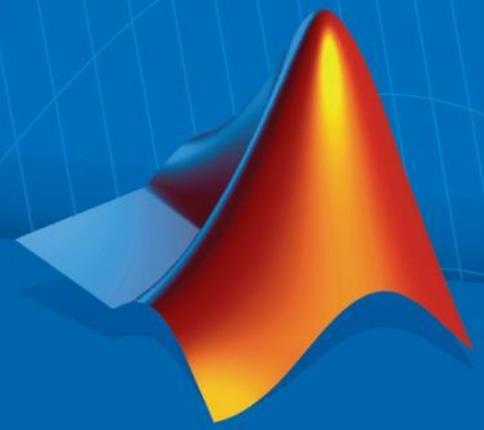
TeraSoft
www.terasoft.com.tw



Integrating MATLAB Analytics into Enterprise Applications

Terasoft

Application Engineer

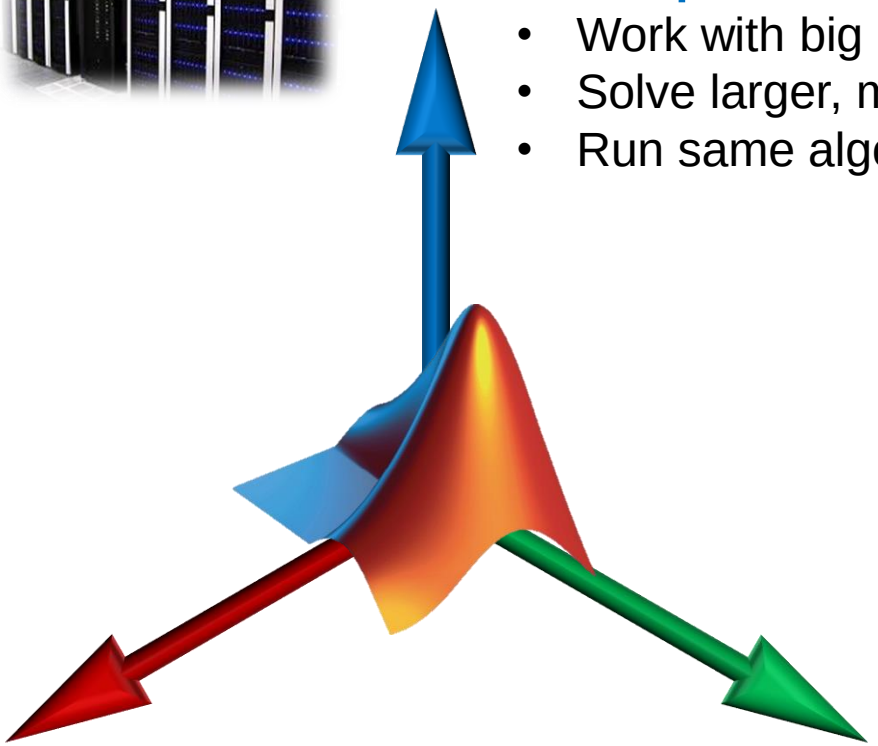
Jeffrey Liu

MathWorks®
Accelerating the pace of engineering and science

Three Dimensions of Scaling

Compute Power

- Work with big data
- Solve larger, more complex problems
- Run same algorithms on desktop and cluster



Access to Analytics

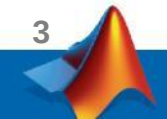
- Share algorithms, protect IP
- Access from web and enterprise systems

IoT and Smart Devices

- Deploy to edge devices in the field
- Combine in central IoT system

Agenda

- Scaling access to analytics
  - Example: Custom web application integration
- Scaling compute power
  - Example: Parallel Computing with MATLAB
- Scaling to IoT and smart devices
  - Example: Embedding analytics in edge devices
- Wrap-up and Q&A



