MATLAB CONFERENCE 2017

Introduction to Data Analytics with MATLAB

David Willingham

WITH SOFTWARE
(and smart people)

ANYTHING IS POSSIBLE

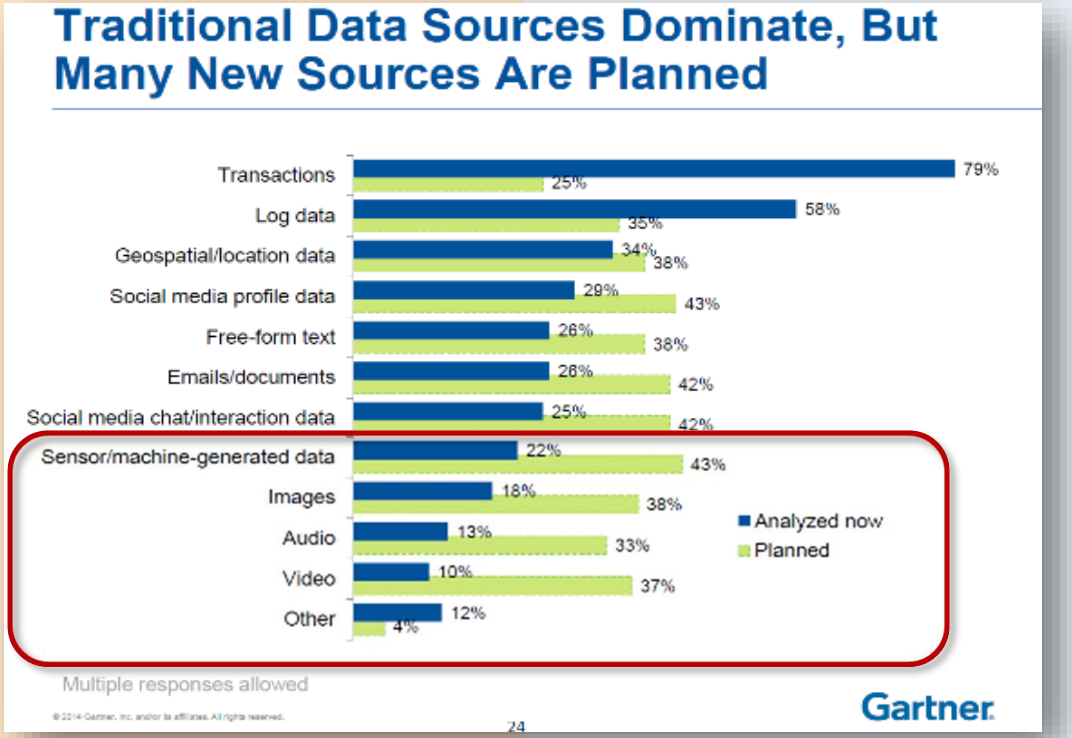
Business and Transactional Data

Repositories
- Databases (SQL)
- NoSQL
- Hadoop

File I/O
- Text
- Spreadsheet
- XML

Web Sources
- RESTful
- JSON
- HTML
- Mapping
- Financial datafeeds

Analytics that increasingly require both business and engineering data



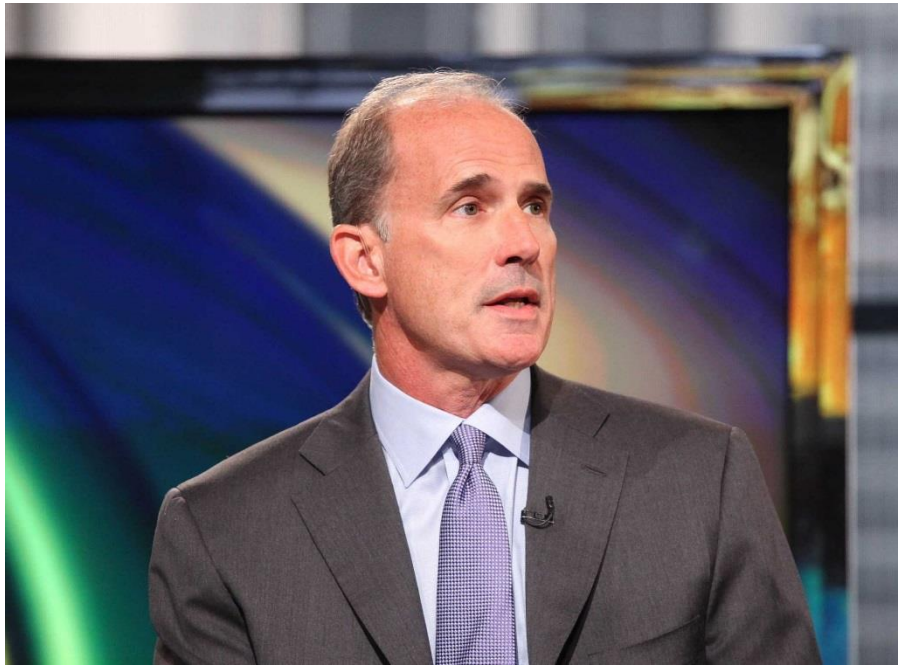
Engineering, Scientific, and Field Data

File I/O
- Text
- Spreadsheet
- XML
- CDF/HDF
- Image
- Audio
- Video
- Geospatial

