Visual Numerics

Data Mining mit der JMSL™ Numerical Library for Java™ Applications

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8. Java Forum Stuttgart

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Agenda

- Visual Numerics
- JMSL™ Numerical Library
- Neuronale Netze (Hintergrund)
- Demos
- Neuronale Netze (Details)
- Kundenbeispiele

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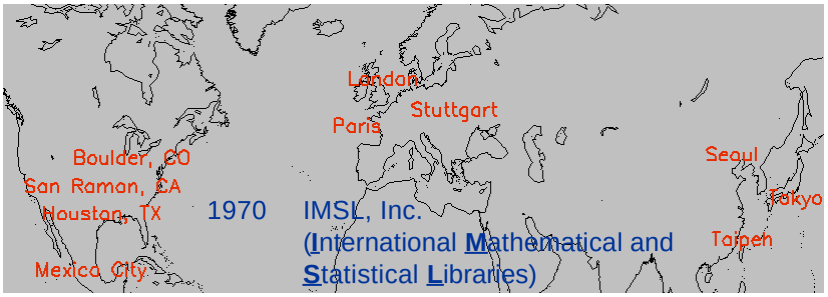

1970 IMSL, Inc. (International Mathematical and Statistical Libraries)

1979 Precision Visuals

1992 Visual Numerics, Inc.

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Visual Numerics

Advanced Analytics

- Embeddable numerical analysis
  - Available for Java, .NET, C/C++, and Fortran
- Sophisticated Visual Data Analysis
  - Development environment including time-series and web-based functionality
- Expert Professional Services for customized algorithm and application development

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IMSL™ Family Benefits Overview

- Clean software architecture
  - Mainstream programming languages
- Accelerate development
- Develop better applications
- Develop flexible applications
- Improve quality and reduce uncertainty
- Reduce costs

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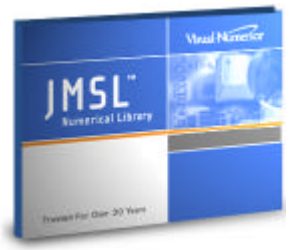
The JMSL™ Numerical Library



- Complete collection of mathematical, statistical and charting classes
- Written in 100% Java™, not an application or environment
  - Embeddable
  - Scalable
- Based upon the “gold standard” IMSL™ Library of algorithms
- Naturally suited for collaboration and sharing across the enterprise
- Fully supported and documented

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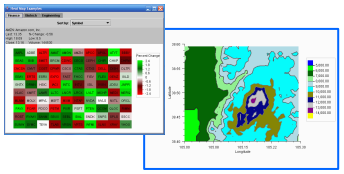
Math, Stat, and Data Mining, Plus Charting

Mathematical, Statistical, Data Mining, and Finance

- Basic Types
- Linear Algebra
- Eigensystems
- Interpolation & Approximation
- Quadrature
- Differential Equations
- Nonlinear Equations
- Optimization
- Finance & Bond Calculations
- Variances, Covariances, & Correlations
- Time Series & Forecasting
- Multivariate Analysis
- Special Functions
- Basic Statistics
- Nonparametric Tests
- Regression
- Analysis of Variance
- Transforms
- Goodness of Fit
- Distribution Functions
- Random Number Generation
- Neural Network



Charting

- Scatter
- Line
- High-Low -Close
- Pie
- Bar
- Histogram
- Log and Semilog
- Polar
- Area
- Contour
- Heat Map
- Box Plot
- Function and Spline
- Error Bar
- Support for XML
- Date/Time Support

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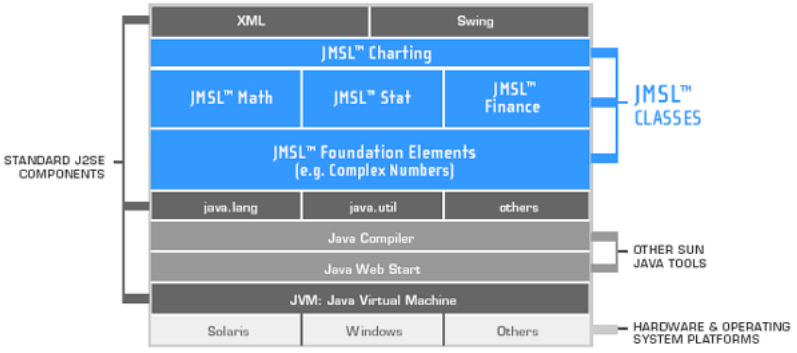
JMSL™ Architecture Overview



