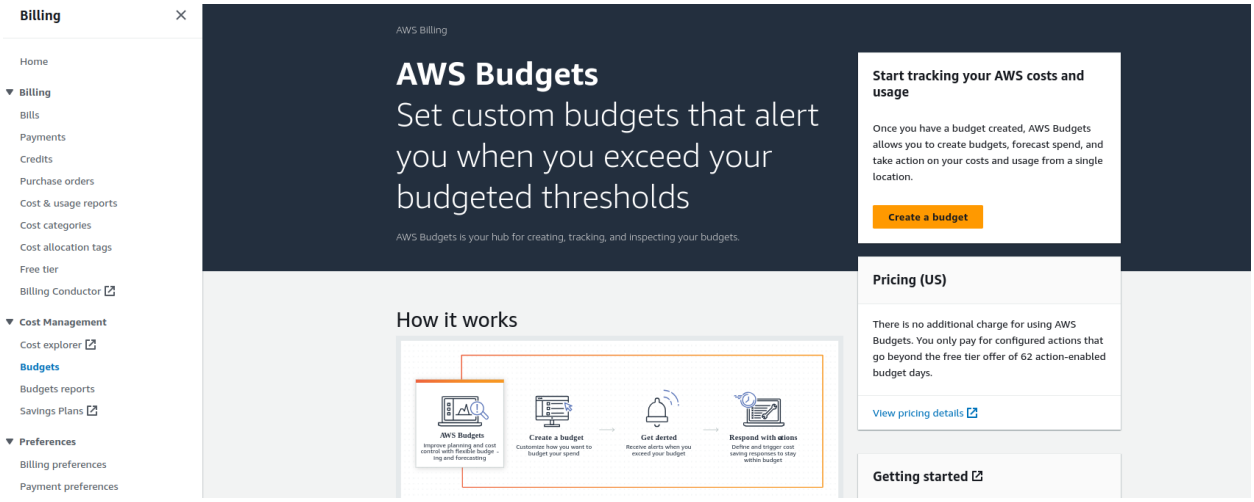
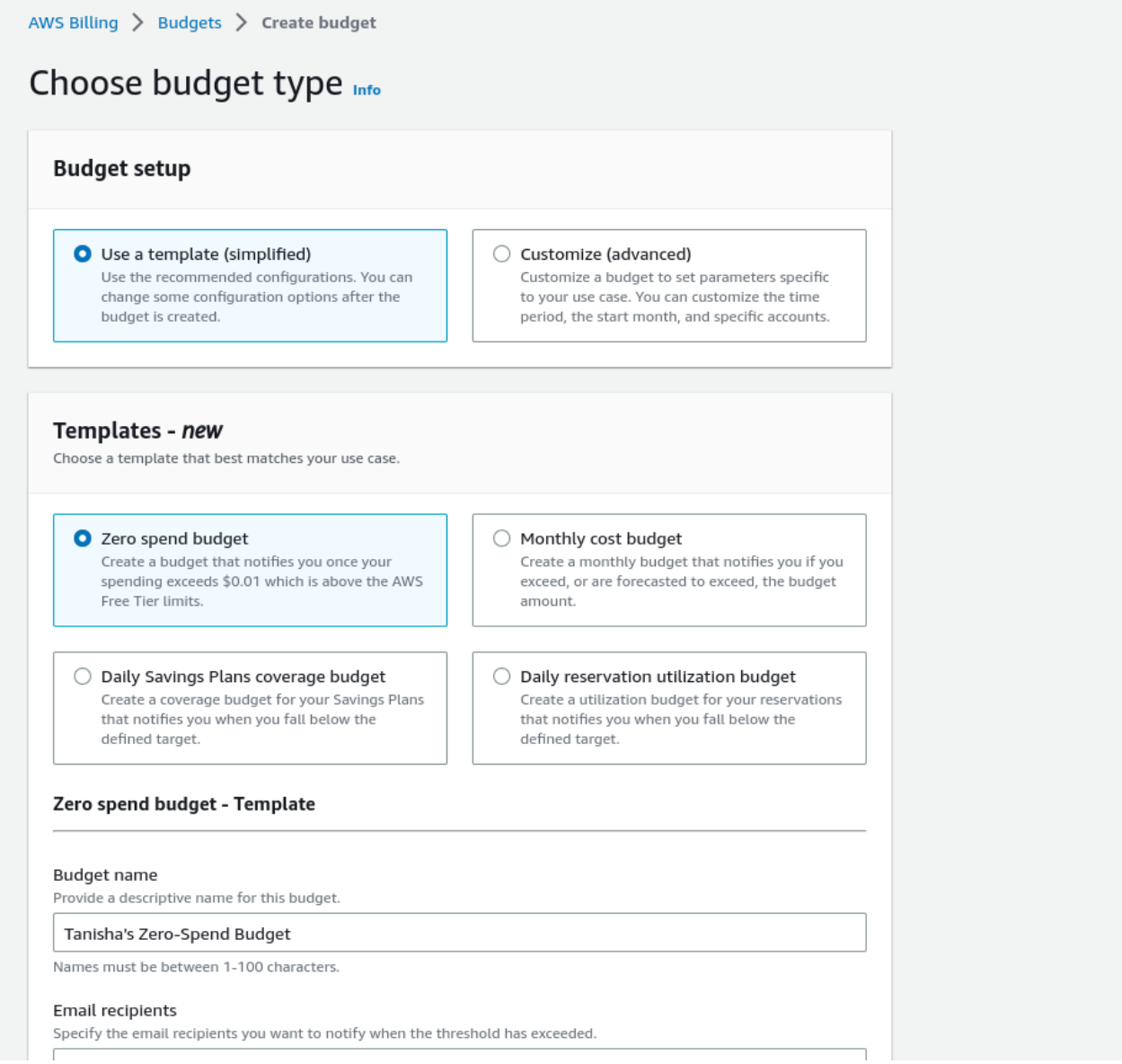
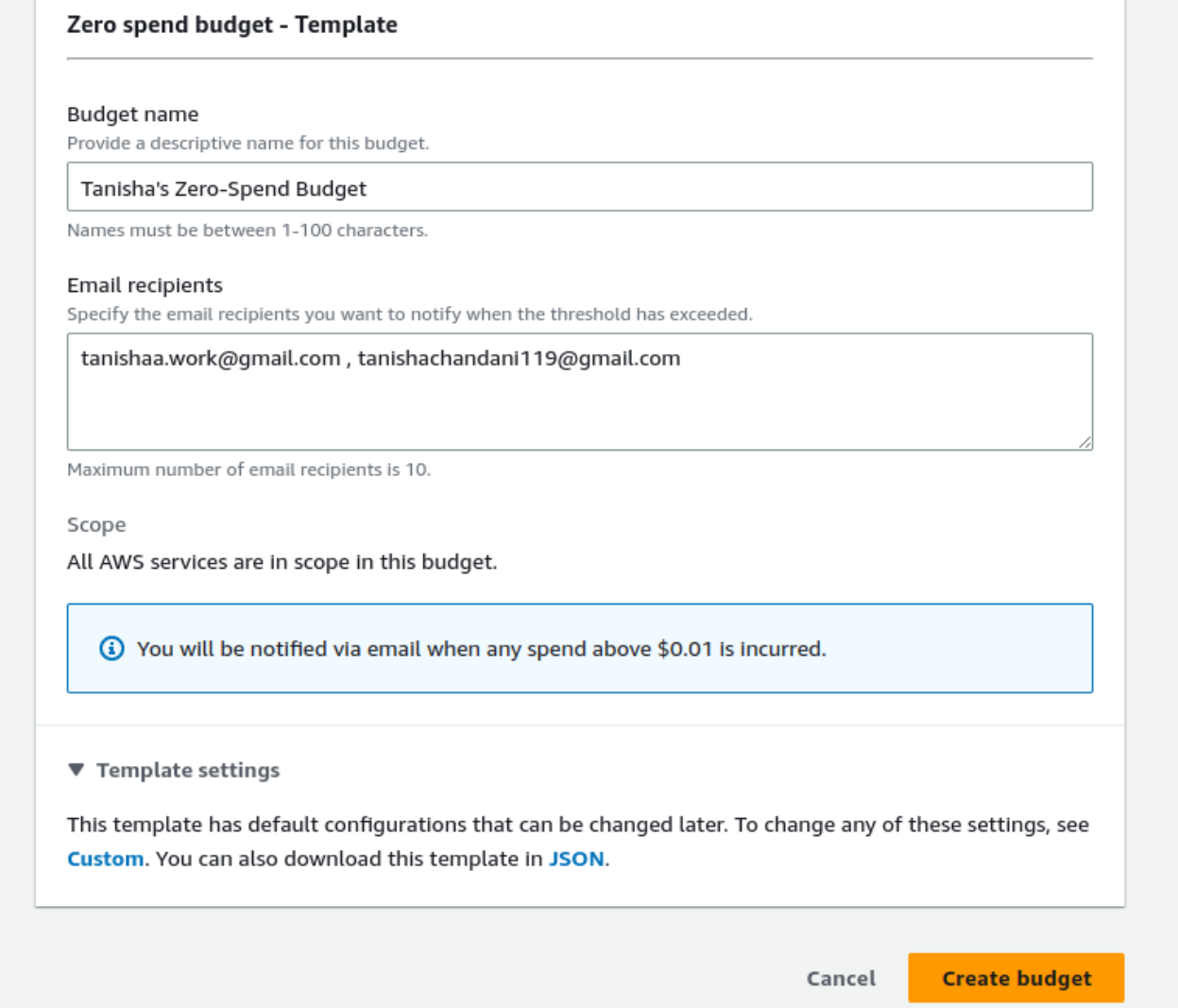
EC2 - Elastic Cloud Compute

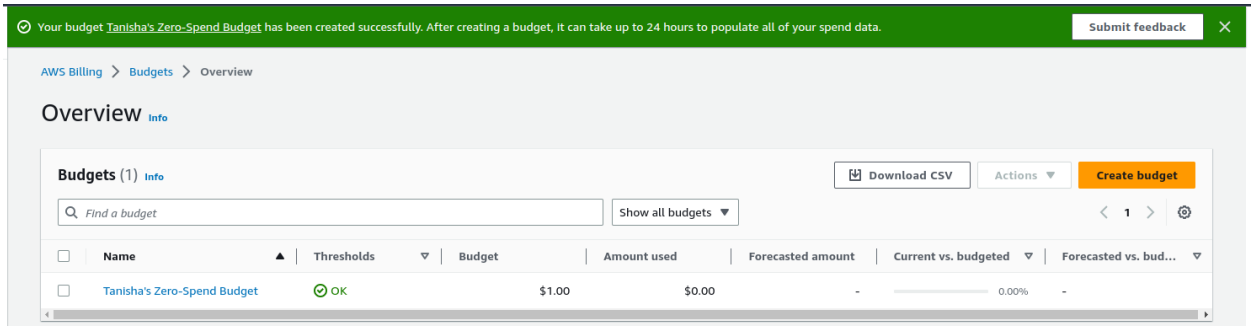
Setting up billing alerts

- This is done to prevent from incurring unexpected charges on services accidentally.
- You can choose from multiple existing templates such as zero-cost or monthly budget, etc.




AWS Billing > Budgets > Create budget
Choose budget type Info
Budget setup
Use a template (simplified)
Use the recommended configurations. You can change some configuration options after the budget is created.
Customize (advanced)
Customize a budget to set parameters specific to your use case. You can customize the time period, the start month, and specific accounts.
Templates - new
Choose a template that best matches your use case.
Zero spend budget
Create a budget that notifies you once your spending exceeds $0.01 which is above the AWS Free Tier limits.
Monthly cost budget
Create a monthly budget that notifies you if you exceed, or are forecasted to exceed, the budget amount.
Daily Savings Plans coverage budget
Create a coverage budget for your Savings Plans that notifies you when you fall below the defined target.
Daily reservation utilization budget
Create a utilization budget for your reservations that notifies you when you fall below the defined target.
Zero spend budget - Template
Budget name
Provide a descriptive name for this budget.
Tanisha's Zero-Spend Budget
Names must be between 1-100 characters.
Email recipients
Specify the email recipients you want to notify when the threshold has exceeded.

