

Cloud Automation in the Azure Cloud Using Terraform with Azure DevOps

Topic	Time	Pre-req knowledge
Overview	30	DevOps Overview, Azure DevOps, Terraform
The Azure Portal	15	Portal knowledge of usual stuff plus Devops
Tools Required to Get Started	30	CLI, Python3, Python VE, VS Code, VS Code Extensions, Web Doc Reference
Azure AZ Basics	30	AZ CLI
Break	15	
Terraform CLI basics and Terraform State	60	Terraform, az2tf.sh
Lunch	45	
Topology Review for Lab	5	
Login to Lab	10	
Terraform Build, Resource Groups	15	CLI, TF
Terraform Build, Virtual Network & Subnets	20	CLI, TF
Terraform Build, Storage Accounts, Backup Vault	15	CLI, TF
Terraform Build, VMs	20	CLI, TF
Terraform Build, Kubernetes Cluster	15	CLI, TF
Break	15	
Bringing it together - Pushing the code to an Azure DevOps Pipeline	60	Az DevOps
Closing	20	

Time Budget

Total Time Allotment	Time Budget	Overages or Underages()		
420	420	0		

Azure AZ Basics

Command	Use Case	Reference
az login	Login to subscription(s)	<a href="https://docs.microsoft.com/en-us/cli/azure/authenticate-azure-cli?view=azure-cli-latest">https://docs.microsoft.com/en-us/cli/azure/authenticate-azure-cli?view=azure-cli-latest</a>
az account	Various, most common to set the subscription context	<a href="https://docs.microsoft.com/en-us/cli/azure/account?view=azure-cli-latest">https://docs.microsoft.com/en-us/cli/azure/account?view=azure-cli-latest</a>
az group	Manage resource groups	<a href="https://docs.microsoft.com/en-us/cli/azure/group?view=azure-cli-latest#az_group_create">https://docs.microsoft.com/en-us/cli/azure/group?view=azure-cli-latest#az_group_create</a>
az network	Manage all types of network resources	<a href="https://docs.microsoft.com/en-us/cli/azure/network?view=azure-cli-latest">https://docs.microsoft.com/en-us/cli/azure/network?view=azure-cli-latest</a>
az network subnet	Manage network subnet resources	<a href="https://docs.microsoft.com/en-us/cli/azure/network/vnet/subnet?view=azure-cli-latest">https://docs.microsoft.com/en-us/cli/azure/network/vnet/subnet?view=azure-cli-latest</a>
az network nsg	Manage network security group resources	<a href="https://docs.microsoft.com/en-us/cli/azure/network/nsg?view=azure-cli-latest">https://docs.microsoft.com/en-us/cli/azure/network/nsg?view=azure-cli-latest</a>
az network lb	Manage public and private network load balancers	<a href="https://docs.microsoft.com/en-us/cli/azure/network/lb?view=azure-cli-latest">https://docs.microsoft.com/en-us/cli/azure/network/lb?view=azure-cli-latest</a>
az storage account	Manage storage account resources	<a href="https://docs.microsoft.com/en-us/cli/azure/storage/account?view=azure-cli-latest">https://docs.microsoft.com/en-us/cli/azure/storage/account?view=azure-cli-latest</a>
az disk	Manage cloud disk block devices	<a href="https://docs.microsoft.com/en-us/cli/azure/disk?view=azure-cli-latest">https://docs.microsoft.com/en-us/cli/azure/disk?view=azure-cli-latest</a>
az network nic	Manage virtual machine network interfaces	<a href="https://docs.microsoft.com/en-us/cli/azure/vm/nic?view=azure-cli-latest">https://docs.microsoft.com/en-us/cli/azure/vm/nic?view=azure-cli-latest</a>
az network public-ip	Manage cloud public IP addresses	<a href="https://docs.microsoft.com/en-us/cli/azure/network/public-ip?view=azure-cli-latest">https://docs.microsoft.com/en-us/cli/azure/network/public-ip?view=azure-cli-latest</a>
az vm	Manage cloud virtual machines	<a href="https://docs.microsoft.com/en-us/cli/azure/vm?view=azure-cli-latest">https://docs.microsoft.com/en-us/cli/azure/vm?view=azure-cli-latest</a>
az backup vault	Manages ASR vaults	<a href="https://docs.microsoft.com/en-us/cli/azure/backup/vault?view=azure-cli-latest">https://docs.microsoft.com/en-us/cli/azure/backup/vault?view=azure-cli-latest</a>
az backup protections	Manage backup protection in Azure cloud with ASR	<a href="https://docs.microsoft.com/en-us/cli/azure/backup/protection?view=azure-cli-latest">https://docs.microsoft.com/en-us/cli/azure/backup/protection?view=azure-cli-latest</a>
az aks	Manage Kubernetes cloud clusters	<a href="https://docs.microsoft.com/en-us/cli/azure/aks?view=azure-cli-latest#az_aks_create">https://docs.microsoft.com/en-us/cli/azure/aks?view=azure-cli-latest#az_aks_create</a>