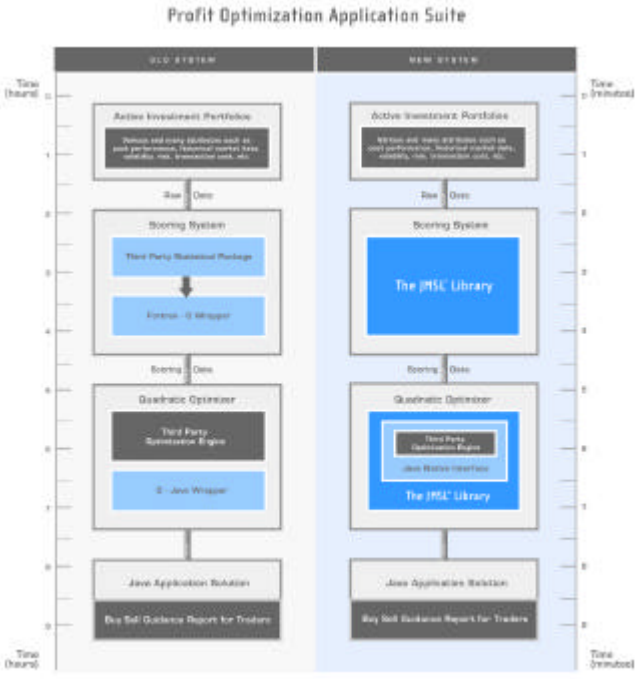
JMSL is the foundation for Java™ applications that require high-end math, statistical, and charting capabilities.

JMSL™ Implementation Options

- The JMSL Library is a pure Java™ class library. It can be used in any context in which Java J2SE can be used
  - Stand alone application running on a PC, Workstation, or Laptop
  - On a Web server
  - In an Applet within a browser
  - Using Java Web Start

Scalability and Embeddability using Numerics in Java™

- Clean Software Architecture
- Allows speed, simplicity, robustness
- Full native programming language
- Increased Performance
  - No wrappers that consume processor time
- Reduced complexity
- Faster Coding
- Easier Maintenance
- Increased stability



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What's New for the JMSL™ Numerical Library 3.0

- New Neural Network Data Mining Package

  Uniqueness:
  - Neural Network algorithms in 100% Java™
  - Fully embeddable technology
  - **Builds upon existing, comprehensive library with strong data mining and forecasting functionality**

  Key components:
  - Feed Forward Neural Network engine well suited for advanced predictive analysis
  - Neural Network pre- and post-processing algorithms for significant time savings
- Addition of important statistics algorithms for an even broader forecasting coverage
- New Chart Type
  - Heat Map to build upon strong, integrated Java charting package

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New Neural Network Data Mining Algorithms in 100% Java™

- Efficient and accurate predictive analysis on a highly scalable and collaborative environment
  - Data mining applications
  - Complex forecasting problems in corporate finance, insurance, business analytics, bioinformatics, life sciences
- Mimic human problem solving processes
  - Apply knowledge gained from past experience to new problems
  - Use historical data with known outcomes to build a predictive model of a complex system and use that data to train the network over time

Neural Network Technology: Main Categories of Applications

- **Forecasting:** predicting one or more quantitative outcomes from both quantitative and categorical input data,
- **Classification:** classifying input data into one of two or more categories, or
- **Statistical pattern recognition:** uncovering patterns, typically spatial or temporal, among a set of variables.

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Traditional Statistical Methods for Forecasting

- Forecasting and predictive models have been build using a variety of well known, traditional statistical methods
  - Linear regression and general least squares
  - Logistic regression and discrimination
  - Principal component analysis
  - Discriminant analysis
  - K-nearest neighbor classification
  - ARMA and ARIMA time series forecasts

Advantages of Neural Networks Over Traditional Methods (1/2)

- Neural Network configurations can be more simplified and yield the same solution as certain traditional statistical applications.
- Neural Networks provide a single framework for solving many traditional problems and can extend the range of problems that can be solved.