Communication Protocols
- CAN (Controller Area Network)
- DDS (Data Distribution Service)
- OPC (OLE for Process Control)
- XCP (eXplicit Control Protocol)

Real-Time Sources
- Sensors
- GPS
- Instrumentation
- Cameras
- Communication systems
- Machines (embedded systems)

“Data is the sword of the 21st century, those who wield it the samurai.”



Google’s Former SVP - Jonathan Rosenberg

- Big data — how to create it, manipulate it, and put it to good use.
- “If you want to work at Google, make sure you can use MATLAB.”

2017 Gartner Magic Quadrant – Data Science

Why MATLAB?

1

MATLAB Analytics work with **business** and **engineering data**

DATA
- Engineering, Scientific, and Field
- Business and Transactional

Data Analytics

2

MATLAB lets **engineers do Data Science** themselves

Embedded Systems
Developed with Model-Based Design

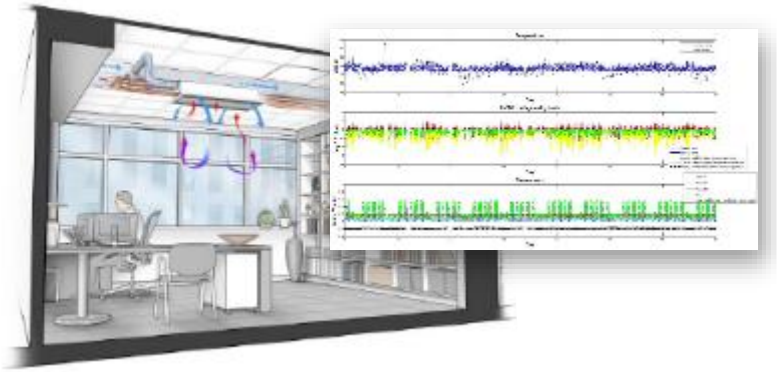
3

MATLAB Analytics **run anywhere**

Enterprise IT Systems

MATLAB for Data Analytics

Customer Examples



Online optimization of building energy use

- Real-time, cloud-based system
- Combines analytics with optimization for predictive control of single-building HVAC
- Energy consumption reduced 15-25%

Online engine health monitoring

- Real-time analytics integrated with enterprise service systems
- Predict sub-system performance (oil, fuel, liftoff, mechanical health, controls)
- Improve aircraft availability and reduce maintenance costs

Cloud-based wheeze analysis

- Medical device to monitor and manage asthma and COPD
- Leverages analytics in cloud and embedded system

http://www.mathworks.com/company/events/conferences/matlab-conference-australia/2015/abstracts.html?expand=cp&#cp_session1