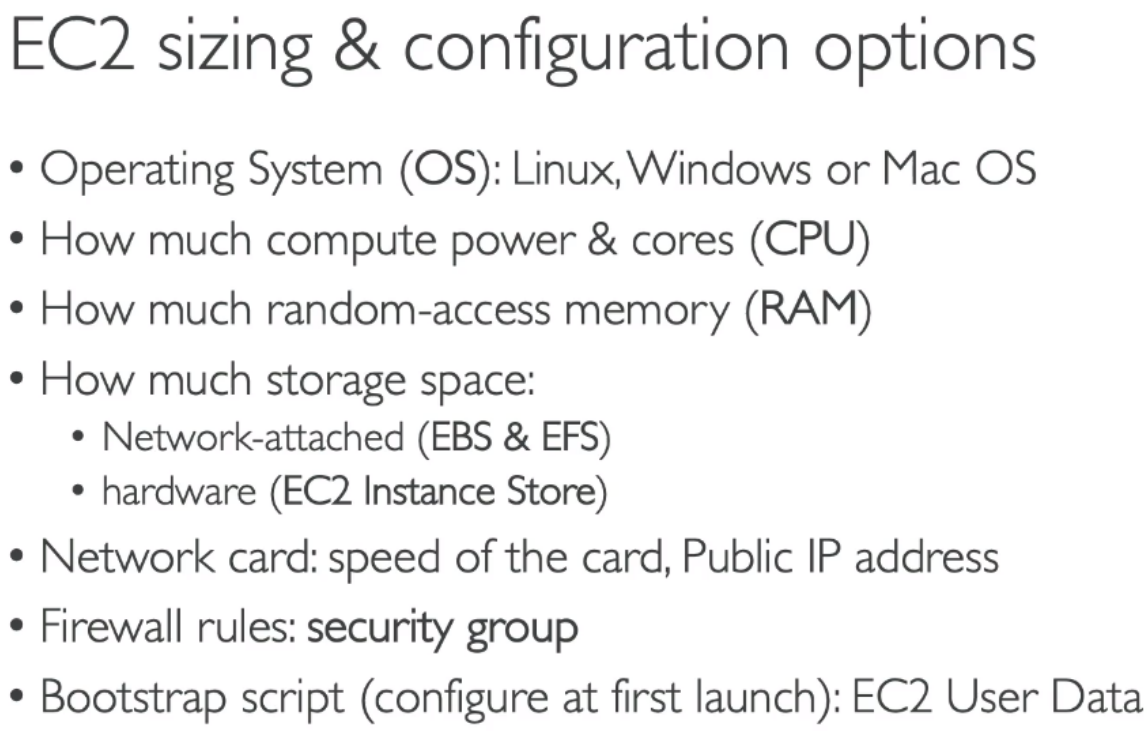




EC2 - Introduction

- Elastic Cloud Compute
- EC2 is one of the services which enable Infrastructure as a Service model for organizations.
- EC2 famously offers virtual servers but that's not all, it also offers much more, such as:
    - Renting virtual machines (EC2)
    - Storing data on virtual drives (EBS)
    - Distributing load / traffic across machines (ELB)
    - Scaling the services of an application using auto-scaling groups (ASG)
- The cloud is to be able to rent these compute whenever you need, on demand, and EC2 is just that.

- **To configure or create an ec2 instance, you will need to choose or decide the following things:**



- Diving into the last point - bootstrap script: **what exactly is bootstrapping?**
  - Bootstrapping is basically the set of launching commands that are run when a machine starts. Basically, it's only run once, on initialization and never again.
  - We can bootstrap our instances using the **EC2 user data script**.
  - EC2 user data is used to automate boot tasks such as:
    - installing updates
    - installing software
    - downloading commonly used files from the internet
    - anything you wanna add

      ** it is worth noting that, the more you add to your ec2 user data script, the more your instance will have to do at boot time.
- The EC2 User Data Script runs with the root user privileges. The "root" user is the superuser with the highest level of administrative privileges, which will allow the script to perform actions that require elevated permissions, such as installing software, modifying system configuration, and creating or deleting files in system directories.

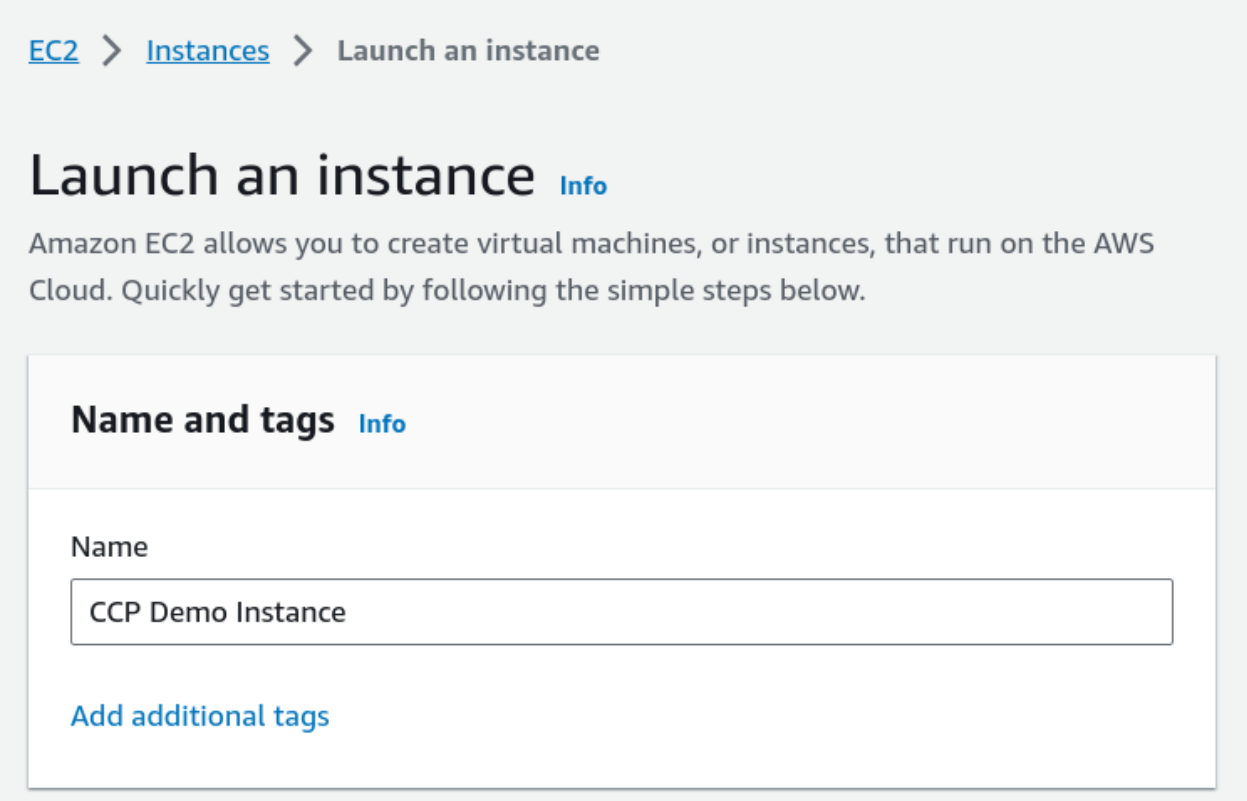
EC2 instance types: example

Instance	vCPU	Mem (GiB)	Storage	Network Performance	EBS Bandwidth (Mbps)
t2.micro	1	1	EBS-Only	Low to Moderate	
t2.xlarge	4	16	EBS-Only	Moderate	
c5d.4xlarge	16	32	1 x 400 NVMe SSD	Up to 10 Gbps	4,750
r5.16xlarge	64	512	EBS Only	20 Gbps	13,600
m5.8xlarge	32	128	EBS Only	10 Gbps	6,800

EC2 Hands-on

- Aim: to launch an ec2 running instance linux

- We'll be launching our first virtual server using the AWS Console
- We'll get a first high-level approach to the various parameters
- We'll see that our web server is launched using EC2 user data
- We'll learn how to start / stop / terminate our instance.



Application and OS Images (Amazon Machine Image) Info

An AMI is a template that contains the software configuration (operating system, application server, and applications) required to launch your instance. Search or Browse for AMIs if you don't see what you are looking for below

Search our full catalog including 1000s of application and OS images

Quick Start

Amazon Linux

macOS

Mac

Ubuntu

ubuntu

Win

Mi

Browse more AMIs

Including AMIs from AWS, Marketplace and the Community

Amazon Machine Image (AMI)

Amazon Linux 2023 AMI — Free tier eligible

ami-02e94b011299ef128 (64-bit (x86)) / ami-0a31c2002672717b6 (64-bit (Arm))

Virtualization: hvm ENA enabled: true Root device type: ebs

Description

Amazon Linux 2023 AMI 2023.2.20231030.1 x86_64 HVM kernel-6.1

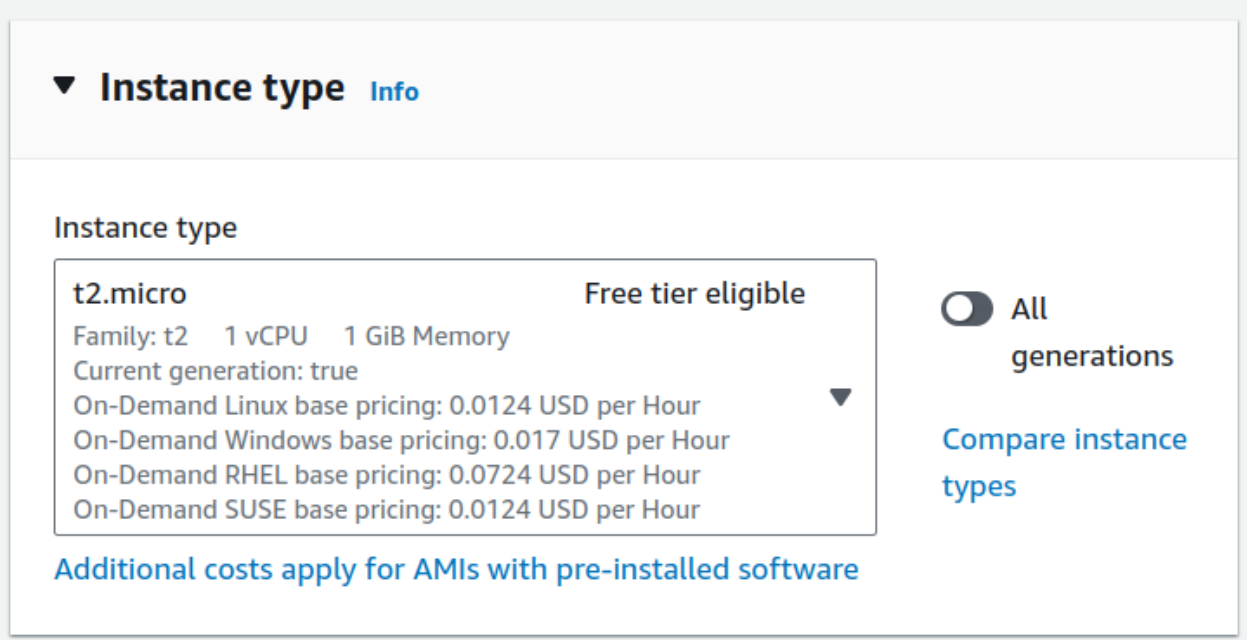
Architecture

64-bit (x86)

AMI ID

ami-02e94b011299ef128

Verified provider



- **The whole key-pair raita (imp to undertsand)**
    1. To be able to use SSH for accessing our instance, we need to choose a key pair.

SSH stands for "Secure Shell." It is a network protocol and a method for securely connecting to remote computers over an unsecured network, like the internet. SSH provides a secure way to access and manage a remote computer or server, allowing you to execute commands, transfer files, and perform various administrative tasks.

