Sharing MATLAB® Based Applications

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Data Analytics and Technical Computing Workflow

HDFS

SERVER

Data Exploration
- Gain Insights
- Filter Data
- Build Intuition
- Hypothesize

Analytics Development
- Create prototype
- Machine Learning
- Optimization
- App Development

Analytics Integration
- Version Control
- Testing Code
- Validation
- Deploy & Share

Desktop

Web Application

http://www.mathworks.com
Ways to share your work using MATLAB

1. Collaborative Development

2. Testing your code

3. Sharing MATLAB programs with MATLAB Users
   - MATLAB Apps
   - Toolbox Packaging

4. Share MATLAB programs with people who do not have MATLAB
   - Create Standalone Executable
   - Integrate MATLAB programs with other applications
   - Deploy MATLAB application on large scale
Engineers and Scientists Need to Produce Robust Software

“Scientists typically develop their own software ... recent studies have found that scientists typically spend 30% or more of their time developing software.

90% or more of them are primarily self-taught ... lack exposure to basic software development practices such as writing maintainable code, using version control and issue trackers, code reviews, unit testing, and task automation.”

Source: Best Practices for Scientific Computing
Wilson, et. al. PLOS Biology – January 2014
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Collaborative Development

- Collaborative development is growing
  - Achieve results faster and more efficiently by sharing code and ideas
  - **Key to success is the capability to manage your code**

- Modern source control environments let you:
  - Track, compare and revert changes in your code
  - Modify your working copy of the code and commit changes when ready to share with others
  - Highlight and resolve differences when multiple people edit the same file
Source Control Integration

- Manage your code from within the MATLAB Desktop
- Leverage modern source control capabilities
  - GIT and Subversion integration in Current Folder browser
- Use Comparison Tool to view and merge changes between revisions
Collaborating using GitHub

GitHub

Chebfun

MATLAB Central

File Exchange

Chebfun

by Chebfun Team

21 Jun 2014 (Updated 10 Dec 2014)

Chebfun is an open-source package for numerical computation with functions to 15-digit accuracy

File Information

Description: Chebfun is an open-source software system for numerical computing with functions. The mathematical basis is piecewise polynomial interpolation implemented with what we call “Chebyshev technology”. The foundations are described, with Chebfun examples, in the book Approximation Theory and Approximation Practice (L. N. Trefethen, SIAM 2013). Chebfun has extensive capabilities for dealing with linear and nonlinear differential and integral operators, and also includes continuous analogues of linear algebra notions the QR and singular value decomposition. The Chebfun2 extension works with functions of two variables defined on a rectangle in the x-y plane.
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Why formally test your code?

- **Testing improves quality**
  - Check that your code works the way you think it should
  - Can easily see what broke and where bugs are located

- **Testing saves development time**
  - Improve or rewrite your code without fear of breaking it
  - Most of the effort we spend on code, we actually spend fixing it
Effectively Test Your Code in MATLAB

- MATLAB Unit Test Framework
  - Script-based interface
  - Function-based interface
  - Object-oriented interface

- Report generation and publishing
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App Packaging

- Apps are self-contained tools, typically with a UI

- Package your app as single installation file
  - Easy distribution and installation into the apps gallery
  - Automatically includes all necessary files
  - Documents required products
Custom Toolbox Packaging

- Package your toolbox as a single installer file
  - Contains all of the code, data, apps, documentation, and examples
  - Checks for dependent files and automatically includes them
  - Documents required products

- Included folders and files automatically appear on path when installed

- View details and uninstall toolboxes with Manage Custom Toolboxes dialog box
Summary – Managing & Sharing MATLAB Code

Testing
- Unit Testing
- Report generation and publishing

Code Quality / Performance
- Analysis
- Complexity
- Debugging
- Profiling

MATLAB Authors
- MATLAB files
- Data
- Documentation

MATLAB End Users

Source control
(Git, Subversion)

Collaborate
- Peer

Get from GitHub

Unit Testing
- Complex
genization
- Debugging
- Profiling

Testing

Source control

MATLAB Central

GitHub

File Exchange
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A Primer on Sharing MATLAB Programs

MATLAB Compiler
MATLAB Compiler SDK
MATLAB Runtime
MATLAB

for k=1:max
x = fft(data)
y = 20*log1

Integrate
algorithms with custom software
Prototype
algorithms on PC's
Accelerate
algorithm execution
Implement
algorithms on embedded processors

MATLAB Coder product
**Deployment using MATLAB Compiler**

**MATLAB Compiler** for sharing MATLAB programs without integration programming

**MATLAB Compiler SDK** provides implementation and platform flexibility for software developers

**MATLAB Production Server** provides the most efficient development path for secure and scalable web and enterprise applications
Demo: Example Used for Deployment

- **Goal**
  - Estimate daily mean global solar radiation given low cost and easily obtained measurements; thus, estimate the power that can be generated from photovoltaic cells

\[
R_s = a \left(1 + bH\right)\left(1 - e^{-c \Delta T^n}\right)
\]
Demo 2: Modeling Global Solar Radiation
Using MATLAB Compiler

Compiled applications can be shared as:

- Standalone desktop applications
- Add-ins for integration with Microsoft Excel® spreadsheets
- Components that run MATLAB code against Hadoop

Create professional software with customizable installers, icons, and splash screens … without integration programming
Sharing Standalone Applications

1. Application Author

2. MATLAB Compiler
   - Standalone Application
   - Excel Add-in
   - Hadoop

3. End User
Using MATLAB Compiler SDK

Flexible toolkit for software developers
- Integrate with applications written in C/C++, .NET, Java
- Develop applications for MATLAB Production Server

Develop a custom application server or deploy with MATLAB Production Server
Integrating MATLAB-based Components

MATLAB

Toolboxes

Application Author

MATLAB Compiler SDK

C/C++ Java .NET MATLAB Production Server

Software Developer

Application author and software developer *might* be same person

MATLAB Runtime

1. Example MATLAB code:
   \[ S = 31; K = 30; C = \text{blsprice}(S, K, 0.1, 0.05, 2, 0); P = C - S + K \times \text{exp} \]

2. MATLAB Compiler SDK

3. MATLAB Production Server

4. MATLAB Runtime

5. Application author and software developer *might* be the same person.
Deployed Applications with Hadoop

MATLAB runtime

Datastore

HDFS

Node

Data

Map

Reduce

Node

Data

Map

Reduce

Node

Data

Map

Reduce

MATLAB MapReduce Code
Scale up with MATLAB Production Server

Most efficient path for creating enterprise applications

Deploy MATLAB programs into production
- Manage multiple MATLAB programs and versions
- Update programs without server restarts
- Reliably service large numbers of concurrent requests

Integrate with web, database, and application servers
Summary - MATLAB Application Deployment

- Share MATLAB programs with people who do not have MATLAB
  - Royalty-free distribution
  - Encryption to protect your IP

- Create both standalone applications and components for integration

- Deploy to desktop, web, and enterprise applications
Additional Resources

- **Documentation**
  - Source Control Integration
  - Techniques for Improving Performance
  - Unit Testing Framework
  - Toolbox Distribution and Documentation Tools

- **Webinars**
  - Programming with MATLAB
  - Speeding up MATLAB Applications

- **MATLAB Central**
  - Open exchange for the MATLAB and Simulink user community
Thank you