

Enterprise Computing Assignment #1

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List of Abbreviations

AMI Amazon Machine Image.

AWS Amazon Web Services.

EBS Elastic Block Store.

EC2 Elastic Compute Cloud.

GCE Google Cloud Engine.

GCP Google Cloud Platform.

IaaS Infrastructure as a Service.

IAM Identity and Access Management.

IT Information Technology.

PaaS Platform as a Service.

SaaS Software as a Service.

VPC Virtual Private Cloud.

1 Cloud Computing

The on-demand delivery of Information Technology (IT) resources over the shared internet is known as cloud computing. It is a concept that allows outsourcing of different IT resources such as storage, processing capabilities, or even software via the network that uses the pay-as-you-go model. Advancements in cloud computing have allowed users to shift away from buying and maintaining the data centers, servers, and other resources to accessing such resources as per their requirement from cloud vendors such as Amazon Web Services (AWS), Microsoft Azure, Google Cloud Platform (GCP). Different sized organizations in the industry are turning their heads towards cloud computing for use cases that range from disaster recovery, data backup, virtual desktop environments to big data analysis and software development.

1.1 Types of Cloud Computing Model

1.1.1 Infrastructure as a Service (IaaS)

Infrastructure as a Service (IaaS) cloud computing model provides computing infrastructure such as servers, network equipment, storage, operating systems through a technology called virtualization. This allows clients that buy IaaS on-demand services complete control over the bought infrastructure such that they don't have to think about maintaining the actual physical hardware. It is the most flexible model as clients have complete control over their infrastructure while still employing the pay-as-you-go model. Amazon Web Services (AWS), Google Cloud Engine (GCE) are some common examples.

1.1.2 Platform as a Service (PaaS)

Platform as a Service (PaaS) cloud computing model provides platform for software creation over the internet. This allows the client company to let its developers focus on software devel-

opment such that they don't have to focus on the underlying operating system, or any infrastructure. It also provides different kinds of services that are helpful for development and testing of applications. AWS Elastic Beanstalk, Heroku are some common examples.

1.1.3 Software as a Service (SaaS)

Software as a Service (SaaS) cloud computing model provides cloud applications managed by third-party distributors over the internet. Mostly small companies and short-term projects that are looking for instant IT solutions use SaaS. Dropbox, Google Workspace, and GoToMeeting are some common examples.

1.2 Benefits of Cloud Computing

1.2.1 Variable Expense

Companies that employ their services using cloud services trade the overhead cost of buying and maintaining infrastructures with variable expense with the pay-as-you-go model.

1.2.2 On-demand Scaling of Resources

Clients can avoid under or over estimating the capacity they need and move towards a better scaled resources using auto scaling services.

1.2.3 Increased Speed of Deployment

Since the IT resources required are available at the push of a button, the deployment process is greatly sped up.

1.2.4 Economies of Scale

With the increase in number of users, the proportional cost saving using the pay-as-you-go model drastically increases.

1.2.5 Global Reach without much Hassle

Clients can deploy their applications to multiple AWS regions without much hassle. This improves their global reach and they can have servers in different geographical regions up and running in few minutes. This ensures low latency for the application hence boosting consumer experience.

1.2.6 No Maintenance Cost

Clients can focus on the delivery of their applications rather than maintaining the infrastructure that are essential. This greatly reduces their maintenance expenditure.

2 AWS Global Infrastructure

In order to deliver highly reliable, scalable cloud services over a secure connection, Amazon has segregated its global infrastructures with 81 availability zones in 25 actual global regions around the globe.

2.1 AWS Regions

These are physical geographical locations where data replication across regions depends on the clients need. Currently there are 25 AWS regions that themselves house one or more availability zones. Each region is completely independent of one another and pricing vary in these regions.

2.2 Availability Zones

These are isolated AWS infrastructures inside an AWS region that are connected via high bandwidth private networks. Currently there are 81 availability zones that themselves house one or more data centers. The availability zones ensure isolation from natural calamities. 21 new availability zones in 7 AWS regions have been announced recently.

2.3 Data Centers

These are physical data centers that store the actual data. Clients can't select data centers instead can select availability zones to deploy their application.

3 Amazon Elastic Compute Cloud (EC2)

Elastic Compute Cloud (EC2) is a service available on the Amazon console dashboard that allows clients to create virtual machines, generally known as EC2 instances. In terms of cloud computing types, an EC2 can be regarded as an IaaS since the client can choose the AMI, and capacity of servers. The said EC2 instances allow clients to host virtual machines on which they can deploy applications in somewhat a similar fashion as an on-premise environment. Few use-cases where EC2 instances are used are as application, web, game, media, mail, database servers. EC2 instances can be launched in the different possible availability zones. The breakdown for Amazon EC2 is as,

- **Elastic** : Since number of instances can be auto-scaled.
- **Compute** : Since most use-cases of EC2 include the use of compute resources.
- **Cloud** : Since EC2 instances are available as cloud service.