Data Analytics Workflow

Access and Explore Data

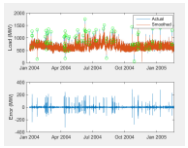
- **Files**

- **Databases**

- **Sensors**

Preprocess Data

- **Working with Messy Data**



- **Data Reduction/ Transformation**

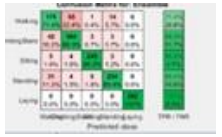
- **Feature Extraction**

Develop Predictive Models

- **Model Creation e.g. Machine Learning**

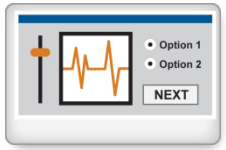
- **Parameter Optimization**

- **Model Validation**



Integrate Analytics with Systems

- **Desktop Apps**

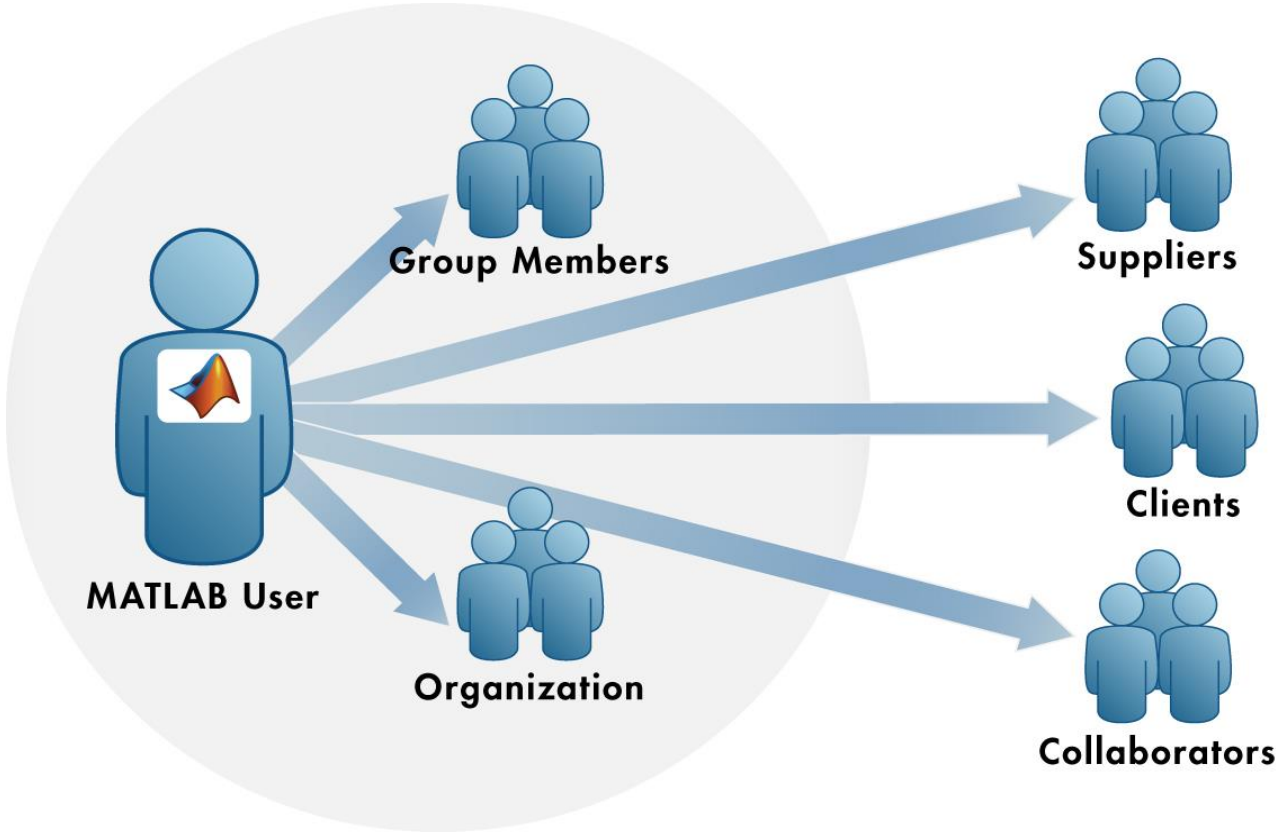


- **Enterprise Scale Systems**

MATLAB Excel .NET .exe C/C++ Java .dll

- **Embedded Devices and Hardware**

Share Programs Outside of MATLAB

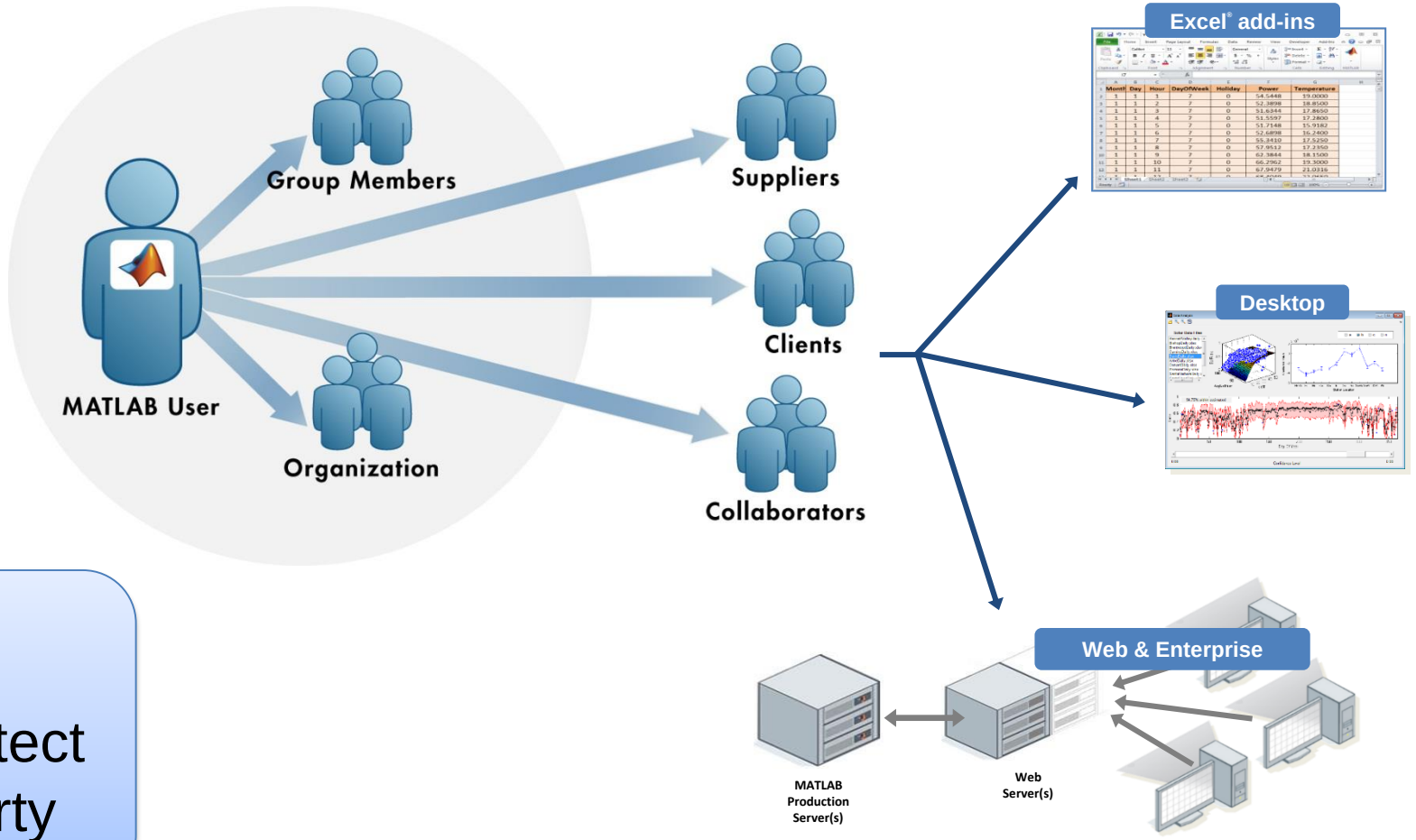


Deploy your MATLAB code to people who don't need MATLAB

Benefits of Deploying MATLAB Code

- Ensure domain experts maintain ownership of ideas, algorithms, and applications
- Integrate with different programming languages
- Implement a common algorithm on different platforms
- Avoid time consuming and error prone recoding
- Easily adopt algorithm improvements throughout lifecycle

A Primer on Sharing MATLAB Programs

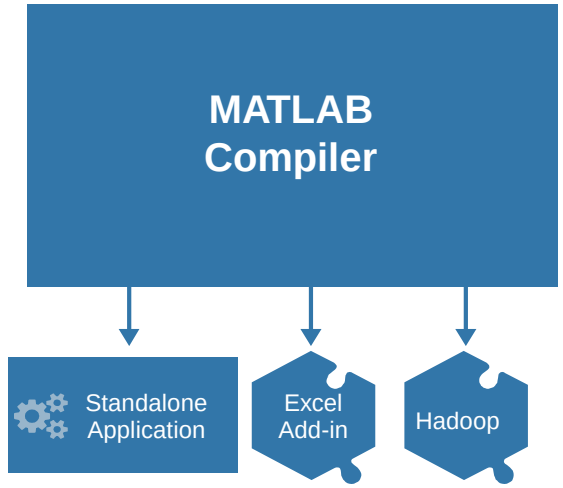


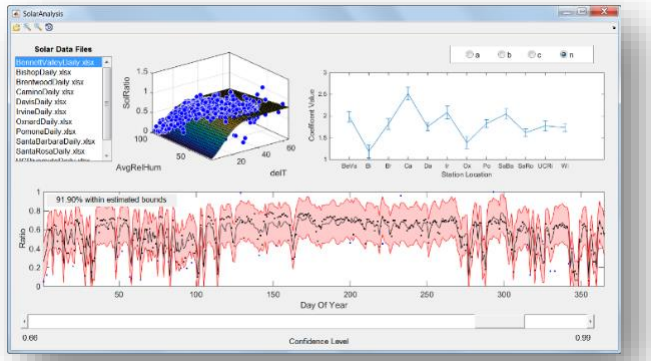
- Royalty-free
- Encryption to protect intellectual property

Using MATLAB Compiler

Compiled applications can be shared as:

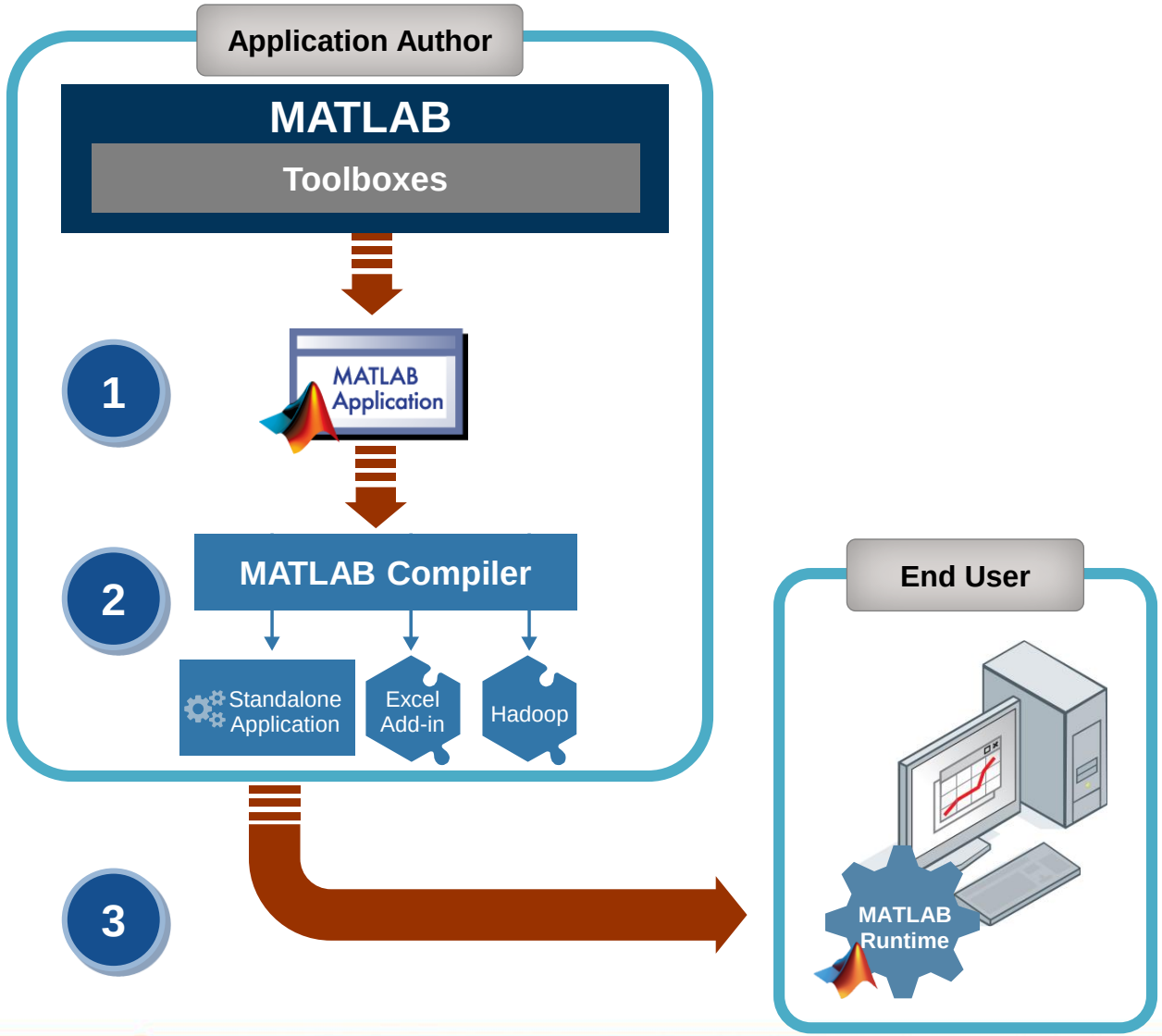
- Standalone desktop applications
- Add-ins for integration with Microsoft Excel spreadsheets
- Components that run MATLAB code against Hadoop





