SQLskills Immersion Event

IEAzure: Azure VMs and Azure SQL Database

Module 2: Azure Virtual Machines

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Overview

- What is Infrastructure as a Service?
- Compliance certifications
- Networking options
- Active Directory Integration from on-premises
- Deploying Azure VMs and installing SQL Server on Azure VMs
- Maintenance considerations for SQL Server
- HA/DR options and how you can extend on-premises to Azure
- Performance scaling compared to on-premises
- Billing and licensing considerations

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What is Infrastructure as a Service (IaaS)

- Instant computing infrastructure, provisioned and managed over the internet
  - Quickly scales up and down with demand
  - Helps avoid the complexity of buying and managing your own physical servers and other infrastructure
  - Azure manages the infrastructure, while you purchase, install, configure, and manage your own software, operating systems, middleware, and applications
  - Improved security, scalability, access to Azure 'fabric' benefits such as availability benefits, Azure Marketplace, and other benefits

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On-premises

- Your organization has to purchase, configure, and install everything
  - Hardware
  - Storage
  - Networking
  - Security devices
  - Meet regulatory requirements
  - Install everything

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Azure Marketplace

- The Azure Marketplace is located in the Azure Portal
- Over a dozen categories to choose from
  - Compute
  - Storage
  - Databases
  - Azure monitoring and management
  - Networking
  - Security + identity
  - Web + Mobile
  - Internet of things
  - and more

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Compute Options

- Choose your OS version: Windows or Linux
- Select the size of the virtual machine, number of cores and memory
  - Sizes matters for the number of disk you can have
  - Number of disk matter for amount of IO you can have
- You can select a virtual machine that already has SQL Server installed
  - I don't recommend that, yet
- Other compute services
  - Virtual machine scale set
  - Azure Container Service
  - Azure Container Registry
  - Function App
  - Batch Service

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Storage Options

- Storage account – blob, file, table, queue
- Azure File Sync
- Data Box Edge / Data Box Gateway (preview)
- Data Lake Storage Gen1
- Azure Data Box
- Backup and Site Recovery (OMS)
- AltaVault AVA-c4 version 4.4.1
- Cloudian HyperCloud for Azure (preview)
- Veeam Cloud Connect for the Enterprise (preview)

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Database Options

- Azure SQL Managed Instance
- SQL Database (Elastic Pool, Hyperscale, Serverless)
- Synapse - SQL Data Warehouse
- Azure Database for MySQL
- Azure Database for PostgreSQL
- Azure Database for MariaDB
- SQL Server X on Windows Server X
- Azure Cosmos DB
- Database as a service for MongoDB
- Azure Cache for Redis

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Azure Monitoring and Management Options

- **Service Health**
- **Insights**
  - Applications
  - Virtual Machines
  - Containers
  - Network
- **Log Analytics**
- **Automation**
- **Backup and Site Recovery**
- **Intune App Protection – mobile device protection**
- **Traffic Manager profile**
- **Deeper dive into monitoring**
  - Alert rules, metrics, Resource Health, and diagnostics

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A walk through the Azure Marketplace for Virtual Machines

IaaS Networking

- **Point-to-Site VPN – (P2S VPN)**
  - Single computer (point) to Azure network (site)
  - Uses certificates
  - Adds flexibility for roaming users
  - Consider Active Directory Certificate Services (AD CS)
- **Site-to-Site VPN – (S2S VPN)**
  - Persistent connection from on-premises to Azure network
  - Requires a static public IP address
- **ExpressRoute**
  - Fastest connection 50Mbps to 100Gbps
  - Limited availability

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Virtual Private Networking

- **Internal networks**
  - VNets – Virtual Networks
    - Can create multiple VNets to isolate environments
    - Can subdivide using Subnets
    - Setup VPNs to allow VNets to communicate
- **Design and plan first**
  - Before creating VMs or other services, setup your VNet

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Network configuration options

Compliance

- **Many certifications**
  - DoD Provisional Authorizations at Impact Levels 5, 4, and 2
  - FedRAMP
  - FIPS 140-2 – US Federal Info Processing Standards
  - HIPPA/HITECH – Health Care
  - ISO 22301, 27001, 27017, 27018, 9001, and more
  - PCI DSS – Payment Card industry
  - CJIS – US Criminal Justice Information Services
  - EU Model Clauses
  - And so many more
- **Azure Trust Center** http://bit.ly/2lKjwzK

