Department of Computer Science & Engineering

SUBJECT: Cloud Computing & Distributed Systems
(21CSP-378/21ITP-378)

BATCH: B.E. CSE (2021-2025)

B.E. III Year – VI Semester

ACADEMIC SESSION (JAN-MAY 2024)

Lab Manual

Chandigarh University

Gharuan, Mohali

Prepared By: Parveen Badoni Verified By: HOD Sign:

CONTENTS

1. UNIVERSITY-VISION AND MISSION

VISION: To be globally recognized as a Centre of Excellence for Research, Innovation, Entrepreneurship and disseminating knowledge by providing inspirational learning to produce professional leaders for serving the society

MISSION:

- Providing world-class infrastructure, renowned academicians and ideal environment for Research, Innovation, Consultancy and Entrepreneurship relevant to the society.
- Offering programs & courses in consonance with National policies for nation building and meeting global challenges.
- Designing Curriculum to match International standards needs of Industry, civil society and for inculcation of traits of Creative Thinking and Critical Analysis as well as Human and Ethical values.
- Ensuring students delight by meeting their aspirations through blended learning, corporate mentoring, professional grooming, flexible curriculum and healthy atmosphere based on co-curricular and extra-curricular activities.
- Creating a scientific, transparent and objective examination/evaluation system to ensure an ideal certification.
- Establishing strategic relationships with leading National and International corporates and universities for academic as well as research collaborations.
- Contributing for creation of healthy, vibrant and sustainable society by involving in Institutional Social Responsibility (ISR) activities like rural development, welfare of senior citizens, women empowerment, community service, health and hygiene awareness and environmental protection

2. DEPARTMENT-VISION AND MISSION

VISION:

To be recognized as a leading Computer Science and Engineering department through effective teaching practices and excellence in research and innovation for creating competent professionals with ethics, values and entrepreneurial attitude to deliver service to society and to meet the current industry standards at the global level.

MISSION:

M1: To provide practical knowledge using state-of-the-art technological support for the experiential learning of our students.

M2: To provide industry recommended curriculum and transparent assessment for quality learning experiences.

M3: To create global linkages for interdisciplinary collaborative learning and research.

M4: To nurture advanced learning platform for research and innovation for student`s profound future growth.

M5: To inculcate leadership qualities and strong ethical values through value based education.

3. PROGRAM EDUCATIONAL OBJECTIVES (PEO)

The Program Educational Objectives of the Computer Science & Engineering undergraduate program are for graduates to achieve the following, within few years of graduation. The graduates of Computer Science & Engineering Program will

PEO 1: Engage in successful careers in industry, academia, and public service, by applying the acquired knowledge of Science, Mathematics and Engineering, providing technical leadership for their business, profession and community

PEO 2: Establish themselves as entrepreneur, work in research and development organization and pursue higher education

PEO 3: Exhibit commitment and engage in lifelong learning for enhancing their professional and personal capabilities.

4. PROGRAM OUTCOMES

Program Outcomes are adopted from the outcomes defined by the National Board of Accreditation of India, which is the permanent signatory of the Washington Accord. Program outcomes are defined to ensure the holistic development of students.

Engineering Graduates will be able to:

PO 1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one‟s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

5. STUDENT OUTCOMES

The Bachelor of Engineering is a programme offered by the Department of Computer Science & Engineering in accordance with the Student Outcome of Computing Accreditation Commission (CAC) and Engineering Accreditation Commission (EAC) of ABET. The Student Outcomes are as follows:

Student Outcomes according to Computing Accreditation Commission (CAC)

SO 1. Analyze a complex computing problem and apply principles of computing and otherrelevant disciplines to identify solutions.
SO 2. Design, implement and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program`s discipline.
SO 3. Communicate effectively in a variety of professional contexts.
SO 4. Recognize professional responsibilities and make informed judgments in computingpractice based on legal and ethical principles.
SO 5. Function effectively as a member or leader of a team engaged in activities appropriateto the program`s discipline.
SO 6. Apply computer science theory and software development fundamentals to produce computing-based solutions.

Student Outcomes according to Engineering Accreditation Commission (EAC)

SO 1. An ability to identify, formulates, and solve complex engineering problems by applying principles of engineering, science, and mathematics
SO 2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as a global, cultural, social, environmental, and economic factor
SO 3. An ability to communicate effectively with a range of audiences
SO 4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
SO 5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
SO 6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.
SO 7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

6. PROGRAM SPECIFIC OUTCOMES (PSOs)

Program Specific Outcomes

PSO1 Exhibit attitude for continuous learning and deliver efficient solutions for emerging challenges in the computation domain.

PSO2 Apply standard software engineering principles to develop viable solutions for Information Technology Enabled Services (ITES).

7. COURSE OBJECTIVE INTERNET OF THINGS LAB (21CSP-378/21ITP-378)

1	To understand how to develop web applications in cloud. □
2	Awareness about working with virtual machine.□
3	Able to design and develop the process involved in creating a cloud based application. □
4	To Implement and use parallel programming using advanced tools like Hadoop

8. COURSE OUTCOMES INTERNET OF THINGS LAB (21CSP-378/21ITP-378)

	Course Outcomes
1	Configure various virtualization tools such as Virtual Box, VMware workstation.
2	Design and deploy a web application in a PaaS environment.
3	Simulate a cloud environment to implement new schedulers.
4	Install and use a generic cloud environment that can be used as a private cloud.
5	Categorize and evaluation of Cloud Applications under various platforms.

9. CO/PO/PSO MAPPING

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	1	1	3	-	-	-	-	-	-	1	1	1
CO2	3	3	3	2	3	-	-	-	-	-	-	2	2	3
CO3	3	-	1	2	2	-	-	-	-	-	-	1	1	3
CO4	3	-	3	1	3	-	-	-	-	-	-	1	1	3
CO5	3	2	3	3	2	1	-	-	-	-	-	3	3	3
AVG	**3**	**2.5**	**2.2**	**1.8**	**2.6**	**1**	**-**	**-**	**-**	**-**	**-**	**1.6**	**1.6**	**2.6**

10. SYLLABUS (AS APPROVED IN BOS)

Chandigarh University, Gharuan, Mohali

<table>
<tr><td rowspan="4"><b>21CSP/ITP-378</b></td><td><b>CLOUD COMPUTING & DISTRIBUTED SYSTEMS LAB</b></td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>Total Contact Hours: 20 Hours</td><td rowspan="3">0</td><td rowspan="3">0</td><td rowspan="3">2</td><td rowspan="3">1</td></tr>
<tr><td>For CSE/IT 6th semester</td></tr>
<tr><td>Prerequisite: Basic Understanding of Computer Organization, Operating Systems, Computer Networks and Data Structures and Algorithms</td></tr>
<tr><td colspan="6">Max Marks-100</td></tr>
<tr><td>Internal-60</td><td colspan="5">External-40</td></tr>
</table>

Course Objectives:

1	To understand how to develop web applications in cloud. ⍰
2	Awareness about working with virtual machine.⍰
3	Able to design and develop the process involved in creating a cloud based application. ⍰
4	To Implement and use parallel programming using advanced tools like Hadoop

Course Outcomes:

COs		**BT Level**
1	Configure various virtualization tools such as Virtual Box, VMware workstation.	BT-2 Understand
2	Design and deploy a web application in a PaaS environment.	BT-6 Create
3	Simulate a cloud environment to implement new schedulers.	BT-5 Evaluate
4	Install and use a generic cloud environment that can be used as a private cloud.	BT-3 Apply
5	Categorize and evaluation of Cloud Applications under various platforms.	BT-4 Analyze

UNIT 1

Experiment No.1: Install VirtualBox or VMware Workstation on a Windows 7 or 8 operating system and set up various flavors of Linux or Windows as virtual machines. (CO-1)
Experiment No.2: To install a C compiler within the virtual machine established using VirtualBox and run basic programs. (CO-1)
Experiment No.3: Installation of Cloud Sim tool and IDE. (CO-1)
Experiment No.4: Use of GAE launcher to launch the web applications. (CO-2)

UNIT 2

Experiment No.5: Simulate a cloud scenario using Matlab and run a scheduling algorithm. (CO-3)
Experiment No.6: To find a procedure to transfer the files from one virtual machine to another virtual machine. (CO-4)
Experiment No.7: Discover a method for initiating a virtual machine using the TryStack (Online OpenStack Demo Version). (CO-4)

UNIT 3

Experiment No.8: Install Hadoop single node cluster and run simple applications like word count. (CO-3)
Experiment No.9: Case Studies on Cloud based machine-learning solutions in healthcare. (CO-5)
Experiment No.10: Lab based Mini Project (CO-5)

TEXT BOOKS

1. Cloud computing a practical approach - Anthony T.Velte, Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill , New Delhi – 2010
2. Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online - Michael Miller - Que 2008

