

A Lecturer's Guide: Installing and Configuring MemVerge CXL Emulation Images in Microsoft Azure

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Prerequisites

Introduction

Create a Primary Linux Virtual Machine

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Configure the VM Disks

Configure Networking

Finalize the VM

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Update and Prepare the OS Image

Create a VM Snapshot

Prerequisites

- You have a Microsoft Azure Account (<https://portal.azure.com>)

Introduction

This document provides a procedure that creates a primary Virtual Machine image. Once the VM has been configured and prepared, a snapshot of the VM will be created that can be cloned for each student in the class.

Create a Primary Linux Virtual Machine

Login to your [Microsoft Azure Portal](#).

Use one of the following methods to create a virtual machine:

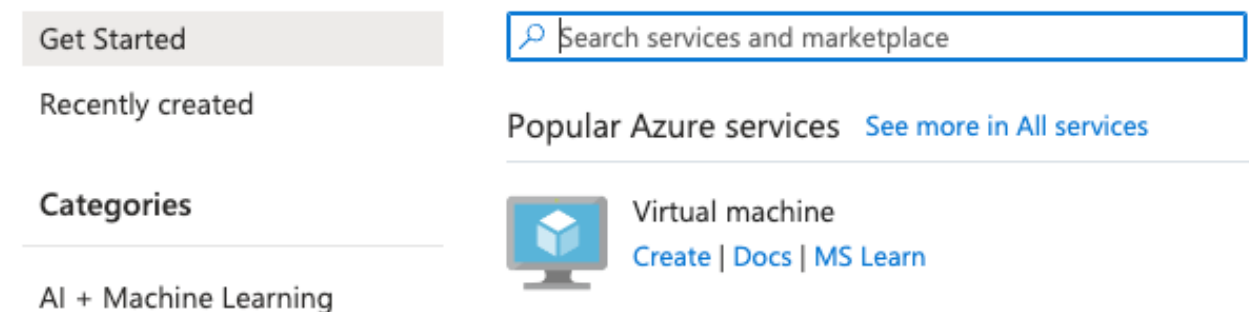
Method 1: From the dashboard, select 'Create a Resource'

Azure services



Find the 'Virtual Machine' in the list or search for it in the search bar, then click 'Create'

Create a resource








Go to the 'Create a new Virtual Machine' section to continue.

Method 2: An alternative method to create a Virtual Machine is to select 'Virtual Machine' on your dashboard, then click 'Create' in the top menu or in the central area if no virtual machines exist. Select 'Azure virtual machine' from the drop-down list of options:



Virtual machines ...

MemVerge (memverge.com)

 Create   Switch to classic  Reservations 



Azure virtual machine

Create a virtual machine  Azure virtual machine  Azure



Azure virtual machine with preset configuration

Create a virtual machine with presets based on your workloads



More VMs and related solutions

Discover and deploy full workloads and Azure products for your business needs



No virtual machines to display





Create a virtual machine that runs Linux or Windows. Select an image from the marketplace or use your own customized image.

[Learn more about Azure virtual machines](#)

[Learn more about Azure Arc virtual machines](#)

[Create a VM](#)

Create ▼

-  **Azure virtual machine**
Create a virtual machine hosted by Azure
-  **Azure virtual machine with preset configuration**
Create a virtual machine with presets based on your workloads
-  **Azure Arc virtual machine**
Create a new Azure Arc virtual machine in one of your non-Azure environments
-  **Azure VMware Solution virtual machine**
Create a VMware virtual machine hosted by Azure

Create a new Virtual Machine

In the VM Creation Screen, select these options:

- **Product details**
 - **Subscription:** Azure subscription 1 (use the default)
 - **Resource Group:** Click 'Create new' and use 'rg-cxldemo' as the resource group name

