Pandit Deendayal Energy University
School of Technology
Cloud Computing – Lab (20CP322P)
B.Tech-Computer Science & Engineering (Sem-VI)

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Lab 7 Assignment
Simulate a cloud scenario using CloudSim

Aim: To Simulate Cloud Environment by adding datacenters and cloudlets of different Topology.

Perform the following:

1. Create a datacenter with one host and run one cloudlet on it.
2. Create two datacenters with one host and a network topology each and run two cloudlets on them.
3. Create two datacenters with one host each and run cloudlets of two users with network topology on them.
4. Create two datacenters with one host each and run two cloudlets on them.
5. Create two datacenters with one host each and run cloudlets of two users on them.
6. Pause and resume the simulation, and create simulation entities (a DatacenterBroker in this example) dynamically.
7. *Perform VM migration between Datacenters considering them as different cloud providers.
    a. Manually
    b. Considering CPU Utilization threshold as criterion for VM migration.
    c. When Simulation clock reaches at specific time.

*Note: (You may use CloudSim Plus for VM Migration)

Experiment:

- **CloudSim Installation and Simulation of cloud environment using CloudSim:**

Theory:

What is CloudSim?

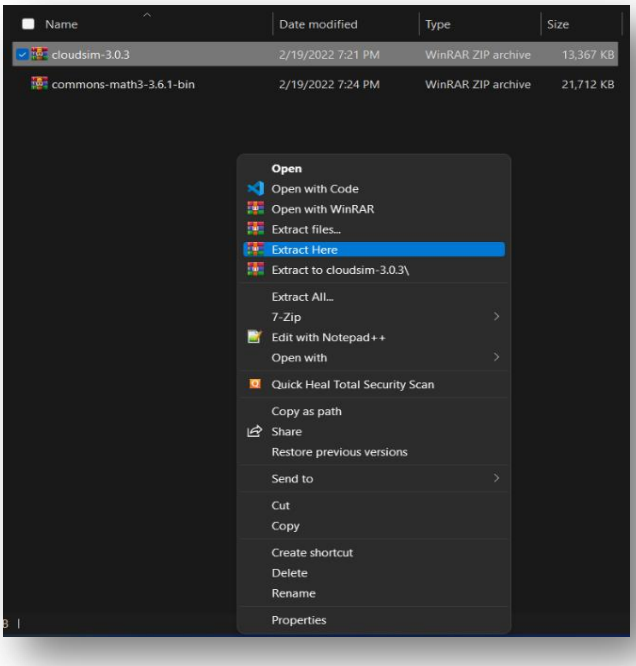
CloudSim is an open-source framework, which is used to simulate cloud computing infrastructure and services. It is developed by the CLOUDS Lab organization and is written entirely in Java. It is used for modelling and simulating a cloud computing environment as a means for evaluating a hypothesis prior to software development in order to reproduce tests and results.

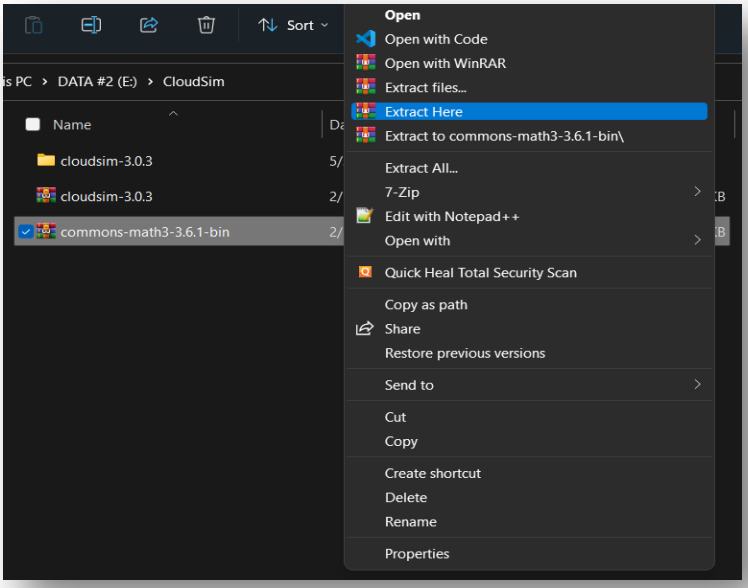
Procedure:

- **Steps for installation of CloudSim on Windows:**

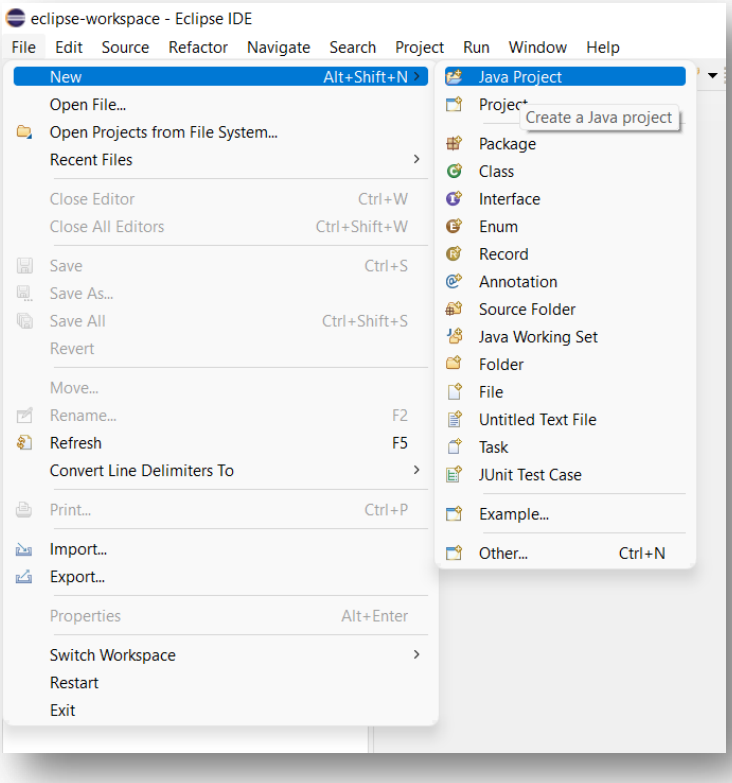
  - Download/Install the following resources on your local system before you start to setup CloudSim.
    - Java Development Kit(JDK)
    - Eclipse IDE for Java developers
    - Download CloudSim source code
    - One external requirement of Cloudsim (common jar package of math-related functions)

    Now unzip Eclipse, CloudSim and Common Math libraries to some common folder.

