Day 2: Cloud Compute

AWS EC2

Categorizing compute services

Services	Key Concepts	Characteristics	Ease of Use
• Amazon EC2	• Infrastructure as a service (IaaS) • Instance-based • **Virtual machines**	• Provision virtual machines that you can manage as you choose	A familiar concept to many IT professionals.
• AWS Lambda	• **Serverless** computing • Function-based • Low-cost	• Write and deploy code that runs on a schedule or that can be triggered by events • Use when possible (architect for the cloud)	A relatively new concept for many IT staff members, but easy to use after you learn how.
• Amazon ECS • Amazon EKS • AWS Fargate • Amazon ECR	• **Container-based** computing • Instance-based	• Spin up and run jobs more quickly	AWS Fargate reduces administrative overhead, but you can use options that give you more control.
• AWS Elastic Beanstalk	• Platform as a service (PaaS) • For **web applications**	• Focus on your code (building your application) • Can easily tie into other services—databases, Domain Name System (DNS), etc.	Fast and easy to get started.

Amazon Elastic Compute Cloud (Amazon EC2)

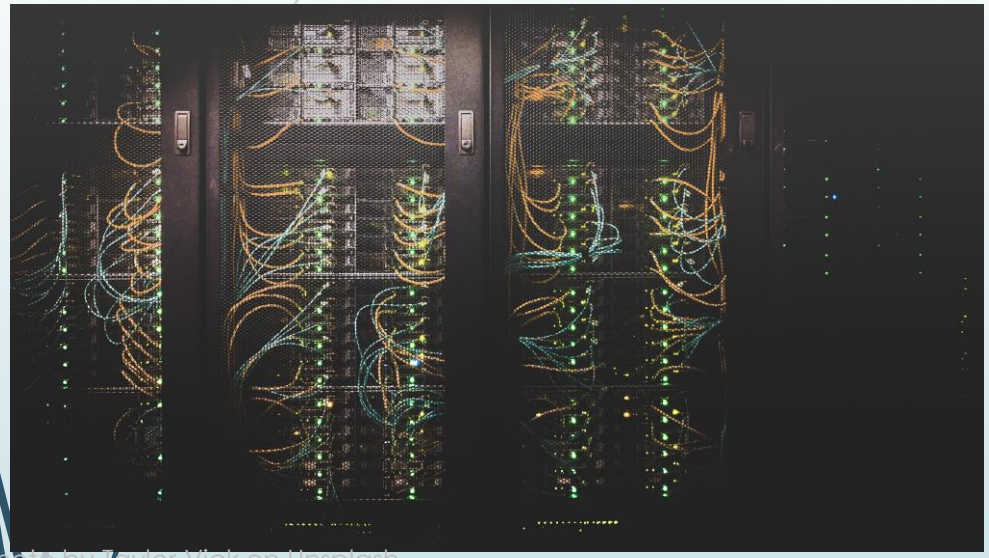
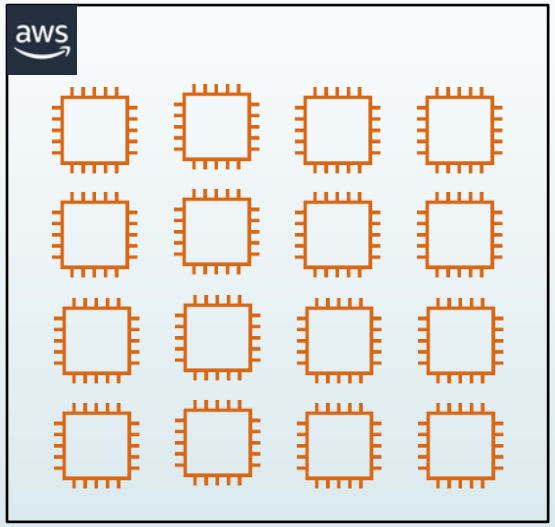


Photo by Taylor Vick on Unsplash

On-premises servers

Example uses of Amazon EC2 instances

- ✓ Application server
- ✓ Web server
- ✓ Database server
- ✓ Game server
- ✓ Mail server
- ✓ Media server
- ✓ Catalog server
- ✓ File server
- ✓ Computing server
- ✓ Proxy server