- **Instance Details**
 - **Virtual Machine name:** cxldemo01
 - **Region:** *Pick a region closest to you*
 - **Availability Options:** No infrastructure redundancy required
 - **Security Type:** Standard
 - **Image:** Ubuntu Server 22.04 LTS (or newer)
 - **VM architecture:** x86
 - **Run with Azure Spot discount:** unchecked
 - **Size:** Standard_E2x_v5 - 2 cpus, 16 GiB memory
- **Administrator account**
 - **Authentication type:** password
 - **Username:** cxldemo
 - **Password:** LearningCXL1sFun!
 - **Confirm password:** LearningCXL1sFun!
- **Inbound port rules**
 - **Public inbound ports:** Allow selected ports
 - **Selected inbound ports:** SSH(22)

Here is an example

Microsoft Azure

Search resources, services, and docs (G+ /)

10

steve.scargall@memver...
MEMVERGE (MEMVERGE.COM)

Home > Virtual machines >

Create a virtual machine

Basics

Disks

Networking

Management

Monitoring

Advanced

Tags

Review + create

Create a virtual machine that runs Linux or Windows. Select an image from Azure marketplace or use your own customized image. Complete the Basics tab then Review + create to provision a virtual machine with default parameters or review each tab for full customization. [Learn more](#)

This subscription may not be eligible to deploy VMs of certain sizes in certain regions.

Project details

Select the subscription to manage deployed resources and costs. Use resource groups like folders to organize and manage all your resources.

Subscription * ⓘ

Azure subscription 1

Resource group * ⓘ

(New) rg-cxldemo

Create new

Instance details

Virtual machine name * ⓘ

cxldem01

Region * ⓘ

(US) West US

Availability options ⓘ

No infrastructure redundancy required

Security type ⓘ

Standard

Image * ⓘ

Ubuntu Server 22.04 LTS - x64 Gen2 (free services eligible)

See all images | Configure VM generation

VM architecture ⓘ

Arm64

☒ x64

Run with Azure Spot discount ⓘ

☐

You are in the free trial period. Costs associated with this VM can be covered by any remaining credits on your subscription. [Learn more](#)

Size * ⓘ

Standard_E2ads_v5 - 2 vcpus, 16 GiB memory (\$108.04/month)

See all sizes

Administrator account

Authentication type ⓘ

SSH public key

☒ Password

Username * ⓘ

cxldemo

Password * ⓘ

.....

Confirm password * ⓘ

.....

Inbound port rules

Select which virtual machine network ports are accessible from the public internet. You can specify more limited or granular network access on the Networking tab.

Public inbound ports * ⓘ

None

☒ Allow selected ports

Select inbound ports *

SSH (22)

All traffic from the internet will be blocked by default. You will be able to change inbound port rules in the VM > Networking page.

Review + create

< Previous

Next : Disks >

Give feedback

Click 'Next: Disks >' to continue

Configure the VM Disks

Use the defaults for most options. As this is a demo environment, set the **OS disk type** to 'Standard SSD'. The disk screen should look similar to the following:

Create a virtual machine ...

- Basics
- Disks
- Networking
- Management
- Monitoring
- Advanced
- Tags
- Review + create

Azure VMs have one operating system disk and a temporary disk for short-term storage. You can attach additional data disks. The size of the VM determines the type of storage you can use and the number of data disks allowed. [Learn more](#)

VM disk encryption

Azure disk storage encryption automatically encrypts your data stored on Azure managed disks (OS and data disks) at rest by default when persisting it to the cloud.

Encryption at host

☐

Encryption at host is not registered for the selected subscription.
[Learn more about enabling this feature](#)

OS disk

OS disk type *

Standard SSD (locally-redundant storage)

The selected VM size supports premium disks. We recommend Premium SSD for high IOPS workloads. Virtual machines with Premium SSD disks qualify for the 99.9% connectivity SLA.

Delete with VM

☒

Key management

Platform-managed key

Enable Ultra Disk compatibility

☐

Data disks for cxldem01

You can add and configure additional data disks for your virtual machine or attach existing disks. This VM also comes with a temporary disk.

LUN	Name	Size (GiB)	Disk type	Host caching	Delete with VM
<div>Create and attach a new disk</div> <div>Attach an existing disk</div>					

^

Advanced

Use managed disks

☒

Gallery package requires managed disks.

Ephemeral OS disk

☒ None

☐ OS cache placement

☐ Temp disk placement

Ephemeral OS disks are currently not supported for the selected instance size.

