

Index of Code Examples

1	File “hello.py”	XiV
2.1	Working with complex numbers	34
2.2	Complex transcendental functions	35
2.3	Java list example	51
2.4	Sorting Java lists	53
2.5	Sorting and removing duplicates	56
2.6	File “Func.py”	62
2.7	A thread example	67
2.8	Benchmarking Jython arrays	70
2.9	Writing a CSV file	75
2.10	Reading a CSV file	75
2.11	Converting CSV file	75
2.12	Reading a CSV file using sniffer	76
2.13	Writing data using the <code>java.io</code> package	78
2.14	Reading data using the <code>java.io</code> package	79
2.15	File “walker.py”	80
2.16	File collector	81
2.17	Building a file list	81
2.18	File list splitter	82
2.19	Swing GUI using Jython	83
3.1	Creating a F1D function	87
3.2	Initiation of a F1D function without parsing	88
3.3	Integration of a function	91
3.4	A function with parameters	93
3.5	Plotting two functions on the same canvas	97
3.6	Plotting two functions using <code>java.awt.Color</code>	98
3.7	Using 2 pads	99
3.8	Using HPlot canvas	101
3.9	Plotting 2D functions	103
3.10	Contour plot	105

3.11	Drawing a FND function	108
3.12	Drawing a FND function	108
3.13	Creating a non-continuous function using the Java class FNon	109
3.14	Creating $1 - \text{erf}(x)$ function using the Apache library	111
3.15	Building a function using Expression Builder	112
3.16	Building a custom function using Expression Builder	112
3.17	Showing a 2D function using 3D canvas	113
3.18	File “p2.py”	114
3.19	Building a custom function	115
3.20	Setting parameters	116
3.21	Setting parameters	116
3.22	Calling Java libraries. Module “special.py”	117
3.23	Calling special functions	118
3.24	Conversion to F1D	118
3.25	Conversion to F1D	118
3.26	Drawing parametric functions	120
3.27	Numerical minimization of a 2D function	123
3.28	Minimization of a 2D function	125
3.29	Minimization of a 2D function n Java	126
3.30	Using Migrad for a 1D function	127
3.31	Using Migrad for a 2D function	127
3.32	Serialization of functions	129
4.1	Transforming an array using the P0D class	135
4.2	Plotting an one-dimensional array using the P0D Java class	139
4.3	Creating an one-dimensional array using the F1D function	140
4.4	Serialized I/O	141
4.5	Java serialized I/O for the P0D class	143
4.6	Writing multiple 1D arrays	143
4.7	Reading multiple 1D arrays	143
4.8	Statistical characteristics of X and Y values	150
4.9	Adding data with correlations	155
4.10	Errors from two input P1D arrays	158
4.11	P1D serialization	160
4.12	Serialization of multiple containers	161
4.13	Serialization using dictionaries	161
4.14	Henon attractor	162
4.15	“measurement.py” module	164
4.16	Adding data	164
4.17	module “average.py”	165
4.18	A weighted average	165
4.19	Drawing P2D data in 3D	168
4.20	Showing P2D data in 3D	169
4.21	Showing objects in 3D using the P3D class	170
4.22	Showing PND data as a histogram	172



4.23	Visualizing a Lorenz vector	183
4.24	3D array using the Python approach	185
4.25	4D arrays using Nd4j Java library	186
5.1	Solving a linear system of equations	190
5.2	Computing eigenvectors of a real symmetric matrix	191
5.3	Working with complex matrices	192
5.4	Creating vectors in La4J	193
5.5	Creating matrices in La4J	193
5.6	Operations on La4J matrices	193
5.7	User-defined transformations	194
5.8	File output and input using the MatrixMarket format	194
5.9	Operations on EJML matrices	195
5.10	File input and output	195
5.11	Matrix visualization using a 2D density plot	196
5.12	Types of matrices of the Colt library	197
5.13	Working with Colt matrices	197
5.14	Matrix operations using multithreading	198
5.15	JBLAS matrix operations	199
5.16	Apache matrix operations	200
5.17	Vector operations	200
5.18	Operations on matrices using the Python approach	201
5.19	Creating a tensor using Redberry	203
5.20	Quadratic equation	204
5.21	Solving a cubic equation	204
5.22	Solving a polynomial equation	204
5.23	Solving a linear system of equations using La4J	205
5.24	Solving a linear system of equations using substitutions	205
5.25	Solving a linear system of equations using EJML	206
5.26	Solving a system of linear equations using Apache Math	206
6.1	Converting to elementary functions	210
6.2	Numeric conversions	210
6.3	Simplifying expression	210
6.4	Reducing to elementary functions	211
6.5	Symbolic substitution rules	211
6.6	Integration and simplification	213
6.7	Integration of symbolic calculations with DMelt Java classes	214
6.8	Series expansion	215
6.9	SymPy symbolic calculations	216
6.10	Differentiation using SymPy	216
7.1	Plotting histograms	220
7.2	Histogram operations	223
7.3	Histogram created from a function	227
7.4	Filling a 2D histogram	236
7.5	Showing several 2D histograms in 3D	237