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

Sharing Standalone Applications

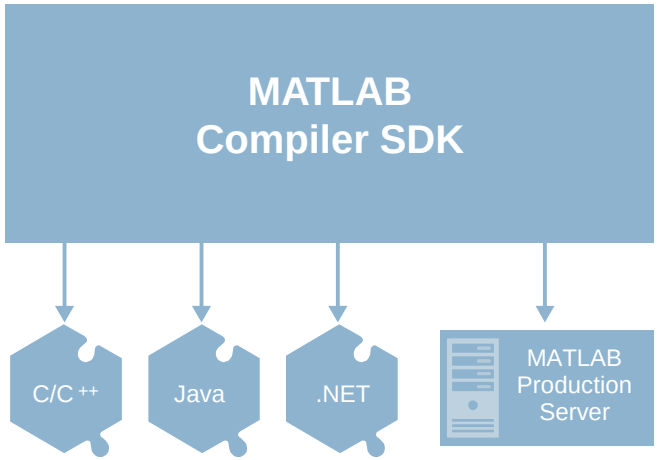


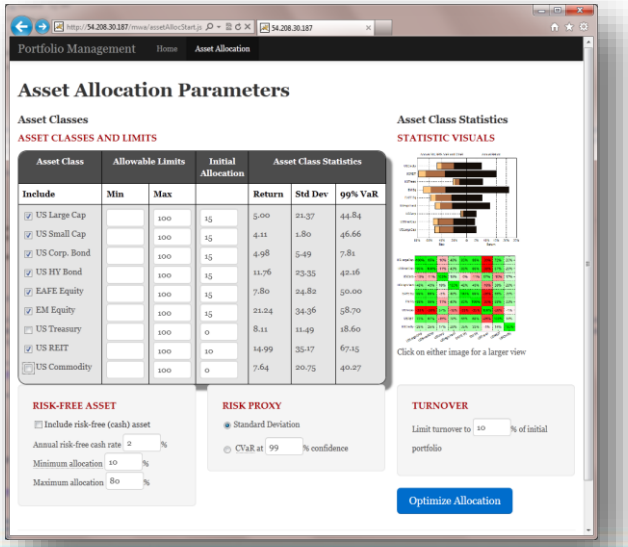
Using MATLAB Compiler SDK

Flexible toolkit for software developers

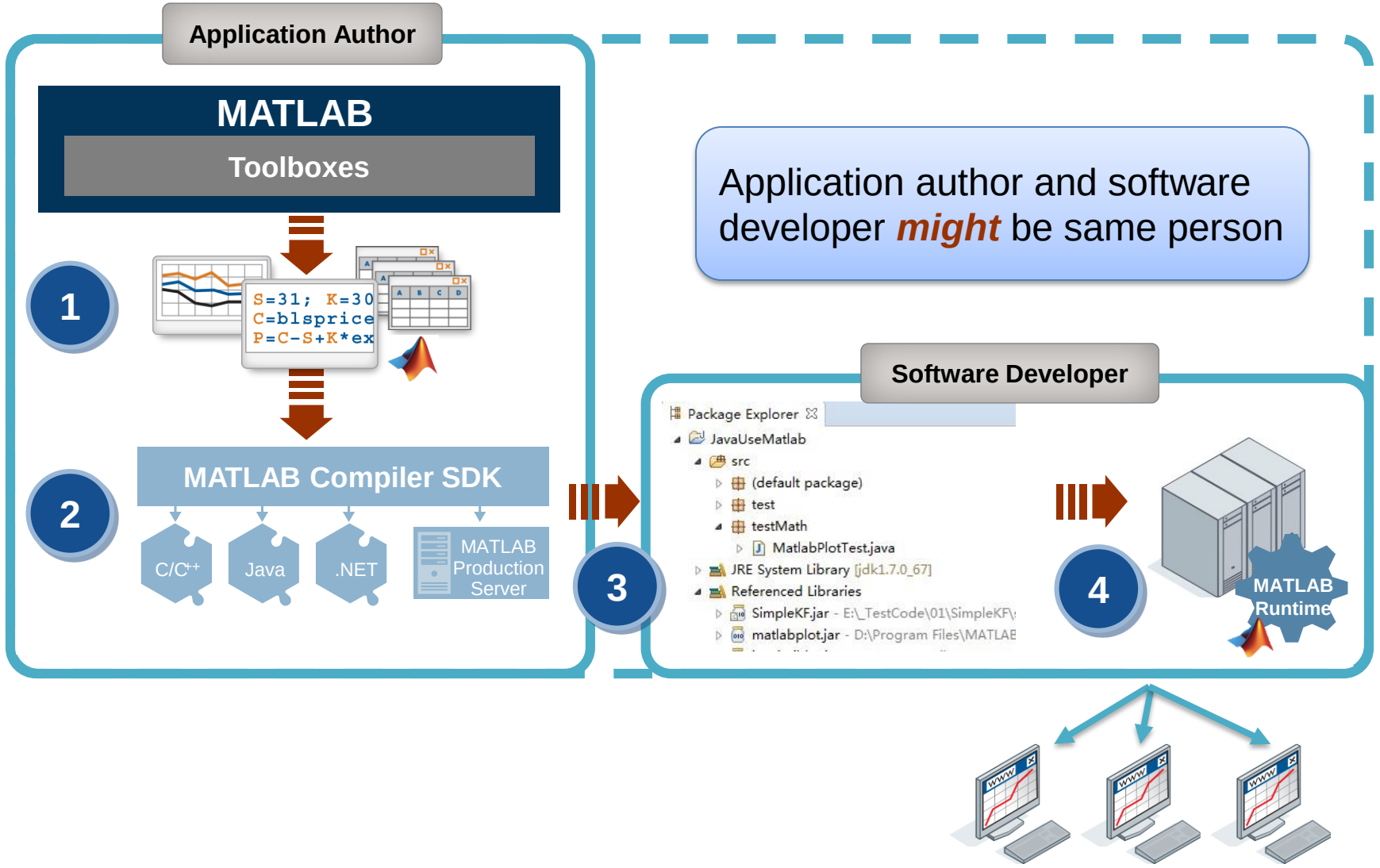
- Integrate with applications written in C/C++, .NET, Java
- Develop applications for MATLAB Production Server