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Advantages of Neural Networks Over Traditional Methods (2/2)

- Neural Networks can provide more accurate and robust solutions for problems where traditional methods cannot be applied
  - Large amounts of noise
  - Short time series
  - Non stationary time series
  - Very large and complex systems
  - Apply without extensive analysis of underlying assumptions

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Demo

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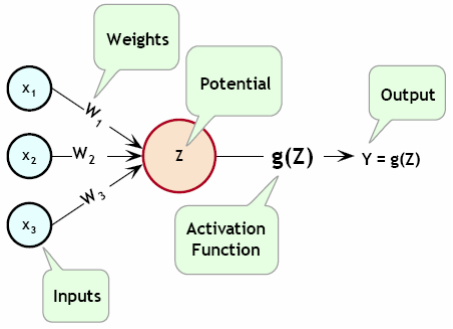
Neural Network Terminology



- *Weights* are applied to *inputs*
- An *activation function* is applied to the potential (*bias* term) at the *perceptron*
- An *output* is the result

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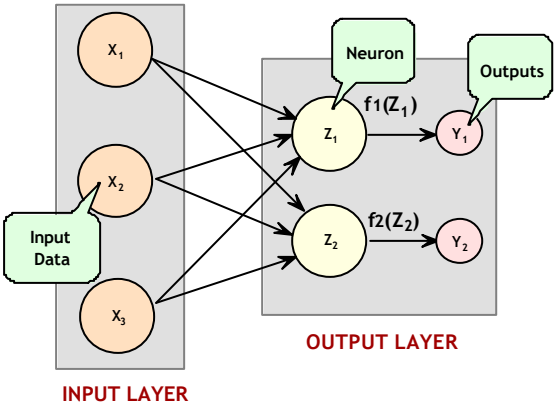
Single Layer Feed Forward Neural Network



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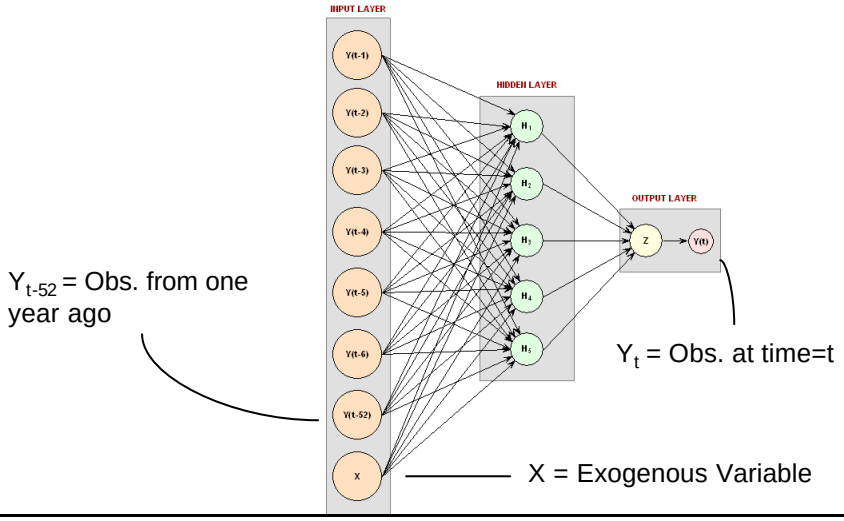
Time Series Forecasting with Exogenous Variables

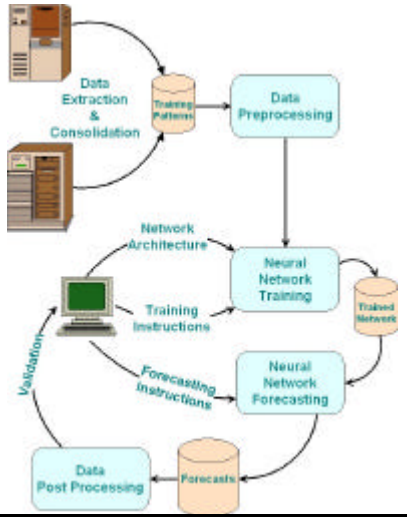


Y_{t-52} = Obs. from one year ago

Y_t = Obs. at time=t

X = Exogenous Variable

Neural Network Data Mining Process Flow Diagram



Visual Numerics components shown in blue rectangles

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Neural Network Data Mining Process Flow: Four Major Steps