Amazon EC2 instances

Photo by panumas nikhomkhai from Pexels

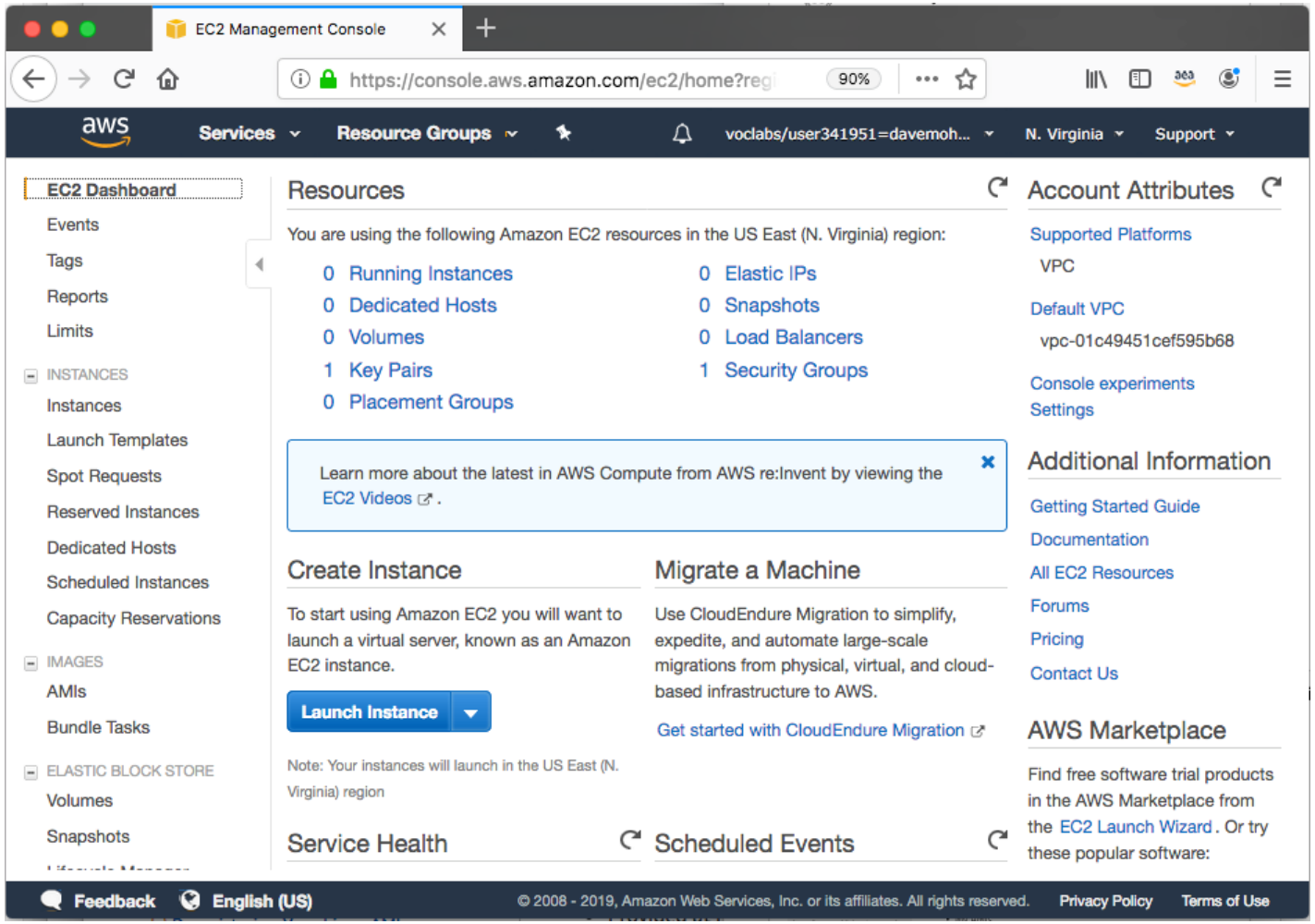
Amazon EC2 overview

- **Amazon Elastic Compute Cloud (Amazon EC2)**
  - Provides virtual machines—referred to as EC2 instances—in the cloud.
  - Gives you *full control* over the guest operating system (Windows or Linux) on each instance.
- You can launch instances of any size into an Availability Zone anywhere in the world.
  - Launch instances from **Amazon Machine Images (AMIs)**.
  - Launch instances with a few clicks or a line of code, and they are ready in minutes.
- You can control traffic to and from instances.

Launching an Amazon EC2 instance

This section of the module walks through **nine key decisions** to make when you create an EC2 instance by using the AWS Management Console **Launch Instance Wizard**.

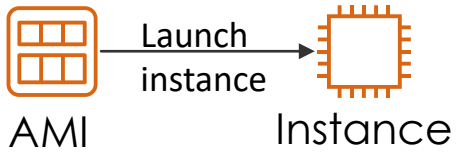
- Along the way, essential Amazon EC2 concepts will be explored.



1. Select an AMI

Choices made using the Launch Instance Wizard:

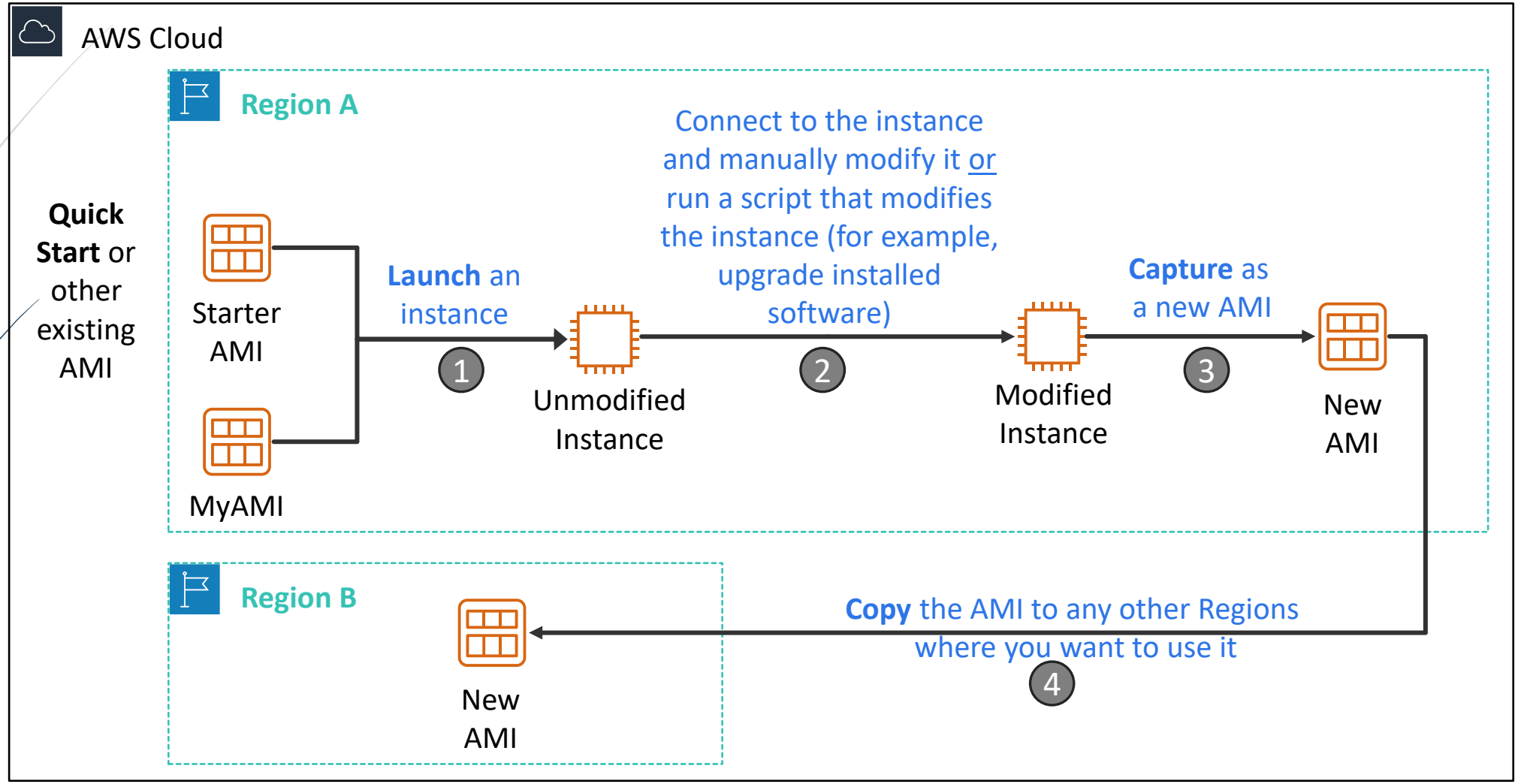
1. **AMI**
2. **Instance Type**
3. **Network settings**
4. **IAM role**
5. **User data**
6. **Storage options**
7. **Tags**
8. **Security group**
9. **Key pair**