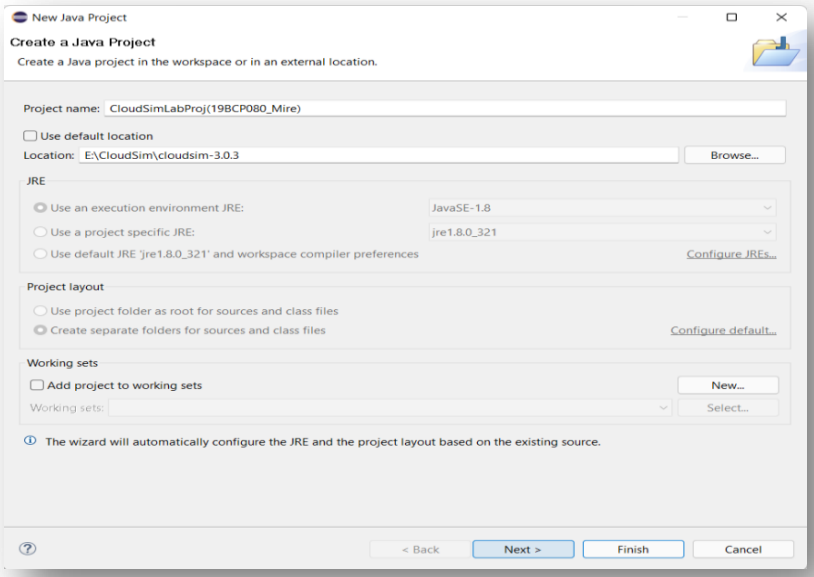




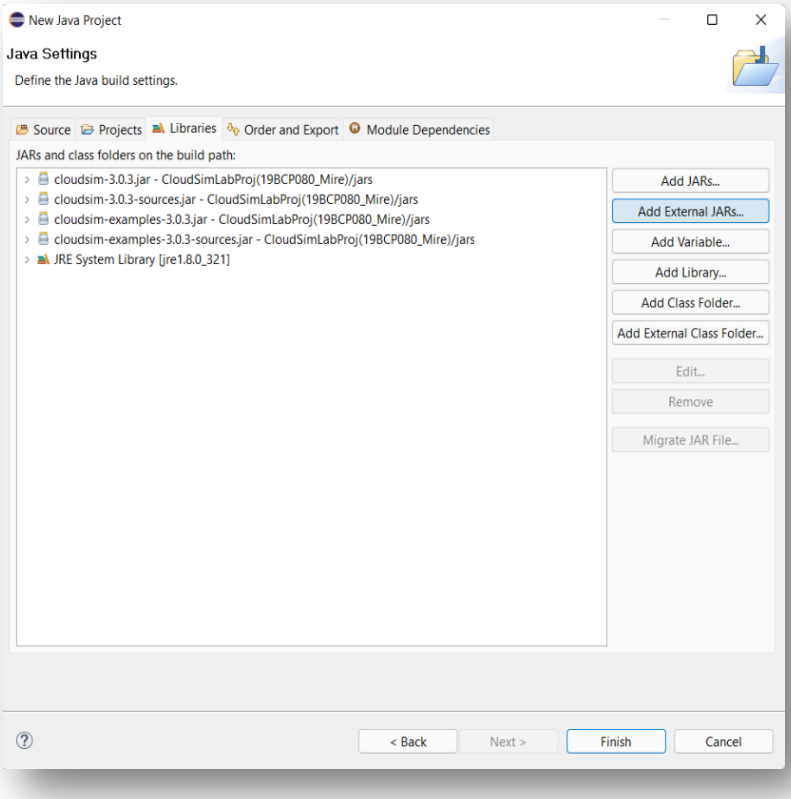
Open Eclipse and navigate the menu: File → New →Java Project, to open the 'New Java Project' wizard.



