

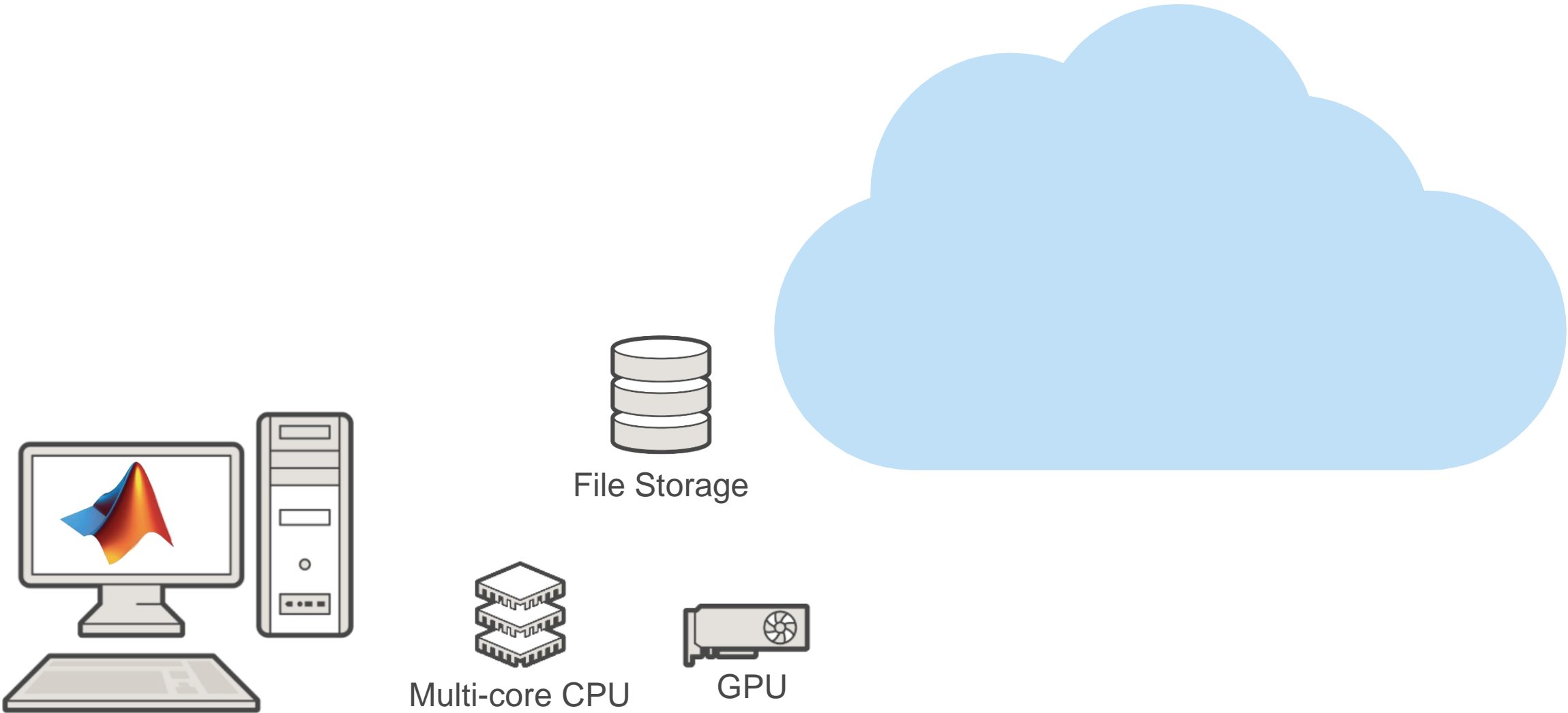
MATLAB EXPO

**Configure and Use MATLAB in the Cloud to
Develop, Scale and Deploy AI Applications**

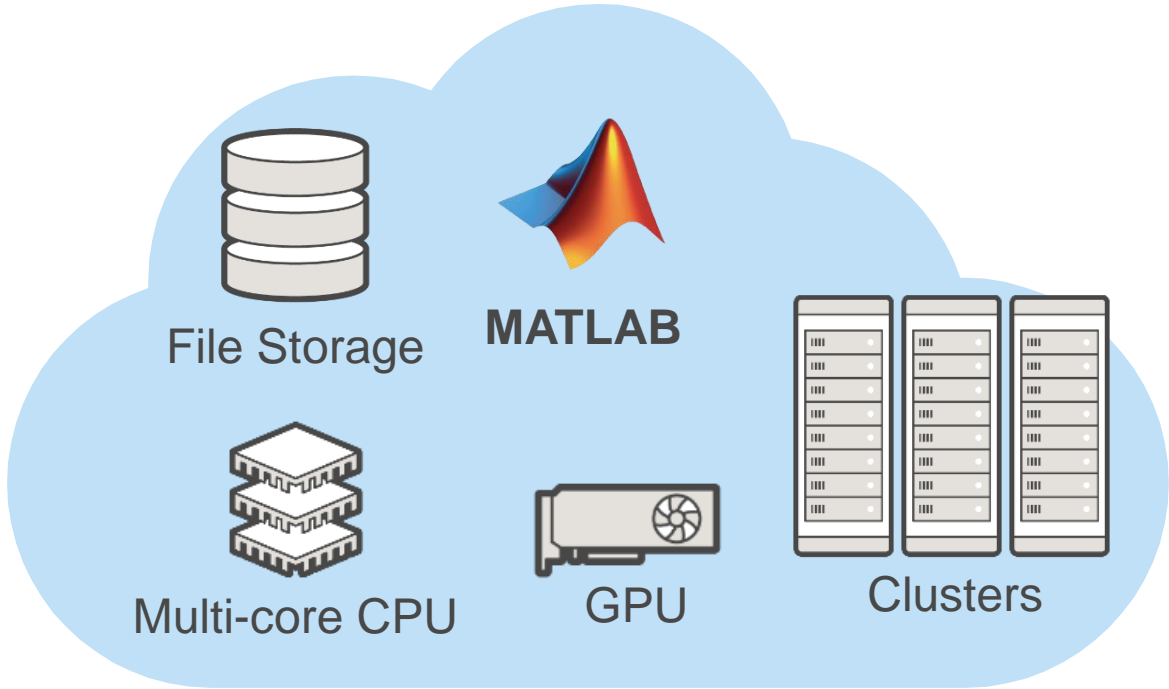
*Hisham El-Masry
Senior Product Manager*



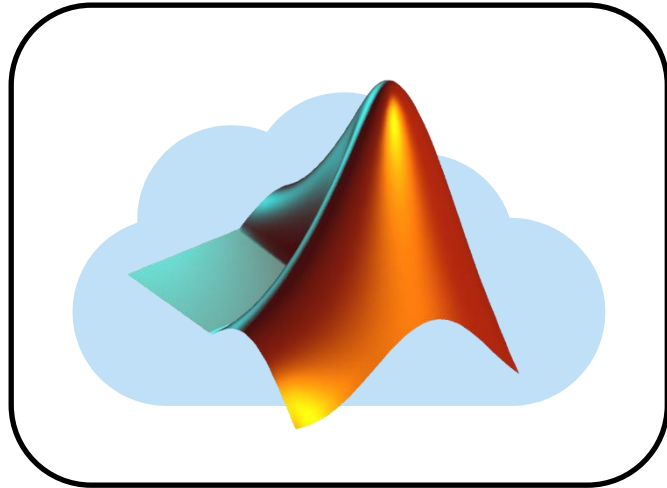
Cloud enables access to large data sets and compute resources



