Erasmus+

e-Lab Prof Eng

Innovative Lifelong e-Learning for Professional Engineers

(e-ProfEng)

586391-EPP-1-2017-1-SE-EPPKA2-CBHE-JP

Training in Electrical Engineering Discipline

Modelling and Simulation in Electrical Engineering

Data visualization in data analysis

Tools

Josip Job

FERIT Osijek 2.4.2019.

Tools

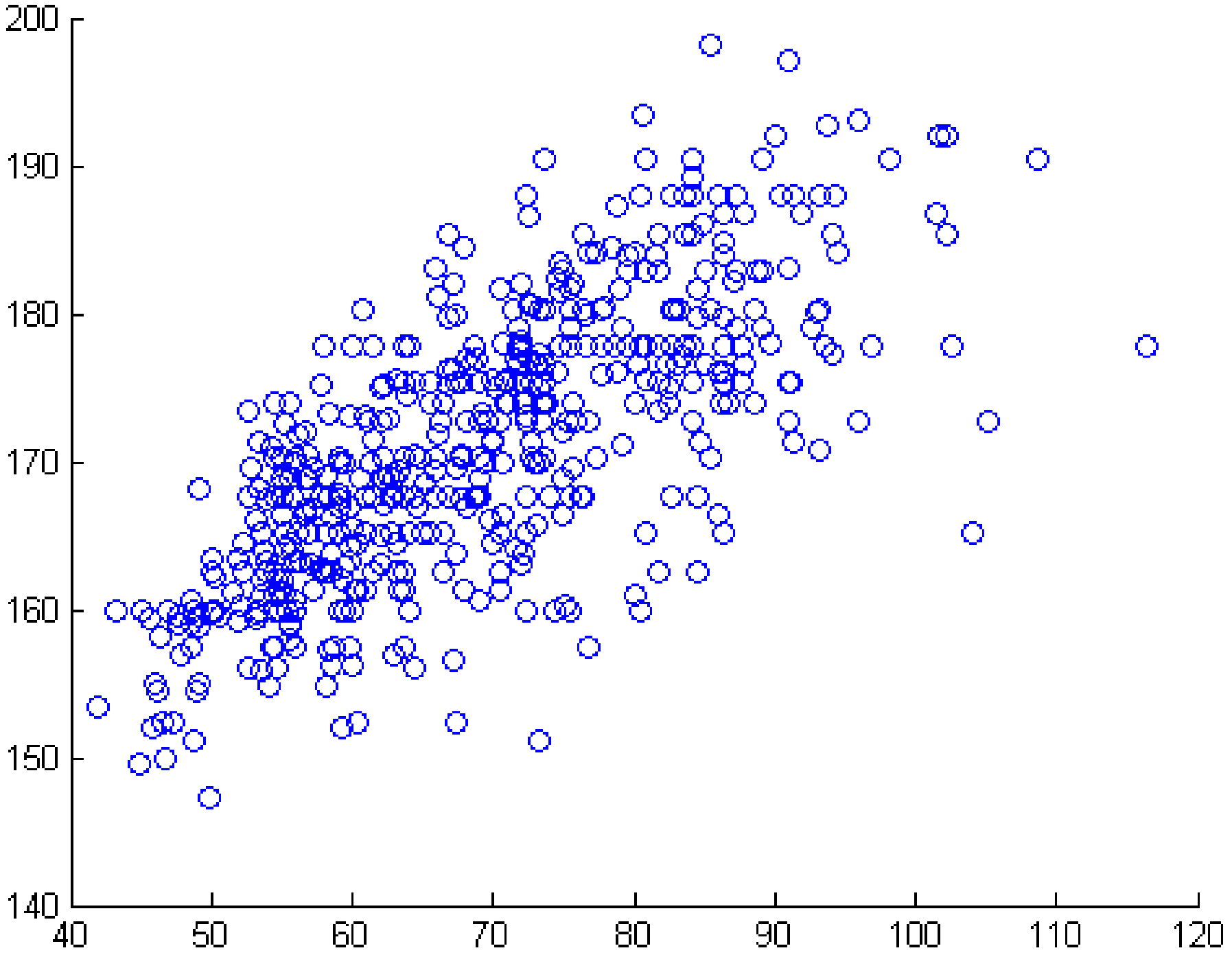
Example

- Grete Heinz, Louis J. Peterson, Roger W. Johnson, and Carter J. Kerk. *Exploring relationships in body dimensions*. Journal of Statistics Education, Volume 11, Number 2, 2003.
- The data give 21 body dimension measurements as well as:
  - age, weight, height, and gender on 507 individuals.
- The 247 men and 260 women were:
  - primarily individuals in their twenties and thirties, with
  - a scattering of older men and women, all exercising several hours a week.
- There are:
  - 507 observations
  - on 25 variables.

www.amstat.org/publications/jse/v11n2/datasets.heinz.html

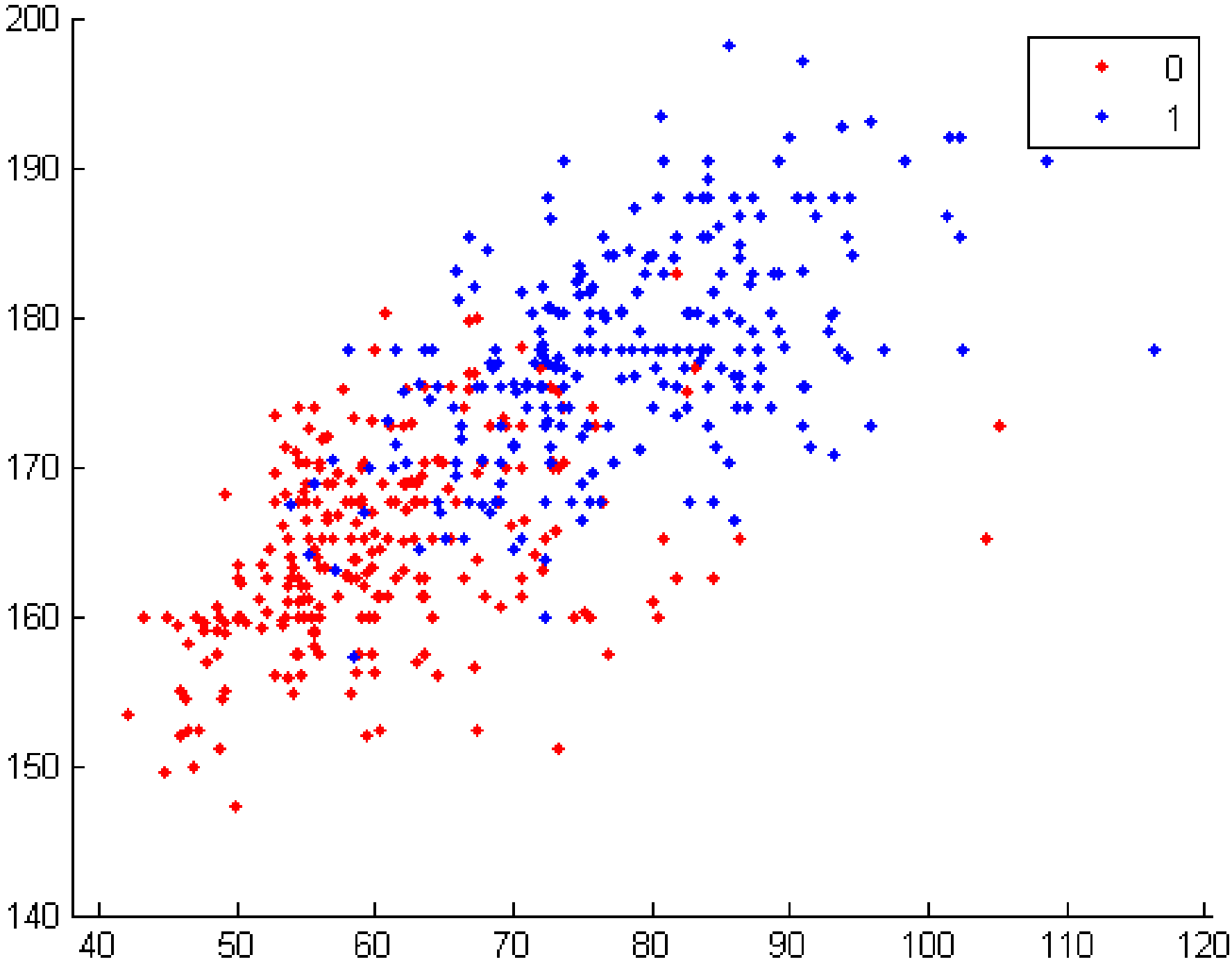
Matlab

```
scatter(body(:,23),body(:,23))
```


200
190
180
170
160
150
140
40
50
60
70
80
90
100
110
120

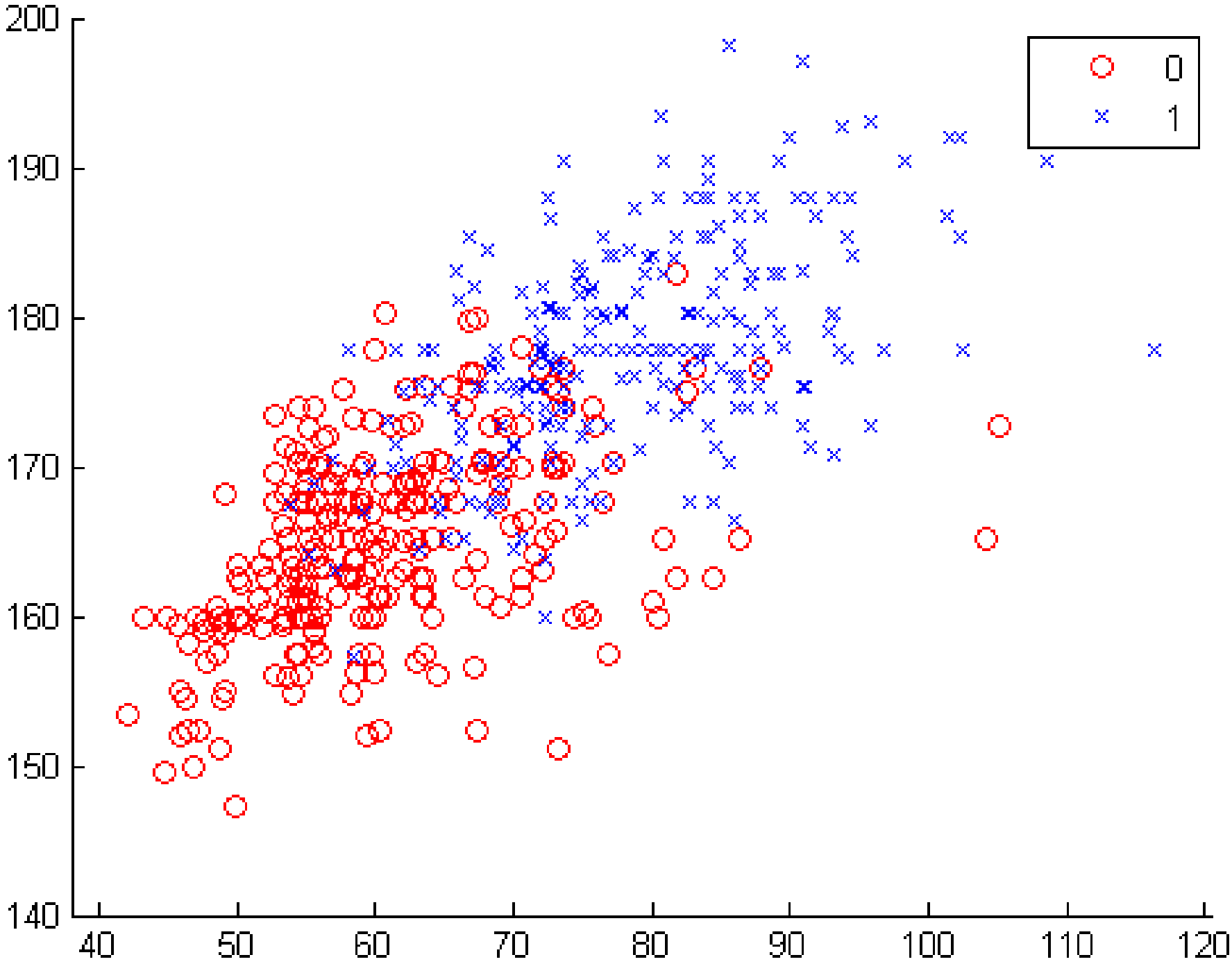
Matlab

```
scatter(body(:,23),body(:,23))
gscatter(body(:,23),body(:,24),gr,'rb')
```


200
190
180
170
160
150
140
40
50
60
70
80
90
100
110
120
0
1

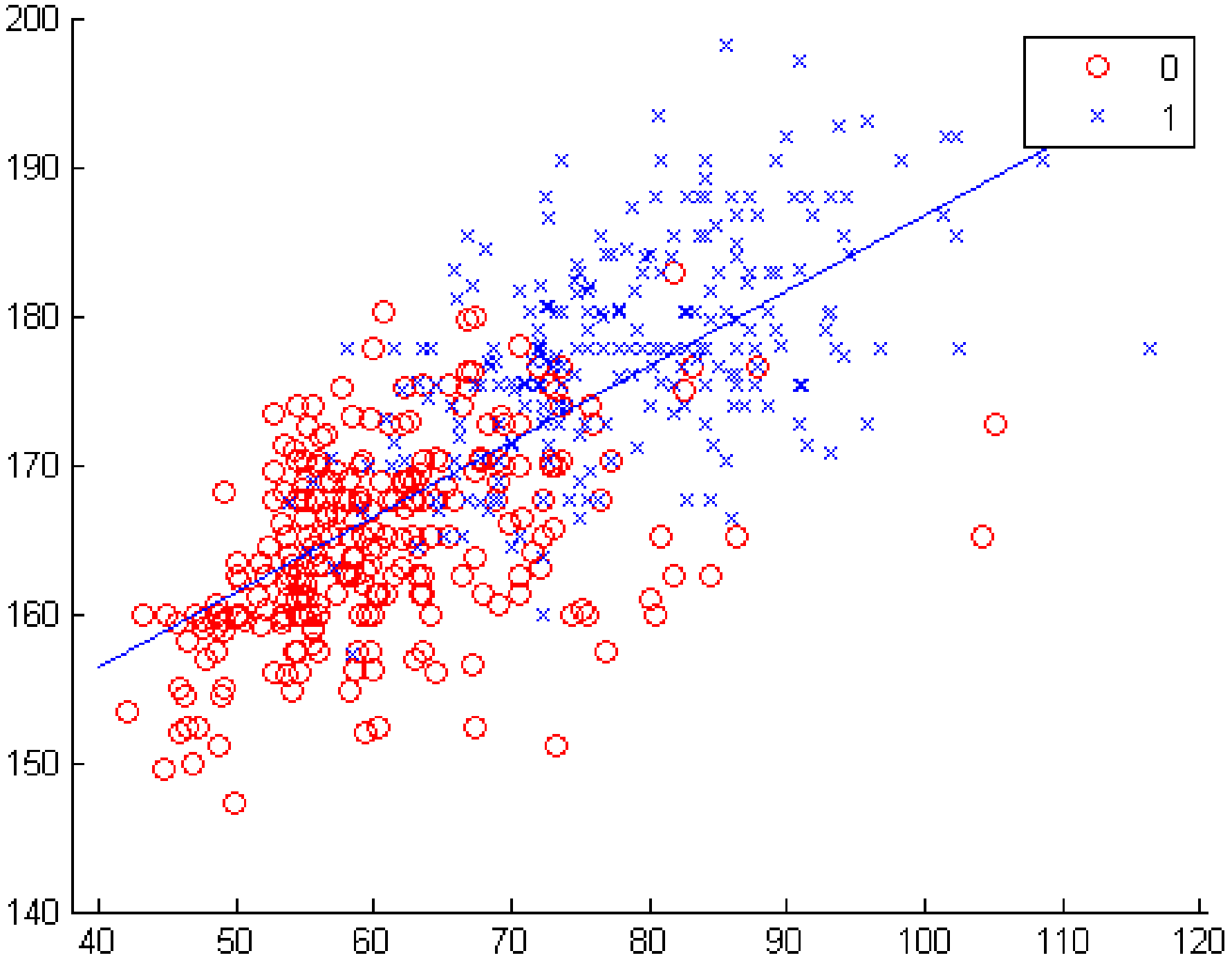
Matlab

```
scatter(body(:,23),body(:,23))
gscatter(body(:,23),body(:,24),gr,'rb')
gscatter(body(:,23),body(:,24),gr,'rb‘, 'ox')
```


200
190
180
170
160
150
140
40
50
60
70
80
90
100
110
120
0
1

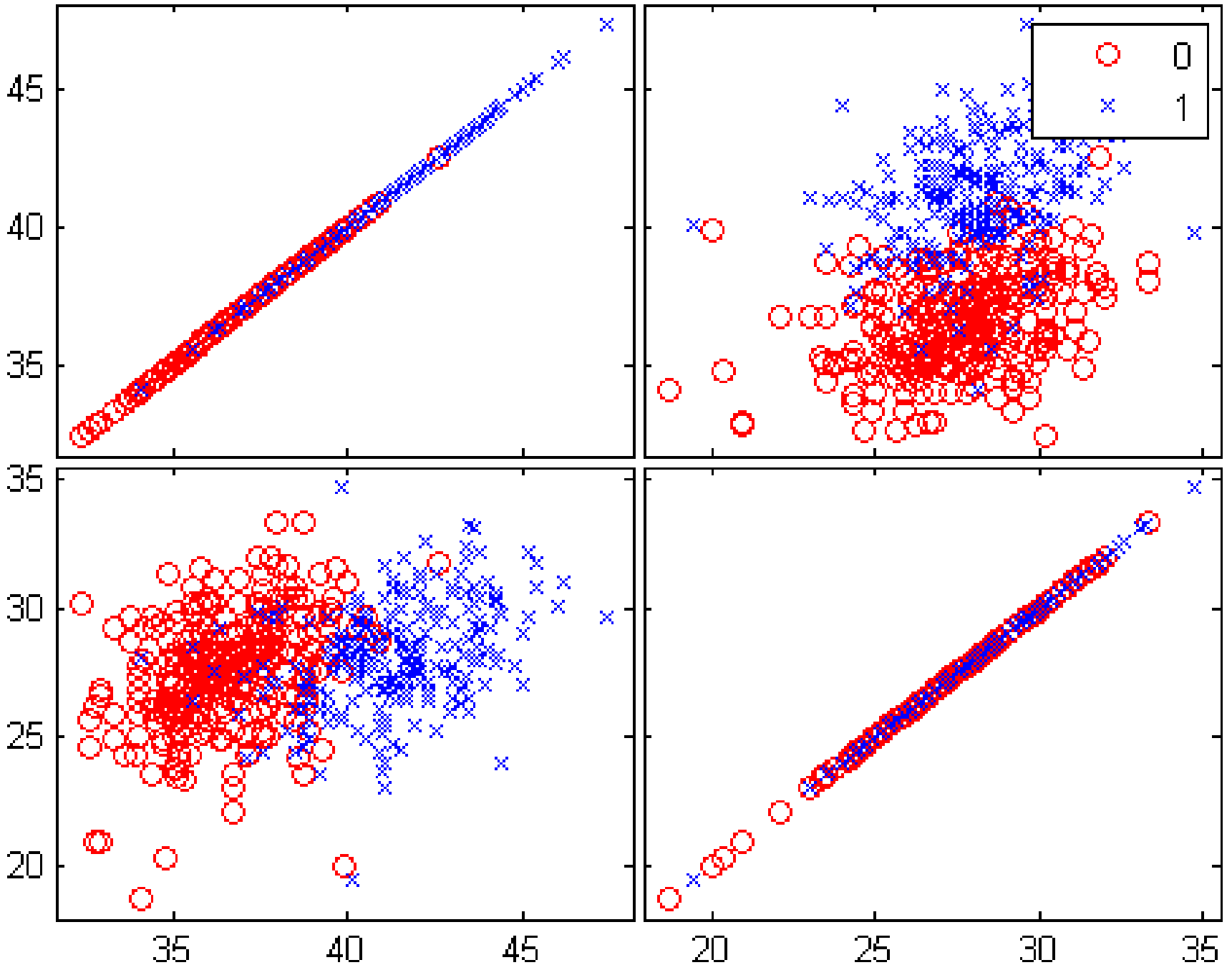
Matlab

```
scatter(body(:,23),body(:,23))
gscatter(body(:,23),body(:,24),gr,'rb')
gscatter(body(:,23),body(:,24),gr,'rb‘, 'ox')
polyfit(body(:,23),body(:,24),1)
ans =

0.5056  136.1819
y=ans * x
y =
156.4064  191.7993
line(x(1,:),y)
```


200
190
180
170
160
150
140
40
50
60
70
80
90
100
110
120
0
1

Matlab

```
gplotmatrix(body(:,[1 2]),body(:,[1
2]),gr,'rb','ox')
```

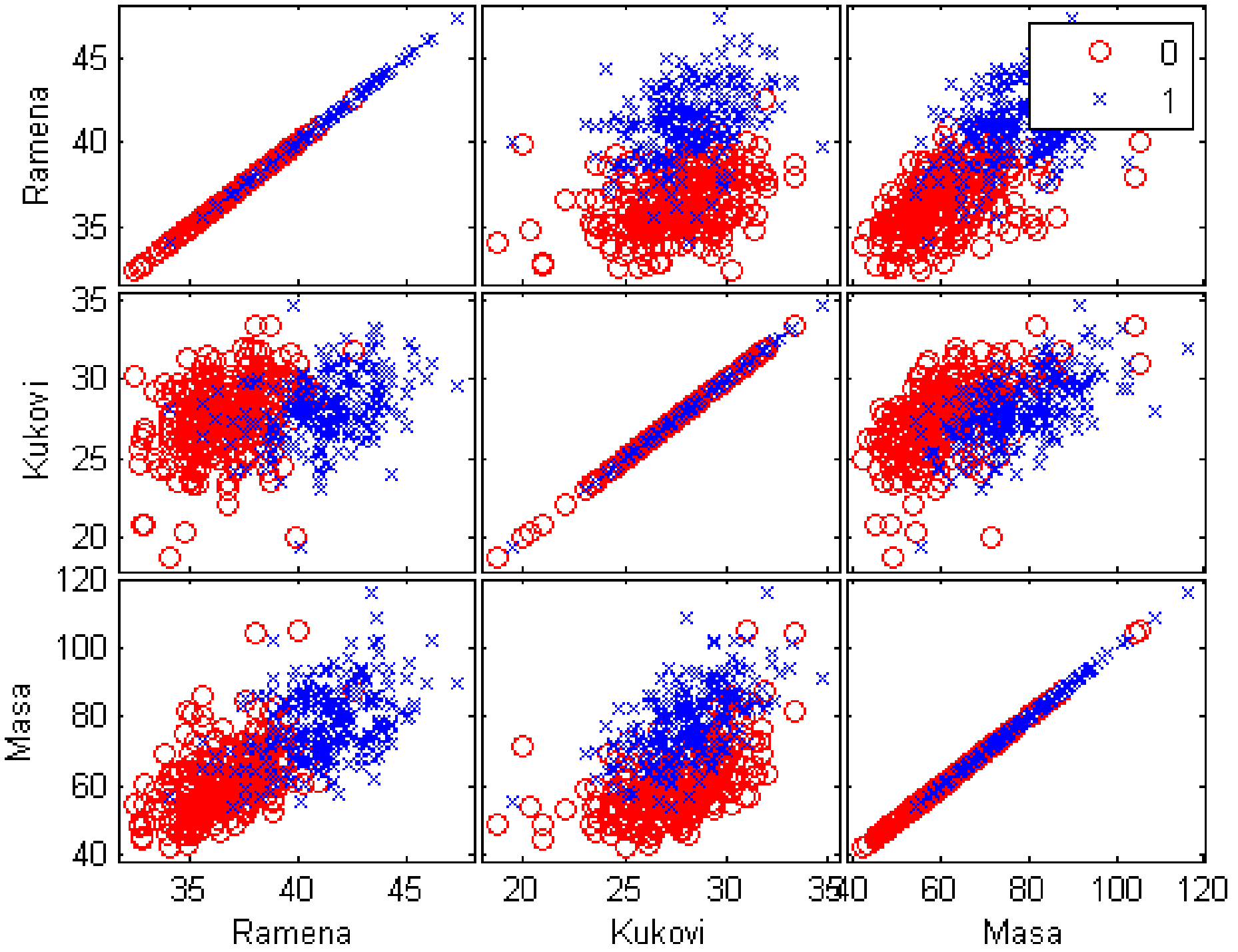

0
1
45
40
35
35
30
25
20
35
40
45
20
25
30
35

Matlab

```
gplotmatrix(body(:,[1 2 23]),body(:,[1 2
23]),gr,'rb','ox',[],'on','',
{'Ramena','Kukovi','Masa'},
{'Ramena','Kukovi','Masa'})
```