3.1 Choose an Amazon Machine Image

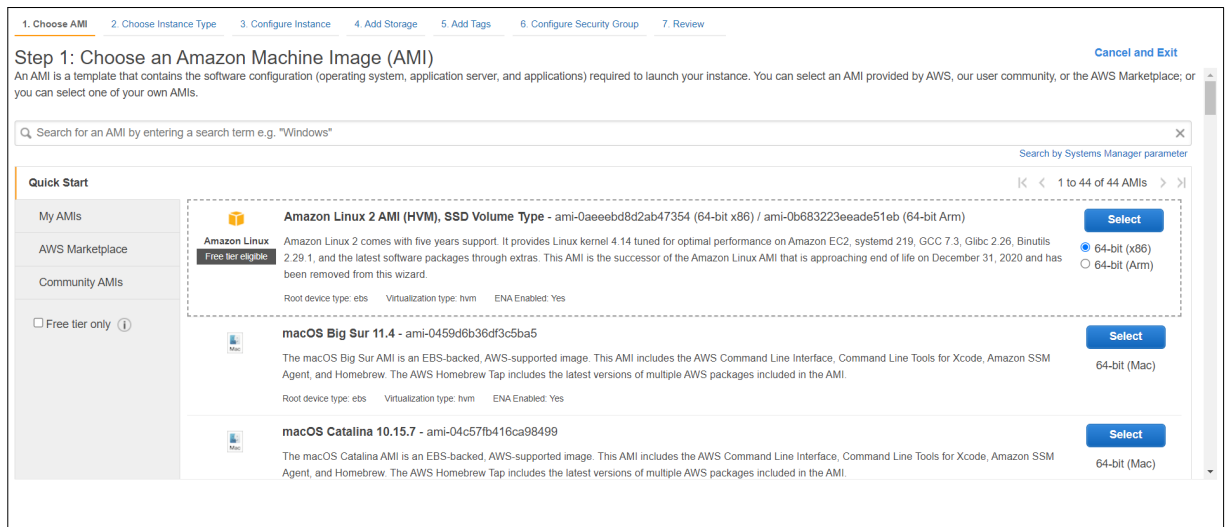


Figure 1: Choose an Amazon Machine Image

This is the first step in creation of an EC2 instance. This step involves selection of an AMI based on which the desired EC2 instance is created. Amazon Machine Image (AMI) is an image that contains the configurations such as operating system, required application servers. AWS allows selection of AMI provided by AWS, or the ones created by the vast user community or some available on the AWS marketplace. For this example, Amazon Linux is selected as the AMI.

3.2 Choose an Instance Type

1. Choose AMI 2. Choose Instance Type 3. Configure Instance 4. Add Storage 5. Add Tags 6. Configure Security Group 7. Review

Step 2: Choose an Instance Type

Amazon EC2 provides a wide selection of instance types optimized to fit different use cases. Instances are virtual servers that can run applications. They have varying combinations of CPU, memory, storage, and networking capacity, and give you the flexibility to choose the appropriate mix of resources for your applications. [Learn more](#) about instance types and how they can meet your computing needs.

Filter by: All instance families Current generation Show/Hide Columns

Currently selected: t2.micro (- ECUs, 1 vCPUs, 2.5 GHz, -, 1 GiB memory, EBS only)

	Family	Type	vCPUs	Memory (GiB)	Instance Storage (GB)	EBS-Optimized Available	Network Performance	IPv6 Support
<input type="checkbox"/>	t2	t2.nano	1	0.5	EBS only	-	Low to Moderate	Yes
<input checked="" type="checkbox"/>	t2	t2.micro <small>Free tier eligible</small>	1	1	EBS only	-	Low to Moderate	Yes
<input type="checkbox"/>	t2	t2.small	1	2	EBS only	-	Low to Moderate	Yes
<input type="checkbox"/>	t2	t2.medium	2	4	EBS only	-	Low to Moderate	Yes
<input type="checkbox"/>	t2	t2.large	2	8	EBS only	-	Low to Moderate	Yes
<input type="checkbox"/>	t2	t2.xlarge	4	16	EBS only	-	Moderate	Yes
<input type="checkbox"/>	t2	t2.2xlarge	8	32	EBS only	-	Moderate	Yes
<input type="checkbox"/>	t3	t3.nano	2	0.5	EBS only	Yes	Up to 5 Gigabit	Yes

Cancel Previous **Review and Launch** Next: Configure Instance Details

Figure 2: Choose an Instance Type

This is the second step in creation of an EC2 instance. This step involves selection of an EC2 types based on which the desired combination of CPU, storage, network performance, memory other resources are set. Elastic Compute Cloud (EC2) instance types provide different optimal combinations out of which *t2.micro*, a free tier type is selected for this example. The *t2.micro* instance type provides 1 vCPU, 1 GiB memory, low to moderate network performance and EBS storage support.