Click 'Next: Networking >' to continue

Configure Networking

Use the defaults for these options, except 'Delete public IP and NIC when VM is deleted', which should be selected (unselected by default). The Networking screen should look similar to the following:

Create a virtual machine ...

Basics Disks **Networking** Management Monitoring Advanced Tags Review + create

Define network connectivity for your virtual machine by configuring network interface card (NIC) settings. You can control ports, inbound and outbound connectivity with security group rules, or place behind an existing load balancing solution.
[Learn more](#)

Network interface
When creating a virtual machine, a network interface will be created for you.

Virtual network * ⓘ

(new) cxldem01-vnet
[Create new](#)

Subnet * ⓘ

(new) default (10.0.0.0/24)
[Create new](#)

Public IP ⓘ

(new) cxldem01-ip
[Create new](#)

NIC network security group ⓘ

☐ None

☒ Basic

☐ Advanced


Public inbound ports * ⓘ

☐ None

☒ Allow selected ports

Select inbound ports *

SSH (22)

 **This will allow all IP addresses to access your virtual machine.** This is only recommended for testing. Use the Advanced controls in the Networking tab to create rules to limit inbound traffic to known IP addresses.

Delete public IP and NIC when VM is

☒

Delete public IP and NIC when VM is deleted ⓘ



Enable accelerated networking ⓘ



i The resource provider 'Microsoft.Network' should be registered in order to enable accelerated networking. [Learn more](#) ↗

Load balancing

You can place this virtual machine in the backend pool of an existing Azure load balancing solution. [Learn more](#) ↗


Load balancing options ⓘ

- ☒ None
- ☐ Azure load balancer
Supports all TCP/UDP network traffic, port-forwarding, and outbound flows.
- ☐ Application gateway
Web traffic load balancer for HTTP/HTTPS with URL-based routing, SSL termination, session persistence, and web application firewall.

Click "Review + Create" to continue.

Finalize the VM

Review the options on the page and click 'Create' to create the VM. It will take a few minutes for the VM to initialize and become available. You will see a progress screen while the VM is initializing, similar to the following:



CreateVm-canonical.0001-com-ubuntu-server-jammy-2-20230907184611 | Overview

Deployment

Delete

Cancel

Redeploy

Download

Refresh


Overview

Inputs

Outputs

Template

Deployment is in progress



Deployment name: CreateVm-canonical.0001-com-ubuntu-server-j...





Subscription: [Azure subscription 1](#)

Resource group: [rg-cxldemo](#)

Start time: 9/7/2023, 9:23:46 PM

Correlation ID: ee18dbbd-b2fa-488d-aa5e-ca6

Deployment details


Resource	Type	Status	Operation details
 cxldem01897	Microsoft.Network/netwo...	Created	Operation details
 cxldem01-ip	Microsoft.Network/public...	OK	Operation details
 cxldem01-nsg	Microsoft.Network/netwo...	OK	Operation details
 cxldem01-vnet	Microsoft.Network/virtual...	OK	Operation details

Give feedback

[Tell us about your experience with deployment](#)

When the VM is available, you will see a screen similar to the following:

Home >



CreateVm-canonical.0001-com-ubuntu-server-jammy-2-20230907184611 | Overview

Deployment

Delete

Cancel

Redeploy

Download


Refresh

Overview


Inputs

Outputs

Template



Your deployment is complete



Deployment name: CreateVm-canonical.0001-com-ubuntu-server-j...

Subscription: [Azure subscription 1](#)

Resource group: [rg-cxldemo](#)

Start time: 9/7/2023, 9:23:46 PM

Correlation ID: ee18dbbd-b2fa-488d-aa5e-ca6

Deployment details

Next steps

[Setup auto-shutdown](#) Recommended

[Monitor VM health, performance and network dependencies](#) Recommended

[Run a script inside the virtual machine](#) Recommended

Go to resource

Create another VM

Give feedback

[Tell us about your experience with deployment](#)

Click 'Go to resource'. Information about the virtual machine will be shown. For example:

cxldem01

Virtual machine

Search

Overview

Activity log

Access control (IAM)