- ***English version:***

```
gplotmatrix(body(:,[1 2 23]),body(:,[1 2
23]),gr,'rb','ox',[],'on','',
{'Shoulders','Hips','Weight'},
{'Shoulders','Hips','Weight'})
```


Ramena
Kukovi
Masa
0
1
35
40
45
20
25
30
35
40
60
80
100
120

Regression Analysis

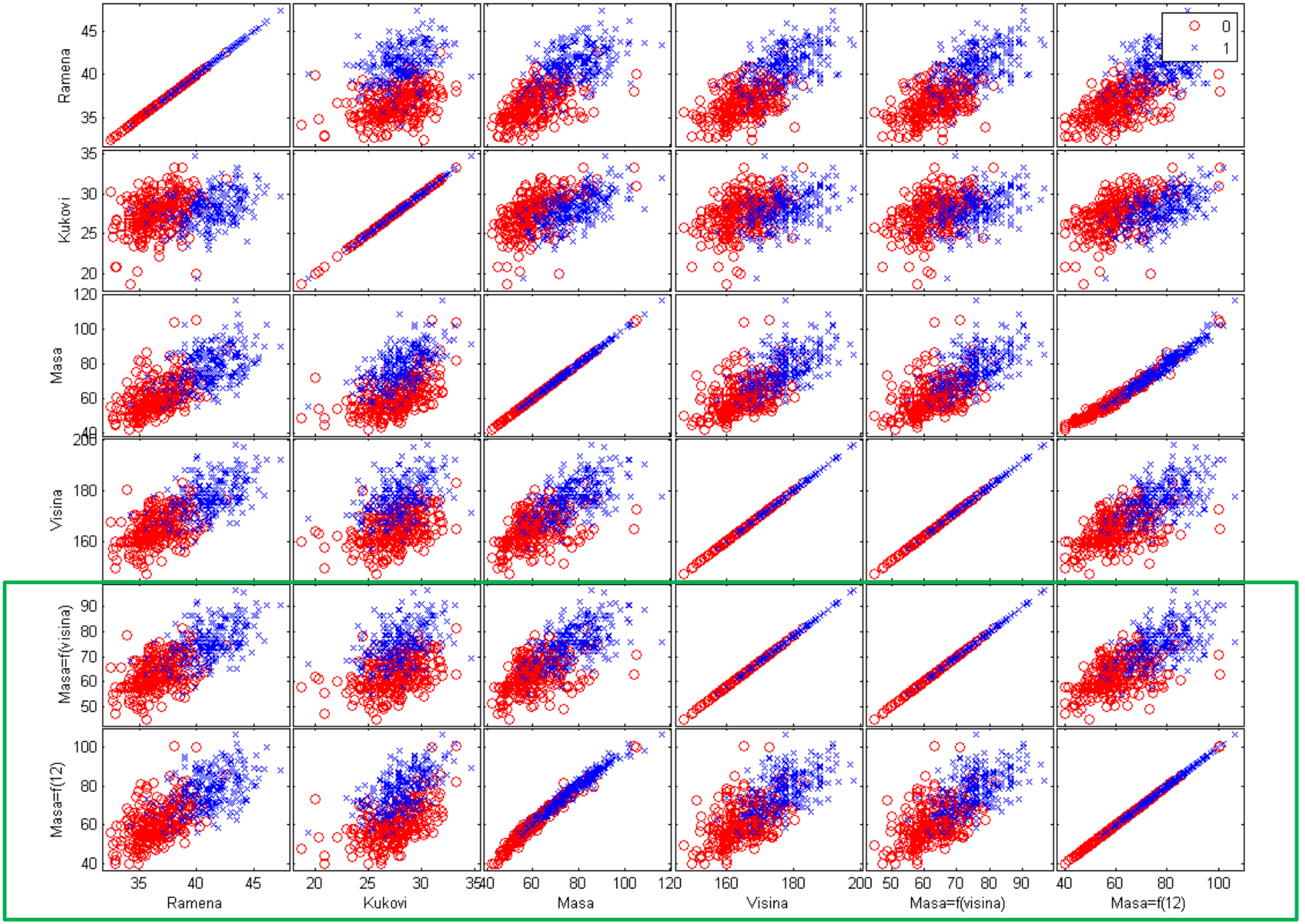
- The regression equation is:

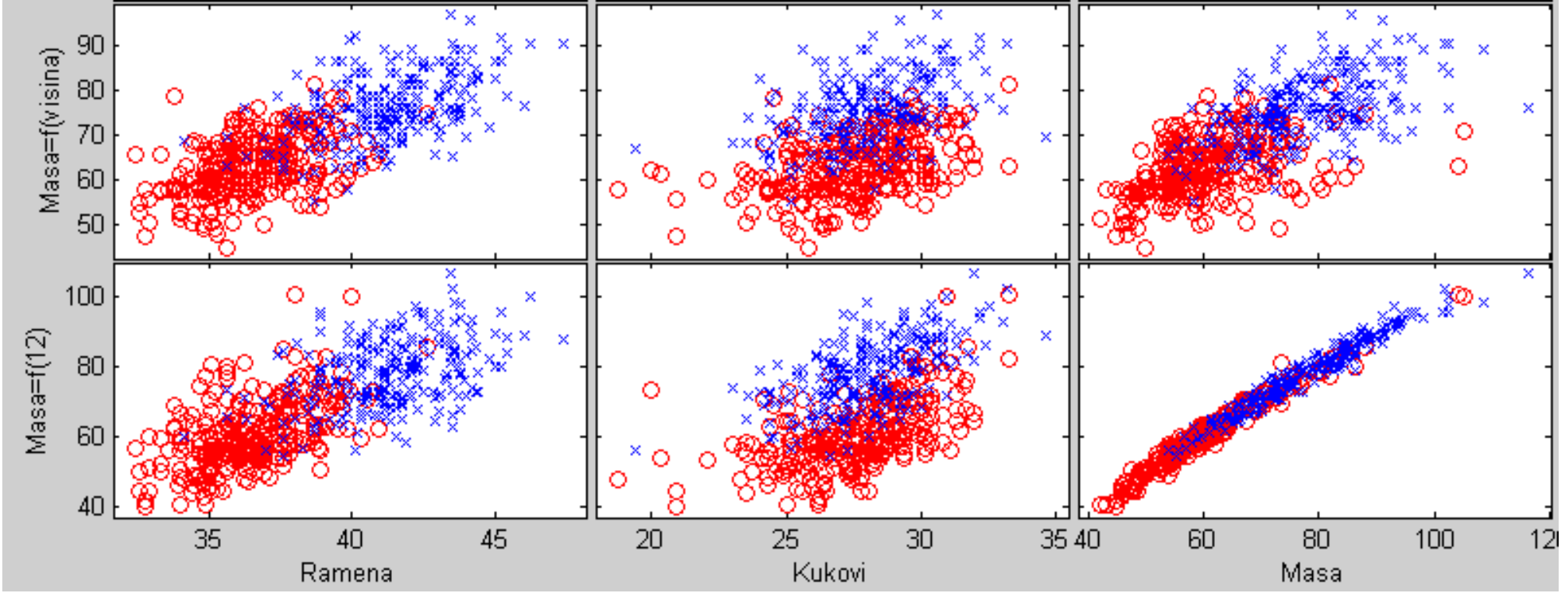
Weight (kg) = - 120 + 0.0781 Shoulder Girth + 0.198 Chest Girth
+ 0.340 Waist Girth + 0.0012 Navel Girth
+ 0.240 Hip Girth + 0.314 Thigh Girth + 0.0547 Flexed Bicep Girth
+ 0.532 Forearm Girth + 0.301 Knee Girth + 0.404 Calf Maximum Girth
- 0.0096 Ankle Minimum Girth - 0.118 Wrist Minimum Girth
+ 0.328 Height

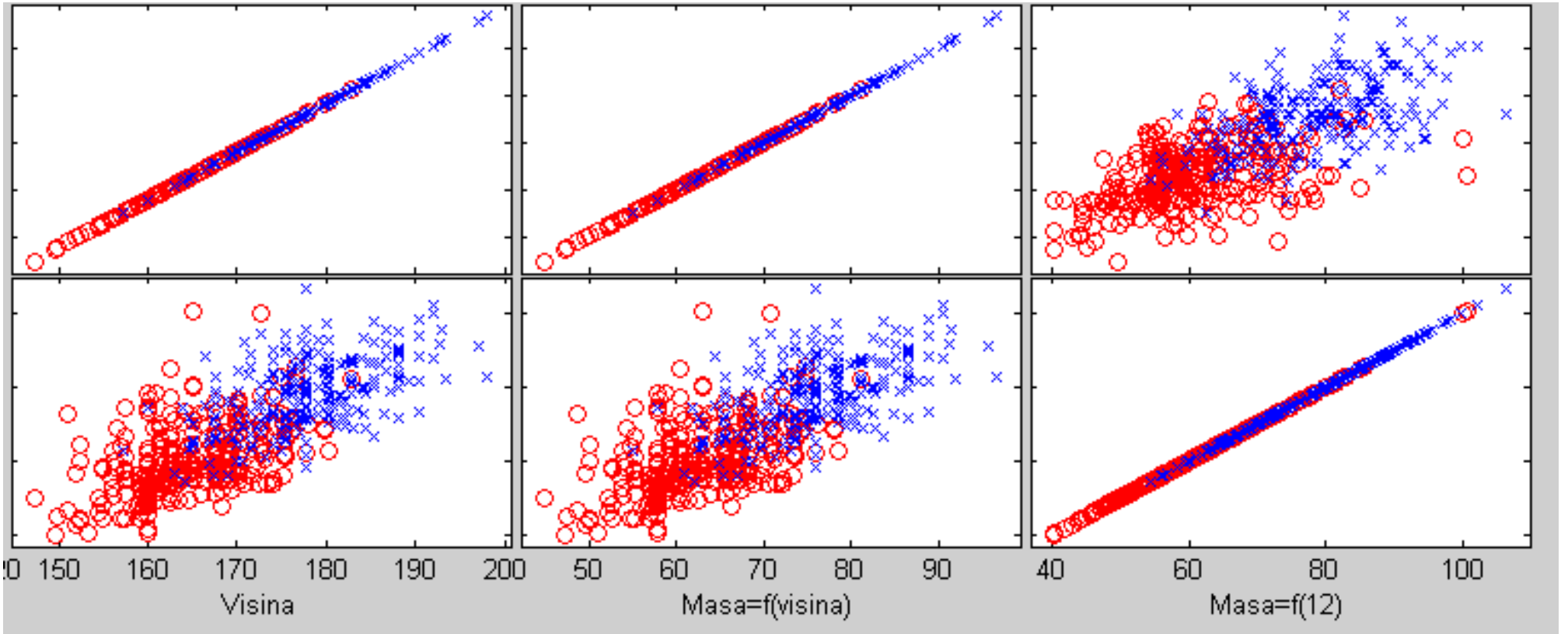
Regression Analysis

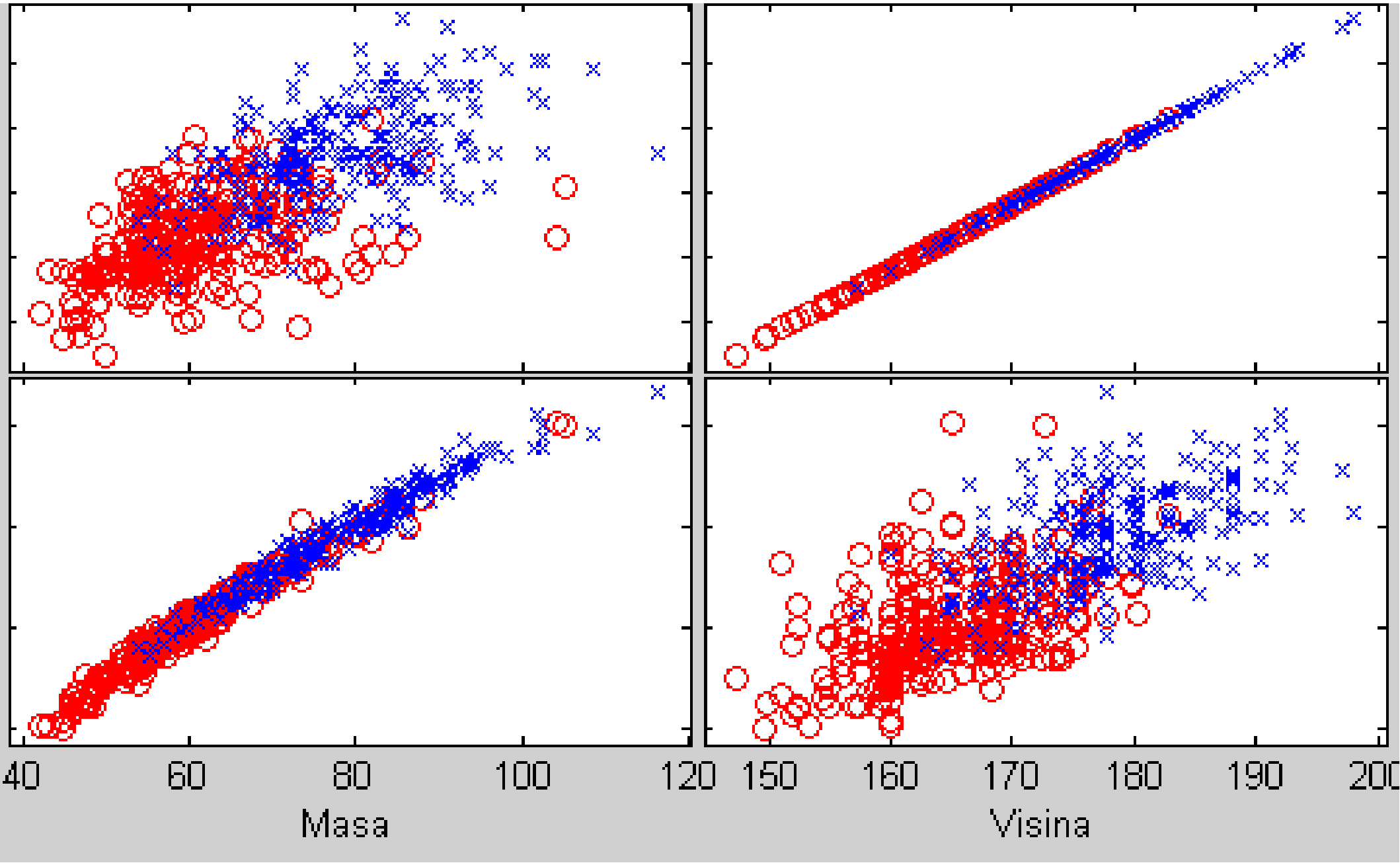
Predictor	Coef	StDev	T	P
Constant	-120.214	2.489	-48.31	0.000
Shoulder Girth	0.07813	0.02979	2.62	0.009
Chest Girth	0.19785	0.03569	5.54	0.000
Waist Girth	0.34042	0.02438	13.96	0.000
Navel Girth	0.00117	0.02291	0.05	0.959
Hip Girth	0.24040	0.04334	5.55	0.000
Thigh Girth	0.31414	0.05148	6.10	0.000
Flexed Bicep	0.05468	0.08526	0.64	0.522
Forearm Girth	0.5321	0.1371	3.88	0.000
Knee Girth	0.30126	0.07740	3.89	0.000
Calf Maximum	0.40387	0.07005	5.77	0.000
Ankle Minimum	-0.00963	0.09992	-0.10	0.923
Wrist Minimum	-0.1180	0.1959	-0.60	0.547
Height	0.32816	0.01560	21.03	0.000

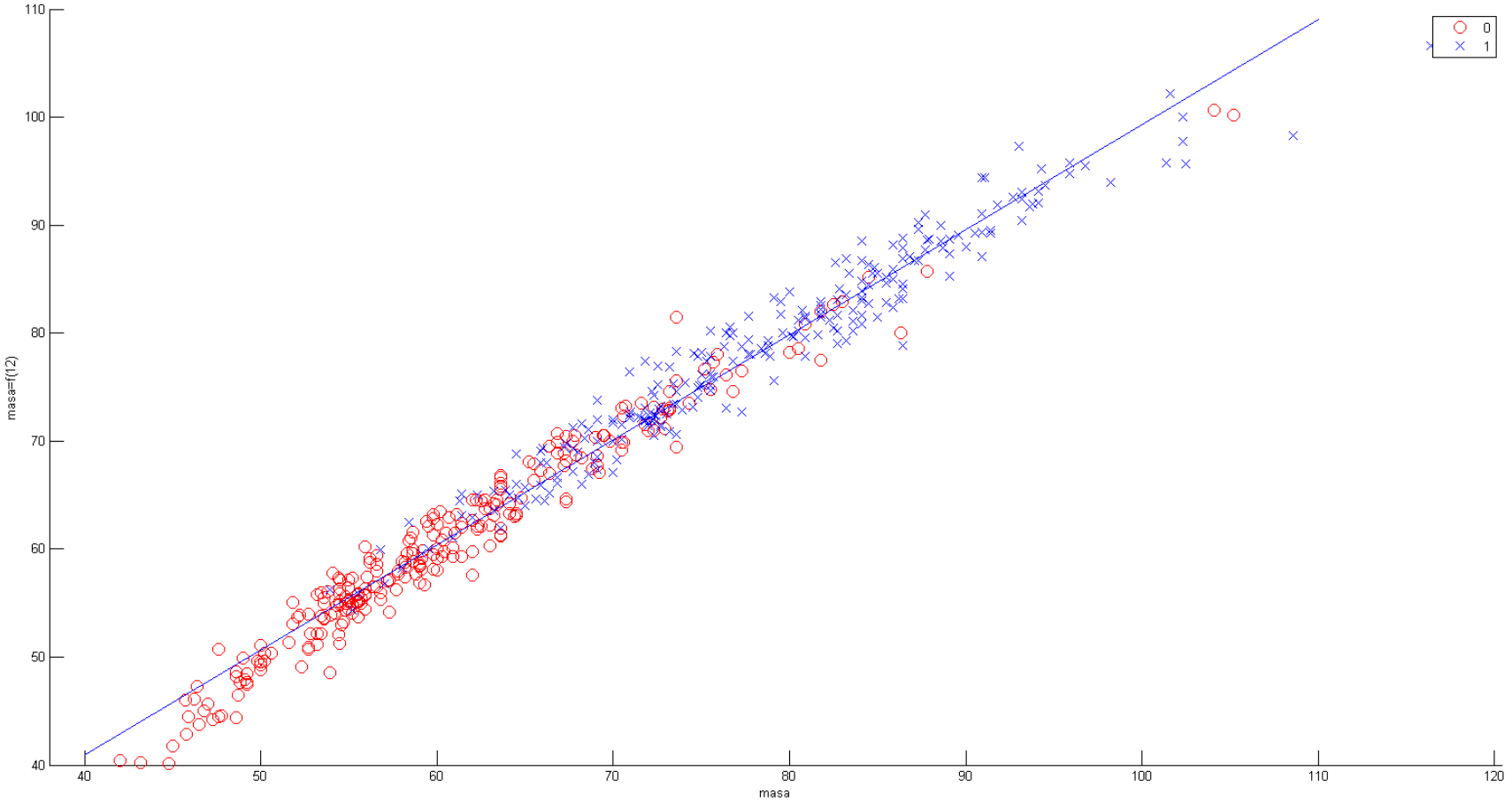
S = 2.204 R-Sq = 97.3% R-Sq(adj) = 97.3%


Ramena
Kukovi
Masa
Visina
Masa=f(visina)
Masa=f(12)
0
1


Masa=f(visina)
Masa=f(12)
Ramena
Kukovi
Masa


Visina
Masa=f(visina)
Masa=f(12)

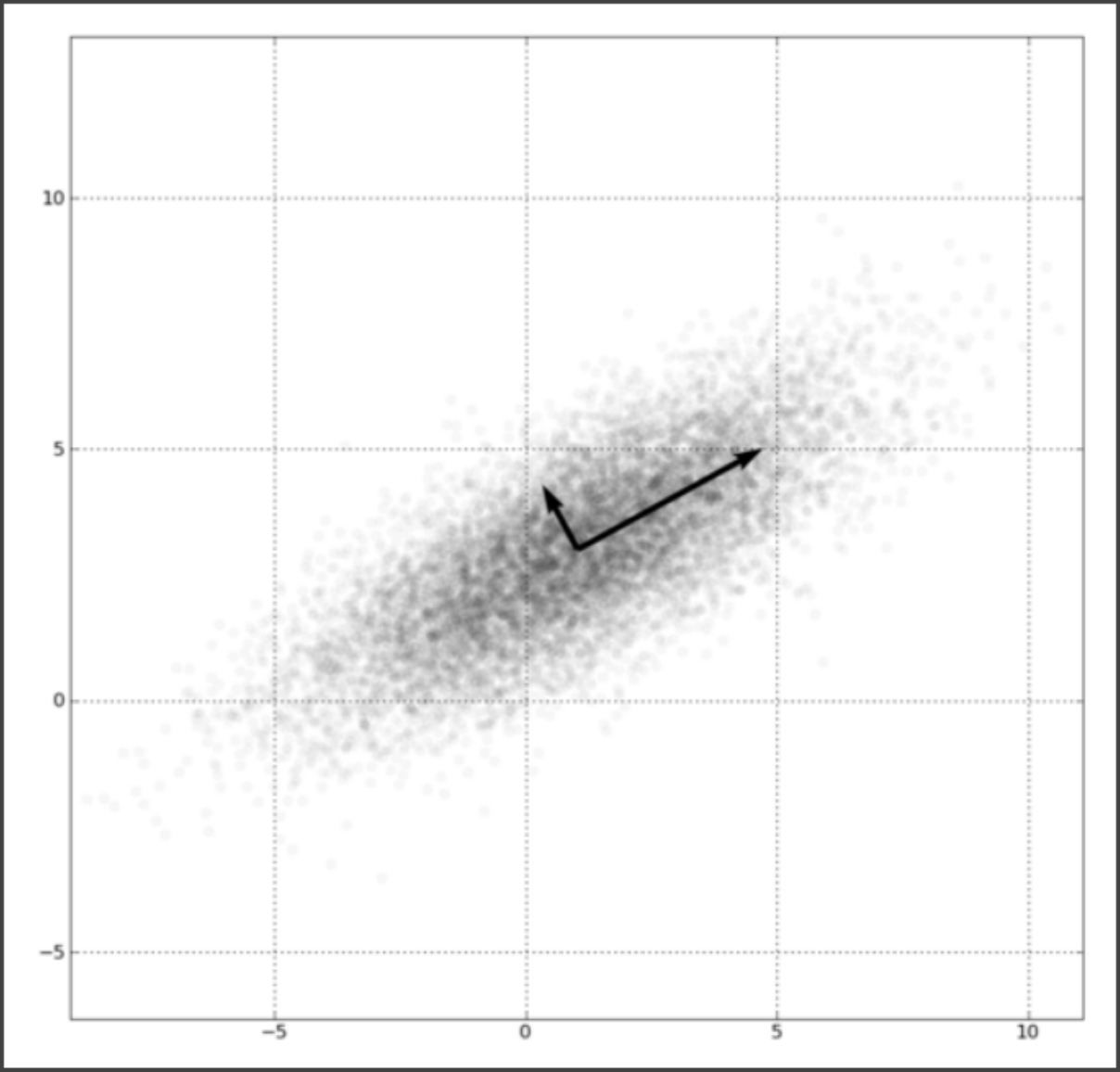

40
60
80
100
120
Masa
150
160
170
180
190
200
Visina


masa=f(12)
masa
0
1
110
100
90
80
70
60
50
40
40
50
60
70
80
90
100
110
120

Dimensionality reduction

- Feature selection
- Feature extraction

Principal Components Analysis



1. Mean-center the data.
2. Find ⊥ basis vectors that maximize the data variance.
3. Plot the data using the top vectors.