Railway Systems

Automotive

Aeronautics

Retail

Finance

Off-highway vehicles

Industrial Automation

Oil & Gas

Clean Energy

Medical Devices

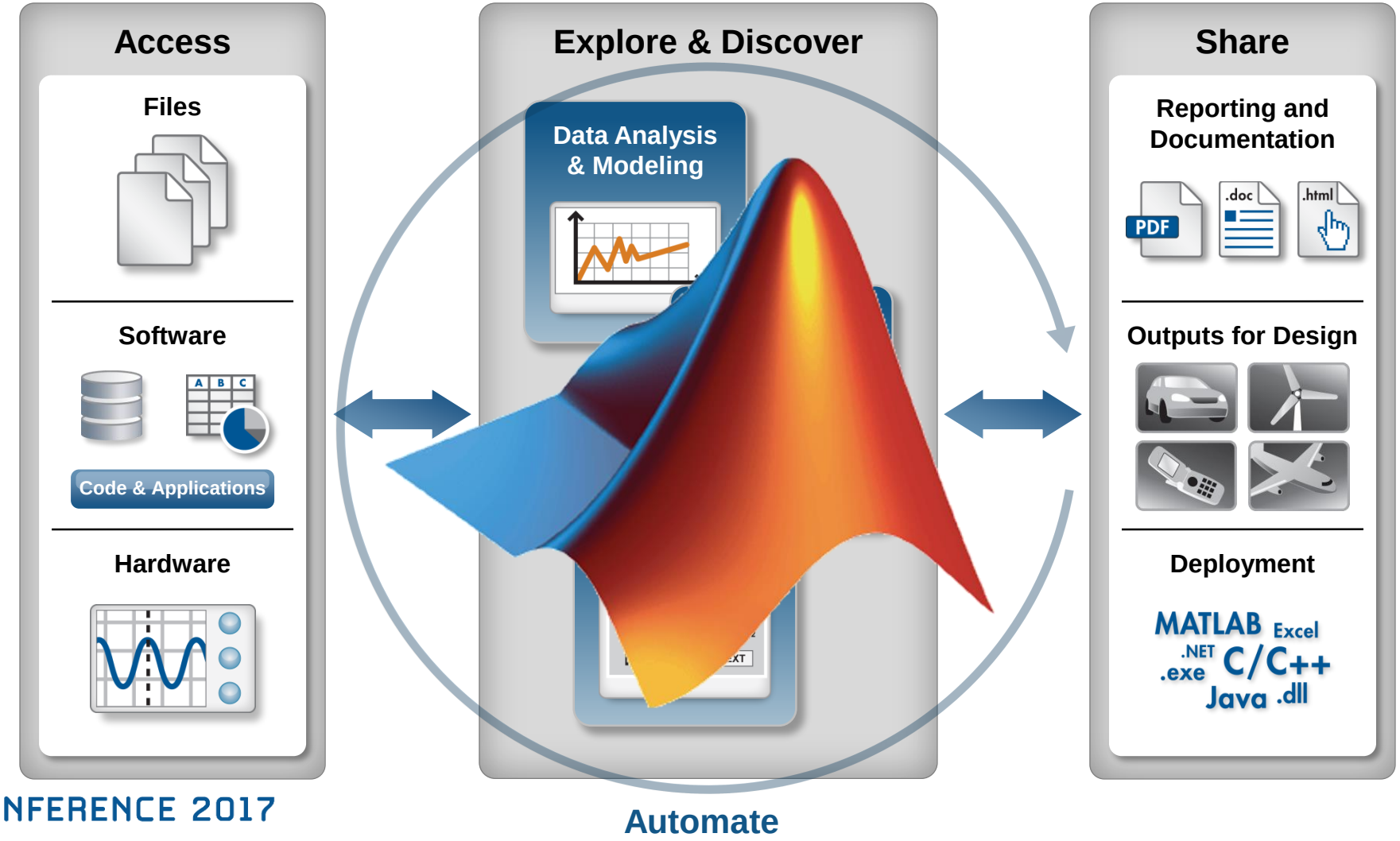
Healthcare Management

Internet

Logistics

Condition Monitoring
Prognostics
Retail Analytics
Fleet Analytics
Operational Analytics
Data Analytics
Process Analytics
Risk Analysis
Health Monitoring
Supply Chain
Mfg Process Analytics
Asset Analytics
Healthcare Analytics

Data Analytics Workflow



Frontier Advisors Develops Web-Based Platform for Portfolio Analytics

Challenge

Provide clients with an industry-first web platform for portfolio modeling and analytics

Solution

Use MATLAB to develop and test analytics modules, and use MATLAB Compiler SDK to deploy them into a production .NET environment

Results

- Quantitative development decoupled from interface development
- Stable, responsive system deployed
- Rapid delivery of new features enabled

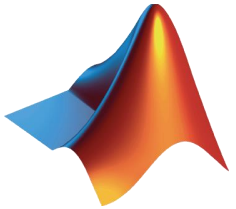
"MATLAB and MATLAB Compiler SDK enabled us to rapidly deliver a sophisticated portfolio analytics web application with confidence that it will return accurate results extremely quickly, ensuring a highly usable and stable platform for our clients."

Lee Eriera

Frontier Advisors

Today's Objectives

- Introduce you to data analysis with MATLAB
- Show how you can overcome common data analysis challenges with MATLAB
- Demonstrate multiple ways of sharing your analysis and results with others



Common Data Analysis Challenges
using Excel

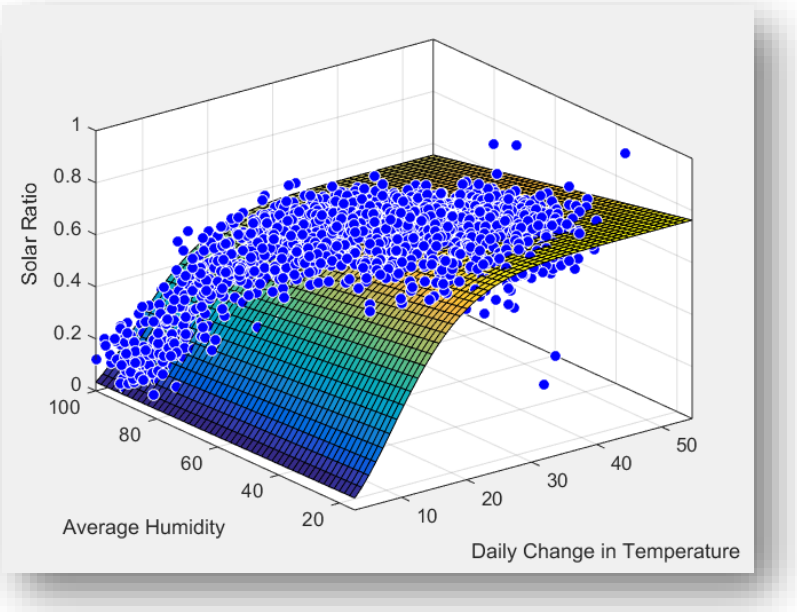
- Complex calculations
- Messy Data
- Speed of Execution
- Automation
- Batch Processing
- Report Generation
- Deployment