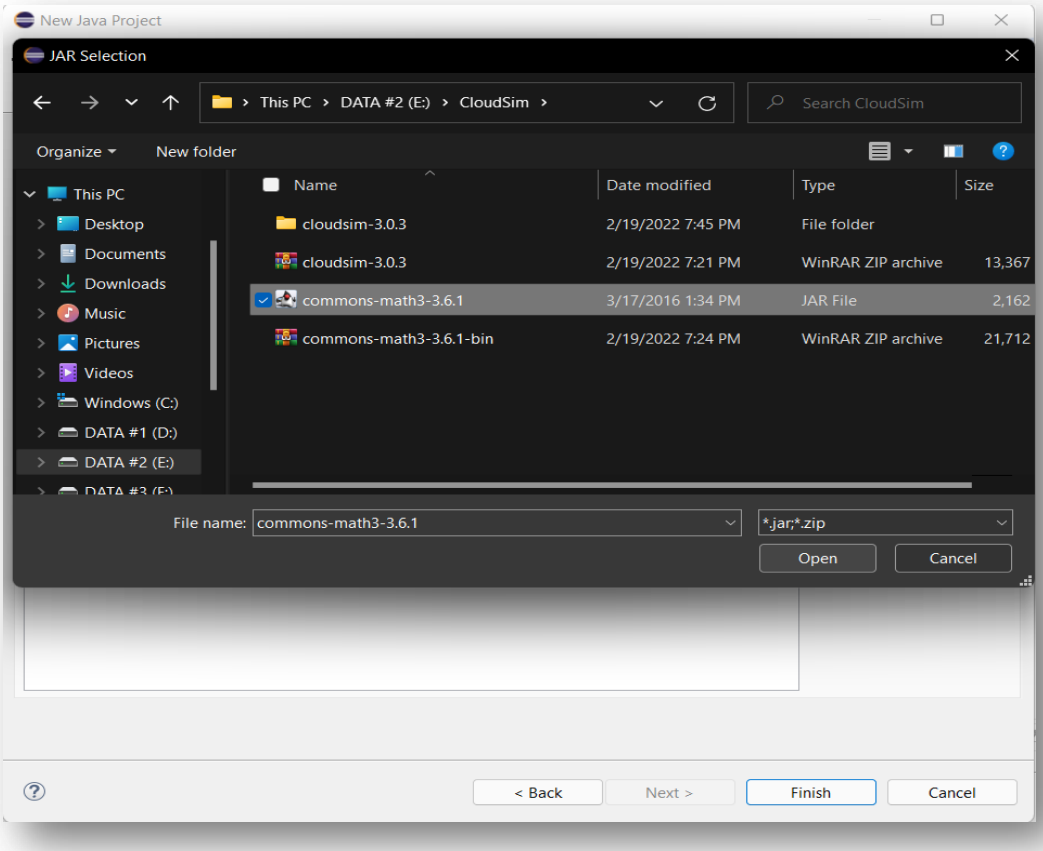
Provide the name to your java project. After then unselect the 'Use default location' option and then click on 'Browse' to open the path where you have unzipped the CloudSim project and then click 'Next' to set project settings. (Make sure you navigate the path till you can see the bin, docs, examples etc folder in the navigation plane.)



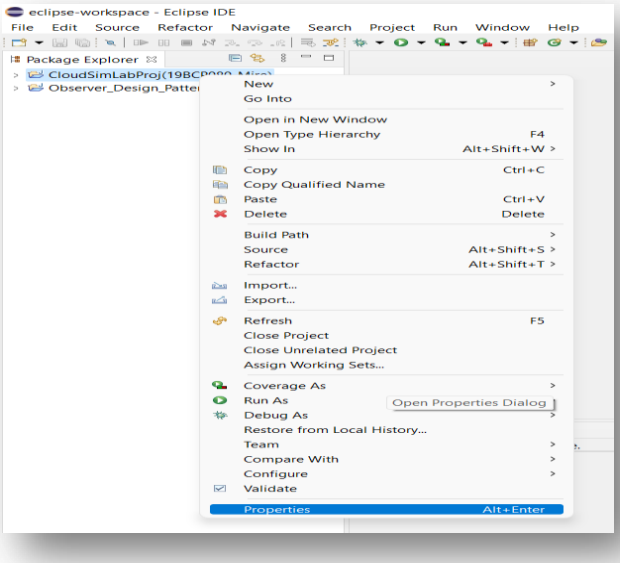
→ Now open 'Libraries' tab and if you do not find commons-math3-3.x.jar (here 'x' means the minor version release of the library which could be 2 or greater) in the list then simply click on 'Add External Jar'.

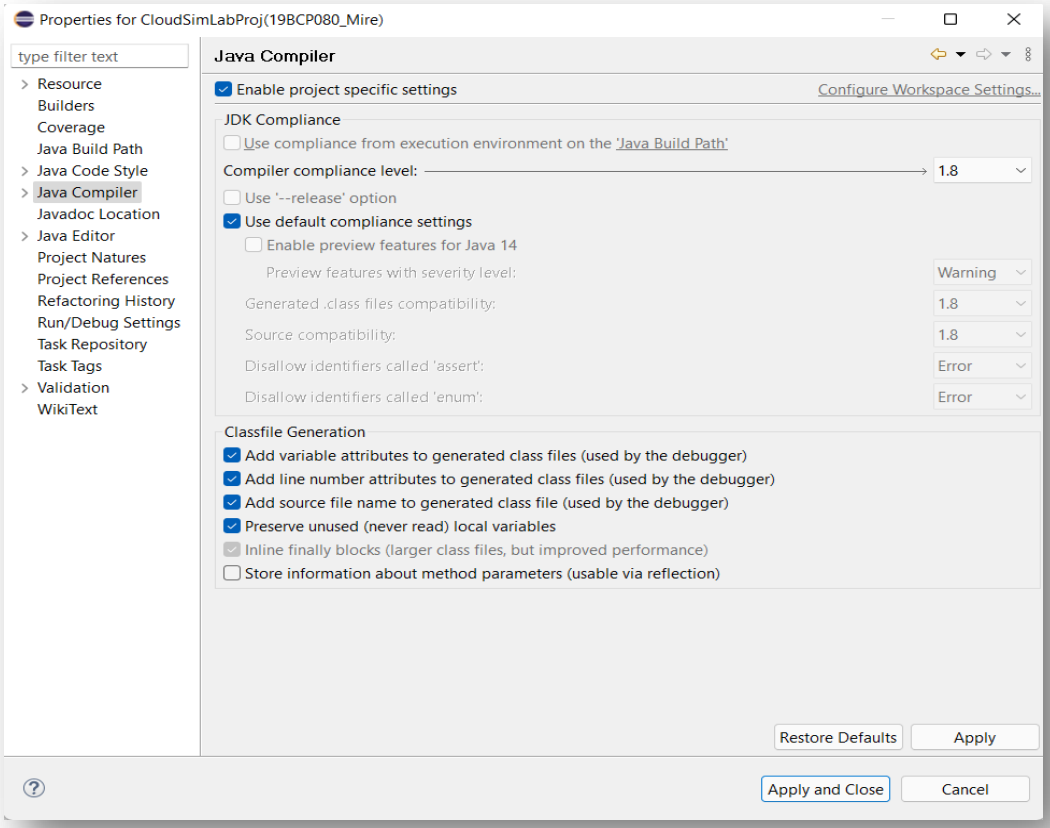


→ Once you have clicked on ‘Add External JARs’ Open the path where you have unzipped the commons-math binaries and select ‘Commons-math3-3.x.jar’ and click on ‘open’, and after then click on ‘Finish’.