7.6	2D contour histogram	238
7.7	Profile histogram	242
7.8	Working with a 2D profile histogram	243
7.9	Saving multiple histograms in a file	245
7.10	Reading histograms from a file	245
7.11	Writing and reading histograms without graphical attributes	246
7.12	Writing 10 arrays to files	248
7.13	Reading histograms	248
8.1	Text label example	262
8.2	Keys and their descriptions	264
8.3	Showing special symbols	267
8.4	Using mathematical symbols	268
8.5	A graph with interactive objects	270
8.6	Chart examples	271
8.7	A pie chart using JFreeChart	272
8.8	SPlot example	275
8.9	Creating a Henon attractor	275
8.10	Drawing “gluon” and “fermion” lines	277
8.11	Building blocks of the DMelt program	278
8.12	Drawing X-Y data using HPlotXY	280
8.13	HPlotXY example	280
8.14	Different types of data showed using HPlotJas	281
8.15	Visualizing 2D functions	282
8.16	Showing data on the HPlot2D canvas	284
8.17	Showing a parametric function in 3D	288
8.18	Drawing a Kuen Surface in 3D	289
8.19	Drawing a half-torus in 3D	290
8.20	Showing real-time data using HPlot	292
8.21	Real-time data showed in SPlot canvas	292
8.22	Showing real-time line traces	293
8.23	Combining plotting area with swing components	295
9.1	Writing objects to a file	301
9.2	Reading objects from a file	301
9.3	Using Java object browser for files	302
9.4	Writing event records with objects	303
9.5	Reading random events from a file	304
9.6	Benchmarking I/O operations	305
9.7	Writing DMelt objects in PFile files	307
9.8	Reading DMelt objects from PFile files	307
9.9	Reading objects using their names	308
9.10	Browsing data in PFile files	309
9.11	Writing an XML file with numeric data	310
9.12	Reading data from an XML HBook file	310
9.13	Reading XML HBook using a data browser	310
9.14	Writing ASCII data	311
9.15	Reading ASCII data	312
9.16	Reading ASCII data in Python	312
9.17	File “table.csv”	313
9.18	Reading the file “table.csv”	313



9.19	Showing “table.csv” file in a spreadsheet	314
9.20	Writing “out.csv” file	314
9.21	Writing lists to EDN files	315
9.22	Reading data from an EDN file	315
9.23	Reading files in the DIF format	316
9.24	Reading a ROOT file	317
9.25	Reading AIDA files	318
9.26	Data prototype. File “experiment.proto”	320
9.27	Generating a code based on Prototype Buffer	321
9.28	Writing data into a file. “WriteData.java” file	321
9.29	Compiling code with Prototype Buffer	322
9.30	Running WriteData program	322
9.31	Reading data. “ReadData.java” file	322
9.32	Running ReadData program	323
9.33	Writing data into a file. “WriteData.py” file	323
9.34	Reading data into a file. “ReadData.py” file	324
9.35	Adding new records. “AddData.py” file	324
9.36	Generating C++ code	325
9.37	Writing data into a file. “write_test.cc” file	325
9.38	Compiling the source codes	326
9.39	Reading data from a file. “read_test.cc” file	326
9.40	Generating C++ code	327
9.41	Creating a simple excel spreadsheet	328
9.42	Creating a large excel file with random numbers	328
9.43	Reading an excel spreadsheet	329
9.44	Creating a excel with styles	329
9.45	A simple object database with addresses	331
9.46	An object database: event records	331
9.47	Creating a file-based map with objects	332
9.48	Reading the file map with objects	333
9.49	Creating a MapDB database with numeric objects	334
9.50	Reading MapDB database	334
9.51	Creating a NeoDatis database with data	334
9.52	Reading objects from a NeoDatis database	335
9.53	Common module: “openDB.py”	336
9.54	Creating a SQL database	337
9.55	Reading a SQL database	338
9.56	Compacting a SQL database to a jar file	339
9.57	A module to work with binary data	339
9.58	Writing a histogram and 2D array to a database	339
9.59	Reading a histogram and 2D array from the database	340
9.60	Creating and filling a HSQLDB database	341
9.61	Creating a simple SQLite database	342
9.62	Reading a SQLite database	343