- Amazon Machine Image (AMI)
  - Is a template that is used to create an EC2 instance (which is a **virtual machine, or VM,** that runs in the AWS Cloud)
  - Contains a **Windows** or **Linux** operating system
  - Often also has some **software** pre-installed
- AMI choices:
  - Quick Start – *Linux and Windows AMIs that are provided by AWS*
  - My AMIs – *Any AMIs that you created*
  - AWS Marketplace – *Pre-configured templates from third par*
  - Community AMIs – *AMIs shared by others; use at your own risk*

Creating a new AMI: Example

AMI details



2. Select an instance type

Choices made using the Launch Instance Wizard:

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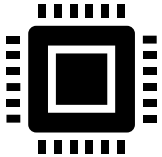
- Consider your use case
  - How will the EC2 instance you create be used?
- The **instance type** that you choose determines –
  - Memory (RAM)
  - Processing power (CPU)
  - Disk space and disk type (Storage)
  - Network performance



- Instance type categories –
  - General purpose
  - Compute optimized
  - Memory optimized
  - Storage optimized
  - Accelerated computing
- Instance types offer *family*, *generation*, and *size*

EC2 instance type naming and sizes

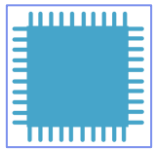
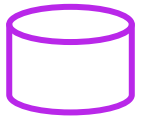
Instance type naming

- Example: **t3.large**
  - T is the family name
  - 3 is the generation number
  - Large is the size

Example instance sizes

Instance Name	vCPU	Memory (GB)	Storage
t3.nano	2	0.5	EBS-Only
t3.micro	2	1	EBS-Only
t3.small	2	2	EBS-Only
t3.medium	2	4	EBS-Only
t3.large	2	8	EBS-Only
t3.xlarge	4	16	EBS-Only
t3.2xlarge	8	32	EBS-Only

Select instance type: Based on use case

	 General Purpose	 Compute Optimized	 Memory Optimized	 Accelerated Computing	 Storage Optimized
Instance Types	a1, m4, m5, t2, t3	c4, c5	r4, r5, x1, z1	f1, g3, g4, p2, p3	d2, h1, i3
Use Case	Broad	High performance	In-memory databases	Machine learning	Distributed file systems

Instance types: Networking features

- The network bandwidth (Gbps) varies by instance type.
  - See Amazon EC2 Instance Types to compare.
- To maximize networking and bandwidth performance of your instance type:
  - If you have interdependent instances, launch them into a **cluster placement group**.
  - Enable enhanced networking.
- Enhanced networking types are supported on most instance types.
  - See the Networking and Storage Features documentation for details.
- Enhanced networking types –
  - **Elastic Network Adapter (ENA):** Supports network speeds of up to 100 Gbps.
  - **Intel 82599 Virtual Function interface:** Supports network speeds of up to 10 Gbps.

3. Specify network settings

Choices made by using the Launch Instance Wizard:

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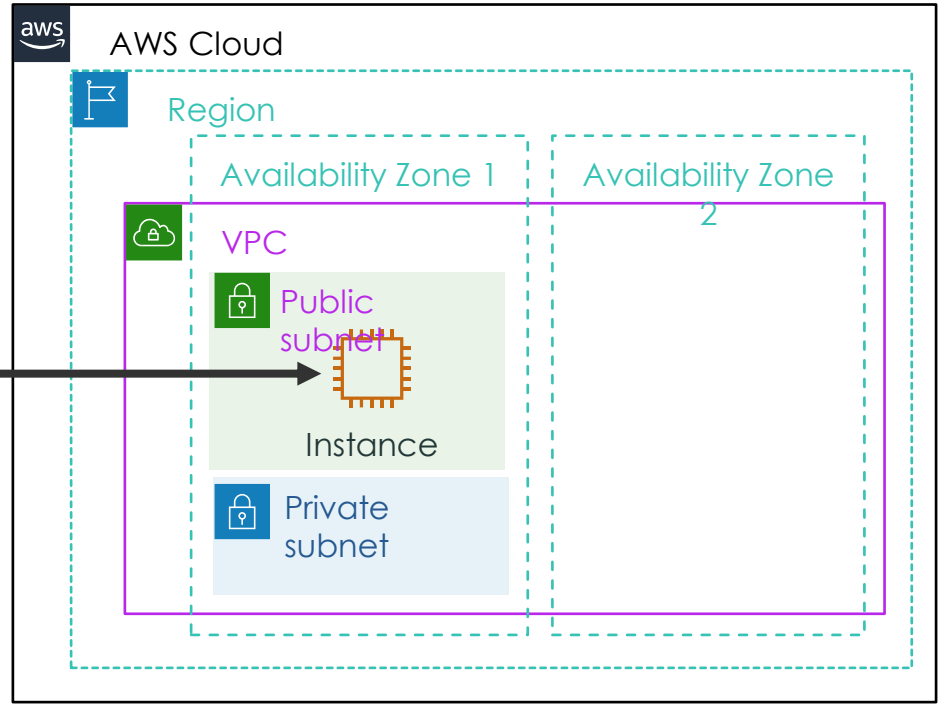
8. **Security group**
9. **Key pair**

- Where should the instance be deployed?
  - Identify the **VPC** and optionally the **subnet**
- Should a **public IP address** be automatically assigned?
  - To make it internet-accessible

Example: specify to deploy the instance here



4. Attach IAM role (optional)

Choices made by using the Launch Instance Wizard:

1. **AMI**
2. **Instance Type**
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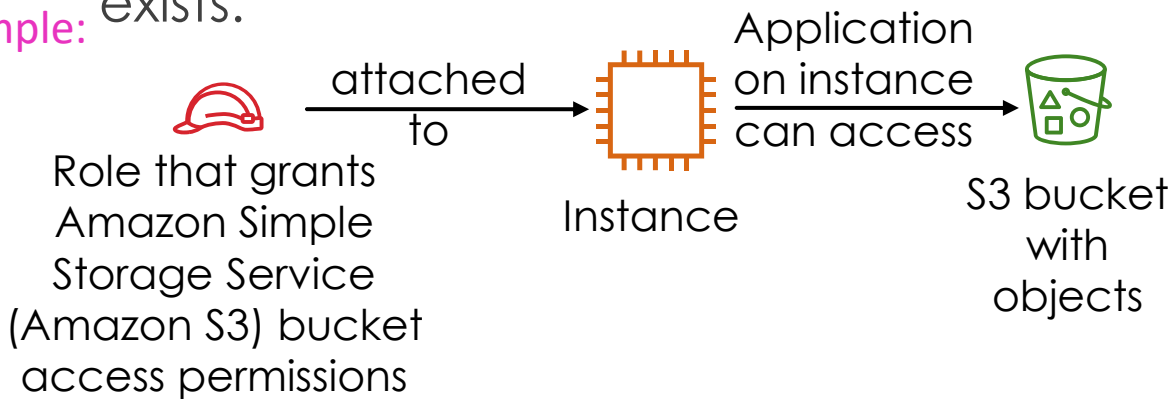
- Will software on the EC2 instance need to interact with other AWS services?
  - If yes, attach an appropriate **IAM Role**.
- An AWS Identity and Access Management (IAM) role that is attached to an EC2 instance is kept in an **instance profile**.
- You are *not* restricted to attaching a role only at instance launch.
  - You can also attach a role to an instance that already exists.

Example:



5. User data script (optional)

Choices made by using the Launch Instance Wizard:

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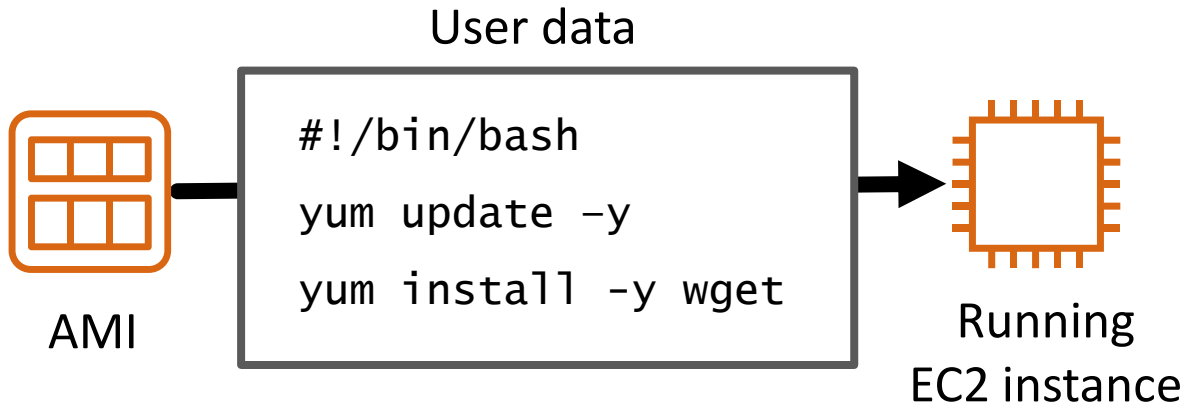

- Optionally specify a user data script at instance launch
- Use **user data** scripts to customize the runtime environment of your instance
  - Script runs the first time the instance starts
- Can be used strategically
  - For example, reduce the number of custom AMIs that you build and maintain

6. Specify storage

Choices made by using the Launch Instance Wizard:

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2. **Instance Type**
3. **Network settings**
4. **IAM role**
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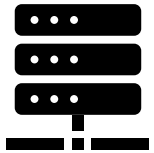
- Configure the root volume
  - Where the guest operating system is installed
- Attach additional storage volumes (optional)
  - AMI might already include more than one volume
- For each volume, specify:
  - The **size** of the disk (in GB)
  - The **volume type**
    - Different types of solid state drives (SSDs) and hard disk drives (HDDs) are available
  - If the volume will be deleted when the instance is terminated
  - If **encryption** should be used