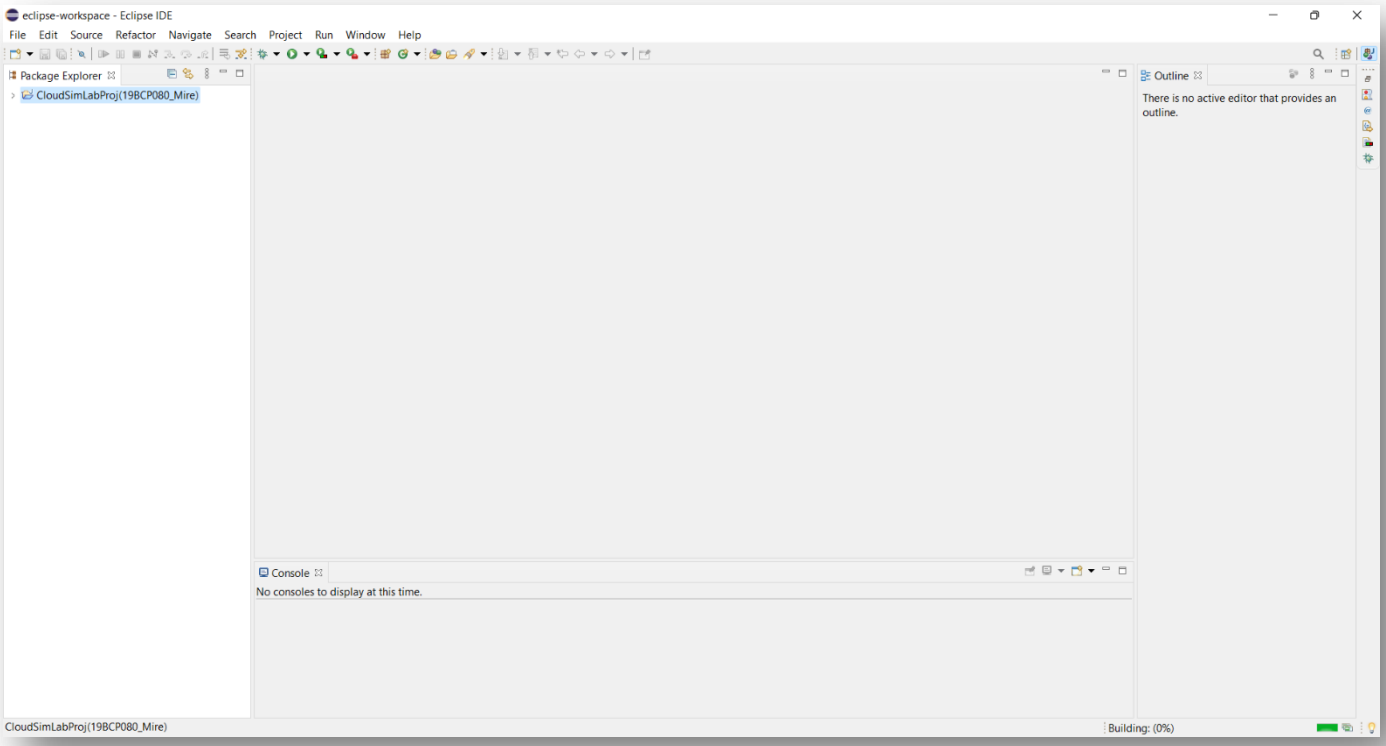


→ To avoid getting an error, you have to download and install the latest java version from Oracle/Java website. And second you have to do some modifications in the eclipse project, and for this, do as per following steps and after modification click on ‘Apply and Close’.