REFERENCE BOOKS

1. Cloud computing for dummies- Judith Hurwitz, Robin Bloor, Marcia Kaufman, Fern Halper, Wiley Publishing, Inc, 2010
2. Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	1	1	3	-	-	-	-	-	-	1	1	1
CO2	3	3	3	2	3	-	-	-	-	-	-	2	2	3
CO3	3	-	1	2	2	-	-	-	-	-	-	1	1	3
CO4	3	-	3	1	3	-	-	-	-	-	-	1	1	3
CO5	3	2	3	3	2	1	-	-	-	-	-	3	3	3
AVG	3	2.5	2.2	1.8	2.6	1	-	-	-	-	-	1.6	1.6	2.6

Mode of Evaluation: The performance of students is evaluated as follows:

	Lab Assessment	
Components	**Continuous Internal Assessment (CAE)**	**Semester End Examination (SEE)**
Marks	**60**	**40**
Total Marks	**100**	

Relationship between the Course Outcomes (COs) and Program Outcomes (POs)

Mapping Between COs and POs		
SN	**Course Outcome (CO)**	**Mapped Programme Outcome (PO)**
1	CO1	PO1, PO3, PO4, PO5, PO12, PSO1, PSO2
2	CO2	PO1, PO2, PO3, PO4, PO5, PO12, PSO1, PSO2
3	CO3	PO1, PO3, PO4, PO5, PO12, PSO1, PSO2
4	CO4	PO1, PO3, PO4, PO5, PO12, PSO1, PSO2
5	CO5	PO1, PO2, PO3, PO4, PO5, PO6, PO12, PSO1, PSO2

0 –NO correlation, 1 = Slight, 2 = Moderate, 3 = Substantial

		PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
Course Code	Course Name	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**PSO1**	**PSO2**
21CSP/ ITP-378	**Cloud Computing & Distributed Systems Lab**	**3**	**2.5**	**2.2**	**1.8**	**2.6**	**1**	**0**	**0**	**0**	**0**	**0**	**1.6**	**1.6**	**2.6**

LIST OF EXPERIMENTS (MAPPED WITH COs)

Sr No.	Experiment Name	Mapped with CO Number(s)
1	Install VirtualBox or VMware Workstation on a Windows 7 or 8 operating system and set up various flavors of Linux or Windows as virtual machines.	**CO1**
2	To install a C compiler within the virtual machine established using VirtualBox and run basic programs.	**CO1**
3	Installation of Cloud-Sim tool and IDE.	**CO1**
4	Use of GAE launcher to launch the web applications.	**CO2**
5	Simulate a cloud scenario using Matlab and run a scheduling algorithm.	**CO3**
6	To find a procedure to transfer the files from one virtual machine to another virtual machine.	**CO4**
7	Discover a method for initiating a virtual machine using the TryStack (Online OpenStack Demo Version).	**CO4**
8	Install Hadoop single node cluster and run simple applications like word count.	**CO3**
9	Case Studies on Cloud based machine-learning solutions in healthcare.	**CO5**
10	Lab based Mini Project	**CO5**

Code of Ethics

I. To uphold the highest standards of integrity, responsible behavior, and ethical conduct in professional activities.

1. To hold paramount the safety, health, and welfare of the public, to strive to comply with ethical design and sustainable development practices, to protect the privacy of others, and to disclose promptly factors that might endanger the public or the environment;

2. To improve the understanding by individuals and society of the capabilities and societal implications of conventional and emerging technologies, including intelligent systems;

3. To avoid real or perceived conflicts of interest whenever possible, and to disclose them to affected parties when they do exist;

4. To avoid unlawful conduct in professional activities, and to reject bribery in all its forms;

5. To seek, accept, and offer honest criticism of technical work, to acknowledge and correct errors, to be honest and realistic in stating claims or estimates based on available data, and to credit properly the contributions of others;

6. To maintain and improve our technical competence and to undertake technological tasks for others only if qualified by training or experience, or after full disclosure of pertinent limitations;

II. To treat all persons fairly and with respect, to not engage in harassment or discrimination, and to avoid injuring others.

7. To treat all persons fairly and with respect, and to not engage in discrimination based on characteristics such as race, religion, gender, disability, age, national origin, sexual orientation, gender identity, or gender expression;

8. To not engage in harassment of any kind, including sexual harassment or bullying behavior;

9. To avoid injuring others, their property, reputation, or employment by false or malicious actions, rumors or any other verbal or physical abuses;

III. To strive to ensure this code is upheld by colleagues and co-workers.

10. To support colleagues and co-workers in following this code of ethics, to strive to ensure the code is upheld, and to not retaliate against individuals reporting a violation.

MANUAL TO CONDUCT EACH EXPERIMENT

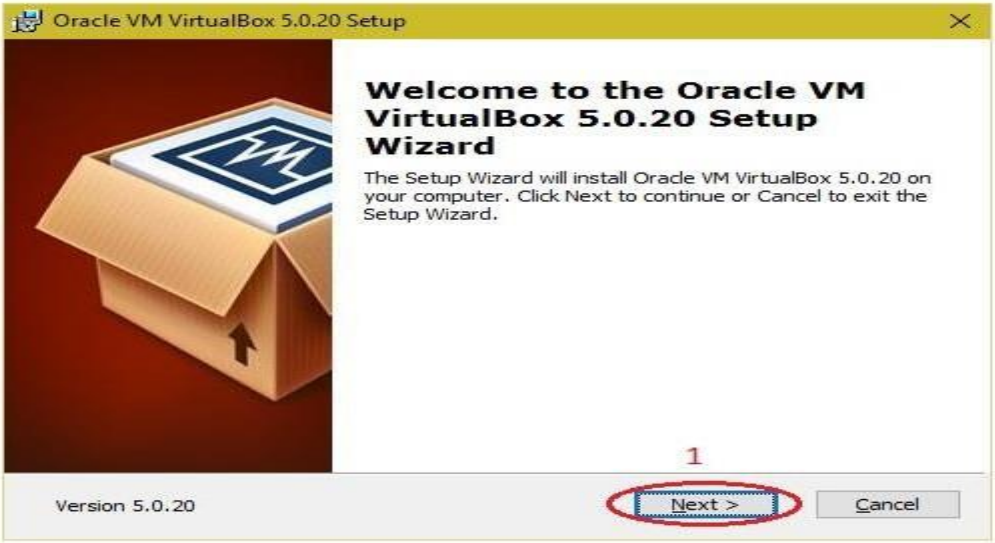
Experiment 1

Aim: Install VirtualBox or VMware Workstation on a windows 7 or 8 Operating System and set up various flavors of Linux or Windows as virtual machines.

PROCEDURE:

<u>Steps to install Virtual Box:</u>

1. **Download the Virtual box exe and click the exe file…and select next button.**

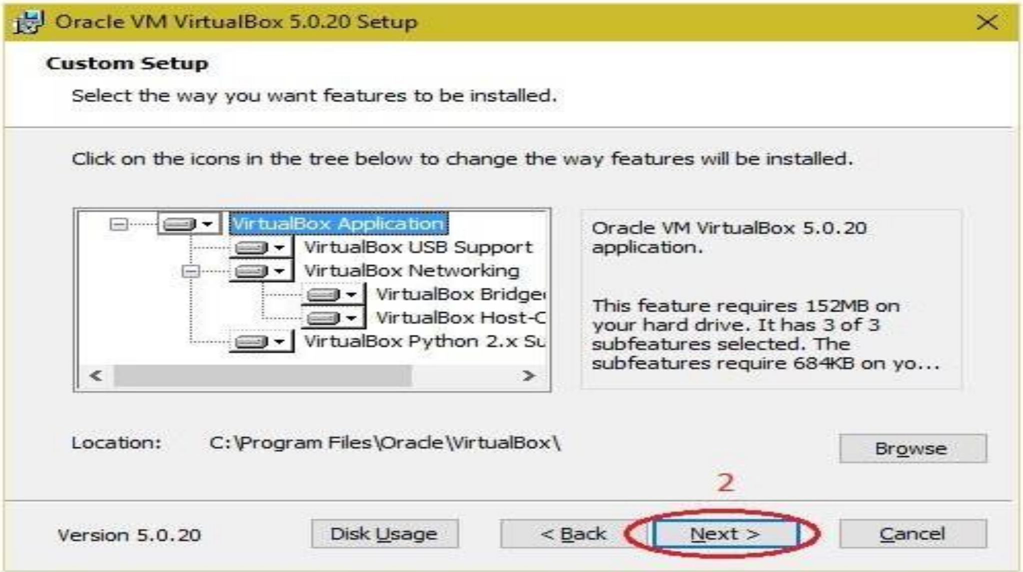


Oracle VM VirtualBox 5.0.20 Setup

Welcome to the Oracle VM VirtualBox 5.0.20 Setup Wizard

The Setup Wizard will install Oracle VM VirtualBox 5.0.20 on your computer. Click Next to continue or Cancel to exit the Setup Wizard.

Version 5.0.20



Oracle VM VirtualBox 5.0.20 Setup

Custom Setup

Select the way you want features to be installed.

Click on the icons in the tree below to change the way features will be installed.