Demo: Solar Radiation Estimation

Introduction to Data Analysis with MATLAB

- Goal:
  - Estimate daily mean global solar radiation given low cost and easily obtained measurements

- Approach:
  - Process historical measurements
  - Develop predictive model
  - Document analysis in a report
  - Apply analysis on multiple files



Modeling Global Solar Radiation

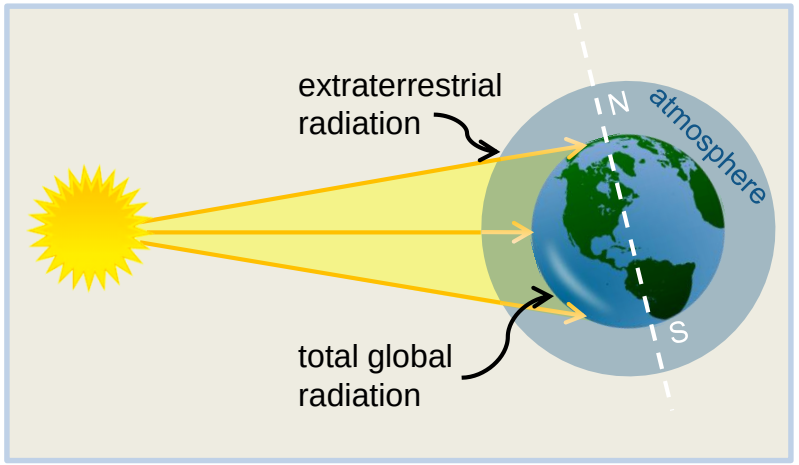
$$R_s = a\,(1 + bH)(1 - e^{-c\,\Delta T^n})$$

Solar Ratio (R_s) = $\dfrac{\text{Global solar radiation}}{\text{Extraterrestrial solar radiation}}$