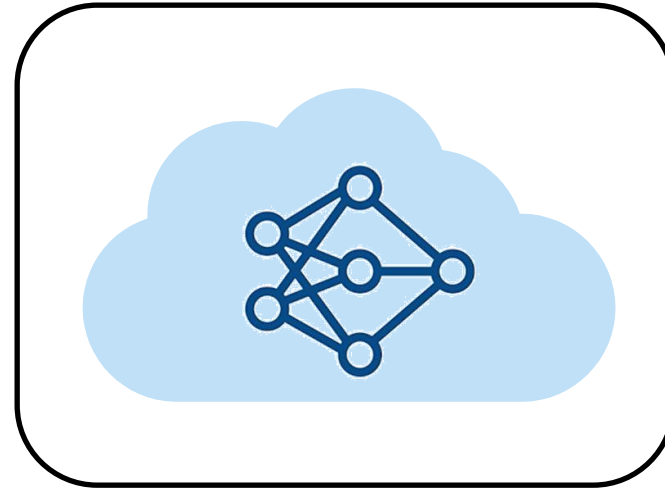
Cloud enables access to large data sets and compute resources



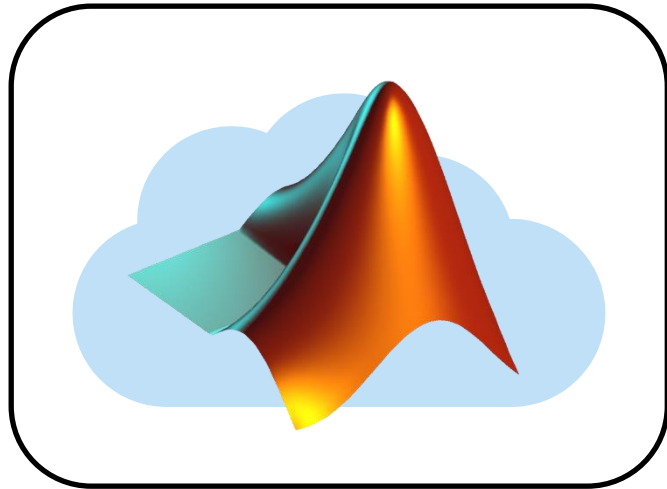
Today we will look at two main topics about the cloud



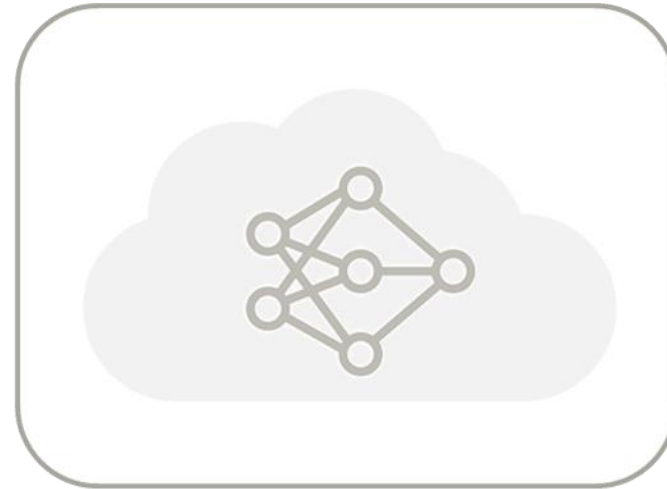
**How to configure MATLAB
in your Cloud environment**



**How to use MATLAB in
your Cloud workflow**



**How to configure MATLAB
in your Cloud environment**



**How to use MATLAB in
your Cloud workflow**

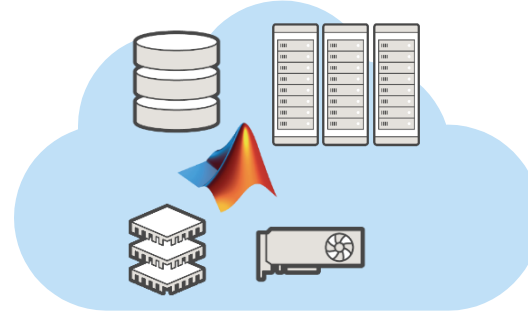
Four Primary Ways to Use MATLAB in the Cloud



Public Clouds



On-Premise/Private Cloud



Hosting Provider



MathWorks Cloud

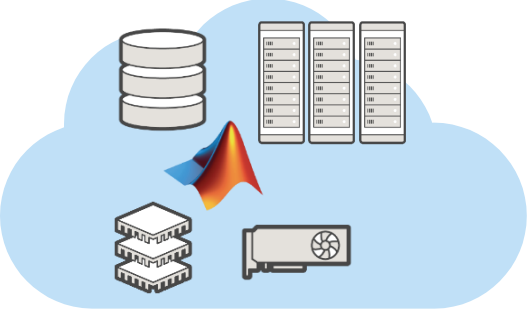
Whatever your cloud environment, MATLAB can work and scale



