

INTERNSHIP STUDIO PROJECT

COURSE: AWS(AMAZON WEB SERVICES)

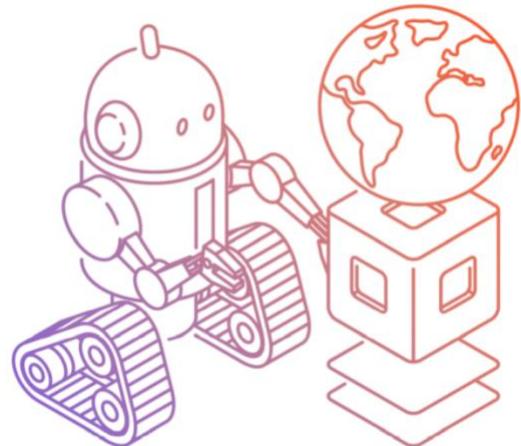
Problem Title : Deploy a Cloud

Submitted by:-

Anannya Priyadarshini Neog

Problem Statement:

A Cloud developer is someone with multiple horizons of skills and ideas, be it Devops, Debugging or programming . You work at a software company IS Robotics , you work as a software engineer, you need to deploy ROS (Robot Operating System) on Cloud which will allow the developers to run their robotic simulation and do more implementation



We Need to deploy ROS Neotic on the Cloud, Which is essentially going to allow the developers monitor and run their codes on the cloud.

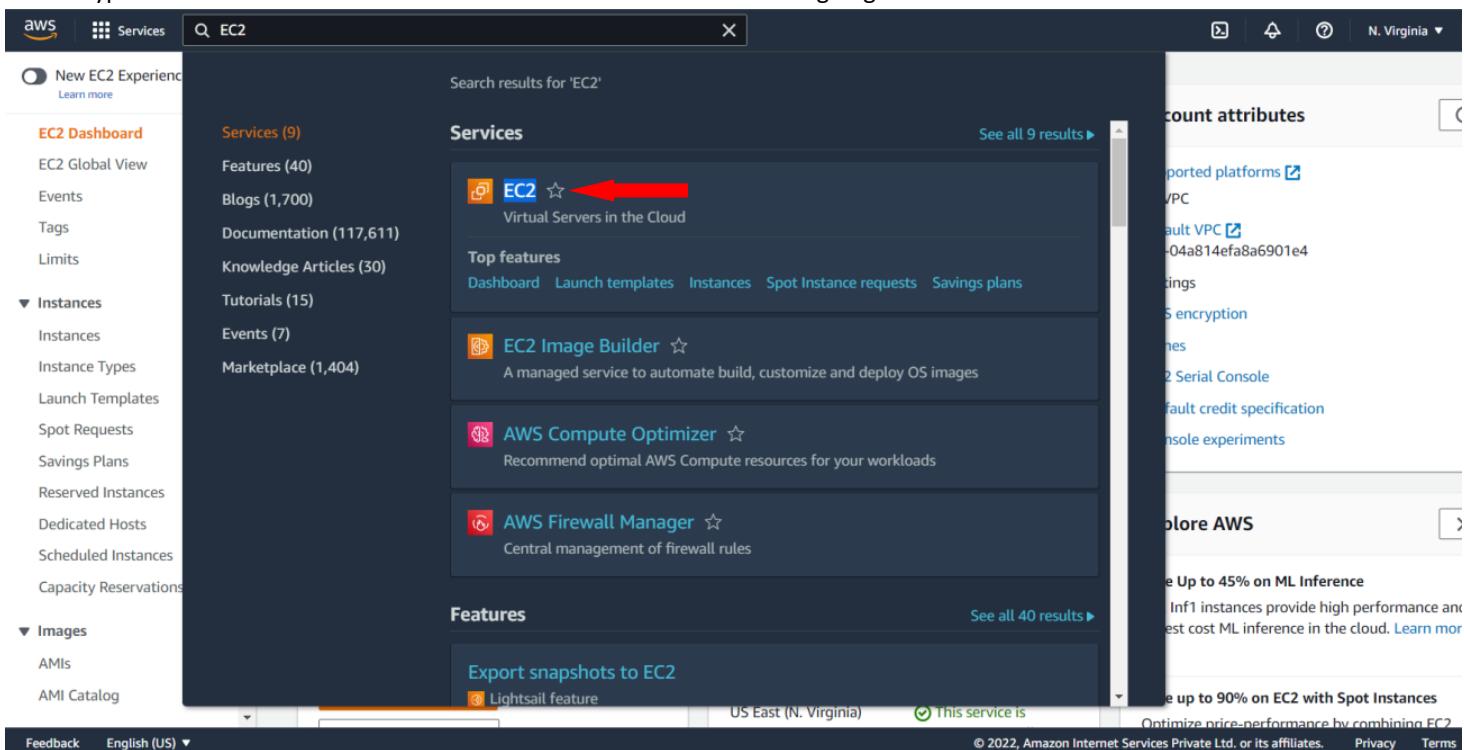
Requirements to make an instance for EC2 in the AWS

- Ubuntu 20.04 LTS
- General purpose t2.micro.
- 30GB of Storage
- Prerequisites: Create a AWS Account.

Steps to make an Instance for EC2 in AWS:

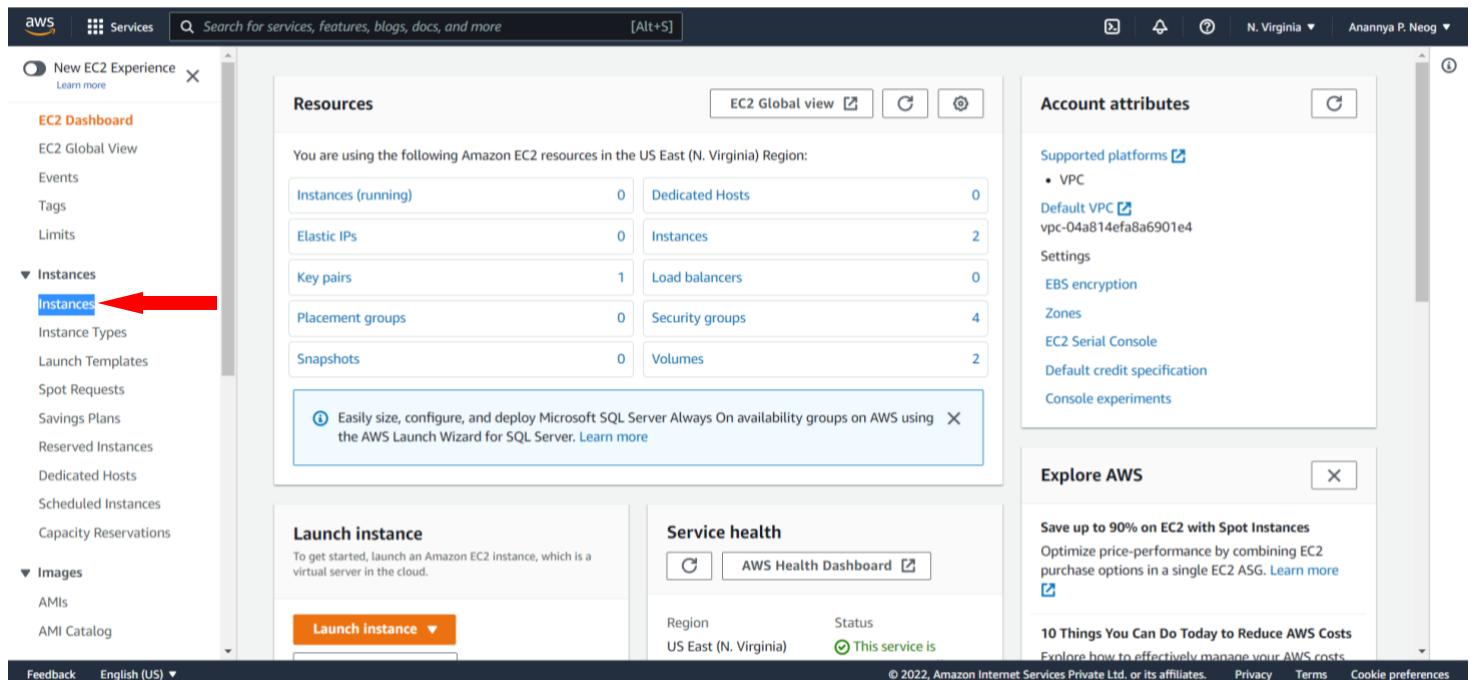
1. Go to EC2

Type 'EC2' in the search bar and click the 'EC2 virtual server' after signing in



The screenshot shows the AWS Management Console search results for 'EC2'. The 'EC2' service is highlighted with a red arrow. The page displays various AWS services and features, including EC2 Image Builder, AWS Compute Optimizer, and AWS Firewall Manager. The sidebar on the left shows navigation links for EC2 Dashboard, Services, Instances, and Images. The bottom of the page includes links for Feedback, English (US), and a copyright notice for 2022.

