.
- Nevertheless, to create prototypes of a new statistical graph, it probably needs more flexibility than a “standard” toolkit offers.