UNIVERSITY OF BIRMINGHAM

An Overview of MATLAB and Other Mathematic Modelling Tools

1. Introduction

MATLAB is a numerical computing environment and programming language. It is a commercial software owned by MathWorks, and is widely used in teaching and research. Although MATLAB has a campus agreement which grants the University unlimited usage of the core MATLAB product and a limited selection of toolboxes, the yearly subscription costs in excess of £100k.

In this scenario, we are investigating potential alternatives to MATLAB in terms of functionality and cost. There is a great variety of mathematical modelling software on the market. Initially we identified a list of more than 20 products including Python, R, SciPy and other variations of these. We shortlisted four major products based on the product features, popularity, maturity and support availability. These four alternative products are GNU Octave, Scilab, Mathematica and Julia. This paper will provide a brief introduction to each product, and compare it to MATLAB in terms of the licensing model, compatibility, programming language syntax, toolbox availability, platform differences and support level.

Finally, we have evaluated each of these products' advantages and disadvantages. Based on our evaluation, we conclude that it might be possible to replace MATLAB's core functions with GNU Octave, Scilab, Mathematica and Julia. However, to replicate all the functions (including the toolboxes that MATLAB provides) would require users to use a combination of these alternative products. Moreover, it would force users to learn to use different products, which would require a lot of effort, potentially affecting the effectiveness of their research output.

2. MATLAB

MATLAB is a numerical computing environment and programming language maintained by the MathWorks. MATLAB allows easy matrix manipulation, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs in other languages. Although it is numeric only, an optional toolbox uses the MuPAD symbolic engine, allowing access to computer algebra capabilities. An additional package, Simulink, adds graphical multi-domain simulation and model-based design for dynamic and embedded systems. MATLAB is widely used in teaching and research, being considered the market leader in this field.

In addition to the MATLAB core, MATLAB has packages in the following areas:

- Data Analysis
- Computational finance
- Image Processing and Computer Vision
- Control Systems
- Signal Processing and communications
- Computational biology
- Parallel Computing
- Simulink toolbox

2.1 EPS Current MATLAB License Model

There is evidence which suggests that staff would like to make more use of MATLAB, but the vendor's current pricing model does not allow this. MathWorks does offer a Campus-wide site license, however it will cost in excess of £100k per annum, and would take the form of a subscription (i.e. the license expires if not renewed each year). The

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University currently has a subscription for MATLAB license. Below is the EPS MATLAB licenses and toolbox purchased (updated in Nov. 2014[1])

FEATURE	LICENSES
MATLAB	400
Simulink	210
Communications System Toolbox *incorporates Communications Toolbox and Communications Blockset*	10
Control System Toolbox	100
Curve Fitting Toolbox	70 *
DSP System Toolbox *incorporates Signal Processing Blockset and Filter Design Toolbox*	10
Data Acquisition Toolbox	10
Fuzzy Logic Toolbox	50 *
Global Optimization Toolbox *formerly known as Genetic Algorithm & Direct Search Toolbox*	10
Model Predictive Control Toolbox	50 *
Neural Network Toolbox	62
Optimization Toolbox	145
Partial Differential Equation Toolbox	10
Robust Control Toolbox	50 *
Signal Processing Toolbox	25
SimElectronics	50 *
Simscape	50
Simulink Control Design	50
Simulink Design Optimization	50 *
SimPowerSystems	50
Statistics Toolbox	45
Symbolic Math Toolbox	170
System Identification Toolbox	10

Some other schools in the University also have MATLAB users; however the stats for this are not available.

3. GNU Octave

GNU Octave (https://www.gnu.org/software/octave/) is a free and open source computer program designed to perform numerical computations, and is mostly compatible with MATLAB. GNU Octave was first conceived in 1988 by James B. Rawling (University of Wisconsin-Madson) and John G. Ekerdt (University of Texas). The full-time development began in 1992, and since then it has experienced several major revisions.