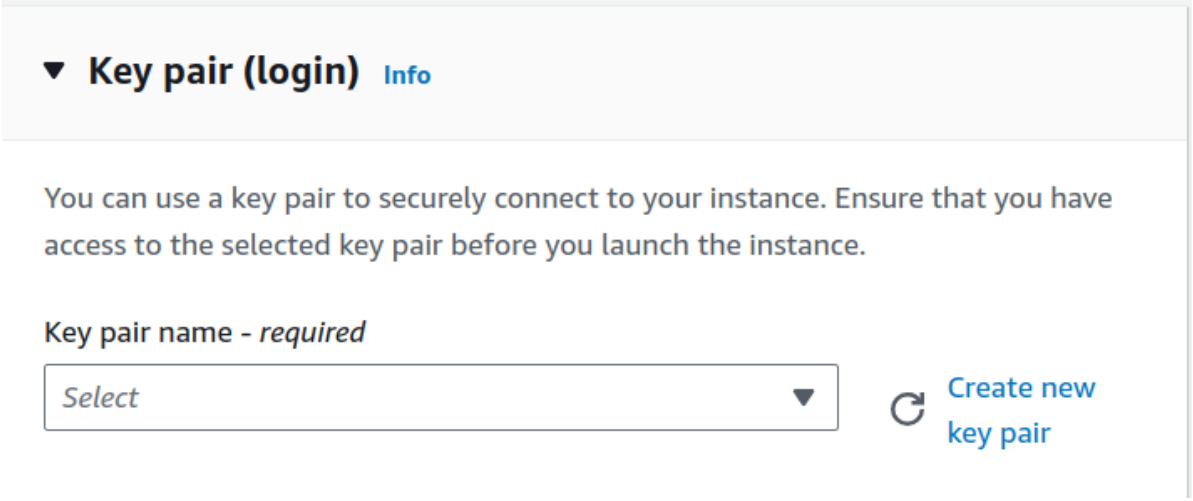
In terms of AWS (Amazon Web Services), SSH is a crucial tool for managing the virtual machines (EC2 instances) that you run in the cloud. Here's a simple explanation of how it works in AWS:

1. EC2 Instances: In AWS, you can create virtual servers called EC2 instances to run your applications and services.
2. Secure Access: To access these EC2 instances and perform tasks like configuration, software installation, and troubleshooting, you use SSH to establish a secure connection between your local computer and the remote EC2 instance.
3. Key Pairs: AWS uses a key pair system to ensure security. When you create an EC2 instance, you specify a key pair (a public key and a private key). The public key is stored on the EC2 instance, and the private key is kept on your local computer.
4. Authentication: When you want to connect to your EC2 instance using SSH, you provide your private key as authentication. The EC2 instance verifies the private key, and if it matches the public key stored on the instance, the connection is established.
5. Remote Control: Once the SSH connection is established, you can remotely control your EC2 instance by running commands in a terminal on your local computer. This allows you to manage and configure your server as needed.

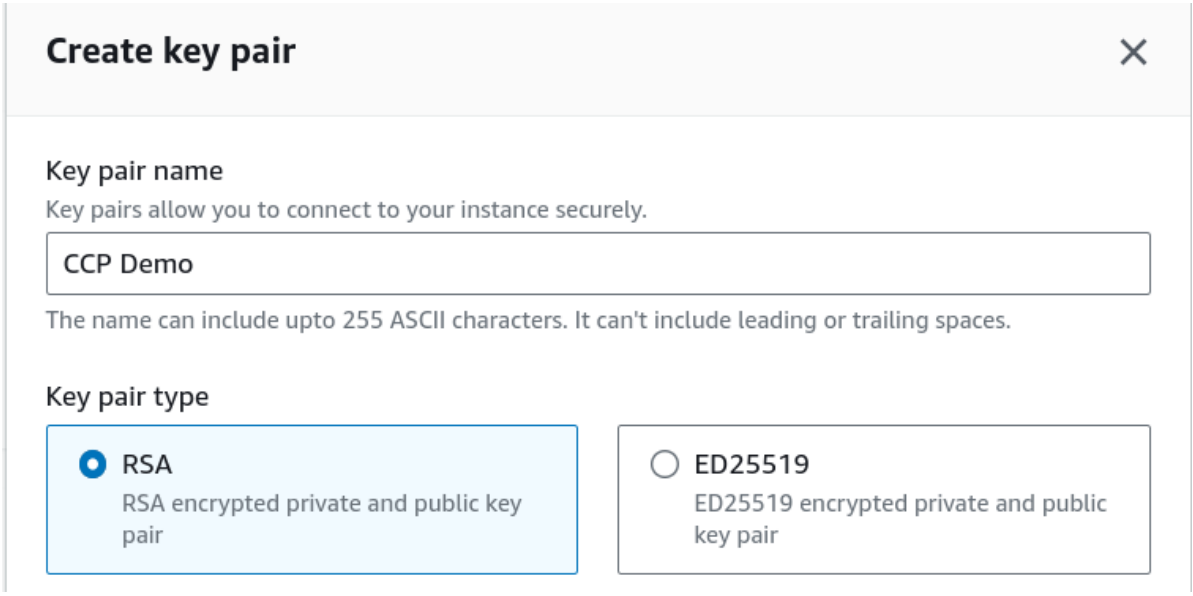
Overall, SSH in AWS ensures that your interactions with your cloud servers are secure and private, protecting your data and preventing unauthorized access. It's an essential tool for managing your cloud infrastructure.

Rege

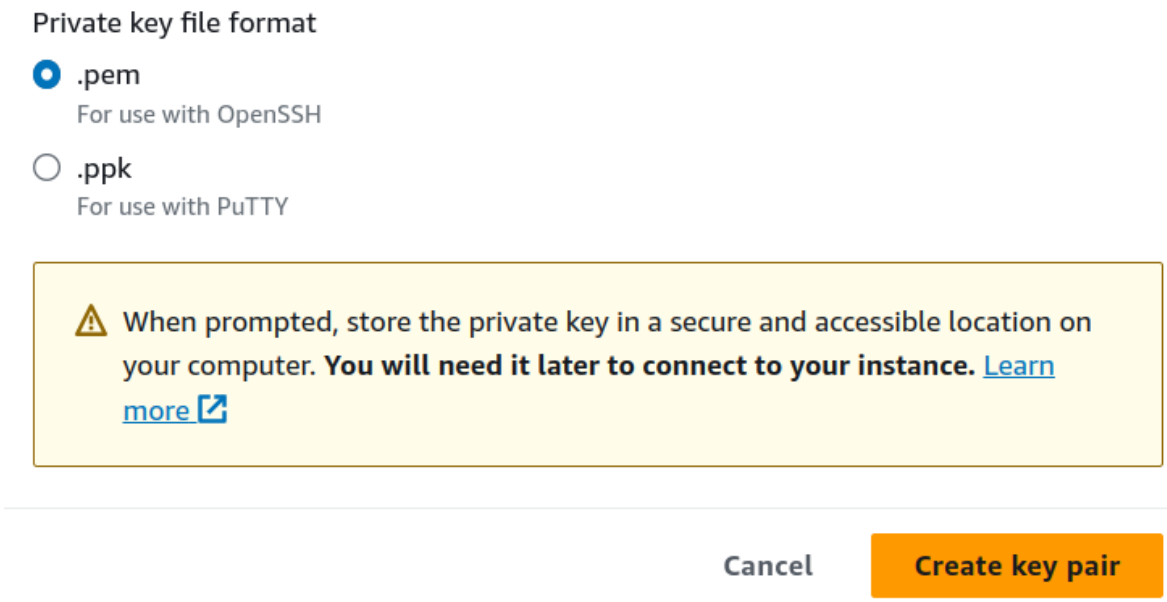
2. If already exists, choose. Else, create new key pair.



3. We need to create one.

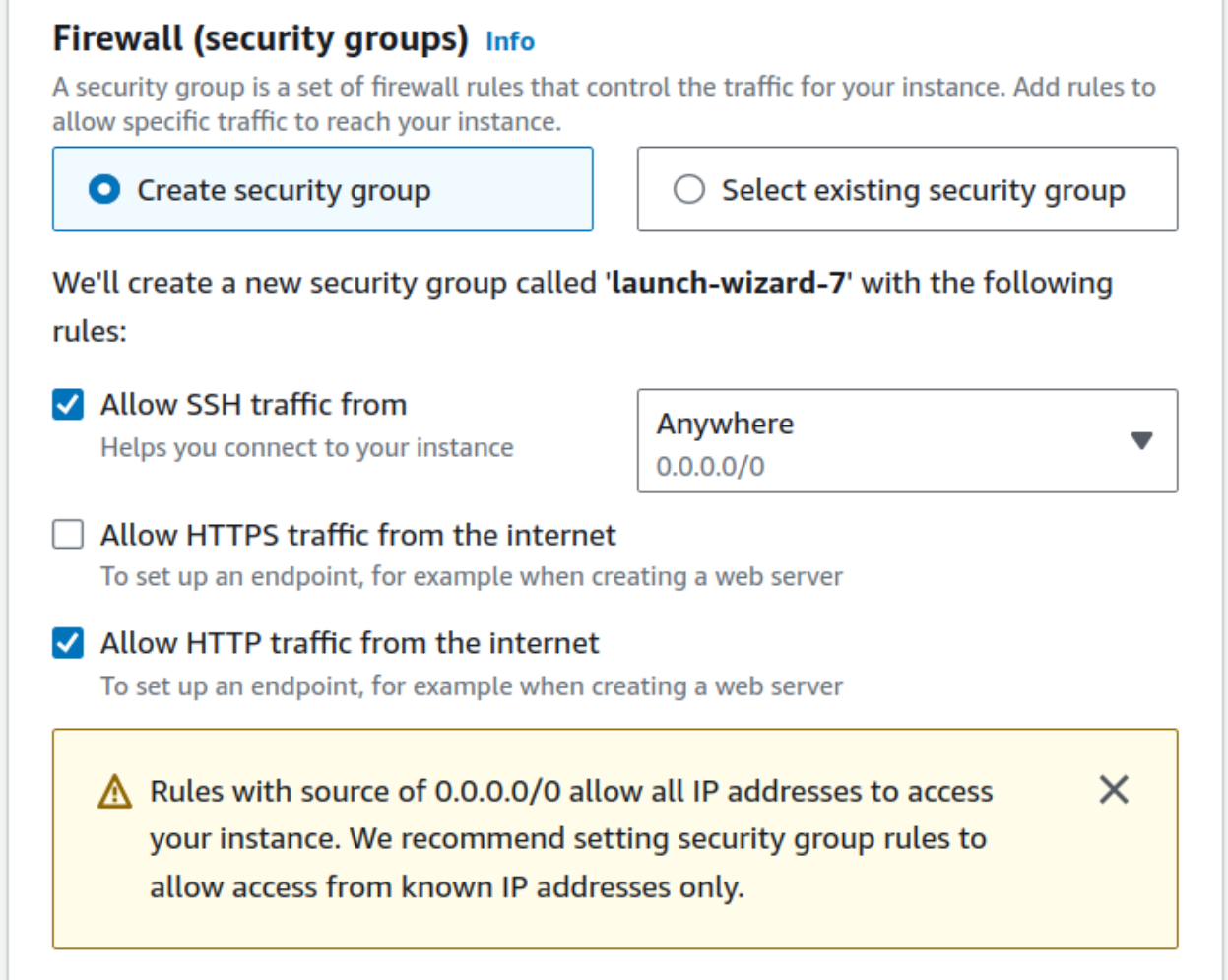


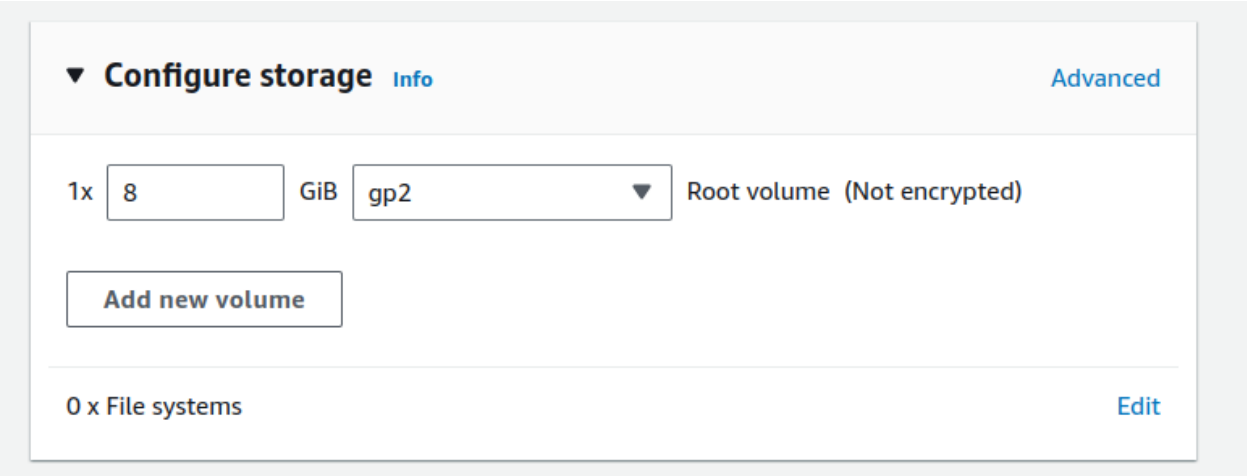
4. .pem or .ppk
    - if you have mac or linux or windows 10, you can use .pem format
    - else, go with .ppk and proceed with the puTTy software for SSH authentication.