- Data Filtering (“Data Pre-processing”)
  - Applied before sending data to a neural network training algorithm
  - Simplifies the network; makes training of the network more efficient
  - Continuous data, such as temperatures and pressures, should be scaled to fall within a range, normally –1 to 1
  - Reduce the dimensionality of data used as input to the network
  - Handling missing data
- Network Training
  - Use historical data to build a predictive model of a complex system
- Forecasting
  - Once the model is built, a current set of conditions can be fed to the model to generate a prediction of one or more target variables
- Network Validation
  - Compare known outcomes with forecasted outcomes
  - Train the network with a subset of the historical data

JMSL Classes and Methods
Pre- / postprocessing

- `ScaleFilter` *Scales or unscales continuous data prior to its use in neural network training, testing, or forecasting.*
- `TimeSeriesFilter` *Converts time series data to the format required for processing by a neural network.*
- `TimeSeriesClassFilter` *Converts time series data to the format required for processing by a neural network.*
- `UnsupervisedNominalFilter` *Converts nominal data into a series of binary encoded columns for input to a neural network. It also reverses the aforementioned encoding; accepting binary encoded data and returns a single nominal class.*
- `UnsupervisedOrdinalFilter` *Converts ordinal data into percentages. It also reverses encoding, accepting a percentage and converting it into an ordinal value.*

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JMSL Classes and Methods
Network Setup / Forecast

- `Network` *A neural network.*
- `FeedForwardNetwork` *A representation of a feed forward neural net network.*
- `Layer` *The base class for layers in a neural network.*
- `InputLayer` *Node layer in a neural net.*
- `HiddenLayer` *Hidden layer in a neural net.*
- `OutputLayer` *Output layer in a neural net.*
- `Node` *A node in a neural network.*
- `InputNode` *A node in the input layer.*
- `Perceptron` *A Perceptron node in a neural network. Perceptrons are created by a factory method in a layer.*
- `OutputPerceptron` *A Perceptron in the output layer.*
- `Link` *A link in the neural network.*

JMSL Classes and Methods Training

- `QuasiNewtonTrainer` *Trains a network using the quasi-Newton method,* `MinUnconMultiVar`.
- `LeastSquaresTrainer` *Trains a feed forward engine using nonlinear least squares solver.*
- `EpochTrainer` *Train the network with randomly selected subsets of the training patterns.*

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Teksouth

Financial Application

Need **Predictive Model to Forecast Compensation Expenses**

Solution **Custom Built Neural Net Analytics Application**

- Ability to better project staffing needs and accurately predict budget expenses
- Data mining, learning engine continuously refines forecasting model
- Ability for military agencies to much more effectively manage budgetary process
- Full application with easy ability to share across the enterprise

TEKSOUTH
CORPORATION

European Grocery Store Chain

- Problem
  - Inventory Planning and Forecasting
  - 200,000+ products and multiple stores
  - Previously relied on historical averages for forecasting
  - Unable to forecast short-term inventory requirements
- Goal
  - Reduce inventory costs through accurate, short-term forecasting of demand by product, by store

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European Grocery Store Chain

- Total Data Mining Solution
  - Numerical Libraries
  - Data Mining expertise
  - Packaged as a customized, configurable, easy-to-use solution
- Technology
  - Neural Net preprocessing
  - Forecasting and Training engines
  - Integrated into customers' intranet applications used by store managers

Summary

- Forecasting techniques can bring real competitive value to many organizations.
- There are a wide range of techniques available for forecasting and Visual Numerics has the tools and expertise to deliver the right solution for any application.

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Major European Wireless Provider

Telecommunications Industry

Need **Forecasting for Cellular Network Optimization**

Solution **IMSL™ Auto_ARIMA Algorithm**

- Required expert algorithm development to combine the concepts of two recent published papers on statistical methods
- Automatically identify and classify outliers (spikes in the data)
- Automatically locate any seasonal trends within the data
- Adjust the forecast to minimize the effect of any outliers and seasonality issues
- Automatically determine the best (p,d,q) ARIMA model for a particular dataset
- Provide the ability to pass a large number of datasets into the algorithm in a timely manner

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Q&A

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Weitere Informationen

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Stand Nr. 30 begrüßen zu dürfen!

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