Develop a custom application server or deploy with MATLAB Production Server

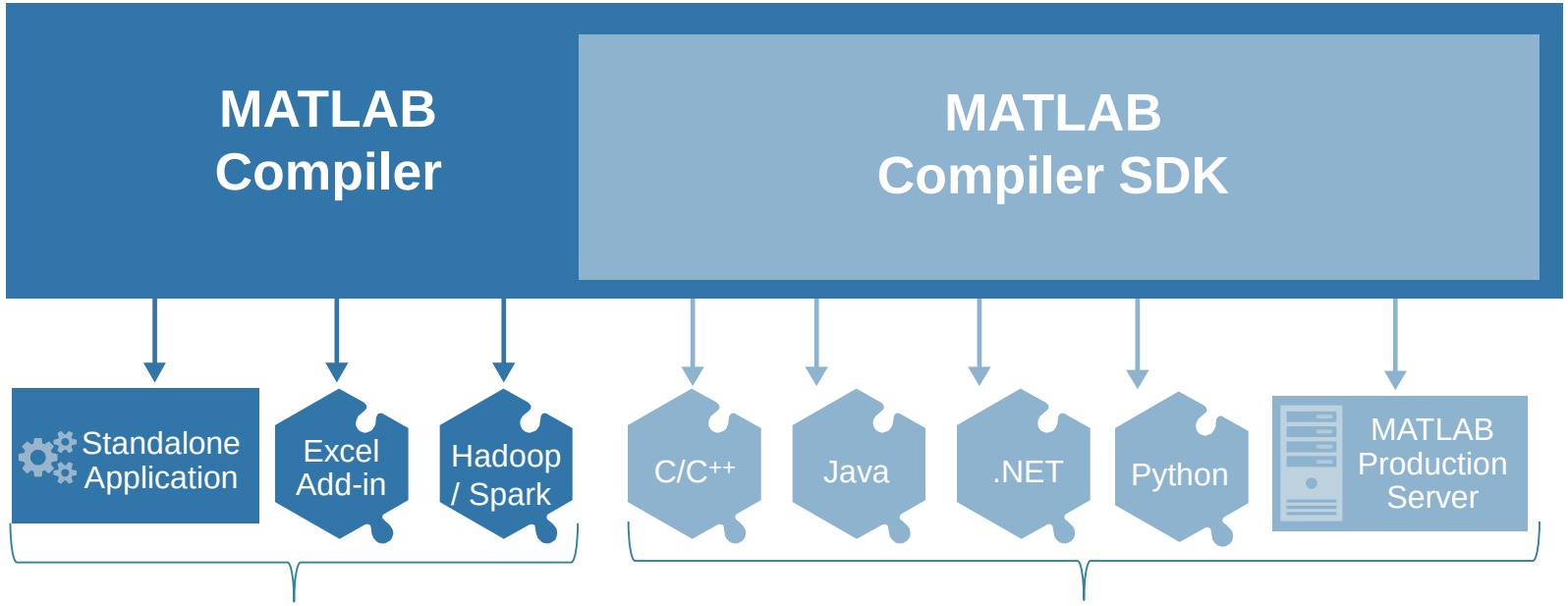




Integrating MATLAB-based Components



Share with People Who Do Not Have MATLAB



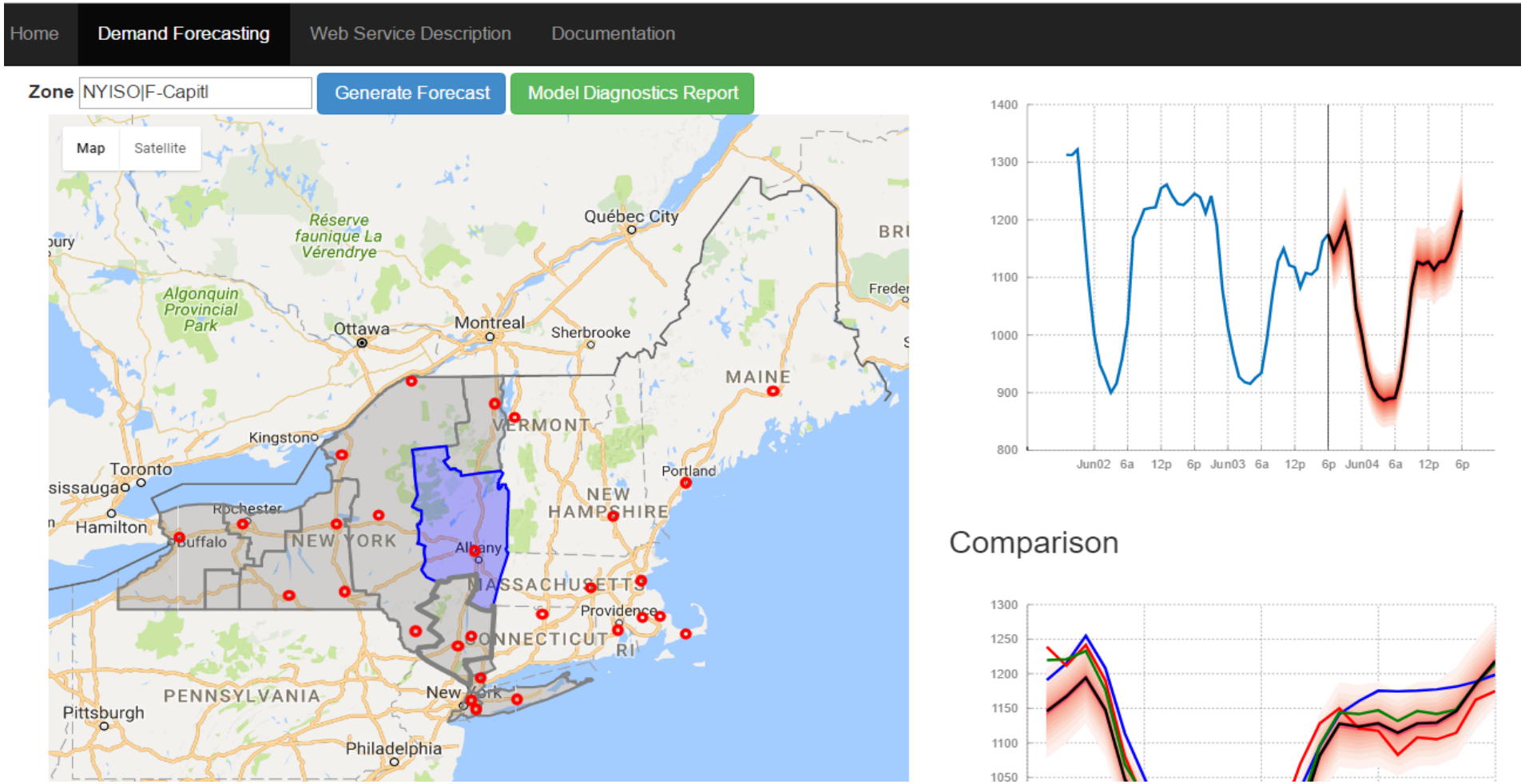
Share Applications Built Completely in MATLAB