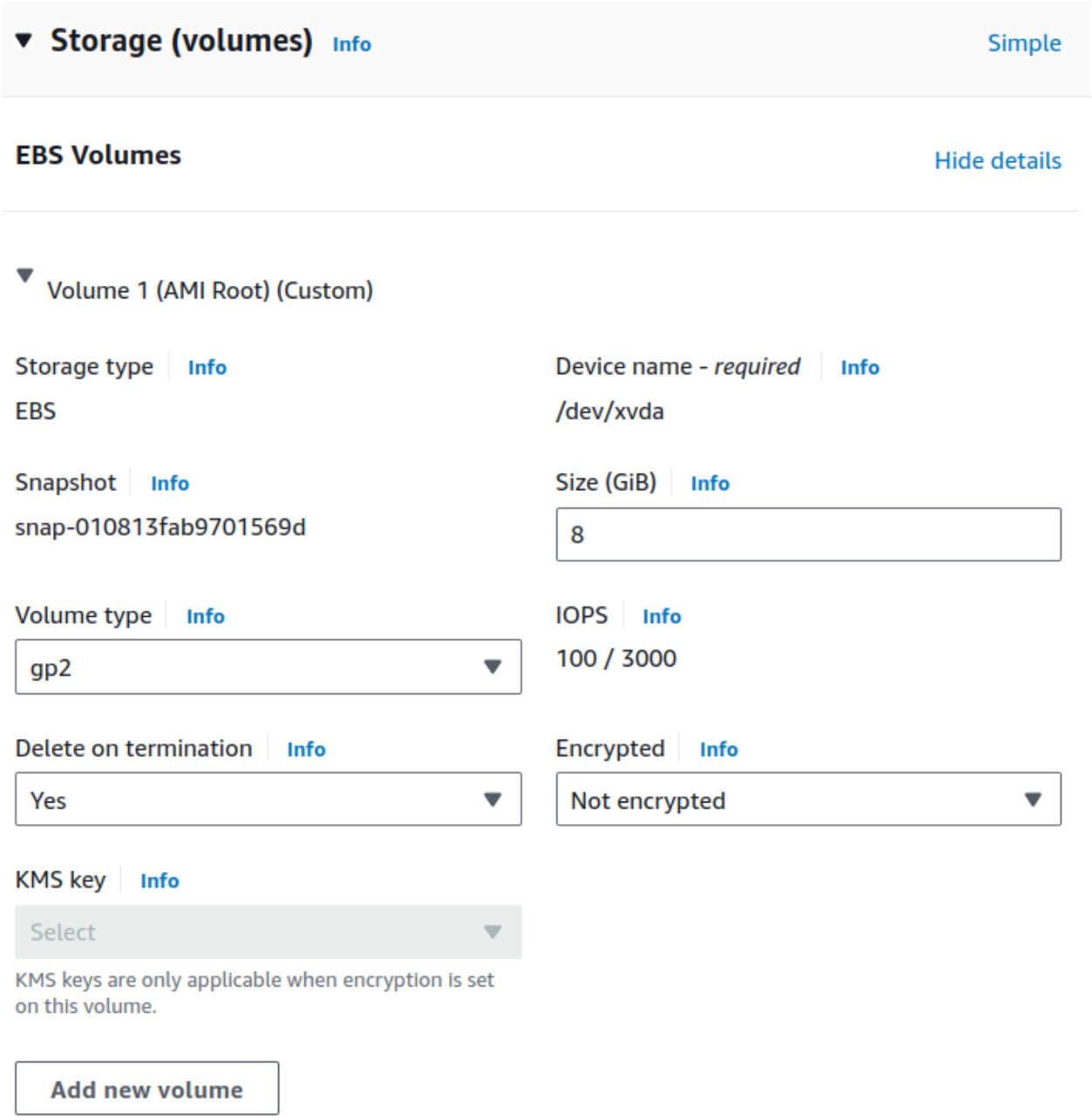
5. As you create, it will automatically download.

- Leave the n/w settings as is for now.





- click on advanced



- the delete on termination is set to **yes** which implies that once you terminate your EC2 instance, your EBS volume will be deleted too. this basically helps ensure you don't incur any unexpected charges.
- Explain advanced details and let every setting be as it is till you get to the user data section. This is the **user data script** we discussed earlier which is for bootstrapping your instance. So, in here, you write you code or upload your code file.

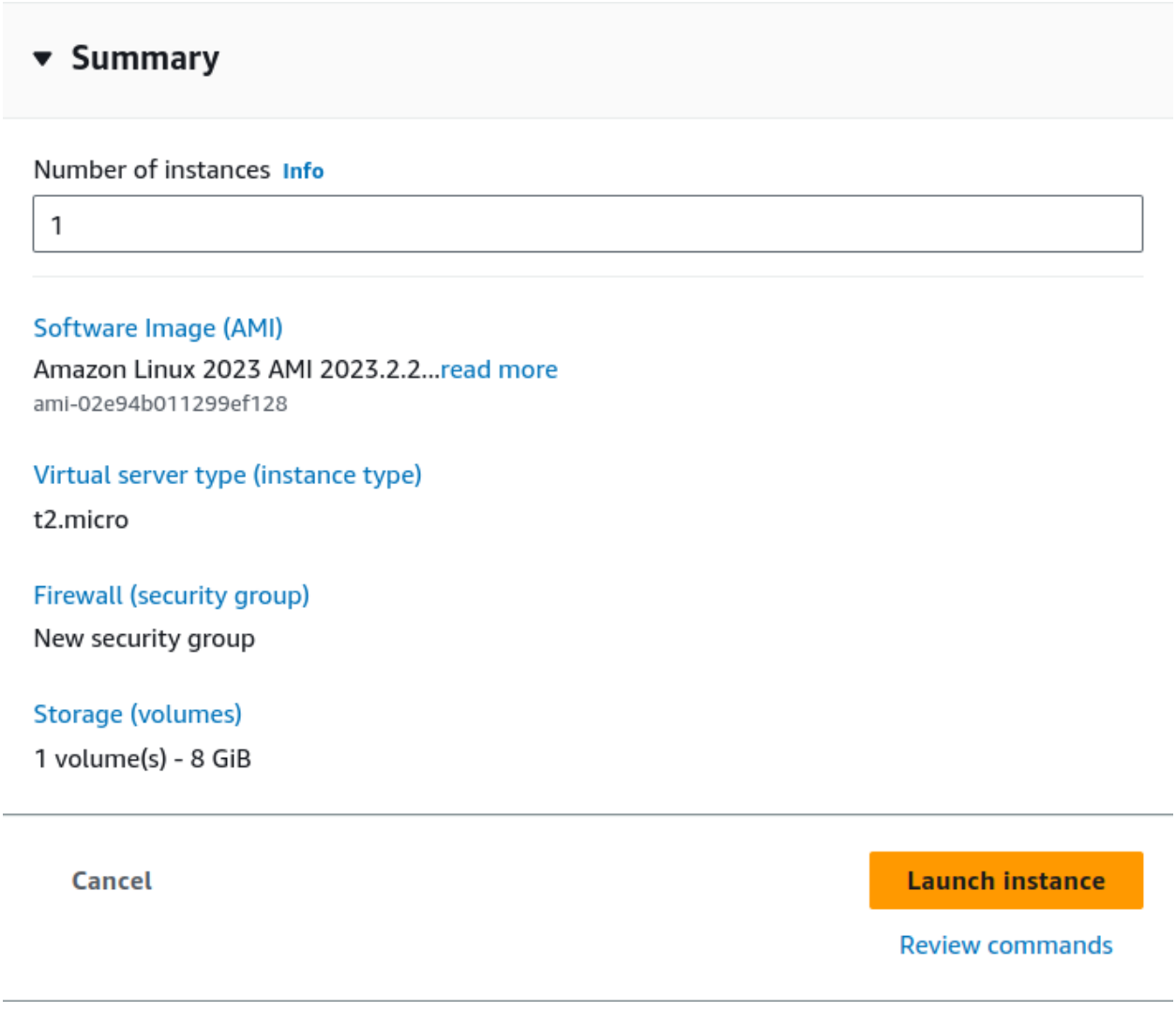
User data - *optional* Info

Upload a file with your user data or enter it in the field.

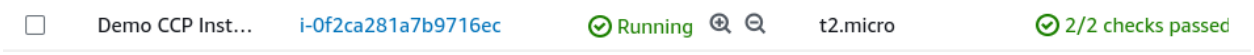
Choose file

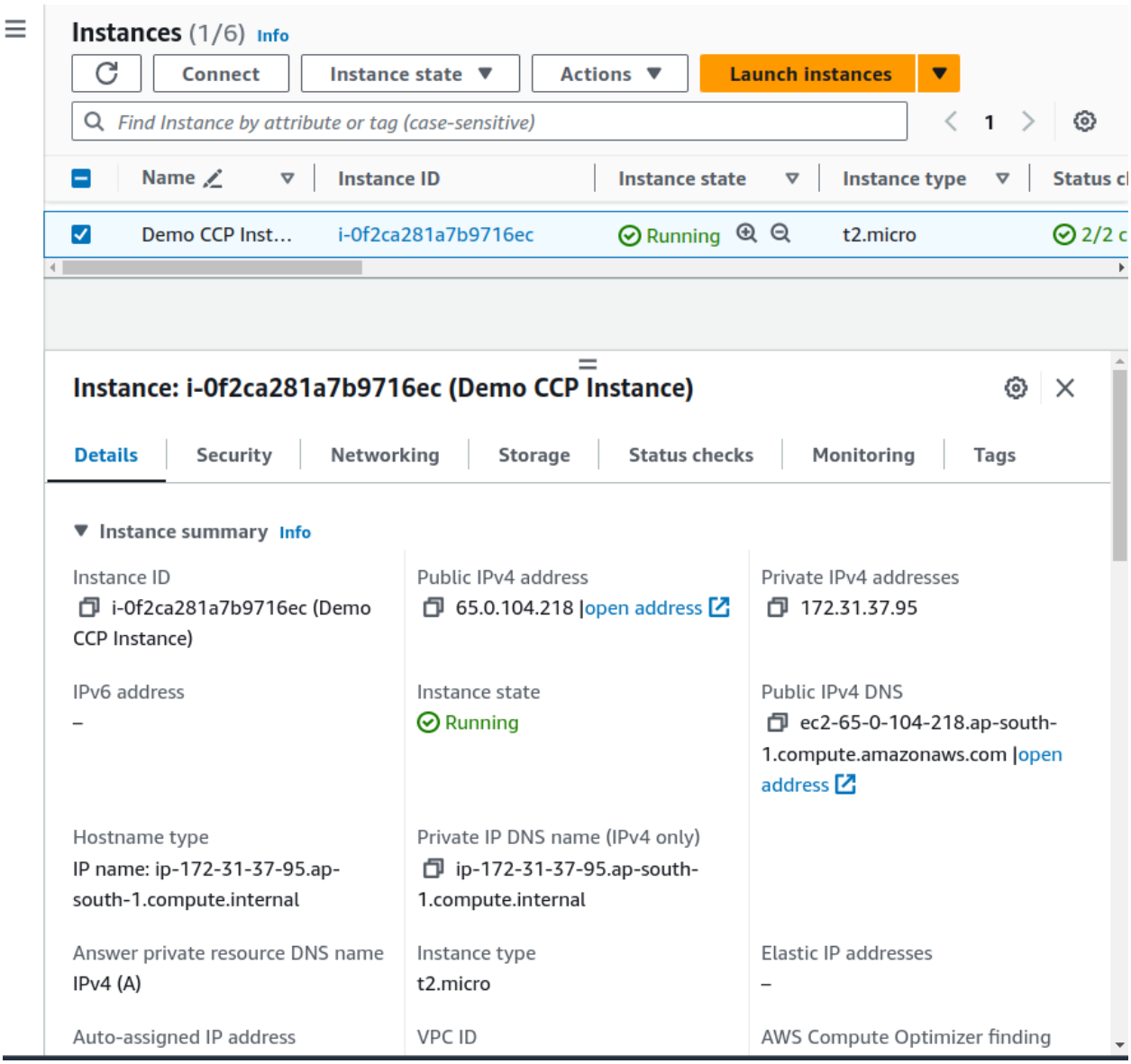
```
yum update -y
yum install -y httpd
systemctl start httpd
systemctl enable httpd
echo "<h1>Hiii I am ${hostname -f} today we are leaning about AWS EC2</h1>" >
/var/www/html/index.html
```

☐ User data has already been base64 encoded

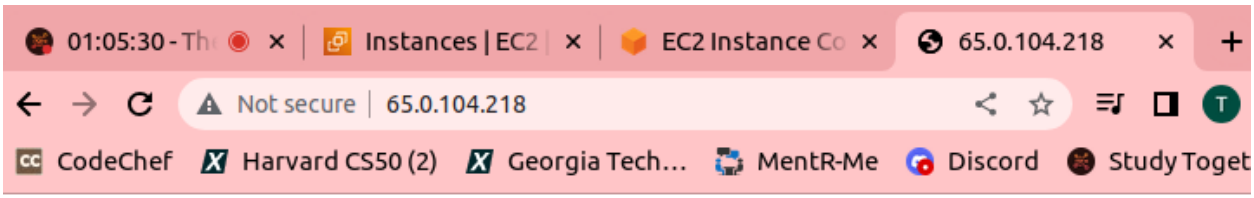


- After launching, wait for the pending state to change to running and for the 2 status checks to pass
- On selecting the instance, you can check out its details below





- Now, to check the web server running on our instance, copy the public IPv4 address of the instance and paste it in your browser. It won't work yet.
- It isn't working because in the URL, you need to make sure that you're using the HTTP protocol.