Public Clouds



On-Premise/Private Cloud



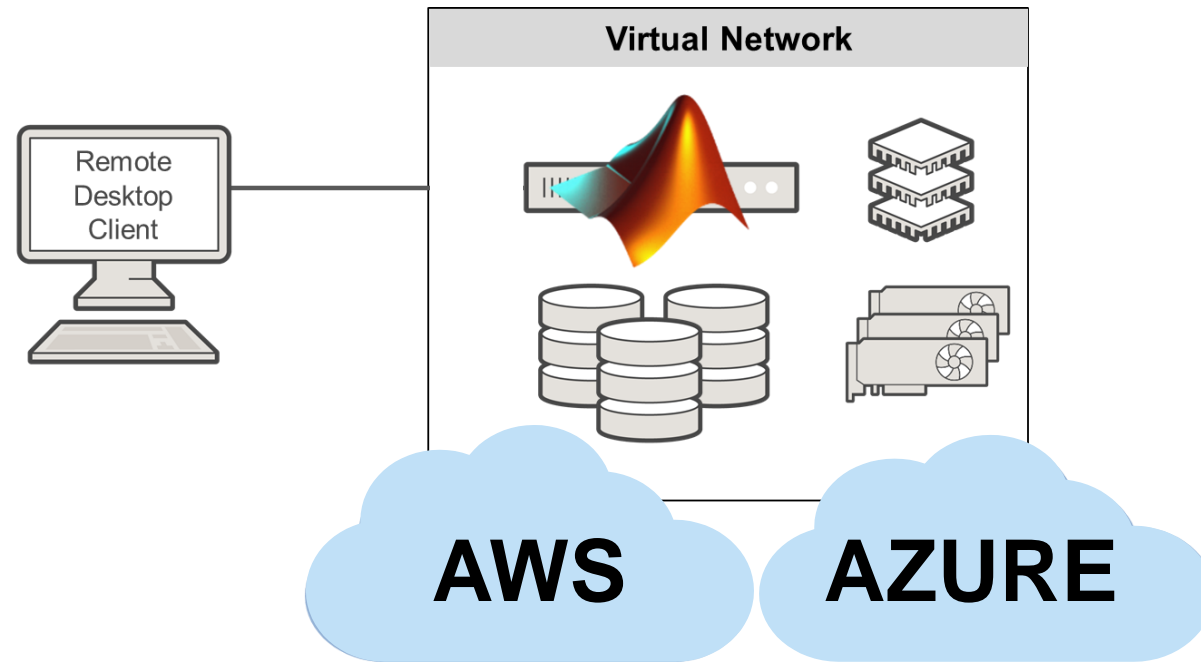
Hosting Provider



MathWorks Cloud

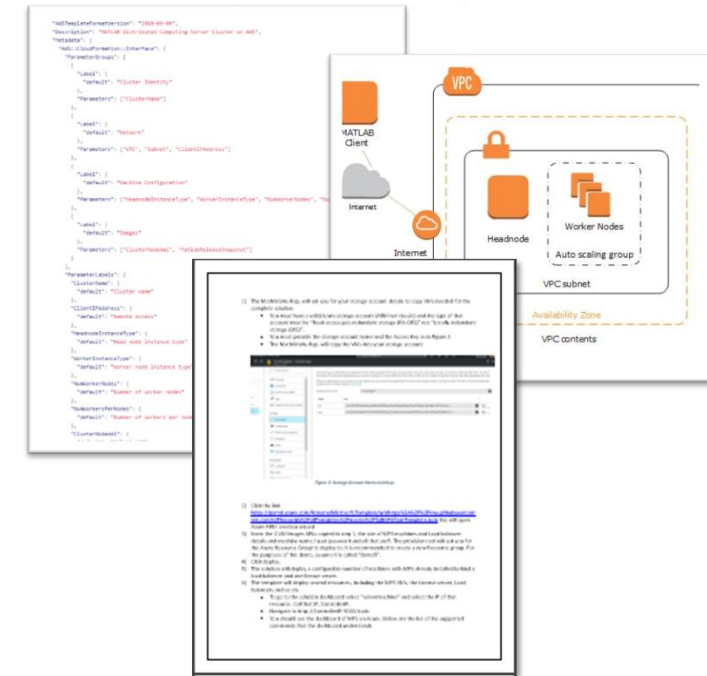
Reference Architectures

Setup MATLAB on AWS or Azure easily with reference architectures



Supports Azure AWS and Microsoft Azure

GitHub



Includes Cloud templates, Architecture diagram, Step-by-step instructions

<https://github.com/mathworks-ref-arch>

Access your cloud data with connectors for MATLAB

AZURE

Support Provided By:	Data Services			
Datastore	Blob Storage <i>(read, out of memory data)</i>			
Database Toolbox <i>(standard ODBC/JDBC)</i>	Azure SQL Database	Azure Database for MySQL/PostgreSQL	SQL Data Warehouse	SQL Server Stretch Database
Support Packages	Blob Storage: Blob, Table, File <i>(read/write/delete, encryption, access control)</i>	Data Lake <i>(read/write/delete, encryption, access control)</i>	CosmosDB: MongoDB, Cassandra, Table interfaces	

AWS

Datastore	Amazon S3 <i>(read, out of memory data)</i>			
Database Toolbox <i>(standard ODBC/JDBC)</i>	Amazon Aurora	Amazon RDS for PostgreSQL/MySQL/MariaDB/Oracle/SQL Server		
Support Packages	Amazon S3 <i>(read/write/delete, encryption, access control)</i>	Amazon EFS <i>(NFS/Linux)</i>	Amazon Athena <i>(Query of S3 data)</i>	

For the complete list, go to <https://www.mathworks.com/cloud.html>

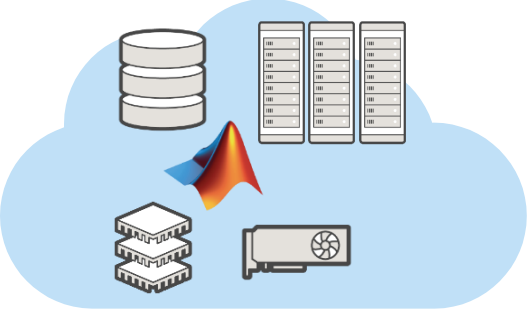
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Public Clouds



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Hosting Provider



MathWorks Cloud

Reference Architectures

Cloud Data Services

Cloud Center

Create and manage your AWS cluster with Cloud Center

Cloud Center

September 2019 Release Notes
To learn about new features and changes in MathWorks® Cloud Center, see Cloud Center Release Notes.

My Clusters
Create a Cluster
Preferences
User Preferences
Global Cluster Access

Create Cluster

* Give this cluster a name

MATLAB Version R2019b

Automatically terminate cluster When cluster is idle

Cluster Log Level Low

> Location & Network

> Cluster Configuration

Shared State Personal Cluster Shareable Cluster

Auto-Manage Cluster Access Set cluster firewall rules to let MATLAB communicate with your cluster

Worker Machine Type Standard (c4.xlarge, 18 core)

Workers per Machine 18

Use a dedicated headnode Some features are available only with a dedicated headnode

Headnode Machine Type Standard (m5.xlarge, 2 core)

Allow cluster to auto-resize

Workers in Cluster Initial Count: 18, Upper Limit: 18, Max: 1024

Machines in Cluster 2 (Including headnode)

Note: You are charged for the use of your cloud provider's clusters. Consider periodically checking your active resources through your cloud provider account.

> Cluster Shared Storage

Persisted Storage 100GB

Amazon S3 Data

Cloud Center

September 2019 Release Notes
To learn about new features and changes in MathWorks® Cloud Center, see Cloud Center Release Notes.

My Clusters
Create a Cluster
Preferences
User Preferences
Global Cluster Access

Filter list

Cluster Name	Region	Maximum Workers	Status	Date Created	MATLAB Version	Actions
Sample_Cluster_3	US	2	Offline	2018-05-22	R2018a	<input type="button" value="Start Up"/> <input type="button" value="Delete"/>
Sample_Cluster_2	US	2	Offline	2018-05-22	R2018a	<input type="button" value="Start Up"/> <input type="button" value="Delete"/>
Sample_Cluster_1	US	18	Offline	2018-05-22	R2018a	<input type="button" value="Start Up"/> <input type="button" value="Delete"/>

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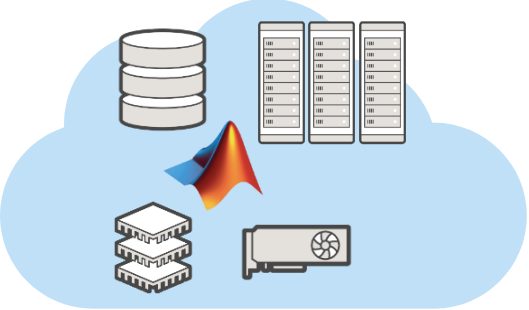
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MathWorks Cloud