2. Click 'Instances'



Resources

You are using the following Amazon EC2 resources in the US East (N. Virginia) Region:

Instances (running)	0	Dedicated Hosts	0
Elastic IPs	0	Instances	2
Key pairs	1	Load balancers	0
Placement groups	0	Security groups	4
Snapshots	0	Volumes	2

Launch instance

To get started, launch an Amazon EC2 instance, which is a virtual server in the cloud.

Service health

Region: US East (N. Virginia) Status: This service is

Account attributes

Supported platforms: VPC

Default VPC: vpc-04a814efa8a6901e4

Settings

EBS encryption

Zones

EC2 Serial Console

Default credit specification

Console experiments

Explore AWS

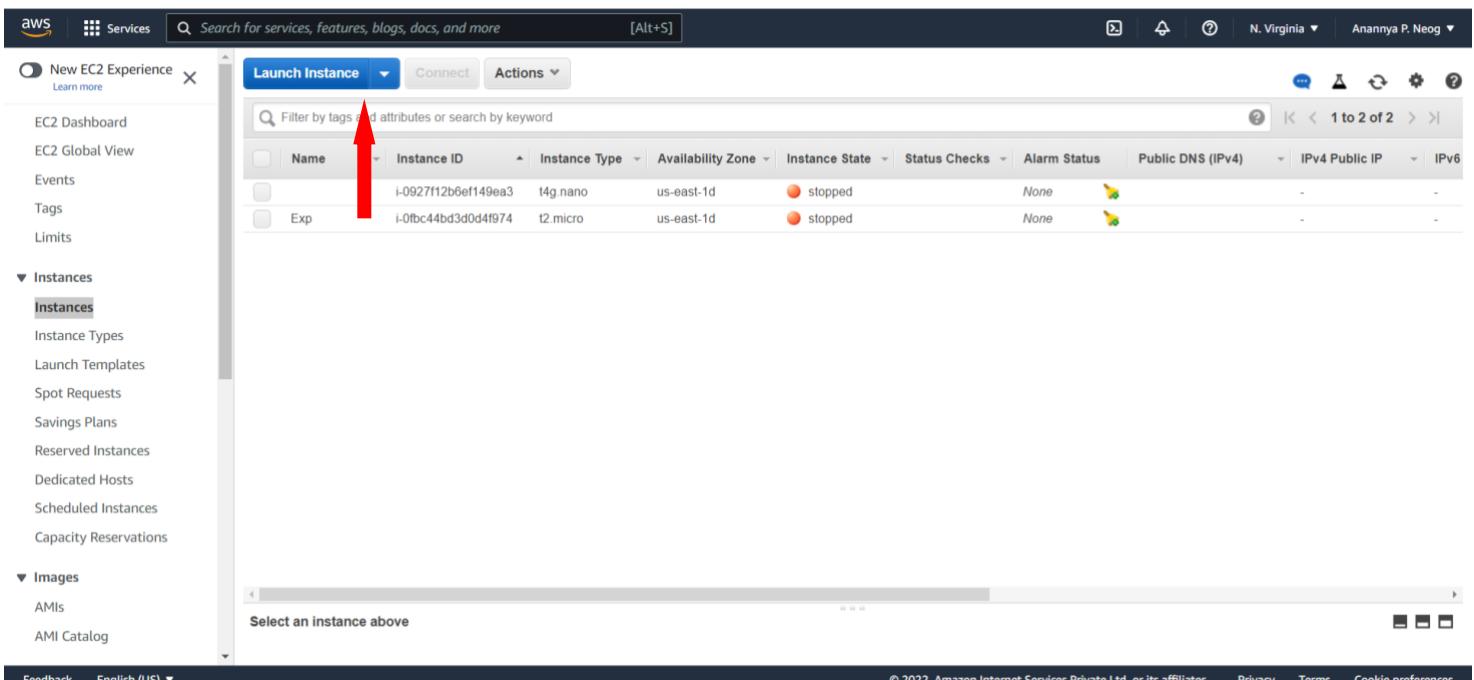
Save up to 90% on EC2 with Spot Instances

Optimize price-performance by combining EC2 purchase options in a single EC2 ASG. [Learn more](#)

10 Things You Can Do Today to Reduce AWS Costs

Explore how to effectively manage your AWS costs.

3. Click 'Launch Instance'



Launch Instance

Filter by tags and attributes or search by keyword

Name	Instance ID	Instance Type	Availability Zone	Instance State	Status Checks	Alarm Status	Public DNS (IPv4)	IPv4 Public IP	IPv6
	i-0927f12b0ef149ea3	t4g.nano	us-east-1d	stopped	None				
Exp	i-0fbca4bd3d0d4f974	t2.micro	us-east-1d	stopped	None				

Select an instance above

4. Choose any machine

We can select any machine by scrolling down but in this project I have chosen '**Ubuntu Server 20.04 LTS (HVM), SSD**

Volume Type' with '**64-bit (x86)**' processor.

You've been invited to try an early, beta iteration of the new launch instance wizard. We will continue to improve the experience over the next few months. We're asking customers for their feedback on this early release. To exit the new launch instance wizard at any time, choose the **Cancel** button. **Try it now!**

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

Step 1: Choose an Amazon Machine Image (AMI)

Free tier eligible and Ruby 1.8.7 available.

Ubuntu Server 20.04 LTS (HVM), SSD Volume Type - ami-04505e74c0741db8d (64-bit x86) / ami-0b49a4a6e8e22fa16 (64-bit Arm)

Ubuntu Server 20.04 LTS (HVM), EBS General Purpose (SSD) Volume Type. Support available from Canonical (<http://www.ubuntu.com/cloud/services>).

Root device type: ebs Virtualization type: hvm ENA Enabled: Yes

Ubuntu Server 18.04 LTS (HVM), SSD Volume Type - ami-0e472ba40eb589f49 (64-bit x86) / ami-0a940cb939351ccca (64-bit Arm)

Ubuntu Server 18.04 LTS (HVM), EBS General Purpose (SSD) Volume Type. Support available from Canonical (<http://www.ubuntu.com/cloud/services>).

Root device type: ebs Virtualization type: hvm ENA Enabled: Yes

Microsoft Windows Server 2019 Base - ami-0c1980dba70861db

Microsoft Windows 2019 Datacenter edition. [English]

Root device type: ebs Virtualization type: hvm ENA Enabled: Yes

Cancel and Exit

Ubuntu (x86) 64-bit (Arm)

Select

64-bit (x86) 64-bit (Arm)

Select

64-bit (x86) 64-bit (Arm)

Select

64-bit (x86)

5. Select any instance type

Select '**t2.micro(Free Tier Eligible)**' and click '**Next: Configure Instance Details**'

Feedback English (US) ▾ © 2022, Amazon Internet Services Private Ltd. or its affiliates. Privacy Terms Cookie preferences

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 Free tier eligible	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

Cancel Previous Review and Launch Next: Configure Instance Details

6. Click 'Next: Add Storage'

Step 3: Configure Instance Details

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.

Number of Instances: 1

Purchasing option: Request Spot Instances

Network: vpc-04a814efa8a6901e4 (default)

Subnet: No preference (default subnet in any Availability Zone)

Auto-assign Public IP: Use subnet setting (Enable)

Hostname type: Use subnet setting (IP name)

DNS Hostname: Enable IP name IPv4 (A record) DNS requests
 Enable resource-based IPv4 (A record) DNS requests
 Enable resource-based IPv6 (AAAA record) DNS requests

Placement group: Add instance to placement group

Capacity Reservation: Open

Domain join directory: No directory



7. Click 'Next: Add Tags'

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.