Daily Temperature Difference (ΔT) = $T_{DailyMax} - T_{DailyMin}$

H is Relative Humidity

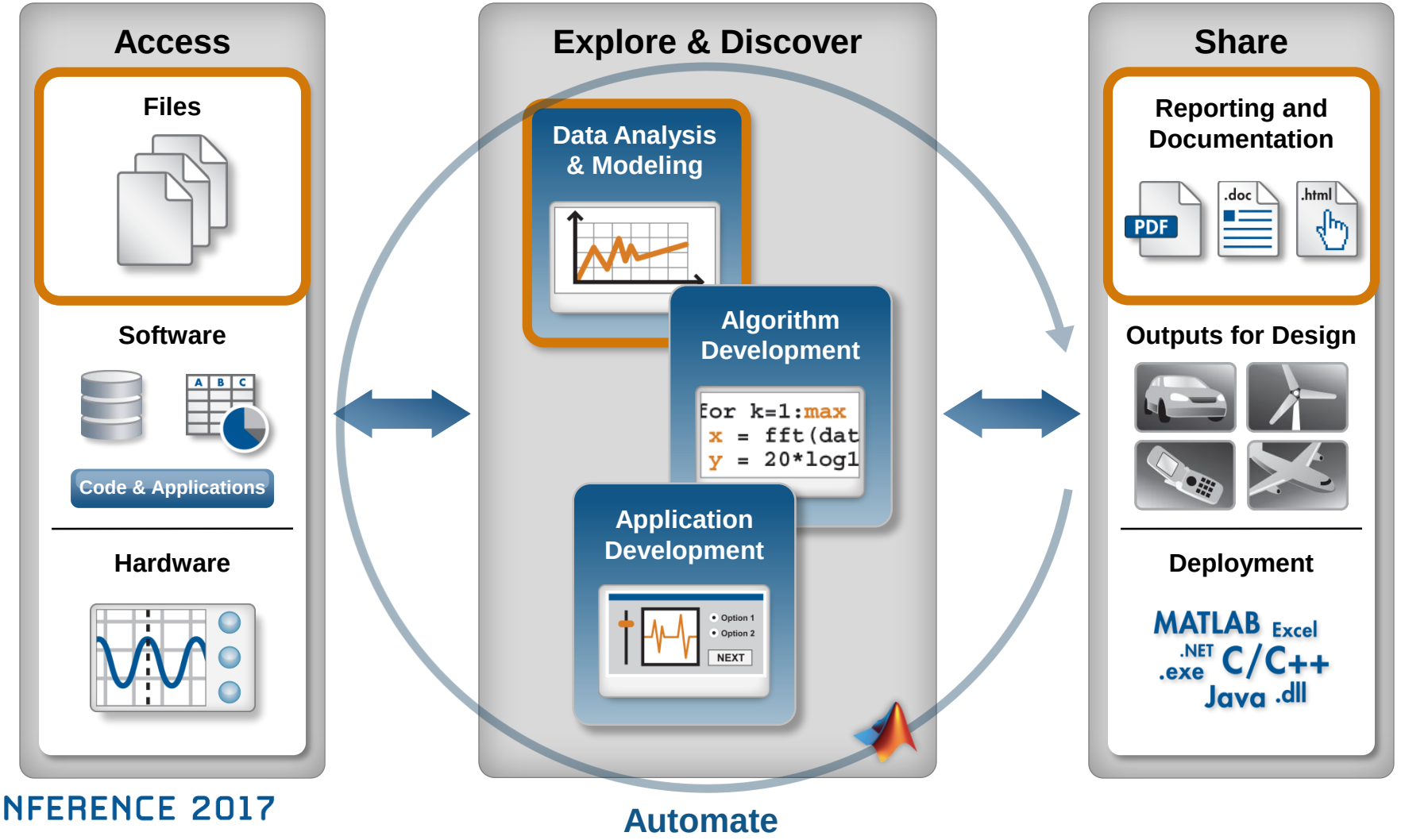
a,b,c,n are the model coefficients



Demo Summary

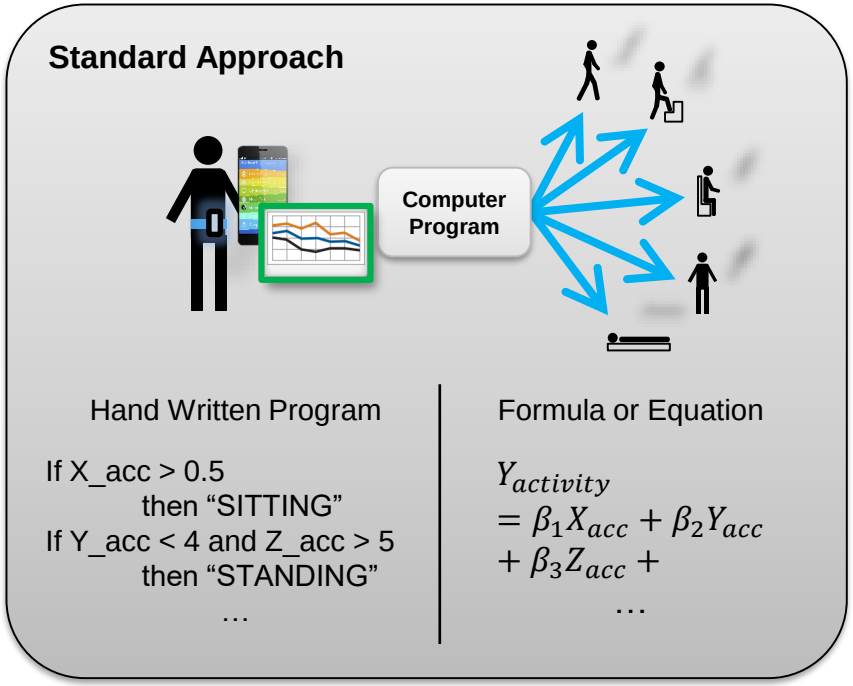
Solar Radiation Estimation

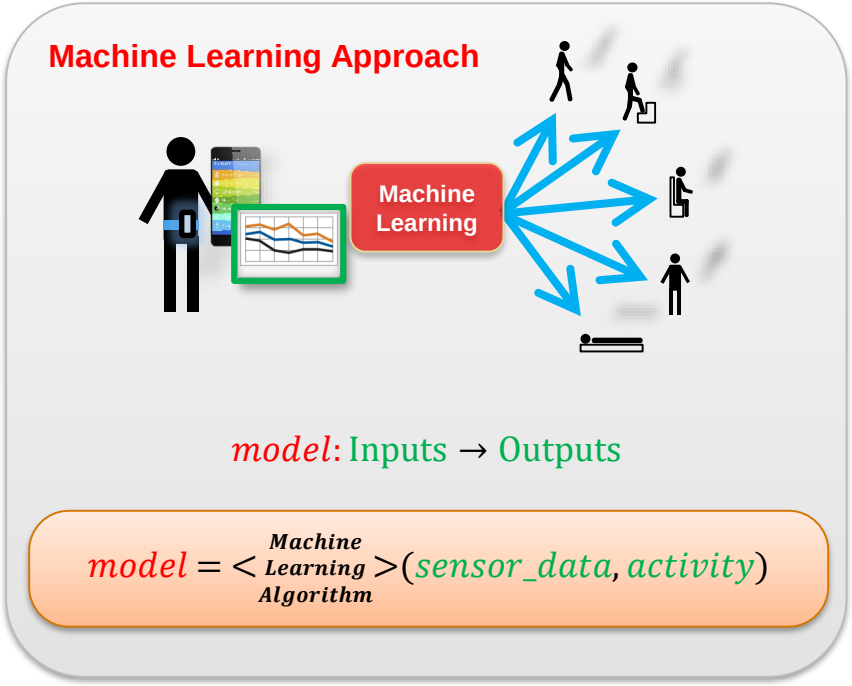
Products Used
- MATLAB
- Curve Fitting Toolbox