Integrate MATLAB Programs With Your Own Software

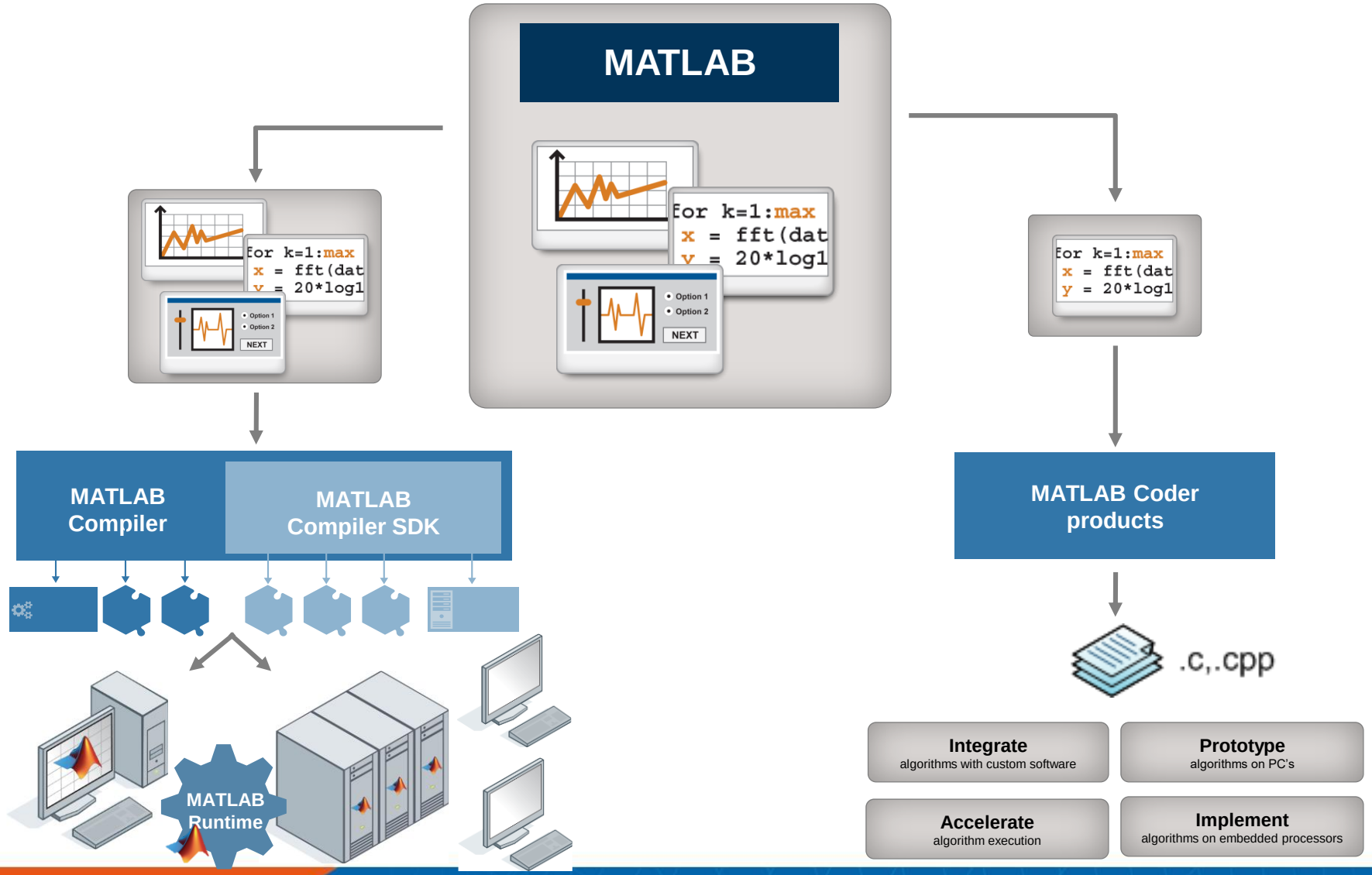
MATLAB Analytics in Production

Example: Load Forecasting Web App

http://ec2-54-165-201-58.compute1.amazonaws.com:8080/DemandForecastWeb/

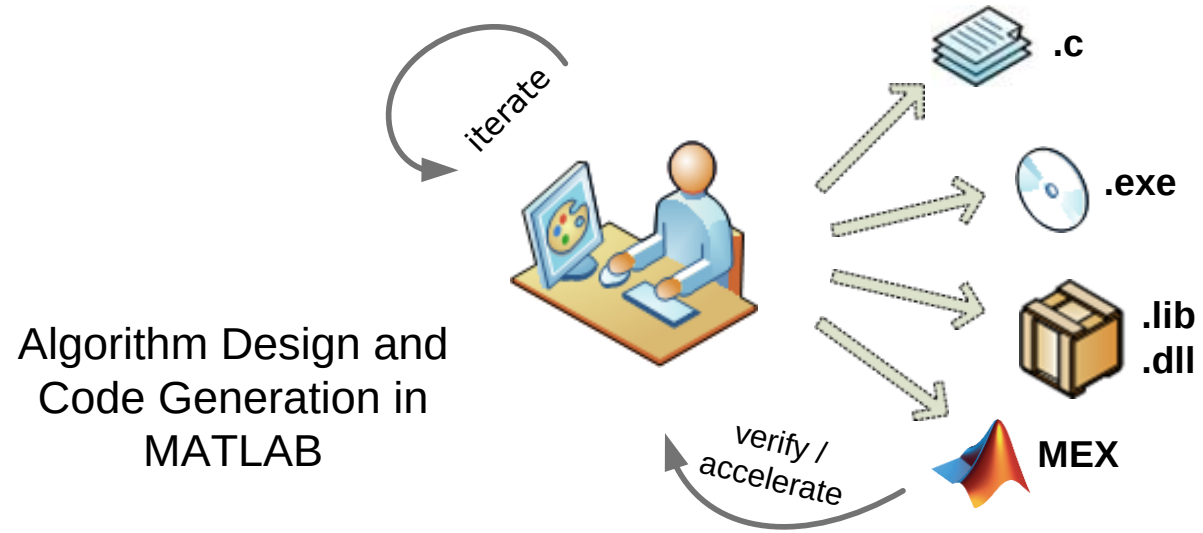


Advising on Deployment or Code Generation



MATLAB Coder

Generate portable and readable C code from MATLAB algorithms

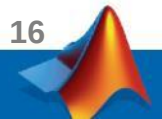


With MATLAB Coder, design engineers can:

- Maintain one design in MATLAB
- Design faster and get to C quickly
- Test more systematically and frequently
- Spend more time improving algorithms in MATLAB

MATLAB Compiler SDK and MATLAB Coder

	MATLAB Compiler MATLAB Compiler SDK	MATLAB Coder
Output	Software components	Portable and readable C source code
MATLAB language support	Full	Subset
Additional libraries	MATLAB Runtime	None
Supported toolboxes	Most toolboxes	Some toolboxes
License model	Royalty-free	Royalty-free
Extensions	MATLAB Production Server	Embedded Coder



Agenda

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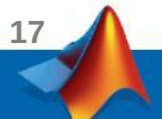
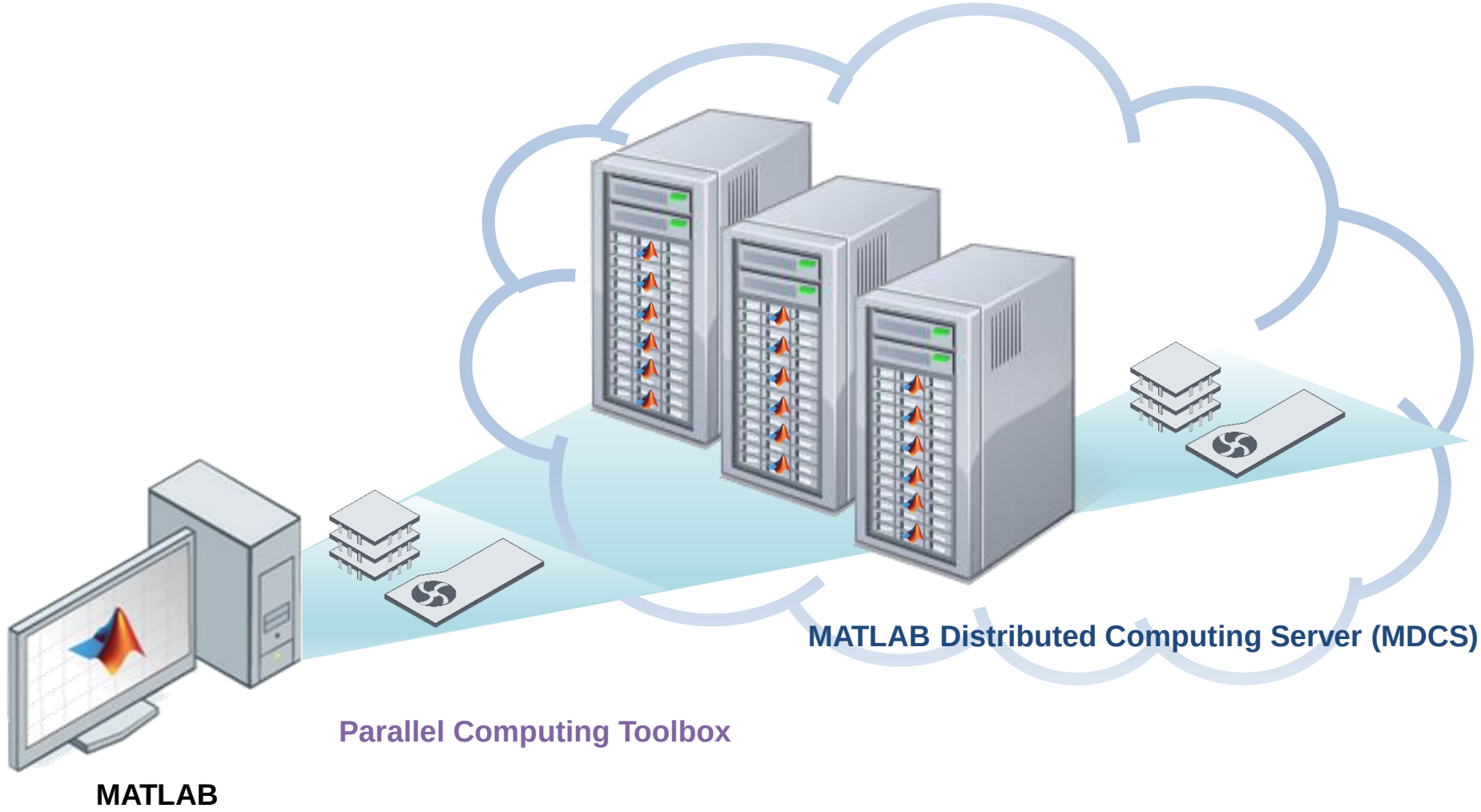
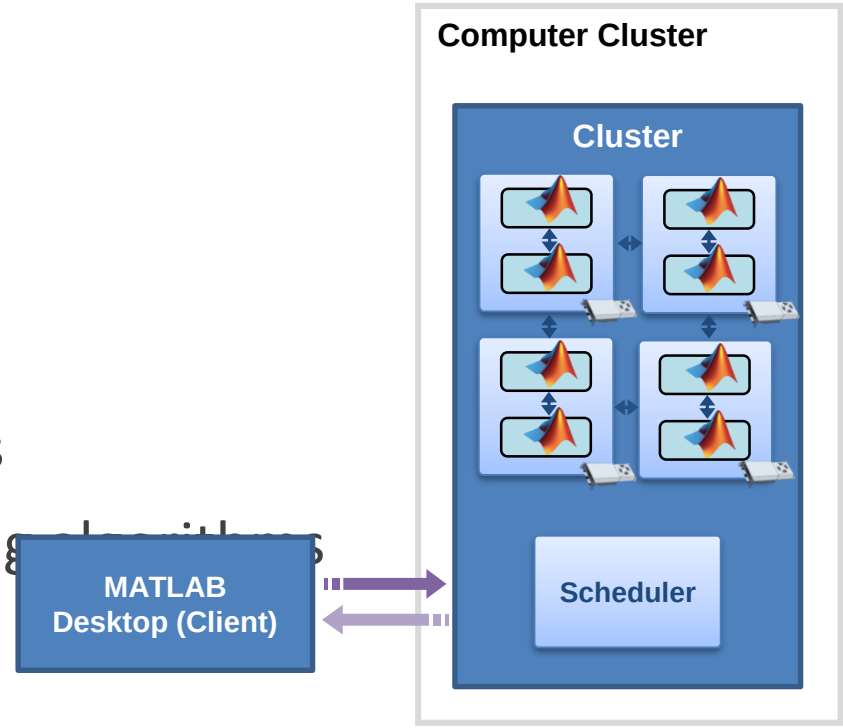