Reference Architectures

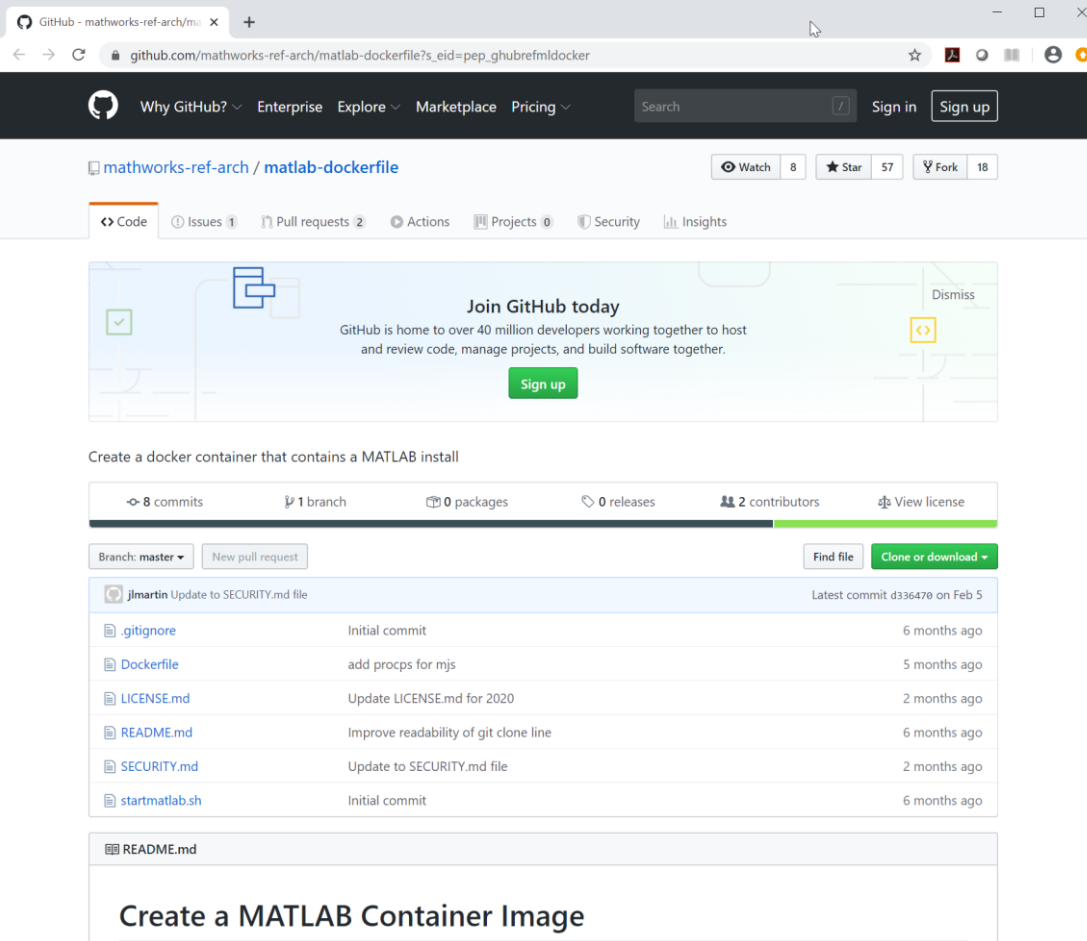
Cloud Data Services

Cloud Center

MATLAB Dockerfile

 **NVIDIA NGC** Deep Learning Container

Create a MATLAB container image with the MATLAB Dockerfile reference architecture



The screenshot shows the GitHub repository page for 'mathworks-ref-arch/matlab-dockerfile'. The page includes a navigation bar with 'Why GitHub?', 'Enterprise', 'Explore', 'Marketplace', and 'Pricing'. Below the navigation bar, there are buttons for 'Watch' (8), 'Star' (57), and 'Fork' (18). The repository name is 'mathworks-ref-arch / matlab-dockerfile'. The page content includes a 'Join GitHub today' banner, a description 'Create a docker container that contains a MATLAB install', and a list of commits. The commits list includes:

Commit	Description	Time
jlmartin Update to SECURITY.md file	Latest commit d33647e on Feb 5	
.gitignore	Initial commit	6 months ago
Dockerfile	add procps for mjs	5 months ago
LICENSE.md	Update LICENSE.md for 2020	2 months ago
README.md	Improve readability of git clone line	6 months ago
SECURITY.md	Update to SECURITY.md file	2 months ago
startmatlab.sh	Initial commit	6 months ago

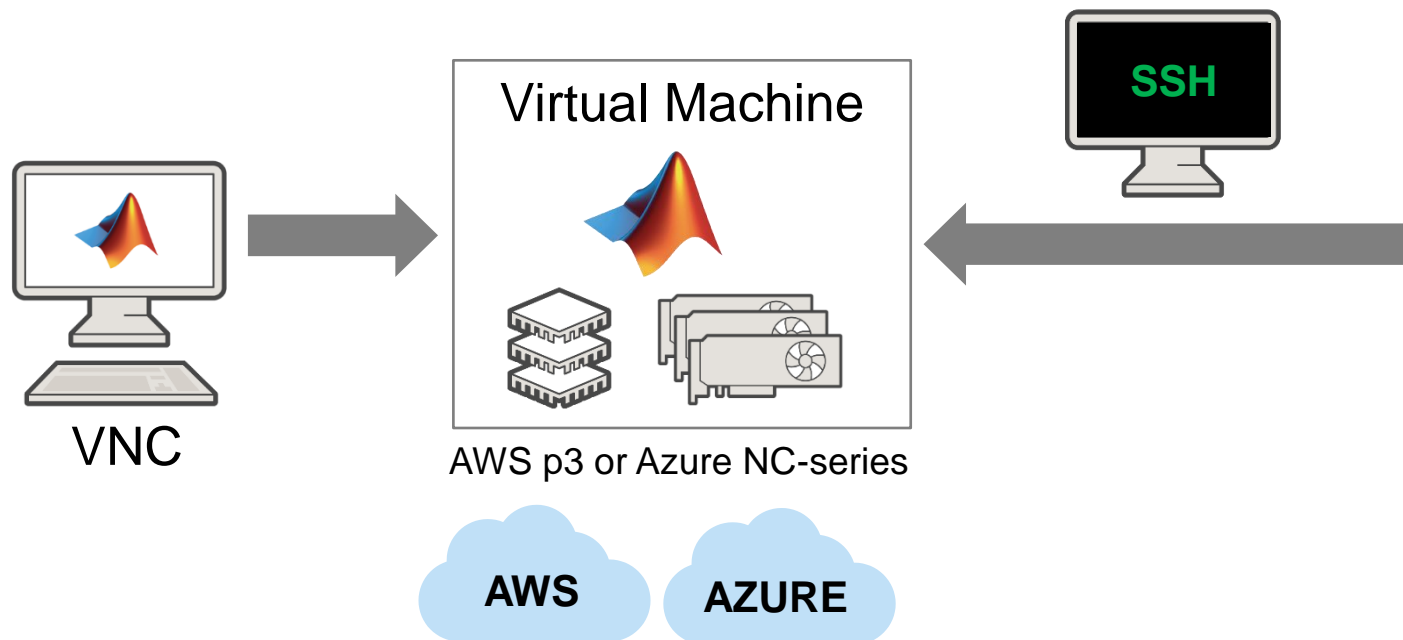
At the bottom of the screenshot, the text 'Create a MATLAB Container Image' is visible.

<https://github.com/mathworks-ref-arch/matlab-dockerfile>

MATLAB Deep Learning Container for NVIDIA GPU Cloud

- Preconfigured Docker container
- MATLAB + 9 Toolboxes for Deep Learning
- Several Pretrained Convolutional Neural Networks

NVIDIA GPU Cloud container registry



< MATLAB Pull r2019a

Publisher	Built By	Latest Tag	Modified	Size
MathWorks	MathWorks	r2019a	June 18, 2019	8.87 GB

Description

MATLAB is a programming platform designed for engineers and scientists. The MATLAB Deep Learning Container provides algorithms, pretrained models, and apps to create, train, visualize, and optimize deep neural networks.

Labels

Deep-Learning HPC High-Performance-Computing Machine Learning Partner

Pull Command

```
docker pull nvcr.io/partners/matlab:r2019a
```

Overview Tags Layers

What is MATLAB?

MATLAB® is a programming platform designed for engineers and scientists. It combines a desktop environment tuned for iterative analysis and design processes with a programming language that expresses matrix and array mathematics directly.

The MATLAB Deep Learning Container provides algorithms, pretrained models, and apps to create, train, visualize, and optimize deep neural networks. You can also access tools for image and signal processing, text analytics, and automatically generating C and CUDA code for deployment on NVIDIA GPUs in data centers and embedded systems.