- VirtualBox Application
  - VirtualBox USB Support
  - VirtualBox Networking
    - VirtualBox Bridge
    - VirtualBox Host-C
  - VirtualBox Python 2.x Su

Oracle VM VirtualBox 5.0.20 application.

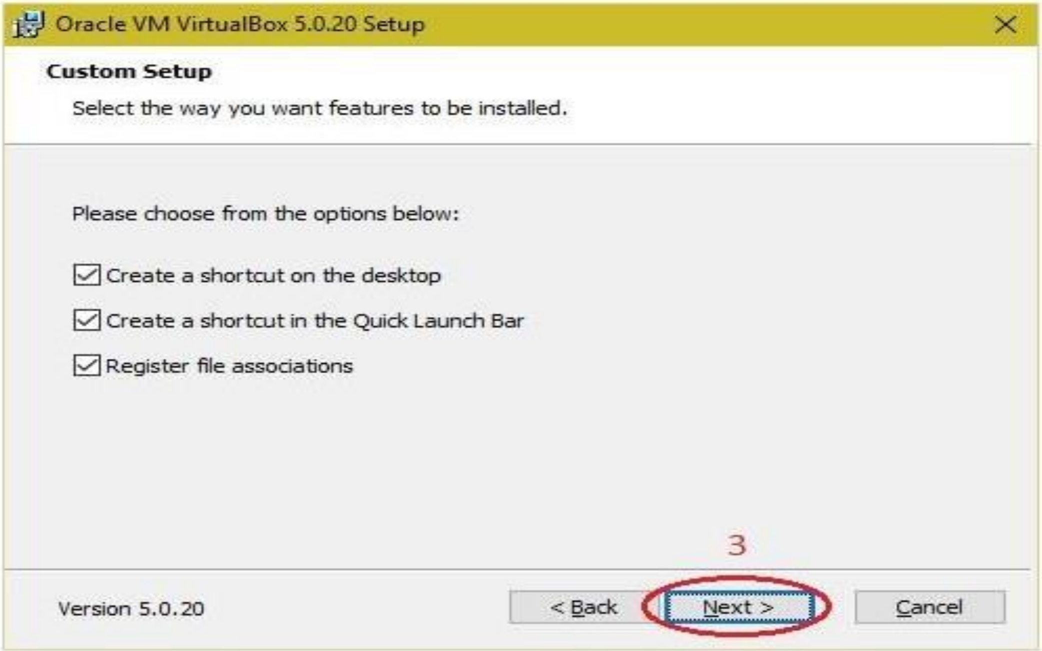
This feature requires 152MB on your hard drive. It has 3 of 3 subfeatures selected. The subfeatures require 684KB on yo...

Location: C:\Program Files\Oracle\VirtualBox\

Version 5.0.20

2. **Click the next button.**

3. **Click the next button**



Oracle VM VirtualBox 5.0.20 Setup

Custom Setup

Select the way you want features to be installed.

Please choose from the options below:

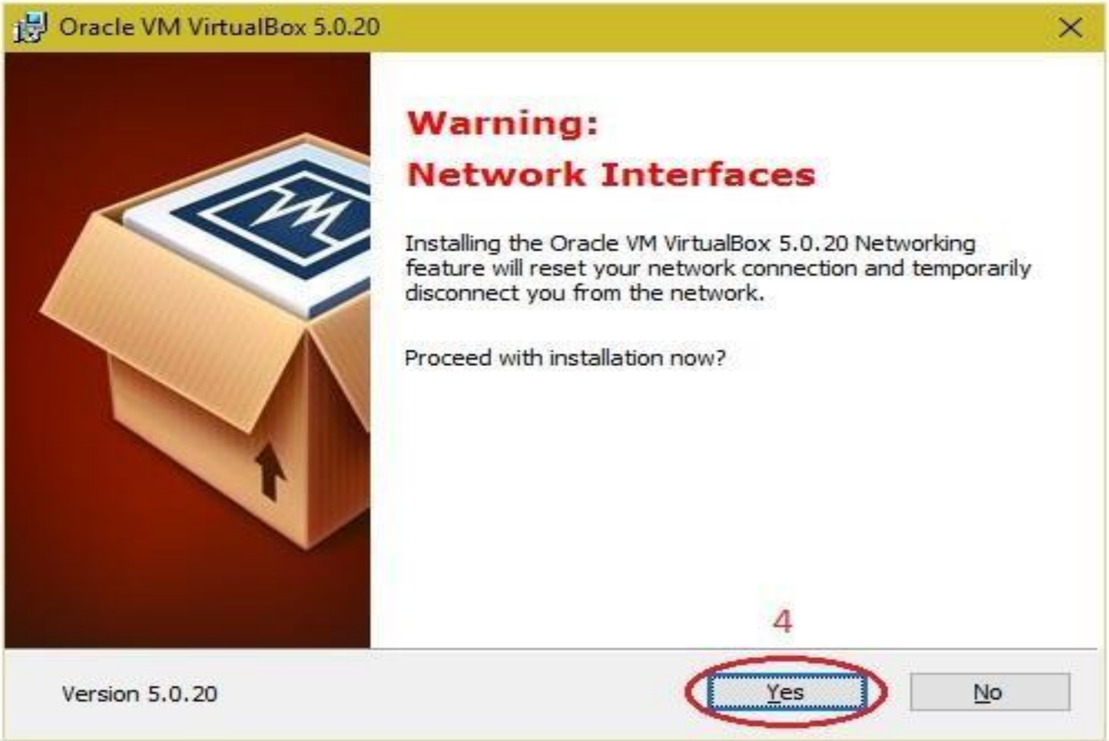
☑ Create a shortcut on the desktop

☑ Create a shortcut in the Quick Launch Bar

☑ Register file associations

Version 5.0.20

4. **Click the YES button.**



Oracle VM VirtualBox 5.0.20

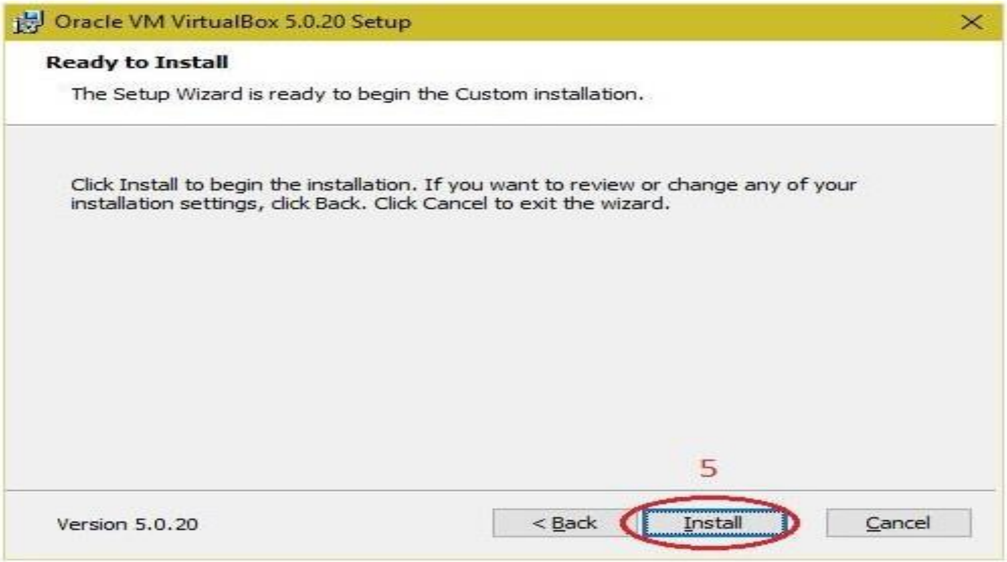
Warning:
Network Interfaces

Installing the Oracle VM VirtualBox 5.0.20 Networking feature will reset your network connection and temporarily disconnect you from the network.

Proceed with installation now?

Version 5.0.20

5. **Click the install button…**



Oracle VM VirtualBox 5.0.20 Setup

Ready to Install

The Setup Wizard is ready to begin the Custom installation.