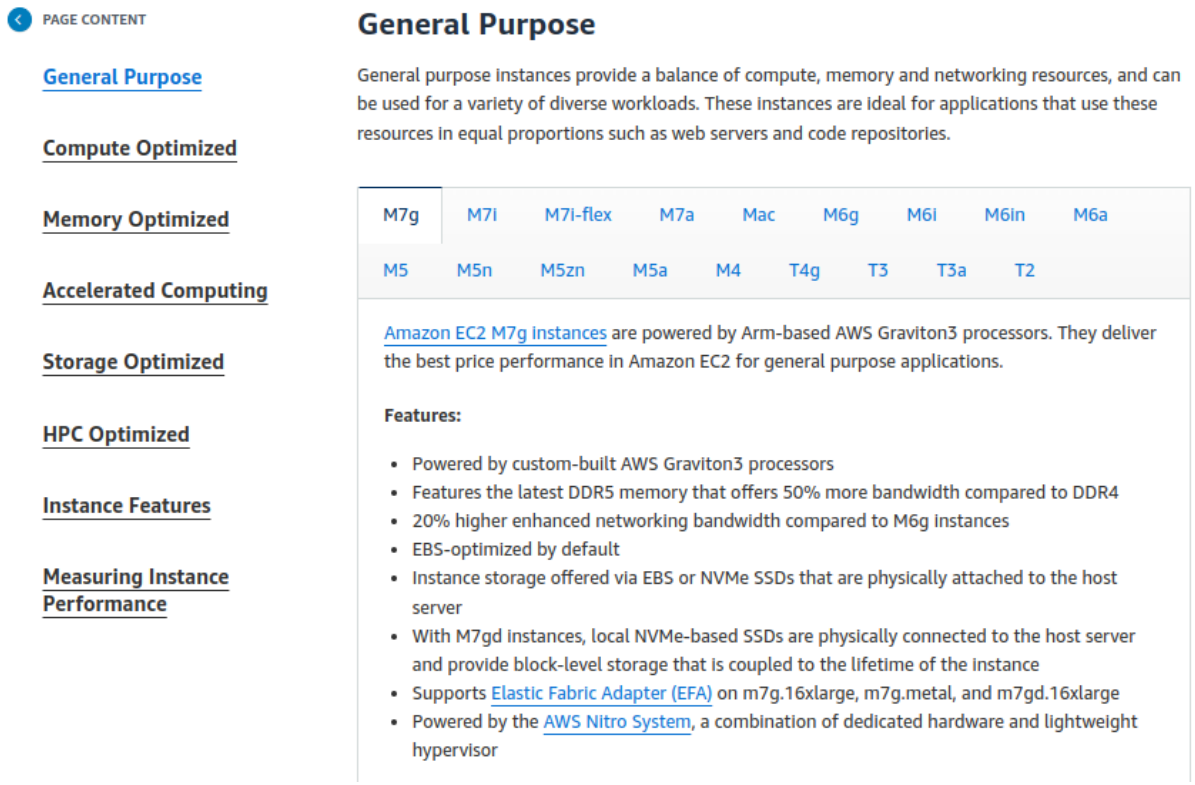
[200~

Hello worldHello world

- **Note:** every time you stop an instance and start it again, the public IP changes.

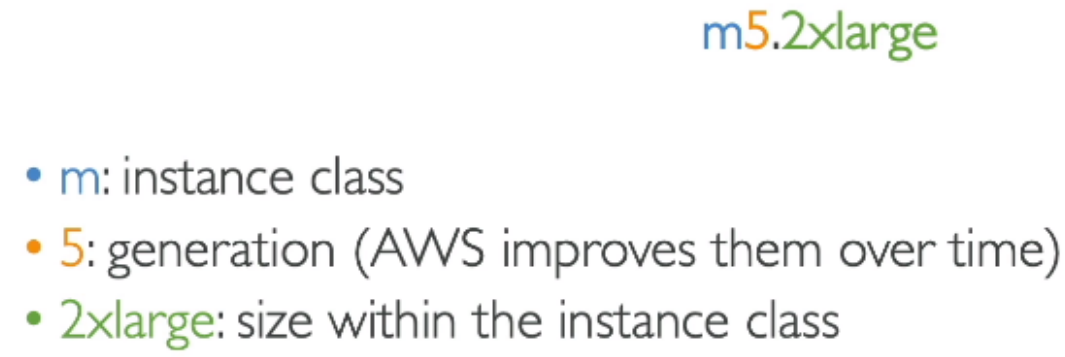
EC2 Instance Types

- Different types of EC2 instances are optimized for different use cases.
- https://aws.amazon.com/ec2/instance-types/
- In here, you will discover different types.
- Each type has its own family. Members of the family are different configurations to choose from, each configuration has its own purpose to serve.



- How to read into a configuration of an instance? You can get an overview like this:

  Here, m instance class is for general purpose registers. Atp, the generation has reached till 7.



- **Note: t2.micro** is a general purpose configuration of EC2 instance included with AWS free-tier.

- **Let’s dive into different types:**

1. **General Purpose**

   General purpose instances provide a balance of compute, memory and networking resources, and can be used for a variety of diverse workloads.

   Typically used to web servers or code repositories.

2. **Compute Optimized**

   - Great for compute-intensive tasks that require high performance processors:
     - Batch processing workloads
     - Media transcoding
     - High performance web servers
     - High performance computing (HPC)
     - Scientific modeling & machine learning
     - Dedicated gaming servers

3. **Memory Optimized**

   Memory optimized instances are designed to deliver fast performance for workloads that process large data sets in memory.

   - Fast performance for workloads that process large data sets in memory
   - Use cases:
     - High performance, relational/non-relational databases
     - Distributed web scale cache stores
     - In-memory databases optimized for BI (business intelligence)
     - Applications performing real-time processing of big unstructured data

4. **Storage Optimized**

- Great for storage-intensive tasks that require high, sequential read and write access to large data sets on local storage
- Use cases:
  - High frequency online transaction processing (OLTP) systems
  - Relational & NoSQL databases
  - Cache for in-memory databases (for example, Redis)
  - Data warehousing applications
  - Distributed file systems

5. **Accelerated Computing**

   Accelerated computing instances use hardware accelerators, or co-processors, to perform functions, such as floating point number calculations, graphics processing, or data pattern matching, more efficiently than is possible in software running on CPUs.

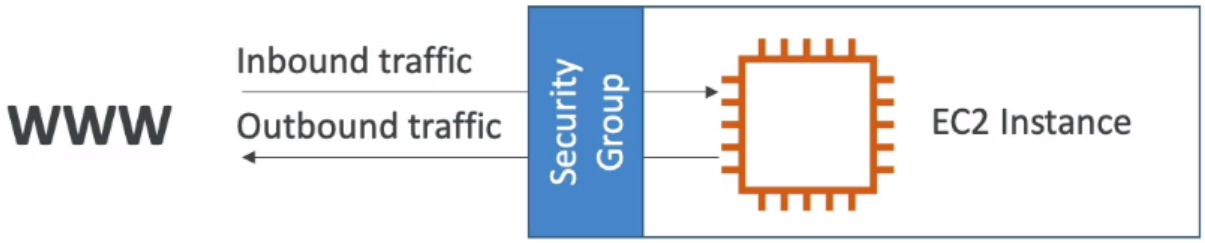
6. **HPC Optimized (High Performance Computing)**

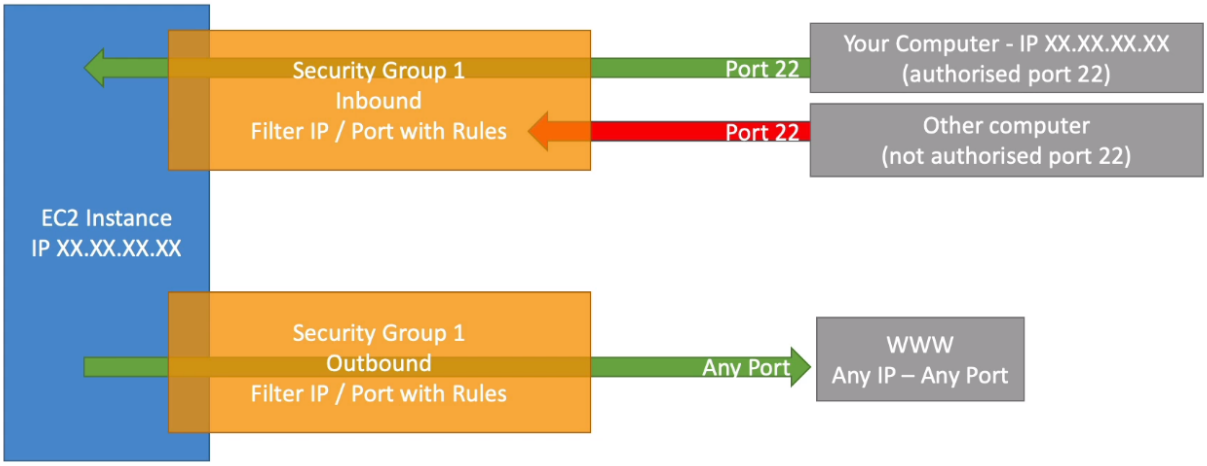
   HPC instances are ideal for applications that benefit from high-performance processors such as large, complex simulations and deep learning workloads.

Security Groups

- Security groups act as firewalls for our EC2 instances.
- They control what traffic is allowed into or out of our EC2 instance.
- Security groups are easy to maintain as they only contain **allow** rules.
- These rules can be applied to certain IP addresses or ports or even another security group.

- They regulate:
  - Access to Ports
  - Authorised IP ranges – IPv4 and IPv6
  - Control of inbound network (from other to the instance)
  - Control of outbound network (from the instance to other)





- Inbound and Outbound rules:

Certainly! Think of inbound and outbound security group rules for an EC2 instance as a set of rules that control who can visit your house (EC2 instance) and where you can go outside.

1. **Inbound Rules (People coming to your house):** These rules decide who is allowed to visit your EC2 instance from the outside. You can set rules to allow specific "visitors" (IP addresses) and say which "doors" (ports) they can use. For example, you might allow your friends to come in through the front door (port 80) but not strangers.
2. **Outbound Rules (You going outside):** These rules determine where you are allowed to go from your EC2 instance. You can set rules to specify which "destinations" (IP addresses) you can visit and which "doors" (ports) you can use. For instance, you might be allowed to go to the park (a specific IP address) through the main gate (a specific port), but not anywhere else.

In both cases, these rules help ensure that your EC2 instance only talks to the right people and goes to the right places, keeping it secure. It's like having a doorman for your virtual house to make sure only approved guests get in and that you don't wander into risky areas.

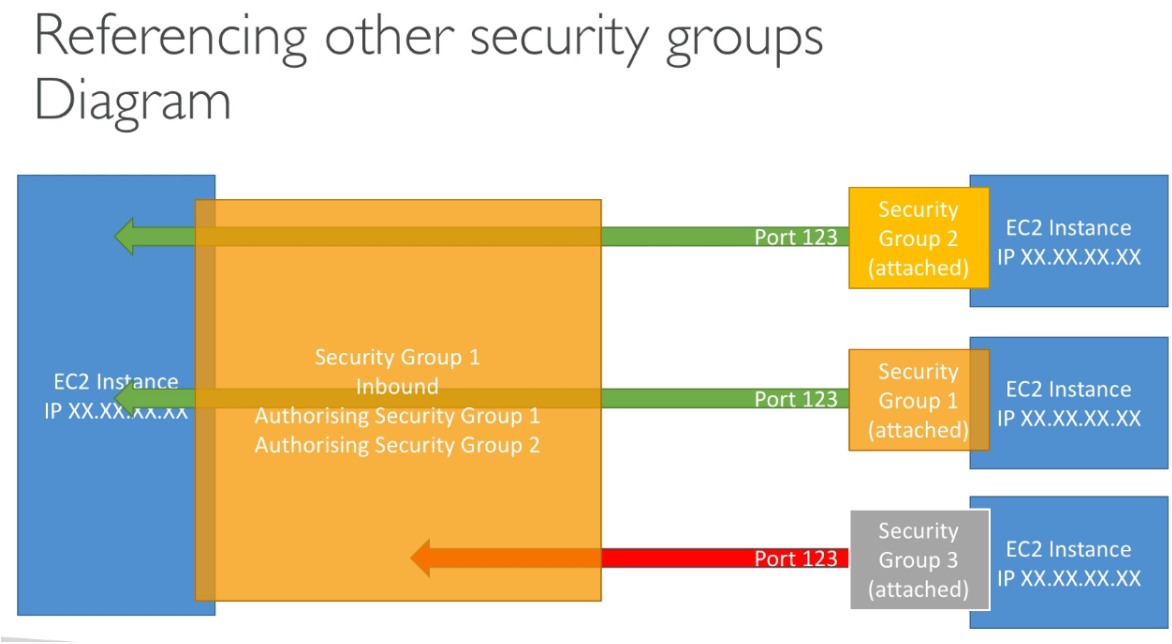
- Security groups have a many-to-many relationship — a security group can be attached to multiple instances and one instance can have multiple security groups.
- By default, all inbound traffic is blocked and all outbound traffic is authorized. This will stay as is unless changed by you.

