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

Prerequisites

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

Introduction

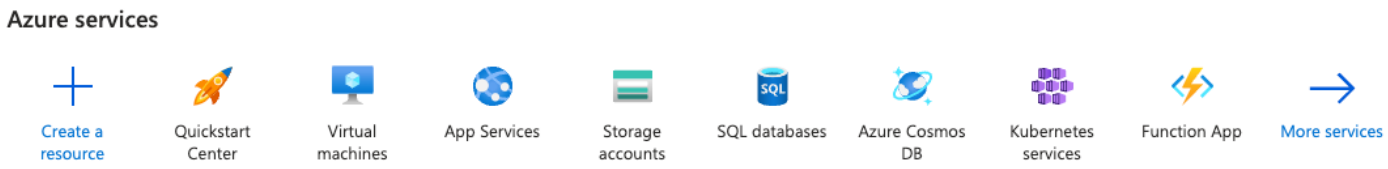
This document provides a procedure that creates a primary Virtual Machine image. Once the VM has been configured and prepared, a snapshot of the VM will be created that can be cloned for each student in the class.

Create a Primary Linux Virtual Machine

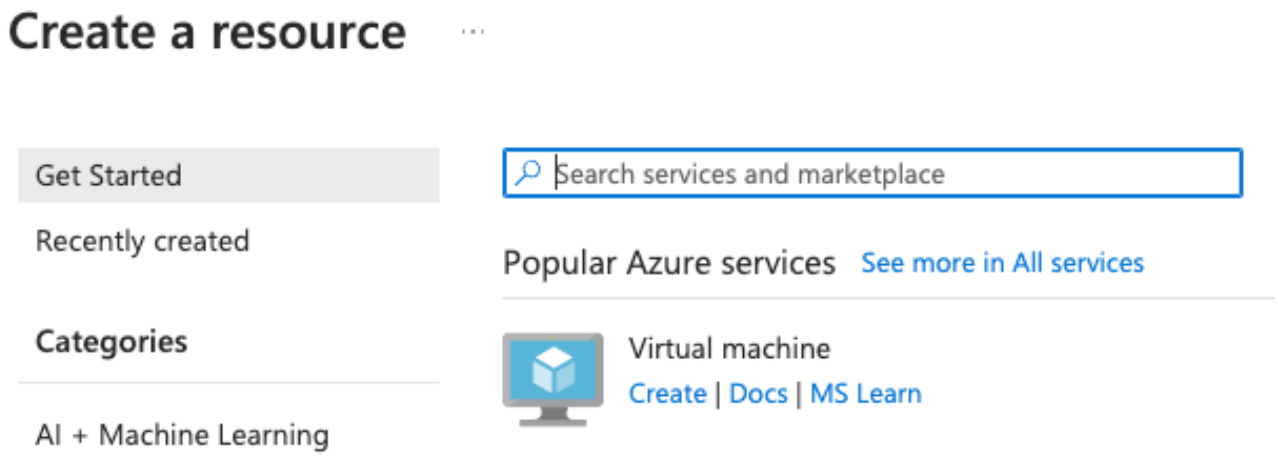
Login to your Microsoft Azure Portal.

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

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

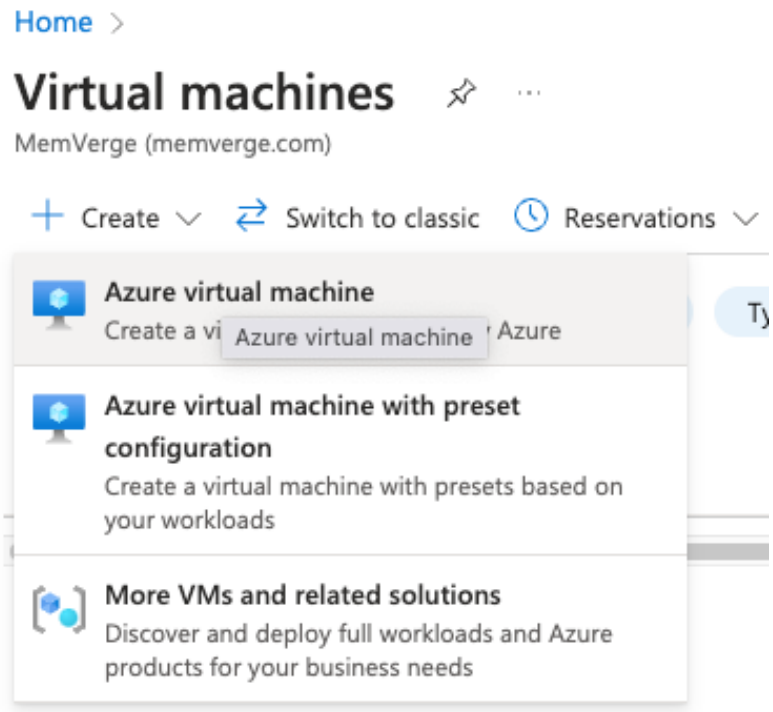


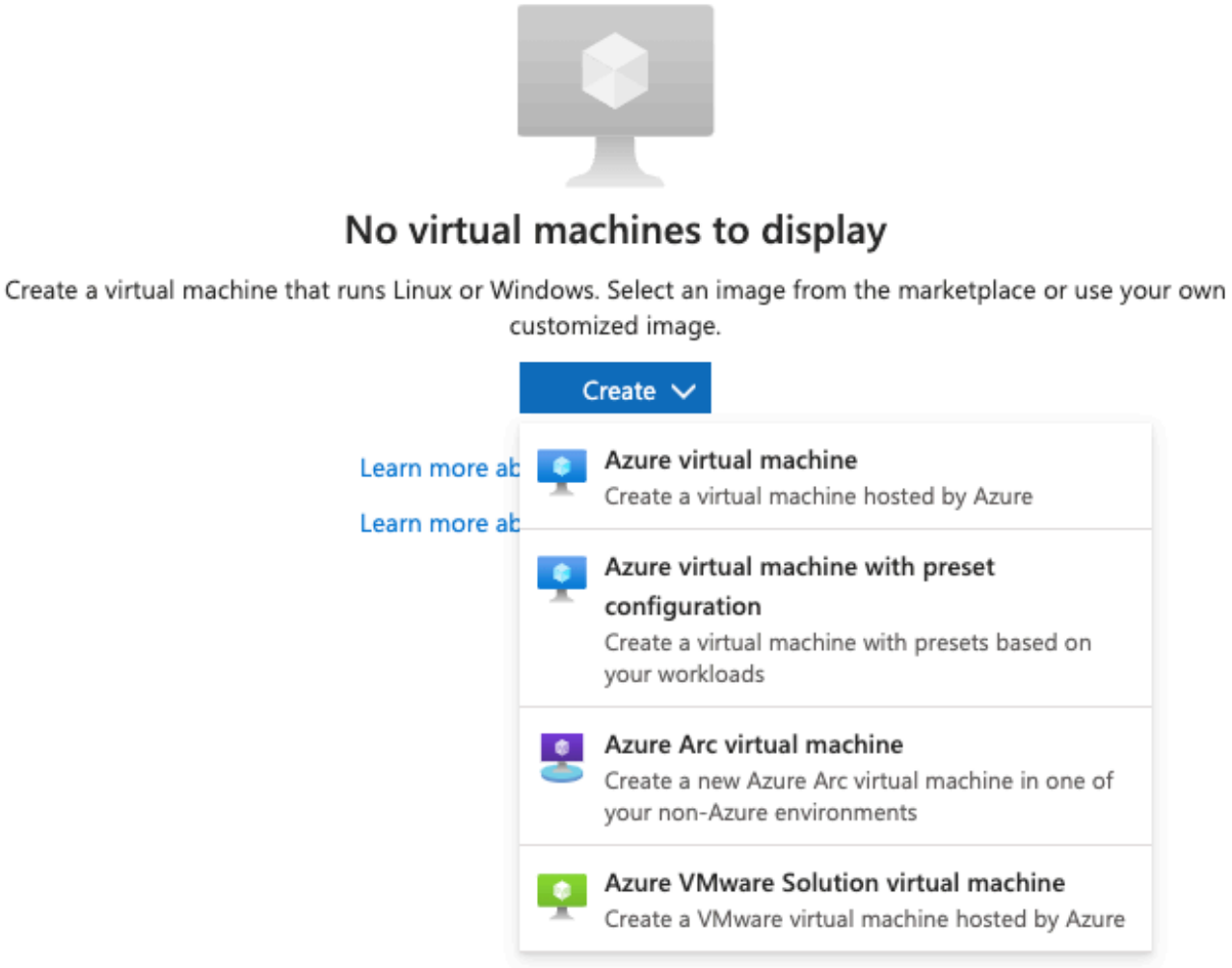
Find the 'Virtual Machine' in the list or search for it in the search bar, then click 'Create'



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:





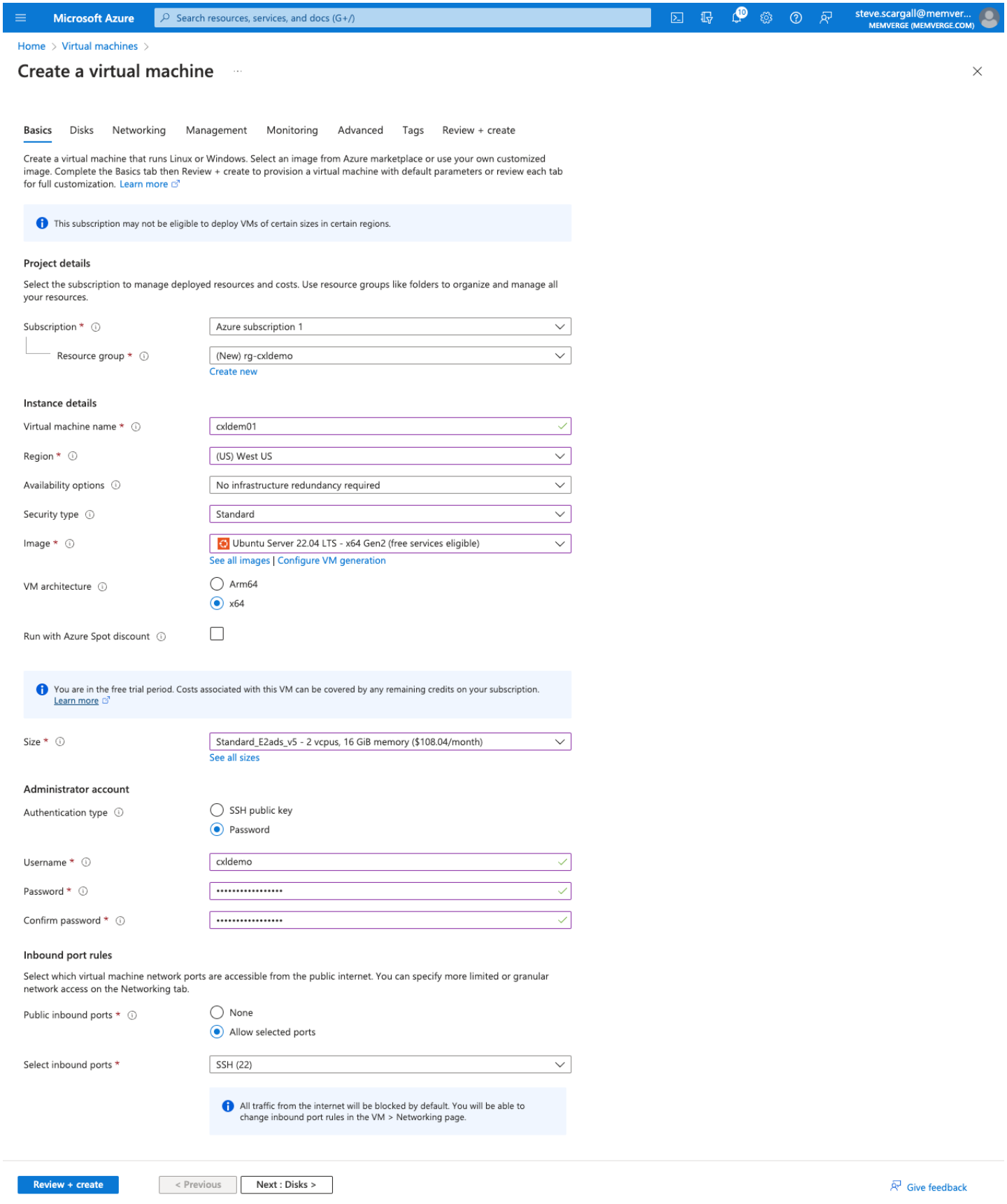
Create a new Virtual Machine

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:** cxluser
  - **Password:** LearningCXL1sFun!
  - **Confirm password:** LearningCXL1sFun!
- **Inbound port rules**
  - **Public inbound ports:** Allow selected ports
  - **Selected inbound ports:** SSH(22)

Here is an example



Click 'Next: Disks >' to continue

Configure the VM Disks

The 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

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

Create and attach a new disk Attach an existing disk

Advanced

Use managed disks

Gallery package requires managed disks.

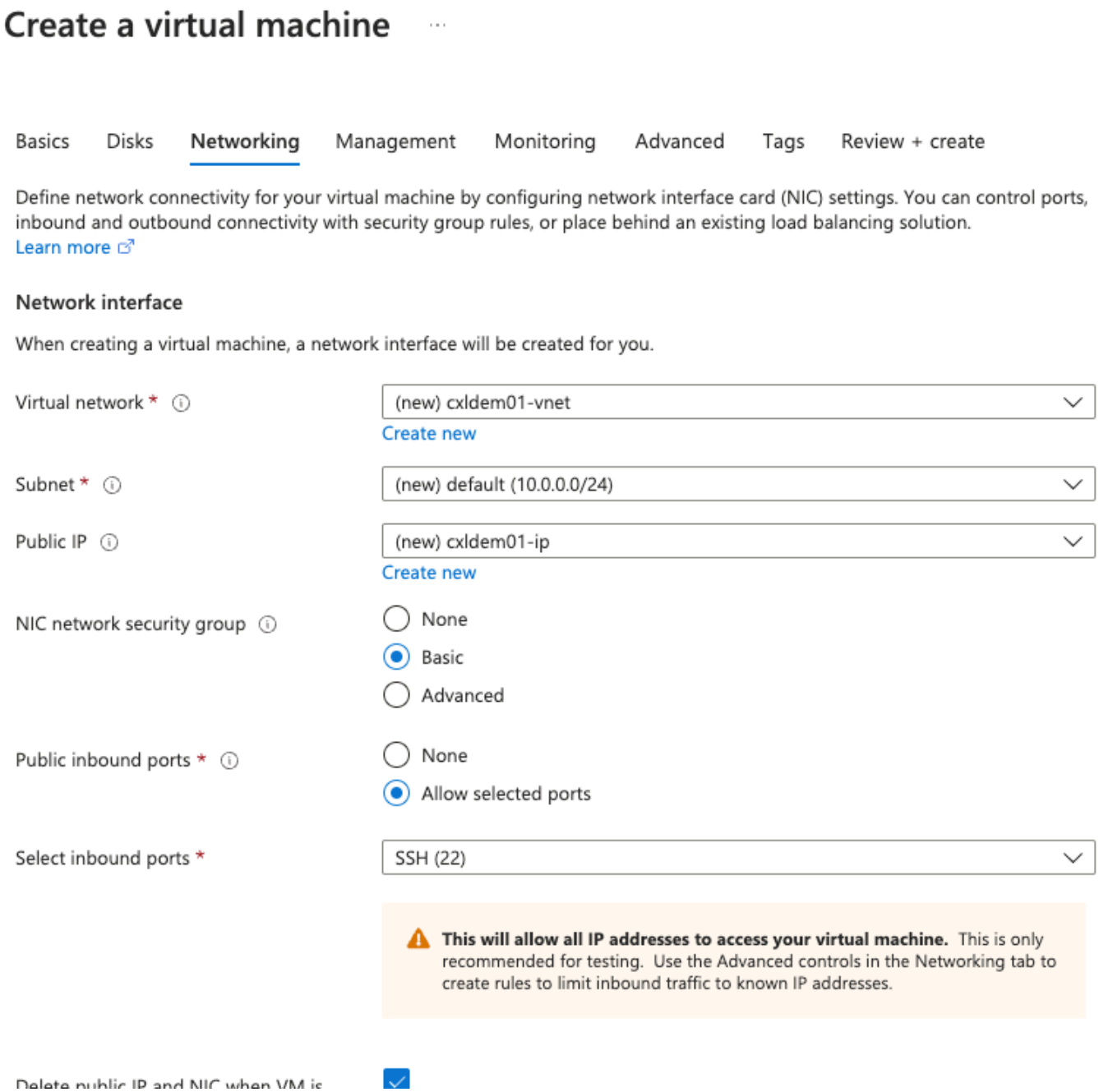
Ephemeral OS disk None OS cache placement Temp disk placement

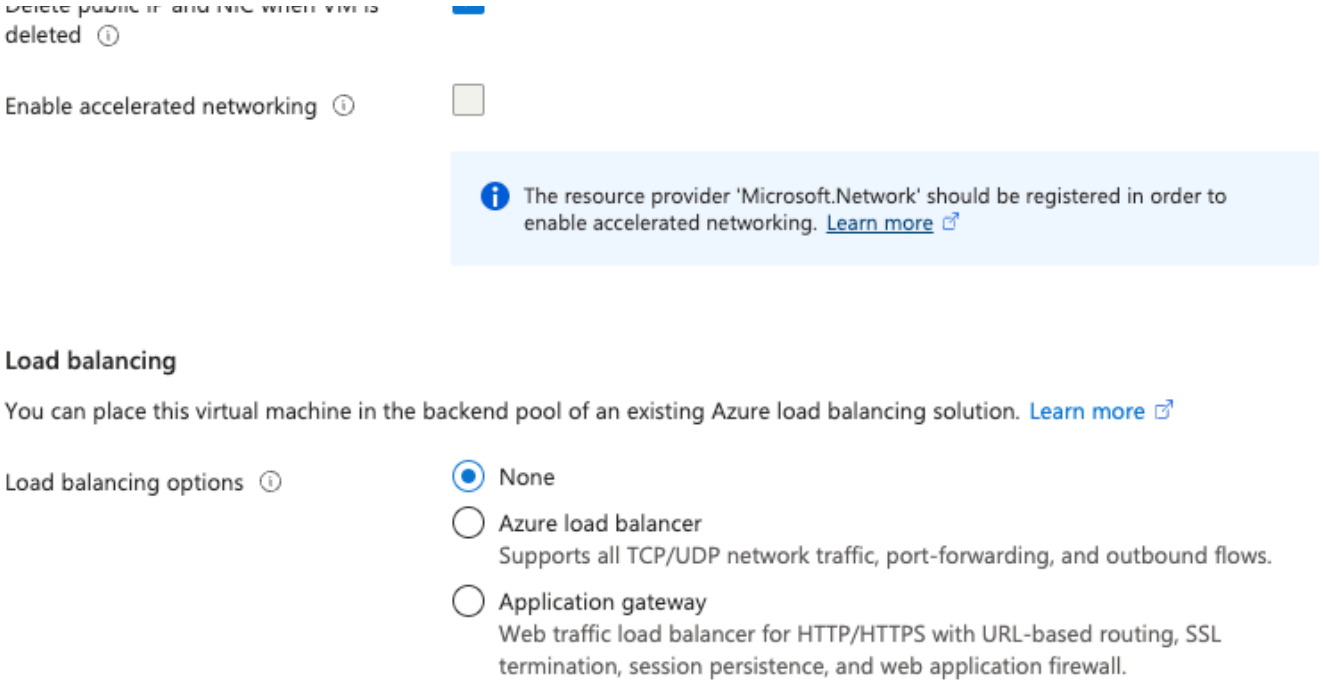
Ephemeral OS disks are currently not supported for the selected instance size.

