

# Working with Virtual Machines

## Overview

In this lab, you set up a game application—a Minecraft server.

The Minecraft server software will run on a Compute Engine instance.

You use an e2-medium machine type that includes a 10-GB boot disk, 2 virtual CPU (vCPU), and 4 GB of RAM. This machine type runs Debian Linux by default.

To make sure there is plenty of room for the Minecraft server's world data, you also attach a high-performance 50-GB persistent solid-state drive (SSD) to the instance. This dedicated Minecraft server can support up to 50 players.


## Objectives

In this lab, you learn how to perform the following tasks:

- Customize an application server
- Install and configure necessary software
- Configure network access
- Schedule regular backups

## Task 1. Create the VM

### Define a VM using advanced options

1. In the Cloud Console, on the **Navigation menu** () , click **Compute Engine > VM instances**.
2. Click **Create Instance**.
3. Specify the following and leave the remaining settings as their defaults:

Property	Value (type value or select option as specified)
Name	mc-server
Region	us-central1
Zone	us-central1-a

<b>Boot disk</b>	Debian GNU/Linux 11 (bullseye)
<b>Identity and API access &gt; Access scopes</b>	Set access for each API
<b>Storage</b>	Read Write

4. Click **Advanced options**.
5. Click **Disks**. You will add a disk to be used for game storage.
6. Click **Add new disk**.
7. Specify the following and leave the remaining settings as their defaults:

Property	Value (type value or select option as specified)
<b>Name</b>	minecraft-disk
<b>Disk type</b>	SSD Persistent Disk
<b>Disk Source type</b>	Blank disk
<b>Size (GB)</b>	50
<b>Encryption</b>	Google-managed encryption key

8. Click **Save**. This creates the disk and automatically attaches it to the VM when the VM is created.
9. Click **Networking**.
10. Specify the following and leave the remaining settings as their defaults:

Property	Value (type value or select option as specified)
Network tags	minecraft-server
Network interfaces	Click <b>default</b> to edit the interface
External IPv4 address	Reserve Static External IP Address
Name	mc-server-ip

11.

Click **Reserve**.

12. Click **Done**.

13. Click **Create**.

## Task 2. Prepare the data disk

### Create a directory and format and mount the disk

The disk is attached to the instance, but it is not yet mounted or formatted.

1. For **mc-server**, click **SSH** to open a terminal and connect.
2. To create a directory that serves as the mount point for the data disk, run the following command:

```
sudo mkdir -p /home/minecraft
```

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3. To format the disk, run the following command:

```
sudo mkfs.ext4 -F -E lazy_itable_init=0,\  
lazy_journal_init=0,discard \  
/dev/disk/by-id/google-minecraft-disk
```

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Result (this is example output):

```
mke2fs 1.42.12 (29-Aug-2014)  
Discarding device blocks: done  
Creating filesystem with 13107200 4k blocks and 3276800 inodes  
Filesystem UUID: 3d5b0563-f29e-4107-ad1a-ba7bf11dcf7c  
Superblock backups stored on blocks:  
    32768, 98304, 163840, 229376, 294912, 819200, 884736, 1605632,  
2654208,  
    4096000, 7962624, 11239424  
Allocating group tables: done  
Writing inode tables: done  
Creating journal (32768 blocks): done  
Writing superblocks and filesystem accounting information: done
```

4. To mount the disk, run the following command:

```
sudo mount -o discard,defaults /dev/disk/by-id/google-minecraft-disk  
/home/minecraft
```

No output is displayed after the disk is mounted.

## Task 3. Install and run the application

The Minecraft server runs on top of the Java Virtual Machine (JVM), so it requires the Java Runtime Environment (JRE) to run. Because the server doesn't need a graphical user interface, you use the headless version of the JRE. This reduces the JRE's resource usage on the machine, which helps ensure that the Minecraft server has enough room to expand its own resource usage if needed.

### Install the Java Runtime Environment (JRE) and the Minecraft server

1. In the SSH terminal for **mc-server**, to update the Debian repositories on the VM, run the following command:

```
sudo apt-get update
```

2. After the repositories are updated, to install the headless JRE, run the following command:

```
sudo apt-get install -y default-jre-headless
```

3. To navigate to the directory where the persistent disk is mounted, run the following command:

```
cd /home/minecraft
```

4. To install **wget**, run the following command:

```
sudo apt-get install wget
```

5. If prompted to continue, type **Y**.
6. To download the current Minecraft server JAR file (1.11.2 JAR), run the following command:

```
sudo wget
```

```
https://launcher.mojang.com/v1/objects/d0d0fe2b1dc6ab4c65554cb734270872b72dadd6/server.jar
```

## Initialize the Minecraft server

1. To initialize the Minecraft server, run the following command:

```
sudo java -Xmx1024M -Xms1024M -jar server.jar nogui
```

Result (**example output**):

```
[21:01:54] [main/ERROR]: Failed to load properties from file:
server.properties
[21:01:54] [main/WARN]: Failed to load eula.txt
[21:01:54] [main/INFO]: You need to agree to the EULA in order to run
the server. Go to eula.txt for more info.
```

**Note:** The Minecraft server won't run unless you accept the terms of the End User Licensing Agreement (EULA).

2. To see the files that were created in the first initialization of the Minecraft server, run the following command:

```
sudo ls -l
```

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**Note:** You could edit the `server.properties` file to change the default behavior of the Minecraft server.