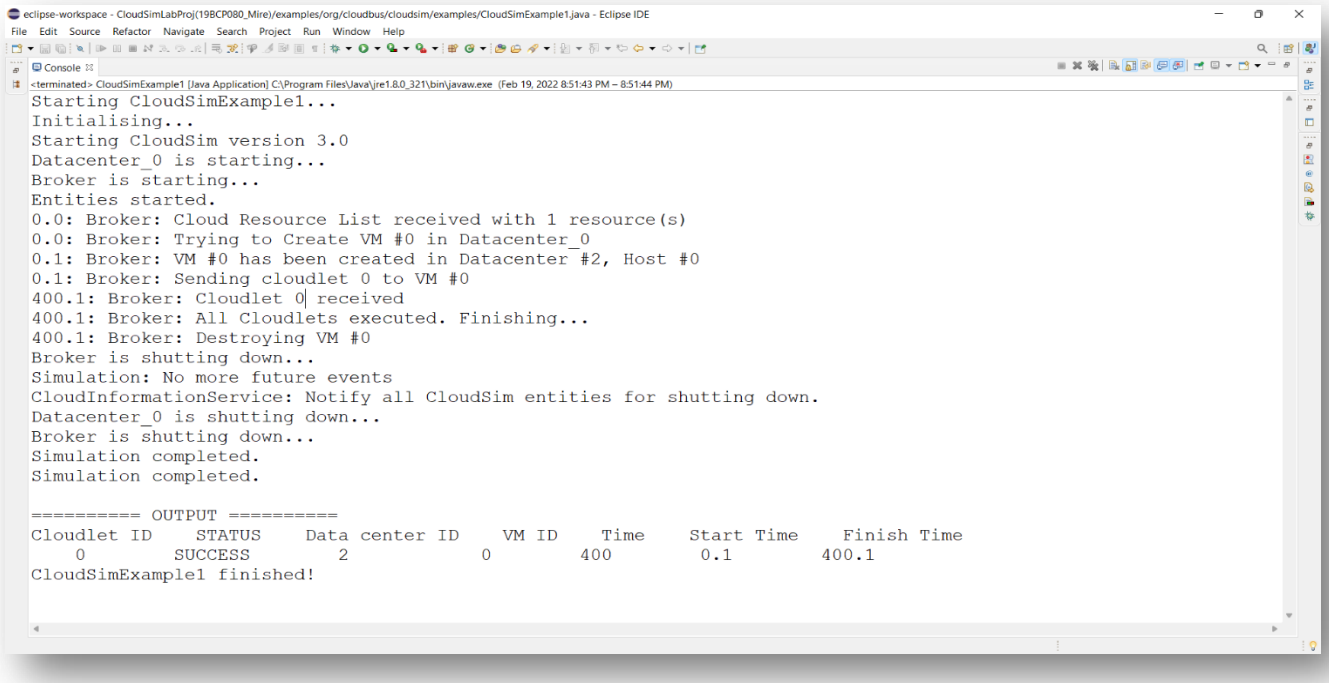


After CloudSim is configured, you will see the following final screen.



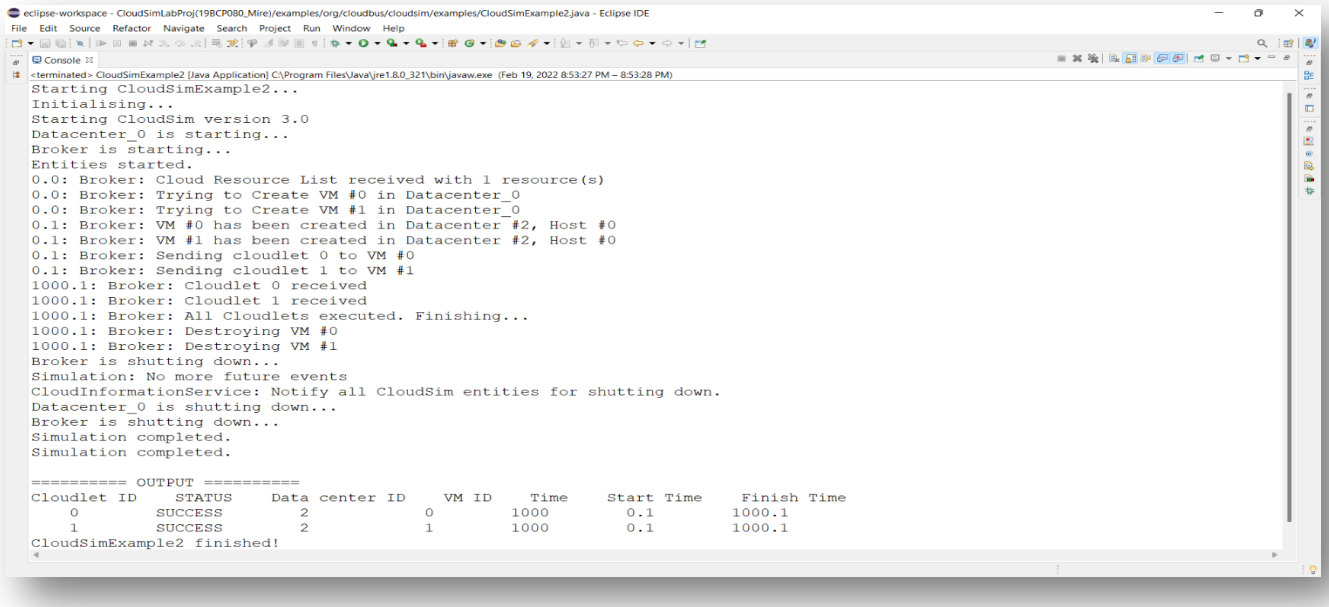
- **[Task- 1]: Create a datacenter with one host and run one cloudlet on it.**

  → Output:

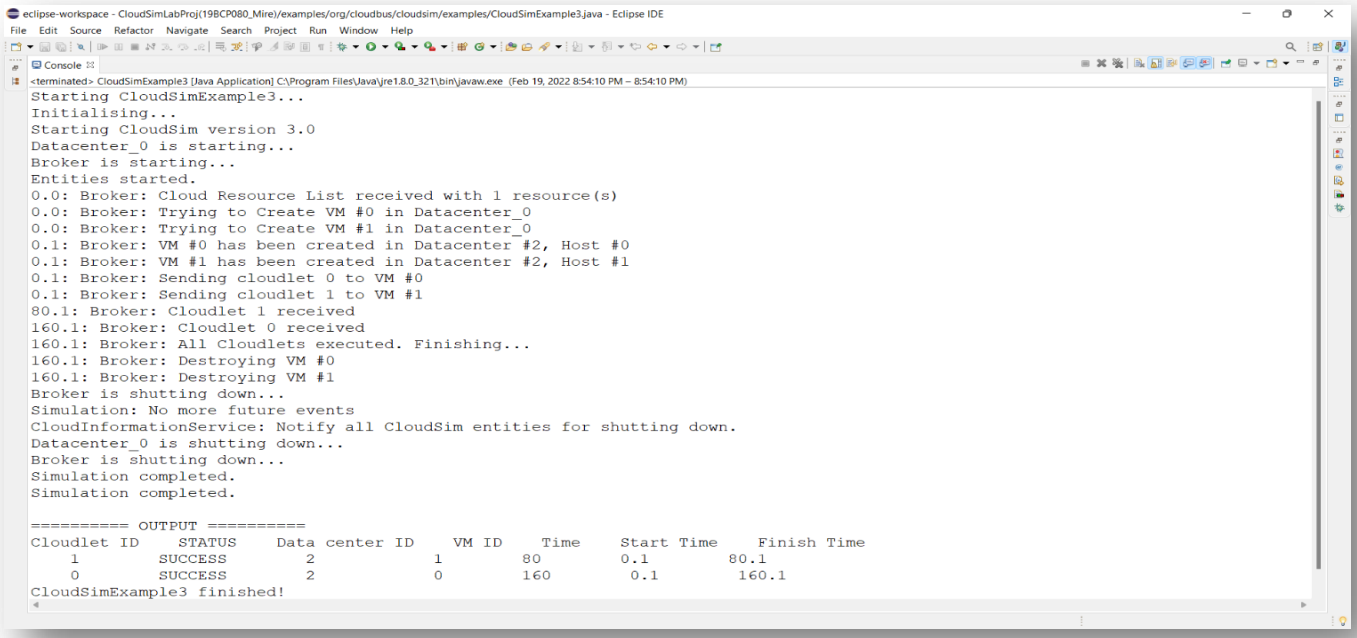


- **[Task- 2]: Create two datacenters with one host and a network topology each and run two cloudlets on them.**

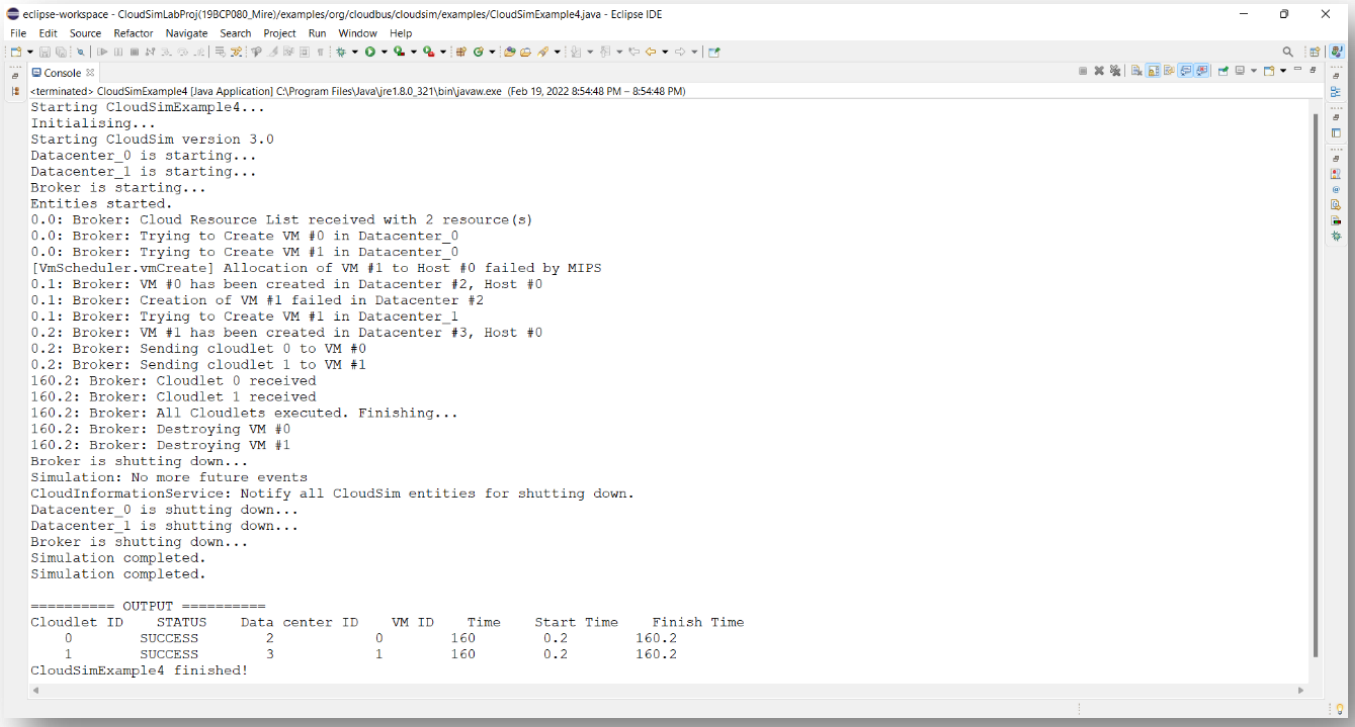
  → Output:



- **[Task- 3]: Create two datacenters with one host each and run cloudlets of two users with network topology on them.**
  → **Output:**