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:

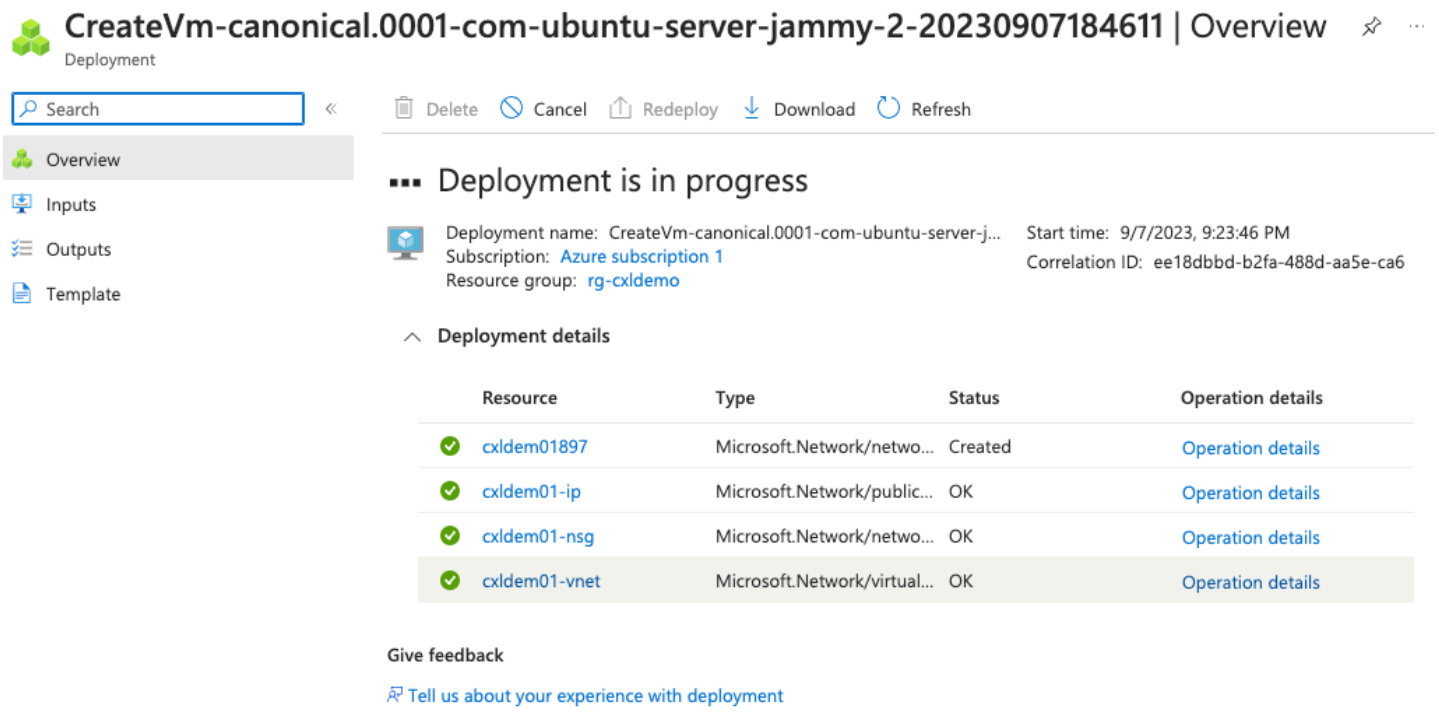




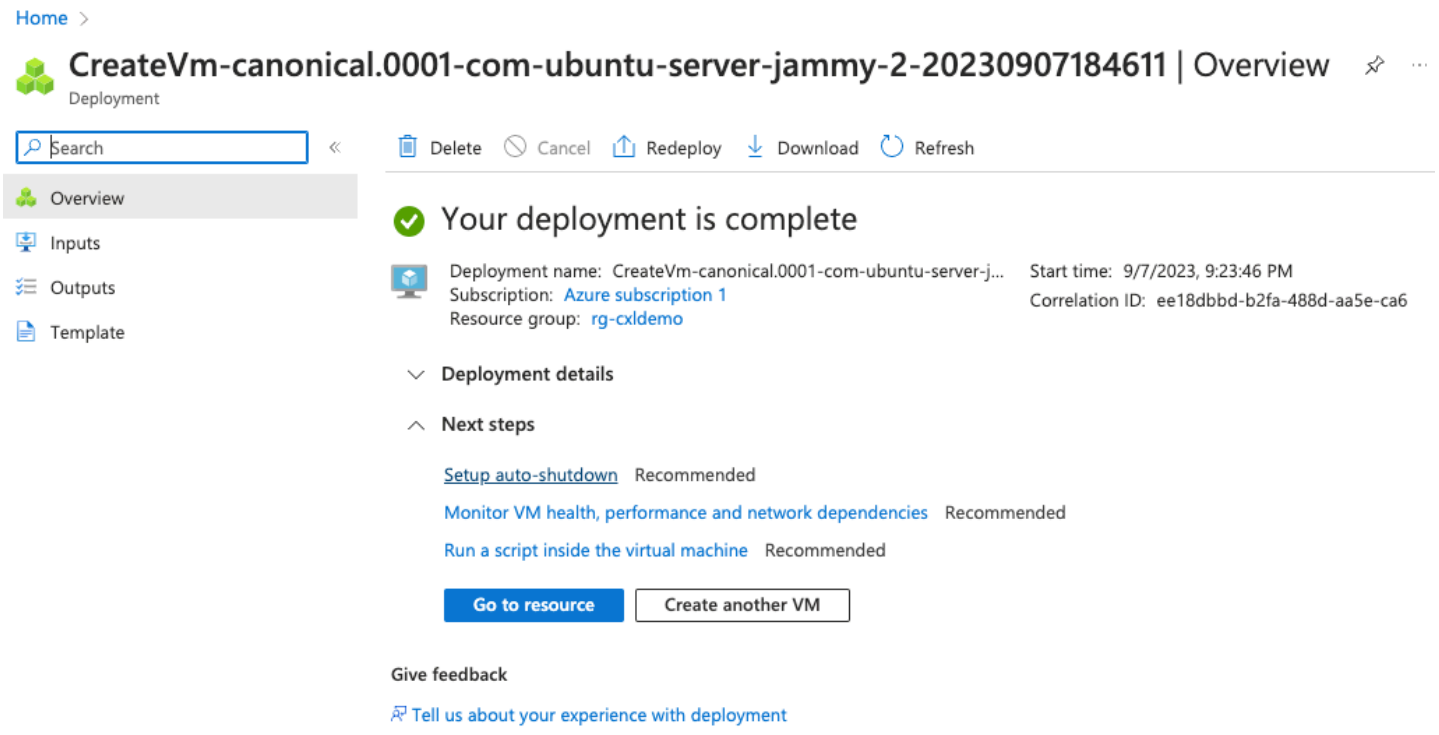
Click "Review + Create" to continue.

Finalize the VM

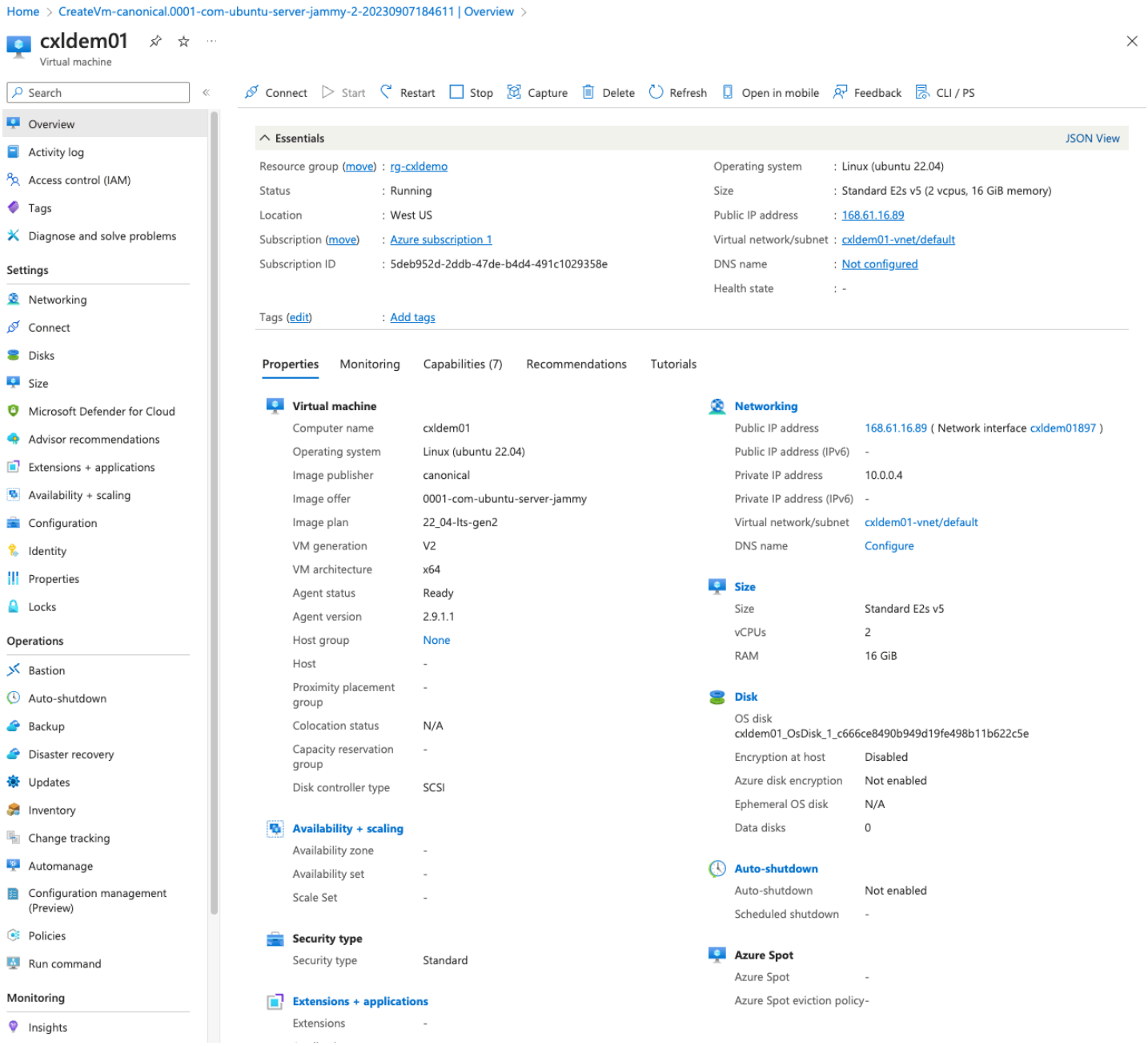
Review the options on the page and click 'Create' to create the VM. It will take a few minutes for the VM to initialize and become available. You will see a progress screen while the VM is initializing, similar to the following:



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



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



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

Linux Terminal:

```
$ ssh cxluser@168.61.16.89
cxluser@168.61.16.89's password:
cxluser@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
```

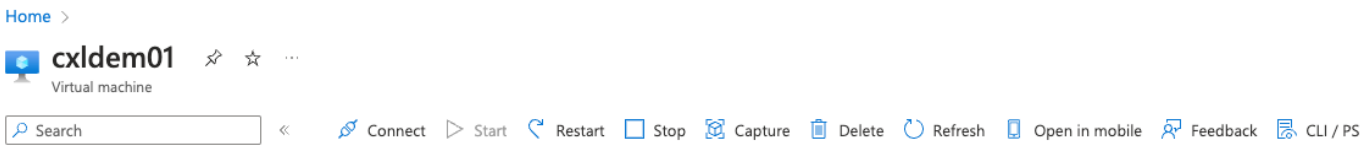
Pull the MemVerge CXL Memory Expansion Image from Docker Hub

```
$ 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.

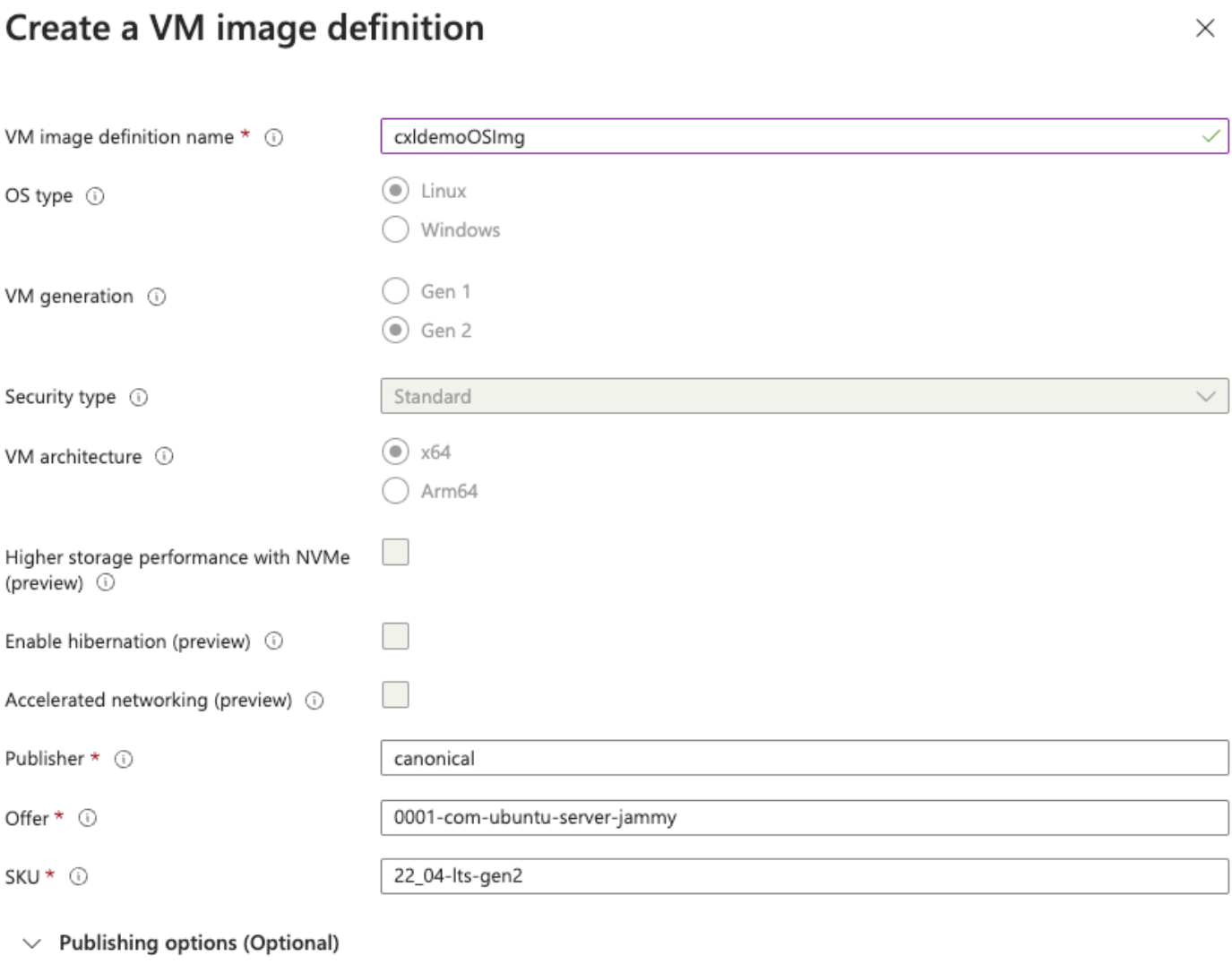
Select the VM in your dashboard, then click 'Capture' from the top menu



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:



- **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

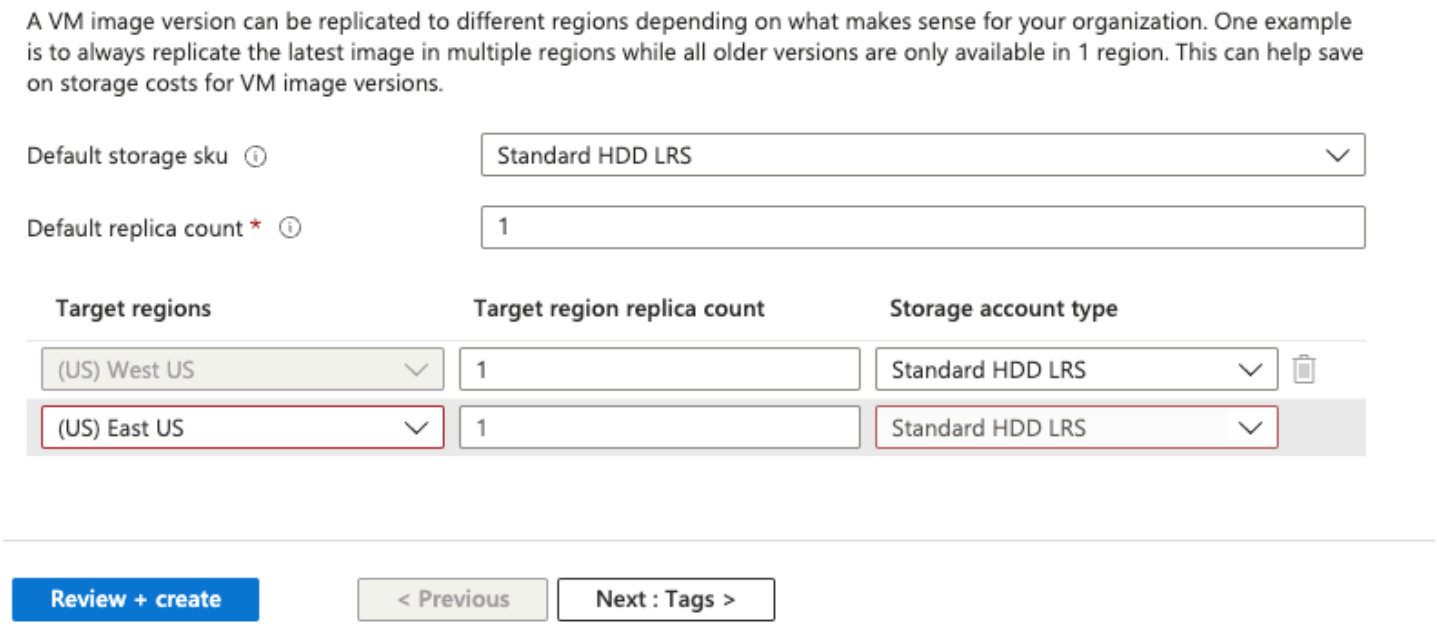
Version number *: 1.0.0

Exclude from latest: [ ]

End of life date: MM/DD/YYYY

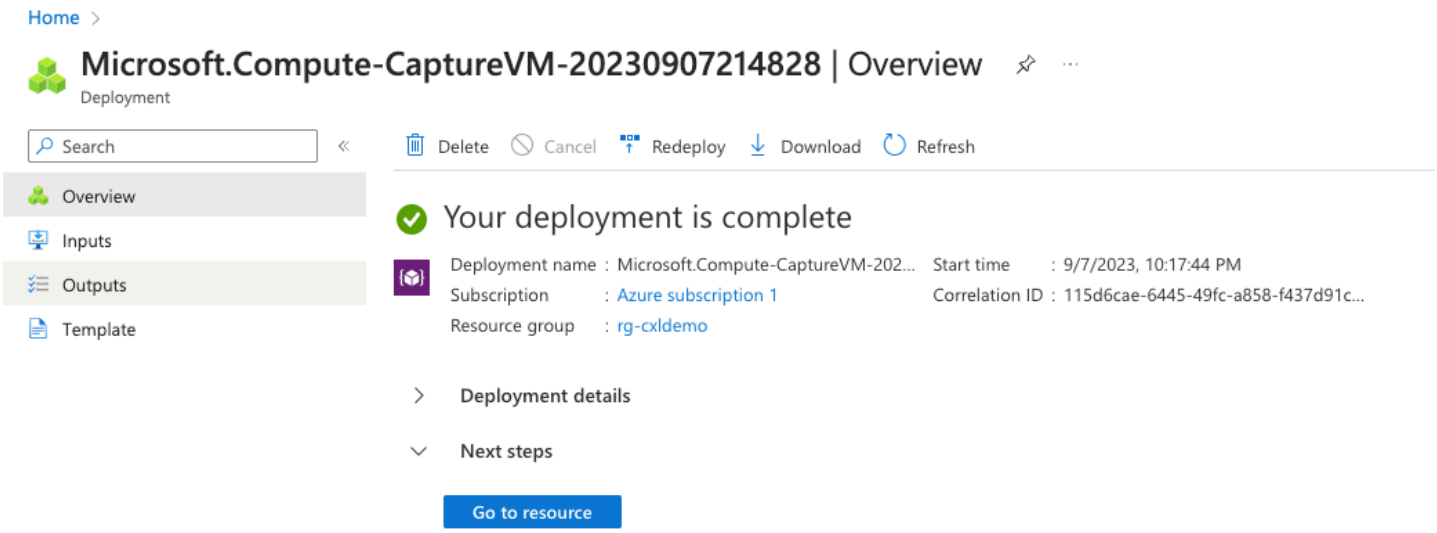
Shallow replication: [ ]

Replication

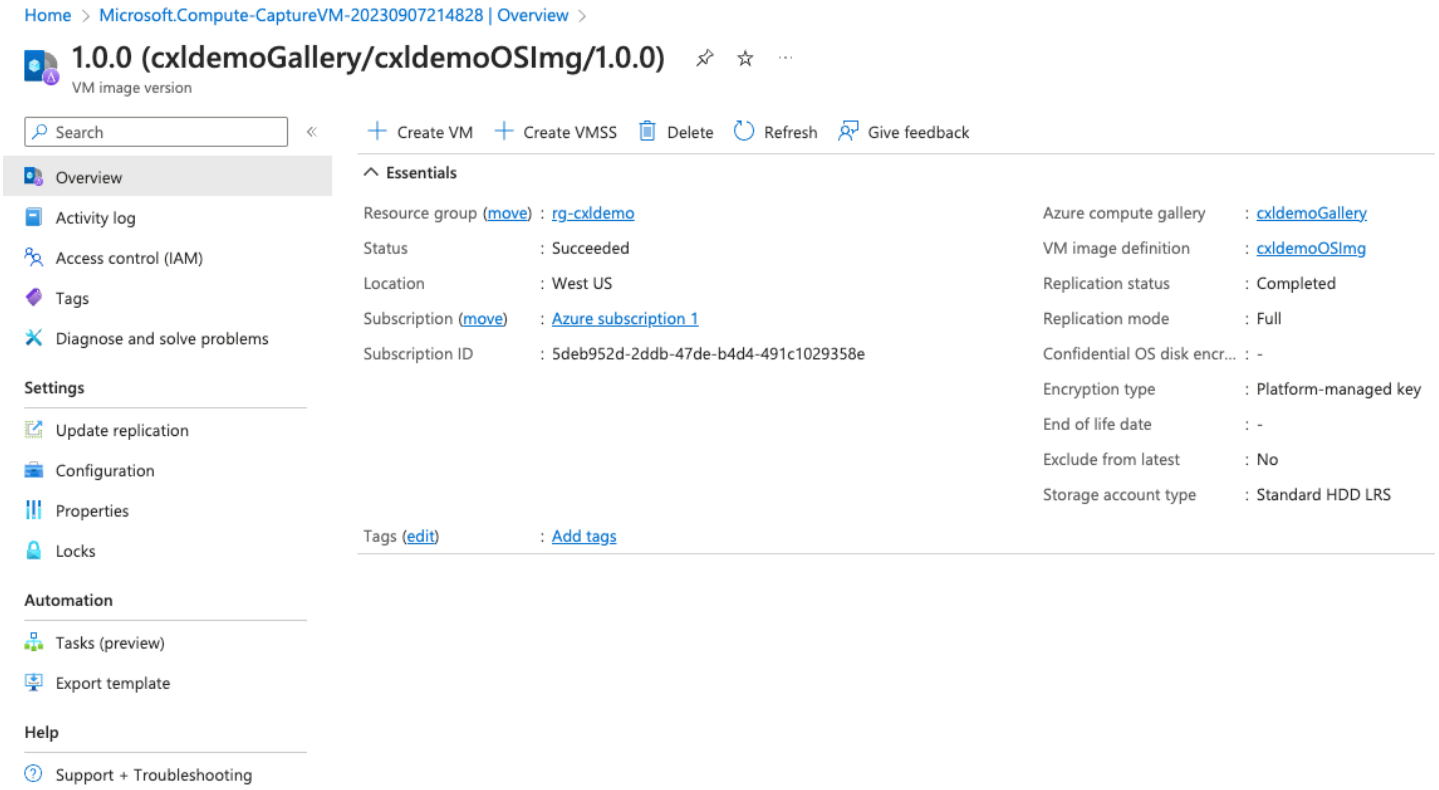


Click 'Review + create' to continue

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:

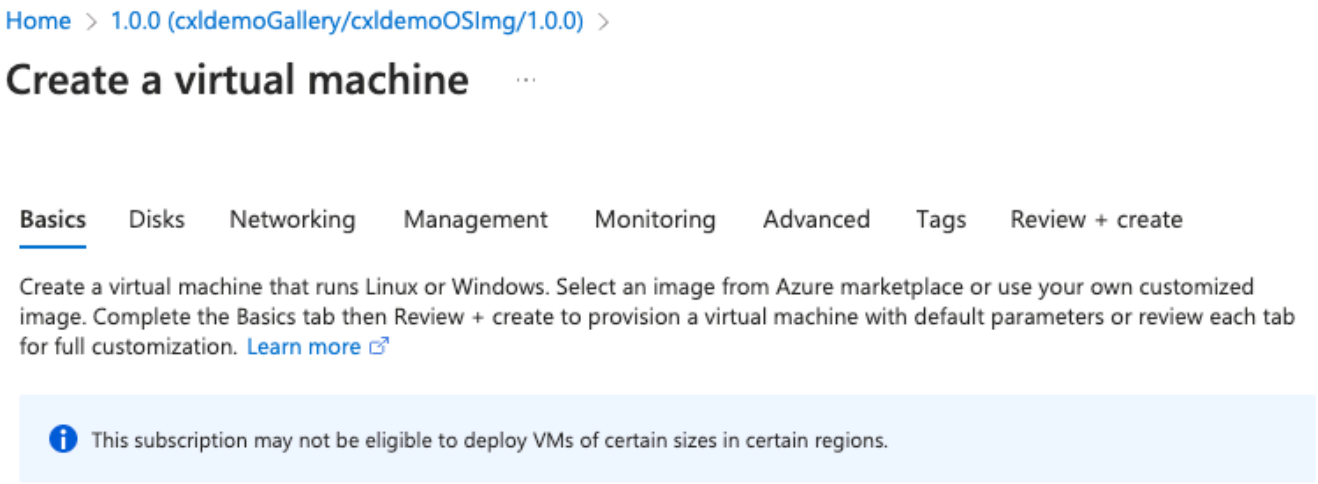


Click 'Go to resource' to continue to the image details, which looks similar to the following:



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



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 * : rg-cxldemo

Create new

Instance details