- Locked down to a region / VPC combination
- Does live "outside" the EC2 – if traffic is blocked the EC2 instance won't see it
- It's good to maintain one separate security group for SSH access
- If your application is not accessible (time out), then it's a security group issue
- If your application gives a "connection refused" error, then it's an application error or it's not launched

- **How to reference security groups from other security groups?**

Basically how this works is:

Imagine you want to set inbound rules for a specific EC2 instance (say A) and you set it to **authorize security group 1 and security group 2** so then what happens is if another EC2 instance (say B) located anywhere, has security group 1 or 2 attached to it then instance B will directly be able to connect to instance A and then you don't have to worry about IP addresses.



- Common security ports to know for the exam

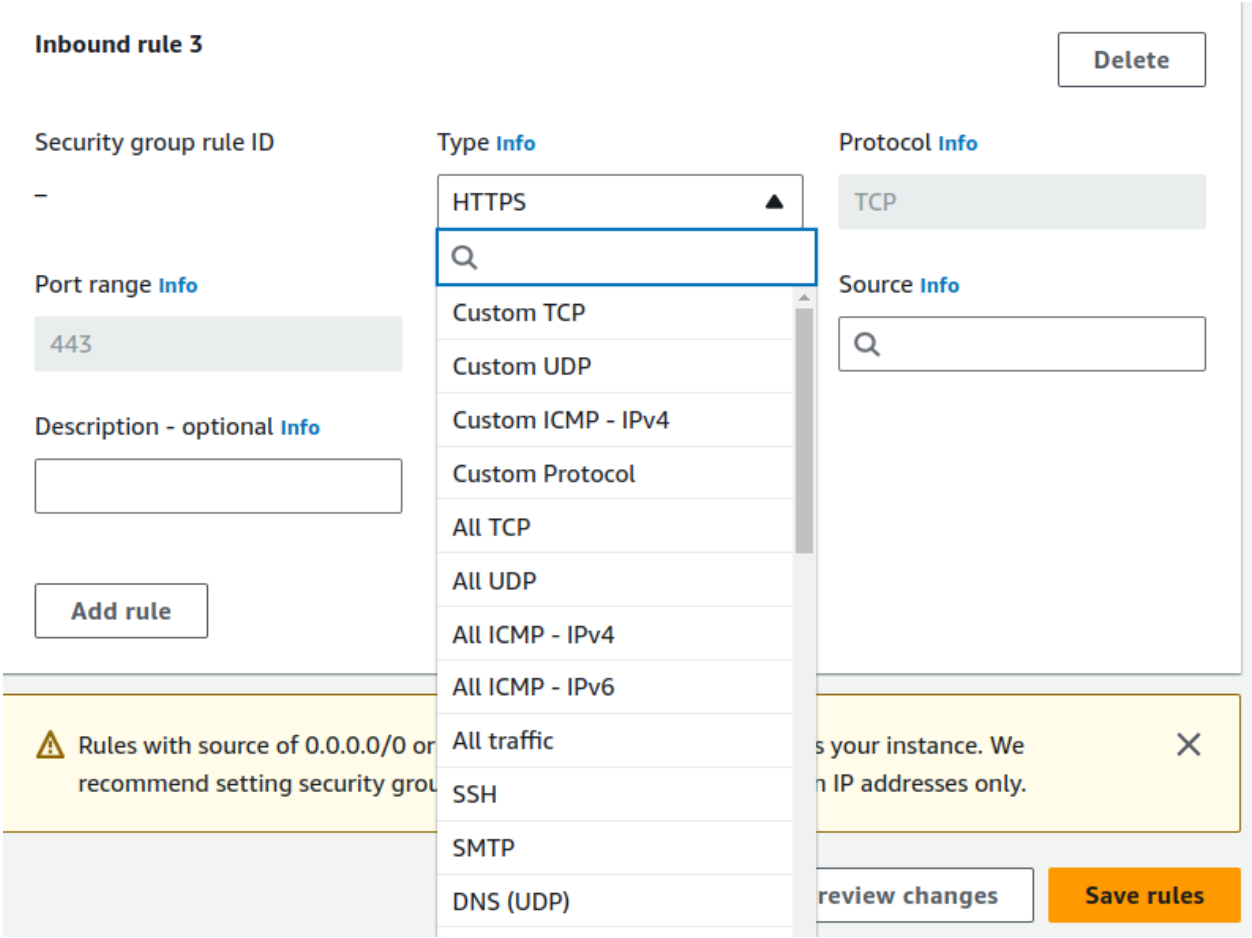
Security Groups Hands-on

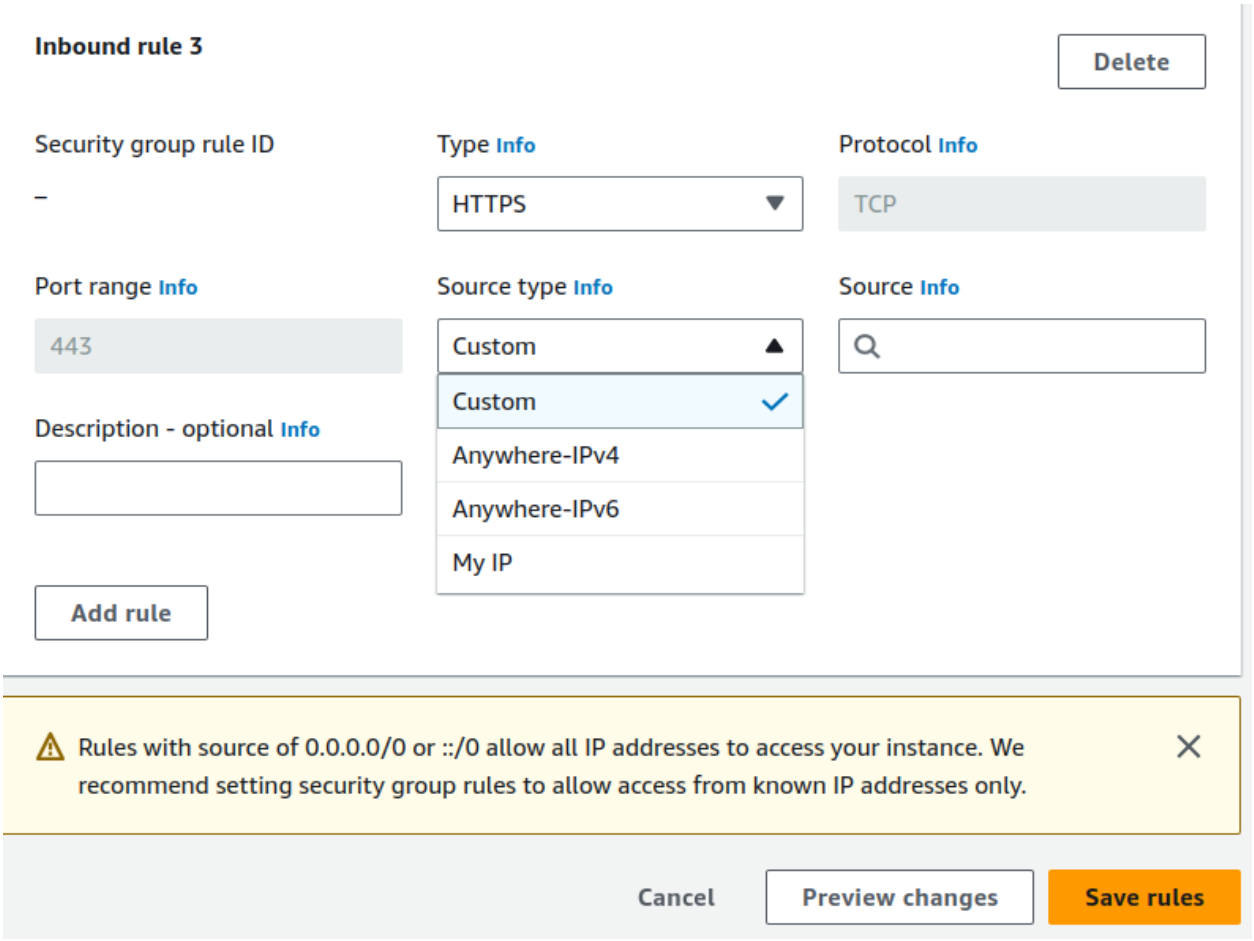
Networking and security >> Security Groups

- A tip: whenever you're trying to access your application with EC2 instance (either through SSH or HTTP query or anything), if it's giving a time out (infinite loading and then **err_time_out**) it means this has something to do with the security groups.

  Possibly with port 80 HTTP rule. Look into it to fix this issue.

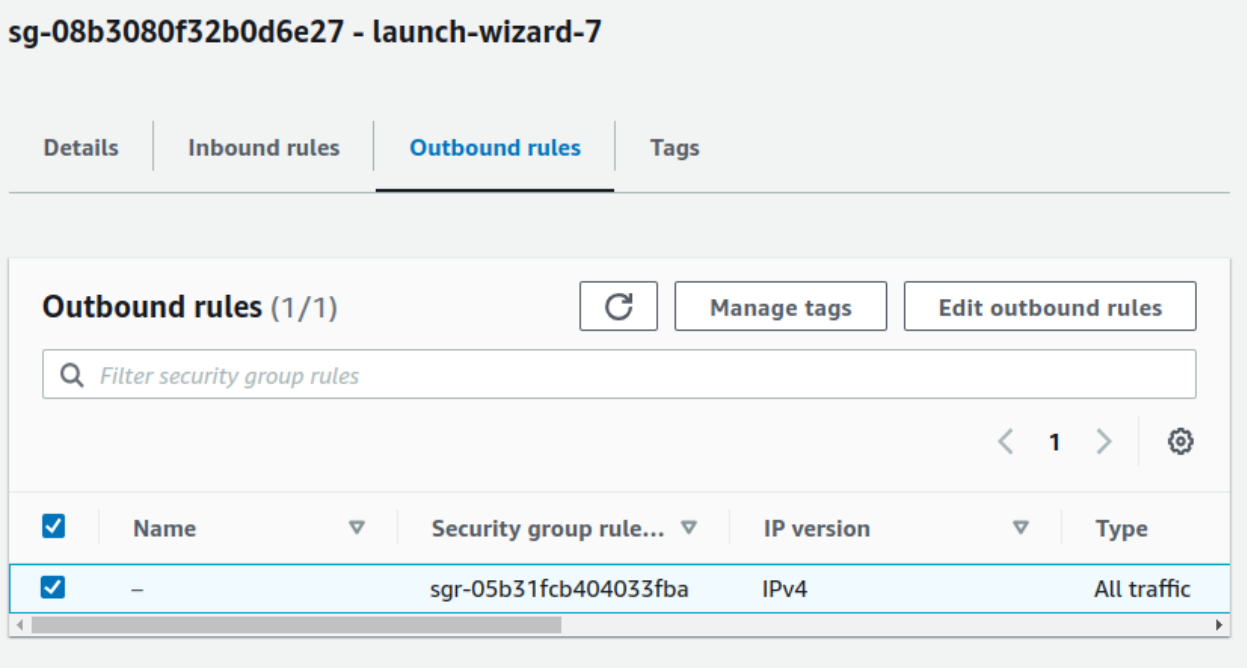
- Easily add or delete your inbound and outbound rules.





Let's say you choose to go with the My IP option, keep in mind that you will get a time out if your IP changes.

- Outbound traffic rule, by default, allows all traffic on IPv4 to anywhere. This allows the EC2 instance to get full internet connectivity anywhere.