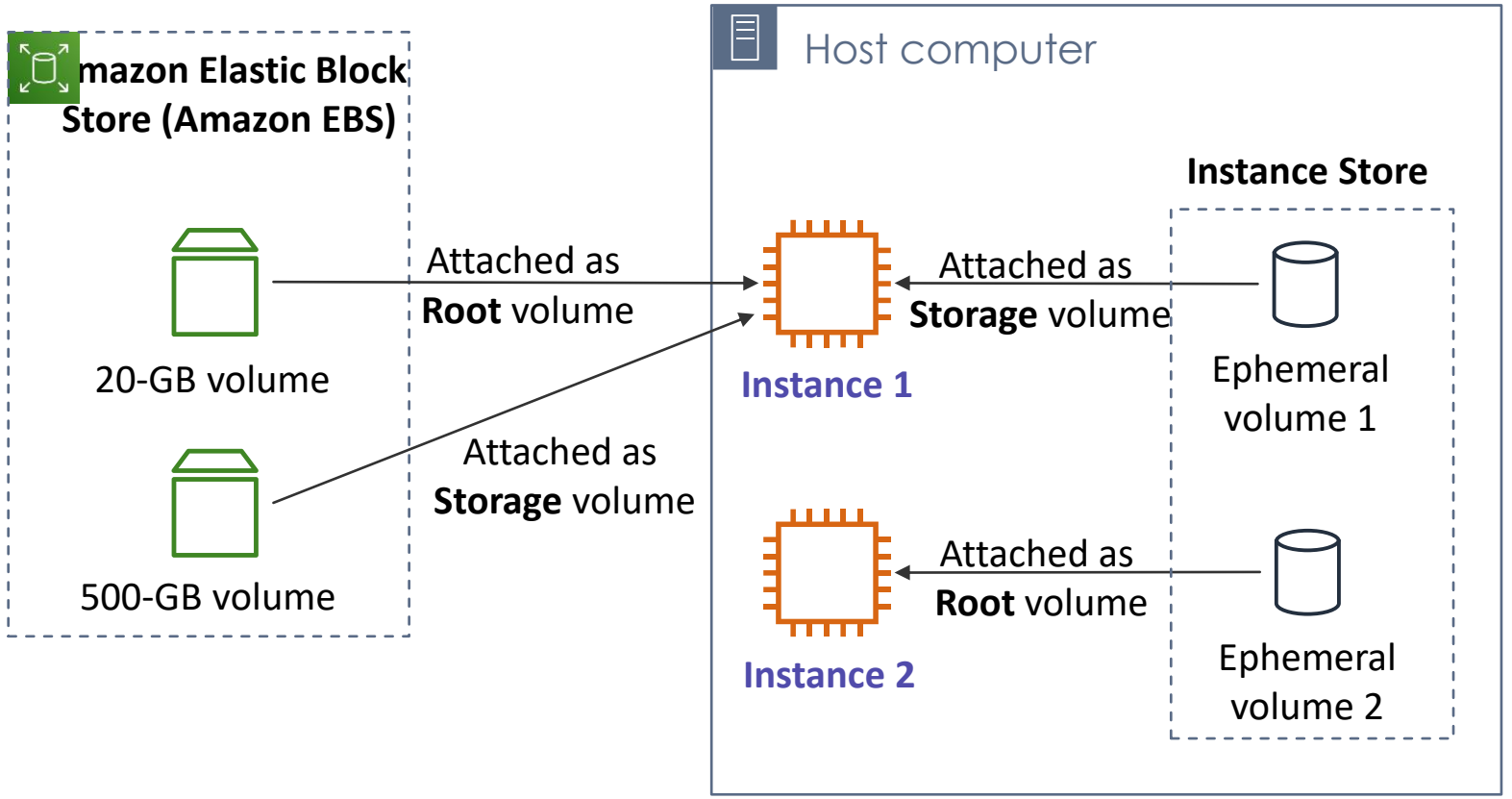


Amazon EC2 storage options

- **Amazon Elastic Block Store (Amazon EBS) –**
  - Durable, block-level storage volumes.
  - You can stop the instance and start it again, and the data will still be there.
- **Amazon EC2 Instance Store –**
  - Ephemeral storage is provided on disks that are attached to the host computer where the EC2 instance is running.
  - If the instance stops, data stored here is deleted.
- Other options for storage (not for the root volume) –
  - Mount an **Amazon Elastic File System (Amazon EFS)** file system.
  - Connect to **Amazon Simple Storage Service (Amazon S3)**.

Example storage options

- **Instance 1** characteristics –
  - It has an **Amazon EBS** *root volume* type for the operating system.
  - What will happen if the instance is stopped and then started again?
- **Instance 2** characteristics –
  - It has an **Instance Store** *root volume* type for the operating system.
  - What will happen if the instance stops (because of user error or a system malfunction)?



7. Add tags

Choices made by using the Launch Instance Wizard:

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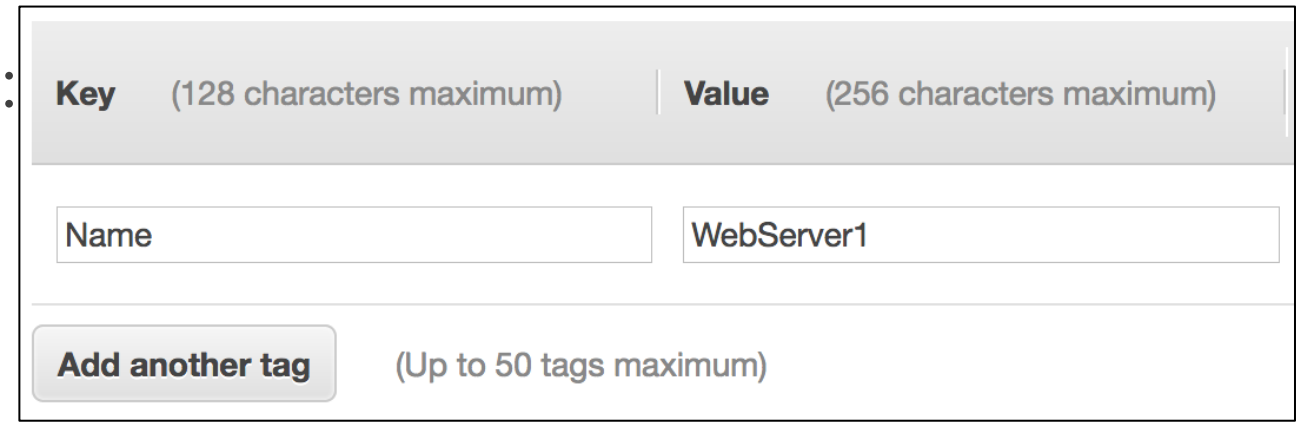
- A tag is a label that you can assign to an AWS resource.
  - Consists of a *key* and an optional *value*.
- Tagging is how you can attach **metadata** to an EC2 instance.
- Potential benefits of tagging—Filtering, automation, cost allocation, and access control.

Example:



8. Security group settings

Choices made by using the Launch Instance Wizard:

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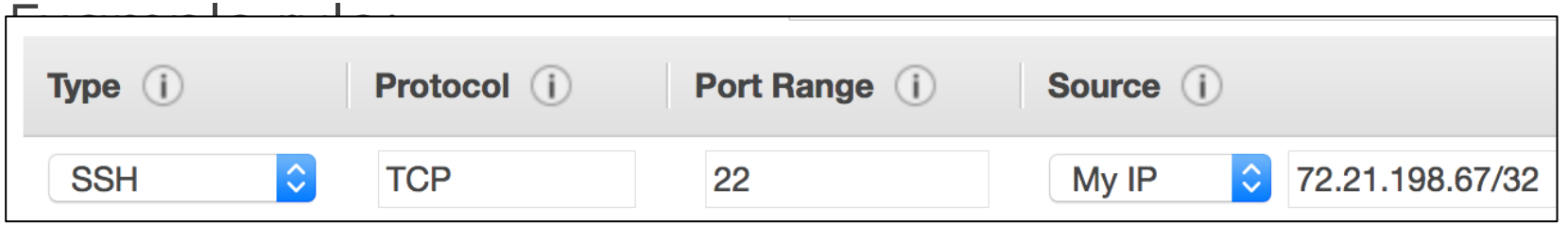
5. **User data**
6. **Storage options**
7. **Tags**
8. **Security group**
9. **Key pair**

- A security group is a **set of firewall rules** that control traffic to the instance.
  - It exists *outside* of the instance's guest OS.
- Create **rules** that specify the **source** and which **ports** that network communications can use.
  - Specify the **port** number and the **protocol**, such as Transmission Control Protocol (TCP), User Datagram Protocol (UDP), or Internet Control Message Protocol (ICMP).
  - Specify the **source** (for example, an IP address or another security group) that is allowed to use the rule.