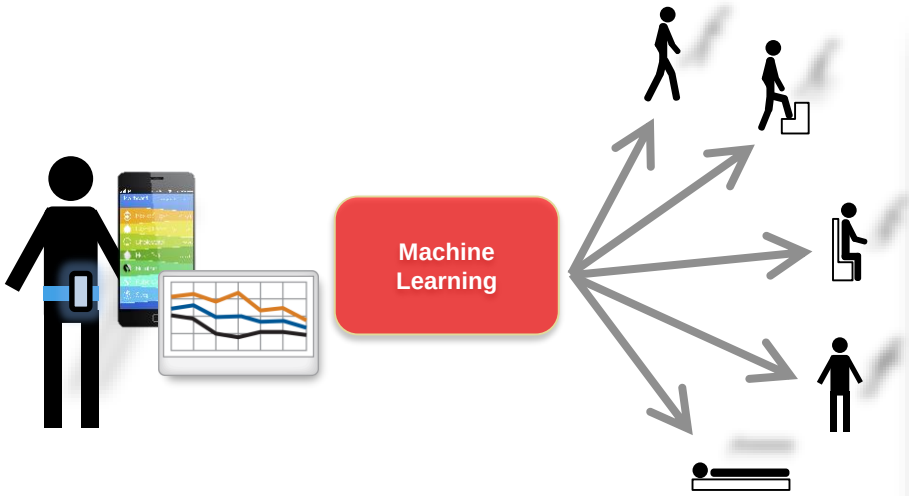
Machine Learning

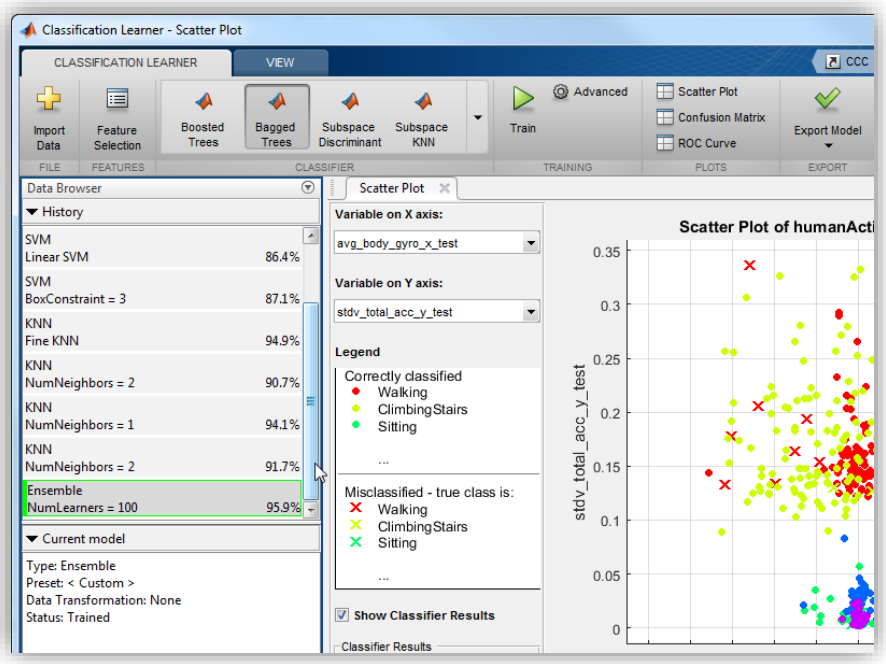
Machine learning uses **data** and produces a **program** to perform a **task**