<https://ngc.nvidia.com/catalog/containers/partners:matlab>

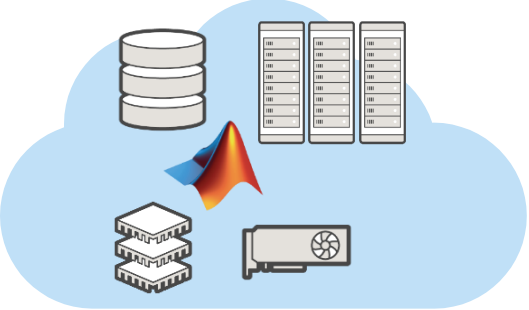
Whatever your cloud environment, MATLAB can work and scale



Public Clouds



On-Premise/Private Cloud



Hosting Provider



MathWorks Cloud

Reference Architectures

Cloud Data Services

Cloud Center

MATLAB Dockerfile

 **NVIDIA NGC** Deep Learning Container



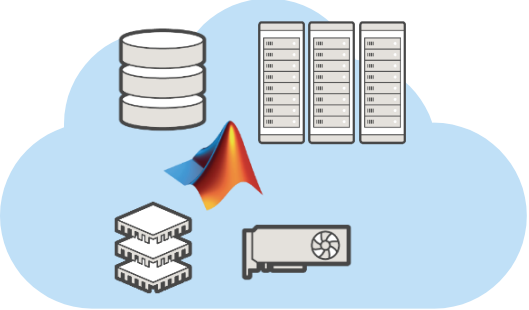
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 **NVIDIA NGC** Deep Learning Container

NIMBIX
PENGUIN COMPUTING
rescale
SABALCORE
Uber Cloud



MATLAB Online
MATLAB Drive

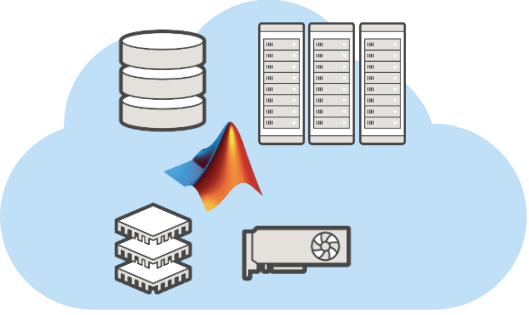
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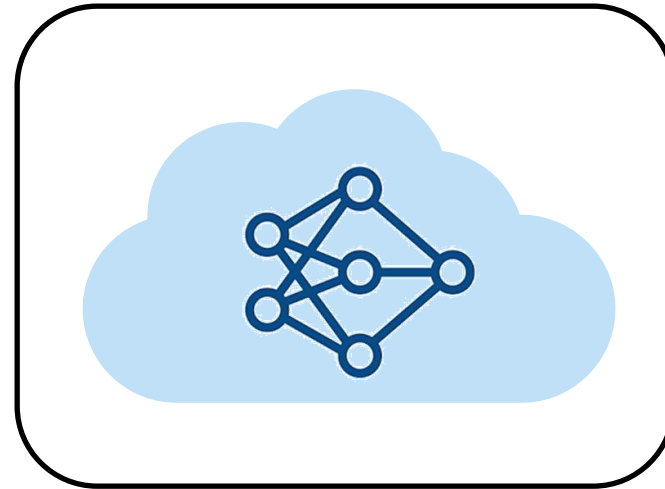
MATLAB Online Server



MATLAB Online
MATLAB Drive



How to configure MATLAB
in your Cloud environment



How to use MATLAB in
your Cloud workflow

Technical Computing Artificial Intelligence Workflow


Access and Explore Data

Preprocess Data


Develop Predictive Models

Integrate Analytics with Systems


Files



Databases



Sensors



Working with Messy Data




Data Reduction/Transformation




Feature Extraction




Model Creation e.g. Machine Learning



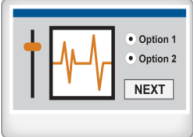
Parameter Optimization



Model Validation



Apps




Enterprise Systems

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

AWS

AZURE



Access and Explore Data

Files



Databases

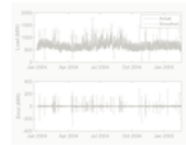


Sensors



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Apps



Enterprise Systems

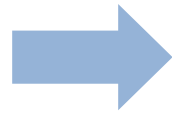
MATLAB Excel
.NET C/C++
.exe Java .dll

AWS

AZURE



Leverage datastores to handle big data on public clouds such as Azure Blobs or Amazon S3 buckets

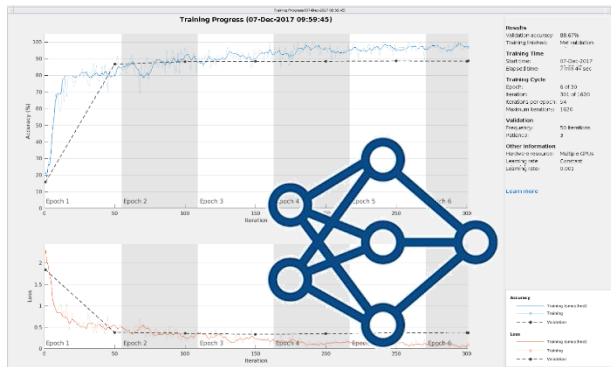
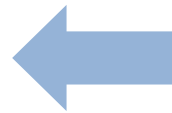


```
setenv('AWS_ACCESS_KEY_ID', access_key_id);  
setenv('AWS_SECRET_ACCESS_KEY', access_key);
```

```
ds = imageDatastore(fileLoc);
```

```
[trainDS, valDS, testDS] = splitEachlabel(ds,...  
    0.7, 0.15, 0.15, 'randomized');
```

```
Net = trainNetwork(trainDS, layers, trainOpts);
```