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Security

- **Network Security Groups (NSGs)**
  - Enforce and control network traffic rules
  - Similar to a firewall
- **Azure Active Directory**
  - Manage identity and access
  - Integrated for both cloud and on-premises
  - Single Sign-on
  - Support for iOS, Mac, OS X, Android, and Windows
  - Extend Active Directory with Azure AD Connect
  - Secure remote access to protect on-premises
  - Self-service capabilities
  - Enterprise scale and SLA at 99.9% uptime

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Show Azure AD Connect

Virtual Machine Deployments

- **Azure Resource Manager**
  - Resource – a manageable item (VM, VNet, etc)
  - Resource group – container of resources
  - Resource provider – a service, Microsoft.Compute, Microsoft.Storage, etc.
  - Resource Manager template – JSON
  - Declarative Syntax – syntax commands
- **Benefits**
  - Manage resources for a solution in a group
  - Repeatedly deploy a solution (dev/QA/testing)
  - Granular billing, access controls, define dependencies, and more

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Virtual Machines

- **Creating the VM**
  - Huge inventory of images
    - OS based, solution templates, application infrastructure, and business applications
  - Image with OS and SQL Server installed
    - Licensed or BYOL (Bring Your Own License)
    - Everything is installed
    - Lots of time spent cleaning, uninstalling
    - Images not currently optimized
  - Image with OS, you install and license SQL Server
    - You specify what gets installed and where
    - Install Resource Provider to get auto-patching, auto-backup, and convert to PAYG license

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VM Storage

- **VM start with C: and D:**
  - C: registered as SATA, labeled /dev/sda by default
  - Max capacity of C: limited to 1TB
  - D: is temporary, nothing important should be placed on it
  - D: is ideal for page or swap files, size varies on size of VM
- **VM size matters**
  - VM size determines number of disk and disk types
    - Standard – HDD
    - Premium – SSDs
    - NVMe SSDs on some models (H-series)

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VM Storage

- **Unmanaged disks**
  - Traditional disk
  - You manage
  - Don't allocate too many disks on the same account
- **Managed disks**
  - Creation and management handled for you
  - Specify size and performance tier (Standard/Premium)
  - Designed for 99.999% availability
  - Up to 50k VM disk in a subscription per region
- **Scale**
  - Add more disks and stripes (RAID)

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VM Storage

- **Standard Disk**
  - HDD
  - Cost effective for dev/test
  - 1GB – 1TB
  - Managed – 32GB, 64GB, 128GB, 512GB, and 1024GB
  - 60 MB/s throughput and 500 IOPS per disk
- **Premium Disk**
  - SSD – high performance
  - 128GB, 512GB, and 1024 GB
  - 200 MB/s throughput and 5000 IOPS per disk
- **Ultra Disk**
  - SSD – higher performance
  - 4GB up to 64TB
  - 300 IOPS/GiB -160k IOPS per disk – 300MB/s – 2000MB/s throughput

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Virtual Machines

- **Sizing**
  - DS2 for SQL Standard and Web – minimum requirement
  - DS3 for SQL Enterprise edition – minimum requirement
- **Storage**
  - Use premium
  - Storage account and SQL VM in the same region
  - Multiple P30 disk – 1 for logs, 1 for data and tempdb
    - More disk striped if higher IO is needed
- **Follow performance best practices for SQL Server in Azure**
  - http://bit.ly/2pKIDJ5

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Azure Market Place, resource groups, creating a VM with SQL installed, creating a VM with OS and install SQL, configure additional disk, Resource Provider, and more…

VM Creation Requirements

- **What did we have to select?**
  - Subscription
  - Resource group
  - Name
  - Region
  - Image
  - Username
  - Password
  - Inbound ports
  - Have a license?
  - Disk options
  - Virtual network
  - Subnet
  - Public IP
  - NSG
  - Public inbound ports
  - Accelerated networking
  - Load balancing
  - Management options

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SQL Server Configuration

- **Fine tune the instance**
  - Correctly size tempdb
  - Maxdop and cost threshold for parallelism
  - Trace flag – 1118 (2014 and below)
  - Trace flag - 3226
  - Min and max server memory
  - Optimize for ad hoc workloads
  - Instant File Initialization
  - SQL Agent alerts
  - Error log rollover
  - Backups

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Instance changes from defaults

Maintenance Considerations

- Maintenance considerations for an Azure virtual machine are no different than any other virtual machine or instance of SQL Server
- Statistics will still need to be manually updated
- Index fragmentation is still a concern and should be addressed
- Corruption can occur anywhere, on-premises and in the cloud – DBCC CHECKDB shouldn't be overlooked
- Validating SQL Server backups and testing your HA/DR solutions are just as important in cloud based solutions as on-premises