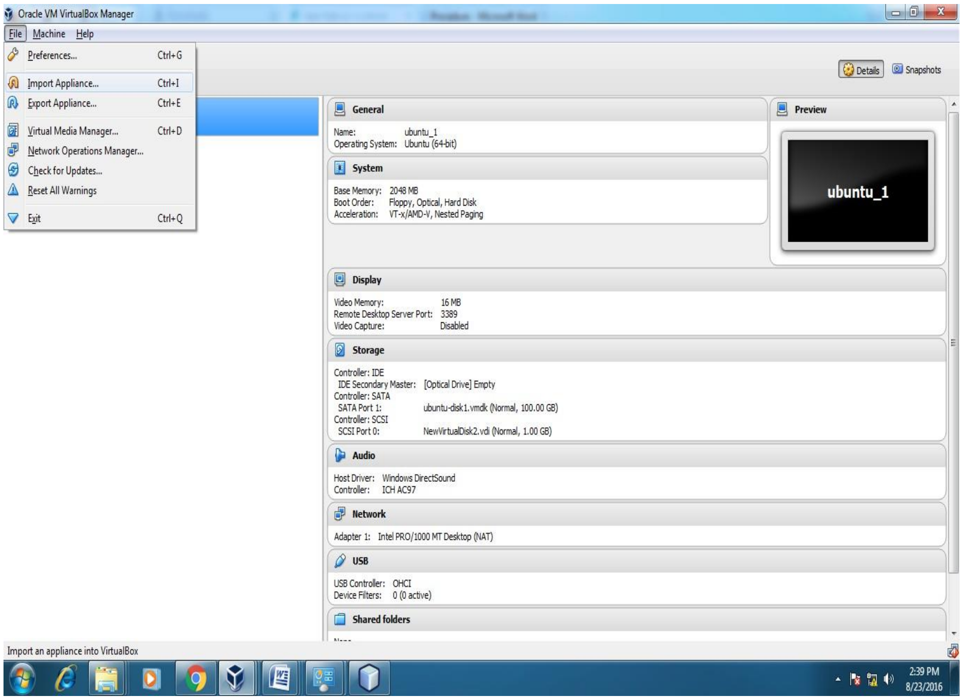
Click Install to begin the installation. If you want to review or change any of your installation settings, click Back. Click Cancel to exit the wizard.

Version 5.0.20

6. **Then installation was completed the show virtual box icon on desktop screen….**

Steps to import Open nebula sandbox:

1. Open Virtual box
2. File □import Appliance
3. Browse OpenNebula-Sandbox-5.0.ova file
4. Then go to setting, select Usb and choose USB 1.1
5. Then Start the Open Nebula


Oracle VM VirtualBox Manager
File Machine Help
Preferences... Ctrl+G
Import Appliance... Ctrl+I
Export Appliance... Ctrl+E
Virtual Media Manager... Ctrl+D
Network Operations Manager...
Check for Updates...
Reset All Warnings
Exit Ctrl+Q
Details
Snapshots
Preview
ubuntu_1
2:39 PM
8/23/2016

General
Name: ubuntu_1
Operating System: Ubuntu (64-bit)

System
Base Memory: 2048 MB
Boot Order: Floppy, Optical, Hard Disk
Acceleration: VT-x/AMD-V, Nested Paging

Display
Video Memory: 16 MB
Remote Desktop Server Port: 3389
Video Capture: Disabled

Storage
Controller: IDE
IDE Secondary Master: [Optical Drive] Empty
Controller: SATA
SATA Port 1: ubuntu-disk1.vmdk (Normal, 100.00 GB)
Controller: SCSI
SCSI Port 0: NewVirtualDisk2.vdi (Normal, 1.00 GB)

Audio
Host Driver: Windows DirectSound
Controller: ICH AC97

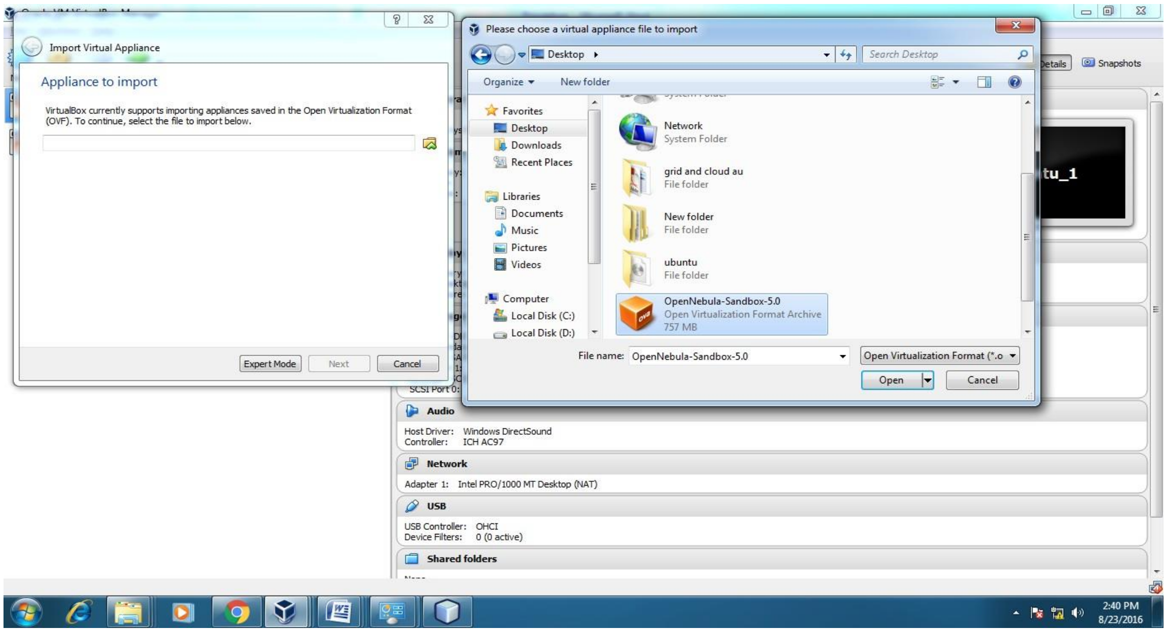
Network
Adapter 1: Intel PRO/1000 MT Desktop (NAT)

USB
USB Controller: OHCI
Device Filters: 0 (0 active)

Shared folders

Import an appliance into VirtualBox

6. **Login using username: root, password:opennebula**



Appliance to import

VirtualBox currently supports importing appliances saved in the Open Virtualization Format (OVF). To continue, select the file to import below.

File name: OpenNebula-Sandbox-5.0
Open Virtualization Format (*.o

SCSI Port 0:

Audio
Host Driver: Windows DirectSound
Controller: ICH AC97

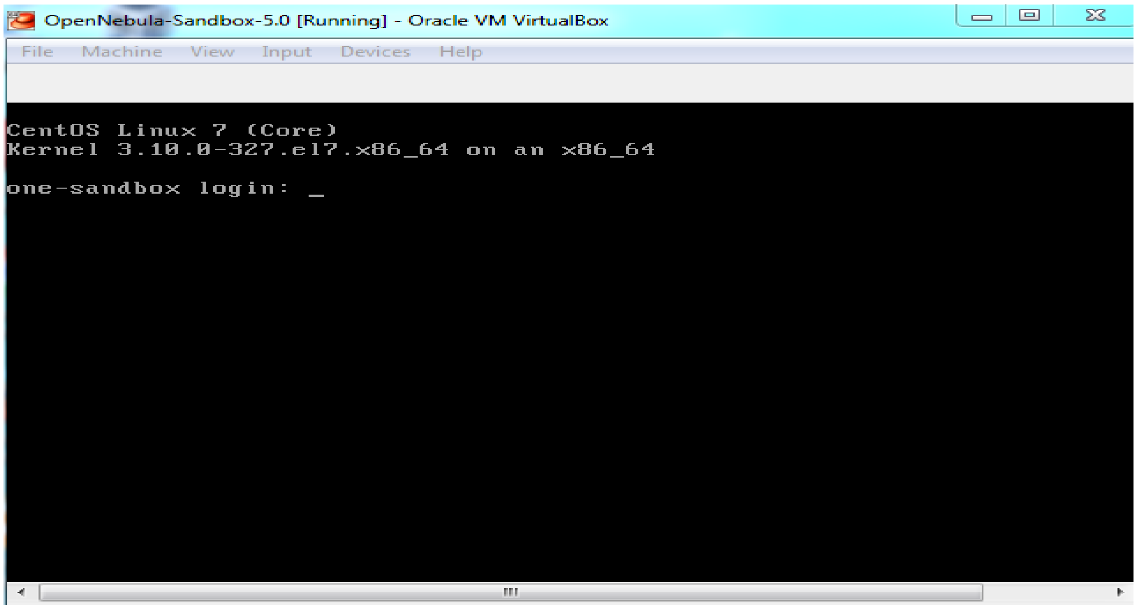
Network
Adapter 1: Intel PRO/1000 MT Desktop (NAT)

USB
USB Controller: OHCI
Device Filters: 0 (0 active)