3.3 Configure Instance Details

The screenshot shows the 'Step 3: Configure Instance Details' page in the AWS Management Console. The page has a progress bar at the top with seven steps: 1. Choose AMI, 2. Choose Instance Type, 3. Configure Instance (active), 4. Add Storage, 5. Add Tags, 6. Configure Security Group, and 7. Review. Below the progress bar, the title 'Step 3: Configure Instance Details' is followed by a brief instruction: 'Configure the instance to suit your requirements. You can launch multiple instances from the same AMI, request Spot instances to take advantage of the lower pricing, assign an access management role to the instance, and more.'

The configuration options are as follows:

- Number of Instances:** A text input field containing '1' and a link 'Launch into Auto Scaling Group'.
- Purchasing option:** A checkbox labeled 'Request Spot instances' which is currently unchecked.
- Network:** A dropdown menu showing 'vpc-7949db04 (default)' with a 'Create new VPC' link.
- Subnet:** A dropdown menu showing 'No preference (default subnet in any Availability Zone)' with a 'Create new subnet' link.
- Auto-assign Public IP:** A dropdown menu showing 'Use subnet setting (Enable)'.
- Placement group:** A checkbox labeled 'Add instance to placement group' which is unchecked.
- Capacity Reservation:** A dropdown menu showing 'Open'.
- Domain join directory:** A dropdown menu showing 'No directory' with a 'Create new directory' link.
- IAM role:** A dropdown menu showing 'None' with a 'Create new IAM role' link.
- Shutdown behavior:** A dropdown menu showing 'Stop'.
- Stop - Hibernate behavior:** A checkbox labeled 'Enable hibernation as an additional stop behavior' which is unchecked.
- Enable termination protection:** A checkbox labeled 'Protect against accidental termination' which is unchecked.

At the bottom right, there are four buttons: 'Cancel' (blue text), 'Previous' (grey), 'Review and Launch' (blue), and 'Next: Add Storage' (grey text).

Figure 3: Configure Instance Details

This is the third step in creation of an EC2 instance. This step involves configuration of the EC2 instance details. Configuration options such as number of instances under the same AMI, different purchasing options, network settings for VPC creation and setting subnets, IAM roles, behavior on shutdown and hibernation can be set using this step of instance launch.

3.4 Add Storage

1. Choose AMI 2. Choose Instance Type 3. Configure Instance 4. Add Storage 5. Add Tags 6. Configure Security Group 7. Review

Step 4: Add Storage

Your instance will be launched with the following storage device settings. You can attach additional EBS volumes and instance store volumes to your instance, or edit the settings of the root volume. You can also attach additional EBS volumes after launching an instance, but not instance store volumes. [Learn more](#) about storage options in Amazon EC2.

Volume Type ⓘ	Device ⓘ	Snapshot ⓘ	Size (GiB) ⓘ	Volume Type ⓘ	IOPS ⓘ	Throughput (MB/s) ⓘ	Delete on Termination ⓘ	Encryption ⓘ
Root	/dev/xvda	snap-02d2a0614e5ce0ce4	8	General Purpose S ⓘ	100 / 3000	N/A	<input checked="" type="checkbox"/>	Not Encrypte ⓘ

[Add New Volume](#)

Free tier eligible customers can get up to 30 GB of EBS General Purpose (SSD) or Magnetic storage. [Learn more](#) about free usage tier eligibility and usage restrictions.

[Cancel](#) [Previous](#) [Review and Launch](#) [Next: Add Tags](#)

Figure 4: Add Storage

This is the fourth step in creation of an EC2 instance. This step involves configuration of the storage settings that determine the EBS volumes used by the launched instance. Instance store volumes are also selected and attached in this step, which is a must since instance store volumes can't be attached after launching the instance. Root directory can also be edited in this step while launching an EC2 instance.

3.5 Add Tags

The screenshot shows the 'Step 5: Add Tags' interface in the AWS Management Console. At the top, a progress bar indicates the current step is '5. Add Tags', with previous steps being '1. Choose AMI', '2. Choose Instance Type', '3. Configure Instance', '4. Add Storage', '6. Configure Security Group', and '7. Review'. Below the progress bar, the title 'Step 5: Add Tags' is followed by explanatory text: 'A tag consists of a case-sensitive key-value pair. For example, you could define a tag with key = Name and value = Webserver. A copy of a tag can be applied to volumes, instances or both. Tags will be applied to all instances and volumes. [Learn more](#) about tagging your Amazon EC2 resources.'