Development VM Prerequisites & Other Key Reference Documents

Package	Source	Comments
Python3	Linux Distribution	
Python VE	Linux Distribution	Only necessary if your distribution came with Python2.x, see <a href="https://community.oracle.com/thread/4148629?start=0&amp;tstart=0">https://community.oracle.com/thread/4148629?start=0&amp;tstart=0</a> for an example
PowerShell	Microsoft (recommended, but not required)	<a href="https://docs.microsoft.com/en-us/powershell/scripting/install/installing-powershell-core-on-linux?view=powershell-7">https://docs.microsoft.com/en-us/powershell/scripting/install/installing-powershell-core-on-linux?view=powershell-7</a>
Azure az CLI	Microsoft	<a href="https://docs.microsoft.com/en-us/cli/azure/install-azure-cli?view=azure-cli-latest">https://docs.microsoft.com/en-us/cli/azure/install-azure-cli?view=azure-cli-latest</a>
Azure AZ PowerShell	Microsoft (recommended, but not required)	<a href="https://docs.microsoft.com/en-us/powershell/azure/install-az-ps?view=azps-4.6.1">https://docs.microsoft.com/en-us/powershell/azure/install-az-ps?view=azps-4.6.1</a> (WARNING! DO NOT RUN POWERSHELL AZURE AZ AND AZURE AZ CLI IN THE SAME TERMINAL SESSION.
Terraform CLI	HashiCorp	<a href="https://learn.hashicorp.com/tutorials/terraform/install-cli">https://learn.hashicorp.com/tutorials/terraform/install-cli</a>
ADAL	Open source	<a href="https://nomodulename.com/m/adal">https://nomodulename.com/m/adal</a> , required by az2tf.sh
py-az2tf-master	Github	An open source tool that imports an Azure tenancy into terraform files
Visual Code Studio	Microsoft (highly recommended)	<a href="https://code.visualstudio.com/download">https://code.visualstudio.com/download</a>
VS Code Extensions	Various	Azure CLI Tools, Azure Powershell AZ, Terraform Syntax highlighting and autocompletion for Terraform V2.2.3, GitHub Pull Requests and Issues 0.14.0, Powershell 2020.4.0, Python for VSCODE 0.2.3, Python-autopep8 1.0.2, Shell launcher 0.4.1, YAML 0.11.0
Azure Devops	3rd Party Block	<a href="https://medium.com/faun/lets-do-devops-build-an-azure-devops-terraform-pipeline-part-2-2-d3516f47286">https://medium.com/faun/lets-do-devops-build-an-azure-devops-terraform-pipeline-part-2-2-d3516f47286</a> - IMPORTANT - In “Use Terraform 0.12.13” , the version of Terraform you select must match what is in azure.tf, in this example, version 1.44.0
Azure DevOPs Boards	Microsoft	<a href="https://docs.microsoft.com/en-us/azure/devops/boards/github/connect-to-github?view=azure-devops">https://docs.microsoft.com/en-us/azure/devops/boards/github/connect-to-github?view=azure-devops</a> - How to connect your repo or your organization’s repo to your Azure DevOps Account
Azure DevOPs Boards & GitHub	Microsoft	<a href="https://docs.microsoft.com/en-us/azure/devops/boards/github/?view=azure-devops">https://docs.microsoft.com/en-us/azure/devops/boards/github/?view=azure-devops</a> - Summary Video explains what Azure DevOps Boards are, and announces the Github integration
Azure Boards for DevOps & GitHub - Installing	Microsoft	<a href="https://docs.microsoft.com/en-us/azure/devops/boards/github/install-github-app?view=azure-devops">https://docs.microsoft.com/en-us/azure/devops/boards/github/install-github-app?view=azure-devops</a> - CAUTION - read the above 2 reference documents prior to installing
Azure DevOPs “Classic” Pieplines	3rd Party Blog	<a href="https://medium.com/faun/lets-do-devops-build-an-azure-devops-terraform-pipeline-part-2-2-d3516f47286">https://medium.com/faun/lets-do-devops-build-an-azure-devops-terraform-pipeline-part-2-2-d3516f47286</a> - The only accurate document I found with a recipe for implementing Terraform with Azure DevOps using the “Classic” editor
Azure DevOps Pricing	Microsoft	<a href="https://azure.microsoft.com/en-us/pricing/details/devops/azure-devops-services/">https://azure.microsoft.com/en-us/pricing/details/devops/azure-devops-services/</a> - first 5 users are free, but must pay \$52/user above 5 users for basic features, or \$52/user for rich features