Access and Explore Data

Preprocess Data

Develop Predictive Models

Integrate Analytics with Systems

Files



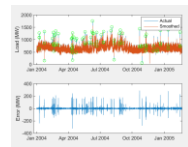
Databases



Sensors



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Enterprise Systems

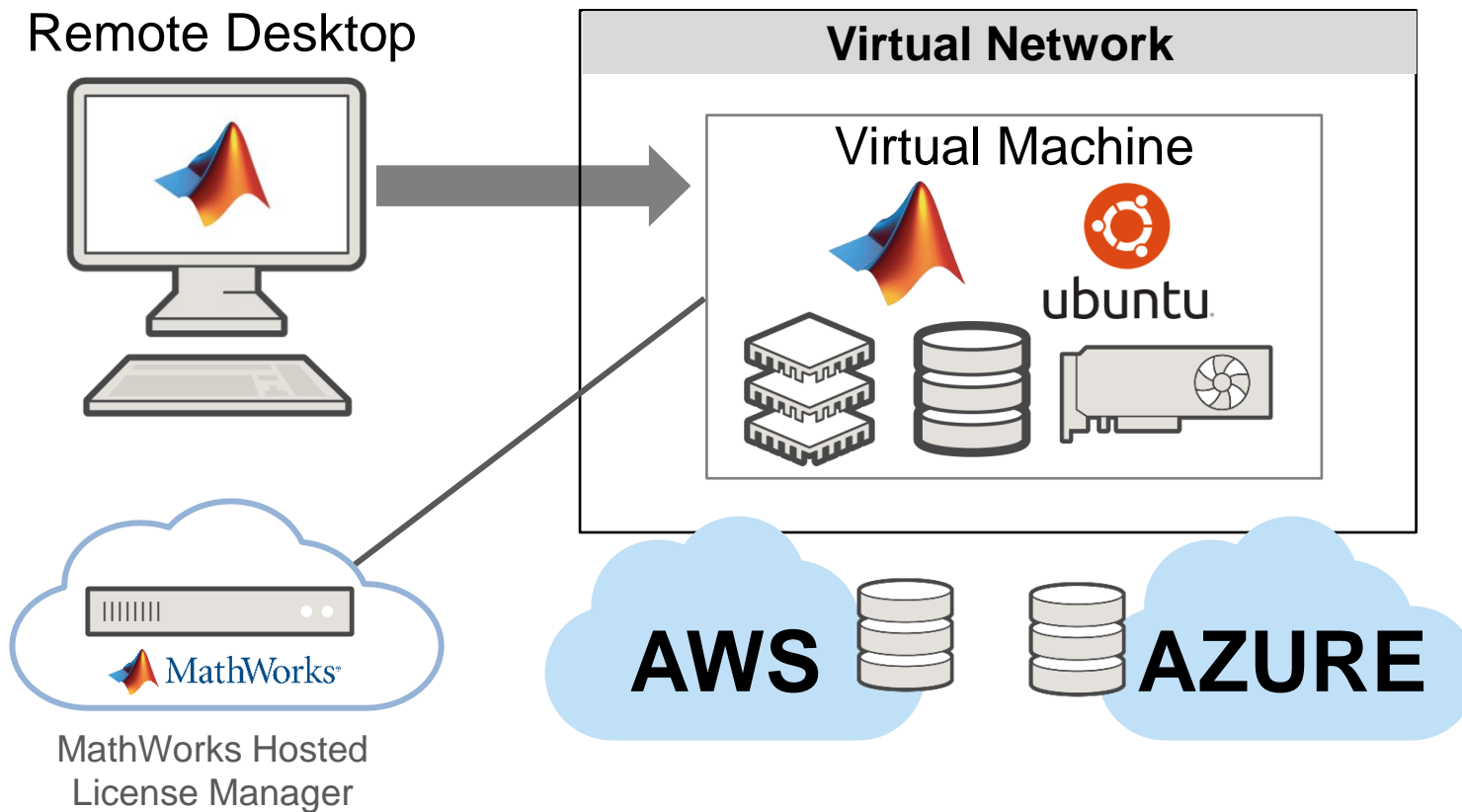
MATLAB Excel
.NET C/C++
.exe Java .dll

AWS

AZURE



Using MATLAB reference architecture to develop analytics on cloud stored data



Use cases in the cloud:

1. Data analytics on cloud-stored data
2. Access to high-end multi-core VMs, GPUs, FPGAs
3. Prototyping parallel algorithms and models on one VM before scaling to a cluster
4. Use a compute cluster for preprocessing of data large sets of data

<https://github.com/mathworks-ref-arch/matlab-on-aws>
<https://github.com/mathworks-ref-arch/matlab-on-azure>

Access and Explore Data

Files



Databases

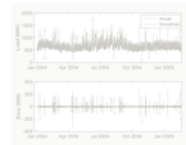


Sensors



Preprocess Data

Working with Messy Data



Data Reduction/Transformation



Feature Extraction



Develop Predictive Models

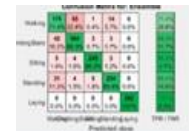
Model Creation e.g. Machine Learning



Parameter Optimization



Model Validation



Integrate Analytics with Systems

Apps



Enterprise Systems

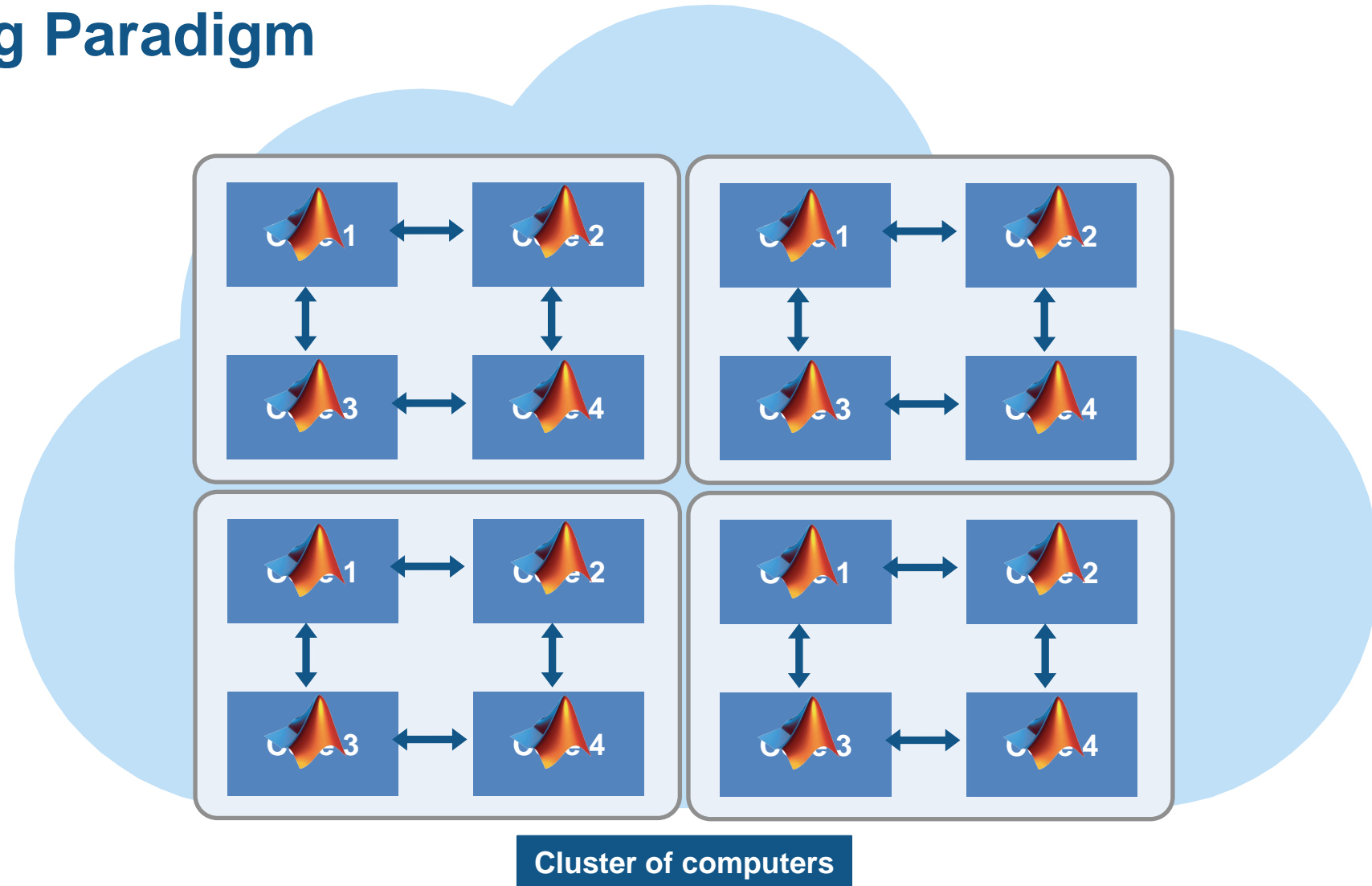
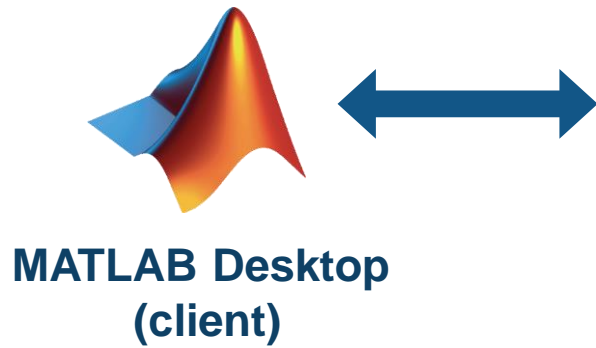
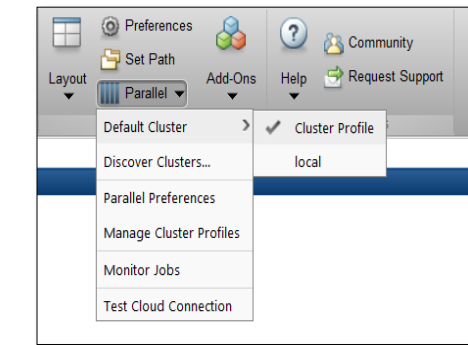
MATLAB Excel
.NET C/C++
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AWS