SSH-ing into your EC2 instance

- This basically means to connect to inside of your servers to perform some maintenance or action.
- SSH is one of the most important functions in the cloud as it lets you control your remote instance or server all using your CLI.
- Once are able to access our ec2 instance or SSH into it, our command line is going to be just as if we were inside that instance machine.

There are different ways of doing so based on your OS:

- Was able to ssh into my ec2 instance by following the commands in the tutorial, didn't get it though.

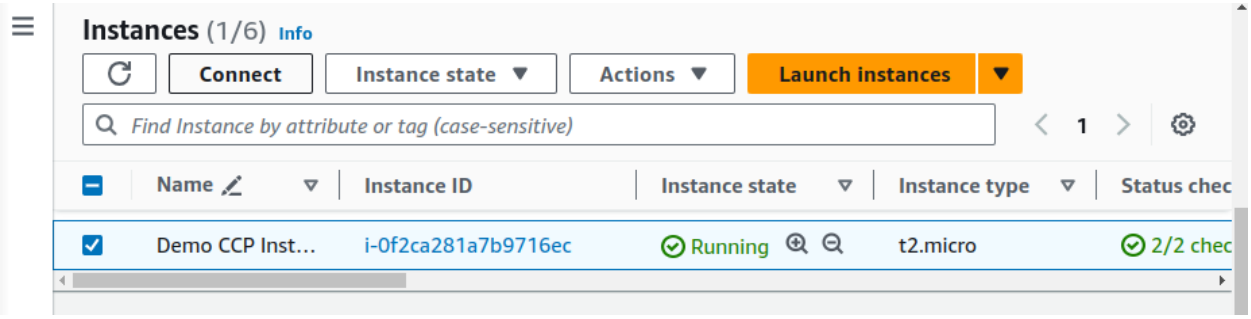
```
meowmeow@tanishas-penguin:~/Desktop/codewithtanisha/AWS Certs/AWS CCP CLF-C01$ ssh -i CCPDemo
.pem ec2-user@3.111.168.216
   ,     #_
   ~\_  ####_        Amazon Linux 2023
  ~~  \_#####\
  ~~     \###|
  ~~       \#/ ___   https://aws.amazon.com/linux/amazon-linux-2023
   ~~       V~' '->
    ~~~         /
      ~~._.   _/
         _/ _/
       _/m/'
Last login: Mon Nov  6 17:20:09 2023 from 13.233.177.5
[ec2-user@ip-172-31-37-95 ~]$
```

- Command to close the connection: ctrl + G
- To get back into it: ssh -i <security_key_pair_file_name (ppk / pem)> ec2-user@<instances_public_IPv4>

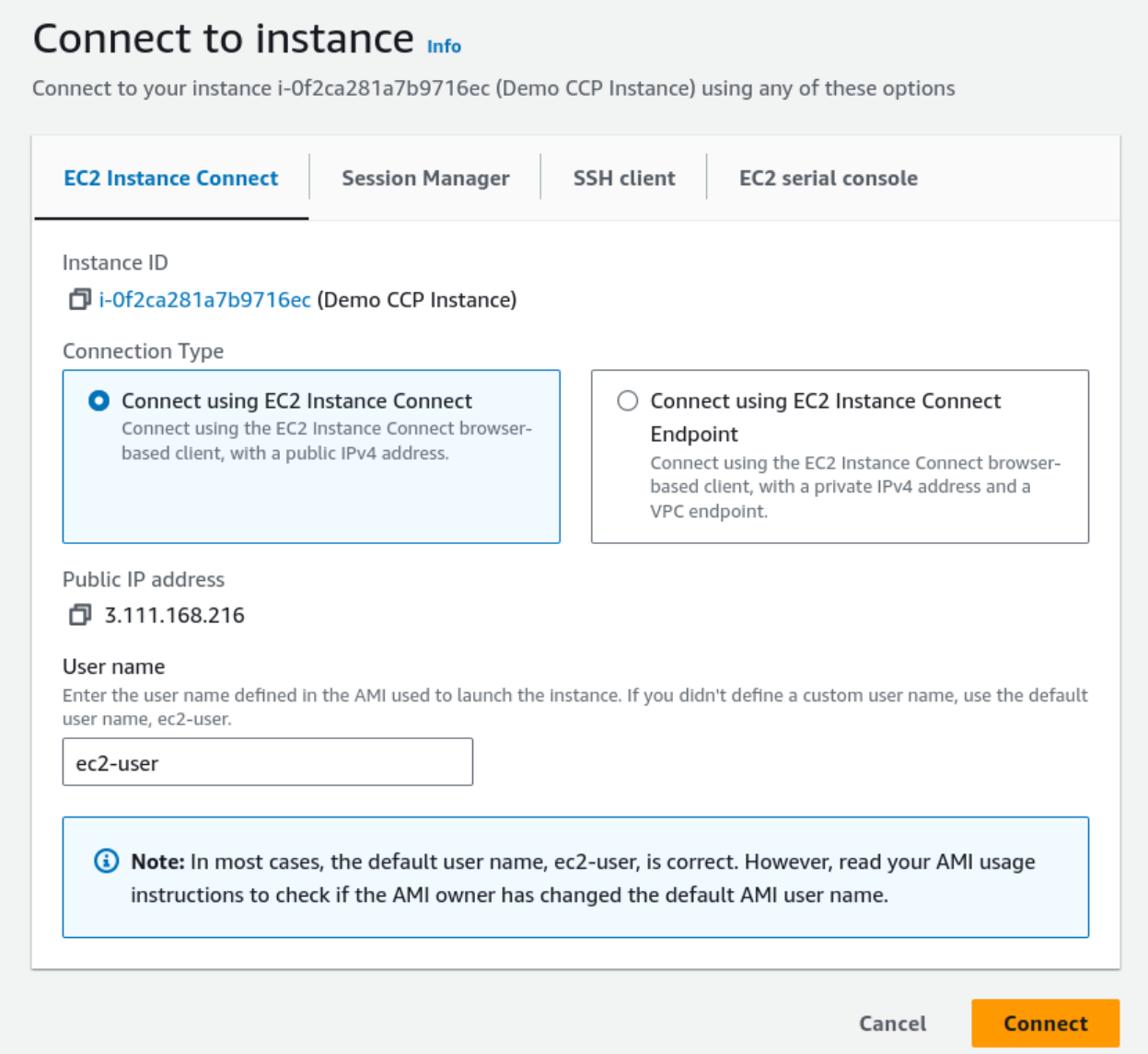
  ex: ssh -i CCPDemo.pem ec2-user@3.111.168.216
- These commands will work only if you're in the directory where your ppk or pem file is stored.

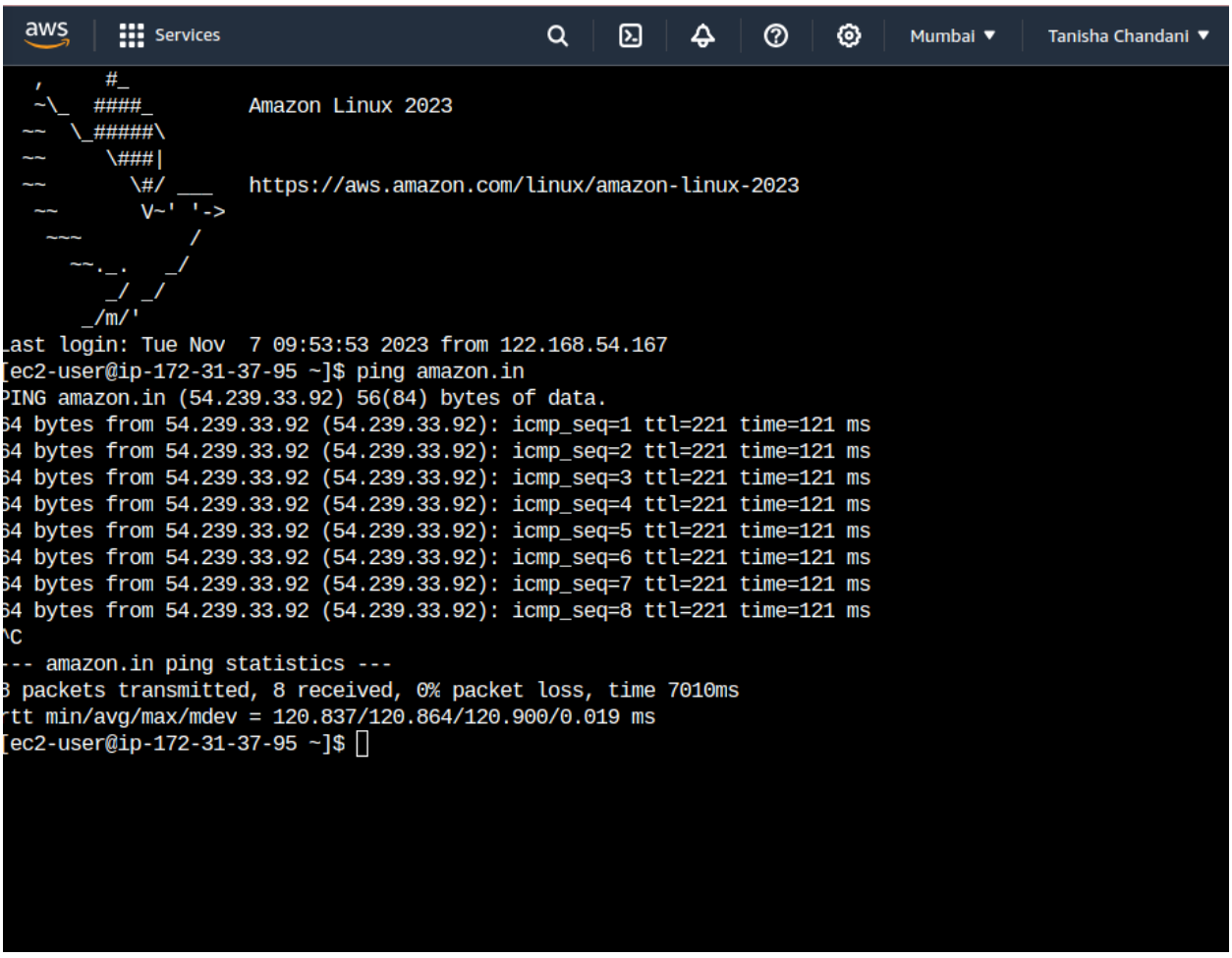
EC2 Instance Connect (easier alt to ssh)

- Allows us to do a browser based SSH session into our instance.

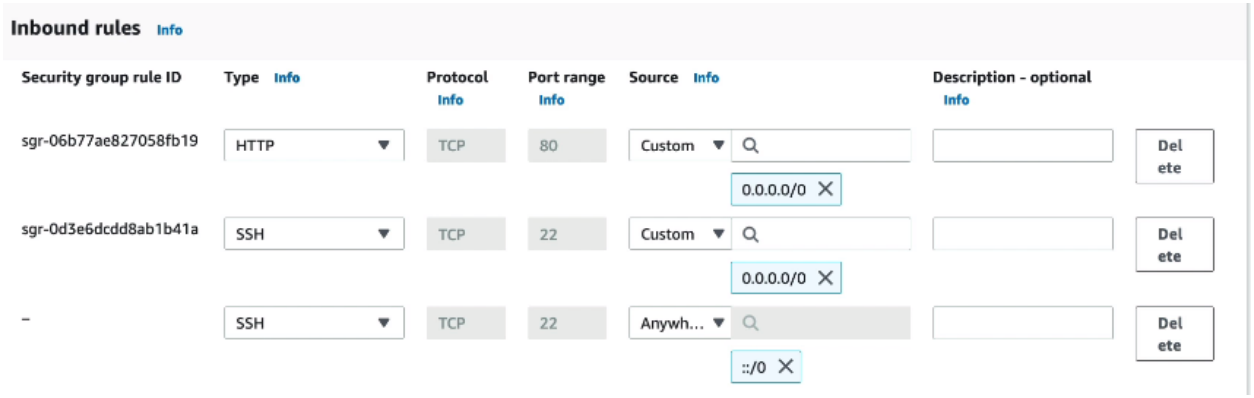


- Once we connect to it, it's going to upload a temporary SSH key for us and establish a connection. This way we don’t need to manage SSH keys.