GNU Octave is a high-level interpreted language, primarily intended for numerical computations. It includes functions designed to compute numerical solutions of linear and nonlinear problems, and perform other numerical experiments. It also provides extensive graphic capabilities for data visualization and manipulation. GNU Octave is normally used through its interactive command line interface, but it can also be used to write non-interactive programs. The Octave language is quite similar to MATLAB, making most programs easily portable. GNU Octave can be run on Linux, BSD, OS X and Windows.

3.1 GNU Octave License

GNU Octave is part of the GNU Project. It is free software under the terms of the GNU General Public License.

3.2 GNU Octave Comparison with MATLAB

Compatibility

GNU Octave was mainly developed to be MATLAB compatible. It has a lot of features in common with MATLAB:

- Matrices as fundamental data types.
- Built-in support for complex numbers.
- Powerful built-in math functions and extensive function libraries.

[1] COLEPS Matlab for Teaching, URL at https://universityofbirmingham.service-now.com/

- Extensibility in the form of user-defined functions.

Syntax Differences

- Whilst MATLAB does not allow syntax, GNU Octave parser does, so programs written for MATLAB might not run in GNU Octave, although it can be worked around using "user preference variables".

Toolbox

- Many of the MATLAB functions are available in GNU Octave; some of them accessible through packages via Octave-forge. Extra packages for GNU Octave are listed at:
    - http://octave.sourceforge.net/packages.php.
    - These packages are classified into 27 categories;
    - see at http://wiki.octave.org/Category:Octave-Forge .
- Not all of MATLAB functions are available in GNU Octave. Unimplemented functions are categorised in Image, Mapping, Optimization, Signal, and Statistics packages. Unimplemented MATLAB functions are also listed at GNU Octave site[2].

Platform Differences

- **Compiler:** There is no GNU Octave compiler, so users cannot convert Octave code into binary for additional speed or distribution. Although it is possible to use JIT to translate Octave into another language, compiling new code into an executable, it would require a significant amount of work to perform each step.
- **Just-In-Time compiler:** GNU Octave doesn't have a "Just-In-Time" compiler which allows the acceleration of for-loops functions. Users must vectorise the code as much as possible.
- **Graphic handles:** Up to GNU Octave 2.9.9 there was no support for graphic handles in GNU Octave itself. In the 3.2.N versions of GNU Octave and beyond, the support for graphics handles is converging towards full compatibility. The patch function is currently limited to 2-D patches, due to an underlying limitation in gnuplot, but the experimental OpenGL backend is starting to see an implementation of 3-D patches.
- Simulink: GNU Octave itself includes no Simulink support.

Support

- GNU Octave is open source free software, so the support and maintainance is mainly through the open source community.

4. Scilab

Scilab (http://www.scilab.org/) is a free open source software package for numerical computation. It was first developed at INRIA (French Institute for Research in Computer Science and Control). Since its conception in 1990s, Scilab has constantly undergone significant changes. In 2010, Scilab Enterprise was founded to guarantee the future of Scilab. Based on the classic open source business model. Scilab Enterprises also offers professional services and support for Scilab.

Scilab includes hundreds of mathematical functions. It has a high level programming language allowing access to advanced data structures, 2-D and 3-D graphical functions. A large number of functionalities are included in Scilab:

- **Maths & Simulation:** for usual engineering and science applications including mathematical operations and data analysis.
- **2-D & 3-D Visualisation:** graphics functions to visualise, annotate and export data, and many ways to create and customise various types of plots and charts.
- **Optimisation:** algorithms to solve constrained and unconstrained continuous and discrete optimisation problems.

[2] "Unimplemented MATLAB functions in GNU Octave", URL at http://hg.savannah.gnu.org/hgweb/octave/file/d63878346099/scripts/help/__unimplemented__.m#l530

- **Statistics:** tools to perform data analysis and modelling.
- **Control System Design & Analysis:** standard algorithms and tools for control system study.
- **Signal Processing:** visualise, analyse and filter signals in time and frequency domains.
- **Application Development:** increase Scilab native functionality and manage data exchanges with external tools.
- **Xcos - Hybrid dynamic systems modeller and simulator:** modelling mechanical systems, hydraulic circuits, control systems, etc.