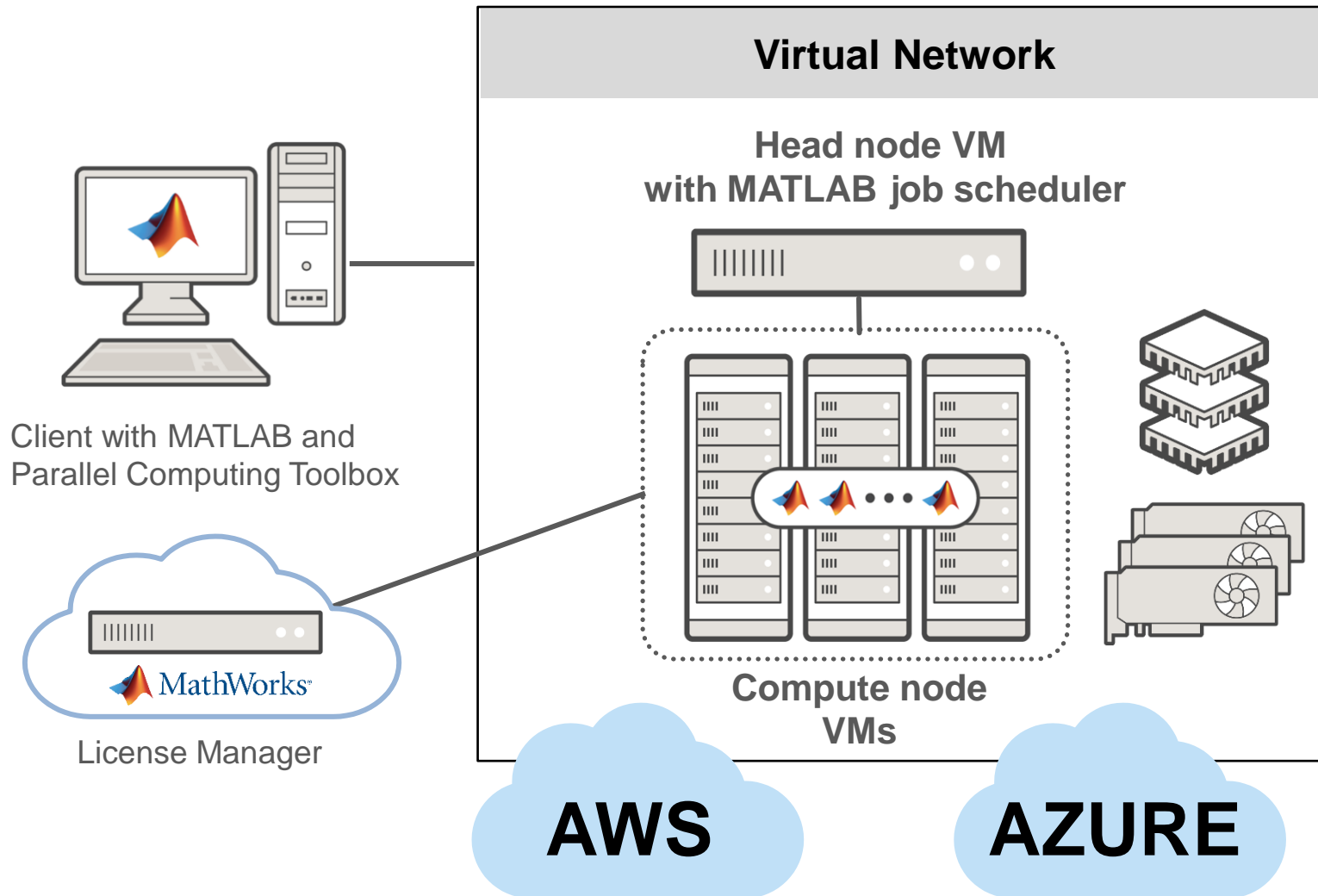
AZURE



Parallel Computing Paradigm



Speed up your parameter sweeps and simulation runs



MATLAB Parallel Server Cloud Reference Architecture

Use cases in the cloud:

1. Parameter sweeps
2. Monte Carlo runs
3. Optimization
4. Distributed array calculations

<https://github.com/mathworks-ref-arch/matlab-parallel-server-on-aws>
<https://github.com/mathworks-ref-arch/matlab-parallel-server-on-azure>

Access and Explore Data

Preprocess Data

Develop Predictive Models

Integrate Analytics with Systems

Files



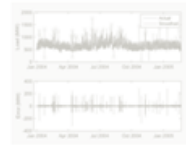
Databases



Sensors



Working with Messy Data



Data Reduction/
Transformation



Feature
Extraction



Model Creation e.g.
Machine Learning



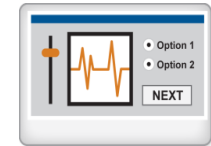
Parameter
Optimization



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Apps



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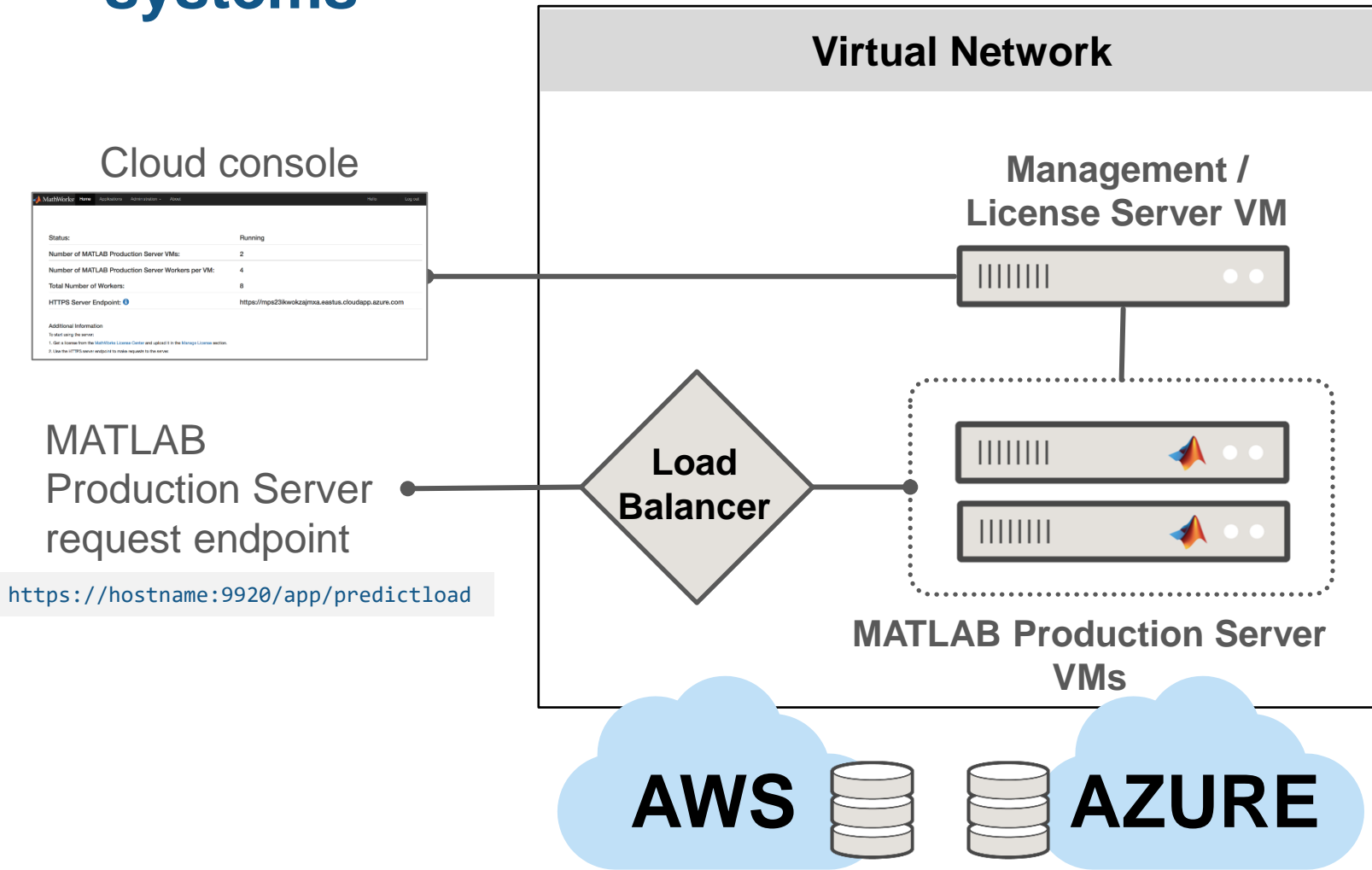
MATLAB Excel
.NET C/C++
.exe Java .dll