Data Exploration

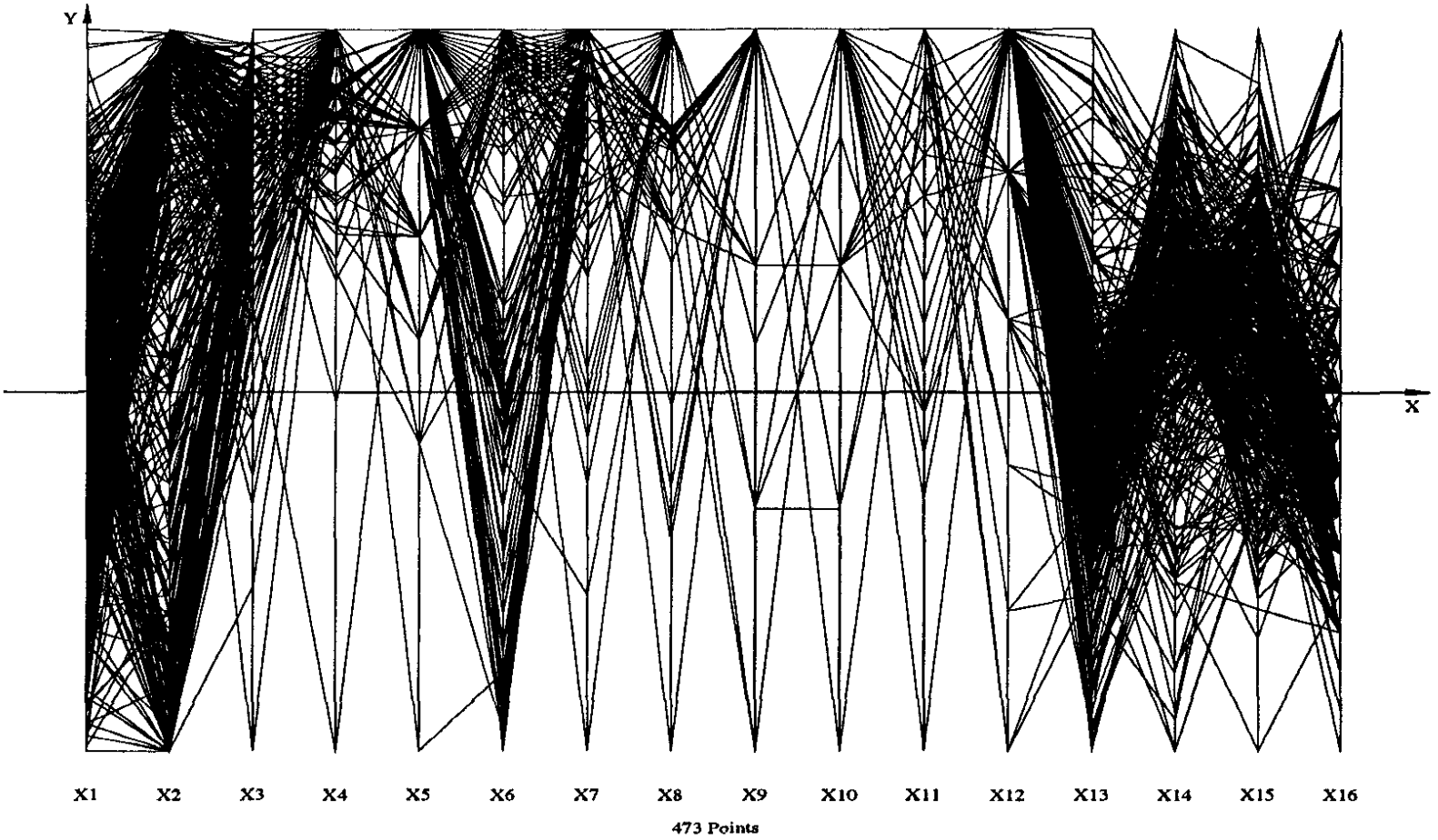


Figure 1: The full dataset consisting of 473 batches

The Multidimensional Detective (Alfred Ilsenberg)

- *„The display of multivariate datasets in parallel coordinates, transforms the search for relations among the variables into a 2-D pattern recognition problem.“*
- The Dataset:
- Production data for 473 batches of a VLSI chip
  - 16 process parameters:
    - X1: The yield: % of produced chips that are useful
    - X2: The quality of the produced chips (speed)
    - X3 … X12: 10 types of defects (zero defects shown at top)
    - X13 … X16: 4 physical parameters
- The Objective:
  - Raise the yield (X1) and maintain high quality (X2)

Production data for 473 batches of a VLSI chip

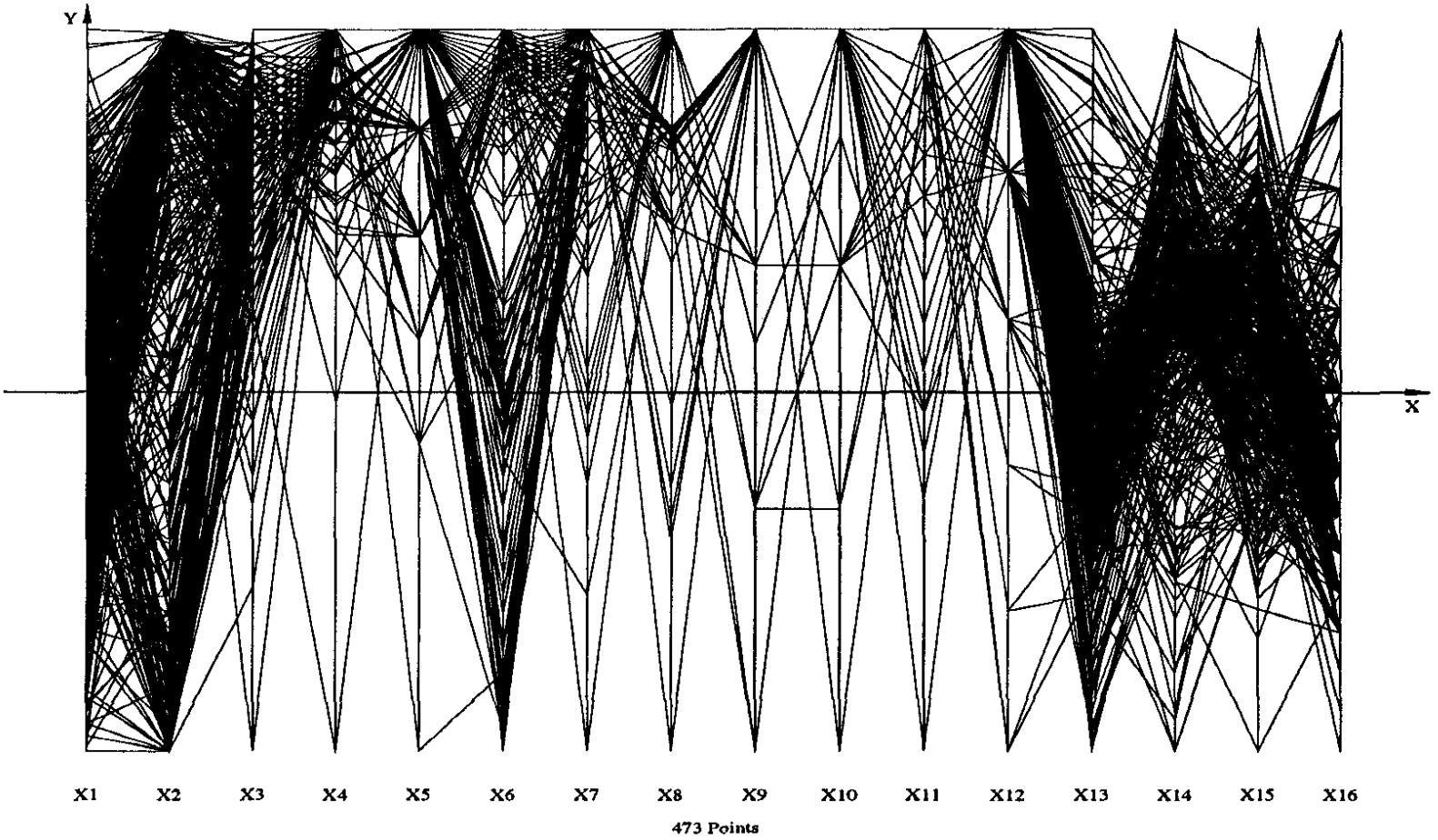


Figure 1: The full dataset consisting of 473 batches

Filtering – searching for high value of x1 and x2

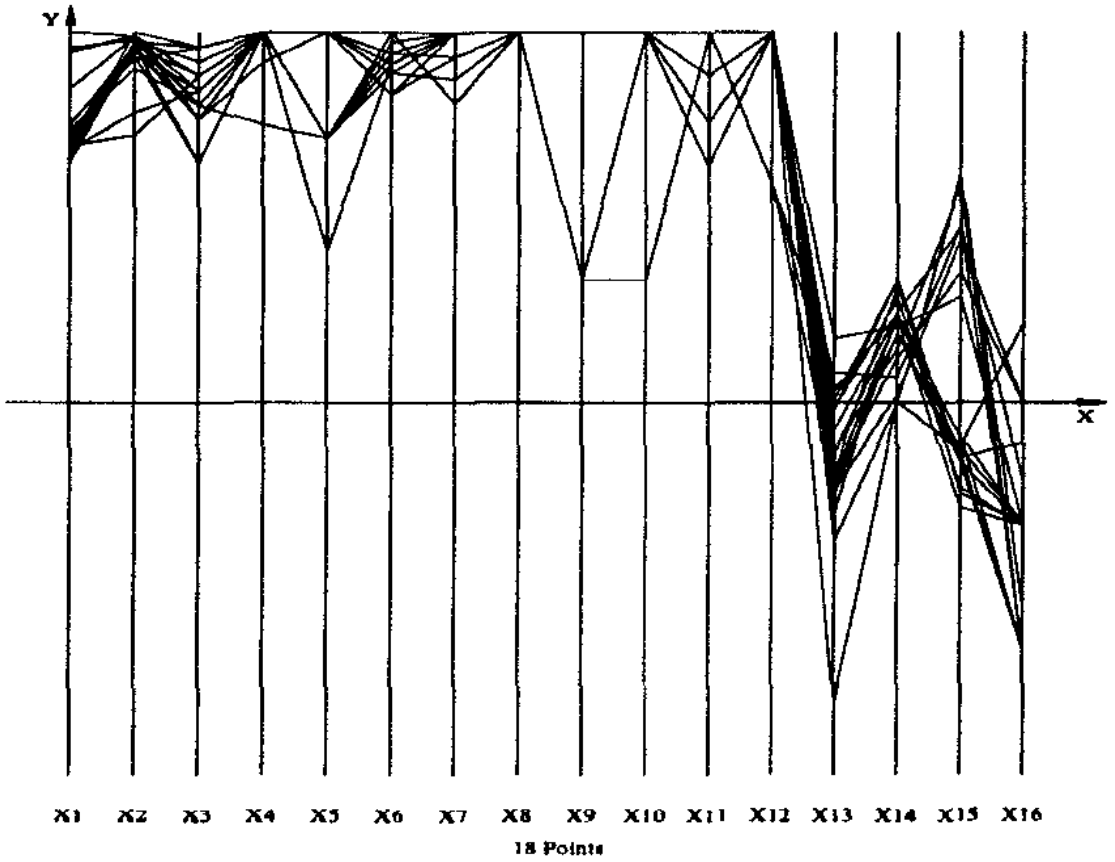


Figure 2: The batches high in Yield, $X1$, and Quality, $X2$.

Without the deffect batches (9/10)

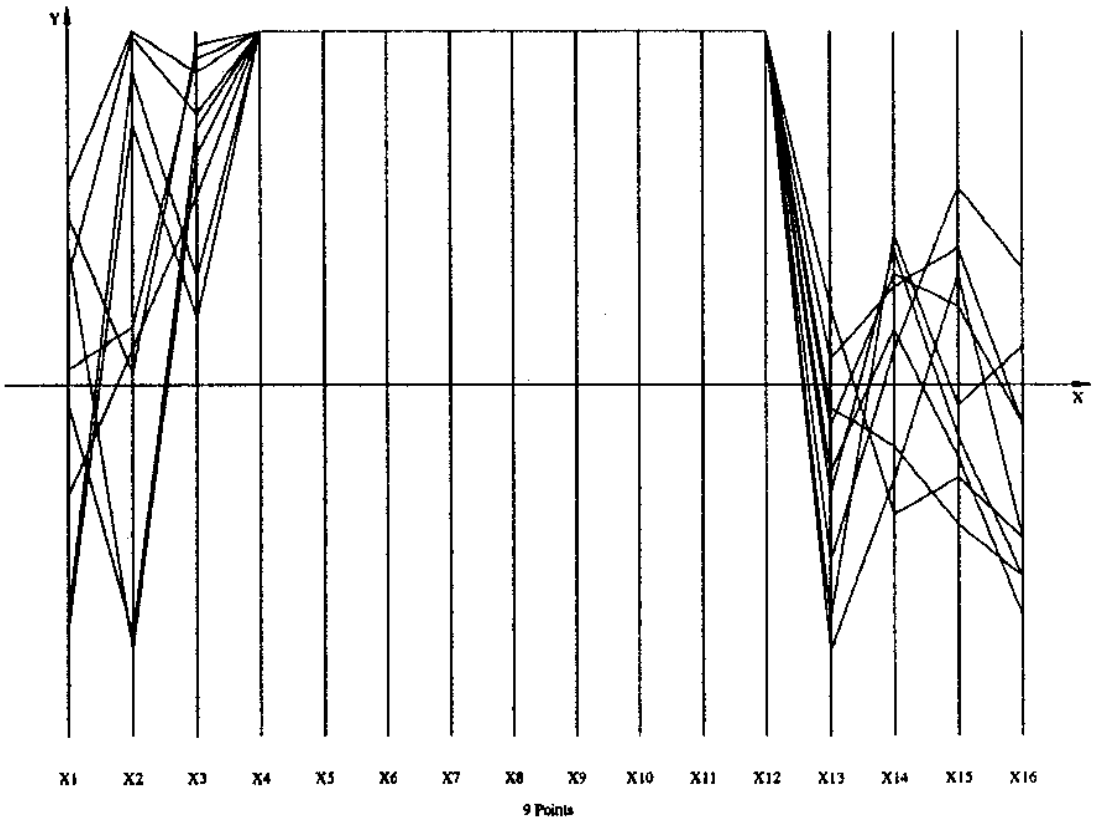


Figure 3: The batches with zero in 9 out of the ten defect types.

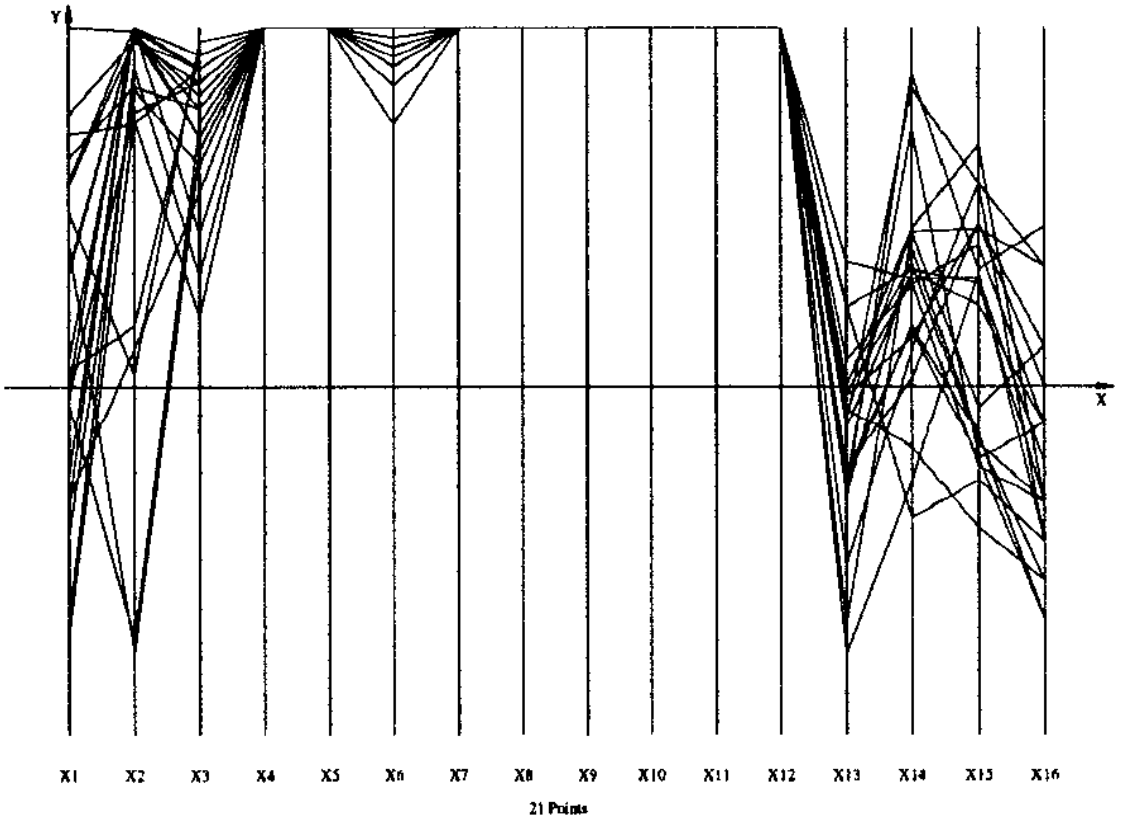


Figure 4: The batches with zero in 8 out of the ten defect types.

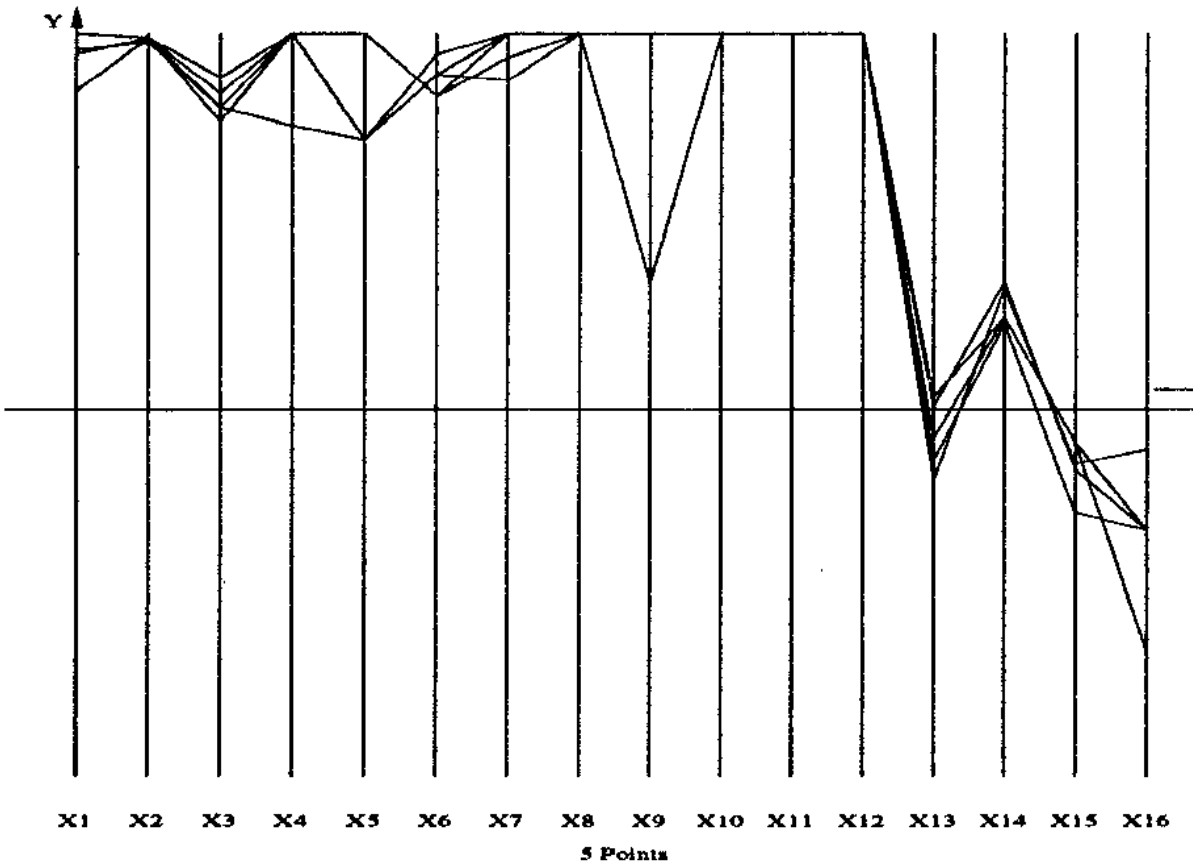


Figure 6: Batches with the highest Yields do not have the lowest defects in $X3$ and $X6$.