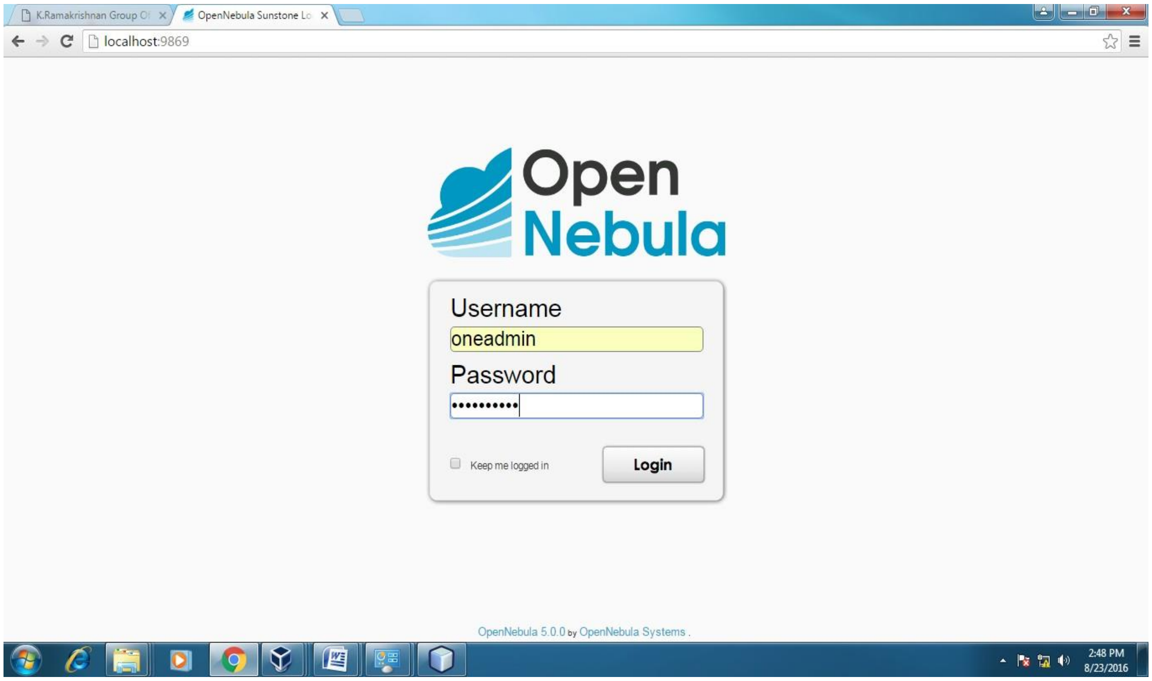
Shared folders

Steps to create Virtual Machine through opennebula

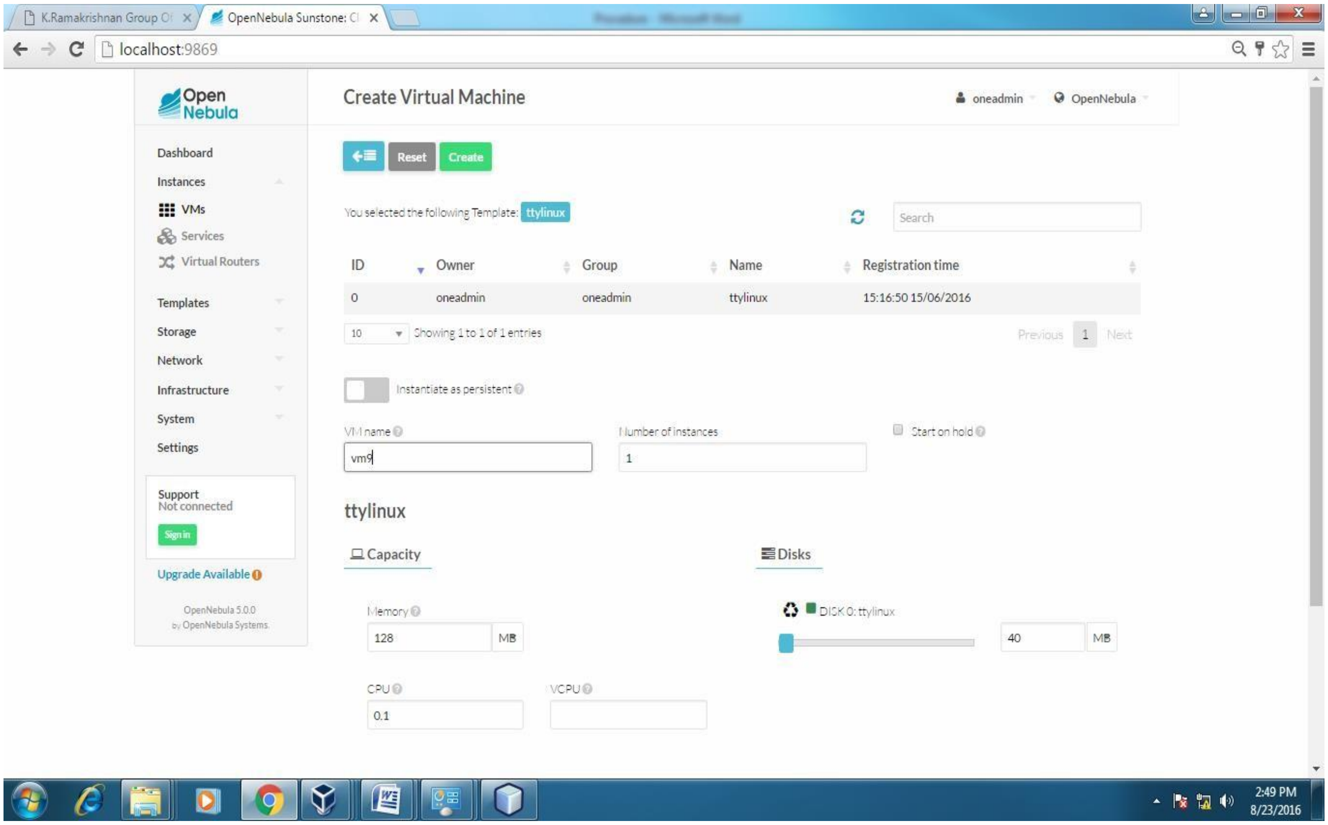
1. Open Browser, type localhost:9869
2. Login using username: oneadmin, password: opennebula
3. Click on instances, select VMs then follow the steps to create Virtaul machine
   a. Expand the + symbol
   b. Select user oneadmin
   c. Then enter the VM name,no.of instance, cpu.
   d. Then click on create button.
   e. Repeat the steps the C, D for creating more than one VMs.



```
CentOS Linux 7 (Core)
Kernel 3.10.0-327.el7.x86_64 on an x86_64

one-sandbox login: _
```



Username
oneadmin
Password
••••••••••



Create Virtual Machine

You selected the following Template: ttylinux

ID	Owner	Group	Name	Registration time
0	oneadmin	oneadmin	ttylinux	15:16:50 15/06/2016

10 Showing 1 to 1 of 1 entries

Instantiate as persistent

VM name: vm9

Number of instances: 1

□ Start on hold

ttylinux

Memory: 128 MB

CPU: 0.1

VCPU:

DISK 0: ttylinux 40 MB

APPLICATIONS:

There are various applications of cloud computing in today's network world. Many search engines and social websites are using the concept of cloud computing like www.amazon.com, hotmail.com, facebook.com, linkedln.com etc. the advantages of cloud computing in context to scalability is like reduced risk, low cost testing, ability to segment the customer base and auto-scaling based on application load.

RESULT:

Thus the procedure to run the virtual machine of different configuration.

VIVA VOCE

1) What is a cloud?

2) What is cloud computing?

3) What are the benefits of cloud computing?

4) What are the different layers that define cloud architecture?

5) What do you mean by cloud delivery models?

6) Explain different models for deployment in cloud computing.

7) What is the difference in cloud computing and computing for mobiles?

8) What do you mean by software as a service?

9) What is the platform as a service?

10) What is on-demand functionality? How is it provided in cloud computing?

11) What are the platforms used for large scale cloud computing?

12) What are the advantages and disadvantages of serverless computing?

13) What are Microservices?

14) Why are microservices important for a true cloud environment?

15) What is meant by Edge Computing?

16) What are some issues with Cloud Computing?