3. To edit the EULA, run the following command:

```
sudo nano eula.txt
```

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4. Change the last line of the file from `eula=false` to `eula=true`.
5. Press **Ctrl+O**, **ENTER** to save the file and then press **Ctrl+X** to exit nano.

**Note:** Don't try to restart the Minecraft server yet. You use a different technique in the next procedure.

## Create a virtual terminal screen to start the Minecraft server

If you start the Minecraft server again now, it is tied to the life of your SSH session: that is, if you close your SSH terminal, the server is also terminated. To avoid this issue, you can use `screen`, an application that allows you to create a virtual terminal that can be "detached," becoming a background process, or "reattached," becoming a foreground process. When a virtual terminal is detached to the background, it will run whether you are logged in or not.

1. To install `screen`, run the following command:

```
sudo apt-get install -y screen
```



2. To start your Minecraft server in a **screen** virtual terminal, run the following command (using the **-S** flag to name your terminal **mcs**):

```
sudo screen -S mcs java -Xmx1024M -Xms1024M -jar server.jar nogui
```

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Result (example output):

```
...
[21:06:06] [Server-Worker-1/INFO]: Preparing spawn area: 83%
[21:06:07] [Server-Worker-1/INFO]: Preparing spawn area: 85%
[21:06:07] [Server-Worker-1/INFO]: Preparing spawn area: 86%
[21:06:08] [Server-Worker-1/INFO]: Preparing spawn area: 88%
[21:06:08] [Server-Worker-1/INFO]: Preparing spawn area: 89%
[21:06:09] [Server-Worker-1/INFO]: Preparing spawn area: 91%
[21:06:09] [Server-Worker-1/INFO]: Preparing spawn area: 93%
[21:06:10] [Server-Worker-1/INFO]: Preparing spawn area: 95%
[21:06:10] [Server-Worker-1/INFO]: Preparing spawn area: 98%
[21:06:11] [Server-Worker-1/INFO]: Preparing spawn area: 99%
[21:06:11] [Server thread/INFO]: Time elapsed: 55512 ms
[21:06:11] [Server thread/INFO]: Done (102.484s)! For help, type "help"
```

## Detach from the screen and close your SSH session

1. To detach the screen terminal, press **Ctrl+A, Ctrl+D**. The terminal continues to run in the background. To reattach the terminal, run the following command:

```
sudo screen -r mcs
```


2. If necessary, exit the screen terminal by pressing **Ctrl+A, Ctrl+D**.
3. To exit the SSH terminal, run the following command:

```
exit
```

## Task 4. Allow client traffic

Up to this point, the server has an external static IP address, but it cannot receive traffic because there is no firewall rule in place. Minecraft server uses TCP port 25565 by default. So you need to configure a firewall rule to allow these connections.

### Create a firewall rule

1. In the Cloud Console, on the **Navigation menu** () , click **VPC network > Firewall**.
2. Click **Create firewall rule**.
3. Specify the following and leave the remaining settings as their defaults:

Property	Value (type value or select option as specified)
Name	minecraft-rule
Target	Specified target tags
Target tags	minecraft-server
Source filter	IPv4 ranges
Source IPv4 ranges	0.0.0.0/0
Protocols and ports	Specified protocols and ports

4.

For **tcp**, specify port **25565**.

5. Click **Create**. Users can now access your server from their Minecraft clients.

## Verify server availability

1. In the left pane, click **IP addresses**.
2. Locate and copy the **External IP address** for the **mc-server** VM.
3. Use [Minecraft Server Status](#) to test your Minecraft server.

**Note:** If the above website is not working, you can use a different site or the Chrome extension:

- [Minecraft Server Status Checker](#)

## Task 5. Schedule regular backups

Backing up your application data is a common activity. In this case, you configure the system to back up Minecraft world data to Cloud Storage.

### Create a Cloud Storage bucket

1. On the **Navigation menu** (≡), click **Compute Engine > VM instances**.
2. For **mc-server**, click **SSH**.

3. Create a globally unique bucket name, and store it in the environment variable `YOUR_BUCKET_NAME`. To make it unique, you can use your Project ID. Run the following command:

```
export YOUR_BUCKET_NAME=<Enter your bucket name here>
```

4. Verify it with echo:

```
echo $YOUR_BUCKET_NAME
```

5. To create the bucket using the `gcloud` storage tool, part of the Cloud SDK, run the following command:

```
gcloud storage buckets create gs://$YOUR_BUCKET_NAME-minecraft-backup
```

**Note:** If this command failed, you might not have created a unique bucket name. If so, choose another bucket name, update your environment variable, and try to create the bucket again.