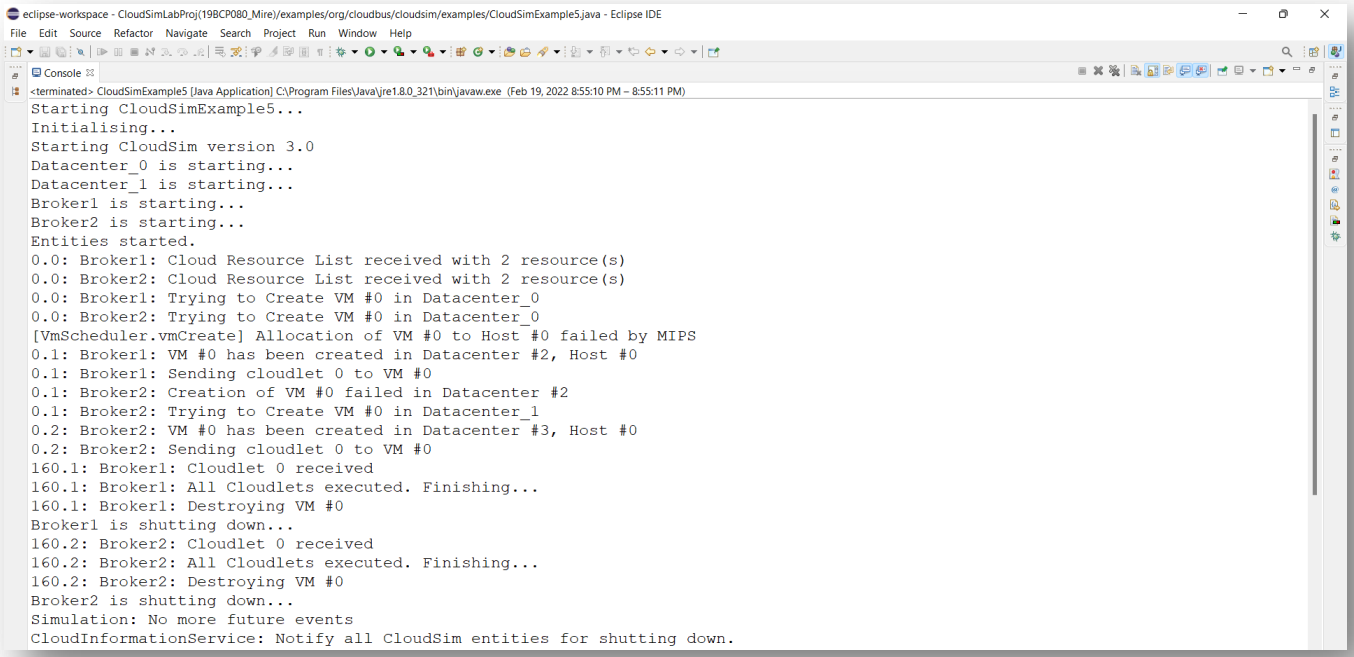


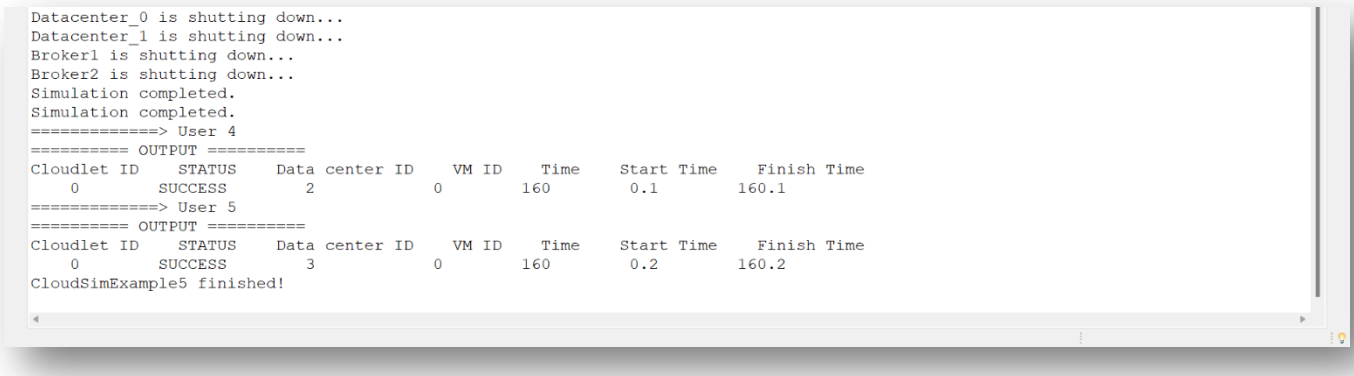
- **[Task- 4]: Create two datacenters with one host each and run two cloudlets on them.**
  → ***Output:***



- **[Task- 5]: Create two datacenters with one host each and run cloudlets of two users on them.**