4.1 Scilab License

Scilab is governed by the CeCILL license (GPL compatible), abiding by the rules of distribution of free software (since Scilab 5 family). Based on the classic open source business model, Scilab Enterprises also offers professional services and support on Scilab.

4.2 Scilab Comparison with MATLAB

Compatibility

Scilab shares some common features as MATLAB:

- High-level, numerically oriented programming language.
- Provides an interpreted programming environment, with matrices as the main data type.
- Built-in support for complex numbers.

Syntax Differences

- Although the syntax of Scilab is similar to MATLAB, it does not run MATLAB code directly. Scilab includes a source code translator for assisting the conversion of code from MATLAB to Scilab.
- Functions in Scilab are not MATLAB m-files but variables. The function(s) are not automatically loaded into Scilab. Usually, users have to execute the command “getf("myfile.sci")” before using it.

Toolbox

The Scilab ATOMS Portal (http://atoms.scilab.org/) is the repository for packaged extension modules for Scilab. It covers many areas from aerospace, bioinformatics to image processing etc. (See detail list in Appendix I). There is not a full list of functions that are not implemented comparing with MATLAB, and many users of Scilab find there is not enough variety of toolboxes available.

Platform Differences

- Scilab can be used as a standalone calculation engine, so all Scilab features can be called by external applications (e.g. Excel and LabVIEW).
- Scilab also provides connectors to Java, Python, C and C++.
- Scilab includes a free package called Xcos (based on Scicos) for modelling and simulation of explicit and implicit dynamical systems, including both continuous and discrete sub-systems. Xcos is the open source equivalent to Simulink from the MathWorks.

Support

- Scilab is free open source software, so it is free to use. Similar to the Red hat Linux service model, Scilab Enterprises can offer commercial services and support on Scilab.

5. Mathematica

Mathematica (https://www.wolfram.com/mathematica/) is a commercial computational software developed by Wolfram Research (founded by Stephen Wolfram in 1987). It is widely used in scientific engineering, mathematical fields, and other areas of technical computing. Mathematica is based on the Wolfram Language. The latest Mathematica is available in the cloud through any web browser, and also as a native desktop system.

It covers the following areas:

- Core Language and Structure
- Data Manipulation & Analysis

- Visualization & Graphics
- Symbolic & Numeric Computation
- Strings & Text
- Graphs & Networks
- Images
- Geometry
- Sound
- Time-Related Computation
- Geographic Data& Computation
- Scientific and Medical Data & Computation
- Engineering Data & Computation
- Financial Data & Computation
- Social, Cultural & Linguistic Data
- Higher Mathematical Computation
- Document & Presentation
- User Interface
- System Operation &Setup
- External Interfaces& Connections
- Cloud & Deployment

5.1 Mathematica License model

According to the Wolfram website, the University appears to have a product site license, however, the cost is not disclosed.

5.2 Mathematica Comparison with MATLAB

Compatibility

- Mathematica is not compatible with MATLAB. Mathematica is designed for symbolic & analytical analysis; MATLAB is for numerical analysis. Mathematica works better with symbolic formulas, while MATLAB focuses on high speed algorithms for numerical computation.
- Since Mathematica is designed for symbolic & analytical analysis, users can use it for numerical calculations, but it is slower for numerical work compared to MATLAB.
- Whilst there is the possibility of working with matrices, it is harder on Mathematica.

Syntax Differences

- The Wolfram language is completely a different to MATLAB. Users will need to learn Wolfram from scratch in order to use it.

Toolbox

- There is no official comparison of the packages provided between Mathematica and MATLAB. Mathematica supports many areas including Images, Geometry, Sound etc (see appendix I for details). From my experience, Mathematica 9 contains at least some of the functionalities of the 18 MATLAB tool boxes [3].