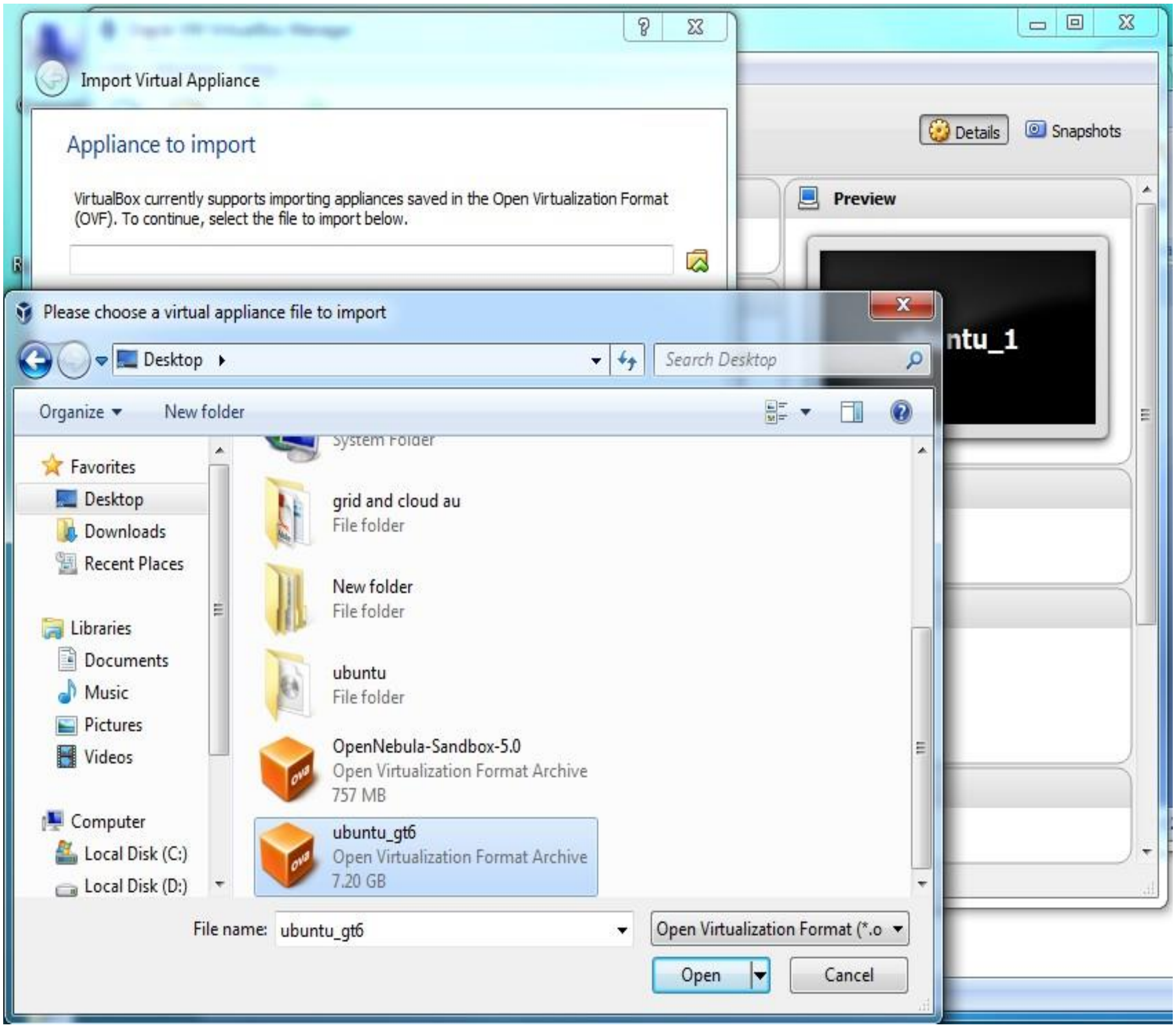
Experiment No. 2

Aim: To Install a C compiler within the virtual machine established using the virtual machine established using virtual box and run basic programs.

PROCEDURE:

<u>Steps to import .ova file:</u>

1. Open Virtual box
2. File →import Appliance
3. Browse ubuntu_gt6.ova file
4. Then go to setting, select Usb and choose USB 1.1
5. Then Start the ubuntu_gt6
6. Login using username: dinesh, password:99425.



Import Virtual Appliance

Appliance to import

VirtualBox currently supports importing appliances saved in the Open Virtualization Format (OVF). To continue, select the file to import below.

Please choose a virtual appliance file to import

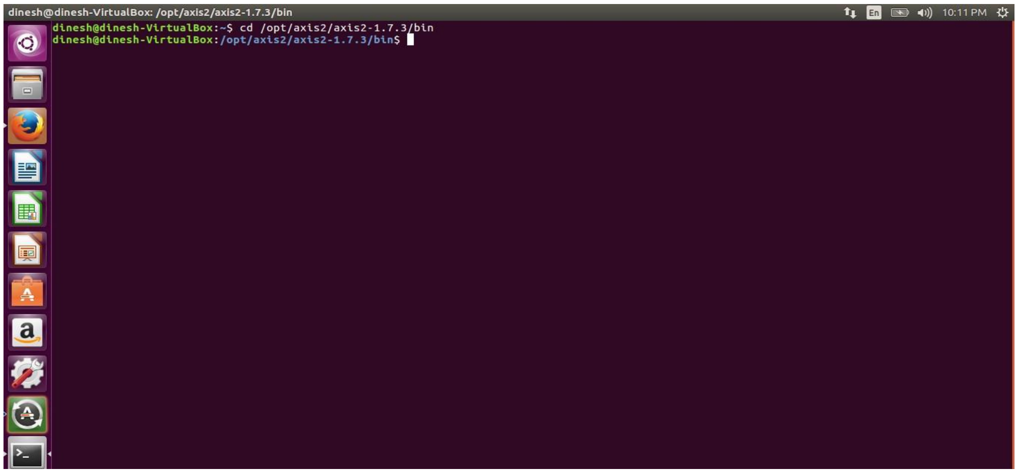
File name: ubuntu_gt6

Open Virtualization Format (*.o

Steps to run c program:

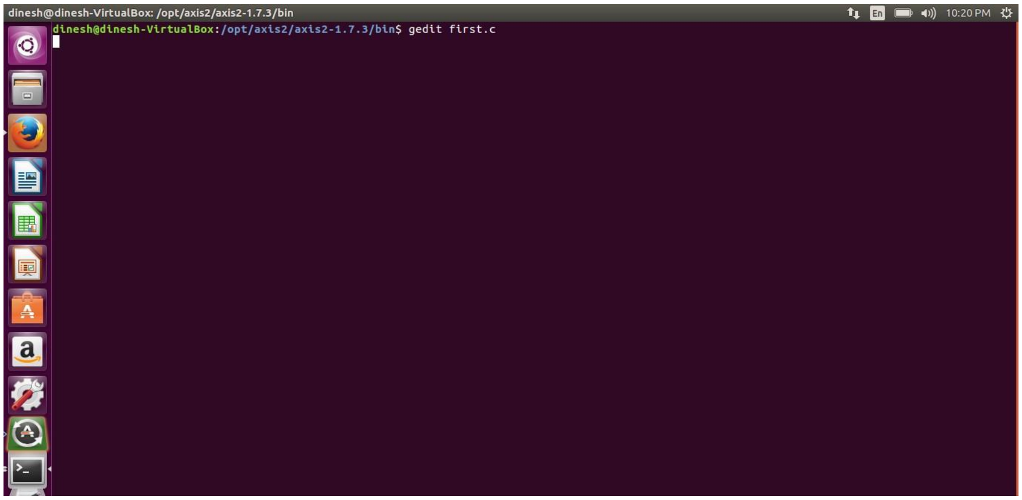
1. Open the terminal
2. Type cd /opt/axis2/axis2-1.7.3/bin then press enter
3. gedit hello.c
4. gcc hello.c
5. ./a.out

1. Type cd /opt/axis2/axis2-1.7.3/bin then press enter



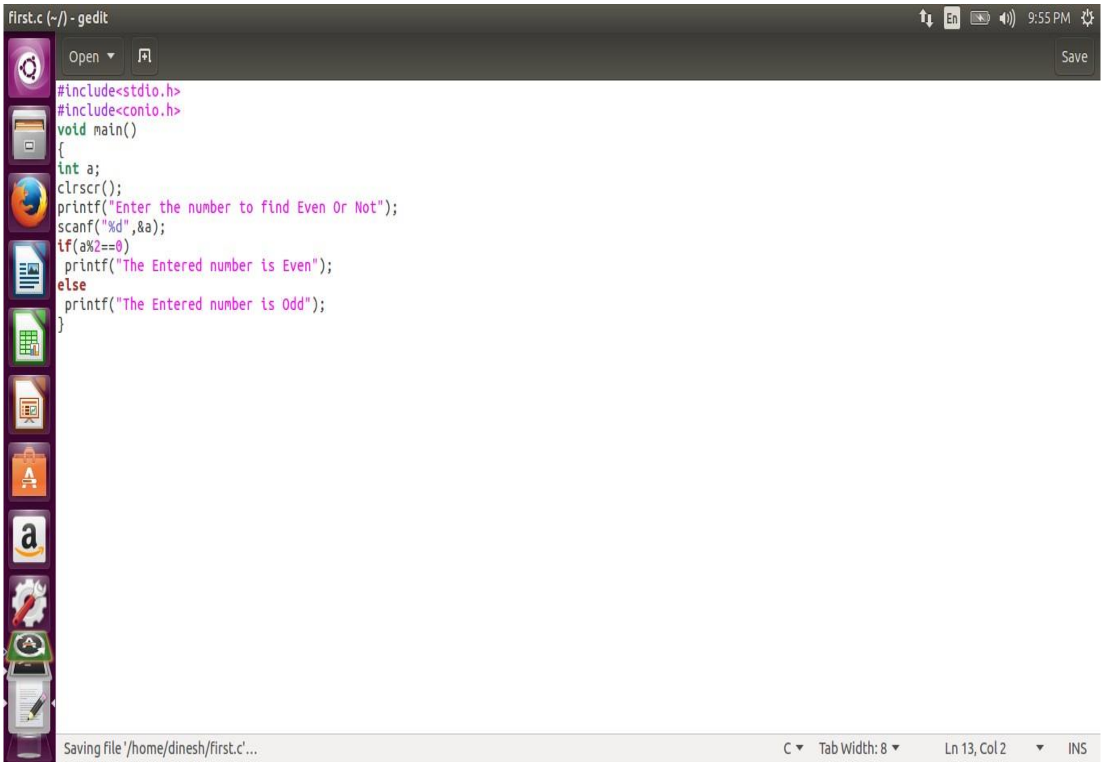
```
dinesh@dinesh-VirtualBox:~$ cd /opt/axis2/axis2-1.7.3/bin
dinesh@dinesh-VirtualBox:/opt/axis2/axis2-1.7.3/bin$ 
```