**Note:** To make this environment variable permanent, you can add it to the root's **.profile** by running this command:

```
echo YOUR_BUCKET_NAME=$YOUR_BUCKET_NAME >> ~/.profile
```

## Create a backup script

1. In the mc-server SSH terminal, navigate to your home directory:

```
cd /home/minecraft
```

2. To create the script, run the following command:

```
sudo nano /home/minecraft/backup.sh
```

3. Copy and paste the following script into the file:

```
#!/bin/bash
screen -r mcs -X stuff '/save-all\n/save-off\n'
/usr/bin/gcloud storage cp -R ${BASH_SOURCE%/*}/world
gs://${YOUR_BUCKET_NAME}-minecraft-backup/$(date
"+%Y%m%d-%H%M%S")-world
screen -r mcs -X stuff '/save-on\n'
```

4. Press **Ctrl+O**, **ENTER** to save the file, and press **Ctrl+X** to exit nano.

**Note:** The script saves the current state of the server's world data and pauses the server's auto-save functionality. Next, it backs up the server's world data directory (world) and places its contents in a timestamped directory (<timestamp>-world) in the Cloud Storage bucket. After the script finishes backing up the data, it resumes auto-saving on the Minecraft server.

5. To make the script executable, run the following command:

```
sudo chmod 755 /home/minecraft/backup.sh
```

## Test the backup script and schedule a cron job

1. In the mc-server SSH terminal, run the backup script:

```
. /home/minecraft/backup.sh
```

2. After the script finishes, return to the Cloud Console.
3. To verify that the backup file was written, on the **Navigation menu** (☰), click **Cloud Storage > Buckets**.
4. Click on the backup bucket name. You should see a folder with a date-time stamp name. Now that you've verified that the backups are working, you can schedule a cron job to automate the task.

5. In the mc-server SSH terminal, open the cron table for editing:

```
sudo crontab -e
```

6. When you are prompted to select an editor, type the number corresponding to **nano**, and press **ENTER**.
7. At the bottom of the cron table, paste the following line:

```
0 */4 * * * /home/minecraft/backup.sh
```

**Note:** That line instructs cron to run backups every 4 hours.

8. Press **Ctrl+O**, **ENTER** to save the cron table, and press **Ctrl+X** to exit nano.

**Note:** This creates about 300 backups a month in Cloud Storage, so you will want to regularly delete them to avoid charges. Cloud Storage offers the Object Lifecycle Management feature to set a Time to Live (TTL) for objects, archive older versions of objects, or "downgrade" storage classes of objects to help manage costs.

## Task 6. Server maintenance

To perform server maintenance, you need to shut down the server.

### Connect via SSH to the server, stop it and shut down the VM

1. In the mc-server SSH terminal, run the following command:

```
sudo screen -r -X stuff '/stop\n'
```

2. In the Cloud Console, on the **Navigation menu** (☰), click **Compute Engine > VM instances**.
3. Click **mc-server**.
4. Click **Stop**.
5. In the confirmation dialog, click **Stop** to confirm. You will be logged out of your SSH session.

**Note:** To start up your instance again, visit the instance page and then click **Start**. To start the Minecraft server again, you can establish an SSH connection with the instance, remount your persistent disk, and start your Minecraft server in a new screen terminal, just as you did previously.

## Automate server maintenance with startup and shutdown scripts

Instead of following the manual process to mount the persistent disk and launch the server application in a screen, you can use metadata scripts to create a startup script and a shutdown script to do this for you.

1. Click **mc-server**.
2. Click **Edit**.
3. For **Metadata**, click **+ Add Item** and specify the following:

Key	Value
startup-script-url	https://storage.googleapis.com/cloud-training/archinfra/mcserver/startup.sh

<b>shutdown-script-url</b>	<a href="https://storage.googleapis.com/cloud-training/archinfra/mcserver/shutdown.sh">https://storage.googleapis.com/cloud-training/archinfra/mcserver/shutdown.sh</a>
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**Note:** You'll have to click **Add item** to add the shutdown-script-url. When you restart your instance, the startup script automatically mounts the Minecraft disk to the appropriate directory, starts your Minecraft server in a screen session, and detaches the session. When you stop the instance, the shutdown script shuts down your Minecraft server before the instance shuts down. It's a best practice to store these scripts in Cloud Storage.

4. Click **Save**.

## Task 7. Review

In this lab, you created a customized virtual machine instance by installing base software (a headless JRE) and application software (a Minecraft game server). You customized the VM by attaching and preparing a high-speed SSD data disk, and you reserved a static external IP so the address would remain consistent. Then you verified availability of the gaming server online.

You set up a backup system to back up the server's data to a Cloud Storage bucket, and you tested the backup system. Then you automated backups using cron. Finally, you set up maintenance scripts using metadata for graceful startup and shutdown of the server.