Platform Differences

- The latest Mathematica is available in the cloud through web browser, and also as a native desktop program. Instead, MATLAB is solely a native desktop program.

Support

- Mathematica is a commercial software, supported by Wolfram Research. It has different support levels, which range from technical services to premier services.

6. Julia

Julia (http://julialang.org/) is a free open source software designed by Jeff Bezanson, Stefan Karpinski, Viral B. Shah and Alan Edelmanin in 2012. It is a high-level dynamic programming language designed to address the requirements of high-performance numerical and scientific computing, while also being effective for general-purpose programming, web use, and as a specification language. It provides a sophisticated compiler, distributed parallel execution, numerical accuracy, and an extensive mathematical function library.

According to its website, a summary of features includes:

[3] "How many MATLAB toolboxes make a Mathematica 9", http://www.walkingrandomly.com/?p=4679

- **Multiple dispatch:** providing ability to define function behaviour across many combinations of argument types
- **Dynamic type system:** types for documentation, optimization, and dispatch
- **Good performance**, approaching that of statically-compiled languages like C
- **Built-in package manager**
- Lisp-like macros and other **meta programming facilities**
- **Call Python functions:** use the PyCall package
- **Call C functions directly:** no wrappers or special APIs
- **Powerful shell-like capabilities** for managing other processes
- Designed for **parallelism** and **distributed computation**
- **Coroutines:** lightweight "green" threading
- **User-defined types** are as fast and compact as **built-ins**
- **Automatic generation** of efficient, **specialized code** for different argument types
- Elegant and extensible **conversions and promotions for numeric** and other types
- **Efficient support for Unicode**, including but not limited to UTF-8
- **MIT licensed:** free and open source

6.1 Julia License Model

The core of the Julia implementation is licensed under the MIT license. Various libraries used by the Julia environment include their own licenses, such as the GPL, LGPL, and BSD.

6.2 Julia Comparison with MATLAB

Compatibility

Julia is not compatible with MATLAB. Julia is designed not only for numerical and scientific computing, but also for general-purpose programming.

Syntax Differences

- Julia is a new language; although MATLAB users may find Julia's syntax familiar, Julia is not a MATLAB clone. There are major syntactic and functional differences. The differences from MATLAB are listed on the Julia website[4].

Toolbox

- As a new language, its latest version is 0.3.11 (27 July 2015). On pkg.julialang.org there is a list of all 731 registered packages for Julia, although not all are tested and passed. It has very versatile packages. For instance, basic Arduino interface for Juia, interface to AWS, image processing etc.
- Julia's weakness is its number and variety of the toolboxes. Although it has quite an active community, it will take years to build packages to compete with the decades of accumulated contributions that MATLAB has.

Platform Differences

- Julia has Jun IDE environment, which makes it easier to use.
- Julia can directly call Python and C functions, no need for special APIs compare to MATLAB.
- Julia's site lists performance benchmarks compared to MATLAB, which in many areas it exceed or equal to MATLAB.

Support

- Julia is open source free software, so the support and maintenance is mainly through the open source community.

7. Pros and Cons

Comparing to MATLAB, GNU Octave, Scilab, Mathematica and Julia, each product has its own pros and cons.

[4] "Noteworthy Differences from other language" http://julia.readthedocs.org/en/latest/manual/noteworthy-differences/

GNU Octave:

Pros:

- It has many features in common with MATLAB: matrices as fundamental data type, built-in support for complex numbers; powerful built-in math functions and extensive function libraries; extensibility in the form of user-defined functions.
- It is the most compatible product with MATLAB. User can import MATLAB code into GNU Octave. By adjusting the "user preference variables", MATLAB code can run directly in GNU Octave.
- It has many additional packages via Octave-forge. These packages provide the same level functions as MATLAB. Unimplemented MATLAB functions are clearly stated at [ref.6]
- GNU Octave is free open source software, which saves the license cost comparing with MATLAB.