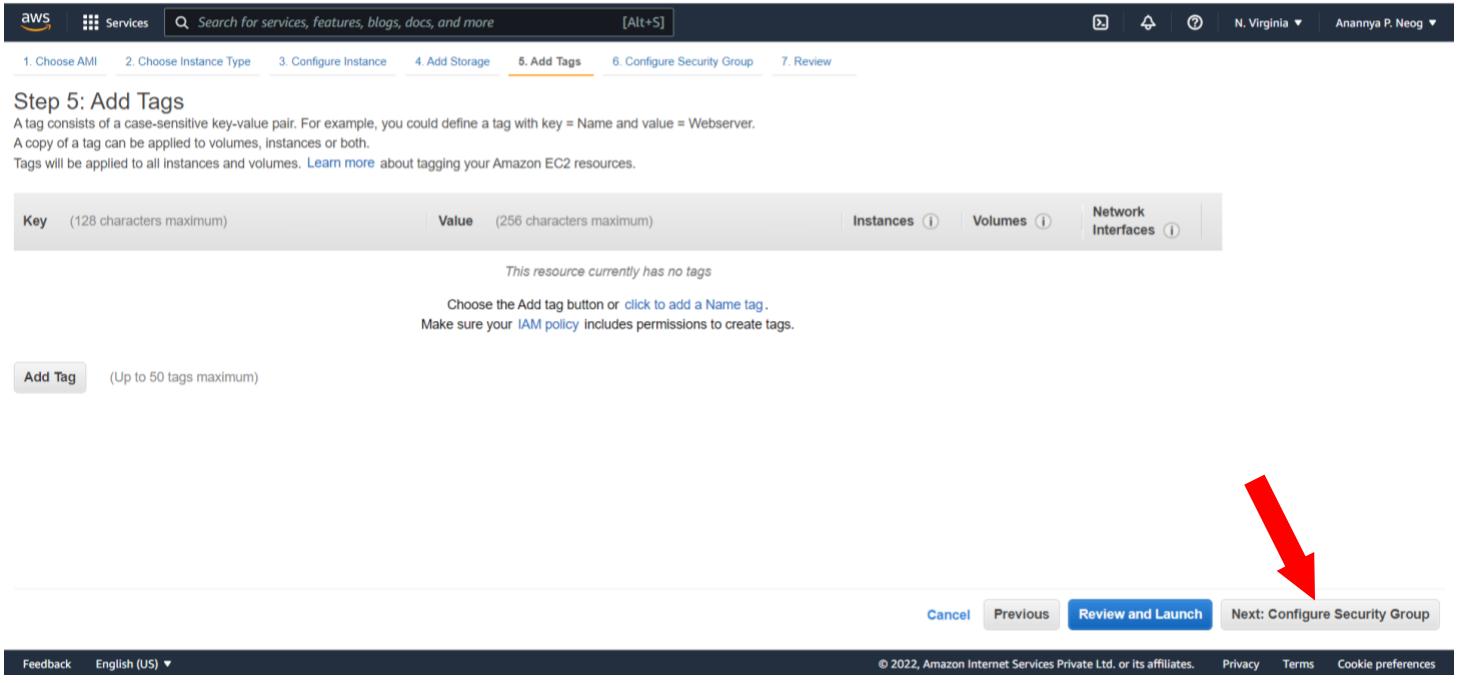
Volume Type	Device	Snapshot	Size (GiB)	Volume Type	IOPS	Throughput (MB/s)	Delete on Termination	Encryption
Root	/dev/sda1	snap-0f7a6eae6d90437c4	8	General Purpose SSD (gp2)	100 / 3000	N/A	<input checked="" type="checkbox"/>	Not Encrypted

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.

Shared file systems: You currently don't have any file systems on this instance. Select "Add file system" button below to add a file system.



8. Click 'Next: Configure Security Group'



Step 5: Add Tags

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.

Key (128 characters maximum) Value (256 characters maximum) Instances (1) Volumes (1) Network Interfaces (1)

This resource currently has no tags

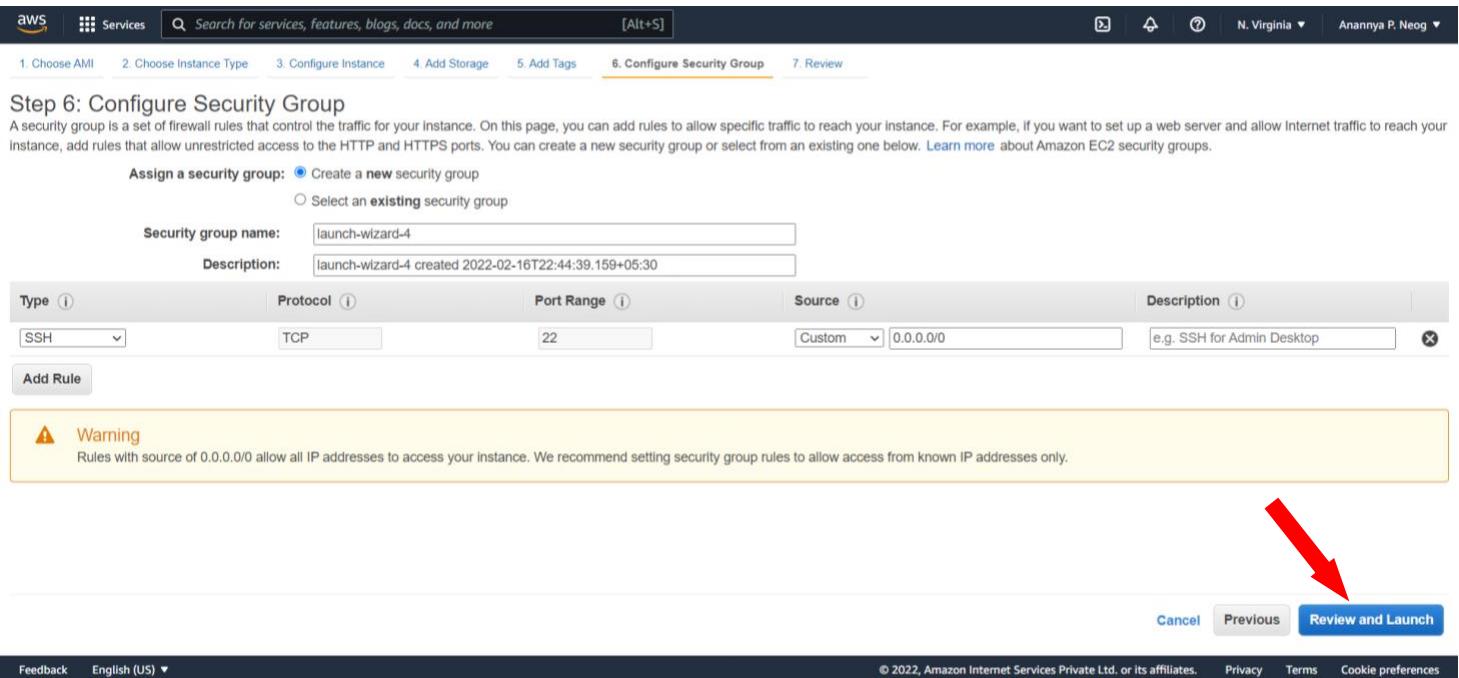
Choose the Add tag button or [click](#) to add a Name tag.

Make sure your [IAM policy](#) includes permissions to create tags.