Bureau of Justice Statistics - Data Online
http://bjs.ojp.usdoj.gov/

Reported crime in Alabama

Year	Population	Property crime rate	Burglary rate	Larceny-theft rate	Motor vehicle theft rate
2004	4525375	4029.3	987	2732.4	309.9
2005	4548327	3900	955.8	2656	289
2006	4599030	3937	968.9	2645.1	322.9
2007	4627851	3974.9	980.2	2687	307.7
2008	4661900	4081.9	1080.7	2712.6	288.6

Reported crime in Alaska

Year	Population	Property crime rate	Burglary rate	Larceny-theft rate	Motor vehicle theft rate
2004	657755	3370.9	573.6	2456.7	340.6
2005	663253	3615	622.8	2601	391
2006	670053	3582	615.2	2588.5	378.3
2007	683478	3373.9	538.9	2480	355.1
2008	686293	2928.3	470.9	2219.9	237.5

Reported crime in Arizona

Year	Population	Property crime rate	Burglary rate	Larceny-theft rate	Motor vehicle theft rate
2004	5739879	5073.3	991	3118.7	963.5
2005	5953007	4827	946.2	2958	922
2006	6166318	4741.6	953	2874.1	914.4
2007	6338755	4502.6	935.4	2780.5	786.7
2008	6500180	4087.3	894.2	2605.3	587.8

Reported crime in Arkansas

Year	Population	Property crime rate	Burglary rate	Larceny-theft rate	Motor vehicle theft rate
2004	2750000	4033.1	1096.4	2699.7	237
2005	2775708	4068	1085.1	2720	262
2006	2810872	4021.6	1154.4	2596.7	270.4
2007	2834797	3945.5	1124.4	2574.6	246.5
2008	2855390	3843.7	1182.7	2433.4	227.6

Reported crime in California

Year	Population	Property crime rate	Burglary rate	Larceny-theft rate	Motor vehicle theft rate
2004	35842038	3423.9	686.1	2033.1	704.8
2005	36154147	3321	692.9	1915	712
2006	36457549	3175.2	676.9	1831.5	666.8
2007	36553215	3032.6	648.4	1784.1	600.2
2008	36756666	2940.3	646.8	1769.8	523.8

Reported crime in Colorado

Year	Population	Property crime rate	Burglary rate	Larceny-theft rate	Motor vehicle theft rate
2004	4601821	3918.5	717.3	2679.5	521.6

Wrangler: Interactive Visual Specification of Data Transformation Scripts

blog wrangle feedback

DataWrangler alpha

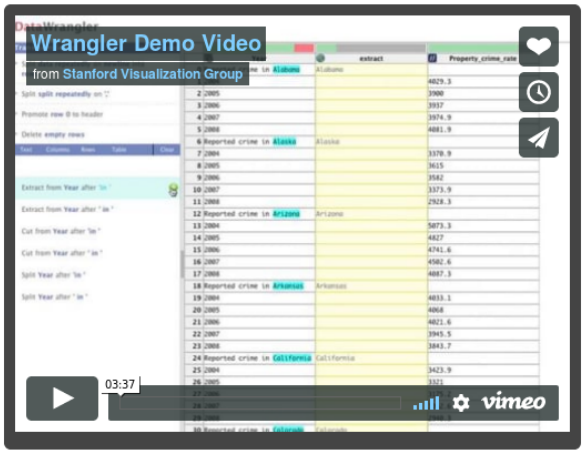
Wrangler is an interactive tool for data cleaning and transformation.
Spend less time formatting and more time analyzing your data.

UPDATE: The Stanford/Berkeley Wrangler research project is complete, and the software is no longer actively supported. Instead, we have started a commercial venture, Trifacta. For the most recent version of the tool, see the free Trifacta Wrangler.

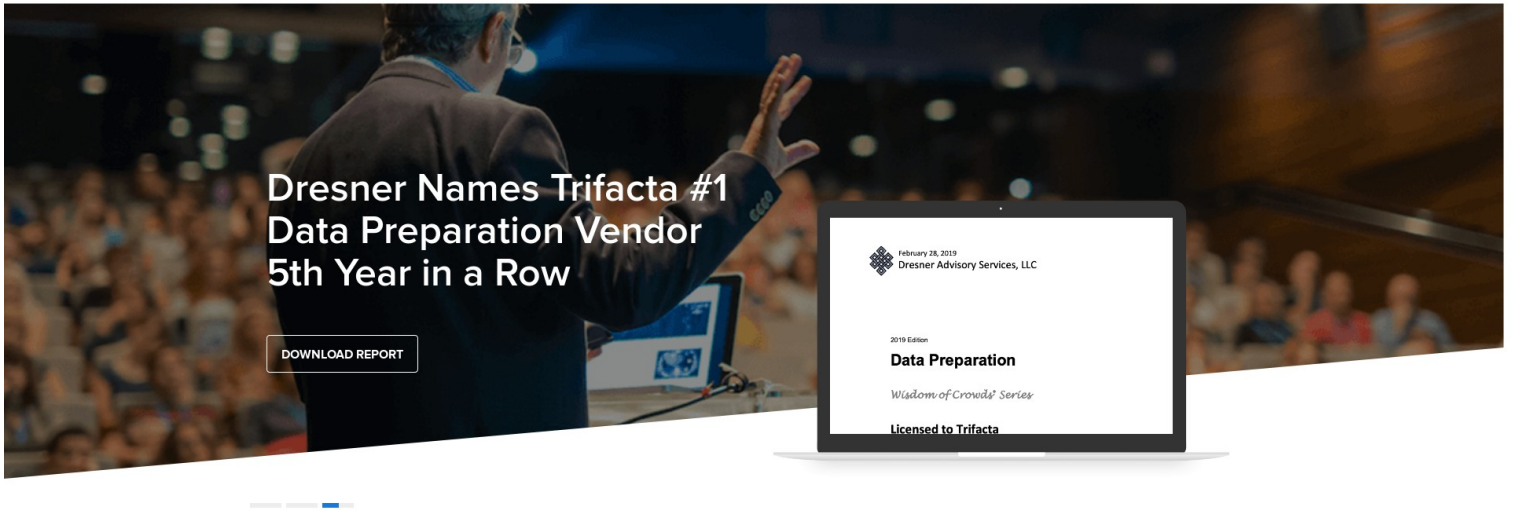
Why wrangle?

- Too much time is spent manipulating data just to get analysis and visualization tools to read it. Wrangler is designed to accelerate this process: spend less time fighting with your data and more time learning from it.
- Wrangler allows interactive transformation of messy, real-world data into the data tables analysis tools expect. Export data for use in Excel, R, Tableau, Protovis, ...
- Want to learn more about Wrangler's design? Take a look at our research paper.
- Wrangler is still a work-in-progress. Please share your feedback and feature requests!

TRY IT NOW



[Sean Kandel et al. CHI'11]
http://vis.stanford.edu/wrangler/



Thousands of Companies Wrangle with Trifacta

Here is the value they are creating

Reduce the complexity of working with data	Accelerate time-to-analysis for your teams	Align IT and business teams around data and analytics	Discover new patterns & unexpected opportunities to drive success
NationBuilder	Deutsche Börse Group	Malwarebytes	gsk
wrangles **voter registration data**	wrangles **stock exchange data**	wrangles **marketing data**	wrangles **disease clinical trial data**

SEE ALL CUSTOMERS

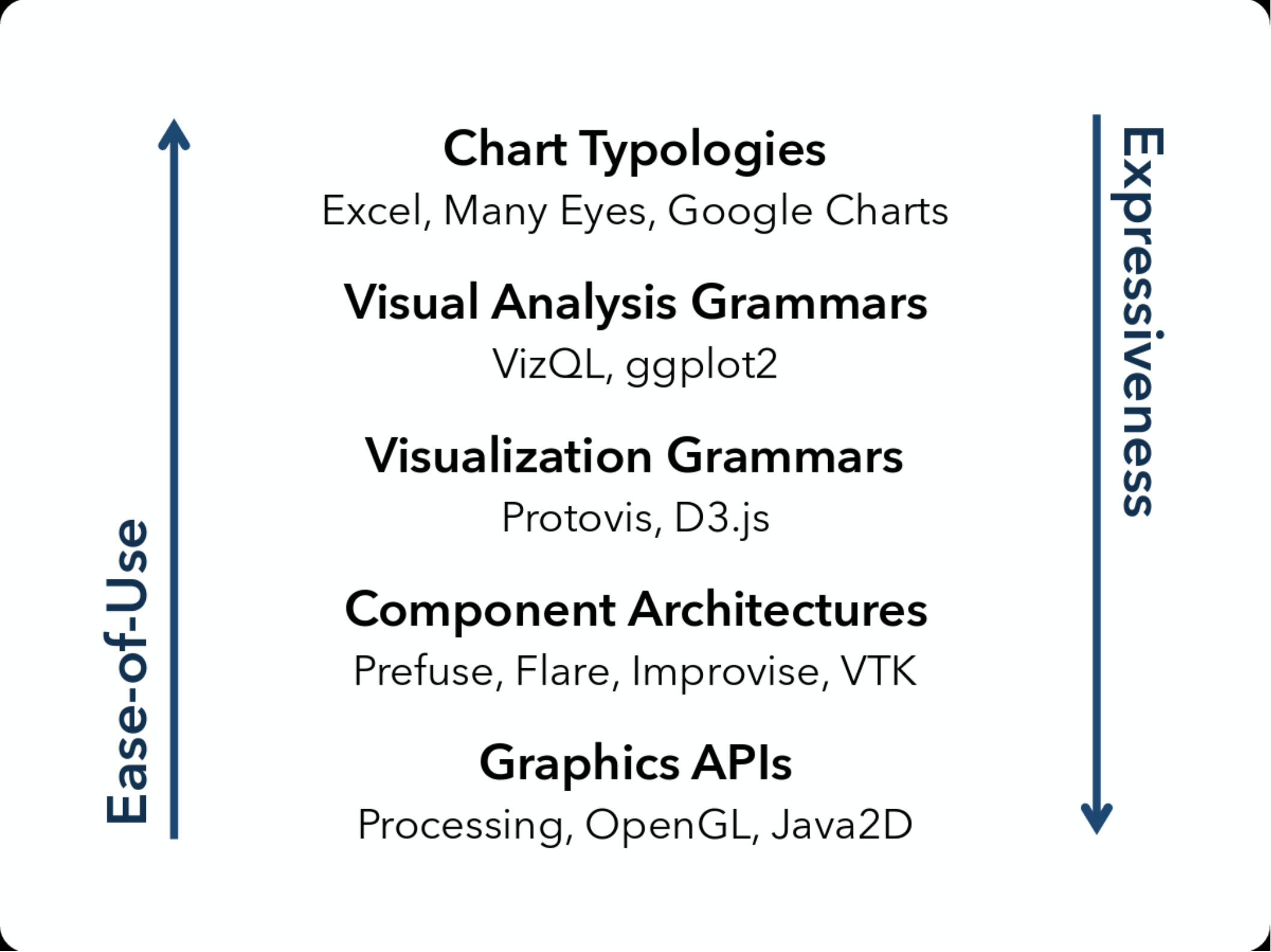
Data Preparation: An Enterprise Imperative

Our ability to solve big problems depends on seeing patterns in the data we collect. But data today comes in many shapes and sizes—and it's changing all the time.

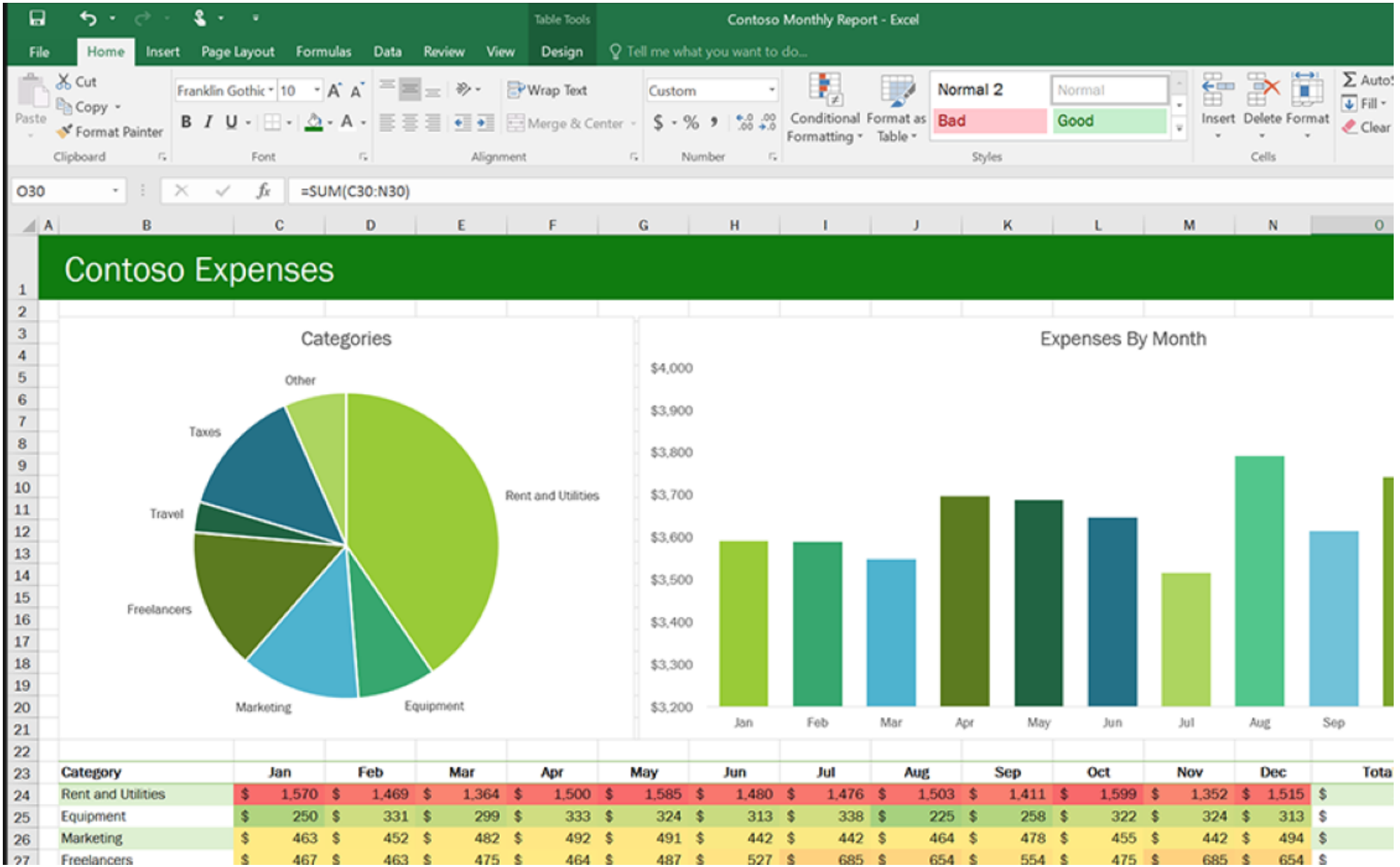
Too often, the messy process of pulling it together prevents us from uncovering patterns and realizing untapped potential.

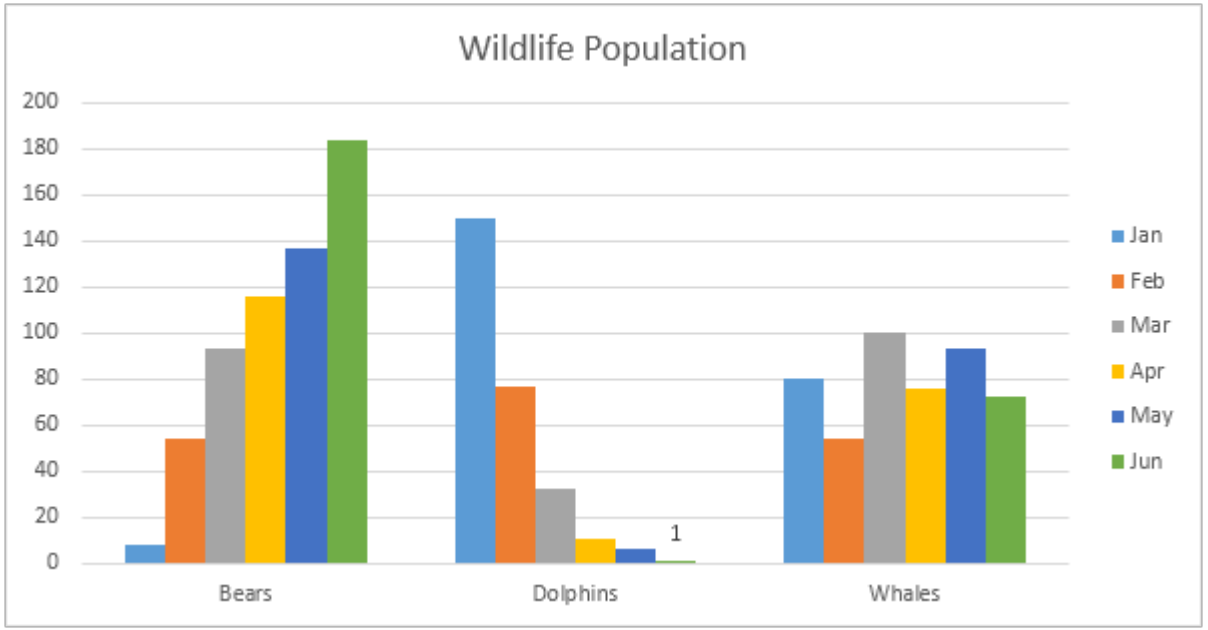
LEARN MORE

SCHEDULE A DEMO


Ease-of-Use
Chart Typologies
Excel, Many Eyes, Google Charts
Visual Analysis Grammars
VizQL, ggplot2
Visualization Grammars
Protovis, D3.js
Component Architectures
Prefuse, Flare, Improvise, VTK
Graphics APIs
Processing, OpenGL, Java2D
Expressiveness

Excel


Contoso Monthly Report - Excel
File
Home
Insert
Page Layout
Formulas
Data
Review
View
Design
Tell me what you want to do...
Cut
Copy
Format Painter
Paste
Clipboard
Franklin Gothic
10
Font
Wrap Text
Merge & Center
Alignment
Custom
Number
Conditional Formatting
Format as Table
Normal 2
Normal
Bad
Good
Styles
Insert
Delete
Format
Cells
AutoSum
Fill
Clear
O30
=SUM(C30:N30)
Contoso Expenses
Categories
Other
Taxes
Travel
Freelancers
Marketing
Equipment
Rent and Utilities
Expenses By Month
$4,000
$3,900
$3,800
$3,700
$3,600
$3,500
$3,400
$3,300
$3,200
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Category
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Tota
Rent and Utilities
$ 1,570
$ 1,469
$ 1,364
$ 1,500
$ 1,585
$ 1,480
$ 1,476
$ 1,503
$ 1,411
$ 1,599
$ 1,352
$ 1,515
Equipment
$ 250
$ 331
$ 299
$ 333
$ 324
$ 313
$ 338
$ 225
$ 258
$ 322
$ 324
$ 313
Marketing
$ 463
$ 452
$ 482
$ 492
$ 491
$ 442
$ 442
$ 464
$ 478
$ 455
$ 442
$ 494
Freelancers
$ 467
$ 463
$ 475
$ 464
$ 487
$ 527
$ 685
$ 654
$ 554
$ 475
$ 685
$ 654


Wildlife Population
200
180
160
140
120
100
80
60
40
20
0
1
Bears
Dolphins
Whales
Jan
Feb
Mar
Apr
May
Jun

Many Eyes

An experiment brought to you by IBM Research and the IBM Cognos software group

Visualizations about 'social'

Subscribe

Showing search results tagged with: '**social**' View all »

Showing 1-30 of 470

Previous 1 2 3 4 5 6 7 8 9 ... 15 16 Next

Explore

Visualizations
Data sets
Comments
Topic centers
My stuff
My topic centers
My watchlist
My contributions
Messages to me

Participate

Create a visualization
Upload a data set
Create a topic center

Learn more

Quick start
Visualization types
Data format and style
About Many Eyes
FAQ
Blog

Contact us

Contact
Report a bug

Legal

Terms of use
Privacy

Sort by date | Sorted by rating

★ 6 1

Thursday June 28 2007, 03:53 PM
Social Network Monthly Visitors (April 2007)

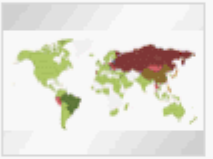
3

Tuesday June 2 2009, 03:42 PM
World Map of Social Networks (June 2009)

4 1

Tuesday June 12 2007, 11:33 PM
Ivan's friends

2

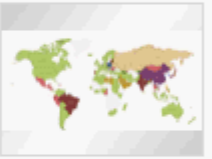


Friday December 18 2009, 04:33 AM
World Map of Social Networks (dec 2009) www.vincos.it

2

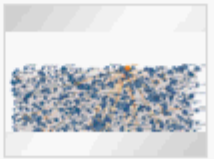
Monday December 17 2007, 10:23 AM
Social networks popularity world map

2



Tuesday June 2 2009, 05:37 PM
DISTRIBUCIÓN MUNDIAL DE LAS PRINCIPALES REDES SOCIALES EN JUNIO

1



Wednesday January 28 2009, 02:37 PM
Old New Testament Social Network

1

Saturday August 7 2010, 02:32 PM
Social Network Size by Registered Users

1

Wednesday May 19 2010, 01:44 PM
Social Media

1

Tuesday September 14 2010, 09:33 PM
When Baltimore Joined Twitter

1

Sunday November 14 2010, 08:54 PM
Restrição a redes sociais

1

Sunday May 31 2009, 04:44 AM
News Blogs Dominated By A Few Startups

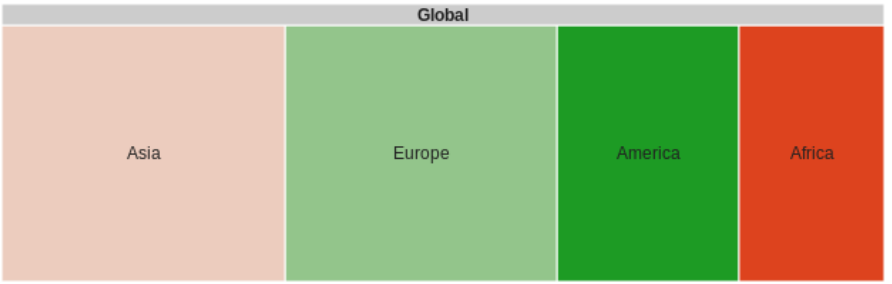
Display live data on your site

About Google chart tools

Google chart tools are powerful, simple to use, and free. Try out our rich gallery of interactive charts and data tools.

GET STARTED CHART GALLERY

Tree Map - view source



more

Rich Gallery

Choose from a variety of charts. From simple scatter plots to hierarchical treemaps, find the best fit for your data.

Customizable

Make the charts your own. Configure an extensive set of options to perfectly match the look and feel of your website.