## Terraform Language Introduction

Doc Link	Task	Source	Description
<a href="https://github.com/andyt530/az2tf">https://github.com/andyt530/az2tf</a>	az2tf	GitHub	A tool that builds Terraform scripts from an existing Azure subscriptions
<a href="https://github.com/David-Kent-Consulting/Cohesion2020DevOpsWorkshop">https://github.com/David-Kent-Consulting/Cohesion2020DevOpsWorkshop</a>	Get the code	David Kent Consulting	Our publicly available project file for this workshop. Includes all code, presentation material, and other reference items. WILL BE MADE PUBLIC ON DAY OF WORKSHOP.
<a href="https://www.terraform.io/docs/configuration/provider-requirements.html">https://www.terraform.io/docs/configuration/provider-requirements.html</a>	Naming Providers and hooking to the Terraform “state”	HashiCorp	Local name defined in the main.tf or azure.tf file, if azure.tf serves the function of main. Within this file we also hook to the backend storage by way of the module “azurerm” within a “terraform” code block.
<a href="https://www.terraform.io/docs/state/index.html">https://www.terraform.io/docs/state/index.html</a>	Understanding the Terraform “state”	HashiCorp	The terraform state is the most important concept to get prior to working with the tool. Used incorrectly and you will destroy cloud infrastructure. Used correctly and your cloud and other infrastructure is well managed.
<a href="https://www.terraform.io/docs/modules/index.html">https://www.terraform.io/docs/modules/index.html</a>	Creating custom modules	HashiCorp	Creating modules that are small and incremental in nature is how we use Terraform in a DevOps type model. Understanding of modules is key to increasing change flow, quality, and decreasing risk.
<a href="https://learn.hashicorp.com/tutorials/terraform/azure-variables">https://learn.hashicorp.com/tutorials/terraform/azure-variables</a>	Simple variables	HashiCorp	Using variables is essential to building code that is reusable. Programmers will find the language declaratives and constructs similar to Python, Java, and PowerShell
<a href="https://www.terraform.io/docs/configuration/types.html">https://www.terraform.io/docs/configuration/types.html</a>	Type Constraints	HashiCorp	Although not required, use of type constraints will help you and others write and maintain high quality code
<a href="https://www.terraform.io/docs/configuration/functions/">https://www.terraform.io/docs/configuration/functions/</a>	Terraform Built-in Functions	HashiCorp	Functions are essential to perform activities like string concatenation, arithmetic, building lists of complex objects and arrays, and other tasks common to building IaC.
<a href="https://www.terraform.io/docs/cli-index.html">https://www.terraform.io/docs/cli-index.html</a>	Terraform CLI	HashiCorp	Commands like “terraform plan”, “terraform apply”, and “terraform destroy”, along with options like “-auto-apply”, “-outpath”, and “-parallelism” are the operational tools most used that cloud admins need for developing and pushing cloud infrastructure change
<a href="https://learn.hashicorp.com/tutorials/terraform/state-import">https://learn.hashicorp.com/tutorials/terraform/state-import</a>	Terraform CLI	HashiCorp	The command “terraform import” is used to import existing cloud infrastructure. With release 0.13.3, it is necessary to: 1) import the state, 2) write configurations to match the existing state, 3) run “terraform plan” to ensure the coded configuration matches the existing state, 4) run “terraform apply” to lock in the state, presuming no changes to infrastructure would be made, and 5) use terraform for all future state changes to the cloud infrastructure
<a href="https://learn.hashicorp.com/tutorials/terraform/automate-terraform">https://learn.hashicorp.com/tutorials/terraform/automate-terraform</a>	The .terraform Directory	HashiCorp	The .terraform directory is the directory where external modules and resource files are stored during the “terraform init” process.
<a href="https://www.terraform.io/docs/providers/index.html">https://www.terraform.io/docs/providers/index.html</a>	Provider Modules	HashiCorp	Provider modules are what bring the value to Terraform from a programmer's perspective. Provider modules go beyond cloud, and include VmWare, Cisco, and others.
<a href="https://www.terraform.io/docs/configuration/resources.html">https://www.terraform.io/docs/configuration/resources.html</a>	Terraform resources	HashiCorp	Understanding your cloud provider's resource modules is key before writing a single line of code.
<a href="http://www.devlo.io/if-else-terraform.html">http://www.devlo.io/if-else-terraform.html</a>	Building code blocks with if-else condition	Lopez Brothers	A meaningful application of the Terraform “if-else” conditional statement with code block example for AWS
<a href="https://stackoverflow.com/questions/57570505/terraform-how-to-use-for-each-loop-on-a-list-of-objects-to-create-resources">https://stackoverflow.com/questions/57570505/terraform-how-to-use-for-each-loop-on-a-list-of-objects-to-create-resources</a>	Using for_each	Stack overflow	How to “flatten” an object into maps usable by the terraform for_each function, aka not fun code, and why I avoid this construct
<a href="https://blog.gruntwork.io/how-to-manage-terraform-state-28f5697e68fa">https://blog.gruntwork.io/how-to-manage-terraform-state-28f5697e68fa</a>	Terraform Workspaces	Gruntwork	How to share or isolate workspaces