2. Type gedit first.c



```
dinesh@dinesh-VirtualBox:/opt/axis2/axis2-1.7.3/bin$ gedit first.c
```

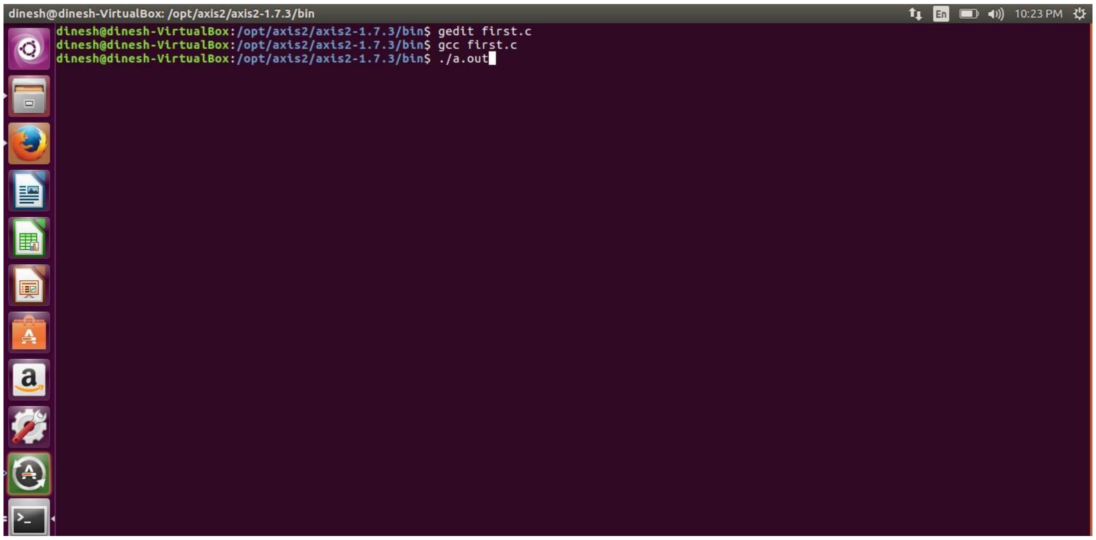
3. Type the c program



```
#include<stdio.h>
#include<conio.h>
void main()
{
int a;
clrscr();
printf("Enter the number to find Even Or Not");
scanf("%d",&a);
if(a%2==0)
 printf("The Entered number is Even");
else
 printf("The Entered number is Odd");
}
```

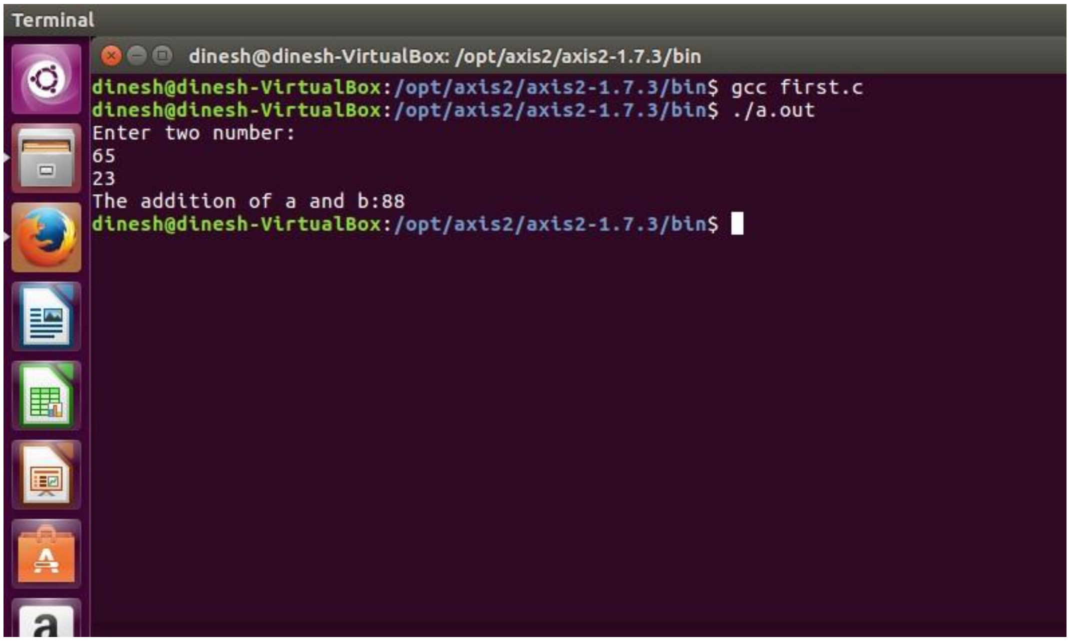
Saving file '/home/dinesh/first.c'...

4. Running the C program



```
dinesh@dinesh-VirtualBox:/opt/axis2/axis2-1.7.3/bin$ gedit first.c
dinesh@dinesh-VirtualBox:/opt/axis2/axis2-1.7.3/bin$ gcc first.c
dinesh@dinesh-VirtualBox:/opt/axis2/axis2-1.7.3/bin$ ./a.out
```

5. Display the output:



```
dinesh@dinesh-VirtualBox: /opt/axis2/axis2-1.7.3/bin
dinesh@dinesh-VirtualBox:/opt/axis2/axis2-1.7.3/bin$ gcc first.c
dinesh@dinesh-VirtualBox:/opt/axis2/axis2-1.7.3/bin$ ./a.out
Enter two number:
65
23
The addition of a and b:88
dinesh@dinesh-VirtualBox:/opt/axis2/axis2-1.7.3/bin$
```

APPLICATIONS:

Simply running all programs in grid environment.

RESULT:

Thus the simple C programs executed successfully.

VIVA VOCE:

1) What is a cloud?

2) What is cloud computing?

3) What are the benefits of cloud computing?

4) What are the different layers that define cloud architecture?

5) What do you mean by cloud delivery models?

6) Explain different models for deployment in cloud computing.

7) What is the difference in cloud computing and computing for mobiles?

8) What do you mean by software as a service?

9) What is the platform as a service?

10) What is on-demand functionality? How is it provided in cloud computing?

11) What are the platforms used for large scale cloud computing?

12) What are the advantages and disadvantages of serverless computing?

13) What are Microservices?

14) Why are microservices important for a true cloud environment?

15) What is meant by Edge Computing?

16) What are some issues with Cloud Computing?

Experiment No. 3

Aim: Installation of Cloud Sim tool and IDE

About Cloud Sim:

CloudSim is a simulation toolkit that supports the modeling and simulation of the core functionality of the cloud, like job/task queue, processing of events, creation of cloud entities(datacenter, datacenter brokers, etc), communication between different entities, implementation of broker policies, etc. This toolkit allows to:

Test application services in a repeatable and controllable environment.

Tune the system bottlenecks before deploying apps in an actual cloud.

Experiment with different workload mix and resource performance scenarios on simulated infrastructure for developing and testing adaptive application provisioning techniques

The core features of CloudSim:

- The Support of modeling and simulation of large-scale computing environments as federated cloud data centers, and virtualized server hosts, with customizable policies for provisioning host resources to virtual machines and energy-aware computational resources
- It is a self-contained platform for modeling cloud service brokers, provisioning, and allocation policies.
- It supports the simulation of network connections among simulated system elements.
- Support for simulation of federated cloud environment, that inter-networks resources from both private and public domains.
- Availability of a virtualization engine that aids in the creation and management of multiple independent and co-hosted virtual services on a data center node.
- Flexibility to switch between the space-shared and time-shared allocation of processing cores to virtualized services.

Procedure:

Before to set up CloudSim, the following resources must be Installed/downloaded on the local system:

1. Java Development Kit (JDK): As the Cloudsim simulation toolkit is a class library written in the Java programming language, therefore, the latest version of Java (JDK) should be installed on your machine, which can be downloaded from Oracles Java portal. For assistance in the installation process, detailed documentation is provided by Oracle itself and you may follow the installation instructions.