Scale Compute Power



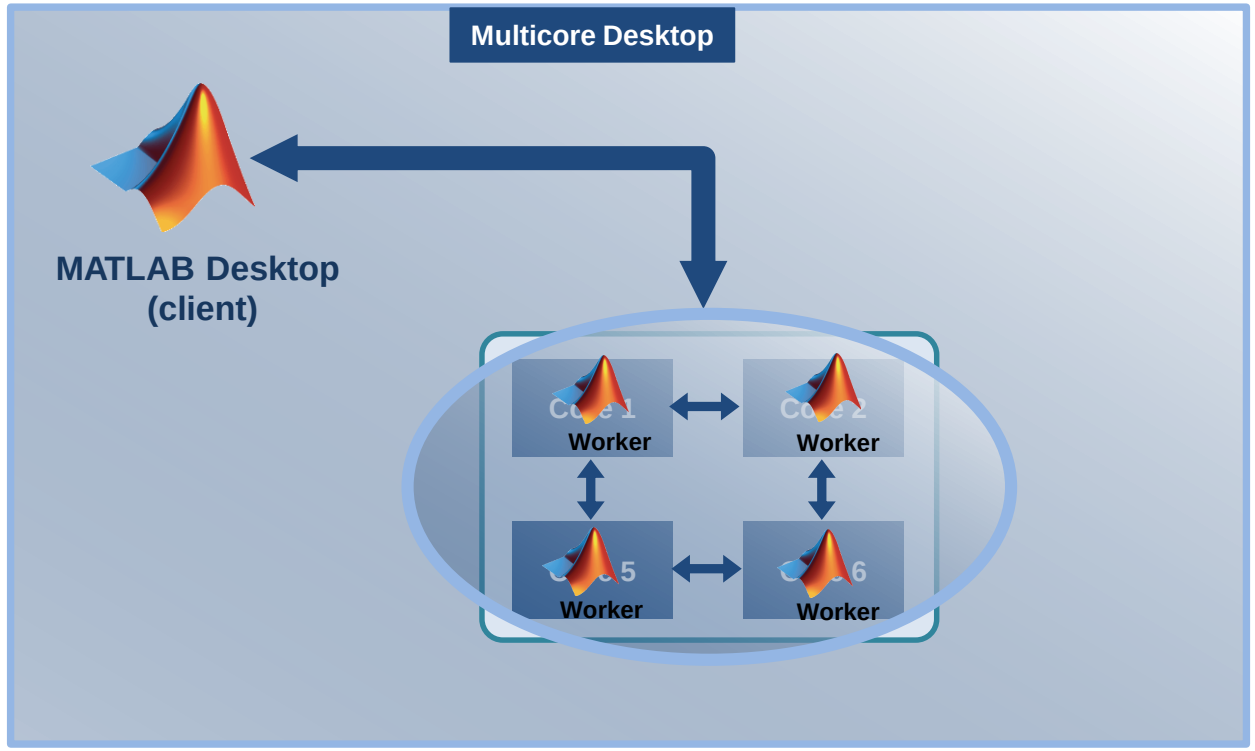
Take Advantage of Cloud Infrastructure

- Scale speed-up:
  - Use more cores
  - Go from hours to minutes
- Scale memory:
  - Utilize tall arrays and distributed arrays
  - Solve larger problems without re-coding algorithms
- Offload computation:
  - Free up desktop
  - Access better computers