HTML5 / SVG

Cross-browser compatibility (adopting VML for older IE versions) and cross-platform portability to iOS and new Android releases. No plugins are needed.

Free

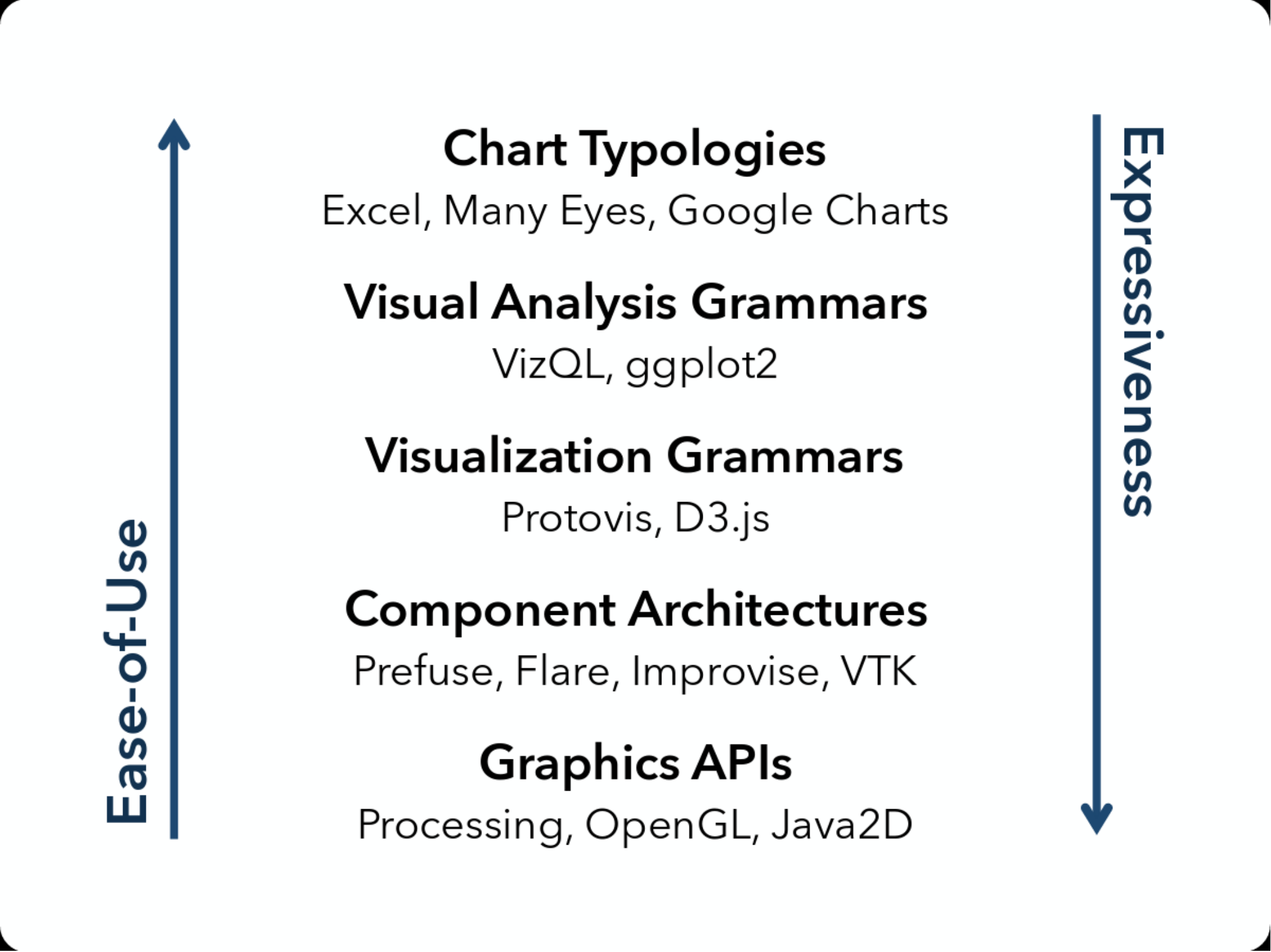
Use the same chart tools Google uses, completely free and with three years' backward compatibility guaranteed.

Controls and Dashboards

Easily connect charts and controls into an interactive dashboard.

Dynamic Data

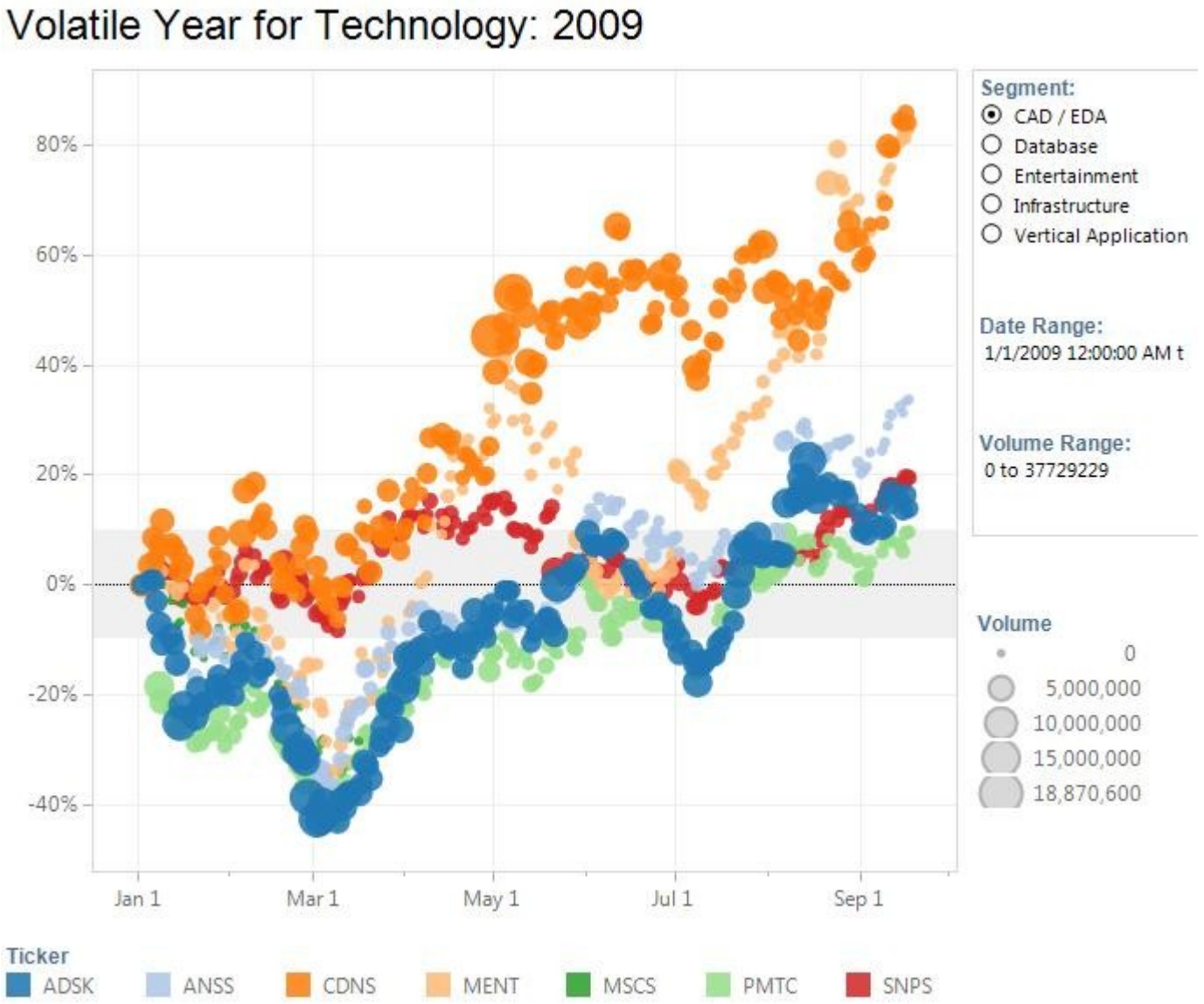
Connect to your data in real time using a variety of data connection tools and protocols.


Ease-of-Use
Chart Typologies
Excel, Many Eyes, Google Charts
Visual Analysis Grammars
VizQL, ggplot2
Visualization Grammars
Protovis, D3.js
Component Architectures
Prefuse, Flare, Improvise, VTK
Graphics APIs
Processing, OpenGL, Java2D
Expressiveness

VizQL™ (Tableau)

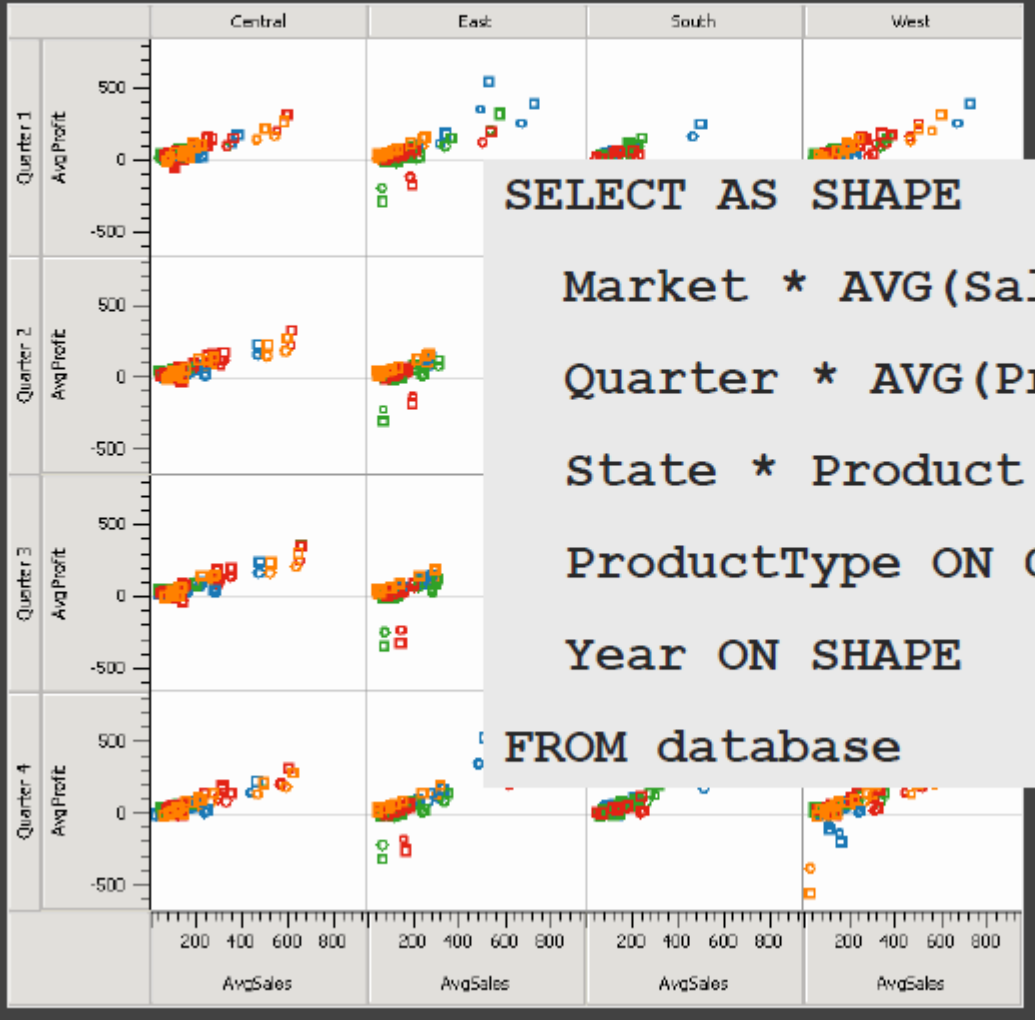
- *Natively visual and therefore faster*
- *At the heart of Tableau is a proprietary technology that makes interactive data visualization an integral part of understanding data.*
- *A traditional analysis tool forces you to analyze data in rows and columns, choose a subset of your data to present, organize that data into a table, then create a chart from that table.*
- *VizQL skips those steps and creates a visual representation of your data right away, giving you visual feedback as you analyze.*
- *As a result you get a much deeper understanding of your data and can work much faster than conventional methods–up to 100 times faster.*

VizQL™ (Tableau)



VizQL™ (Tableau)

Visual Query Language (VizQL)




```
SELECT AS SHAPE
   Market * AVG(Sales) ON COLS
   Quarter * AVG(Profit) ON ROWS
   State * Product IN PANES
   ProductType ON COLOR
   Year ON SHAPE
FROM database
```

ggplot2

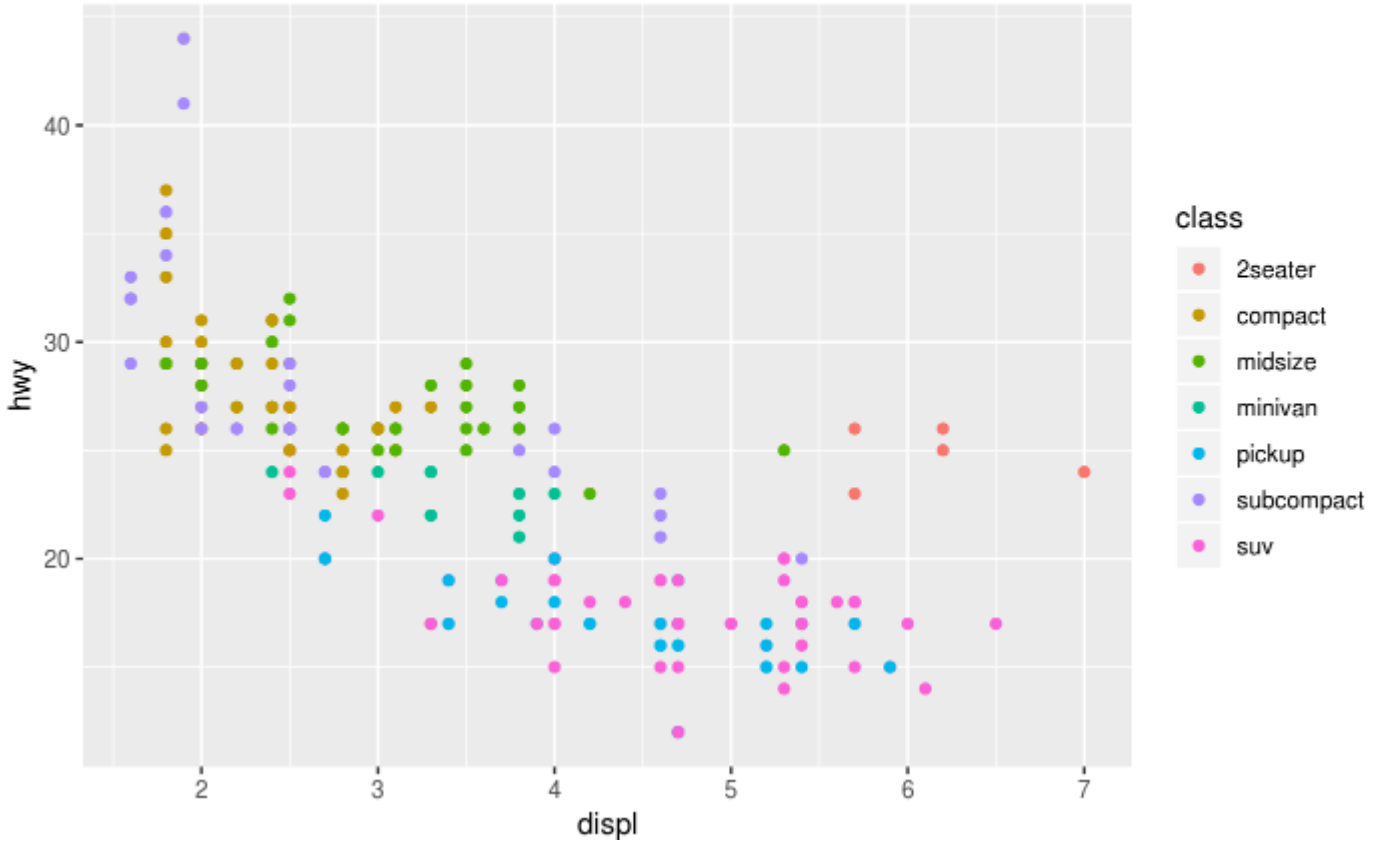
- *ggplot2 is a system for declaratively creating graphics, based on The Grammar of Graphics.*
- *You provide the data, tell ggplot2 how to map variables to aesthetics, what graphical primitives to use, and it takes care of the details.*

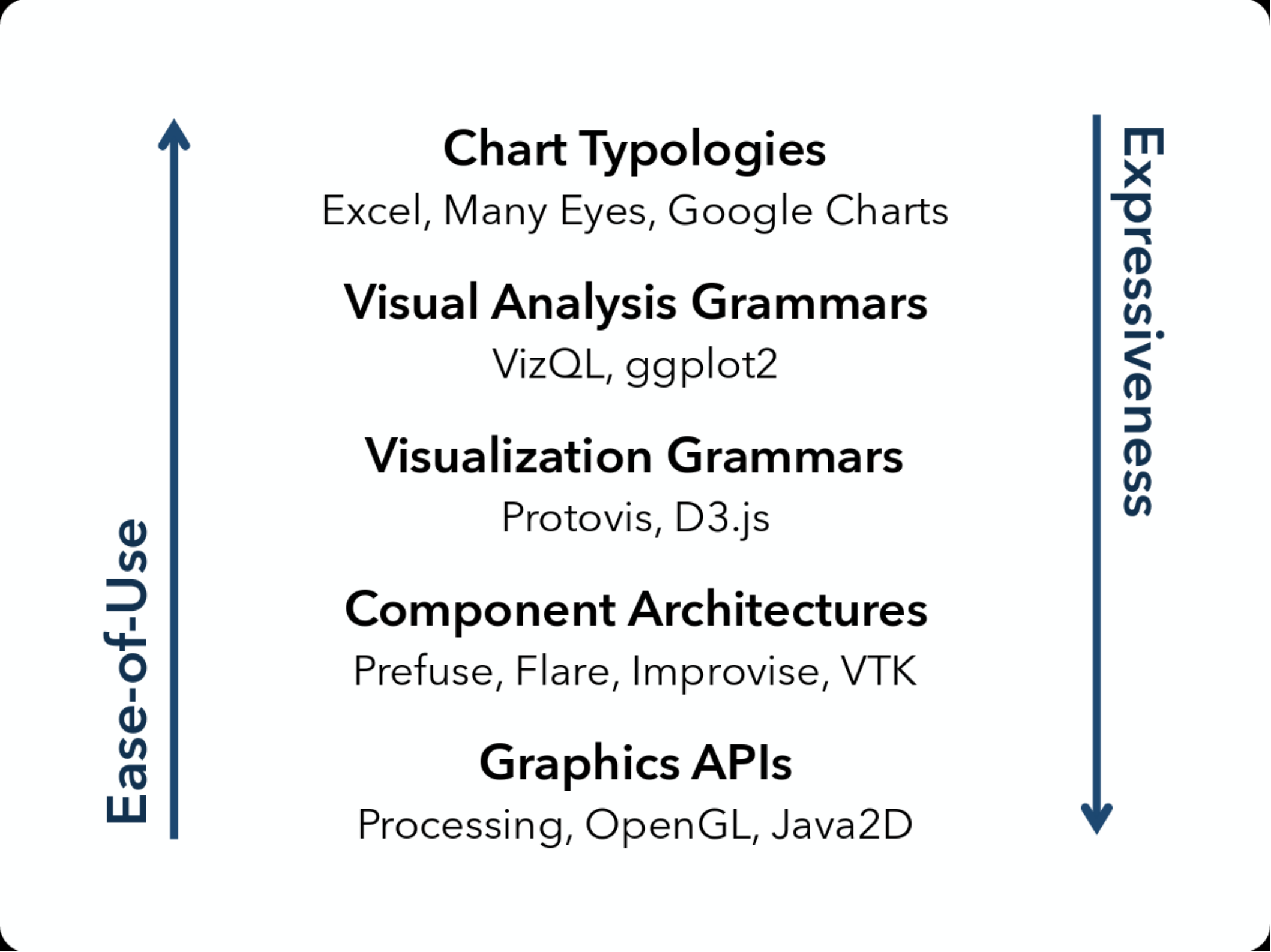
ggplot2

- *Usage*
  - *It's hard to succinctly describe how ggplot2 works because it embodies a deep philosophy of visualisation.*
  - *However, in most cases you start with ggplot(), supply a dataset and aesthetic mapping (with aes()).*
  - *You then add on layers (like geom_point() or geom_histogram()), scales (like scale_colour_brewer()), faceting specifications (like facet_wrap()) and coordinate systems (like coord_flip()).*

ggplot2

```
library(ggplot2)

ggplot(mpg, aes(displ, hwy, colour = class)) +
  geom_point()
```




Ease-of-Use
Chart Typologies
Excel, Many Eyes, Google Charts
Visual Analysis Grammars
VizQL, ggplot2
Visualization Grammars
Protovis, D3.js
Component Architectures
Prefuse, Flare, Improvise, VTK
Graphics APIs
Processing, OpenGL, Java2D
Expressiveness

Protovis
A graphical approach to visualization

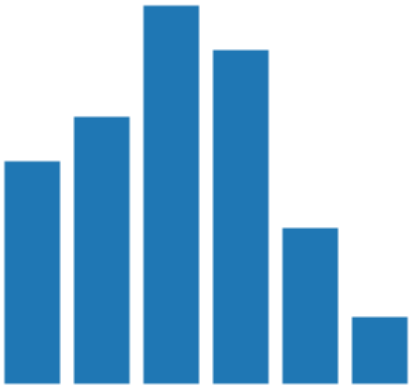
- *Protovis composes custom views of data with simple marks such as bars and dots.*
- *Unlike low-level graphics libraries that quickly become tedious for visualization, Protovis defines marks through dynamic properties that encode data, allowing inheritance, scales and layouts to simplify construction.*

Protovis

Getting Started

How does Protovis work? Consider this bar chart, which visually encodes an array of numbers with height:

```
var vis = new pv.Panel()
    .width(150)
    .height(150);

vis.add(pv.Bar)
    .data([1, 1.2, 1.7, 1.5, .7, .3])
    .width(20)
    .height(function(d) d * 80)
    .bottom(0)
    .left(function() this.index * 25);

vis.render();
```

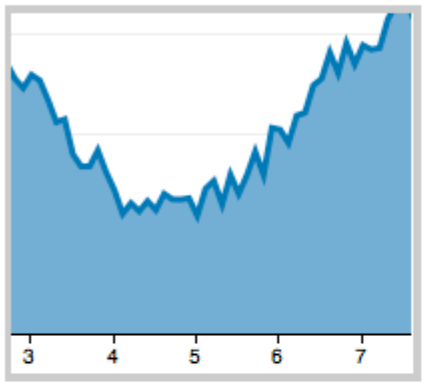


This blue bar is rendered once per number, mapping the data to height using a little function (`d * 80`). Thus, a *mark* represents a *set* of graphical elements that share data and visual encodings. Although marks are simple by themselves, you can combine them in interesting ways to make rich, interactive visualizations.