Demo: Machine Learning Using Mobile Phone Data



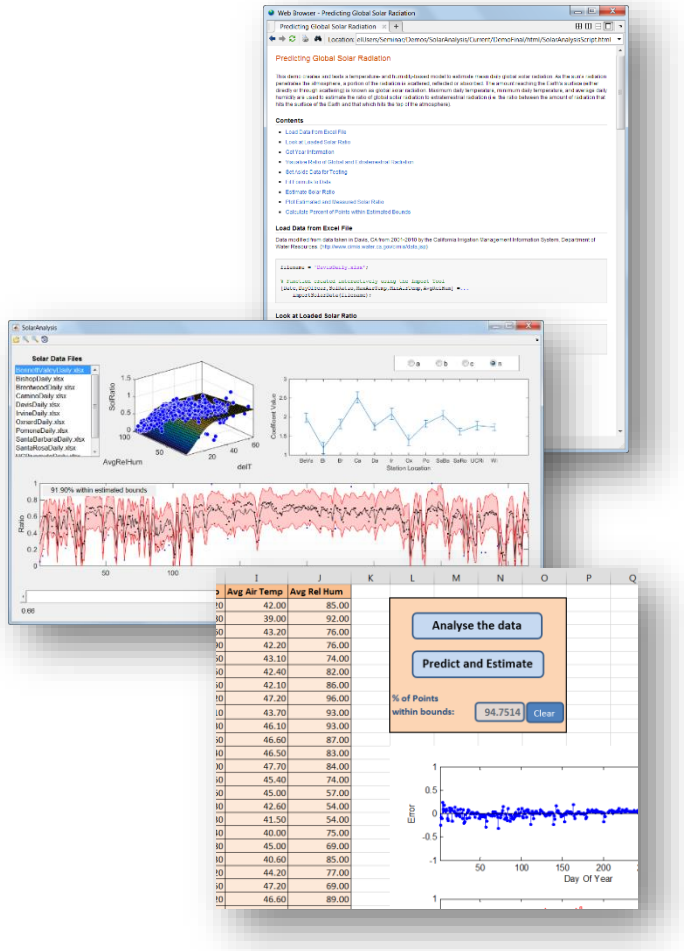


Data:

- 3-axial Accelerometer data
- 3-axial Gyroscope data

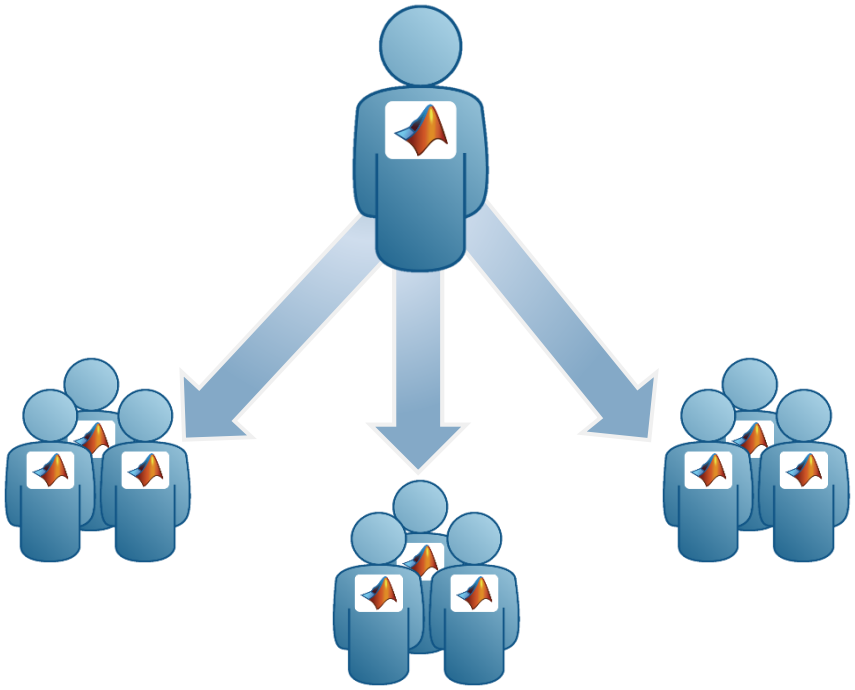
Sharing Results from MATLAB

- Automatically generate reports
- Create and package applications
- Deploy to other environments