Virtual machine name * : cxldemo01

Region * : (US) West US

Availability options : No infrastructure redundancy required

Security type : Standard

Image * : cxldemoGallery/cxldemoOSImg/1.0.0/cxldemoGallery/cxldemoOSImg/1.0.0

See all images | Configure VM generation

VM architecture :
- Arm64
- x64 (selected)

Arm64 is not supported with the selected image.

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_E2s_v5 - 2 vcpus, 16 GiB memory ($102.20/month)

See all sizes

Administrator account

Authentication type :
- SSH public key
- Password (selected)

Username :

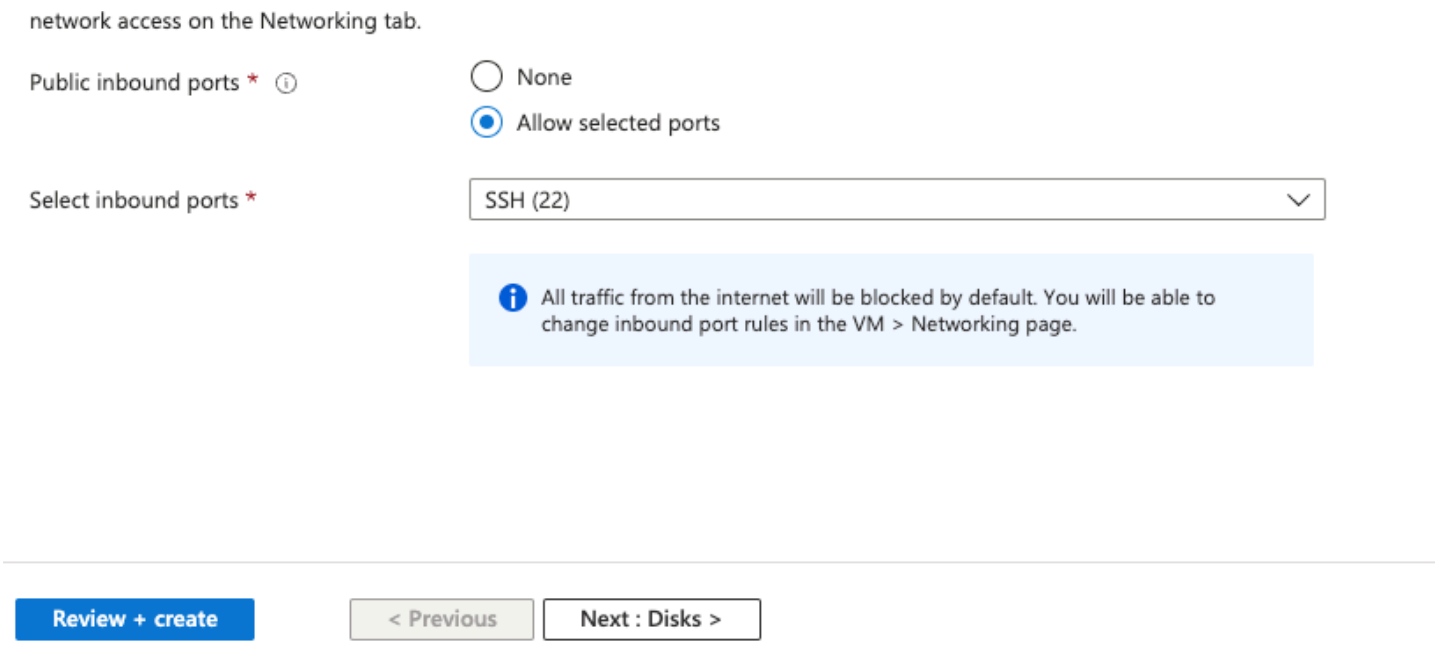
Password :

Confirm password :

Administrator account is predefined with specialized images. Learn more about specialized images

Inbound port rules

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



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.

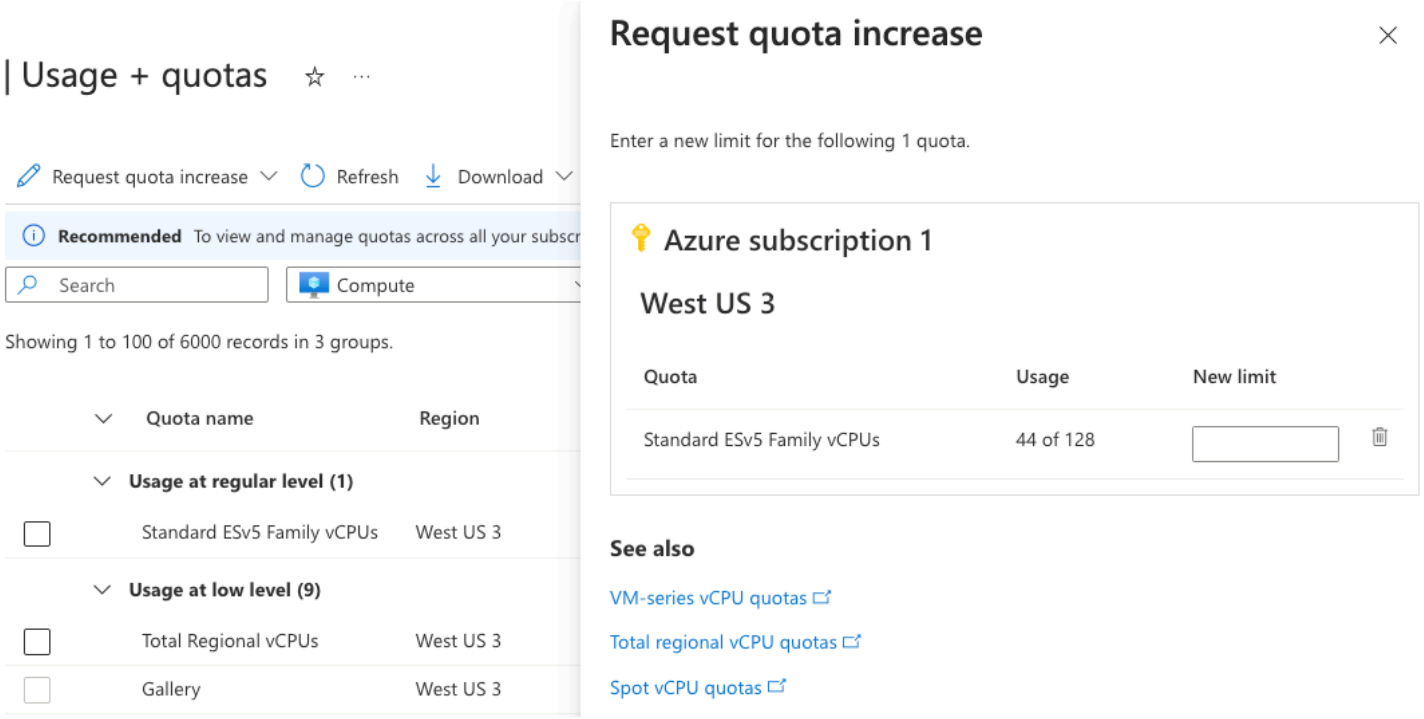
Upgrade the Resource Quota

Creating VMs requires CPU and Public IP Addresses. Depending on these resource quotas for your account, you may have to request a quota increase.

From the Azure Dashboard Home, select or find 'Usage + quotas'.

Request Additional vCPUs for Compute Instances.

Select 'Compute' from the resource type drop-down and find the instance type 'Standard ESv5 Family vCPUs'. Click the pencil icon on the right to change the maximum number of vCPUs. Each compute node needs two vCPUs. For example, to run 30 virtual machines, the vCPU limit needs to be 60 or higher.