9. Identify or create the key pair

Choices made by using the Launch Instance Wizard:

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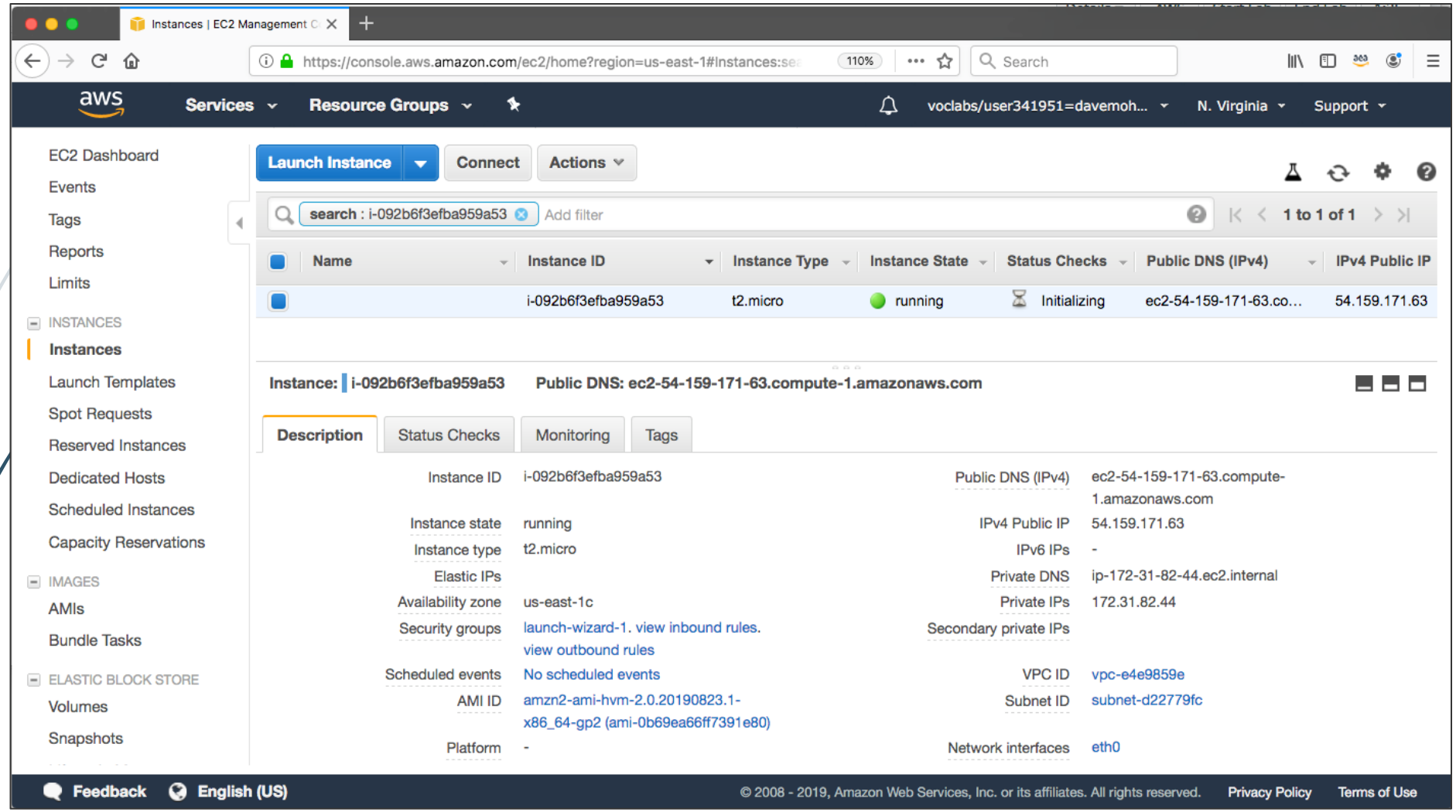
8. **Security group**
9. **Key pair**

- At instance launch, you specify an existing key pair *or* create a new key pair.
- A key pair consists of –
  - A **public key** that AWS stores.
  - A **private key** file that you store.
- It enables secure connections to the instance.
- For **Windows AMIs –**
  - Use the private key to obtain the administrator password that you need to log in to your instance.
- For **Linux AMIs –**
  - Use the private key to use SSH to securely connect to your instance.

mykey.pem

Amazon EC2 console view of a running EC2 instance



Launch an EC2 instance with the AWS Command Line Interface

- EC2 instances can also be created programmatically.

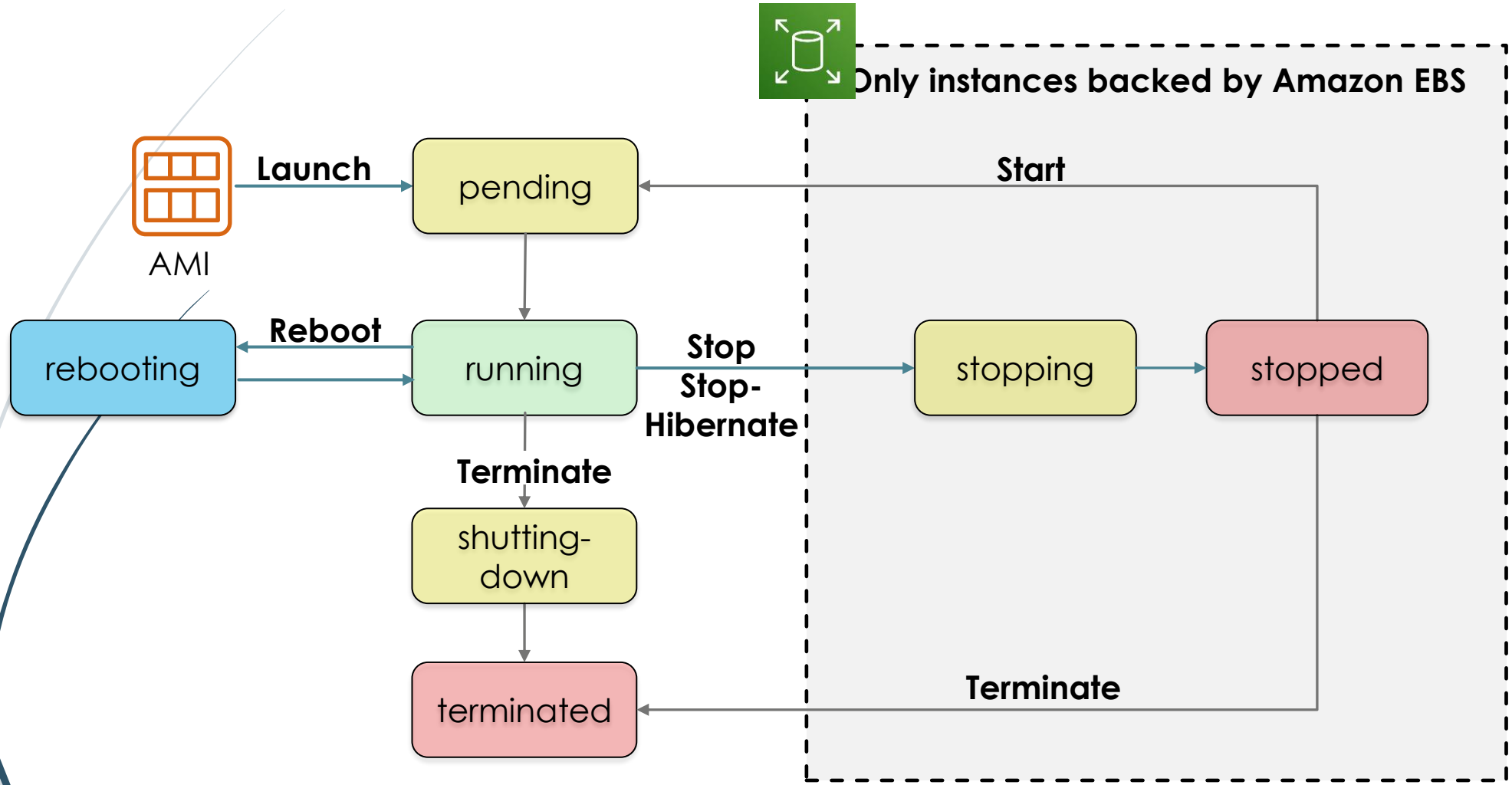
AWS Command Line Interface (AWS CLI)