Tags

Diagnose and solve problems

Settings

Networking

Connect

Disks

Size

Microsoft Defender for Cloud

Advisor recommendations

Extensions + applications

Availability + scaling

Configuration

Identity

Properties

Locks

Operations

Bastion

Auto-shutdown

Backup

Disaster recovery

Updates

Inventory

Change tracking

Automanage

Configuration management (Preview)

Policies

Run command

Monitoring

Insights

Connect

Start

Restart

Stop

Capture

Delete

Refresh

Open in mobile

Feedback

CLI / PS

Essentials

JSON View

Resource group (move) : [rg-cxldemo](#)

Status : Running

Location : West US

Subscription (move) : [Azure subscription 1](#)

Subscription ID : 5deb952d-2ddb-47de-b4d4-491c1029358e

Operating system : Linux (ubuntu 22.04)

Size : Standard E2s v5 (2 vcpus, 16 GiB memory)

Public IP address : [168.61.16.89](#)

Virtual network/subnet : [cxldem01-vnet/default](#)

DNS name : [Not configured](#)

Health state : -

Tags (edit) : [Add tags](#)

Properties

Monitoring

Capabilities (7)

Recommendations

Tutorials

Virtual machine

Computer name : cxldem01

Operating system : Linux (ubuntu 22.04)

Image publisher : canonical

Image offer : 0001-com-ubuntu-server-jammy

Image plan : 22_04-lts-gen2

VM generation : V2

VM architecture : x64

Agent status : Ready

Agent version : 2.9.1.1

Host group : [None](#)

Host : -

Proximity placement group : -

Colocation status : N/A

Capacity reservation group : -

Disk controller type : SCSI

Availability + scaling

Availability zone : -

Availability set : -

Scale Set : -

Security type

Security type : Standard

Extensions + applications

Extensions : -

Networking

Public IP address : [168.61.16.89](#) (Network interface [cxldem01897](#))

Public IP address (IPv6) : -

Private IP address : 10.0.0.4

Private IP address (IPv6) : -

Virtual network/subnet : [cxldem01-vnet/default](#)

DNS name : [Configure](#)

Size

Size : Standard E2s v5

vCPUs : 2

RAM : 16 GiB

Disk

OS disk : [cxldem01_OsDisk_1_c666ce8490b949d19fe498b11b622c5e](#)

Encryption at host : Disabled

Azure disk encryption : Not enabled

Ephemeral OS disk : N/A

Data disks : 0

Auto-shutdown

Auto-shutdown : Not enabled

Scheduled shutdown : -

Azure Spot

Azure Spot : -

Azure Spot eviction policy : -

Connect to the VM

Using an SSH Client, connect to the VM using the public IP address shown in the 'Networking' section of the VM information. For this example, the public IP address is 168.61.16.89. Using a Linux Terminal, Putty (Windows), or MobaXTerm.

Use the `cxldemo` user and password `LearningCXL1sFun!` that was configured during the VM creation procedure.

Linux Terminal:

```
$ ssh cxldemo@168.61.16.89
cxldemo@168.61.16.89's password:
cxldemo@cxldem01:~$
```

Update and Prepare the OS Image

The following steps will prepare the OS for the lab. Once this first VM has been prepared, it can be cloned as many times as there are students to save time.

Update the package repository cache. This allows packages to be installed.

```
$ sudo apt update
```

Install podman

```
$ sudo apt install -y podman
```

Pull the MemVerge CXL Memory Expansion Image from Docker Hub

```
$ podman pull docker.io/mvpool/qemu_cxl_memexp
```

Create a VM Snapshot

Once all the required packages have been installed, a snapshot of the VM should be taken using the [Azure Portal](#) from which other VM can be created. Watch [How to capture a VM image and use it from the image gallery](#) for a walk through of this procedure.

Select the VM in your dashboard, then click 'Capture' from the top menu



In the 'Create an image' window, ensure the Resource Group matches the VM resource group. Use the default options and change or select the following:

- **Resource group:** rg-cxldemo
- **Instance Details**
 - **Share image to Azure compute gallery:** Yes, share it to a gallery as a VM image version
- **Gallery details**
 - **Target Azure compute gallery:** Click 'Create new', then use 'cxldemoGallery' as a name.