The main area contains a table for adding tags. The table has four columns: 'Key' (128 characters maximum), 'Value' (256 characters maximum), 'Instances' (with an info icon), 'Volumes' (with an info icon), and 'Network Interfaces' (with an info icon). A single tag is entered: 'Name' as the key and 'Server_1' as the value. Checkmarks are present in the 'Instances', 'Volumes', and 'Network Interfaces' columns, indicating the tag is applied to all three. A close button (X) is in the 'Network Interfaces' column. Below the table, there is a button 'Add another tag' and a note '(Up to 50 tags maximum)'. At the bottom right, there are four buttons: 'Cancel', 'Previous', 'Review and Launch' (highlighted in blue), and 'Next: Configure Security Group'.

Key (128 characters maximum)	Value (256 characters maximum)	Instances ⓘ	Volumes ⓘ	Network Interfaces ⓘ
Name	Server_1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

[Add another tag](#) (Up to 50 tags maximum)

[Cancel](#) [Previous](#) [Review and Launch](#) [Next: Configure Security Group](#)

Figure 5: Add Tags

This is the fifth step in creation of an EC2 instance. This step involves adding or editing tags for the instance. Tags are nothing but key-value identifier pair used to filter the launched instances. For this example, a *Name* tag with the value *Server_1* is created. This tag is associated to all instance, volume and the used network interfaces.

3.6 Configure Security Groups

1. Choose AMI 2. Choose Instance Type 3. Configure Instance 4. Add Storage 5. Add Tags 6. Configure Security Group 7. Review

Step 6: Configure Security Group

A security group is a set of firewall rules that control the traffic for your instance. On this page, you can add rules to allow specific traffic to reach your instance. For example, if you want to set up a web server and allow Internet traffic to reach your instance, add rules that allow unrestricted access to the HTTP and HTTPS ports. You can create a new security group or select from an existing one below. [Learn more](#) about Amazon EC2 security groups.

Assign a security group: ☒ Create a new security group ☐ Select an existing security group

Security group name:

Description:

Type	Protocol	Port Range	Source	Description
All traffic	All	0 - 65535	Anywhere 0.0.0.0/0 ::0	e.g. SSH for Admin Desktop

Add Rule

Warning

Rules with source of 0.0.0.0/0 allow all IP addresses to access your instance. We recommend setting security group rules to allow access from known IP addresses only.

[Cancel](#) [Previous](#) [Review and Launch](#)

Figure 6: Configure Security Groups

This is the sixth step in creation of an EC2 instance. This step involves configuration of security groups that are essentially act as firewall to control the inbound traffic to the launched instances. The rules can be set for different traffic types, to follow various communication protocols, use the required port ranges accordingly and source address. For this example, all traffic is allowed for requests coming from any address on the internet. This is obviously not the recommended setting since security will be compromised.

3.7 Review and Launch

1. Choose AMI 2. Choose Instance Type 3. Configure Instance 4. Add Storage 5. Add Tags 6. Configure Security Group 7. Review

Step 7: Review Instance Launch

Please review your instance launch details. You can go back to edit changes for each section. Click **Launch** to assign a key pair to your instance and complete the launch process.

⚠ Improve your instances' security. Your security group, launch-wizard-2, is open to the world.

Your instances may be accessible from any IP address. We recommend that you update your security group rules to allow access from known IP addresses only. You can also open additional ports in your security group to facilitate access to the application or service you're running, e.g., HTTP (80) for web servers. [Edit security groups](#)

▼ AMI Details [Edit AMI](#)

amzn2-ami-hvm-2.0.20210525.0-x86_64-gp2 - ami-0ae0ebd8d2ab47354

Amazon Linux 2 AMI 2.0.20210525.0 x86_64 HVM gp2

Root Device Type: ebs Virtualization type: hvm

▼ Instance Type [Edit instance type](#)

Instance Type	ECUs	vCPUs	Memory (GiB)	Instance Storage (GB)	EBS-Optimized Available	Network Performance
t2.micro	-	1	1	EBS only	-	Low to Moderate

▼ Security Groups [Edit security groups](#)

Security Group ID	Name	Description
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[Cancel](#) [Previous](#) [Launch](#)

Figure 7: Review and Launch

This is the seventh and final step in creation of an EC2 instance. This step involves reviewing the set configurations in step 1 to 6 and launching the instance. While launching the instance, clients are recommended to use an existing key pair or generate a new one, that is an encrypted key used for remote access. Once launched the instance will take some time to clear the different status checks.