Add Tag (Up to 50 tags maximum)

Cancel Previous Review and Launch Next: Configure Security Group

9. Click 'Review and Launch'



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: launch-wizard-4

Description: launch-wizard-4 created 2022-02-16T22:44:39.159+05:30

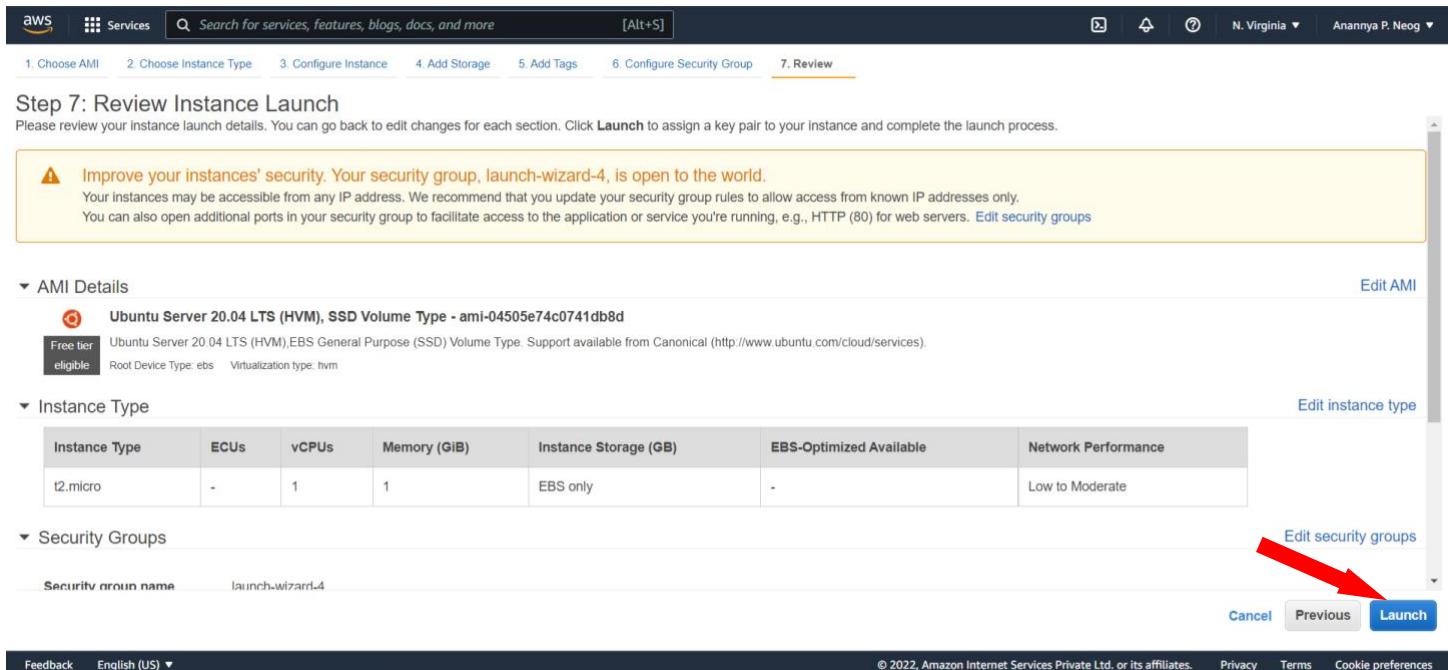
Type (1)	Protocol (1)	Port Range (1)	Source (1)	Description (1)
SSH	TCP	22	Custom 0.0.0.0/0	e.g. SSH for Admin Desktop

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

10. Click 'Launch'



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.

AMI Details

Ubuntu Server 20.04 LTS (HVM), SSD Volume Type - ami-04505e74c0741db8d

Instance Type

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

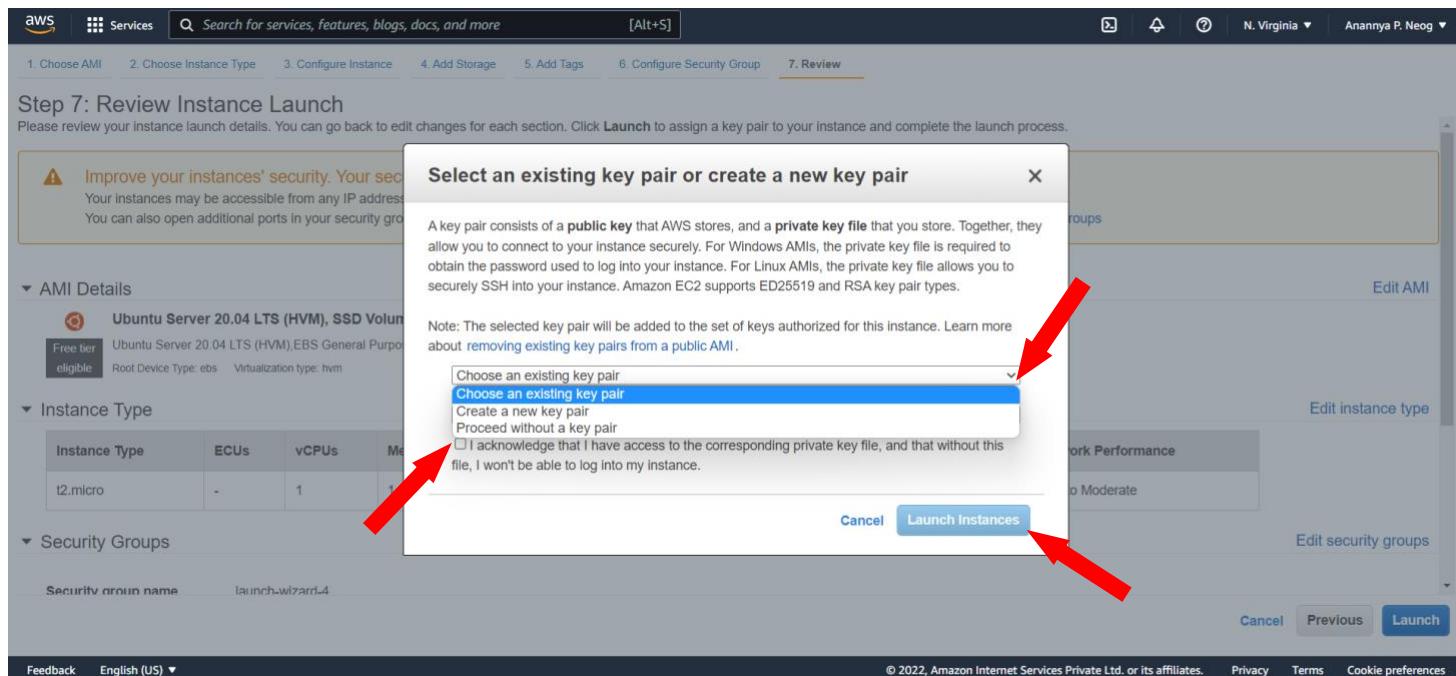
Security Groups

Security group name: launch-wizard-4

Launch (highlighted with a red arrow)

11. Select any option, mark the tick below and click 'Launch Instances'

- We can select any option but I already had so used that one
- Mark the tick button to acknowledge
- Click the '**Launch Instances**' button



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.

AMI Details

Ubuntu Server 20.04 LTS (HVM), SSD Volume Type - ami-04505e74c0741db8d

Instance Type

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

Security Groups

Security group name: launch-wizard-4

Select an existing key pair or create a new key pair

A key pair consists of a **public key** that AWS stores, and a **private key file** that you store. Together, they allow you to connect to your instance securely. For Windows AMIs, the private key file is required to obtain the password used to log into your instance. For Linux AMIs, the private key file allows you to securely SSH into your instance. Amazon EC2 supports ED25519 and RSA key pair types.