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Azure VMs – How to Connect

- External
  - TCP ports in Windows firewall
  - SQL Server must be listening on TCP ports
  - Authentication type? Mixed or AD
  - NSGs configured for proper port
  - DNS need configuring?
- Internal
  - Specify server name and configure connection string if same VNet
  - VPN configured between subnets

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High Availability and Disaster Recovery

- **HA/DR options**
  - Always On Availability Groups
  - Always On Failover Cluster Instances
  - Log shipping
  - Database mirroring
  - SQL Server backup and restore with Azure Blob storage service

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High Availability and Disaster Recovery

- **Azure-only Availability Groups**
  - Currently requires a WSFC
  - Due to WSFC, must have a domain controller
  - Servers will need to be in the same resource group
  - Select your service name carefully
- **Hybrid**
  - Easy to extend on-premises AG with a secondary in Azure
  - Requires VPN, extend AD to Azure
  - Inexpensive DR solution

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High Availability and Disaster Recovery

- **Failover Cluster Instances**
  - Azure storage options
    - Windows Server 2016 Storage Spaces Direct (S2D)
    - Third party tool – SIOS Datakeeper
    - Remote iSCSI Target shared blocks storage via ExpressRoute
  - Azure Shared Disk – GA July 2020
    - Industries first shared cloud block storage

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High Availability and Disaster Recovery

- **Log shipping**
  - Just like on-premises
  - Primary or secondary is in Azure
  - Requires VPN
  - Allows for load delay
- **Database mirroring**
  - Cross-site disaster recovery using server certificates
    - Doesn't require same domain or VPN
  - Cross-site with Active Directory would require VPN
  - Deprecated in 2016

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High Availability and Disaster Recovery

- **SQL Server backup with Azure Blob Storage Service**
  - Backup on-premises to Azure Blob Storage
  - 2016 enhancements
    - Striping to multiple blobs for support up to 12.8TB
    - Snapshot backup – nearly instantaneous backups and rapid restores for DB files
    - Managed Backup Scheduling – custom schedules

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Performance Scaling

- **On Premises you add memory to a physical or virtual**
  - Azure VM – Change VM size
- **On Premises you can add more CPUs**
  - Azure VM – Change VM size
- **On Premises you can add additional network adapters**
  - Azure VM – add network adapters
- **On Premises you can migrate to different and faster storage**
  - Azure VM – increase the number of disk for additional storage and IOPS

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Performance Scaling

- **Migrate to a larger virtual machine**
  - Select a larger VM and migrate
  - Not a seamless migration
  - VM is migrated and started
  - Offline operation
  - Example: D1 V2 VM migrated to a D2 V2 VM took approximately 5 minutes

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Demo

Resizing an Azure virtual machine

Billing Considerations and Licensing

- **Virtual machines are offered in a variety of sizes broken out by purpose**
  - General purpose – Balanced CPU-to-memory ratio – ideal for testing and dev, small to medium databases, and low to medium traffic web servers
  - Compute optimized – High CPU-to-memory ratio – good for medium traffic web servers, network appliance, and application servers
  - Memory optimized – High memory-to-core ratio – great for relational database servers, medium to large caches, and in-memory analytics
  - Storage optimized – High disk throughput and IO. Ideal for Big Data, SQL, and NoSQL databases
  - GPU – Specialized virtual machines targeted for heavy graphic rendering and video editing. Mining bitcoin too
  - High performance compute – The fastest and most powerful CPU virtual machines with optional high-throughput network interfaces (RDMA)

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Billing Considerations and Licensing

- **Each category of virtual machines have numerous options within that range, each one with a different price per hour depending on the number of cores, ram, and temporary storage**
- **Just like with on-premises, Developer edition is free, you pay to run the compute of the VM**
- **Customers with software assurance can bring their SQL Server licenses with one of the BYOL SQL Server images**
- **You incur billing while the server is up, for Dev and QA, migrate to a lower level VM or shutdown and deallocate the VM to avoid expense**

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Key Takeaways

- Microsoft Azure is a cloud computing platform and infrastructure that you can use to start building, deploying, and managing applications in today
- Azure is compliant and secure
- You can extend your local Active Directory to Azure for seamless integration
- SQL Server can be run on Azure VMs by spinning up an OS with SQL Server already installed, or you can install SQL Server and BYOL
- Most common HA/DR options for on-premises SQL Server still apply to IaaS
- Scale Azure VMs much like you would on-premises
- Billing is very granular; you pay for what you use/provision

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Review

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Questions?

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