Parallel Computing Paradigm

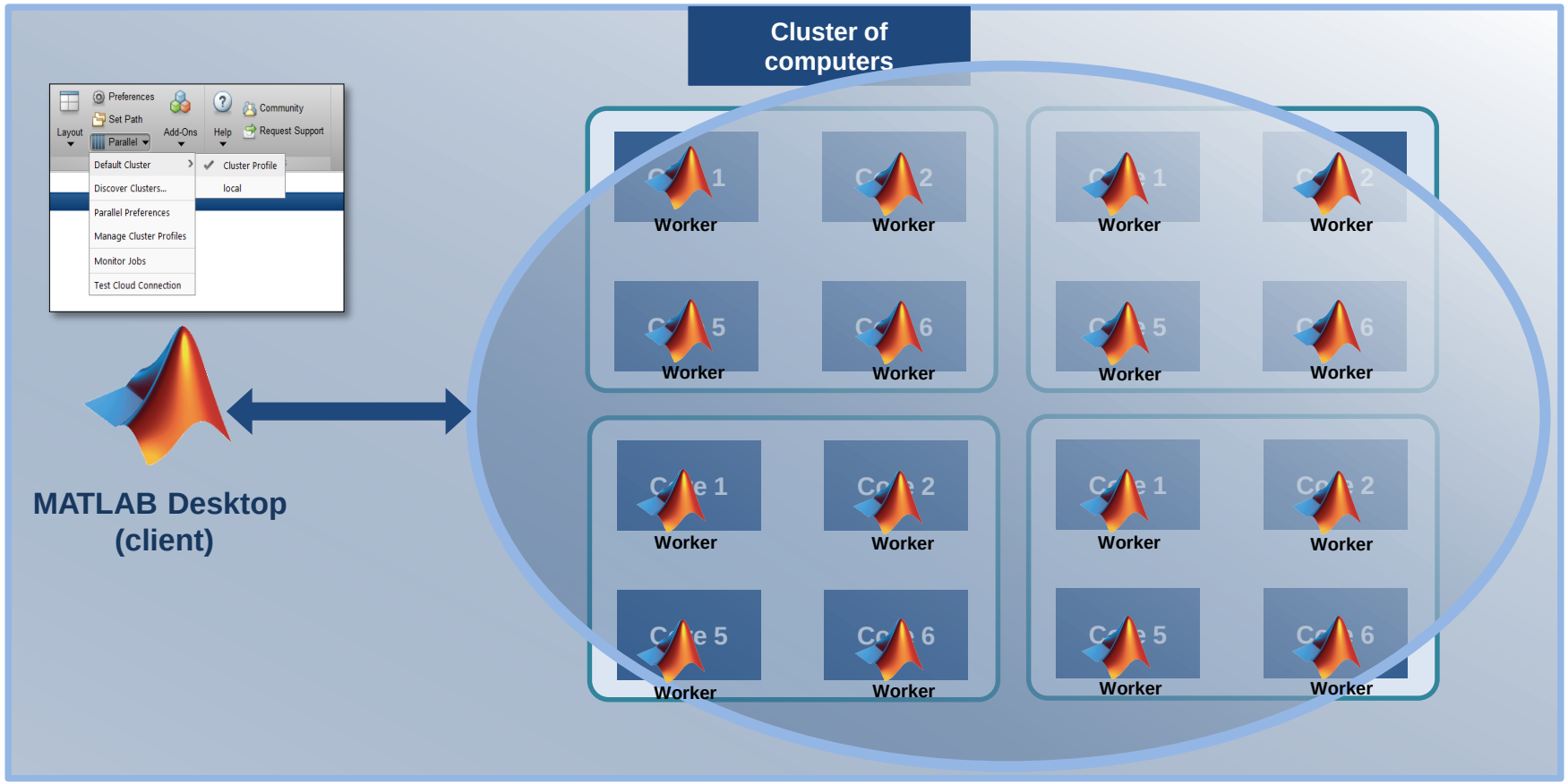
Multicore Desktops



MATLAB multicore

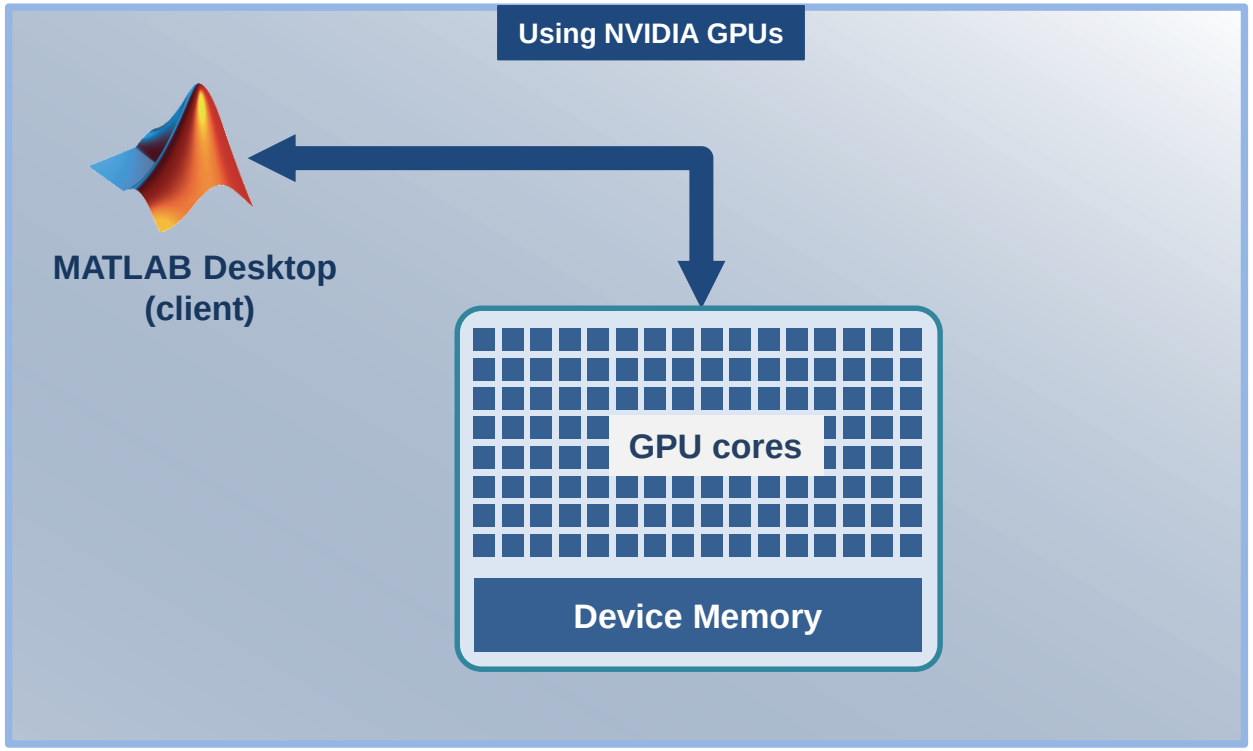
Parallel Computing Paradigm

Cluster Hardware



Parallel Computing Paradigm

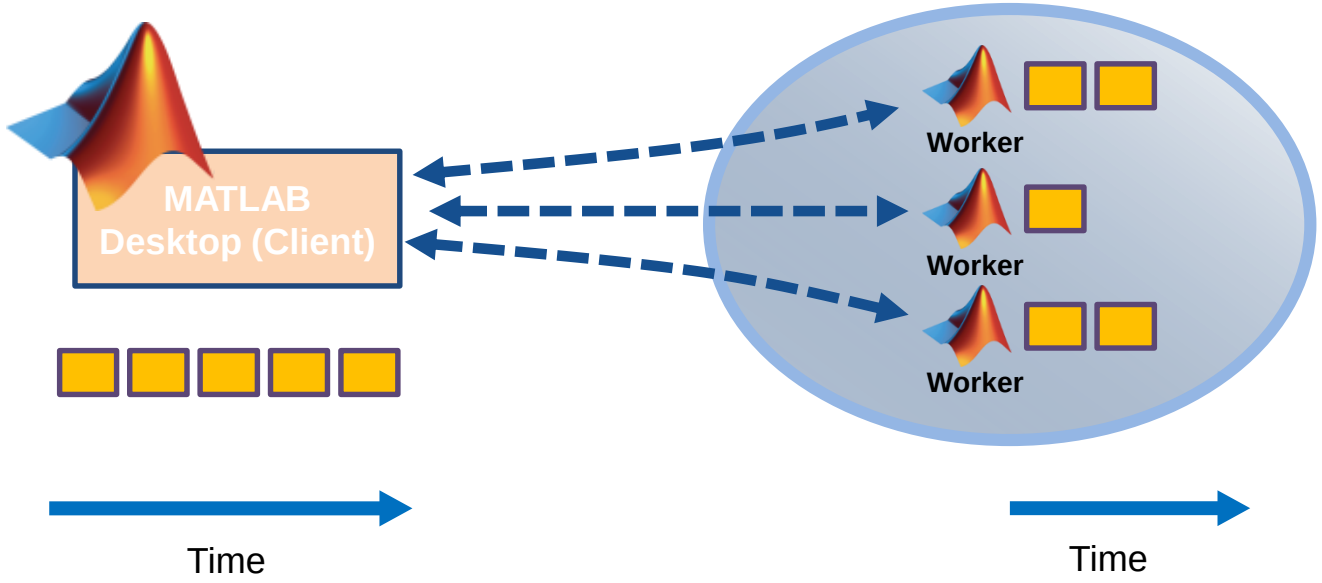
NVIDIA GPUs



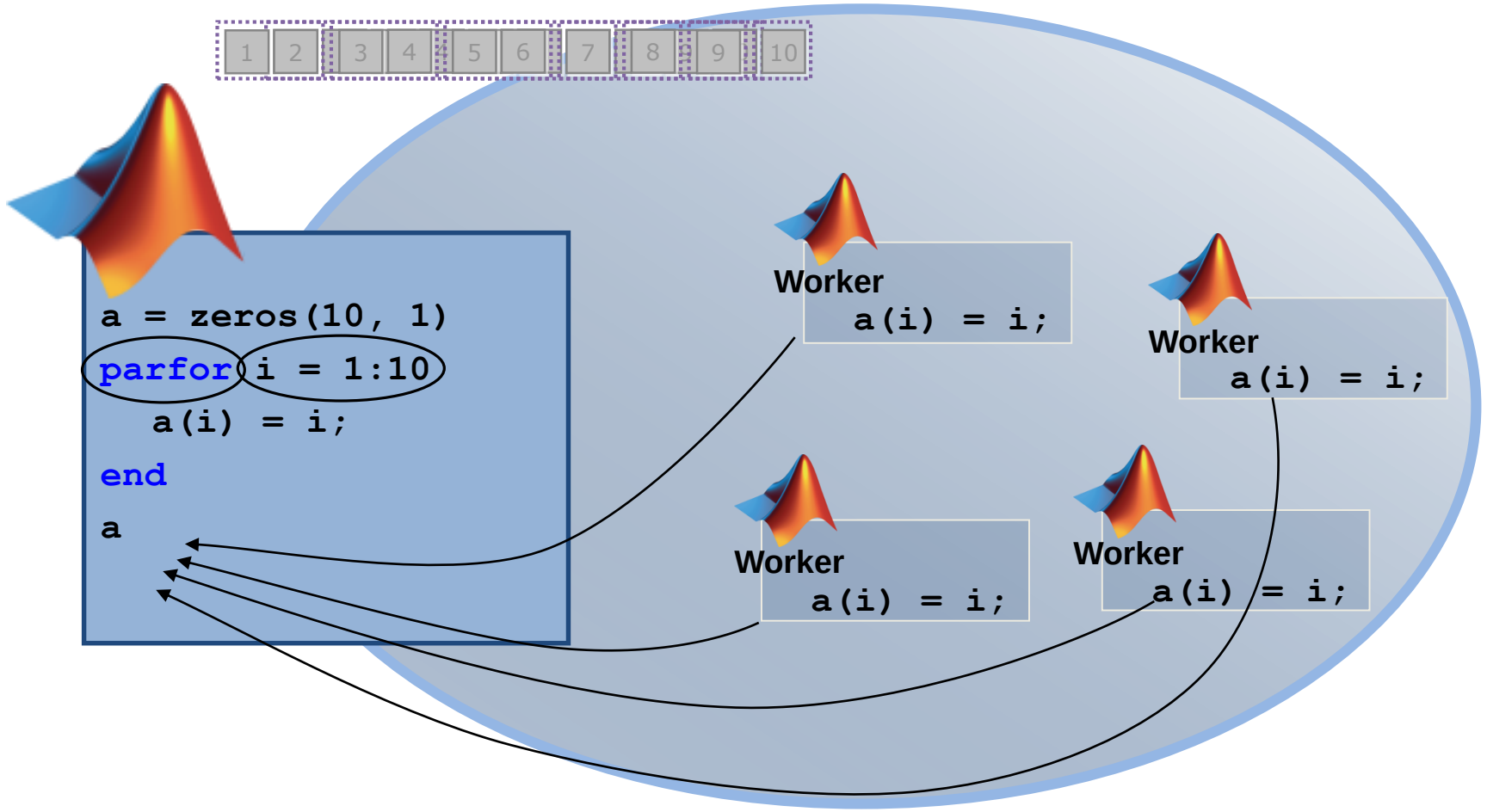
Explicit Parallelism: Independent Tasks or Iterations

Parallel for loops

- Ideal problem for parallel computing
- No dependencies or communications between tasks
- Examples: parameter sweeps, Monte Carlo simulations



The Mechanics of `parfor` Loops



Pool of MATLAB Workers

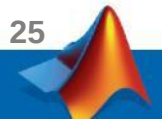
Parallel computing with MATLAB is more than `parfor`

Well-known features

- parallel-enabled toolboxes
- `parfor`
- `gpuArray`

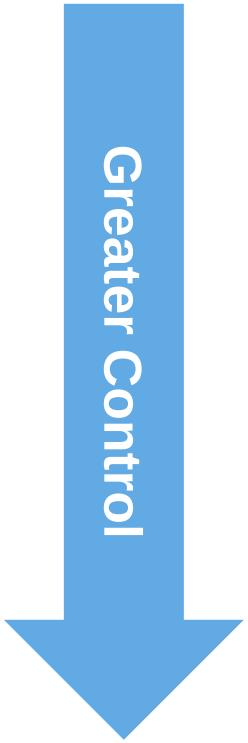
Full spectrum of support

- batch submission, jobs and tasks
  `batch, createJob, createTask`
- asynchronous queue for feval
  `parfeval`
- mapreduce (with and without Hadoop)
  `mapreduce`
- message passing
  `labSend, labReceive`
- distributed arrays (“global arrays”)
  `distributed`



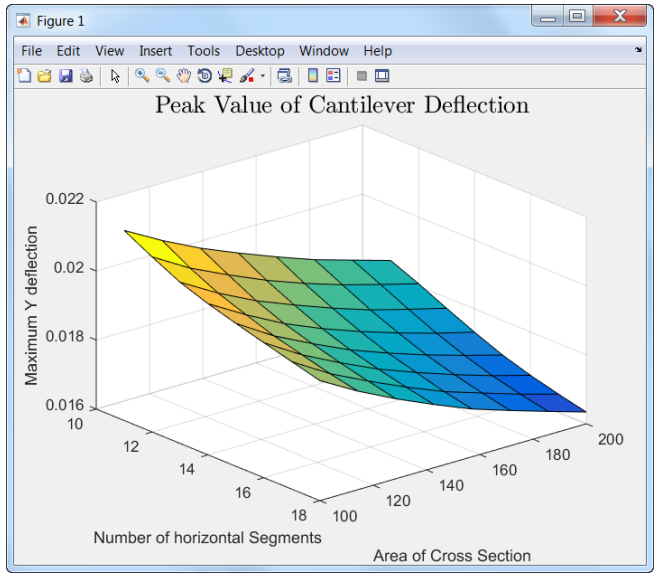