Cons:

- GNU Octave doesn't include any Simulink support.
- There is no GNU Octave compiler, so user cannot convert Octave code into binary for additional speed or distribution.

Scilab:

Pros:

- Scilab is compatible with MATLAB. Scilab includes a source code translator for assisting the conversion of code from MATLAB to Scilab.
- Scilab includes a free package called Xcos (based on Scicos) for modelling and simulation. Xcos is the open source equivalent to MathWorks' Simulink.
- Scilab is free open source software, which cuts the license cost compared to MATLAB. Scilab Enterprises can also offer professional services and support on Scilab; (need to look into how much the support fee would be.)

Cons:

- Scilab cannot run MATLAB code directly. Although it has a source code translator for MATLAB, the successful rate is variable due to the lack of corresponding functions/packages in Scilab.
- There is no full list of which functions are not implemented compared to MATLAB; many users of Scilab find that are not enough varieties of toolboxes available.

Mathematica

Pros:

- Mathematica supports different platforms. The latest Mathematica Online are available in the cloud through web browser, as well as the native desktop program.
- Although there is no official comparison between the packages provided by Mathematica and MATLAB, the former supports many areas including Images, Geometry, Sound etc (see appendix I for details). From a user's experience, Mathematica 9 contains at least some of the functionalities of the 18 MATLAB tool boxes [ref. 10].
- Mathematica is a commercial software, and according to their website, the University already has acquired a site license for it: staff and student should make the best use of it.

Cons:

- Mathematica is not compatible with MATLAB. Mathematica is designed for symbolic & analytical analysis; MATLAB is for numerical analysis. Mathematica works better with symbolic formula, while MATLAB focuses on high speed algorithms for numerical computation.
- Wolfram language is a different language to MATLAB, requiring users to spend time learning it.

Julia:

Pros:

- Julia is not only designed for numerical and scientific computing, but also for general-purpose programming.
- Julia's site lists performance benchmarks compared to MATLAB: in many areas it exceeds or equals MATLAB.

- Julia is free open source software, which cuts the license cost.

Cons:

- Julia is a new language, although MATLAB users may find Julia's syntax familiar, Julia is not a MATLAB clone. It will require users to spend time and effort to learn a new language.
- Julia's weakness is its number of the packages: although it has quite an active community, it will take years to build packages to compete with the decades of accumulated contributions that MATLAB has.

8. Conclusion

Based on the evaluations above, in principle it is possible to replace MATLAB's core functions with a combination of GNU Octave, Scilab, Mathematica and Julia, saving the University the MATLAB licensing cost. However, although replicating MATLAB functionalities, including the toolboxes that MATLAB provides, could be potentially doable, it would be highly impractical. It would require significant development effort and the final result would not be a seamless solution. Besides, users would be required to learn to use a combination of these alternative products, which would be also highly unpopular and inneficient.

9. Recommendations

Based on the evidence above, there does not appear to be an alternative software that is a clear, free, full clone of Matlab. Cheaper alternatives could be considered, but these would have serious impact on both on functionality and usability. Because of this, the IT Innovation Centre considers a site subscription to MATLAB to be the optimal option.

10. References:

1. "From Matlab to Scilab", URL at http://wiki.scilab.org/MatlabToScilab
2. Neeraj Sharma and Matthias K. Gobbert, Department of Mathematics and Statistics, University of Maryland, Baltimore County, "A COMPARATIVE EVALUATION OF MATLAB, OCTAVE, FREEMAT, AND SCILAB FOR RESEARCH AND TEACHING," http://userpages.umbc.edu/~gobbert/papers/SharmaGobbertTR2010.pdf
3. "GNU Octave" Wikipedia page, URL at https://en.wikipedia.org/wiki/GNU_Octave
4. "Unimplemented MATLAB functions in GNU Octave", URL at http://hg.savannah.gnu.org/hgweb/octave/file/d63878346099/scripts/help/__unimplemented__.m#l530
5. http://wiki.octave.org/FAQ#How_is_Octave_different_from_MATLAB.3F
6. "The best MATLAB Alternative" https://amca01.wordpress.com/2011/08/31/the-best-MATLAB-alternative/
7. "Scientific computation software revisited" http://www.dedoimedo.com/computers/scientific-new.html
8. "MATLAB-Scilab equivalents" http://help.scilab.org/docs/5.5.2/en_US/section_36184e52ee88ad558380be4e92d3de21.html