Connect to instance Info
Connect to your instance i-0f2ca281a7b9716ec (Demo CCP Instance) using any of these options
EC2 Instance Connect
Session Manager
SSH client
EC2 serial console
Instance ID
i-0f2ca281a7b9716ec (Demo CCP Instance)
Connection Type
Connect using EC2 Instance Connect
Connect using the EC2 Instance Connect browser-based client, with a public IPv4 address.
Connect using EC2 Instance Connect Endpoint
Connect using the EC2 Instance Connect browser-based client, with a private IPv4 address and a VPC endpoint.
Public IP address
3.111.168.216
User name
Enter the user name defined in the AMI used to launch the instance. If you didn't define a custom user name, use the default user name, ec2-user.
ec2-user
Note: In most cases, the default user name, ec2-user, is correct. However, read your AMI usage instructions to check if the AMI owner has changed the default AMI user name.
Cancel
Connect



- Note: this will only work if you have allowed port 22 (SSH) in your inbound rules. Sometimes you need to add both IPv4 and IPv6 from anywhere for it to work.



EC2 Instance Purchasing Options

- **On-Demand Instances** – short workload, predictable pricing, pay by second
- **Reserved** (1 & 3 years)
  - **Reserved Instances** – long workloads
  - **Convertible Reserved Instances** – long workloads with flexible instances
- **Savings Plans** (1 & 3 years) –commitment to an amount of usage, long workload
- **Spot Instances** – short workloads, cheap, can lose instances (less reliable)
- **Dedicated Hosts** – book an entire physical server, control instance placement
- **Dedicated Instances** – no other customers will share your hardware
- **Capacity Reservations** – reserve capacity in a specific AZ for any duration

EC2 On Demand

- Pay for what you use:
  - Linux or Windows - billing per second, after the first minute
  - All other operating systems - billing per hour
- Has the highest cost but no upfront payment
- No long-term commitment

- Recommended for **short-term** and **un-interrupted workloads**, where you can't predict how the application will behave

EC2 Reserved Instances

- Up to 72% discount compared to On-demand
- You reserve a specific instance attributes **(Instance Type, Region, Tenancy, OS)**
- **Reservation Period** – **1 year** (+discount) or **3 years** (+++discount)
- **Payment Options** – **No Upfront** (+), **Partial Upfront** (++), **All Upfront** (+++)
- **Reserved Instance's Scope** – **Regional** or **Zonal** (reserve capacity in an AZ)
- Recommended for steady-state usage applications (think database)
- You can buy and sell in the Reserved Instance Marketplace

- **Convertible Reserved Instance**
  - Can change the EC2 instance type, instance family, OS, scope and tenancy
  - Up to 66% discount

Note: the % discounts are different from the video as AWS change them over time – the exact numbers are not needed for the exam. This is just for illustrative purposes ☺

EC2 Savings Plans

- Get a discount based on long-term usage (up to 72% - same as RIs)
- Commit to a certain type of usage ($10/hour for 1 or 3 years)
- Usage beyond EC2 Savings Plans is billed at the On-Demand price

- Locked to a specific instance family & AWS region (e.g., M5 in us-east-1)
- Flexible across:
  - Instance Size (e.g., m5.xlarge, m5.2xlarge)
  - OS (e.g., Linux, Windows)
  - Tenancy (Host, Dedicated, Default)

EC2 Spot Instances

- Can get a **discount of up to 90%** compared to On-demand
- Instances that you can "lose" at any point of time if your max price is less than the current spot price
- The **MOST cost-efficient** instances in AWS

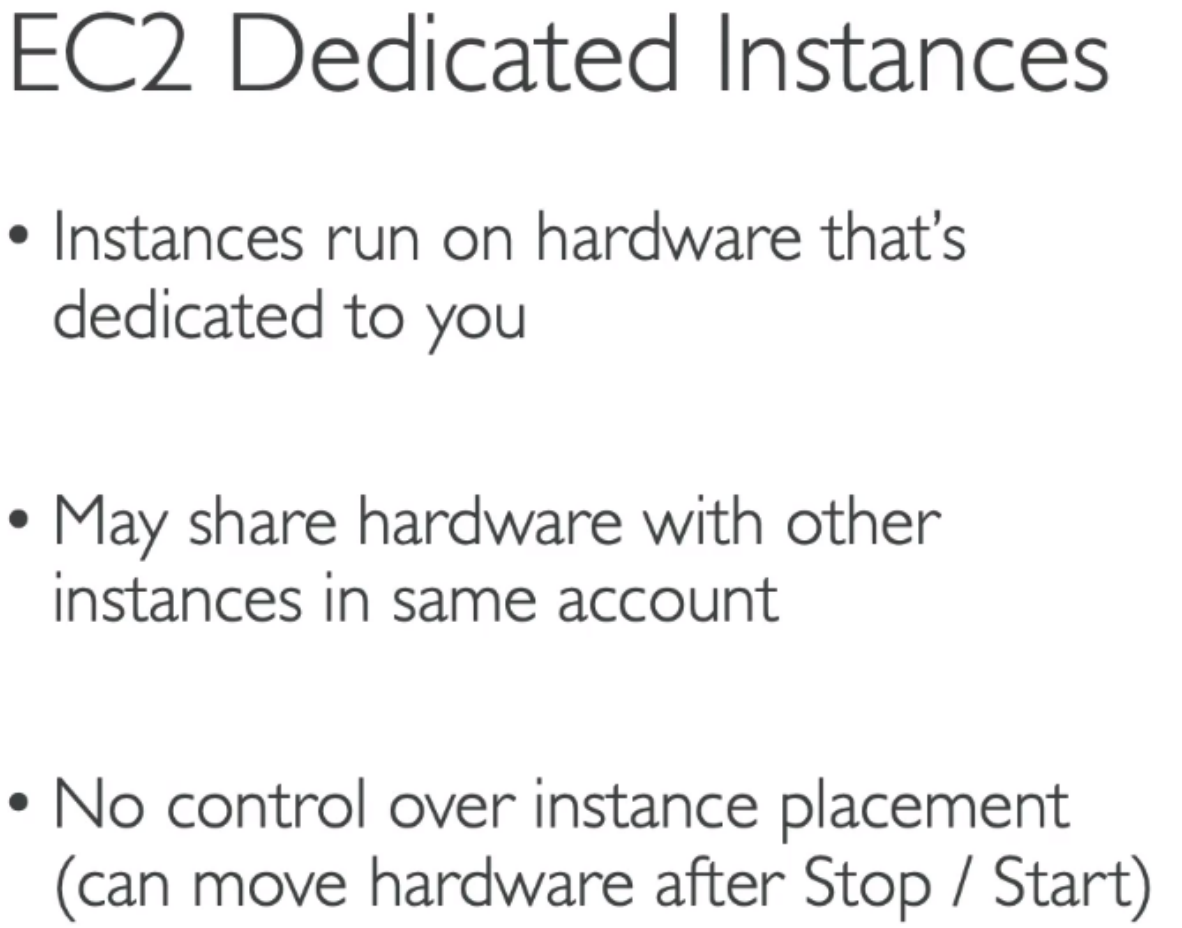
- **Useful for workloads that are resilient to failure**
  - Batch jobs
  - Data analysis
  - Image processing
  - Any **distributed** workloads
  - Workloads with a flexible start and end time

- **Not suitable for critical jobs or databases**

EC2 Dedicated Hosts

- A physical server with EC2 instance capacity fully dedicated to your use
- Allows you address **compliance requirements** and **use your existing server-bound software licenses** (per-socket, per-core, pe—VM software licenses)
- Purchasing Options:
  - **On-demand** – pay per second for active Dedicated Host
  - **Reserved** - 1 or 3 years (No Upfront, Partial Upfront, All Upfront)
- The most expensive option

- Useful for software that have complicated licensing model (BYOL – Bring Your Own License)
- Or for companies that have strong regulatory or compliance needs



- **The key difference between dedicated instances and dedicated hosts is that —**

  With EC2 dedicated hosts, you have complete physical isolation on a physical server (host). This means you have exclusive access to the entire server, and no other AWS customers' instances can run on the same host.

  When you use dedicated instances, it means that the physical hardware your virtual machines (EC2 instances) run on is reserved exclusively for your AWS account. While the physical hardware may be shared with other AWS customers' dedicated instances, there is a virtual barrier that separates your instances from theirs. Your instances don't mix or interact with instances from other AWS accounts on the same hardware.

** dedicated instance is like owning a floor in a building while dedicated host is like owning the whole damn building.

EC2 Capacity Reservations

- Reserve **On-Demand** instances capacity in a specific AZ for any duration
- You always have access to EC2 capacity when you need it
- **No time commitment** (create/cancel anytime), **no billing discounts**
- Combine with Regional Reserved Instances and Savings Plans to benefit from billing discounts
- You're charged at On-Demand rate whether you run instances or not

- Suitable for short-term, uninterrupted workloads that needs to be in a specific AZ

- **How to choose a pricing option? (imp for exam)**

Which purchasing option is right for me?

- **On demand:** coming and staying in resort whenever we like, we pay the full price
- **Reserved:** like planning ahead and if we plan to stay for a long time, we may get a good discount.
- **Savings Plans:** pay a certain amount per hour for certain period and stay in any room type (e.g., King, Suite, Sea View, …)
- **Spot instances:** the hotel allows people to bid for the empty rooms and the highest bidder keeps the rooms. You can get kicked out at any time
- **Dedicated Hosts:** We book an entire building of the resort
- **Capacity Reservations:** you book a room for a period with full price even you don't stay in it

Price Comparison
Example – m4.large – us-east-1

Price Type	Price (per hour)
On-Demand	$0.10
Spot Instance (Spot Price)	$0.038 - $0.039 (up to 61% off)
Reserved Instance (1 year)	$0.062 (No Upfront) - $0.058 (All Upfront)
Reserved Instance (3 years)	$0.043 (No Upfront) - $0.037 (All Upfront)
EC2 Savings Plan (1 year)	$0.062 (No Upfront) - $0.058 (All Upfront)
Reserved **Convertible** Instance (1 year)	$0.071 (No Upfront) - $0.066 (All Upfront)
Dedicated Host	On-Demand Price
Dedicated Host Reservation	Up to 70% off
Capacity Reservations	On-Demand Price

Shared Responsibility Model for EC2

Shared Responsibility Model for EC2

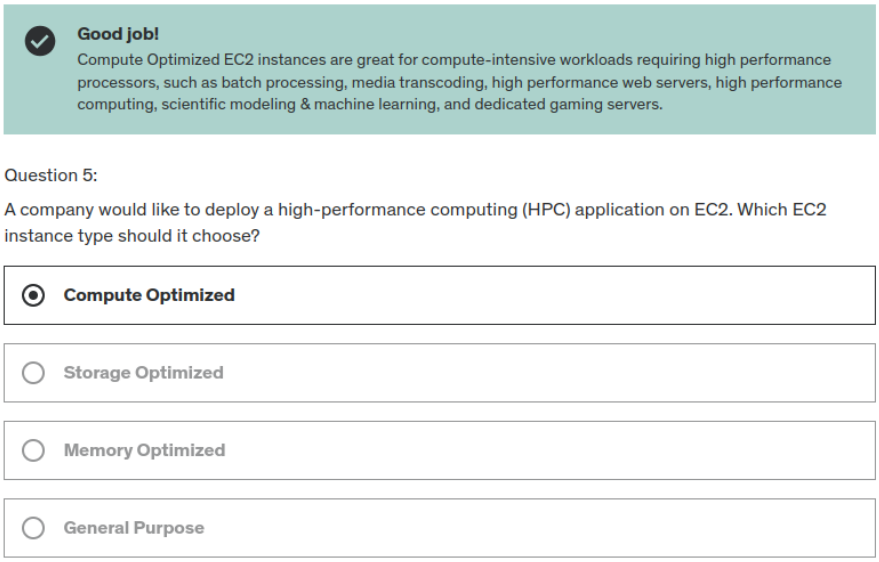
- Infrastructure (global network security)
- Isolation on physical hosts
- Replacing faulty hardware
- Compliance validation

- Security Groups rules
- Operating-system patches and updates
- Software and utilities installed on the EC2 instance
- IAM Roles assigned to EC2 & IAM user access management
- Data security on your instance

Concluding

EC2 Section – Summary

- **EC2 Instance:** AMI (OS) + Instance Size (CPU + RAM) + Storage + security groups + EC2 User Data
- **Security Groups:** Firewall attached to the EC2 instance
- **EC2 User Data:** Script launched at the first start of an instance
- **SSH:** start a terminal into our EC2 Instances (port 22)
- **EC2 Instance Role:** link to IAM roles
- **Purchasing Options:** On-Demand, Spot, Reserved (Standard + Convertible), Dedicated Host, Dedicated Instance



Good job!
Reserved Instances are good for long workloads. You can reserve instances for 1 or 3 years.

Question 7:

Which EC2 Purchasing Option should you use for an application you plan on running on a server continuously for 1 year?

- (●) **Reserved Instances**
- ( ) Spot Instances
- ( ) On-demand Instances
- ( ) Convertible Instances