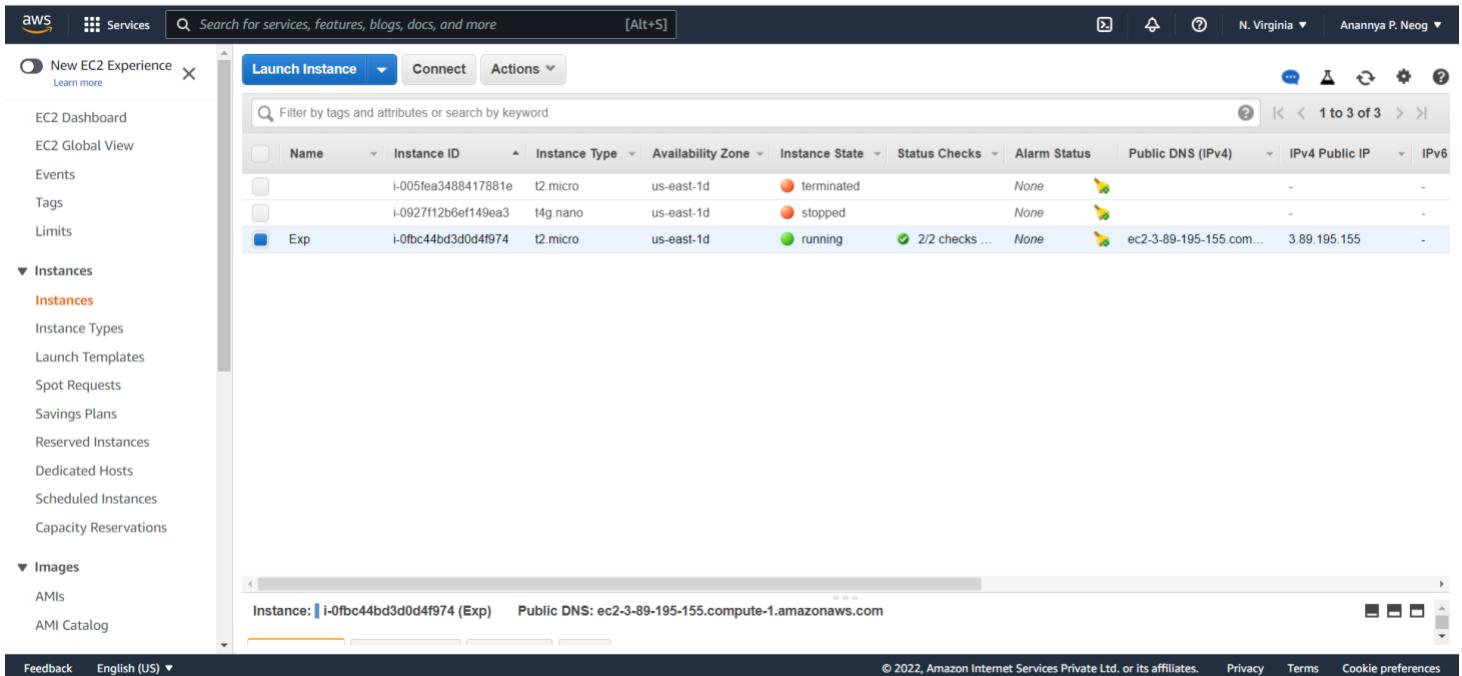
Note: The selected key pair will be added to the set of keys authorized for this instance. Learn more about [removing existing key pairs from a public AMI](#).

Choose an existing key pair
Choose an existing key pair (highlighted with a red arrow)
Create a new key pair
Proceed without a key pair
 I acknowledge that I have access to the corresponding private key file, and that without this file, I won't be able to log into my instance.

Launch Instances (highlighted with a red arrow)

12. Final Window

Wait till the instance's status shows running and then the server is ready



The screenshot shows the AWS EC2 Instances page. The left sidebar is collapsed. The main content area displays a table of instances. One instance is selected, showing its details in a modal window at the bottom. The instance is named 'Exp', has an ID of i-0fbcc44bd3d0d4f974, is a t2 micro type, located in us-east-1d, and is currently running. Its public DNS is ec2-3-89-195-155.compute-1.amazonaws.com and its public IP is 3.89.195.155. The modal window also shows the instance ID and public DNS.

Name	Instance ID	Instance Type	Availability Zone	Instance State	Status Checks	Alarm Status	Public DNS (IPv4)	IPv4 Public IP	IPv6
i-005fea3488417881e	t2.micro	us-east-1d	terminated	None					
i-0927f12b6ef149ea3	t4g.nano	us-east-1d	stopped	None					
Exp	i-0fbcc44bd3d0d4f974	t2 micro	us-east-1d	running	2/2 checks ...	None	ec2-3-89-195-155.com...	3.89.195.155	

Steps to Install ROS Neotic (After Cloud is hosted and running):

1. Configure your Ubuntu repositories

Configure your Ubuntu repositories to allow "restricted," "universe," and "multiverse." You can [follow the Ubuntu guide](#) for instructions on doing this.

2. Setup your sources.list

Setup your computer to accept software from packages.ros.org.

```
sudo sh -c 'echo "deb http://packages.ros.org/ros/ubuntu $(lsb_release -sc) main" > /etc/apt/sources.list.d/ros-latest.list'
```

3. Set up your keys

```
• sudo apt install curl # if you haven't already installed curl
• curl -s https://raw.githubusercontent.com/ros/rosdistro/master/ros.asc | sudo apt-key add -
```

4. Installation

First, make sure your Debian package index is up-to-date:

```
sudo apt update
```

5. Desktop-Full Install:

Everything in **Desktop** plus 2D/3D simulators and 2D/3D perception packages

```
sudo apt install ros-noetic-desktop-full
```

6. Slam-Gmapping Install:

There are even more packages available in ROS. You can always install a specific package directly.

e.g.

```
sudo apt install ros-noetic-slam-gmapping
```

7. Environment setup

You must source this script in every **bash** terminal you use ROS in.

```
source /opt/ros/noetic/setup.bash
```

***NOTE:** To check for more information, visit: <http://wiki.ros.org/noetic/Installation/Ubuntu>

i-0fbc44bd3d0d4f974 (Exp)

Public IPs: 3.89.195.155 Private IPs: 172.31.86.152

i-0fbcc44bd3d0d4f974 (Exp)

Public IPs: 3.89.195.155 Private IPs: 172.31.86.152

```
i-0fbc44bd3d0d4f974 (Exp) | EC2 Instance Connect - Google Chrome
  console.aws.amazon.com/ec2/v2/connect/ubuntu/i-0fbc44bd3d0d4f974

Waiting for cache lock: Could not get lock /var/lib/dpkg/lock-frontend. It is held by process 2370
(apt)
Reading package lists... 0%
Reading package lists... Done
Building dependency tree
Reading state information... Done
curl is already the newest version (7.68.0-1ubuntu2.7).
0 upgraded, 0 newly installed, 0 to remove and 56 not upgraded.
ubuntu@ip-172-31-86-152:~$ 
ubuntu@ip-172-31-86-152:~$ 
ubuntu@ip-172-31-86-152:~$ curl -s https://raw.githubusercontent.com/ros/rosdistro/master/ros.asc |
  sudo apt-key add -
OK
ubuntu@ip-172-31-86-152:~$ 
ubuntu@ip-172-31-86-152:~$ sudo apt update
Hit:1 http://us-east-1.ec2.archive.ubuntu.com/ubuntu focal InRelease
Get:2 http://us-east-1.ec2.archive.ubuntu.com/ubuntu focal-updates InRelease [114 kB]
Get:3 http://us-east-1.ec2.archive.ubuntu.com/ubuntu focal-backports InRelease [108 kB]
Hit:4 http://security.ubuntu.com/ubuntu focal-security InRelease
Get:5 http://us-east-1.ec2.archive.ubuntu.com/ubuntu focal-updates/main amd64 Packages [1572 kB]
Setting up ros-noetic-gmapping (1.4.2-1focal.20220107.002506) ...
Setting up ros-noetic-slam-gmapping (1.4.2-1focal.20220107.014410) ...
ubuntu@ip-172-31-86-152:~$ source /opt/ros/noetic/setup.bash
ubuntu@ip-172-31-86-152:~$ 
ubuntu@ip-172-31-86-152:~$ rosversion -d
noetic
ubuntu@ip-172-31-86-152:~$ roscore
... logging to /home/ubuntu/.ros/log/e8aa5fc8-8e86-11ec-9eec-91e0d64c2e65/roslaunch-ip-172-31-86-15
2-48304.log
Checking log directory for disk usage. This may take a while.
Press Ctrl-C to interrupt
Done checking log file disk usage. Usage is <1GB.
oscore
started roslaunch server http://ip-172-31-86-152:35539/
```

i-0fbc44bd3d0d4f974 (Exp)