Programming Parallel Applications (CPU)

- Built-in support with toolboxes
- Simple programming constructs:
  `parfor, batch, distributed`
- Advanced programming constructs:
  `createJob, labSend, spmd`



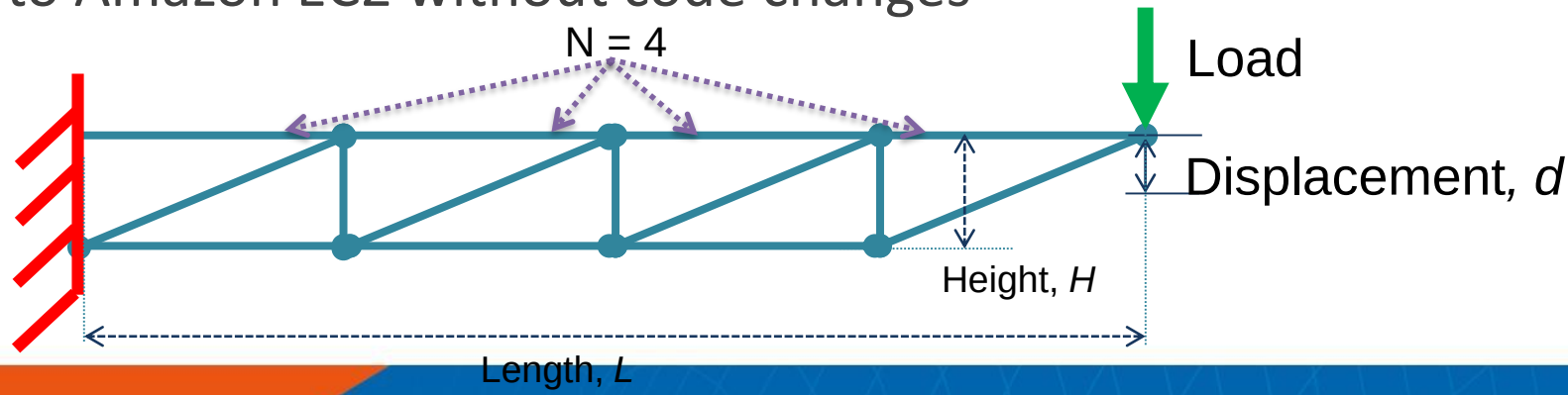
Example: Compute Intensive Problem

Objective: Run a parameter sweep to find peak value of cantilever deflection



Approach:

- Large number of embarrassingly parallel tasks
- Prototype algorithm on desktop
- Scale to Amazon EC2 without code changes



Three Dimensions of Scaling – MathWorks Solutions

Compute Power

- Parallel Computing Toolbox
- MATLAB Distributed Computing Server

Access to Analytics

- MATLAB Compiler
- MATLAB Compiler SDK
- MATLAB Production Server

Smart Devices and IoT

- Code Generation Tools
- ThingSpeak

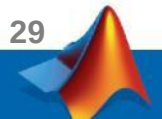
Next Steps – How can we help?

Resources

- Seminars and technical deep dives
- Data Analytics
- Parallel Computing
- Desktop and Web Deployment
- Embedded Code Generation
- ThingSpeak

More options

- Technical support
- Advanced customer support
- Installation, enterprise, and cloud deployment
- Training courses
- Consulting services



Thank you!