Appendix I – High Level Comparison of MATLAB, GNU Octave, Scilab, Mathematica and Julia

Tool	Matlab	GNU Octave	Scilab	Mathematica	Julia
Cost	Commercial subscription - expensive	Free	Free	Commercial subscription	Free
License	Commercial	Open Source	Open Source	Commercial	OpenSource
Matlab Compatible (Y/N)	Y	Y- MATLAB code can run in GNU Octave by setting "user preference variables"	Mostly-Use translator to convert MATLAB code	Not Compatible	Not Compatible
Description	Numerical computing environment and programming language	Mature high-quality Matlab clone. It has the highest degree of Matlab compatibility of all the clones.	Open source software package for numerical computation	commercial computational software designed for symbolic & analytical analysis	New language designed for efficiency and speed.
Features:					
Use matrices as data type	Y	Y	Y	N	N
Built-in support for complex numbers	Y	Y	Y	N	N
Powerful built-in math functions	Y	Y	Y	Y	Y
Extensive function Libraries	Y	Y	Y	Y	Y
Extensibility in user-defined functions	Y	Y	Y	Y	Y
Strong support for plots	Y	Y	Y	Y	Y
Simulink Support	Y	N	Y- Xcos is the open source equivalent to Simulink	N	N
Varieties of Toolboxes Availability	Extensive availability	Extensive; unimplemented functions mainly in image, mapping, optimization, signal and statistics.	Good availability; however, many users find not enough varieties of toolboxes available	Toolboxes comparable about some functions from 18 toolboxes of MATLAB	Limited availability
Windows Compatibility	Y	Y	Y	Y	Y
Documentation	Y	Y	Y	Y	Y
Support	Commercial	Open Source Community	Options for Open Source Community Support or subscribe to Scilab Enterprise Support	Commercial Support	Open Source Community
Website	http://uk.mathworks.com/	http://www.gnu.org/software/octave/	http://www.scilab.org/	https://www.wolfram.com/mathematica/	http://julialang.org/

Ref: An Overview of MATLAB and Other Mathematic Modelling Tools (12/10/2015)
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Appendix II – Toolboxes Supported by Each Product