AWS

AZURE



Deploy, scale, and integrate your analytics with operational systems

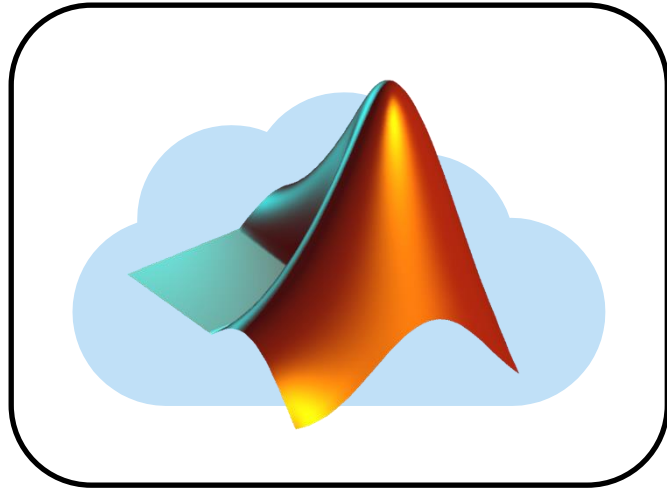


MATLAB Production Server Cloud Reference Architecture

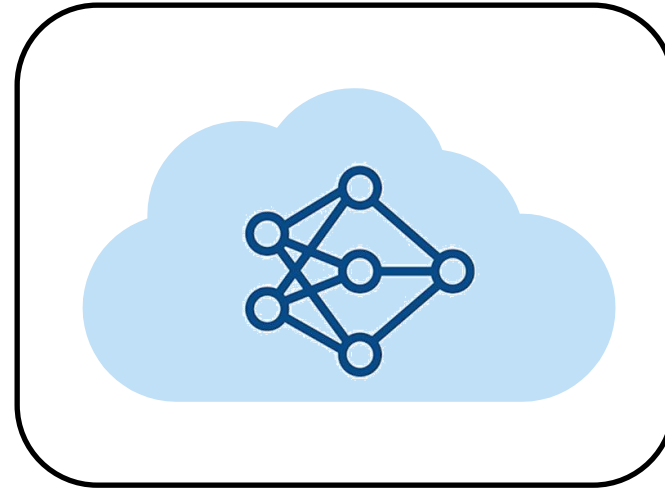
Use cases in the cloud:

1. Deploy AI models or algorithms as microservice APIs
2. Scalable deployed models and analytics
3. Support hundreds to thousands of concurrent requests
4. Integration with operational systems: IoT / streaming data analytics

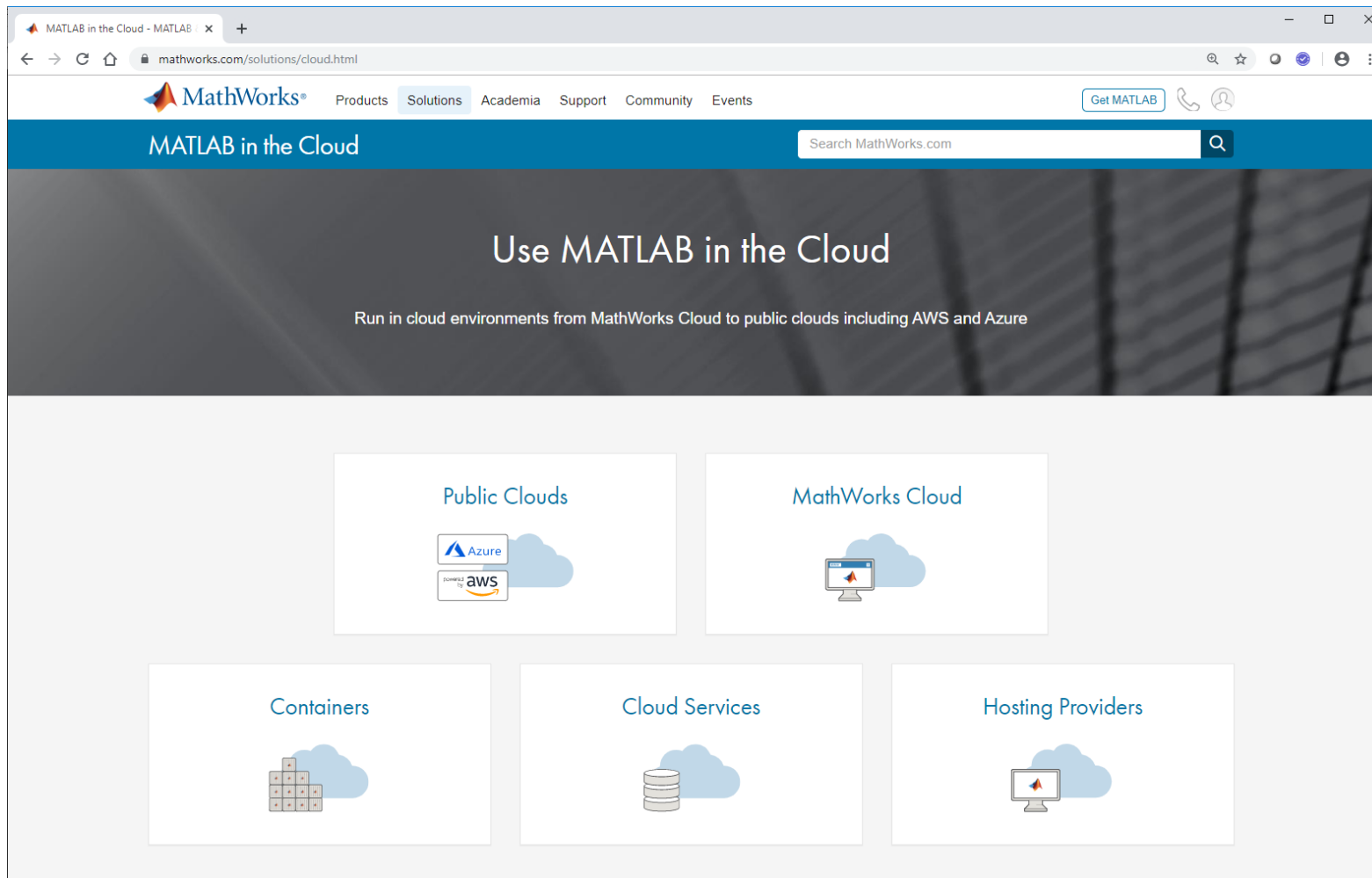
<https://github.com/mathworks-ref-arch/matlab-production-server-on-aws>
<https://github.com/mathworks-ref-arch/matlab-production-server-on-azure>



**How to configure MATLAB
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**How to use MATLAB in
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<https://www.mathworks.com/cloud.html>