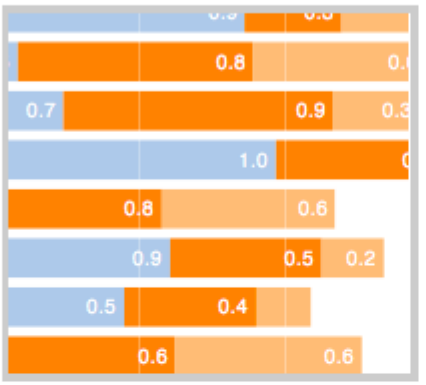
Protovis

Conventional

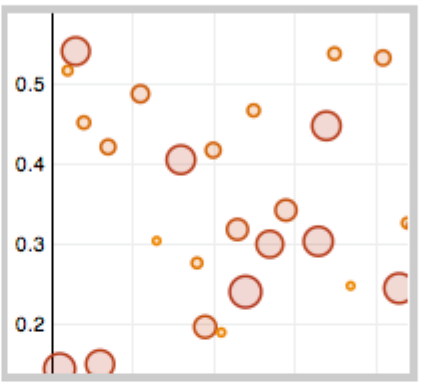
While Protovis is designed for custom visualization, it is still easy to create many standard chart types. These simpler examples serve as an introduction to the language, demonstrating key abstractions such as quantitative and ordinal scales, while hinting at more advanced features, including stack layout.



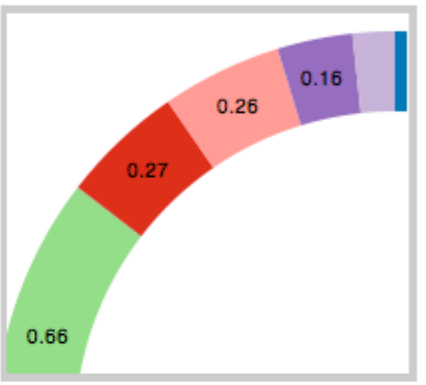
Area Charts



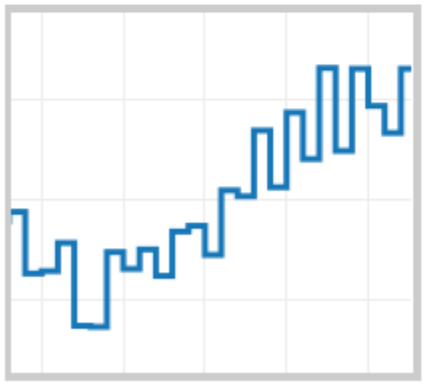
Bar & Column Charts



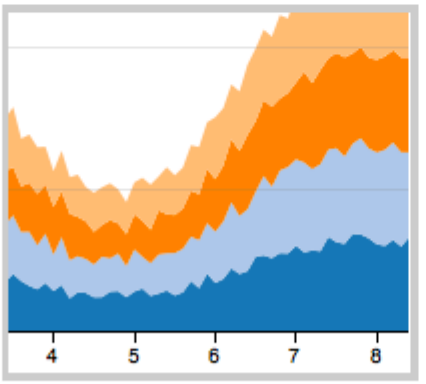
Scatterplots



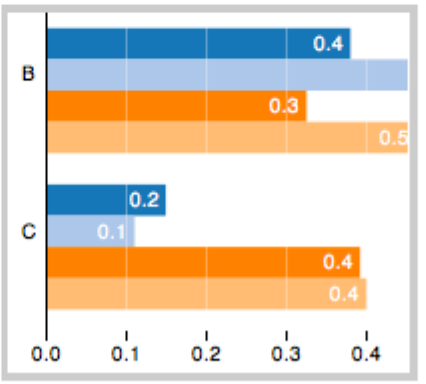
Pie & Donut Charts



Line & Step Charts



Stacked Charts

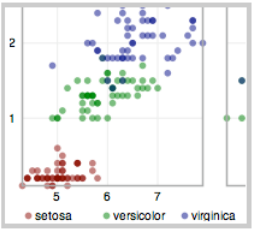


Grouped Charts

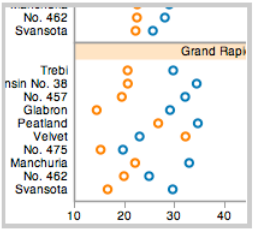
Protovis

Custom

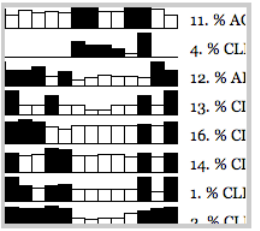
Many charting libraries provide stock chart designs, but offer only limited customization; Protovis excels at custom visualization design through a concise representation and precise control over graphical marks. These examples, including a few recreations of unusual historical designs, demonstrate the language's expressiveness.



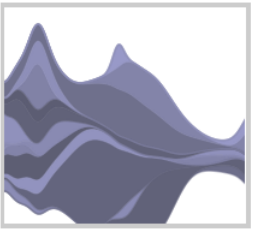
Anderson's Flowers



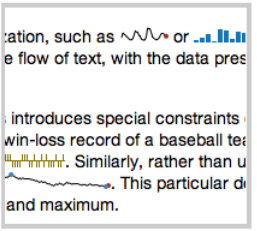
Becker's Barley



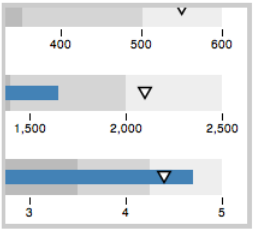
Bertin's Hotel



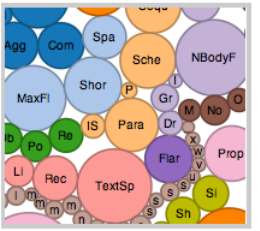
Streamgraphs



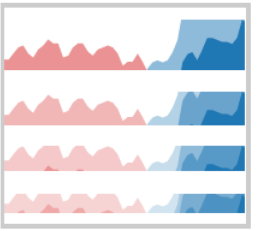
Sparklines



Bullet Charts

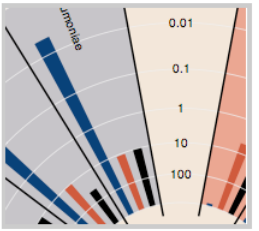


Bubble Charts

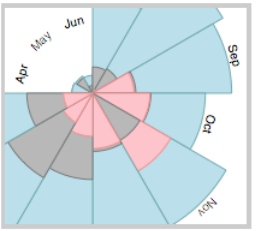


Sizing the Horizon

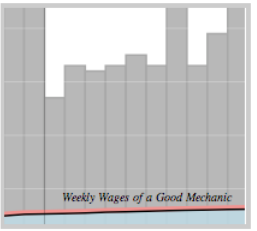
Candlestick Charts



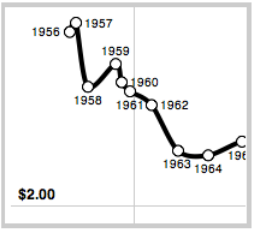
Burtin's Antibiotics



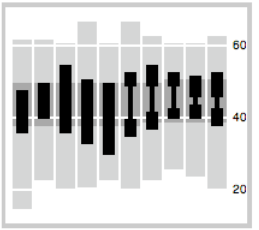
Nightingale's Rose



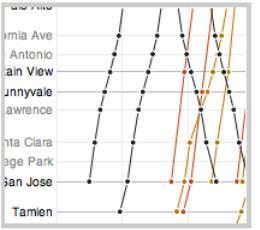
Playfair's Wheat



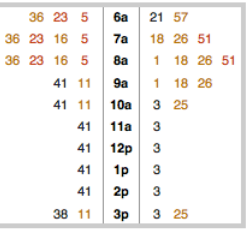
Gas & Driving



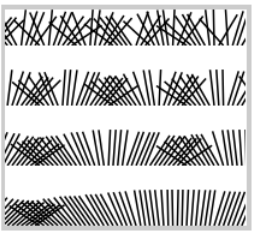
Seattle Weather



Marey's Trains



Stemplots



Merge Sort

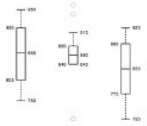
D3.js
Data-Driven Documents

- *D3.js is a JavaScript library for manipulating documents based on data. D3 helps you bring data to life using HTML, SVG, and CSS. D3's emphasis on web standards gives you the full capabilities of modern browsers without tying yourself to a proprietary framework, combining powerful visualization*

D3.js

Visual Index

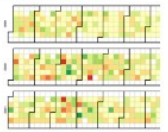
Box Plots



Bubble Chart

Bullet Charts

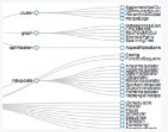
Calendar View



Non-contiguous Cartogram

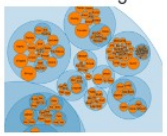
Chord Diagram

Dendrogram

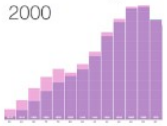


Force-Directed Graph

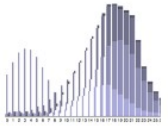
Circle Packing



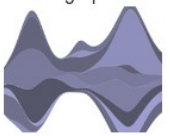
Population Pyramid



Stacked Bars



Streamgraph

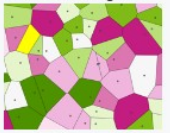


Sunburst

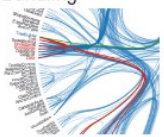
Node-Link Tree

Treemap

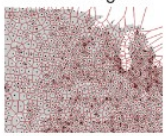
Voronoi Diagram



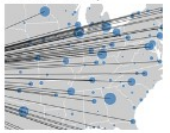
Hierarchical Edge Bundling



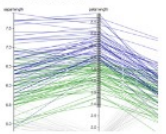
Voronoi Diagram



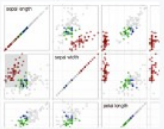
Bubble Map



Parallel Coordinates

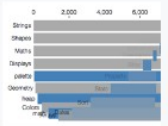


Scatterplot Matrix

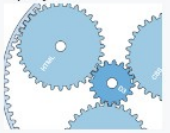


Zoomable Pack Layout

Hierarchical Bars

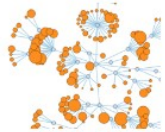


Epicyclical Gears



Collision Detection

Collapsible Force Layout



Force-Directed States

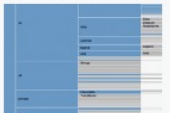
Versor Dragging

Choropleth

Collapsible Tree Layout

Zoomable Treemap

Zoomable Icicle



Data-Driven Documents

- Home
- Gallery
- Examples
- Tutorials
- Plugins

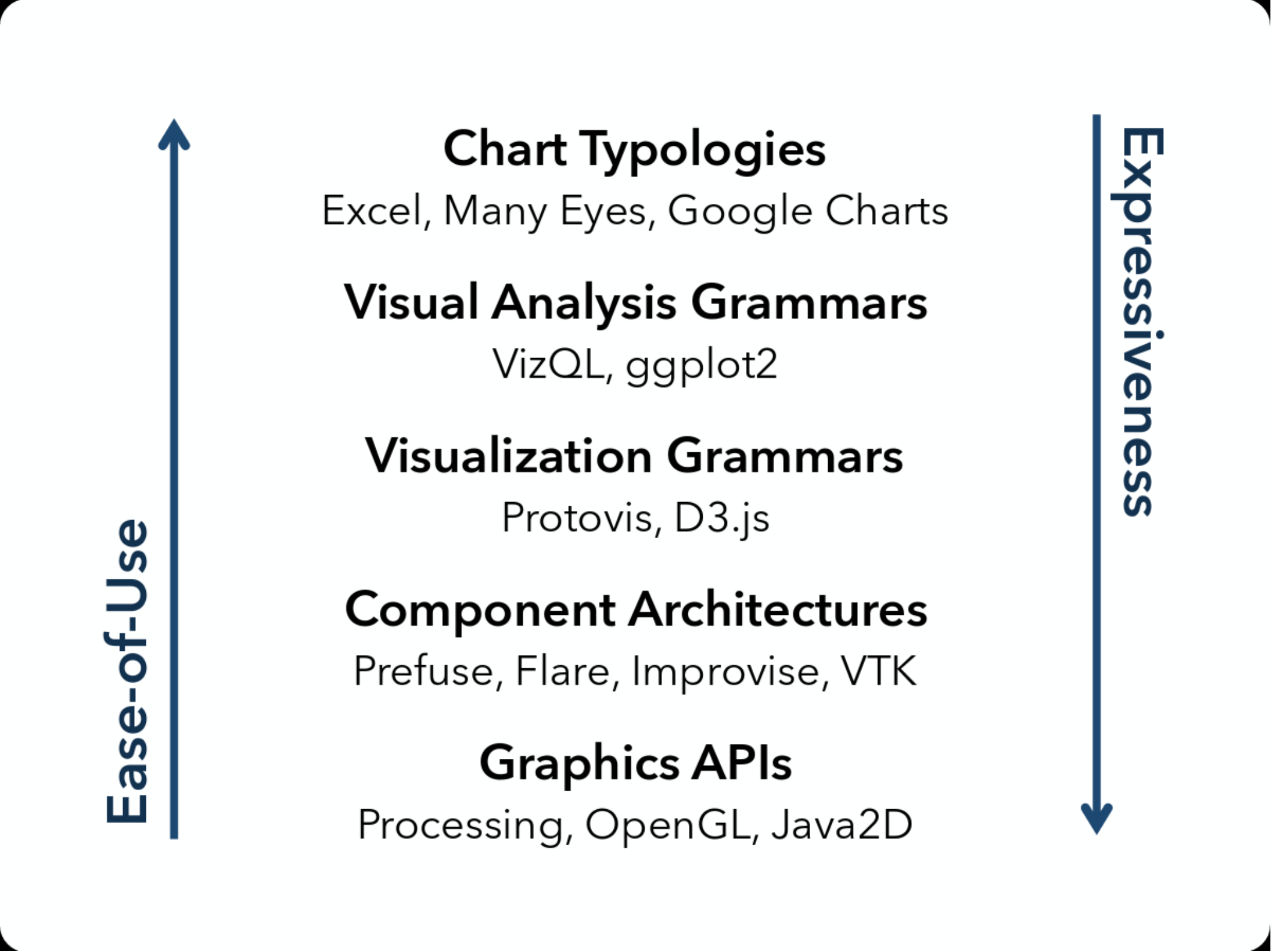
Help

- Stack Overflow
- Slack
- Google Group
- Gitter

API Reference

- Arrays
- Axes
- Brushes
- Chords
- Collections
- Colors
- Color Schemes
- Delimiter-Separated Values
- Dispatches
- Dragging
- Easings
- Fetches
- Forces
- Geographies
- Hierarchies
- Interpolators
- Number Formats
- Paths
- Polygons
- Quadtrees
- Random Numbers
- Scales
- Selections
- Shapes
- Time Formats
- Time Intervals
- Timers
- Transitions
- Voronoi Diagrams
- Zooming

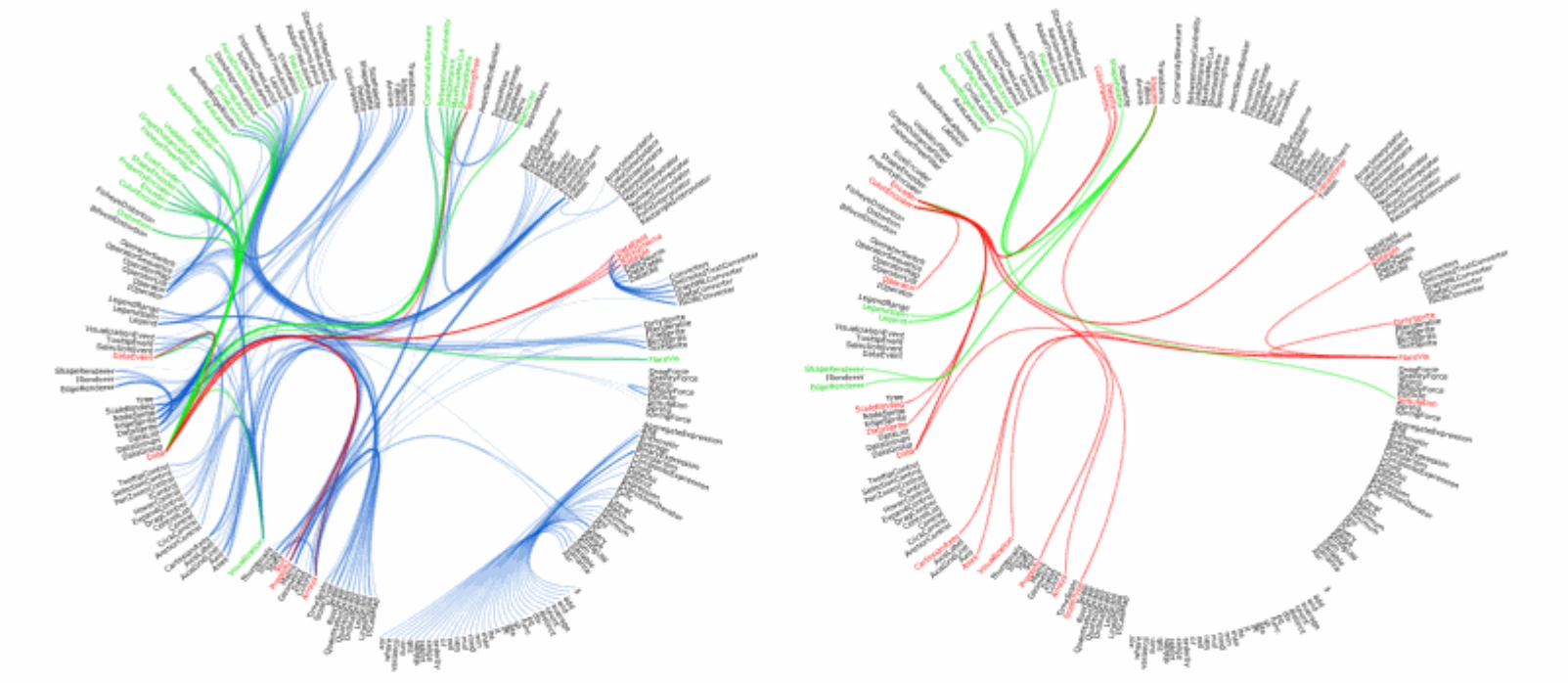
Translations (Unofficial)


Ease-of-Use
Chart Typologies
Excel, Many Eyes, Google Charts
Visual Analysis Grammars
VizQL, ggplot2
Visualization Grammars
Protovis, D3.js
Component Architectures
Prefuse, Flare, Improvise, VTK
Graphics APIs
Processing, OpenGL, Java2D
Expressiveness

Prefuse

- *Prefuse is a Java-based toolkit for building interactive information visualization applications. It supports a rich set of features for data modeling, visualization and interaction. It provides optimized data structures for tables, graphs, and trees, a host of layout and visual encoding techniques, and support for animation, dynamic queries, integrated search, and database connectivity.*
-
- *Prefuse uses the Java 2D graphics library, and is easily integrated into Swing applications or Java applets. Prefuse is licensed under the terms of a BSD license, and can be used freely for commercial and non-commercial purposes.*

flare DATA VISUALIZATION FOR THE WEB



Flare makes it easy to create interactive data visualizations.

Flare is an ActionScript library for creating visualizations that run in the Adobe Flash Player. From basic charts and graphs to complex interactive graphics, the toolkit supports data management, visual encoding, animation, and interaction techniques. Even better, flare features a modular design that lets developers create customized visualization techniques without having to reinvent the wheel.

View the demos and sample applications to see a few of the visualizations that flare makes it easy to build.

To begin making your own visualizations, download flare and work through the tutorial. You should also get familiar with the API documentation. Need more help? Visit the help forum (you'll need a SourceForge login to post).

Flare is open-source software released under a BSD license, meaning it can be freely deployed and modified (and even sold for $$). Flare's design was adapted from its predecessor prefuse, a visualization toolkit for Java.

Flare Demos

DOWNLOAD

Flare Alpha
Released 2009.01.24
Source .ZIP (1.2mb)

Development Version
github.com/prefuse/Flare

TOOLS

Improvise

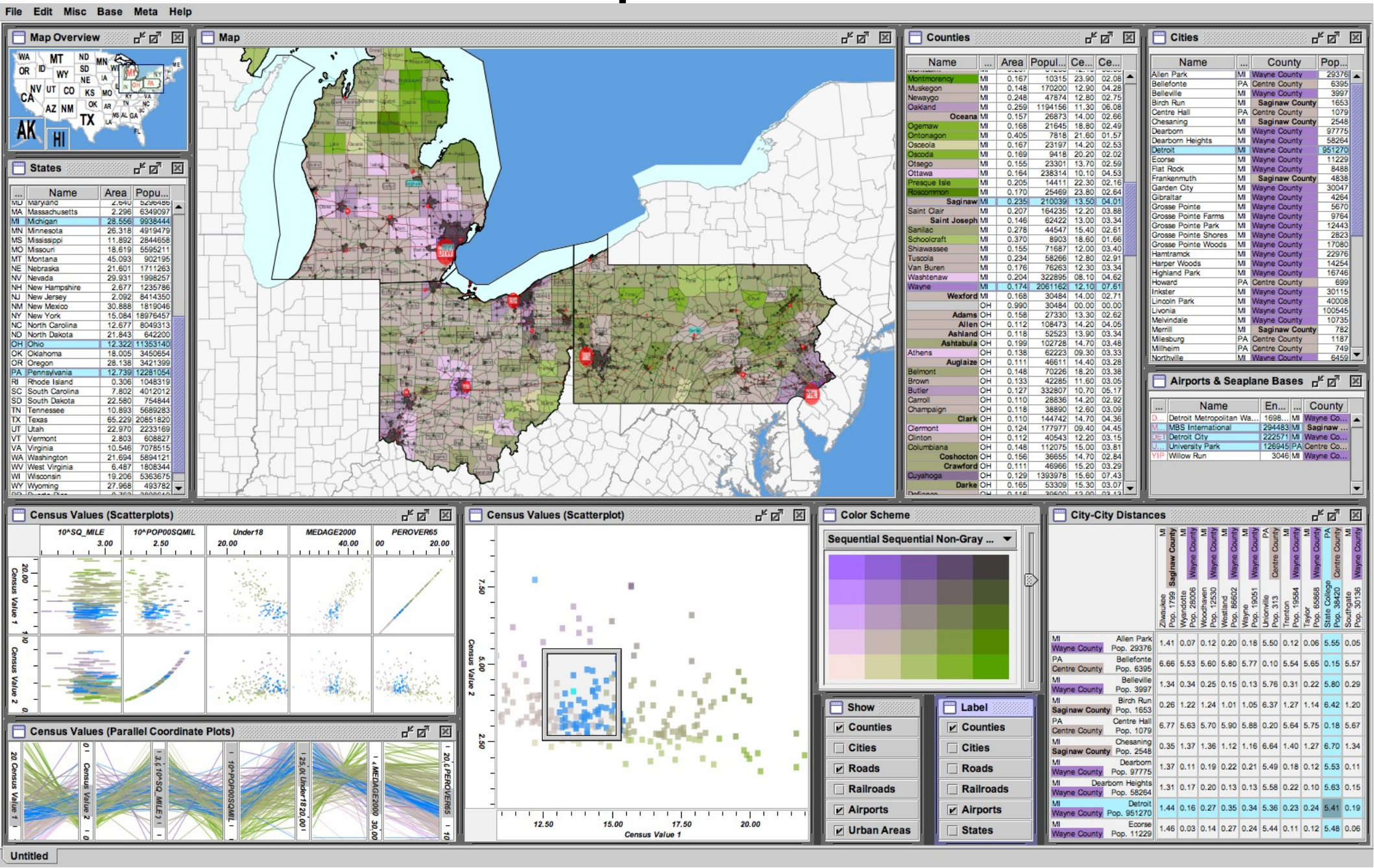
Exploratory visualization based on multiple coordinated views is a rapidly growing area of information visualization. Ideally, users would be able to explore their data by switching freely between building and browsing in a flexible, integrated, interactive graphical environment that requires little or no programming skill to use. However, the possibilities for displaying data across multiple views depends on the flexibility of coordination, the expressiveness of graphical encoding, and the ability of users to comprehend the structure of their visualizations as they work. As a result, exploration has been limited in practice to a small fraction of useful visualizations.