9.63	Example of a configuration file	344
9.64	Reading configuration file	345
9.65	Reading a configuration file	346
10.1	Descriptive statistics with Colt	354
10.2	Showing statistics of a histogram	355
10.3	Statistical analysis of lists	357
10.4	Calculation of correlation coefficients	358
10.5	Creating random numbers in Python loops	361
10.6	Random numbers using high-level DMelt methods	361
10.7	Colt random numbers	362
10.8	An empirical distribution of random numbers	363
10.9	Creating random density distributions in Colt	363
10.10	Convoluting Gamma with Poisson random numbers	367
10.11	Checking random numbers using a histogram	370
10.12	Random arrays with arbitrary PDF	371
10.13	Statistical summary of the binomial PDF	372
10.14	Creating random numbers using the Gamma function	373
10.15	Calculating the p -value for the Normal distribution	374
10.16	Numeric calculation of the p -value	374
10.17	Calculating the number events for p -value of 0.05	375
10.18	Calculating the p -value for the Poisson statistics	375
10.19	p -value for the Poisson statistics with uncertainty	375
10.20	Converting the p -value 3×10^{-7} to Z	376
10.21	Statistical significances for 3 and 5 σ	377
10.22	95% confidence interval using the t -distribution	378
10.23	Calculation of p -value for the Poisson statistics	380
10.24	Calculation of CL_b using a Monte Carlo method	381
10.25	95% confidence interval in the Cousins–Highland method	381
10.26	Calculation of a χ^2 test for X–Y data	383
10.27	Calculation of the χ^2 test	384
10.28	Comparing two histograms using the χ^2 test	385
10.29	Creating fake data for limit settings	386
10.30	Calculating exclusion limit using histograms	387
10.31	Creating fake “Higgs” data using random numbers	389
10.32	Calculating 5σ significance for “Higgs discovery”	390



10.33	Fitting data with a signal plus background function	392
10.34	Propogation of statistical uncertainties	394
10.35	Propogation of statistical uncertainties for arrays	395
10.36	Uncertainty propagation using a Monte Carlo method	396
10.37	Uncertainty propagation using random numbers	396
11.1	Creating data for the linear regression analysis	400
11.2	Linear regression analysis	402
11.3	Performing a fit using a Gaussian function	411
11.4	Preparing histograms for curve fitting	413
11.5	Signal+background fit of data	414
11.6	Creating a histogram with multiple peaks	415
11.7	Fitting multiple peaks	416
11.8	Fitting a 2D histogram using an analytic function	418
11.9	Fitting $x-y$ data with a second-order polynomial	420
11.10	An interactive fit of $x-y$ data	421
11.11	Performing a polynomial regression	422
11.12	Data preparation for fitting	423
11.13	Creating a fit function	423
11.14	Fitting data using the MIGRAD algorithm	424
11.15	Visualization of the fit results	424
11.16	Step 1: Data preparation	426
11.17	Step 2: Fit results	426
11.18	Performing a symbolic regression using input data	428
11.19	Drawing results of symbolic regression	429
12.1	Reading a CSV file from the web	434
12.2	Downloading a CSV file showing it in a spreadsheet	434
12.3	Transforming data records	435
12.4	Skimming data records	436
12.5	Slimming data records	436
12.6	Sorting records	437
12.7	A custom sorting function	437
12.8	Module “unique.py”	438
12.9	Testing duplicate removal module	438
12.10	Removing duplicate entries	439
12.11	Sorting and removing duplicates using <code>java.util</code>	440
12.12	Creating a file with multiple events	441
12.13	Analyzing complex data	446
12.14	Creating metadata records	446
12.15	Data analysis using metadata	446
12.16	Making an external file with metadata	446
12.17	Using external metadata records	446
12.18	Creating data files with arrays	446



