# SECTION 2: Azure Virtual Machines

## Creating a Virtual Machine

Azure Portal - http://portal.azure.com/

Ways to create a virtual machine:

- Home Page > Create a Resource
- All Services > Virtual Machines
- Resource Group > Add

Properties of a virtual machine (Basic Tab):

- Subscription
- Resource Group
- Virtual Machine Name
- Region
- Availability Options
- Image
- Size

You need to choose the authentication type between username/password and SSH key.

## Availability

- It's a word that effectively means "uptime", or the percentage of time that your application is working as intended.
- 100% availability is not achievable
- Even Facebook, Instagram, and Google Search has downtime
- You might think "99% availability" is pretty good but it's not
- 99% availability means 15 minutes per day of downtime, or 7.3 hours per month

## High Availability

- Taking steps to increase your availability
- As close to 100% as you can practically get
- Achieved through redundancy, auto scaling, backups and failover plans
- Every VM eventually needs to be rebooted, so it's better to have two of the same

## Azure Availability Sets

- Availability of VMs is achieved through Availability Sets
- Machines that are in the same set are distributed by Azure across fault domains and update domains
- Fault domains are hardware failures that can possibly happen
- Update domains are the intentional "bringing down" of a VM for Azure updates
- 2 VMs in an Availability Set will be distributed so that no single hardware failure or Azure update brings them both down

## Azure Availability Zones

- Within a region are data centers
- For regions that support this, you can manually place your VMs in different data centers
- If you do this, you can be more assured that any regional or building-level event won't affect all your servers at once

## Azure SLA for VMs

https://azure.microsoft.com/en-ca/support/legal/sla/virtual-machines/v1_8/

| MONTHLY UPTIME PERCENTAGE | SERVICE CREDIT |
| --- | --- |
| < 99.99% | 10% |
| < 99% | 25% |
| < 95% | 100% |

- For all Virtual Machines that have two or more instances deployed across two or more Availability Zones in the same Azure region, we guarantee you will have Virtual Machine Connectivity to at least one instance at least 99.99% of the time.

- For all Virtual Machines that have two or more instances deployed in the same Availability Set, we guarantee you will have Virtual Machine Connectivity to at least one instance at least 99.95% of the time.

- For any Single Instance Virtual Machine using premium storage for all Operating System Disks and Data Disks, we guarantee you will have Virtual Machine Connectivity of at least 99.9%.

## Fault Domain

A fault domain is essentially a rack of servers, that share a power supply, cooling and Internet access between them. Let's say you had two virtual machines running your web site, and they were running on *the same* rack of servers, if the power supply was to fail both virtual machines would be affected. Your website would go down. That would not be good.

So that's why you want to distribute "across" fault domains for multiple identical servers by putting them in an availability set.

## Update Domain

When Azure rolls out new software updates to it's platform, it does not do them all at once. It rolls out updates a group of servers at a time. This way, if something goes wrong, they can undo it easily. And only a small percentage of the whole platform is negatively affected.

These are called update domains. Again, if you had two virtual machines running in the same update domain, when Azure runs an update to those machines, it does them both at the same time. This means they need to be rebooted. Or could possibly be affected by a bad update.

By spreading the virtual machines "across" update domains, you ensure that only one of your machines is updated at one time. This is also done by putting them in an availability set.

## Instance Families

- General purpose
- Compute-optimized
- Memory-optimized
- Storage-optimized
- High-performance
- GPU

## General Purpose

Balanced memory, CPU and storage.

### Compute Optimized

Double the CPU, compared to the general purpose machine. Good for something like a database server that can use a more powerful CPU.

### Memory Optimized

Double the memory, compared to the general purpose machine. Good for something like a caching server that can use a more RAM.

### Storage Optimized

Double the local (temporary) storage, compared to the general purpose machine. Good for something like a caching server that can use a more RAM.

### High Performance Compute (HPC)

Very special hardware that is optimized for performance. It has the fastest CPUs, fastest memory and motherboards. It runs on a special high-speed data network. If you really need a super-computer type hardware, this type of machine is worth looking at.

### GPU

Most VM servers do not come with a Graphics Processing Unit (GPU). Why would they? These machines do not have monitors attached to them and do not need to process graphics. But some applications use the GPU for calculations, and so there are servers with GPU capabilities that can be created. Good for video rendering projects and bitcoin mining.