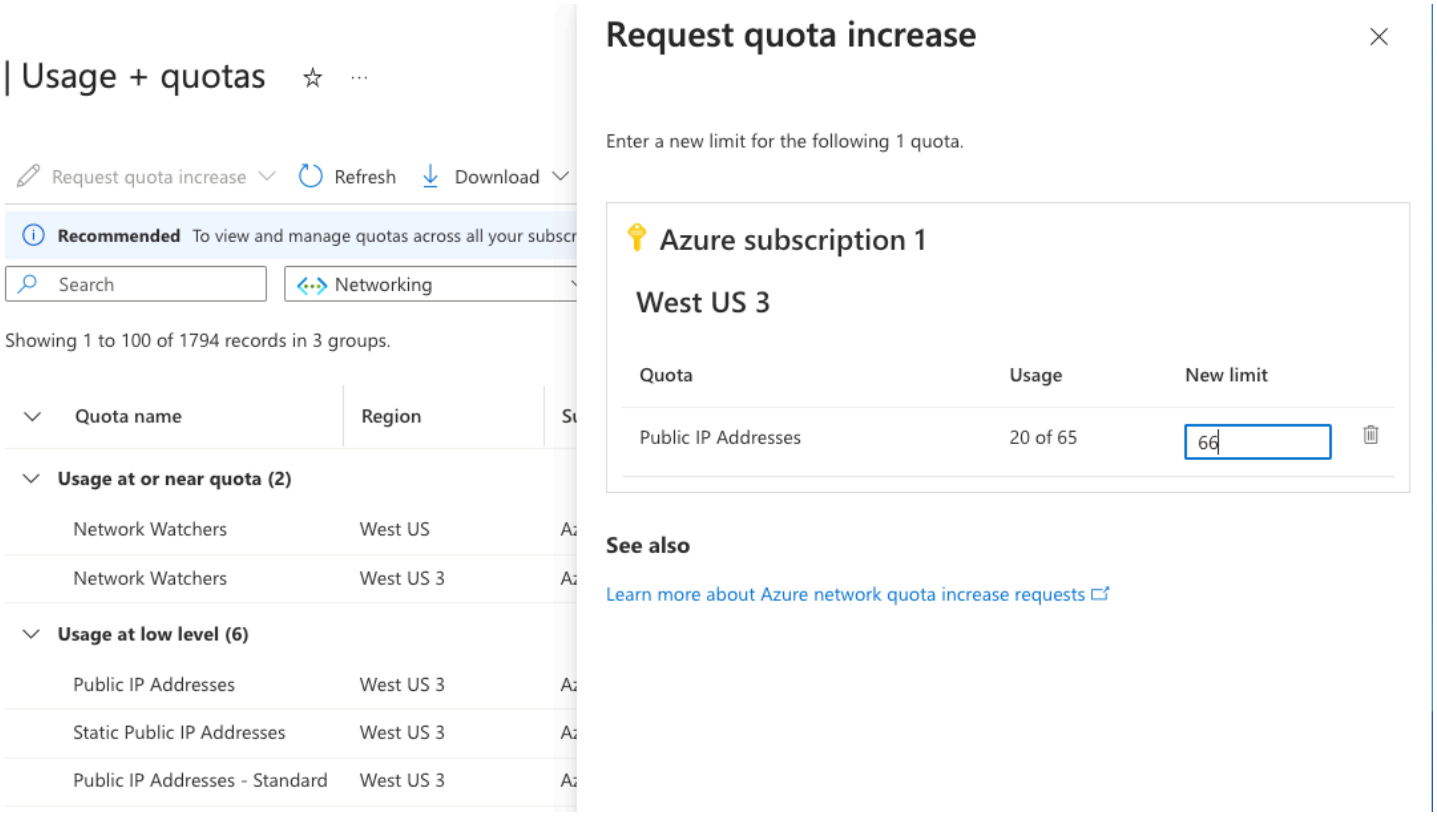
Click 'Submit' to continue.

The process is automated. Upon success, you'll be granted the resources. A support ticket must be created to assist if a failure occurs.

Request Additional Public IP Addresses

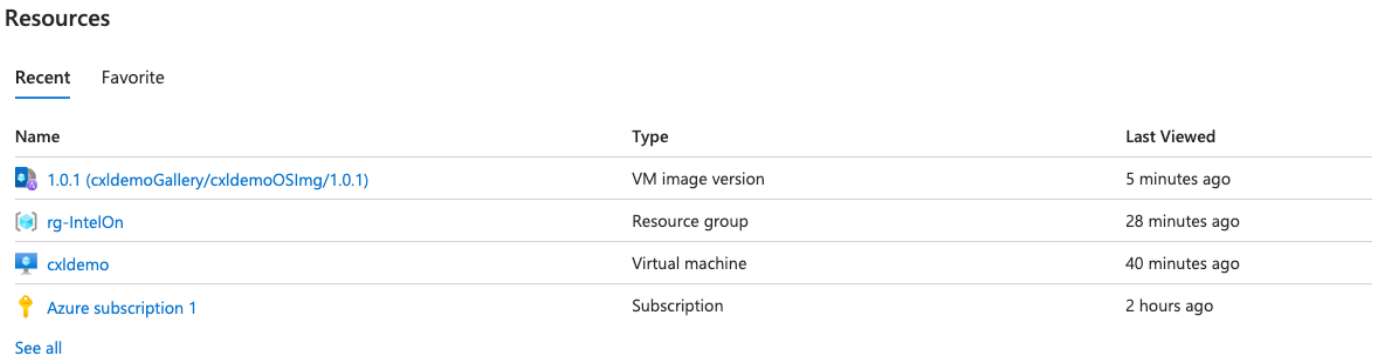
Select 'Networking' from the resource type drop-down and find 'Public IP Addresses' and 'Static Public IP Addresses' in the list. Click the pencil icon to edit the resource, enter the new maximum limit, then click 'Submit'.

The process is automated. Upon success, you'll be granted the resources. A support ticket must be created to assist if a failure occurs.

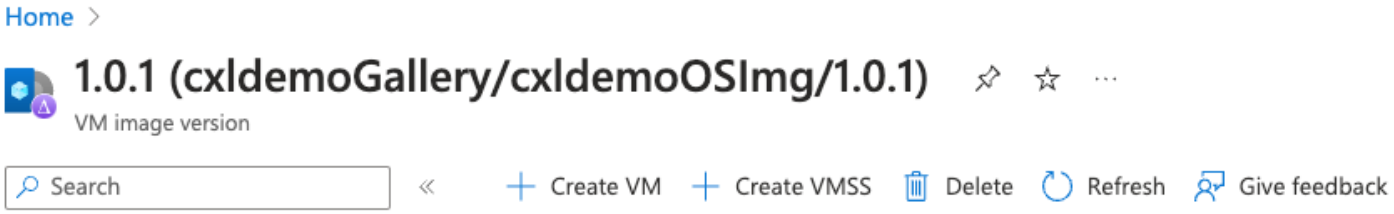


Scale the number of VMs

Find the 'VM image version' from the Azure Portal home page under 'Resources'. It may be in the 'Recent' list. Click 'See all' if it is not. Select the OS Image - "1.01 (cxldemoGallery/cxldemoOSImg/1.0.1)"



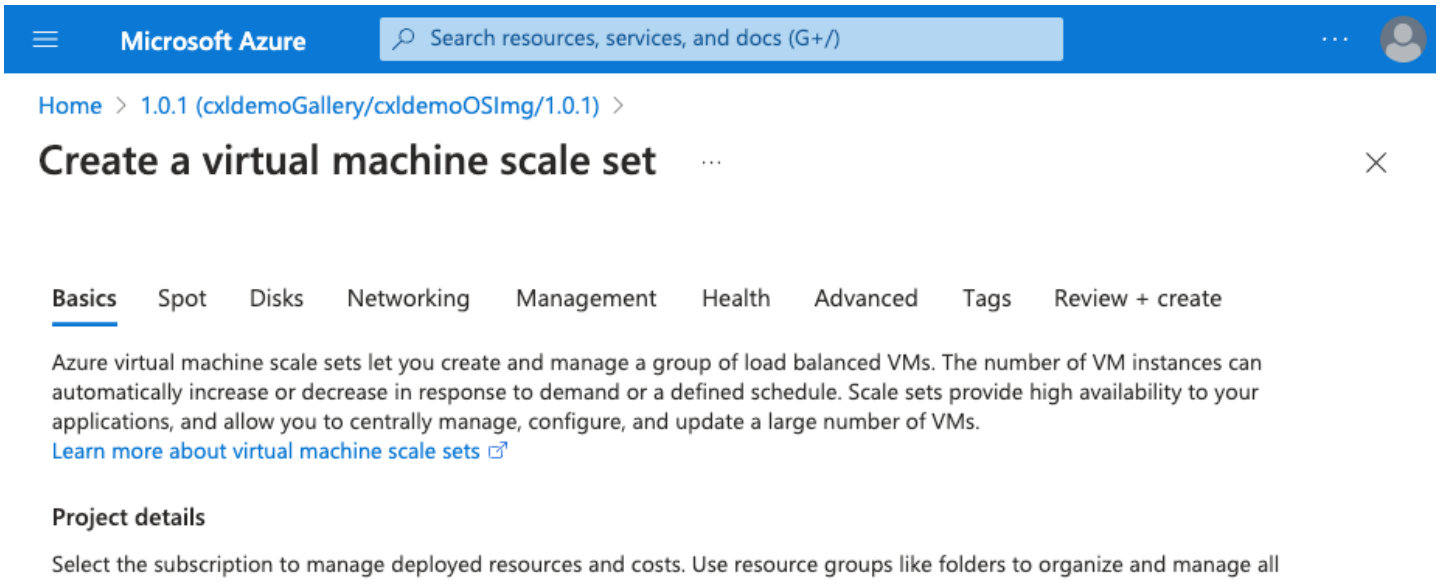
To create a single VM from the OS image, select 'Create VM' from the commands at the top. To create multiple VMs in one go, or change the number of VMs over time, choose 'Create VMSS' from the command options.



Create a Virtual Machine Scale Set (VMSS)