- This example shows how simple the command can be.
  - This command assumes that the key pair and security group already exist.
  - More options could be specified. See the AWS CLI Command Reference for details.

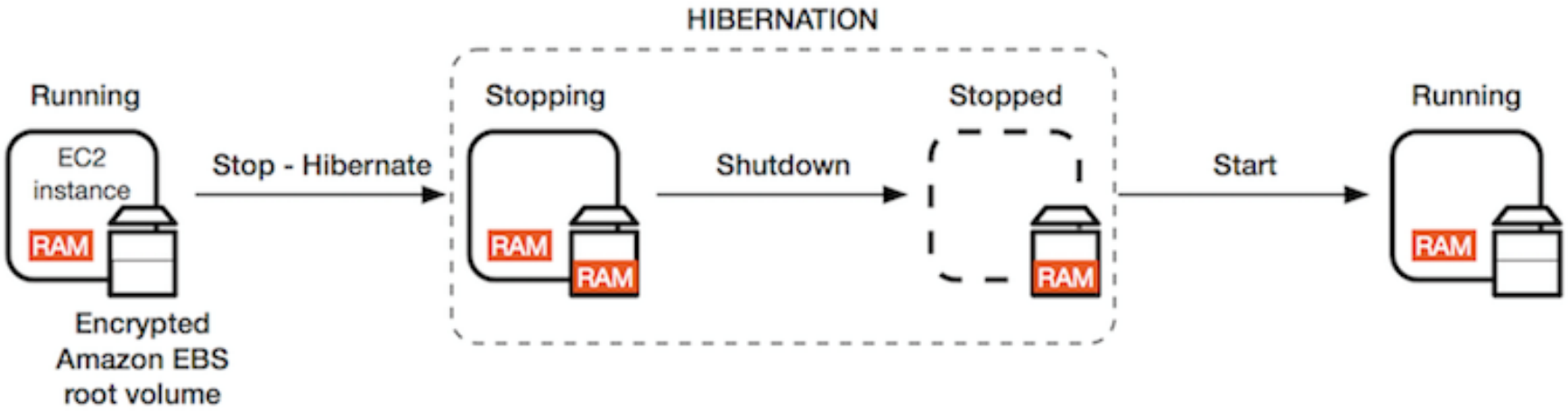
Example command:

```
aws ec2 run-instances \
--image-id ami-1a2b3c4d \
--count 1 \
--instance-type c3.large \
--key-name MyKeyPair \
--security-groups MySecurityGroup \
--region us-east-1
```

Amazon EC2 instance lifecycle



Instance hibernation option



- Benefits
  - It saves the contents from the instance memory (RAM).
  - On instance restart, RAM contents are reloaded, previously running processes are resumed.
  - You can save on cost in a hibernated state versus a running state (costs are similar to a stopped instance).
- Prerequisites
  - Only certain Linux AMIs (such as Amazon Linux 2) and only certain instance families support it.
  - Instance must have an encrypted Amazon EBS root volume and a maximum of150 GB RAM.
  - Hibernation must be enabled at instance launch.

Amazon CloudWatch for monitoring

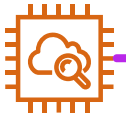
- Use **Amazon CloudWatch** to monitor EC2 instances
  - Provides near-real-time metrics
  - Provides charts in the Amazon EC2 console **Monitoring** tab that you can view
  - Maintains 15 months of historical data

- **Basic monitoring**
  - Default, no additional cost
  - Metric data sent to CloudWatch every 5 minutes