## Billing of VMs

Virtual Machines are charged by the minute. So if you only use 10 minutes of a VM, you only pay for that much.

## Virtual Machine Security

By default, no ports are open. No traffic will be allowed from the internet to the VM. If you are intending to use the machine as a web server, you might want to open ports 80 (HTTP) and 443 (HTTPS).

## Hybrid Benefit

If you have an enterprise license for Windows from Microsoft, you can allocate one of your licenses for Azure and save a lot of money.

## Data Disks

Each instance type allows a different number of additional disks. So A1_V2 instance only allows "2 data disks". You can then create data disks and attach them to the VM. You can do this at creation or any time after.

It used to be that data disks could be up to 4TB, but Microsoft recently announced that you can create up to 32TB each. Ultra Data Disks have up to 64TB each.

You pay for this of course.

## Virtual Network

All VMs must belong to one network. Since Virtual Machines can have multiple NIC cards (depending on which one you select), you can add them to multiple subnets for increased network performance and increased flexibility for inter-machine communication.

## Accelerated Networking

This is a relatively new feature of Azure, that allows Virtual Machines on the same network to talk to each other at a much faster pace than normal. Azure has found some optimizations for communication that can be enabled here.

## Auto-Shutdown

Save money on VMs by having development and QA servers to auto shutdown. This could be done during creation, afterwards, or by site-wide policy.

## Backup Policy

This is the backup schedule that can be enabled. You can choose to keep daily, weekly, monthy and yearly backups.

## Tagging

A recommended way to add meta-data to resources in Azure, to track things such as billing, creation, environment, etc.

## ARM Template

A JSON file (template and parameter files) that define the infrastructure as code. You can redeploy an environment by deploying it's template. Azure lets you download the template just before creation, or after the deployment has completed.

## Connect to a Server

Windows Servers generally are connected to using RDP, while Linux Servers are connected to using SSH.

# SECTION 3: Managing Virtual Machines

## Resizing a Virtual Machine

You can change the machine size in a limited way while it's running. It can be resized to another machine type that is available in the current hardware cluster. This is a simple reboot operation.

You can change the machine size in a flexible way when it's stopped. The machine will have to be moved to another hardware cluster to resize.

If your machine is in an availability set, you might have to resize all machines in the set at the same time due to the way the hardware cluster is managed.

## Turning a Virtual Machine into a Web Server

Using the Server Manager in Windows, chose the web server role. It will install IIS, and it will be able to accept requests on port 80.

## Network Security Group (NSG)

A list of static rules that either allow or deny traffic from travelling over the network. Such as blocking all traffic coming in from the Internet if you wish. Or allowing traffic in on certain ports.

## Ways of Interacting with a Virtual Machine

- Azure Portal
- Powershell
- CLI / Bash
- REST API

## PowerShell cmdlets

https://docs.microsoft.com/en-us/azure/virtual-machines/windows/ps-common-ref

- New-AzVM - Name "vmname"
- Get-AzVM
- Stop-AzVM
- Start-AzVM
- Restart-AzVM
- Remove-AzVM

## How to Install PowerShell for Azure on Your Machine

https://docs.microsoft.com/en-us/powershell/azure/install-az-ps?view=azps-2.8.0

## Bash / CLI Commands

https://docs.microsoft.com/en-us/azure/virtual-machines/linux/cli-manage

- az vm stop
- az vm deallocate
- az vm start
- az vm restart
- az vm create
- az vm list
- az vm delete

## Detaching Data Disks

Data disks can be detached from one VM and attached to another VM

# SECTION 4: Monitoring and Securing Virtual Machines

## Virtual Machine Disk Encryption

Disks are encrypted by default using Secure Storage Encryption (SSE). You can take control of the security keys by creating a key using Azure key vault and using that key to encrypt your disks instead.

## Endpoint Protection

Installs anti-malware software to examine traffic entering a virtual machine and detecting any malicious intention. Not enabled by default.

## Monitoring Agent

In order to enable full metrics and alerts on a virtual machine, you need to install the monitoring agent software on that machine. This sends the data from the machine back up to Azure which allows that type of tracking.

## Monitoring and Reporting

**Azure Monitor** - a centralized dashboard that collects all the logs, metrics and events from your resources

**Azure Service Health** - lets you know about any Azure-related service issues including region-wide downtime