Azure Modules Used in This Workshop

Doc Link	Module	Description
<a href="https://www.terraform.io/docs/providers/azurerm/index.html">https://www.terraform.io/docs/providers/azurerm/index.html</a>	Index to the Azure provider modules	This index includes access to all Azure resource modules, plus some basic instructions
<a href="https://www.terraform.io/docs/providers/azurerm/guides/azure_cli.html">https://www.terraform.io/docs/providers/azurerm/guides/azure_cli.html</a>	azurerm	This is the module that allows your Terraform client to connect to your Azure subscription and connect to a storage account for management of the terraform state.
<a href="https://www.terraform.io/docs/providers/azurerm/r/resource_group.html">https://www.terraform.io/docs/providers/azurerm/r/resource_group.html</a>	azurerm_resource_group	Create, update, and remove resource groups
<a href="https://www.terraform.io/docs/providers/azurerm/r/virtual_network.html">https://www.terraform.io/docs/providers/azurerm/r/virtual_network.html</a>	azurerm_virtual_network	Create, update, and remove virtual networks
<a href="https://www.terraform.io/docs/providers/azurerm/r/subnet.html">https://www.terraform.io/docs/providers/azurerm/r/subnet.html</a>	azurerm_subnet	Create, update, and remove subnets that are associated with a virtual network
<a href="https://www.terraform.io/docs/providers/azurerm/r/network_security_group.html">https://www.terraform.io/docs/providers/azurerm/r/network_security_group.html</a>	azurerm_network_security_group	Create, update, and remove network security groups
<a href="https://www.terraform.io/docs/providers/azurerm/r/public_ip.html">https://www.terraform.io/docs/providers/azurerm/r/public_ip.html</a>	azurerm_public_ip	Create, update, and remove public IP address resources
<a href="https://www.terraform.io/docs/providers/azurerm/r/lb.html">https://www.terraform.io/docs/providers/azurerm/r/lb.html</a>	azurerm_lb	Create, update, and remove network load balancers
<a href="https://www.terraform.io/docs/providers/azurerm/r/storage_account.html">https://www.terraform.io/docs/providers/azurerm/r/storage_account.html</a>	azurerm_storage_account	Create, update, and remove storage accounts
<a href="https://www.terraform.io/docs/providers/azurerm/r/network_interface.html">https://www.terraform.io/docs/providers/azurerm/r/network_interface.html</a>	azurerm_network_interface	Create, update, and remove network interfaces used by instances and some types of cloud appliances
<a href="https://www.terraform.io/docs/providers/azurerm/r/linux_virtual_machine.html">https://www.terraform.io/docs/providers/azurerm/r/linux_virtual_machine.html</a>	azurerm_linux_virtual_machine	Create, update, and remove linux virtual machines
<a href="https://www.terraform.io/docs/providers/azurerm/r/mysql_server.html">https://www.terraform.io/docs/providers/azurerm/r/mysql_server.html</a>	azurerm_mysql_server	Create, update, and remove an Azure mySQL PasS Appliance
<a href="https://www.terraform.io/docs/providers/azurerm/r/container_registry.html">https://www.terraform.io/docs/providers/azurerm/r/container_registry.html</a>	azurerm_container_registry	Create, update, and remove container registries
<a href="https://www.terraform.io/docs/providers/azurerm/r/kubernetes_cluster.html">https://www.terraform.io/docs/providers/azurerm/r/kubernetes_cluster.html</a>	azurerm_kubernetes_cluster	Create, update, and remove Kubernetes clusters

Azure DevOps Workshop Reference

Doc Link	Source	Description
<a href="https://azure.microsoft.com/en-us/overview/devops-tutorial/#understanding">https://azure.microsoft.com/en-us/overview/devops-tutorial/#understanding</a>	Microsoft	An overview of DevOps from Microsoft's perspective, and an overview of the Azure DevOps tool
<a href="https://docs.microsoft.com/en-us/azure/devops/boards/work-items/workflow-and-state-categories?view=azure-devops&amp;tabs=agile-process">https://docs.microsoft.com/en-us/azure/devops/boards/work-items/workflow-and-state-categories?view=azure-devops&amp;tabs=agile-process</a>	Microsoft	Workflows
<a href="https://docs.microsoft.com/en-us/azure/devops/boards/get-started/permissions-access-boards?view=azure-devops">https://docs.microsoft.com/en-us/azure/devops/boards/get-started/permissions-access-boards?view=azure-devops</a>	Microsoft	Permissions