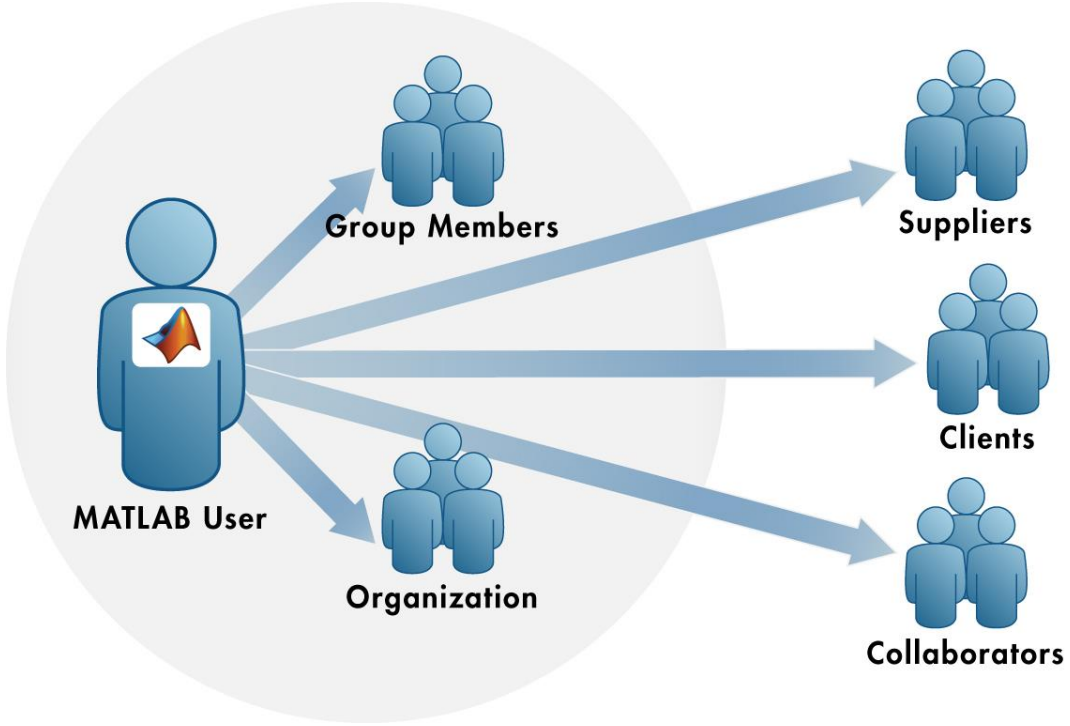


MATLAB Programs Can be Shared With Anyone

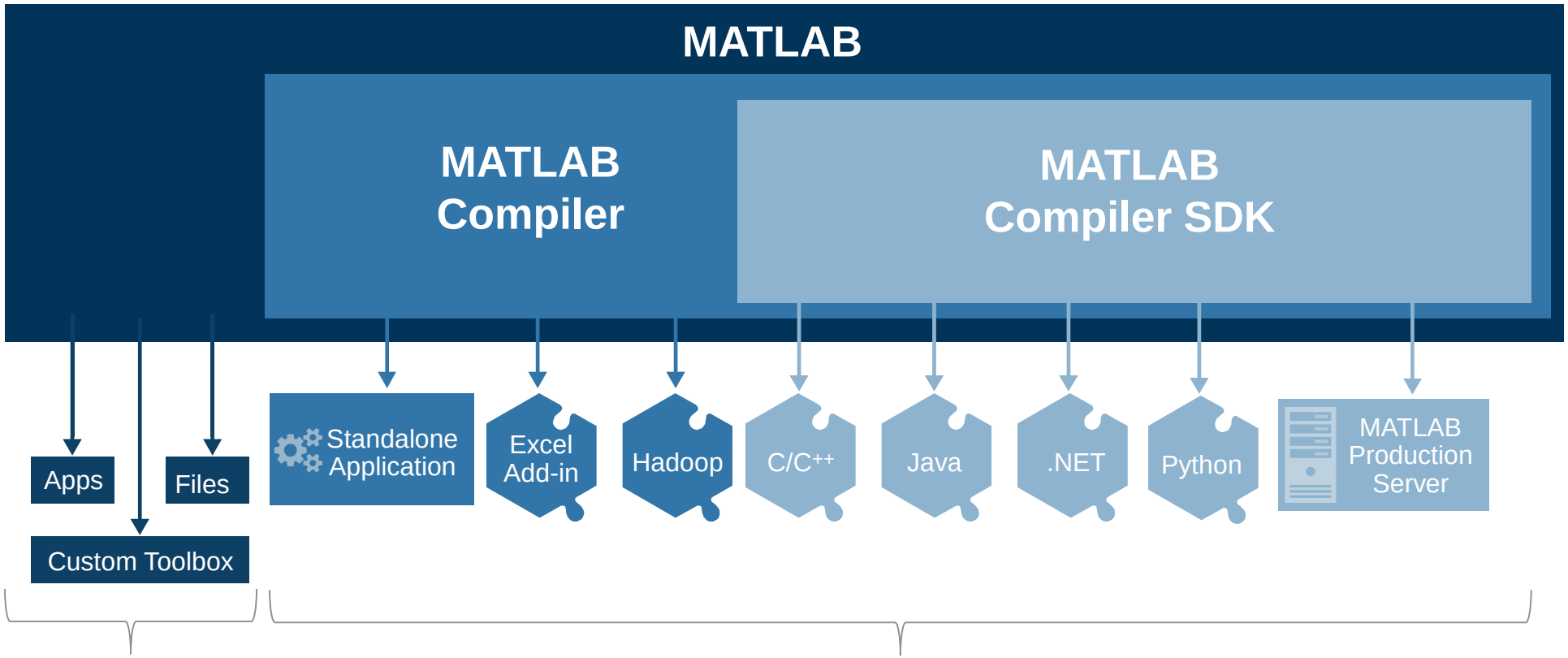
Share With Other MATLAB Users



Share With People Who do Not Have MATLAB



Write Your Programs Once
Then Share To Different Targets



3rd Party Excel Add Ins for Forecasting

- Challenges:
  - Manual
  - Automation
  - Batch Processing
  - Tuning (Optimizing)
  - Speed of Execution
  - Report Generation

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