12.19	Module “readthread.py”	447
12.20	Reading data in two threads	447
12.21	Data writer. Module “pwrite.py”	449
12.22	Module “readthread2.py”	449
12.23	Data reader using 1 thread	450
12.24	Reading data in parallel using 3 independent threads	450
12.25	Module “functhread.py”	451
12.26	Evaluation of four functions in parallel	452
12.27	Creating a data set using the Rutherford formula	456
12.28	Analyzing a particle distribution	457
12.29	Creating data with independent particle production	459
12.30	Modelling distances between particles	460
12.31	Modelling correlations between particles	461
12.32	Plotting multiplicity distributions	463
12.33	Studies of fluctuations	465
12.34	Getting data from the Web	468
12.35	“reader.py” module to read a CSV file	469
12.36	Analyzing galaxies	470
12.37	Reading a data file	471
12.38	Analyzing elementary particles	471
13.1	Creating a CSV file with input and output	477
13.2	Creating a neural net and train using a CSV file	477
13.3	Restoring the neural network	478
13.4	Programming a neural network using Encog	478
13.5	Solving the XOR problem with the Neuroph package	480
13.6	Training backpropagation neural network using words	481
13.7	Backpropagation neural network using words	482
13.8	Creating a data set for neural network studies	483
13.9	Standardizing input data for neural networks	484
13.10	Rescaling the data for neural networks	485
13.11	Preparing data for neural network studies	486
13.12	Building a feedforward neural network	486
13.13	Training a neural net	488
13.14	Neural network verification	489
13.15	Using the neural network for predictions	490
13.16	Building a simple Bayesian network (I)	492
13.17	Working with Bayesian networks (II)	493
13.18	Building a Bayesian network for hospital visitors	493
13.19	Preparing data and graphical canvas for a Kohonen SOFM	495
13.20	Building a Kohonen SOFM with self-organizing neurons	496



13.21	Preparing data for a Kohonen SOFM in 3D	497
13.22	Running a Kohonen SOFM in 3D	498
13.23	Illustrating a Bayesian self-organizing map (BSOM)	499
13.24	Running a non interactive BSOM	501
13.25	A Python module "NNpython.py"	502
13.26	Creating a data set	503
13.27	Neural network training and predictions	503
14.1	Creating data for a clustering analysis	507
14.2	Visualizing data for used for clustering	509
14.3	Running the K-means algorithm	510
14.4	Running the C-means algorithm with visualization	511
14.5	Running an interactive clustering analysis	513
14.6	Building a list of particles	514
14.7	Clustering particles into jets	515
14.8	Creating a histogram for smoothing	516
14.9	Applying the Lowess smoothing to a histogram	517
14.10	Interpolating scattered data	517
14.11	Smoothing using the Cubic smoothing spline	519
14.12	Example of a peak finder for arrays	520
14.13	Running a peak finder using a histogram	521
14.14	Eccentricity analysis in the X–Y plane	523
14.15	Running a PCA analysis in 2D space	524
14.16	Creating a simple decision tree	525
15.1	Extracting data from images	528
15.2	Table filled with numeric values	530
15.3	Conversion from kg to lb	532
15.4	Calculations with units and uncertainties	532
15.5	Calculation of the velocity of a falling object	532
15.6	Loading an image using the ImageJ package	534
15.7	Opening an image in ImageJ	534
15.8	Extracting the pixel array from an image	535
15.9	Statistical analysis of image colors	535
15.10	Building the histogram with image colors	535
15.11	Image creation after changing the pixel array	537
15.12	Edge detection of images	537
15.13	Discrete Fourier transforms for random matrices	538
15.14	Compound interest calculations	539
15.15	Creating a time series file	540
15.16	Exporting time series into external files	541
15.17	Exporting time series data in external files	542
15.18	Accessing time ranges	542
15.19	Plotting time series	543
15.20	Time series with a moving average	544
15.21	Creating a candlestick chart	545



16.1	Jython scripting with operator overloading	548
16.2	Showing histograms using “Example.java”	552
16.3	Compilation script “compile.sh”	553
16.4	file “Histogram.java”	555
16.5	PHP script “applet.php”	556
16.6	PHP script “list_files.php”	557
16.7	Showing histograms using “Example.bsh”	559
16.8	Showing histograms using “Example.groovy”	561
16.9	Creating a chart using JFreeChart and Groovy	562
16.10	Showing histograms using “Example.rb”	563
17.1	Creating custom functions in jMathLab scripts	577
17.2	Finding roots of the polynomial $3x^4 + 2x^3 + 5x^2 + 7x + 4$	578
17.3	Benchmarking Octave calculations in jMathLab	589
17.4	Benchmarking Jython calculations	589
17.5	Numeric integration in jMathLab	592
17.6	Plotting a function and its indefinite integral	593
17.7	Example of simplifying an expression	595
17.8	Showing data and a function on the same plot	597
17.9	Drawing two functions using the plot2d canvas	600
17.10	Showing a surface plot of the function $x^2 + y^2$ in 3D	602
17.11	Showing data in 3D using the same canvas	603
17.12	Solving a system of linear equations	604
17.13	Solving a system of equations symbolically	604
17.14	Non linear regression of $x - y$ data array	610
17.15	Plotting a histogram in Octave	611
17.16	Integrating an Octave calculation with Java	612
17.17	Integrating an Octave calculation with Python/Jython	612



Author Queries

Chapter

Query Refs.	Details Required	Author's response
	No queries.	