Public IPs: 3.89.195.155 Private IPs: 172.31.86.152

```
i-0fbc44bd3d0d4f974 (Exp) | EC2 Instance Connect - Google Chrome
  console.aws.amazon.com/ec2/v2/connect/ubuntu/i-0fbc44bd3d0d4f974

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ubuntu@ip-172-31-86-152:~$ 
ubuntu@ip-172-31-86-152:~$ 
ubuntu@ip-172-31-86-152:~$ curl -s https://raw.githubusercontent.com/ros/rosdistro/master/ros.asc |
  sudo apt-key add -
OK
ubuntu@ip-172-31-86-152:~$ 
ubuntu@ip-172-31-86-152:~$ sudo apt update
Hit:1 http://us-east-1.ec2.archive.ubuntu.com/ubuntu focal InRelease
Get:2 http://us-east-1.ec2.archive.ubuntu.com/ubuntu focal-updates InRelease [114 kB]
Get:3 http://us-east-1.ec2.archive.ubuntu.com/ubuntu focal-backports InRelease [108 kB]
Hit:4 http://security.ubuntu.com/ubuntu focal-security InRelease
Get:5 http://us-east-1.ec2.archive.ubuntu.com/ubuntu focal-updates/main amd64 Packages [1572 kB]
Setting up ros-noetic-gmapping (1.4.2-1focal.20220107.002506) ...
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Get:5 http://us-east-1.ec2.archive.ubuntu.com/ubuntu focal-updates/main amd64 Packages [1572 kB]
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roscore
started roslaunch server http://ip-172-31-86-152:35539/
```

i-0fbcc44bd3d0d4f974 (Exp)

Public IPs: 3.89.195.155 Private IPs: 172.31.86.152

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i-0fbcc44bd3d0d4f974 (Exp) | EC2 Instance Connect - Google Chrome
console.aws.amazon.com/ec2/v2/connect/ubuntu/i-0fbcc44bd3d0d4f974
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0 upgraded, 0 newly installed, 0 to remove and 56 not upgraded.
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  sudo apt-key add -
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ubuntu@ip-172-31-86-152:~$ sudo apt update
Hit:1 http://us-east-1.ec2.archive.ubuntu.com/ubuntu focal InRelease
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Get:3 http://us-east-1.ec2.archive.ubuntu.com/ubuntu focal-backports InRelease [108 kB]
Hit:4 http://security.ubuntu.com/ubuntu focal-security InRelease
Get:5 http://us-east-1.ec2.archive.ubuntu.com/ubuntu focal-updates/main amd64 Packages [1572 kB]
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roscore
started roslaunch server http://ip-172-31-86-152:35539/
```

i-0fbcc44bd3d0d4f974 (Exp)

Public IPs: 3.89.195.155 Private IPs: 172.31.86.152

Speakers (Realtek High Definition Audio): 42%

1-0

console.aws.amazon.com/ec2/v2/connect/ubuntu/i-0fbcc44bd3d0d4f97

```
Setting up ros-noetic-gmapping (1.4.2-1focal.20220107.002506) ...
Setting up ros-noetic-slam-gmapping (1.4.2-1focal.20220107.014410) ...
ubuntu@ip-172-31-86-152:~$ source /opt/ros/noetic/setup.bash
ubuntu@ip-172-31-86-152:~$ rosdistro list
ubuntu@ip-172-31-86-152:~$ rosdistro list -d
noetic
ubuntu@ip-172-31-86-152:~$ roscore
...
... logging to /home/ubuntu/.ros/log/e8aa5fc8-8e86-11ec-9eec-91e0d64c2e65/roslaunch-ip-172-31-86-152-48304.log
Checking log directory for disk usage. This may take a while.
Press Ctrl-C to interrupt
Done checking log file disk usage. Usage is <1GB.
oscore
started roslaunch server http://ip-172-31-86-152:35539/
ros_comm version 1.15.14
```

SUMMARY

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PARAMETERS

```
* /rosdistro: noetic
* /rosversion: 1.15.14
```

NODES

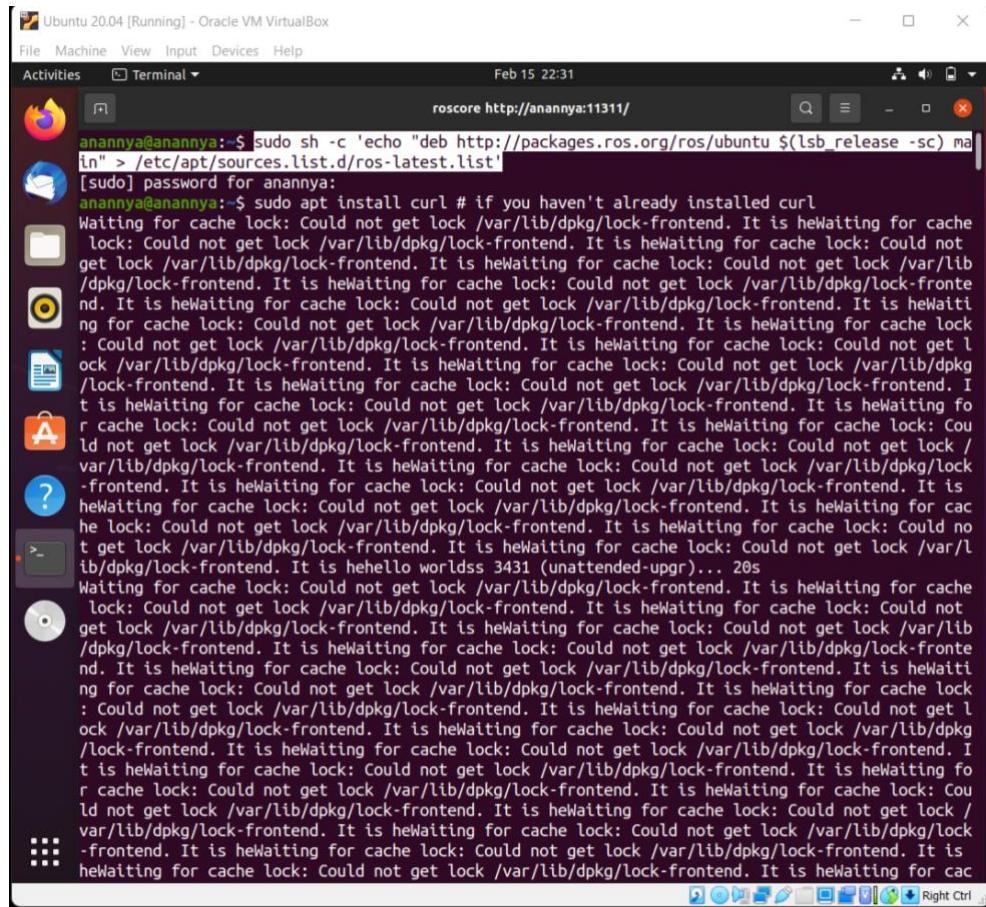
auto-starting new master

```
process[master]: started with pid [48314]
ROS_MASTER_URI=http://ip-172-31-86-152:11311/
oscore http://ip-172-31-86-152:11311/
setting /run_id to e8aa5fc8-8e86-11ec-9eec-91e0d64c2e65
process[rosout-1]: started with pid [48324]
started core service [/rosout]
```

i-0fbc44bd3d0d4f974 (Exp)

Public IPs: 3.89.195.155 Private IPs: 172.31.86.152

- I've also done the same in Ubuntu terminal



Ubuntu 20.04 [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Activities Terminal ▾ Feb 15 22:31

roscore http://anannya:11311/

The following packages were automatically installed and are no longer required:
libfprint-2-tod1 libl1m10
Use 'sudo apt autoremove' to remove them.

The following NEW packages will be installed:
curl
0 upgraded, 1 newly installed, 0 to remove and 188 not upgraded.
Need to get 161 kB of archives.
After this operation, 411 kB of additional disk space will be used.
Ign:1 http://in.archive.ubuntu.com/ubuntu focal-updates/main amd64 curl amd64 7.68.0-1ubuntu2.5
Err:1 http://security.ubuntu.com/ubuntu focal-updates/main amd64 curl amd64 7.68.0-1ubuntu2.5
404 Not Found [IP: 43.255.166.254 80]
E: Failed to fetch http://security.ubuntu.com/ubuntu/pool/main/c/curl/curl_7.68.0-1ubuntu2.5_amd64.deb 404 Not Found [IP: 43.255.166.254 80]
E: Unable to fetch some archives, maybe run apt-get update or try with --fix-missing?
anannya@anannya:~\$ hello world

anannya@anannya:~\$ sudo apt install curl
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following packages were automatically installed and are no longer required:
libfprint-2-tod1 libl1m10
Use 'sudo apt autoremove' to remove them.
The following NEW packages will be installed:
curl
0 upgraded, 1 newly installed, 0 to remove and 188 not upgraded.
Need to get 161 kB of archives.
After this operation, 411 kB of additional disk space will be used.
Ign:1 http://in.archive.ubuntu.com/ubuntu focal-updates/main amd64 curl amd64 7.68.0-1ubuntu2.5
Err:1 http://security.ubuntu.com/ubuntu focal-updates/main amd64 curl amd64 7.68.0-1ubuntu2.5
404 Not Found [IP: 43.255.166.254 80]
E: Failed to fetch http://security.ubuntu.com/ubuntu/pool/main/c/curl/curl_7.68.0-1ubuntu2.5_amd64.deb 404 Not Found [IP: 43.255.166.254 80]
E: Unable to fetch some archives, maybe run apt-get update or try with --fix-missing?
anannya@anannya:~\$ hello world

anannya@anannya:~\$ curl -s https://raw.githubusercontent.com/ros/rosdistro/master/ros.asc | sudo