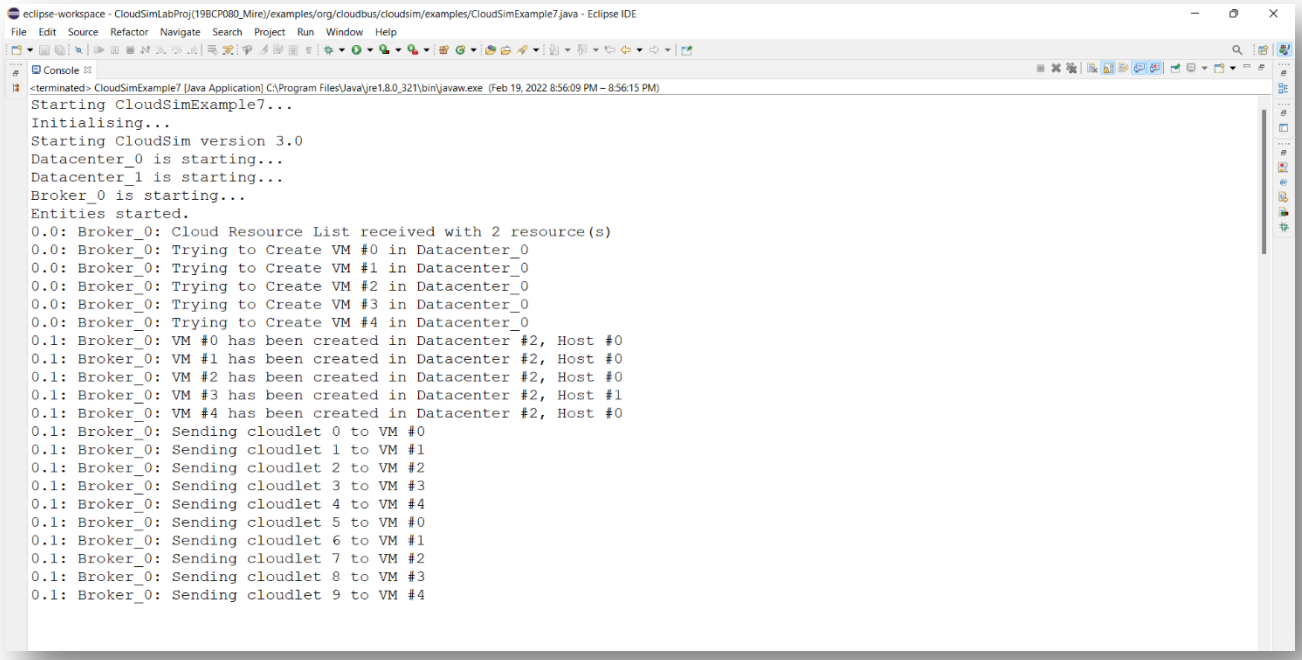
→ ***Output:***

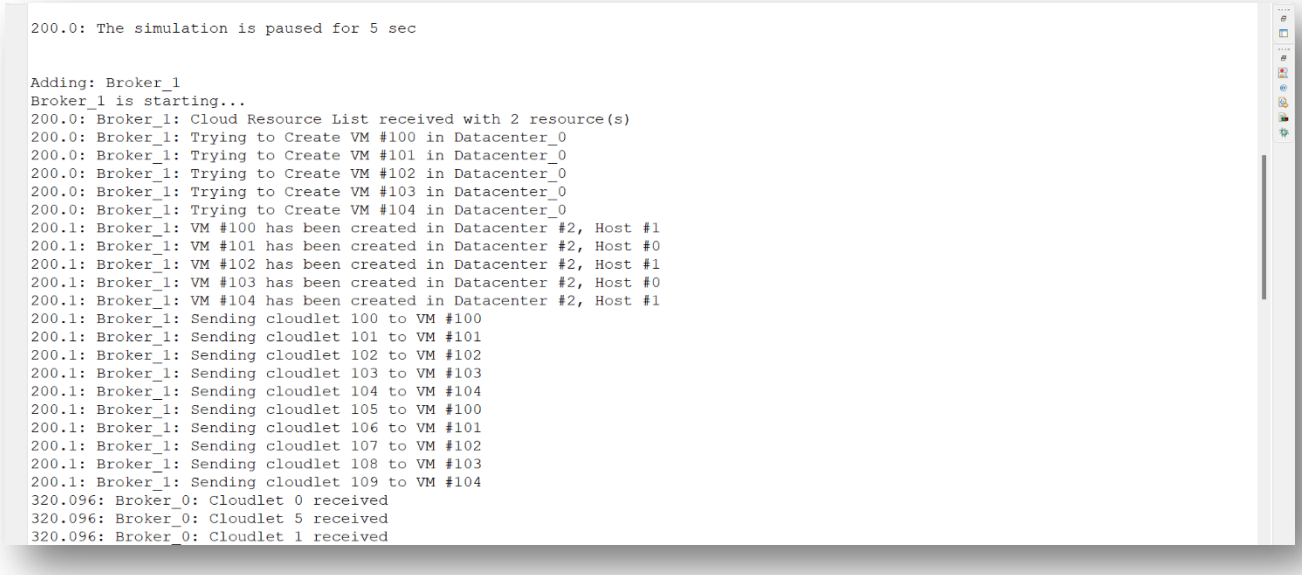




- **[Task- 6]: Pause and resume the simulation, and create simulation entities (a DatacenterBroker in this example) dynamically.**

→ ***Output:***





```
320.096: Broker_0: Cloudlet 6 received
320.096: Broker_0: Cloudlet 2 received
320.096: Broker_0: Cloudlet 7 received
320.096: Broker_0: Cloudlet 4 received
320.096: Broker_0: Cloudlet 9 received
320.096: Broker_0: Cloudlet 3 received
320.096: Broker_0: Cloudlet 8 received
320.096: Broker_0: All Cloudlets executed. Finishing...
320.096: Broker_0: Destroying VM #0
320.096: Broker_0: Destroying VM #1
320.096: Broker_0: Destroying VM #2
320.096: Broker_0: Destroying VM #3
320.096: Broker_0: Destroying VM #4
Broker_0 is shutting down...
519.996: Broker_1: Cloudlet 101 received
519.996: Broker_1: Cloudlet 106 received
519.996: Broker_1: Cloudlet 103 received
519.996: Broker_1: Cloudlet 108 received
519.996: Broker_1: Cloudlet 100 received
519.996: Broker_1: Cloudlet 105 received
519.996: Broker_1: Cloudlet 102 received
519.996: Broker_1: Cloudlet 107 received
519.996: Broker_1: Cloudlet 104 received
519.996: Broker_1: Cloudlet 109 received
519.996: Broker_1: All Cloudlets executed. Finishing...
519.996: Broker_1: Destroying VM #100
519.996: Broker_1: Destroying VM #101
519.996: Broker_1: Destroying VM #102
519.996: Broker_1: Destroying VM #103
519.996: Broker_1: Destroying VM #104
```

```
Broker_1 is shutting down...
Simulation: No more future events
CloudInformationService: Notify all CloudSim entities for shutting down.
Datacenter_0 is shutting down...
Datacenter_1 is shutting down...
Broker_0 is shutting down...
Broker_1 is shutting down...
Simulation completed.
Simulation completed.

========== OUTPUT ==========
Cloudlet ID    STATUS    Data center ID    VM ID        Time    Start Time    Finish Time
    0        SUCCESS        2             0            320        0.1            320.1
    5        SUCCESS        2             0            320        0.1            320.1
    1        SUCCESS        2             1            320        0.1            320.1
    6        SUCCESS        2             1            320        0.1            320.1
    2        SUCCESS        2             2            320        0.1            320.1
    7        SUCCESS        2             2            320        0.1            320.1
    4        SUCCESS        2             4            320        0.1            320.1
    9        SUCCESS        2             4            320        0.1            320.1
    3        SUCCESS        2             3            320        0.1            320.1
    8        SUCCESS        2             3            320        0.1            320.1
CloudSimExample7 finished!
```

- **[Task- 7]: Perform VM migration between Datacenters considering them as different cloud providers.**
  - a. **Manually**
  - b. **Considering CPU Utilization threshold as criterion for VM migration.**
  - c. **When Simulation clock reaches at specific time.**

→ **Output:**