- **Operating system state:** Specialized: VMs created from this image are completely configured and do not require parameters such as hostname and admin user/password.
- **Target VM image definition:** Click 'Create new'. In the popup window enter a 'VM image definition name', eg: 'cxldemoOSImg'. Use the default for the remaining options. For example:

Create a VM image definition



VM image definition name *	<input type="text" value="cxldemoOSImg"/>
OS type	<input checked="" type="radio"/> Linux <input type="radio"/> Windows
VM generation	<input type="radio"/> Gen 1 <input checked="" type="radio"/> Gen 2
Security type	<input type="text" value="Standard"/>
VM architecture	<input checked="" type="radio"/> x64 <input type="radio"/> Arm64
Higher storage performance with NVMe (preview)	<input type="checkbox"/>
Enable hibernation (preview)	<input type="checkbox"/>
Accelerated networking (preview)	<input type="checkbox"/>
Publisher *	<input type="text" value="canonical"/>
Offer *	<input type="text" value="0001-com-ubuntu-server-jammy"/>
SKU *	<input type="text" value="22_04-lts-gen2"/>

▼ Publishing options (Optional)

- **Version details:**
 - **Version number:** 1.0.0

The options should look similar to the following:

Create an image ...

- Basics
- Tags
- Review + create

Create an image from this virtual machine that can be used to deploy additional virtual machines and virtual machine scale sets. With a shared image, you can easily replicate the image to Azure regions around the world and manage versions of the image. Certain information from the virtual machine will be carried forward to the image including OS type, VM generation, plan, and publishing details. [Learn more](#)

Project details

Subscription

Azure subscription 1

Resource group *

rg-cxldemo

Instance details

Region

(US) West US

Share image to Azure compute gallery

☒ Yes, share it to a gallery as a VM image version.

☐ No, capture only a managed image.

Automatically delete this virtual machine after creating the image

☐

Gallery details

Target Azure compute gallery *

(new) cxldemoGallery

Create new

Operating system state

☐ Generalized: VMs created from this image require hostname, admin user, and other VM related setup to be completed on first boot

☒ Specialized: VMs created from this image are completely configured and do not require parameters such as hostname and admin user/password

Target VM image definition *

(new) cxldemoOSImg

Create new

Version details

Version number *

1.0.0

Exclude from latest

☐

End of life date

MM/DD/YYYY

Shallow replication

☐

Replication

A VM image version can be replicated to different regions depending on what makes sense for your organization. One example is to always replicate the latest image in multiple regions while all older versions are only available in 1 region. This can help save on storage costs for VM image versions.

Default storage sku ⓘ

Standard HDD LRS

Default replica count * ⓘ

1

Target regions	Target region replica count	Storage account type
(US) West US	1	Standard HDD LRS
(US) East US	1	Standard HDD LRS

Review + create


< Previous

Next : Tags >

Click 'Review + create' to continue

Review the summary page and click 'Create' to finalize the image. The VM will be stopped while the image creation process completes. When the procedure completes, you'll see a confirmation page similar to the following:

Home >

 **Microsoft.Compute-CaptureVM-20230907214828** | Overview

Deployment

Delete

Cancel

Redeploy

Download


Refresh

Overview

Inputs

Outputs

Template

 Your deployment is complete

Deployment name : Microsoft.Compute-CaptureVM-202...

Subscription : Azure subscription 1

Resource group : rg-cxldemo

Start time : 9/7/2023, 10:17:44 PM

Correlation ID : 115d6cae-6445-49fc-a858-f437d91c...

> Deployment details

< Next steps

Go to resource





Click 'Go to resource' to continue to the image details, which looks similar to the following:

1.0.0 (cxldemoGallery/cxldemoOSImg/1.0.0) ...