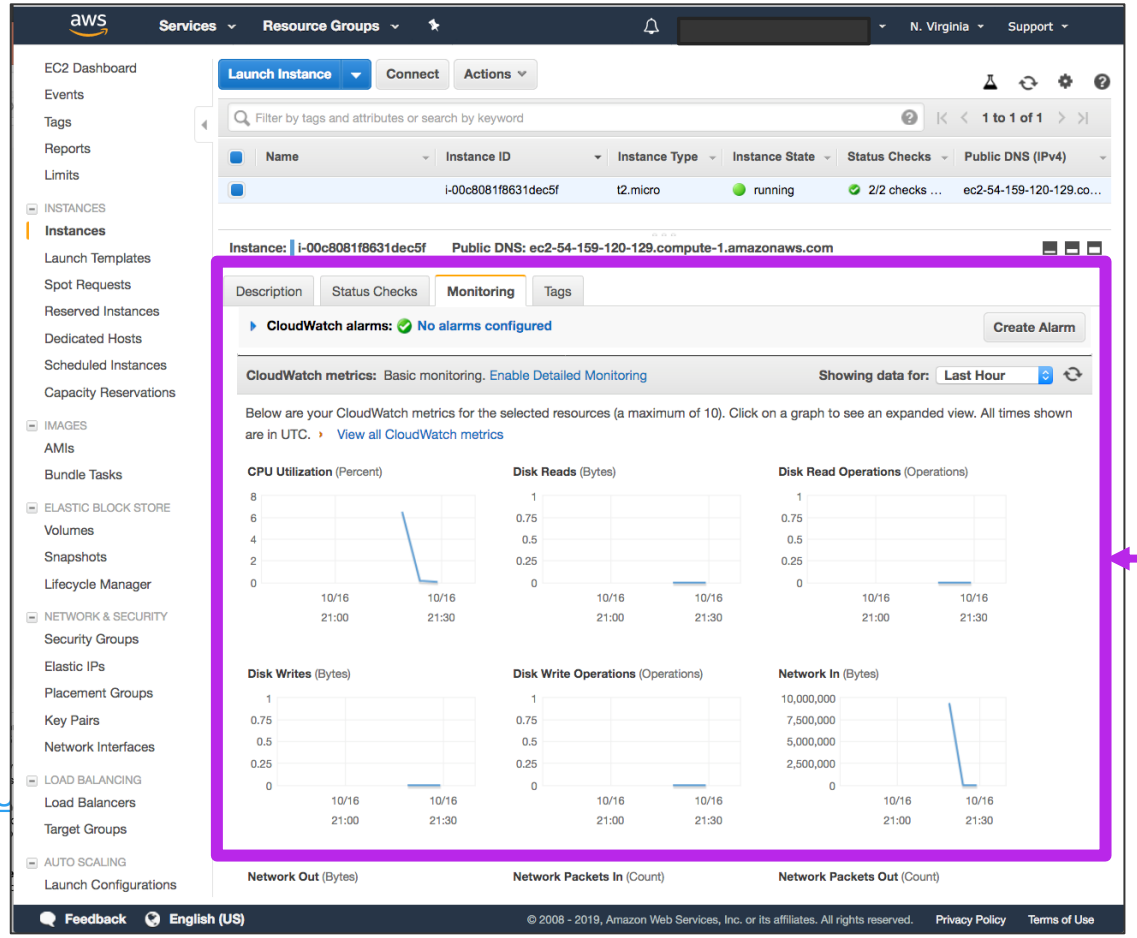
- **Detailed monitoring**
  - Fixed monthly rate for seven pre-selected metrics
  - Metric data delivered every 1 minute

- **Metrics**
  - https://docs.aws.amazon.com/AWSEC2/latest/UserGu viewing_metrics_with_cloudwatch.html

Amazon CloudWatch



Instance with CloudWatch

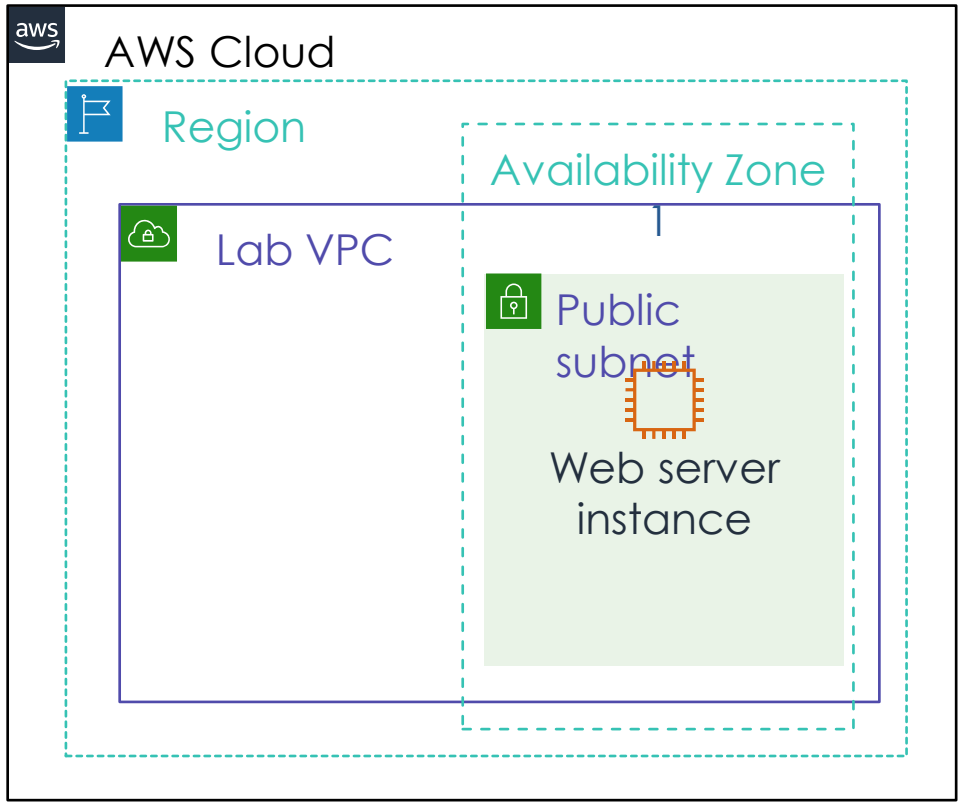


Section 2 key takeaways

- **Amazon EC2** enables you to run Windows and Linux **virtual machines** in the cloud.
- You launch **EC2 instances** from an **AMI** template into a VPC in your account.
- You can choose from many **instance types**. Each instance type offers different combinations of CPU, RAM, storage, and networking capabilities.
- You can configure **security groups** to control access to instances (specify allowed ports and source).
- **User data** enables you to specify a script to run the first time that an instance launches.
- Only **instances that are backed by Amazon EBS can be stopped.**
- You can use **Amazon CloudWatch** to capture and review metrics on EC2 instances.

Lab: scenario

In this lab, you will launch and configure your first virtual machine that runs on Amazon EC2.



Lab: Tasks

- Task 1 – Launch Your Amazon EC2 Instance
- Task 2 – Monitor Your Instance
- Task 3 – Update Your Security Group and Access the Web Server
- Task 4 – Resize Your Instance: Instance Type and EBS Volume
- Task 5 – Explore EC2 Limits
- Task 6 – Test Termination Protection

Lab: Final product

By the end of the lab, you will have:

1. Launched an instance that is configured as a web server
2. Viewed the instance system log
3. Reconfigured a security group
4. Modified the instance type and root volume size