Kubernetes와 컨테이너화 된 마이크로 서비스에 클라우드 네이티브 MATLAB 기능을 배포하기

엄준상 부장, 매스웍스코리아
Optimizing cost with Simulation and Digital Twins

Carl Wouters
Frontier Advisors Develops Web-Based Platform for Portfolio Analytics

“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 Erla, Frontier Advisors

Challenge

Provide clients with an industry-first web platform for portfolio modelling 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

Learn about Frontier Advisors Technology

Link to User Story
Professor Eun ok Jung has developed a SEIR model using MATLAB. She predicts infection rate in South Korea and provides scientific background for KDCA.

The model is published using MATLAB Web App Server, and freely accessible from browser.

For her profound contribution, she received the honor of a President’s Commendation from President award on April 21, 2020.
Electricity Load and Price Forecasting Webinar Case Study
version 1.7.0.1 (12.3 MB) by Ameya Deoras
Slides and MATLAB® code for the day-ahead system load and price forecasting case study.

Overview  Functions  Examples  Reviews (25)  Discussions (79)

Electricity Load & Price Forecasting/
- importData.m

Electricity Load & Price Forecasting/Load/
- fetchDataLoadData(startDate, endDate)
- genPredictors(data, term, holidays)
- loadForecast(date, temperature, isHoliday)
- TreesInDetail.m

Electricity Load & Price Forecasting/Load/Load who
- loadForecast(date, temperature, isHoliday)

Electricity Load & Price Forecasting/Load/loadForecast.m

function y = loadForecast(date, temperature, isHoliday)
% LOADFORECAST performs a day-ahead load forecast using a pre-trained
% Neural-Network or Bagged Regression Tree model
%
% USAGE:
% y = loadForecast(model, date, hour, temperature, isWorkingDay))

% Process inputs
date = datenum(date);
if date < 7e5 % Convert from Excel numeric date to MATLAB numeric date if necessary
date = x2mdate(date);
end
Load forecasting deployed on MATLAB Production Server

Spotfire extension for MATLAB Production Server
Deploy MATLAB & Simulink models using MATLAB Production Server

Deploy MATLAB algorithms directly without recoding

Integrate with a broad array of databases, data stores and streaming services

Data sources / applications

Analytics Development

MATLAB

MATLAB Compiler SDK

Package

MATLAB Production Server

Worker processes

Request Broker

Scale to service hundreds of concurrent requests while Securing access

Access from a wide range of enterprise applications

Enterprise Application

Mobile / Web Application

3rd party dashboard

MATLAB
Understanding resource utilization using production server dashboard

Size your MATLAB Production Server
What to consider?

### Accessibility
- Data
- Models
- APIs
- CI/CD

### Infrastructure
- Compute
- Memory
- Security
- Network Access

### Maintenance & Recovery
- Health Check
- Backup
- Server management

### Scalability

**Vertical**
- Bigger/Smaller server
- High up-front cost vs. risk of running out of resources

**Horizontal**
- Number of nodes required concurrently
- Load balancing across nodes/VMs
- Regional and Global LBs

**Either way requires high maintenance if you keep on-premise!**
Key Takeaways

- Deploying MATLAB algorithms into cloud-native webservices using MATLAB Production Server

- Comparing VM based and Container based provisioning of MATLAB Production Server
  - Selecting deployment strategy based on requirements
  - Available reference architectures

- New Kubernetes-hosted MATLAB Production Server is
  - Performant
  - Resilient
  - Provides on-demand scaling
Marketplace products can be provisioned and purchased directly from Azure.
VM based reference architecture for MATLAB Production Server
Deploying to cloud using MATLAB Production Server

VM based MATLAB Production Server:
- Every instance is a separate VM
- Windows or Linux OS
- Manual scaling capability
- Web dashboard configuration