```
Ubuntu 20.04 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal ▾ Feb 15 22:32
roscore http://anannya:11311/
anannya@anannya:~$ curl -s https://raw.githubusercontent.com/ros/rosdistro/master/ros.asc | sudo apt-key add -
Command 'curl' not found, but can be installed with:
  sudo snap install curl # version 7.76.1, or
  sudo apt install curl # version 7.68.0-1ubuntu2.5
See 'snap info curl' for additional versions.
gpg: no valid OpenPGP data found.

anannya@anannya:~$ curl -s https://raw.githubusercontent.com/ros/rosdistro/master/ros.asc | sudo apt-key add -
Command 'curl' not found, but can be installed with:
  sudo snap install curl # version 7.76.1, or
  sudo apt install curl # version 7.68.0-1ubuntu2.5
See 'snap info curl' for additional versions.
gpg: no valid OpenPGP data found.
anannya@anannya:~$ sudo apt install curl
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following packages were automatically installed and are no longer required:
  libfprint2-tod1 libllyvm10
Use 'sudo apt autoremove' to remove them.
The following NEW packages will be installed:
  curl
0 upgraded, 1 newly installed, 0 to remove and 188 not upgraded.
Need to get 161 kB of archives.
After this operation, 411 kB of additional disk space will be used.
Ign:1 http://in.archive.ubuntu.com/ubuntu focal-updates/main amd64 curl amd64 7.68.0-1ubuntu2.5
```

```
Ubuntu 20.04 [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities Terminal ▾ Feb 15 22:33
roscore http://anannya:11311/
gpg: no valid OpenPGP data found.
anannya@anannya:~$ sudo snap install curl
curl 7.81.0 from Wouter van Bommel (woutervb) installed
anannya@anannya:~$ curl -s https://raw.githubusercontent.com/ros/rosdistro/master/ros.asc | sudo apt-key add -
OK
anannya@anannya:~$ hello world

anannya@anannya:~$ sudo apt update
Hit:1 http://in.archive.ubuntu.com/ubuntu focal InRelease
Get:2 http://in.archive.ubuntu.com/ubuntu focal-updates InRelease [114 kB]
Get:3 http://security.ubuntu.com/ubuntu focal-security InRelease [114 kB]
Get:4 http://in.archive.ubuntu.com/ubuntu focal-backports InRelease [108 kB]
Ign:5 http://in.archive.ubuntu.com/ubuntu focal-updates/main amd64 Packages
Get:6 http://in.archive.ubuntu.com/ubuntu focal-updates/main i386 Packages [602 kB]
Get:7 http://security.ubuntu.com/ubuntu focal-security/main i386 Packages [376 kB]
Ign:8 http://in.archive.ubuntu.com/ubuntu focal-updates/main Translation-en
Get:9 http://in.archive.ubuntu.com/ubuntu focal-updates/main amd64 DEP-11 Metadata [282 kB]
Get:10 http://packages.ros.org/ros/ubuntu focal InRelease [4,676 B]
Ign:11 http://in.archive.ubuntu.com/ubuntu focal-updates/main DEP-11 48x48 Icons
Get:12 http://in.archive.ubuntu.com/ubuntu focal-updates/main DEP-11 64x64 Icons [98.3 kB]
Ign:13 http://security.ubuntu.com/ubuntu focal-security/main amd64 Packages
Get:14 http://packages.ros.org/ros/ubuntu focal/main i386 Packages [18.5 kB]
Ign:15 http://in.archive.ubuntu.com/ubuntu focal-updates/main amd64 c-n-f Metadata
Get:16 http://security.ubuntu.com/ubuntu focal-security/main Translation-en [217 kB]
Get:17 http://in.archive.ubuntu.com/ubuntu focal-updates/restricted amd64 Packages [801 kB]
Get:18 http://packages.ros.org/ros/ubuntu focal/main amd64 Packages [640 kB]
Ign:19 http://security.ubuntu.com/ubuntu focal-security/main amd64 DEP-11 Metadata
Get:20 http://security.ubuntu.com/ubuntu focal-security/main DEP-11 48x48 Icons [18.3 kB]
Ign:21 http://in.archive.ubuntu.com/ubuntu focal-updates/restricted i386 Packages
Ign:22 http://security.ubuntu.com/ubuntu focal-security/main DEP-11 64x64 Icons
Get:23 http://in.archive.ubuntu.com/ubuntu focal-updates/restricted Translation-en [114 kB]
Ign:24 http://in.archive.ubuntu.com/ubuntu focal-updates/restricted amd64 c-n-f Metadata
Get:25 http://security.ubuntu.com/ubuntu focal-security/main amd64 c-n-f Metadata [9,560 B]
Ign:26 http://security.ubuntu.com/ubuntu focal-security/restricted i386 Packages
Get:27 http://in.archive.ubuntu.com/ubuntu focal-updates/universe i386 Packages [667 kB]
Get:28 http://security.ubuntu.com/ubuntu focal-security/restricted amd64 Packages [748 kB]
```

Ubuntu 20.04 [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Activities Terminal Feb 15 22:33

roscore http://anannya:11311/

```
gpg: no valid OpenPGP data found.
anannya@anannya:~$ sudo snap install curl
curl 7.81.0 from Wouter van Bommel (woutervb) installed
anannya@anannya:~$ curl -s https://raw.githubusercontent.com/ros/rosdistro/master/ros.asc | sudo apt-key add -
OK
anannya@anannya:~$ hello world
anannya@anannya:~$ sudo apt update
Hit:1 http://in.archive.ubuntu.com/ubuntu focal InRelease
Get:2 http://in.archive.ubuntu.com/ubuntu focal-updates InRelease [114 kB]
Get:3 http://security.ubuntu.com/ubuntu focal-security InRelease [114 kB]
Get:4 http://in.archive.ubuntu.com/ubuntu focal-backports InRelease [108 kB]
Ign:5 http://in.archive.ubuntu.com/ubuntu focal-updates/main amd64 Packages
Get:6 http://in.archive.ubuntu.com/ubuntu focal-updates/main i386 Packages [602 kB]
Get:7 http://security.ubuntu.com/ubuntu focal-security/main i386 Packages [376 kB]
Ign:8 http://in.archive.ubuntu.com/ubuntu focal-updates/main Translation-en
Get:9 http://in.archive.ubuntu.com/ubuntu focal-updates/main amd64 DEP-11 Metadata [282 kB]
Get:10 http://packages.ros.org/ros/ubuntu focal InRelease [4,676 B]
Ign:11 http://in.archive.ubuntu.com/ubuntu focal-updates/main DEP-11 48x48 Icons
Get:12 http://in.archive.ubuntu.com/ubuntu focal-updates/main DEP-11 64x64 Icons [98.3 kB]
Ign:13 http://security.ubuntu.com/ubuntu focal-security/main amd64 Packages
Get:14 http://packages.ros.org/ros/ubuntu focal/main i386 Packages [18.5 kB]
Ign:15 http://in.archive.ubuntu.com/ubuntu focal-updates/main amd64 c-n-f Metadata
Get:16 http://security.ubuntu.com/ubuntu focal-security/main Translation-en [217 kB]
Get:17 http://in.archive.ubuntu.com/ubuntu focal-updates/restricted amd64 Packages [801 kB]
Get:18 http://packages.ros.org/ros/ubuntu focal/main amd64 Packages [640 kB]
Ign:19 http://security.ubuntu.com/ubuntu focal-security/main amd64 DEP-11 Metadata
Get:20 http://security.ubuntu.com/ubuntu focal-security/main DEP-11 48x48 Icons [18.3 kB]
Ign:21 http://in.archive.ubuntu.com/ubuntu focal-updates/restricted i386 Packages
Ign:22 http://security.ubuntu.com/ubuntu focal-security/main DEP-11 64x64 Icons
Get:23 http://in.archive.ubuntu.com/ubuntu focal-updates/restricted Translation-en [114 kB]
Ign:24 http://in.archive.ubuntu.com/ubuntu focal-updates/restricted amd64 c-n-f Metadata
Get:25 http://security.ubuntu.com/ubuntu focal-security/main amd64 c-n-f Metadata [9,560 B]
Ign:26 http://security.ubuntu.com/ubuntu focal-security/restricted i386 Packages
Get:27 http://in.archive.ubuntu.com/ubuntu focal-updates/universe i386 Packages [667 kB]
Get:28 http://security.ubuntu.com/ubuntu focal-security/restricted amd64 Packages [748 kB]
```

Right Ctrl

Ubuntu 20.04 [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Activities Terminal Feb 15 22:34

roscore http://anannya:11311/