Improvise is a fully-implemented Java software **architecture** and user interface that enables users to build and browse highly-coordinated visualizations interactively. By coupling a shared-object **coordination model** with a declarative **visual query language**, users gain precise control over how navigation and selection affects the appearance of data across multiple views, using a potentially infinite number of variations on well-known **coordination patterns** such as synchronized scrolling, overview+detail, brushing, drill-down, and semantic zoom.

Improvise has been used to build **numerous visualizations** for exploring information including election results, particle trajectories, network loads, music collections, the chemical elements, and even the dynamic coordination structure of its own visualizations in situ. This last technique—***integrated metavisualization***—is unique to Improvise.

Last modified: Sun Sep 21 11:15:45 2014 by Chris Weaver

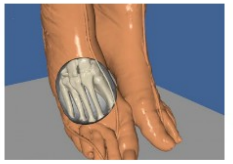
Improvise


File Edit Misc Base Meta Help
Map Overview
Map
Counties
Cities
States
Airports & Seaplane Bases
Census Values (Scatterplots)
Census Values (Scatterplot)
Color Scheme
City-City Distances
Census Values (Parallel Coordinate Plots)
Show
Counties
Cities
Roads
Railroads
Airports
Urban Areas
Label
Counties
Cities
Roads
Railroads
Airports
States
Untitled

VTK – Visualization Toolkit

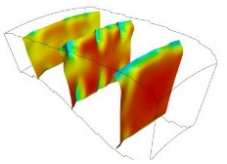
- *The Visualization Toolkit (VTK) is open source software for manipulating and displaying scientific data.*
- *It comes with state-of-the-art tools for 3D rendering, a suite of widgets for 3D interaction, and extensive 2D plotting capability.*
- *VTK is part of Kitware's collection of supported platforms for software development.*
- *The platform is used worldwide in commercial applications, as well as in research and development.*

VTK



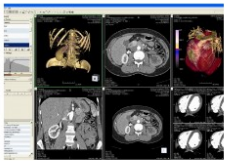
full_womanFoot

CT scan from the visible woman dataset. An isosurface of the skin is clipped with a sphere to reveal the underlying bone structure. Author: Original visualization author Bill Lorensen.



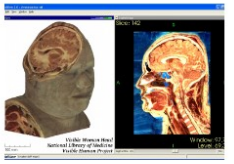
full_warpComb

Visualization the combustion process in a segment of an annular combustor. The combustor is where fuel and air is burned in a gas turbine. Author: VTK Textbook (Schroeder, Martin, Lorensen et al.)



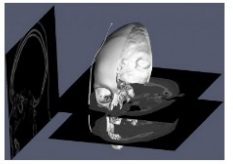
full_VVC30_CTA_Kidney_Cardiac 05_03_06

Volume rendering and CT display of a human torso, with emphasis on the kidney.



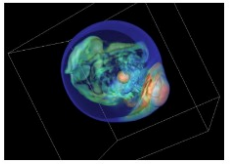
full_VolViewVW

Volume rendering and image display from the visible woman dataset.



full_VisibleWoman

Volume rendering and image display from the visible woman dataset.

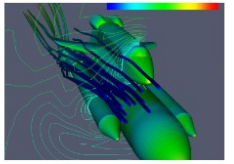


full_supernova

Volume rendering of a supernova delineating the rapid, unsaturated, nonlinear growth of a long-wavelength, (l=1,2 mode instability) which may have ramifications for the supernova mechanism, energetics, and dynamics and phenomenology. Dataset Courtesy of the Terascale Supernova Initiative (TSI)

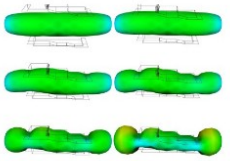
full_SphereInPieces

Processing a dataset in parallel. The different colors indicate on which processor id the data was processed.



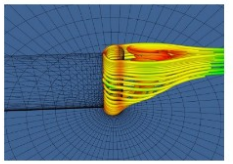
full_shuttle

Fluid flow around the space shuttle. Coloring of the data corresponds to flow density at that point.



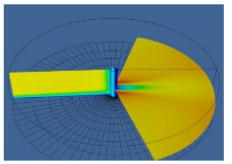
full_plate52

An animation of a plastic blow molding process. A hot balloon of plastic is shaped by moving molds at the same time the balloon is inflated.



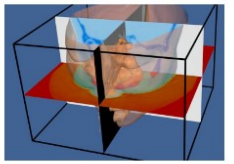
full_plate50

The flow of fluid (LOx) around a tube is described using streamtubes.



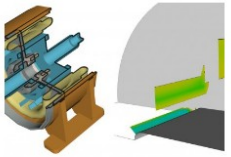
full_plate49

Data in the vicinity of fluid flow (LOx) around a tube.



full_plate46

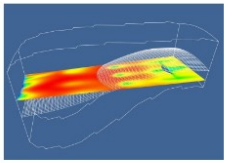
Visualizing a CT scan of the human head using an isosurface of the skin, and cross-sectional planes through the data.



full_plate41

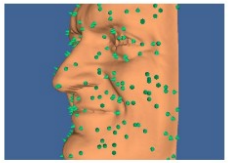
full_plate40bottom

An isosurface of a pine root from an MRI image sequence.



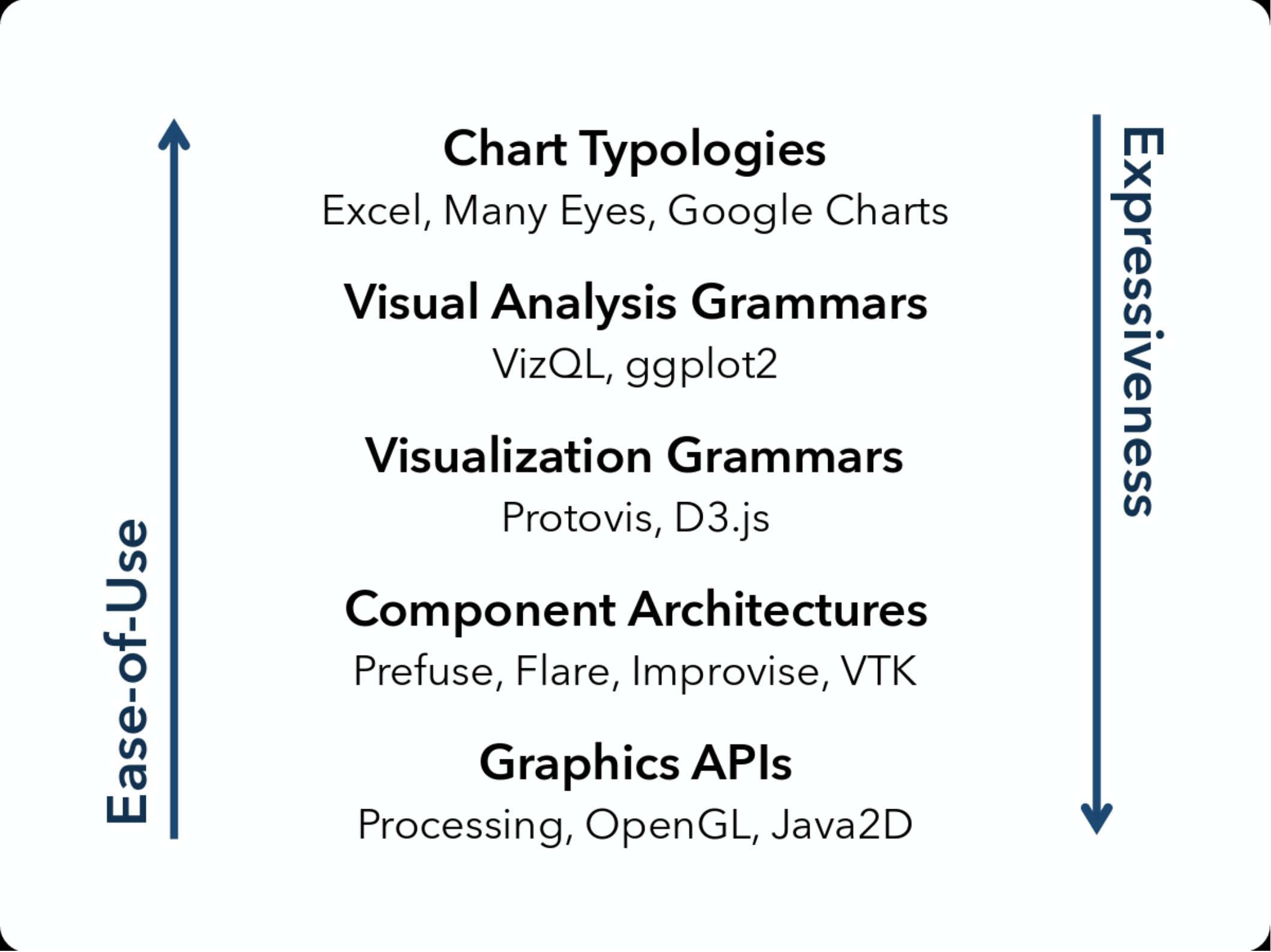
full_plate39

Visualization the combustion process in a segment of an annular combustor. The combustor is where fuel and air is burned in a gas turbine.



full_plate34

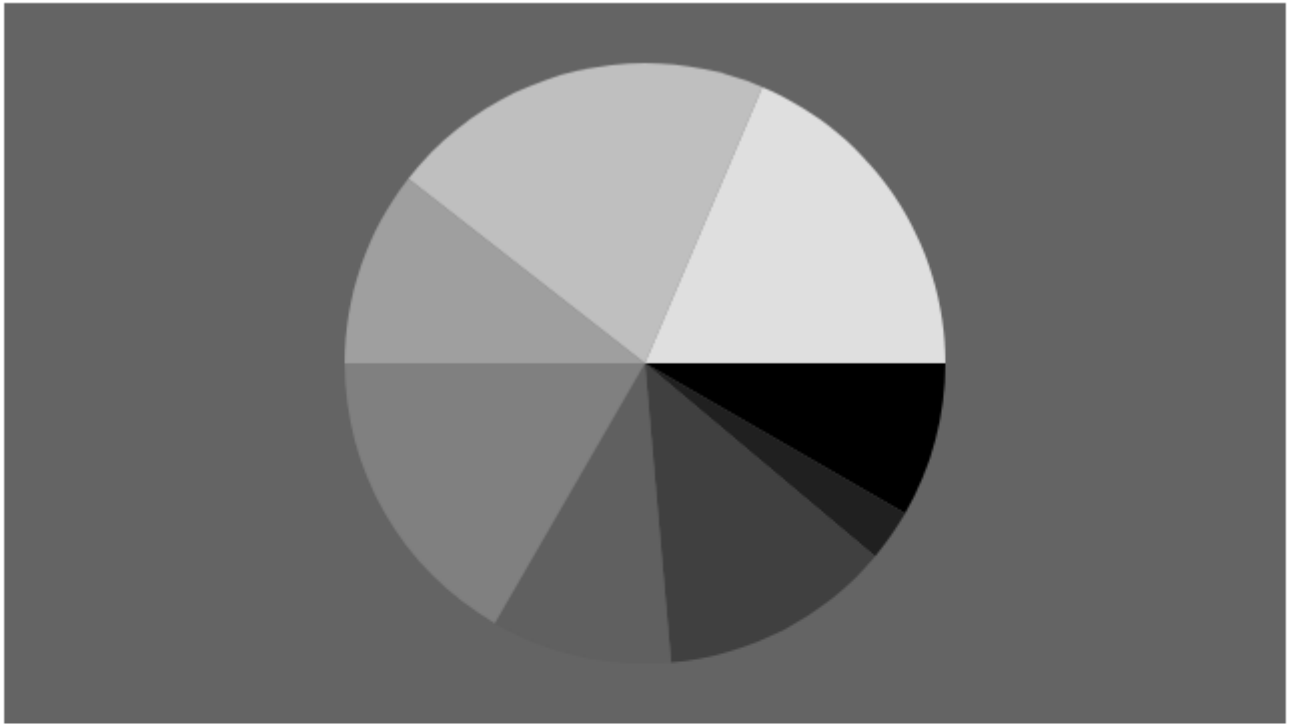
Glyphing a polygonal model of a human face to indicate the direction of surface normals.


Ease-of-Use
Chart Typologies
Excel, Many Eyes, Google Charts
Visual Analysis Grammars
VizQL, ggplot2
Visualization Grammars
Protovis, D3.js
Component Architectures
Prefuse, Flare, Improvise, VTK
Graphics APIs
Processing, OpenGL, Java2D
Expressiveness

Processing

- *Processing is a flexible software sketchbook and a language for learning how to code within the context of the visual arts.*

Processing

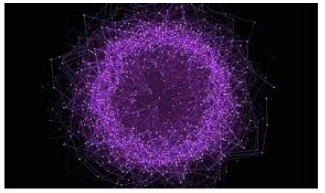


Pie Chart

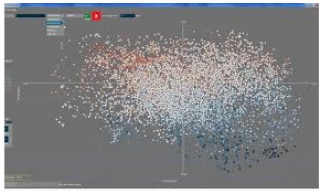
Uses the arc() function to generate a pie chart from the data stored in an array.

```
int[] angles = { 30, 10, 45, 35, 60, 38, 75, 67 };

void setup() {
  size(640, 360);
  noStroke();
  noLoop();  // Run once and stop
}

void draw() {
  background(100);
  pieChart(300, angles);
}

void pieChart(float diameter, int[] data) {
  float lastAngle = 0;
  for (int i = 0; i < data.length; i++) {
    float gray = map(i, 0, data.length, 0, 255);
    fill(gray);
    arc(width/2, height/2, diameter, diameter, lastAngle, lastAngle+radians(data[i]));
    lastAngle += radians(data[i]);
  }
}
```

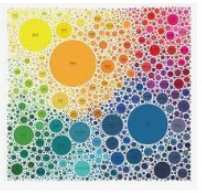
Processing tutorial: Overview of data visualizatio...
youtube.com



Processing Sound Visualization - YouTube
youtube.com

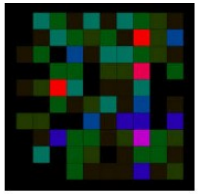


Clinical Data Visualization with Processing - Y...
youtube.com

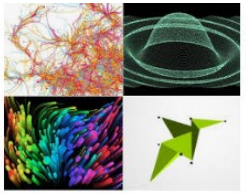


XML/Data Visualization Que...
forum.processing.org

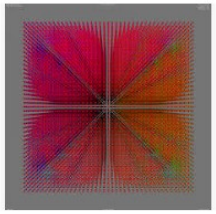
3D Data Visualization Via Processing & OpenG...
pinterest.com



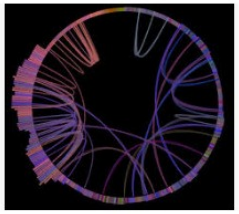
Data visualization tutorial i...
flowingdata.com



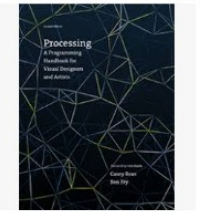
JavaScript Visualization Framewo...
hackernoon.com



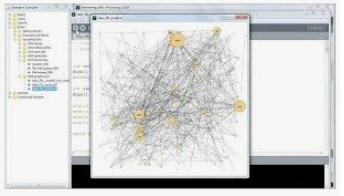
Minecraft type engine for a dat...
forum.processing.org



processing visualization examples...
pinterest.com

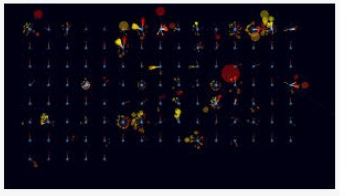


Books \ Processing.org
processing.org



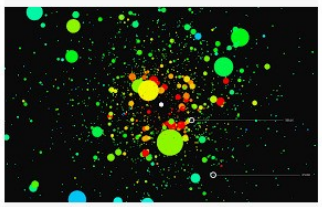
Processing: Interactive Data Visualization
linkedin.com

Infographics and data visualization: ne...
wildinwoods.wordpress.com



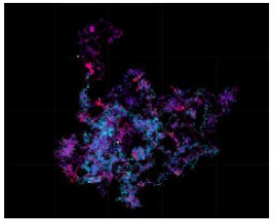
Visualizing Pressible [Processing]: Blog Clusters & ...
creativeapplications.net

Processing Abstract Visualization — Stock P...
depositphotos.com

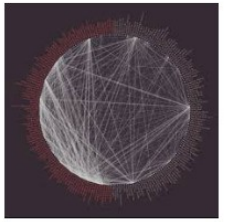


Data in an Alien Context: Kepler Visualization ...
blog.blprnt.com

Cadin Batrack
cadinbatrack.com

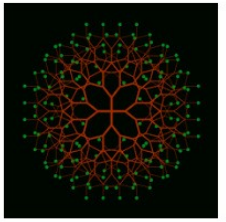


Bitalizer [Processing]: Visualizing 0s a...
creativeapplications.net

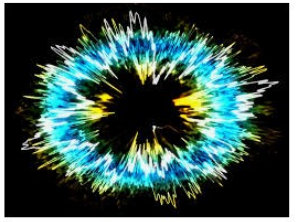


Data Visualization Archives - P...
michellechandra.com

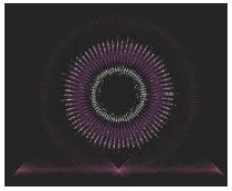
Processing Abstract Visualization Sto...
dreamstime.com



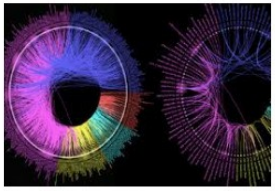
Pulse: A Biometric Data Visual...
jennykang.me



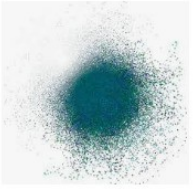
Processing Audio Visualization (PAV)
skpdvdd.github.io



ICM Week 9: Final Project Prop...
1023.io

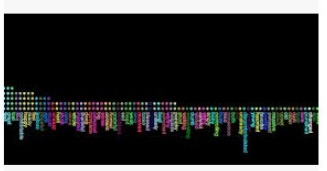


Visualization and Data processing. | Do...
researchgate.net



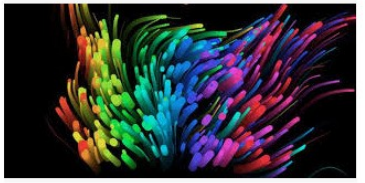
Processing Music Visualiz...
behance.net

Because it's Friday: Exploring Zipcodes (...
blog.revolutionanalytics.com

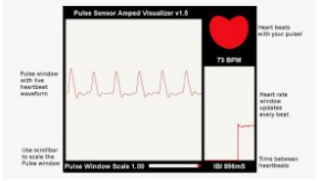


Processing and Data Visualization with Jer Th...
matthewhealy.net

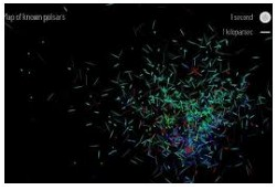
Processing — Alyssa Marie
alyssa-reyes-portfolio.squarespace.com



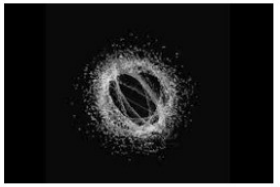
Processing.JS - Port of the Processing Visualization ...
pinterest.com



Processing Visualization App – World Famous ...
pulsesensor.com

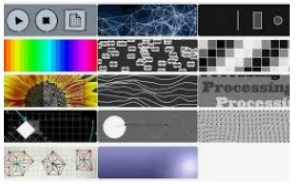


Pulsar Visualization, Laura Kogler's Por...
laurakogler.net

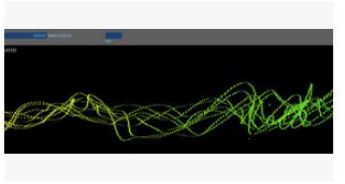


processing visualization interaction 1 - ...
youtube.com

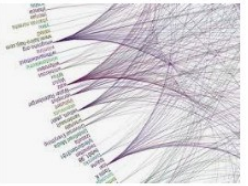
Visual analysis of geocod...
researchgate.net



Dynamic, Lightweight Visualization
blog.codinghorror.com



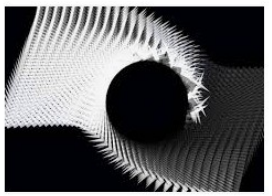
nick lally // art, geography, software » processing
nicklally.com



visualcomplexity.com | Visualizing t...
visualcomplexity.com

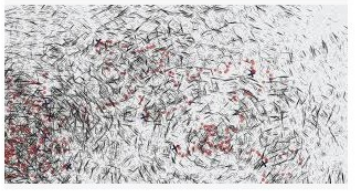
Selected Works | blprnt.blg
blog.blprnt.com

How do I get Processing t...
stackoverflow.com



Music visualization with Processing - "...
youtube.com

Sound Data Visualization Fractal...
shutterstock.com



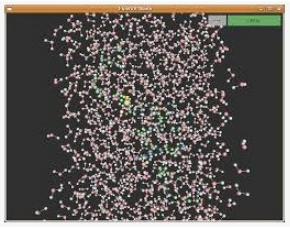
Visualizing Fontane's "Brücke am Tay" [Processing] ...
creativeapplications.net

Visualizing web site interlinkage using ...
peterkrantz.com

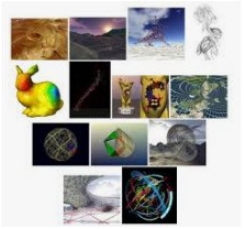
Processing.org
processing.org

OpenGL

- *OpenGL is the premier environment for developing portable, interactive 2D and 3D graphics applications.*
- *Since its introduction in 1992, OpenGL has become the industry's most widely used and supported 2D and 3D graphics application programming interface (API), bringing thousands of applications to a wide variety of computer platforms.*
- *OpenGL fosters innovation and speeds application development by incorporating a broad set of rendering, texture mapping, special effects, and other powerful visualization functions.*
- *Developers can leverage the power of OpenGL across all popular desktop and workstation platforms, ensuring wide application deployment.*