Reference Architectures available on GitHub:
- AWS
- Azure
- GCP
Key Takeaways

✓ Deploying MATLAB algorithms using MATLAB Production Server

✓ VM based provisioning of MATLAB Production Server on cloud

➢ Container based provisioning of MATLAB and Simulink models on the cloud

▪ New Kubernetes-hosted MATLAB Production Server is
  – Performant
  – Resilient
  – Provides on-demand scaling
MATLAB Compiler provides Package Docker Images for reuse
Microservices from MATLAB & Simulink using MATLAB Compiler SDK

**Develop**
- MATLAB Function
- Machine/Deep Learning Model
- Simulink Simulation

**Compile**
- MATLAB Compiler
- MATLAB Compiler SDK

**Package**
- MATLAB models and Simulink simulations into a Docker container with HTTP RESTful endpoint(s)

**Distribute**
- Container Registry

**Operationalize**
- Client application
- MATLAB/Simulink Microservice
- Other Microservice

**Microservices Architecture Application**

Create Microservice Docker Containers with MATLAB 17
Deploy MATLAB and Simulink algorithms in containers

Turn proof of concepts…

Into production web services deployed with DevOps principles

Package MATLAB models and Simulink simulations into a Docker container with RESTful HTTP endpoint(s) using the new microservice feature in MATLAB Compiler SDK R2022a.

Create Microservice Docker Containers with MATLAB
Deploying to cloud using MATLAB Production Server

Container-based MATLAB Production Server
- Any Kubernetes cluster (Vendor independent)
- Lightweight, lower upfront infrastructure cost (New pods can be started quickly)
- Linux only
- Autoscaling
- CLI configuration

Reference Architectures available on GitHub:
- Any Kubernetes cluster, including AWS, Azure, and GCP
How can we manage containers? Enter: Kubernetes

Kubernetes autoscaling based on requests

This makes it easy on solutions architect to design, plan and scale with a lot of flexibility
Deploying K8s hosted MATLAB Production Server
Which cloud architecture should we use?

CTO
Drives operational strategy

클라우드 소프트웨어 종속을 방지하고 반복 가능하고
자동화된 배포를 위해 가능한 경우 컨테이너에서
표준화된 환경을 구성하고 싶습니다.

MATLAB Production Server에는 이를 쉽게 수행할
수 있는 Kubernetes 기반 배포 참조 아키텍처가
있습니다.

System Architect
Deploys and operationalizes models on Azure cloud
Which cloud architecture should we use?

Process Engineer
Develops models in MATLAB and Simulink

System Architect
Deploys and operationalizes models on Azure cloud

Windows 기반 소프트웨어를 필요로 하는 통합 기능이 있습니다.

이 경우 Windows VM 기반 MATLAB Production Server 배포를 사용해야 합니다.
MATLAB Online – hosted, managed, and controlled by you

1. Hosted and managed by your organization, for ex. https://matlab.acme.com

2. Sign in with your organizational credentials
MATLAB Online – hosted, managed, and controlled by you

3 Integrated with your NFS

4 Includes Live Editor and MATLAB Apps
Different pools of MATLAB compute on a single server license

Optional Configuration

Different MATLAB versions

Different hardware resources (memory, GPUs)

Core Services

Kubernetes

Ingress Controller

MATLAB R2020a

Resource-Proxy

MATLAB

Window Manager

Display

Resource-Proxy

MATLAB

Window Manager

Display

Resource-Proxy

MATLAB

Window Manager

Display

https://matlab.yourcompany.com
Key Takeaways

✓ Deploying MATLAB algorithms into cloud-native webservices using MATLAB Production Server

✓ Comparing VM based and Container based provisioning of MATLAB Production Server
  – Selecting deployment strategy based on requirements
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✓ New Kubernetes-hosted MATLAB Production Server is
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Call to Action

Explore the MATLAB Production Server Reference Architecture for Kubernetes

https://github.com/mathworks-ref-arch/matlab-production-server-on-kubernetes

- Uses existing MATLAB license server
- Works with cloud-managed or on-premise Kubernetes clusters
Thank you