VM image version

<< [+ Create VM](#) [+ Create VMSS](#) [Delete](#) [Refresh](#) [Give feedback](#)



Overview

-  Activity log
-  Access control (IAM)
-  Tags
-  Diagnose and solve problems

Settings

-  Update replication
-  Configuration
-  Properties
-  Locks

Automation

-  Tasks (preview)
-  Export template

Help

-  Support + Troubleshooting

Essentials


Resource group (move)	: rg-cxldemo	Azure compute gallery	: cxldemoGallery
Status	: Succeeded	VM image definition	: cxldemoOSImg
Location	: West US	Replication status	: Completed
Subscription (move)	: Azure subscription 1	Replication mode	: Full
Subscription ID	: 5deb952d-2ddb-47de-b4d4-491c1029358e	Confidential OS disk encr...	: -
		Encryption type	: Platform-managed key
		End of life date	: -
		Exclude from latest	: No
		Storage account type	: Standard HDD LRS
Tags (edit)	: Add tags		


Click 'Create VM' from the list of commands at the top. You will be presented with a prepopulated 'Create a virtual machine' form with most of the details automatically populated based on the VM configuration we created earlier. The only fields that require attention are:

- Virtual machine name: cxldemo01 (increment for each new VM)
- Authentication type: Password

Create a virtual machine ...

Basics Disks Networking Management Monitoring Advanced Tags Review + create

Create a virtual machine that runs Linux or Windows. Select an image from Azure marketplace or use your own customized image. Complete the Basics tab then Review + create to provision a virtual machine with default parameters or review each tab for full customization. [Learn more](#) 

 This subscription may not be eligible to deploy VMs of certain sizes in certain regions.

Project details

Select the subscription to manage deployed resources and costs. Use resource groups like folders to organize and manage all your resources.

Subscription *	<div><div></div><div>Azure subscription 1</div><div>▼</div></div>
Resource group *	<div><div></div><div>rg-cxldemo</div><div>▼</div></div> <div>Create new</div>

Instance details

Virtual machine name *	<div><div></div><div>cxldemo01</div><div>✓</div></div>
Region *	<div><div></div><div>(US) West US</div><div>▼</div></div>
Availability options	<div><div></div><div>No infrastructure redundancy required</div><div>▼</div></div>
Security type	<div><div></div><div>Standard</div><div>▼</div></div>
Image *	<div><div></div><div>cxldemoGallery/cxldemoOSimg/1.0.0/cxldemoGallery/cxldemoOSimg/1.0.0</div><div>▼</div></div> <div>See all images Configure VM generation</div>
VM architecture	<div><div><input type="radio"/> Arm64</div><div><input checked="" type="radio"/> x64</div></div> <div><div></div><div>Arm64 is not supported with the selected image.</div></div>
Run with Azure Spot discount	<div><div></div><div><input type="checkbox"/></div></div>

i You are in the free trial period. Costs associated with this VM can be covered by any remaining credits on your subscription. [Learn more](#)

Size *	<div><div></div><div>Standard_E2s_v5 - 2 vcpus, 16 GiB memory (\$102.20/month)</div><div>▼</div></div> <div>See all sizes</div>
--------	---

Administrator account

Authentication type	<div><div><input type="radio"/> SSH public key</div><div><input checked="" type="radio"/> Password</div></div>
Username	<div><div></div></div>
Password	<div><div></div></div>
Confirm password	<div><div></div></div> <div><div></div><div>Administrator account is predefined with specialized images. Learn more about specialized images</div></div>

Inbound port rules

Select which virtual machine network ports are accessible from the public internet. You can specify more limited or granular

network access on the Networking tab.

Public inbound ports * ⓘ

- ☐ None
☒ Allow selected ports

Select inbound ports *

SSH (22) ▼

i All traffic from the internet will be blocked by default. You will be able to change inbound port rules in the VM > Networking page.

Review + create

< Previous

Next : Disks >

Click 'Review + create' to continue to the summary screen. Verify the details are correct, then click 'Create' to create the new VM. Once the VM is provisioned, click 'Go to resource'.

SSH to the new VM using the IP Address shown on the VM summary page.

Repeat the procedure for the required number of student VMs. TODO: This step should use the 'Create VMSS' UI option in the snapshot image to deploy as many VMs as needed. See [Create a VM from a generalized image version](#).

Note: The region must have the available resources to use this approach.