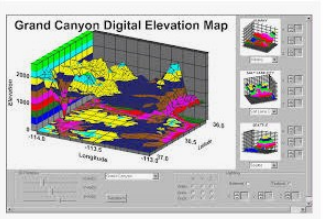


OpenGL Visualization of Molecular Dynami...
researchgate.net

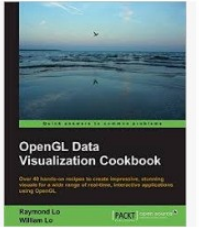


jReality: 3D Visualization Library w...
geeks3d.com

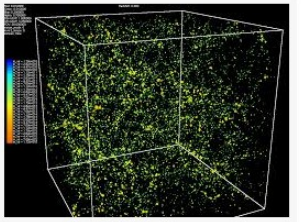
java - Codeswarm software project visualiza...
unix.stackexchange.com



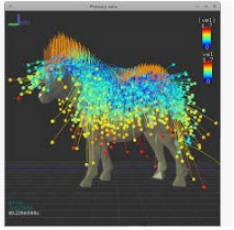
MFC OpenGL 3D Charting, OpenGL Data Visual...
quinn-curtis.com



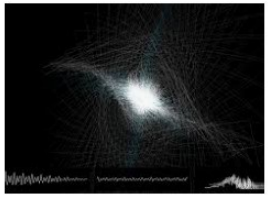
OpenGL Data Visualization ...
scholar.harvard.edu



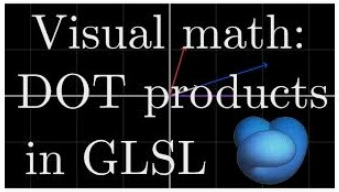
Cosmological Simulations
users.utu.fi



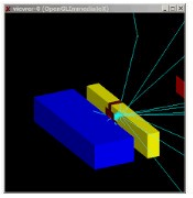
Visualization — Woo 1.0+rev4305-...
woodem.org



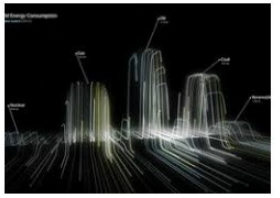
Sound Visualization with OpenGL
ccrma.stanford.edu



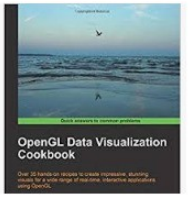
Coding a visualization of dot products in OpenGL/...
youtube.com



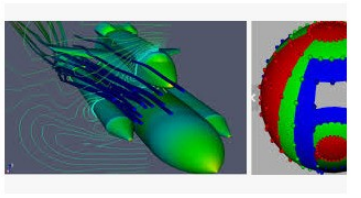
Geant4 Vis Tutorial using t...
conferences.fnal.gov



Marcin Ignac : opengl projects
marcinignac.com

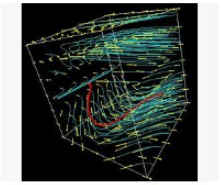


OpenGL Data Visualizatio...
amazon.com

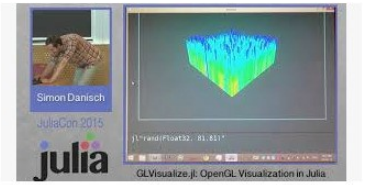


EGL Eye: OpenGL Visualization without an X Server
devblogs.nvidia.com

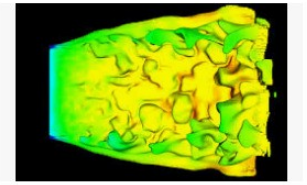
3D Data Visualization Via Processing & OpenG...
pinterest.com



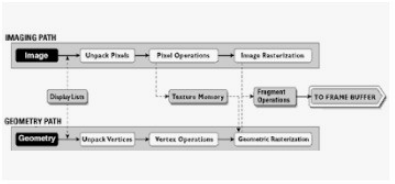
CS 453 / 553 Home Page
eecs.oregonstate.edu



Simon Danisch: GLVisualize.jl - OpenGL visualization f...
youtube.com



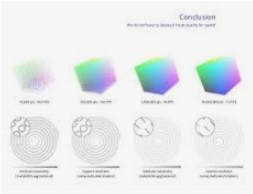
svPerfGL - Scientific Visualization OpenGL G...
dav.lbl.gov



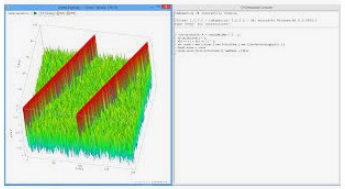
OpenGL Overview
opengl.org

Python & OpenGL for Scientific Visualization
labri.fr

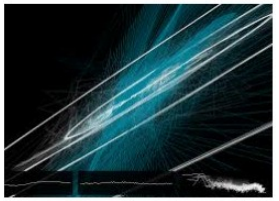
GitHub - ViRGiL175/sound-visualizer: OpenGL visuali...
github.com



Modern OpenGL scientific visualization
slideshare.net

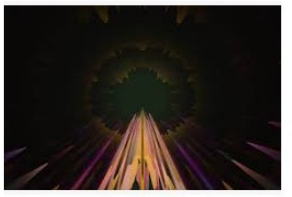


C# for 3D visualizations and Plotting in .NET - The ...
ilnumerics.net

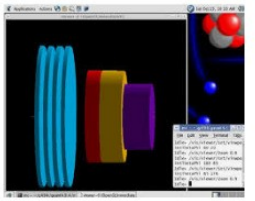


Sound Visualization with OpenGL
ccrma.stanford.edu

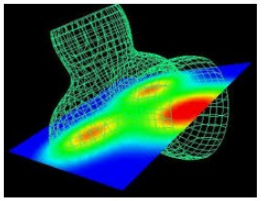
OpenGL Visualization of Hurricane Is...
slideplayer.com



RetroArch 1.3.6 - OpenGL Music visualiz...
youtube.com



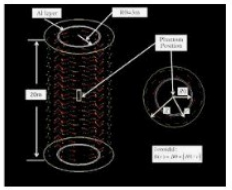
OpenGL-visualization of the facility ...
researchgate.net



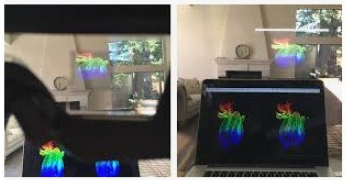
CS 453 / 553 Home Page
eecs.oregonstate.edu

Processing Audio Visualization ...
skpdvdd.github.io

The World's Best Photos of opengl and visualizer - ...
hiveminer.com

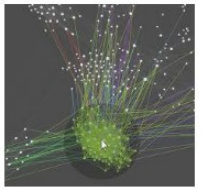


Configuration of toroidal fields i...
researchgate.net

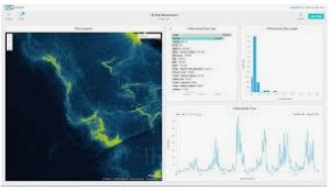


Rendering Stereoscopic 3D Models using OpenGL...
hub.packtpub.com

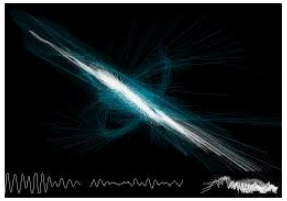
Sound Visualization with OpenGL
ccrma.stanford.edu



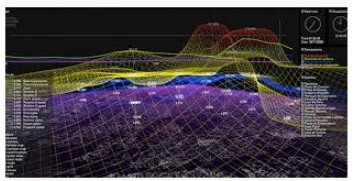
Features
gephi.org



Pro Tip: Linking OpenGL for Server-Side Renderi...
devblogs.nvidia.com

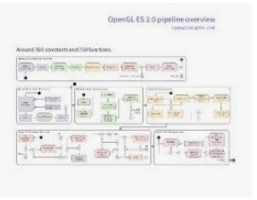


Sound Visualization with OpenGL
ccrma.stanford.edu



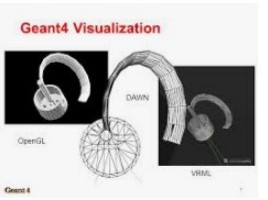
victor vina | htmaa
fab.cba.mit.edu

Redway3d OpenGL Graphics Benc...
geeks3d.com



Modern OpenGL scientific visualization
slideshare.net

Audio Visualization with OpenGL C++ - YouTube
youtube.com



Geant4 Visualization 1 OpenGL DAW...
slideplayer.com

Visualization Library: Open...
visualizationlibrary.org

Java2D

- *The Java 2D API provides two-dimensional graphics, text, and imaging capabilities for Java programs through extensions to the Abstract Windowing Toolkit (AWT).*
- *This comprehensive rendering package supports line art, text, and images in a flexible, full-featured framework for developing richer user interfaces, sophisticated drawing programs, and image editors.*
- *Java 2D objects exist on a plane called user coordinate space, or just user space.*
- *When objects are rendered on a screen or a printer, user space coordinates are transformed to device space coordinates.*

Interactive Data Exploration

Tableau, ***Lyra, Polestar, Voyager***

Graphical Interfaces

Visual Analysis Grammars

VizQL, ggplot2, ***Vega-Lite***

Visualization Grammars

Protovis, D3.js, ***Vega***

Declarative Languages

Component Architectures

Prefuse, Flare, Improvise, VTK

Graphics APIs

Processing, OpenGL, Java2D

Programming Toolkits

Tableau

Tableau is business intelligence software that helps people see and understand their data.

Fast Analytics

Connect and visualize your data in minutes. Tableau is 10 to 100x faster than existing solutions.

Big Data, Any Data

From spreadsheets to databases to Haadoop to cloud services, explore any data.

Update Automatically

Get the freshest data with a live connection to your data or get automatic updates on a schedule you define.

Ease of Use

Anyone can analyze data with intuitive drag & drop products. No programming, just insight.

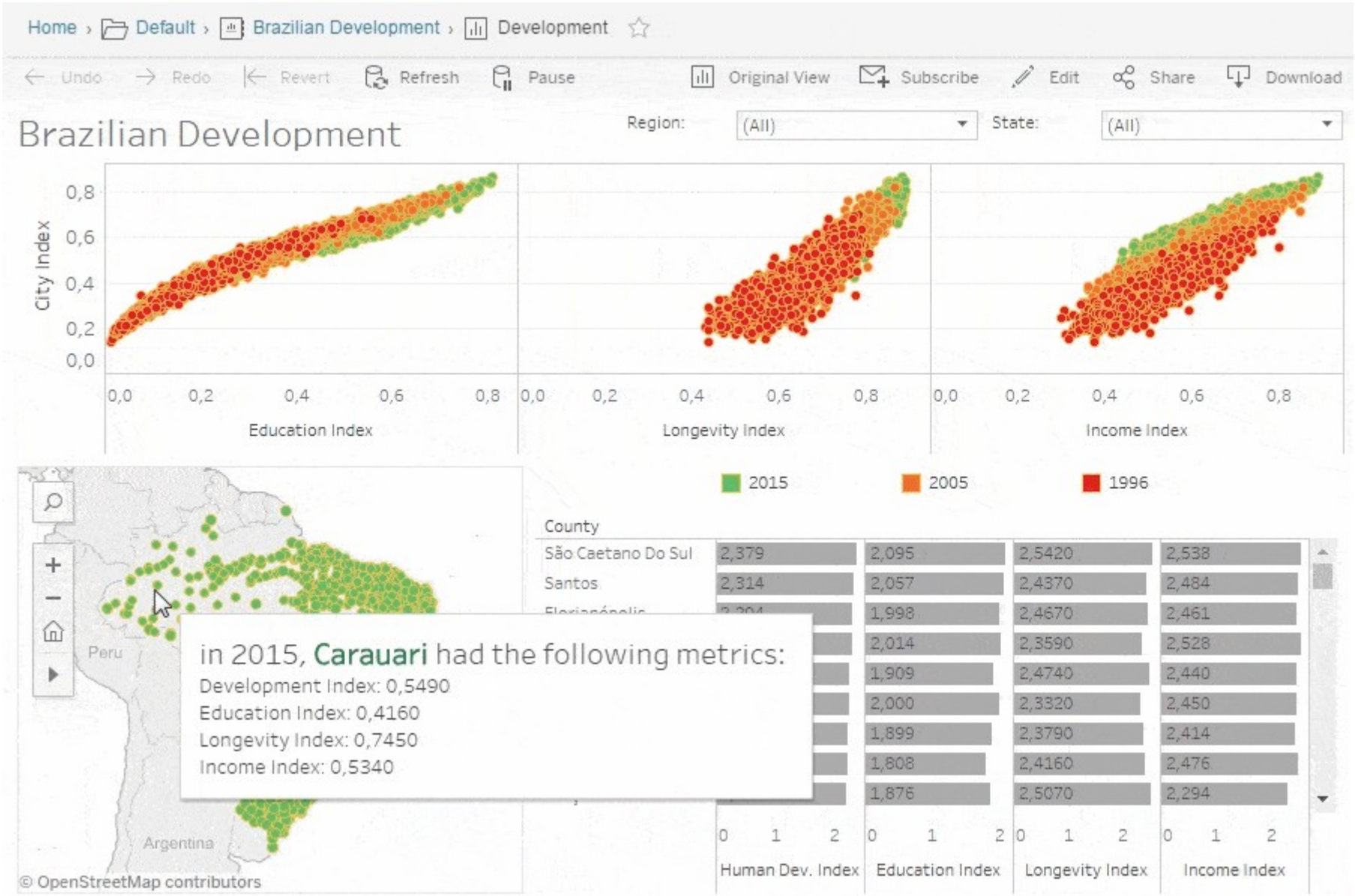
Smart Dashboards

Combine multiple views of data to get richer insight. Best practices of data visualization are baked right in.

Share in Seconds

Publish a dashboard with a few clicks to share it live on the web and on mobile devices.

Tableau


Home › Default › Brazilian Development › Development
Undo
Redo
Revert
Refresh
Pause
Original View
Subscribe
Edit
Share
Download
Brazilian Development
Region:
(All)
State:
(All)
City Index
0,8
0,6
0,4
0,2
0,0
0,0
0,2
0,4
0,6
0,8
Education Index
Longevity Index
Income Index
2015
2005
1996
County
São Caetano Do Sul
Santos
2,379
2,095
2,5420
2,538
2,314
2,057
2,4370
2,484
1,998
2,4670
2,461
2,014
2,3590
2,528
1,909
2,4740
2,440
2,000
2,3320
2,450
1,899
2,3790
2,414
1,808
2,4160
2,476
1,876
2,5070
2,294
0
1
2
Human Dev. Index
Education Index
Longevity Index
Income Index
Peru
Argentina
in 2015, Carauari had the following metrics:
Development Index: 0,5490
Education Index: 0,4160
Longevity Index: 0,7450
Income Index: 0,5340
© OpenStreetMap contributors

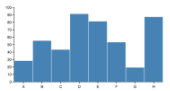
Vega

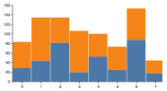
- Vega is a visualization grammar, a declarative language for creating, saving, and sharing interactive visualization designs.
- With Vega, you can describe the visual appearance and interactive behavior of a visualization in a JSON format, and generate web-based views using Canvas or SVG.

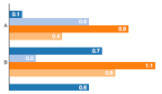
Example Gallery

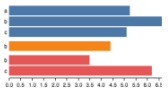
Vega

Bar Charts


Bar Chart

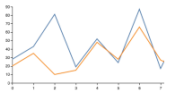

Stacked Bar Chart

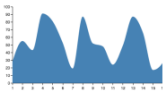

Grouped Bar Chart

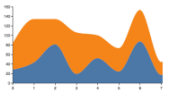

Nested Bar Chart

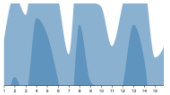

Population Pyramid

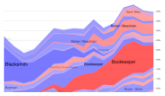
Line & Area Charts


Line Chart


Area Chart


Stacked Area Chart

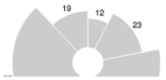

Horizon Graph


Job Voyager

Circular Charts

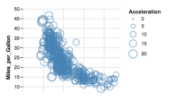

Pie Chart

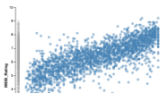

Donut Chart

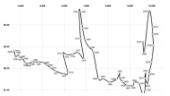


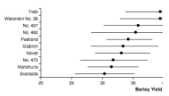
Radial Plot

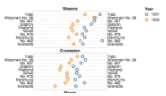
Dot & Scatter Plots


Scatter Plot

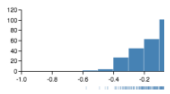

Scatter Plot Null Values

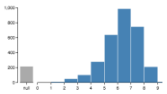

Connected Scatter Plot

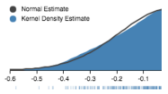

Error Bars


Barley Trellis Plot

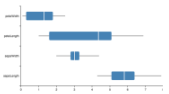
Distributions

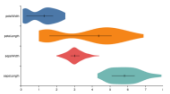

Histogram

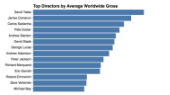

Histogram Null Values

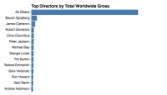


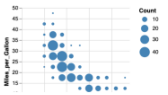
Probability Density

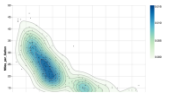

Box Plot

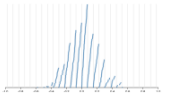

Violin Plot


Top K Plot


Top K Plot With Others


Binned Scatter Plot

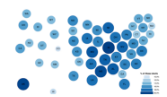

Contour Plot


Wheat Plot


Hypothetical Outcome Plots

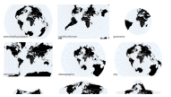
Geographic Maps


County Unemployment

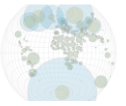

Dorling Cartogram

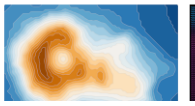

World Map

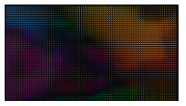

Earthquakes


Projections

Zoomable World Map


Distortion Comparison


Volcano Contours


Wind Vectors

Tree Diagrams


Tree Layout


Radial Tree Layout

Treemap

Circle Packing

Sunburst

Network Diagrams

Edge Bundling

Force Directed Layout

Reorderable Matrix

Arc Diagram

Airport Connections

Other Chart Types

Heatmap

Parallel Coordinates

Word Cloud

Timelines

Beeswarm Plot

Custom Visual Designs

Budget Forecasts

Wheat And Wages

Falkensee Population

Annual Temperature

Weekly Temperature

U District Cuisine

Interaction Techniques

Crossfilter Flights

Overview Plus Detail

Brushing Scatter Plots

Zoomable Scatter Plot

Global Development

Interactive Legend

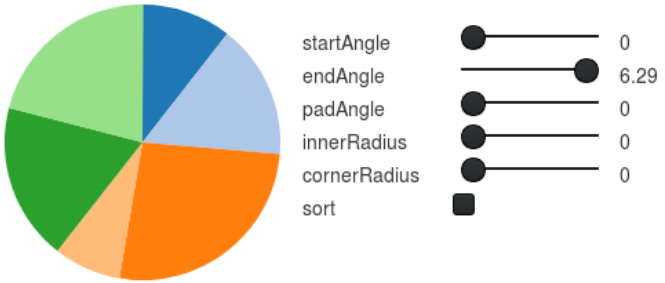
Stock Index Chart

Pi Monte Carlo

Vega

Pie Chart Example

A pie chart encodes proportional differences among a set of numeric values as the angular extent and area of a circular slice.



View in Online Vega Editor

Vega JSON Specification <>

```
{
  "$schema": "https://vega.github.io/schema/vega/v5.json",
  "width": 200,
  "height": 200,
  "autosize": "none",

  "signals": [
    {
      "name": "startAngle", "value": 0,
      "bind": {"input": "range", "min": 0, "max": 6.29, "step": 0.01}
    },
    {
      "name": "endAngle", "value": 6.29,
      "bind": {"input": "range", "min": 0, "max": 6.29, "step": 0.01}
    },
    {
      "name": "padAngle", "value": 0,
      "bind": {"input": "range", "min": 0, "max": 0.1}
    },
    {
      "name": "innerRadius", "value": 0,
      "bind": {"input": "range", "min": 0, "max": 90, "step": 1}
    },
    {
      "name": "cornerRadius", "value": 0,
      "bind": {"input": "range", "min": 0, "max": 10, "step": 0.5}
    },
    {
      "name": "sort", "value": false,
      "bind": {"input": "checkbox"}
    }
  ],

  "data": [
    {
      "name": "table",
      "values": [
        {"id": 1, "field": 4},
        {"id": 2, "field": 6},
        {"id": 3, "field": 10},
```

Polestar

- PoleStar is Tableau-style User Interface for visual analysis, building on top of Vega-Lite.

  „This project is an alpha software. We are working on improving its code and documentation.“

  „WE NO LONGER PLAN TO MAINTAIN THIS PROJECT. PLEASE FOLLOW THE NEW VERSION OF VOYAGER WHICH SUPPORTS ALL INTERACTIONS IN POLESTAR“

Voyager 2

- *Voyager 2 is a data exploration tool that blends manual and automated chart specification.*
- *Voyager 2 combines PoleStar, a traditional chart specification tool inspired by Tableau and Polaris (research project that led to the birth of Tableau), with two partial chart specification interfaces:*

  (1) wildcards let users specify multiple charts in parallel,

  (2) related views suggest visualizations relevant to the currently specified chart.
- *With Voyager 2, we aim to help analysts engage in both breadth-oriented exploration and depth-oriented question answering.*

Conferences and Journals

- *Conferences*
  - *https://www.eurovis.org/ EuroVis – Eurographics Conference on Visualization*
  - *ieeevis.org IEEE Information Visualization (InfoVis)*
  - *IEEE Conference on Visual Analytics Science and Technology IEEE Visual Analytics Science and Technology (VAST)*
  - *InfoVis IEEE Scientific Visualization (SciVis)*
  - *https://sigchi.org/conferences/conference-history/chi/ CHI – Conference on Human Factors in Computing Systems*
- *Journals*
  - *https://ieeexplore.ieee.org/xpl/aboutJournal.jsp?punumber=2945 IEEE transactions on visualization and computer graphics*
  - *https://journals.sagepub.com/home/ivi SAGE journals: Information Visualization*
  - *https://onlinelibrary.wiley.com/journal/14678659 Computer Graphics Forum*
  - *https://ieeexplore.ieee.org/xpl/aboutJournal.jsp?punumber=38 IEEE Computer Graphics and Applications*
  - *https://www.springer.com/engineering/mechanics/journal/12650 Springer: Journal of Visualization*

Useful links

- *Hanspeter Pfister (Data Visualization @Harvard)*
    - *http://www.cs171.org*
- *Jeffrey Heer (Data Visualization @University of Washington)*
    - *https://courses.cs.washington.edu/courses/cse512/19sp/*
    - *https://homes.cs.washington.edu/~jheer/*
    - *http://idl.cs.washington.edu/ (UW Interactive Data Lab)*
- *Mike Bostock (Creator of D3.js)*
    - *https://d3js.org/*
- *Edward Tufte (pioneer in the field of data visualization)*
    - *https://www.edwardtufte.com*

Data Sources

Data.gov

Census.gov

Dataverse Network

Climate Data Sources

Climate Station Records

CDC Data (Disease Control and Prevention)

World Bank Catalog

Free SVG Maps

UK Office for National Statistics

StateMaster

Quandl