```
anannya@anannya:~$ sudo apt install ros-noetic-desktop-full
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following package was automatically installed and is no longer required:
  libfprint-2-tod1
Use 'sudo apt autoremove' to remove it.
The following additional packages will be installed:
  autoconf automake autopoint autotools-dev binfmt-support blt bzip2-doc cmake
  cmake-data comerr-dev cpp-8 cython3 debhelper default-libmysqlclient-dev dh-autoreconf
  dh-strip-nondeterminism docutils-common dwz fltk1.3-doc fluid fonts-lato fonts-lyx
  freeglut3 freeglut3-dev gazebo11 gazebo11-common gazebo11-plugin-base gcc-10-base
  gcc-8 gcc-8-base gdal-data gettext gfortran gfortran-8 gfortran-9 gir1.2-gtk-2.0
  gir1.2-harfbuzz-0.0 google-mock googletest graphviz hdf5-helpers
  iverbs-providers icu-devtools ignition-tools intltool-debian javascript-common
  krb5-multidev libaec-dev libaec0 libann0 libapr1 libapr1-dev libaprutil1
  libaprutil1-dev libarchive-cpio-perl libarchive-zip-perl libarmadillo-dev
  libarmadillo9 libarpack2 libarpack2-dev libassimp-dev libassimp5 libassuan-dev
  libatk1.0-dev libatomic1 libavcodec-dev libavdevice-dev libavdevice58 libavfilter-dev
  libavformat-dev libavresample-dev libavresample4 libavutil-dev libblas-dev libblas3
  libblkid-dev libblkid1 libboost-all-dev libboost-atomic-dev libboost-atomic1.71-dev
  libboost-atomic1.71.0 libboostchrono-dev libboostchrono1.71-dev
  libboostcontainer1.71.0 libboostcontainer-dev libboostcontainer1.71-dev
  libboostcontext1.71.0 libboostcontext-dev libboostcontext1.71-dev
  libboostcoroutine1.71.0 libboostcoroutine-dev libboostcoroutine1.71-dev
  libboost-dev libboost-exception-dev libboostexception1.71-dev libboost-fiber-dev
  libboostfiber1.71-dev libboostfiber1.71.0 libboostfilesystem-dev
  libboostfilesystem1.71-dev libboostgraph-dev libboostgraphparallel-dev
  libboostgraphparallel1.71-dev libboostgraphparallel1.71.0 libboostgraph1.71-dev
  libboostgraph1.71.0 libboostiostreams-dev libboostiostreams1.71-dev
  libboostlocale-dev libboostlocale1.71-dev libboostlog-dev libboostlog1.71-dev
  libboostlog1.71.0 libboostmath-dev libboostmath1.71-dev libboostmath1.71.0
  libboostmpi-dev libboostmpi-dev libboostmpi1.71-dev libboostmpi1.71.0 libboostnumpy-dev
  libboostnumpy1.71-dev libboostnumpy1.71.0 libboostprogramoptions-dev
  libboostprogramoptions1.71-dev libboostprogramoptions1.71.0 libboostpython-dev
```

Right Ctrl

Ubuntu 20.04 [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Activities Terminal Feb 15 22:36

roscore http://anannya:11311/

```
anannya@anannya:~$ sudo apt update
Hit:1 http://in.archive.ubuntu.com/ubuntu focal InRelease
Get:2 http://in.archive.ubuntu.com/ubuntu focal-updates InRelease [114 kB]
Get:3 http://security.ubuntu.com/ubuntu focal-security InRelease [114 kB]
Hit:4 http://packages.ros.org/ros/ubuntu focal InRelease
Hit:5 http://in.archive.ubuntu.com/ubuntu focal-backports InRelease
Get:6 http://security.ubuntu.com/ubuntu focal-security/main amd64 DEP-11 Metadata [40.7 kB]
Get:7 http://security.ubuntu.com/ubuntu focal-security/universe amd64 DEP-11 Metadata [66.5 kB]
Get:8 http://security.ubuntu.com/ubuntu focal-security/multiverse amd64 DEP-11 Metadata [2,464 B]
Fetched 337 kB in 3s (116 kB/s)
hello world
Reading package lists... Done
Building dependency tree
Reading state information... Done
372 packages can be upgraded. Run 'apt list --upgradable' to see them.
anannya@anannya:~$ hello world
```

Ubuntu 20.04 [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

Activities Terminal Feb 15 22:36

roscore http://anannya:11311/

```
anannya@anannya:~$ sudo apt install ros-noetic-slam-gmapping
[sudo] password for anannya:
Sorry, try again.
[sudo] password for anannya:
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following packages were automatically installed and are no longer required:
  libfprint-2-tod1 libl1v10
Use 'sudo apt autoremove' to remove them.
The following additional packages will be installed:
  autoconf automake autotools-dev bzip2-doc cmake cmake-data cpp-8
  default-libmysqlclient-dev docutils-common gcc-10-base gcc-8 gcc-8-base gfortran
  gfortran-8 gfortran-9 google-mock googletest graphviz ibverbs-providers icu-devtools
  libanano libapr1 libapr1-dev libaprutil1 libaprutil1-dev libbassuan-dev libatomic1
  libblas3 libboost-all-dev libboost-atomic-dev libboost-atomic1.71-dev
  libboost-atomic1.71.0 libboost-chrono-dev libboost-chrono1.71-dev
  libboost-chrono1.71.0 libboost-container-dev libboost-container1.71-dev
  libboost-container1.71.0 libboost-context-dev libboost-context1.71-dev
  libboost-context1.71.0 libboost-coroutine-dev libboost-coroutine1.71-dev
  libboost-coroutine1.71.0 libboost-date-time-dev libboost-date-time1.71-dev
  libboost-dev libboost-exception-dev libboost-exception1.71-dev libboost-fiber-dev
  libboost-fiber1.71-dev libboost-fiber1.71.0 libboost-filesystem-dev
  libboost-filesystem1.71-dev libboost-graph-dev libboost-graph-parallel-dev
  libboost-graph-parallel1.71-dev libboost-graph-parallel1.71.0 libboost-graph1.71-dev
  libboost-graph1.71.0 libboost-iostreams-dev libboost-iostreams1.71-dev
  libboost-locale-dev libboost-locale1.71-dev libboost-log-dev libboost-log1.71-dev
  libboost-log1.71.0 libboost-math-dev libboost-math1.71-dev libboost-math1.71.0
  libboost-mpi-dev libboost-mpi-python-dev libboost-mpi1.71-dev
  libboost-mpi1.71.0 libboost-mpi1.71.0 libboost-numpy-dev
  libboost-numpy1.71-dev libboost-numpy1.71.0 libboost-program-options-dev
  libboost-program-options1.71-dev libboost-program-options1.71.0 libboost-python-dev
  libboost-python1.71-dev libboost-python1.71.0 libboost-random-dev
  libboost-random1.71-dev libboost-random1.71.0 libboost-regex-dev
  libboost-regex1.71-dev libboost-regex1.71.0 libboost-serialization-dev
  libboost-serialization1.71-dev libboost-serialization1.71.0 libboost-stacktrace-dev
  libboost-stacktrace1.71-dev libboost-stacktrace1.71.0 libboost-system-dev
```