<table>
<tr><th colspan="2">MATLAB</th><th>GNU Octave</th><th>Scilab</th><th>Mathematica</th><th>Julia</th></tr>
<tr><th colspan="2">Matlab Core</th><th>Octave Forge</th><th>Scilab language</th><th>Wolfram Language</th><th>Julia language</th></tr>
<tr>
<td>Data Analysis
Curve Fitting Toolbox
Database Toolbox
Global Optimization Toolbox
Neural Network Toolbox
Optimization Toolbox
Parallel Computing Toolbox
Statistics and Machine Learning Toolbox
Symbolic Math Toolbox
Control Systems
Simulink
Control System Toolbox
Signal Processing Toolbox
Simulink Control Design
Simulink Design Optimization
SimPowerSystems
Stateflow
System Identification Toolbox
Fuzzy Logic Toolbox
Model Predictive Control Toolbox
Robust Control Toolbox
SimElectronics
Simscape
Signal Processing and communications
Simulink
Communications System Toolbox
Data Acquisition Toolbox
DSP System Toolbox
Instrument Control Toolbox
Partial Differential Equation Toolbox
Image Processing and Computer Vision
Computer Vision System Toolbox
Image Acquisition Toolbox
Image Processing Toolbox
Parallel Computing Toolbox
Signal Processing Toolbox
Computational biology
Bioinformatics Toolbox
Curve Fitting Toolbox
Global Optimization Toolbox
Image Processing Toolbox
Instrument Control Toolbox
Optimization Toolbox
Parallel Computing Toolbox
Signal Processing Toolbox
SimBiology</td>
<td>Computational finance
Curve Fitting Toolbox
Database Toolbox
Datafeed Toolbox
Econometrics Toolbox
Financial Instruments Toolbox
Financial Toolbox
Global Optimization Toolbox
Optimization Toolbox
Parallel Computing Toolbox
Spreadsheet Link EX
Parallel Computing
Parallell Computing Toolbox
MATLAB Distributed Computing Server
Code Generation
Simulink Coder
Embedded Coder
HDL Coder
Vision HDL Toolbox
Simulink PLC Coder
Fixed-Point Designer
DO Qualification Kit (for DO-178)
IEC Certification Kit (for ISO 26262 and IEC 61508)
Real-Time Simulation and Testing
Simulink Real-Time
Simulink Desktop Real-Time
Verification, Validation, and Test
Simulink Verification and Validation
Simulink Design Verifier
Simulink Test
Simulink Code Inspector
HDL Verifier
Polyspace Bug Finder
Polyspace Code Prover
Simulation Graphics and Reporting
Simulink 3D Animation
Gauges Blockset
Simulink Report Generator</td>
<td>Agora Octave - rapid collaboration tool to code distribution
Bim Package - solving Diffusion Advection Reaction (DAR) Partial Differential Equations
Communication package
Control package
Dicom package - Digital communication in medicine (DICOM)
Fem-fenics -solving partial differential equations
Financial package
Geometry package
Image package
Instrument control package
Interval package - real-valued interval arithmetic
IO package
Java package
Mapping package
Mechanics package
Ocs package - Octave Circuit Simulator
Optimization package
Parallel package
Robotics package
Signal package
Sockets package
Statistics package
Symbolic package
TISEAN package - analysis of time series with methods based on the theory of nonlinear deterministic dynamical systems, or chaos theory
TISEAN package:Procedure
Video package</td>
<td>Aerospace
Bionformatics
Contributed Scilab Binaries
Data Analysis and Statistics
Data Handling
Documentation
Editor Styles
Education
Finite State Machines
GUI
Graphics
Graphs
Image Processing
Instruments Controls
Linear algebra
Manuals
Modeling and Control Tools
Number theory
Numerical Maths
Optimazation
Physics
Real-time
Scilab development
Technical
Tests
Windows Tools
Xcos</td>
<td>Data Manalipulation & Analysis
Visualization & Graphics
Strings & Text
Graphs & Networks
Higher Mathematical Computation
Images
Geographic Data & Computation
Time-Related Computation
Symbolic & Numeric computation
Sound
Engineering Data& Computation
Scientific and Medical Data & computation
Social, Cultural & Linguistic Data
Geometry
Financial Data & Computation</td>
<td>AffineTransforms - Computational geometry with affine transformations
Arduino - Basic Arduino interface for Julia
ArrayViews - A Julia package to explore a new system of array views
AudioIO - Simple Audio IO in Julia
BayesNets - Bayesian Networks for Julia
Bio - Bioinformatics and Computational Biology Infrastructure for Julia
Calculus - Calculus functions in Julia
Clustering - A Julia package for data clustering
CompilerOptions - A Julia package for reading compiler options
Contour -Calculating contour curves for 2D scalar fields in Julia
DCEMRI - DCE MRI analysis in Julia
DataFrames - library for working with tabular data in Julia
DataStructures - Julia implementation of Data structures
Digits - Julia package for integer digit manipulation
DistributedArrays - Distributed Arrays in Julia
A few example of packages are listed above, http://pkg.julialang.org/ lists all 731 registered packages for Julia programming language</td>
</tr>
</table>

• Statistics and Machine Learning Toolbox					