Azure virtual machine scale sets let you create and manage a group of load balanced VMs. The number of VM instances can automatically increase or decrease in response to demand or a defined schedule. Scale sets provide high availability to your applications, and allow you to centrally manage, configure, and update a large number of VMs.Learn more about virtual machine scale sets

The following shows the options used. You can change the options to suit your requirements. The 'Instance count' specifies how many new VMs will be created.



your resources.

Subscription * Azure subscription 1

Resource group * rg-IntelOn

Create new

Scale set details

Virtual machine scale set name * cxldemoSet

Region * (US) West US 3

Availability zone None

Orchestration

A scale set has a "scale set model" that defines the attributes of virtual machine instances (size, number of data disks, etc). As the number of instances in the scale set changes, new instances are added based on the scale set model.
Learn more about the scale set model

Orchestration mode *

- **Flexible:** achieve high availability at scale with identical or multiple virtual machine types
- **Uniform:** optimized for large scale stateless workloads with identical instances

Security type Standard

Instance details

Image * cxldemoGallery/cxldemoOSImg/1.0.1/cxldemoGallery/cxldemoOSImg/1.0.1

See all images | Configure VM generation

VM architecture

- Arm64
- x64

Arm64 is not supported with the selected image.

Run with Azure Spot discount

Size * Standard_E2s_v5 - 2 vcpus, 16 GiB memory ($91.98/month)

See all sizes

Scaling

Scaling mode

- **Manually update the capacity**: Maintain a fixed amount of instances.
- **Autoscaling**: Scaling based on a CPU metric, on any schedule.

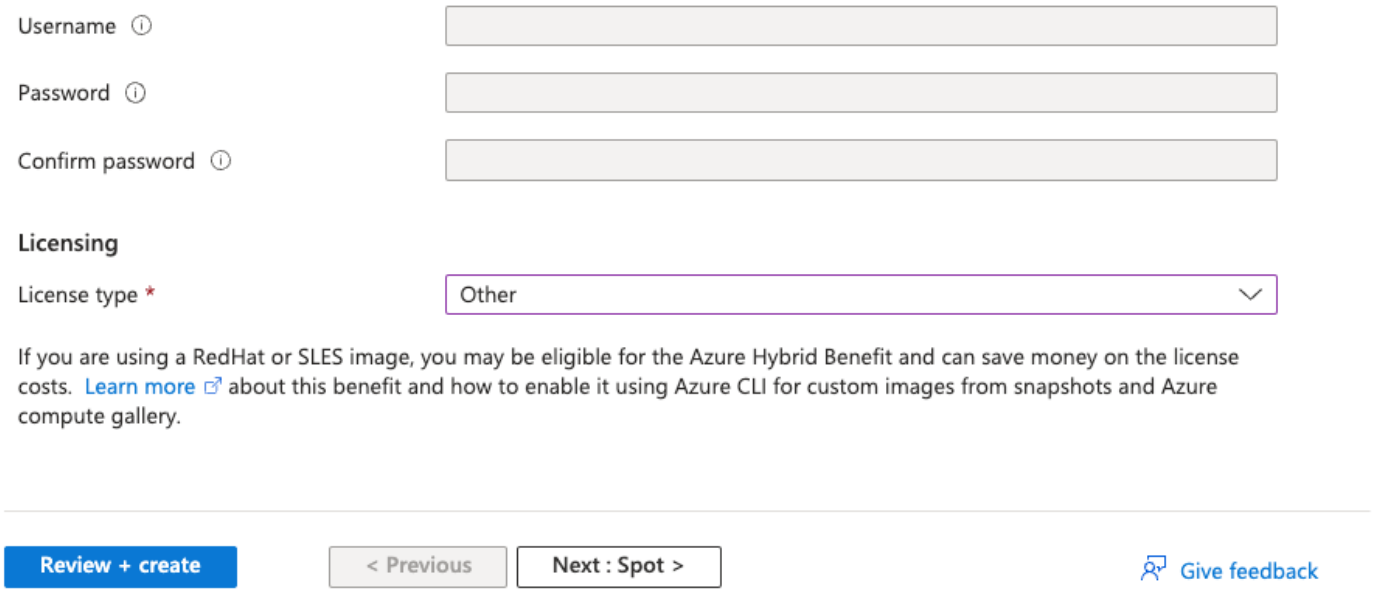
Instance count * 2

Configure scaling options

Administrator account

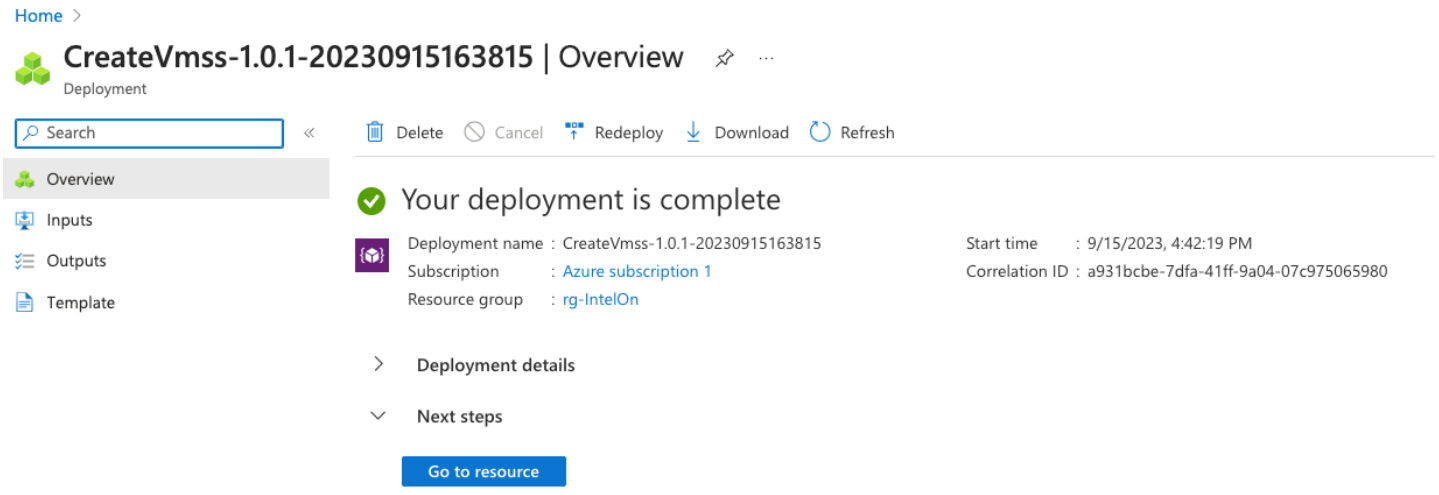
Authentication type

- Password
- SSH public key

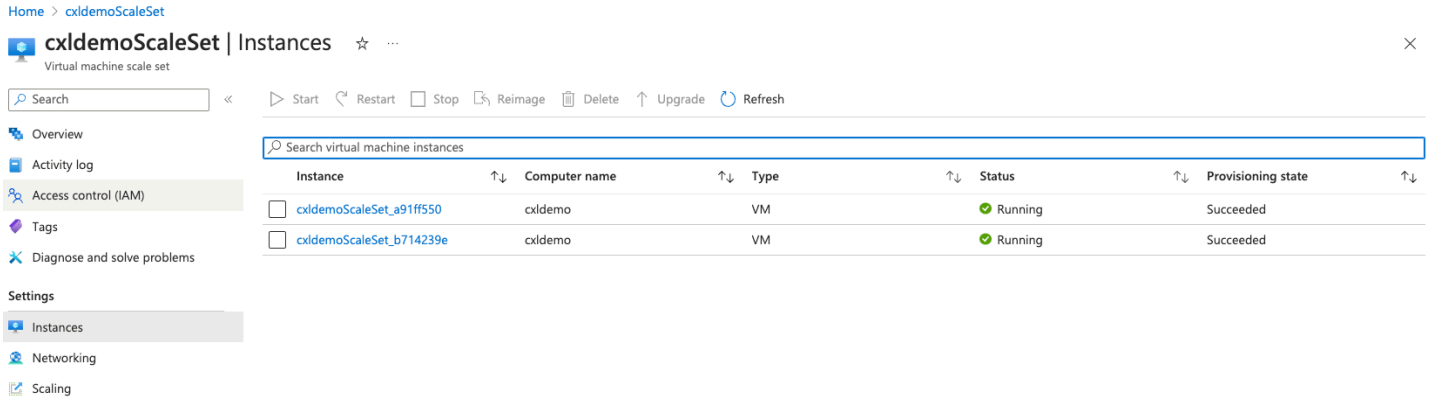


Click 'Review + create' to continue or 'Next: Spot >' to review and configure options. The defaults are good enough for this lab.

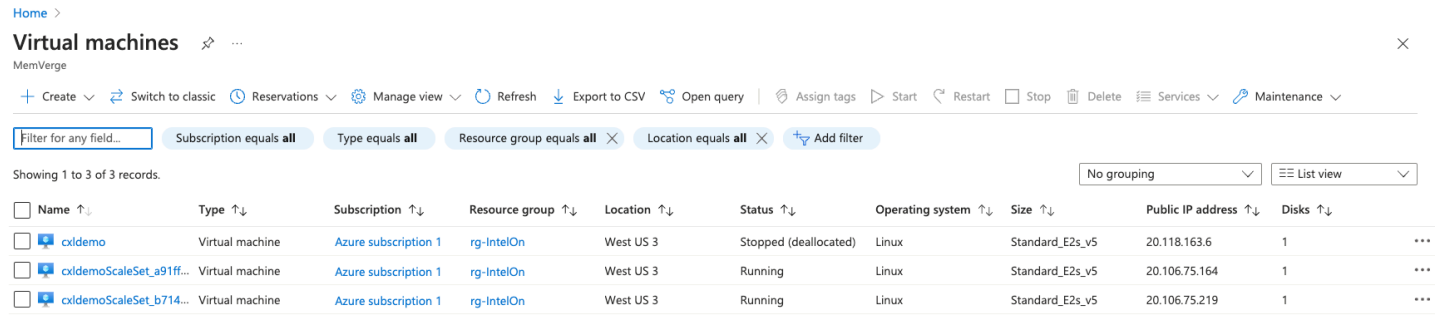
The new deployment may take several minutes, depending on the options and number of VMs that will be created. Once the VMSS deployment is complete, click 'Go to resource'



View the VMs in the Settings → Instances page

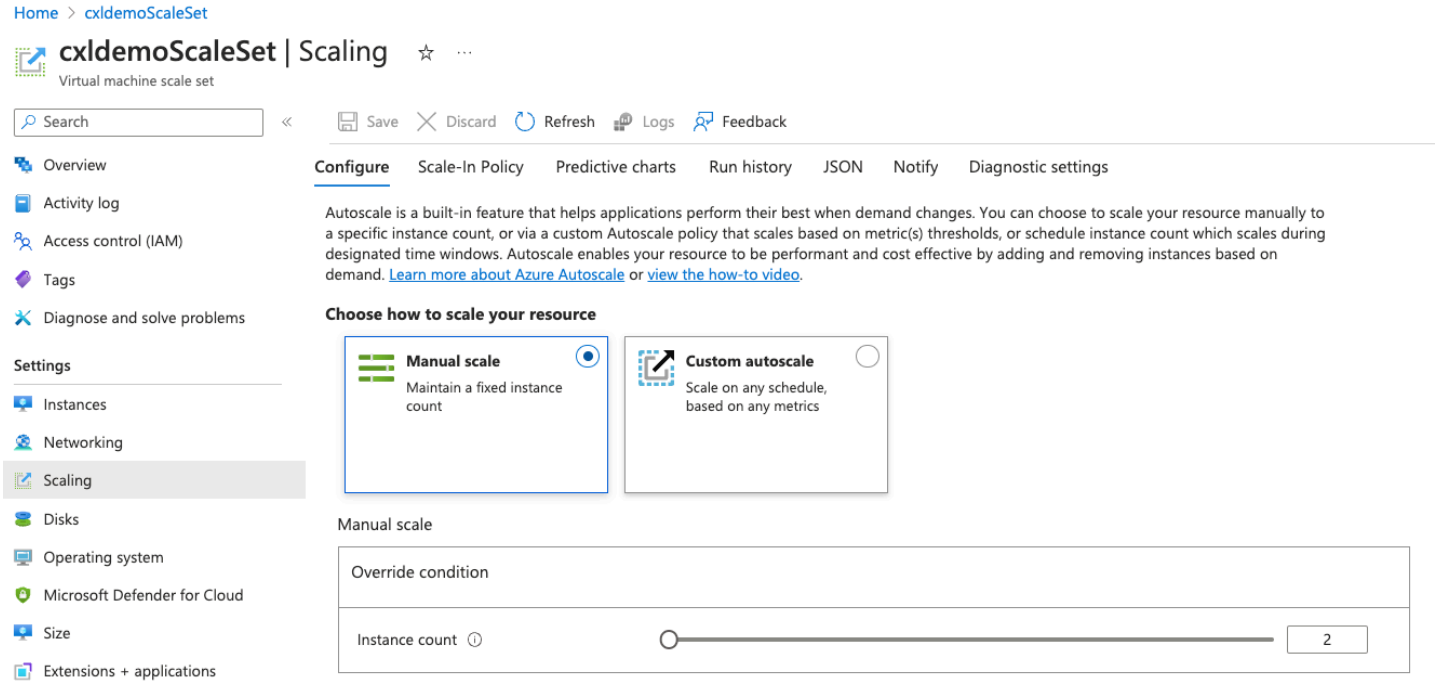


You can also see a list of VMs from the 'Virtual Machines' page. Home → Virtual Machines.



Modify the Number of VM Instances

Within the Scale Set, go to Settings → Scaling in the menu on the left and change the desired number of VMs



Click 'Save' to continue. This will deploy the requested number of VMs.