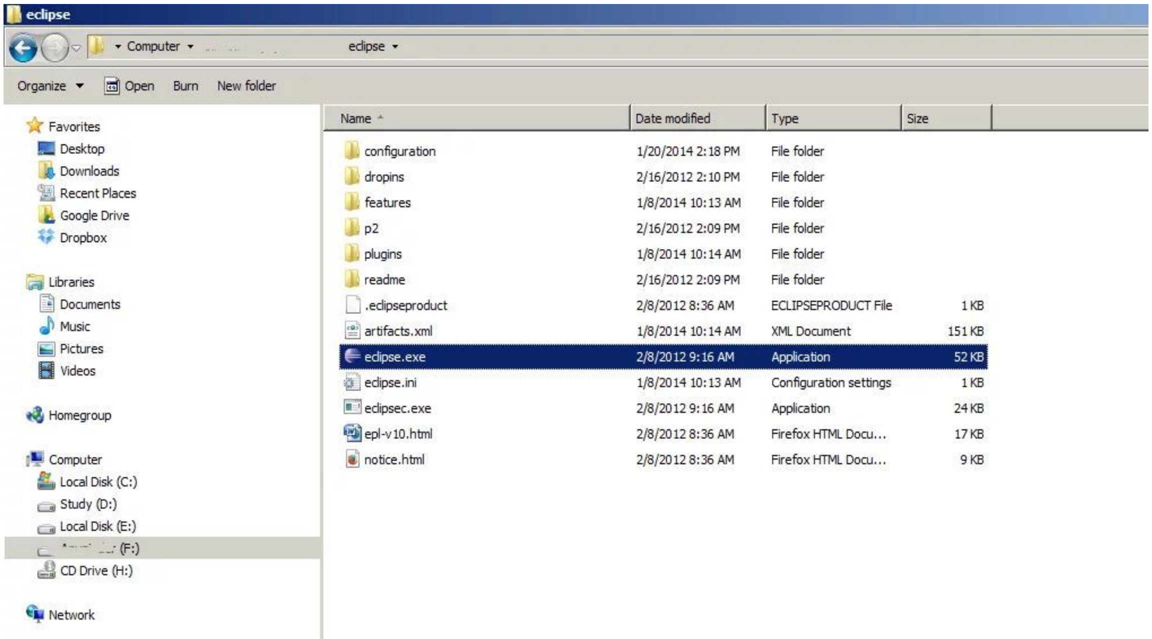
2. Eclipse IDE for Java developers: As per your current installed operating system (Linux/Windows). Before you download make sure to check if the 32-bit or 64-bit version is applicable to your Computer machine.

3. Download CloudSim source code: To date, various versions of CloudSim are released the latest version is 5.0, which is based on a container-based engine. Whereas to keep the setup simple for beginners we will be setting up the most used version i.e. 3.0.3

4. One external requirement of Cloudsim i.e. common jar package of math-related functions is to be downloaded from the Apache website.

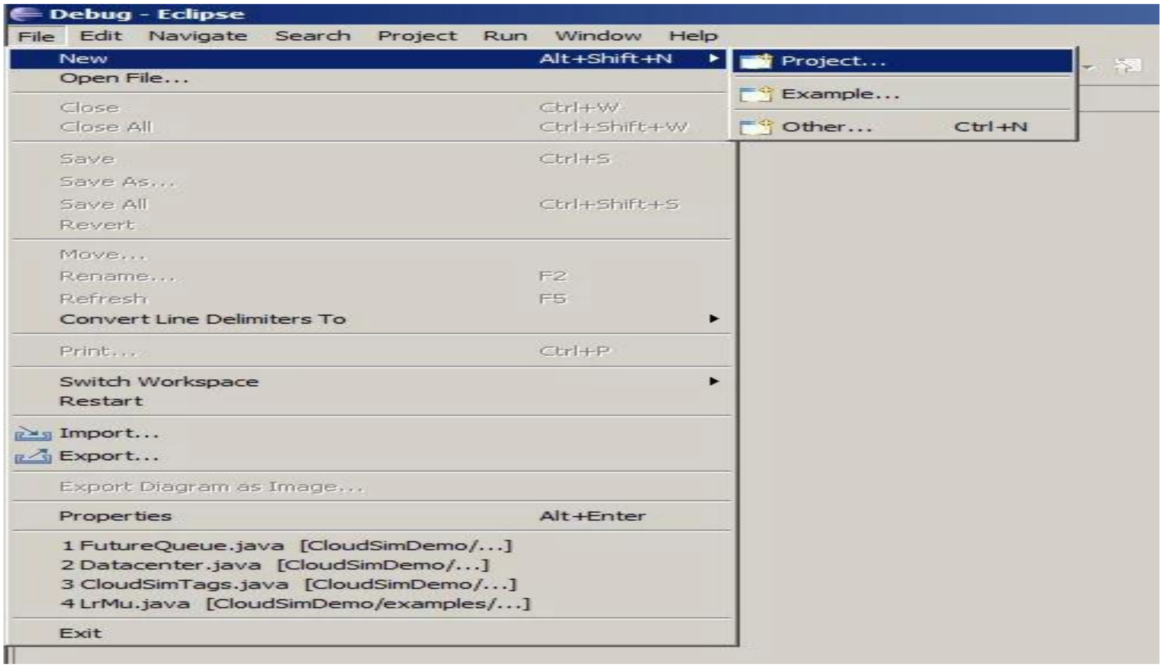
Installation of Cloud Sim:

First of all, navigate to the folder where you have unzipped the Eclipse folder and open Eclipse.exe

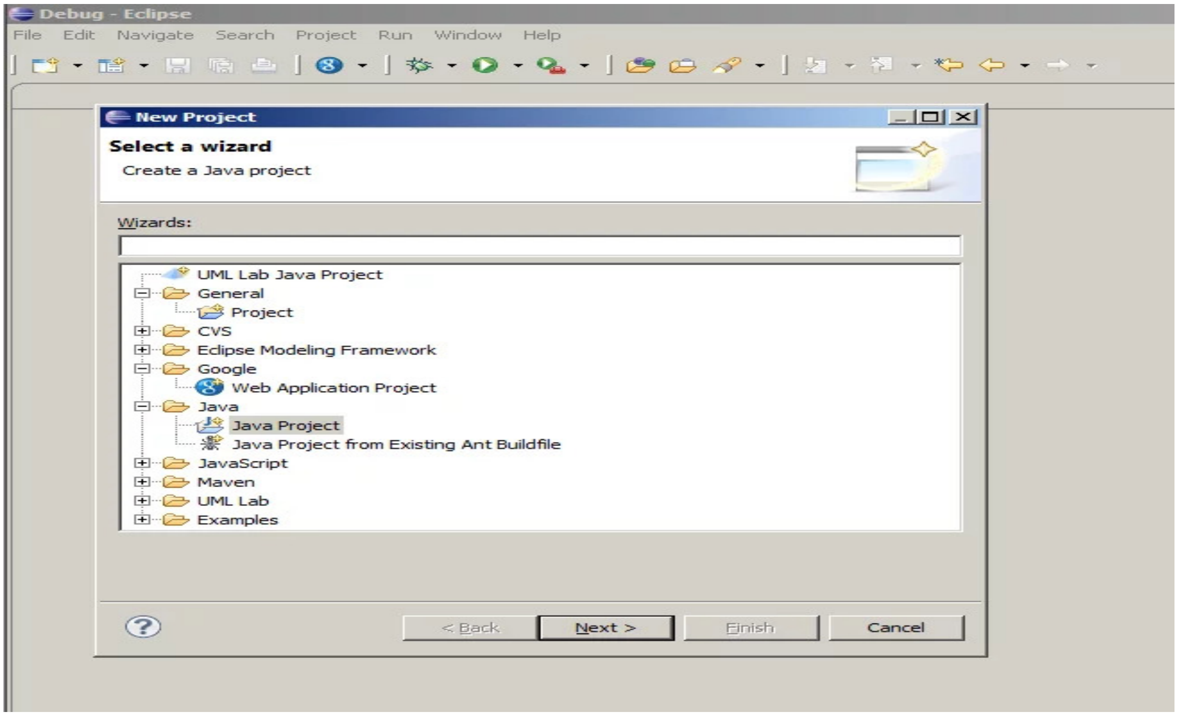


Name	Date modified	Type	Size
configuration	1/20/2014 2:18 PM	File folder	
dropins	2/16/2012 2:10 PM	File folder	
features	1/8/2014 10:13 AM	File folder	
p2	2/16/2012 2:09 PM	File folder	
plugins	1/8/2014 10:14 AM	File folder	
readme	2/16/2012 2:09 PM	File folder	
.eclipseproduct	2/8/2012 8:36 AM	ECLIPSEPRODUCT File	1 KB
artifacts.xml	1/8/2014 10:14 AM	XML Document	151 KB
eclipse.exe	2/8/2012 9:16 AM	Application	52 KB
eclipse.ini	1/8/2014 10:13 AM	Configuration settings	1 KB
eclipsec.exe	2/8/2012 9:16 AM	Application	24 KB
epl-v10.html	2/8/2012 8:36 AM	Firefox HTML Docu...	17 KB
notice.html	2/8/2012 8:36 AM	Firefox HTML Docu...	9 KB

Now within Eclipse window navigate the menu: *File* -> *New* -> *Project*, to open the new project wizard



A '*New Project*' wizard should open. There are a number of options displayed and you have to find & select the '*Java Project*' option, once done Click *'Next'*



Select a wizard

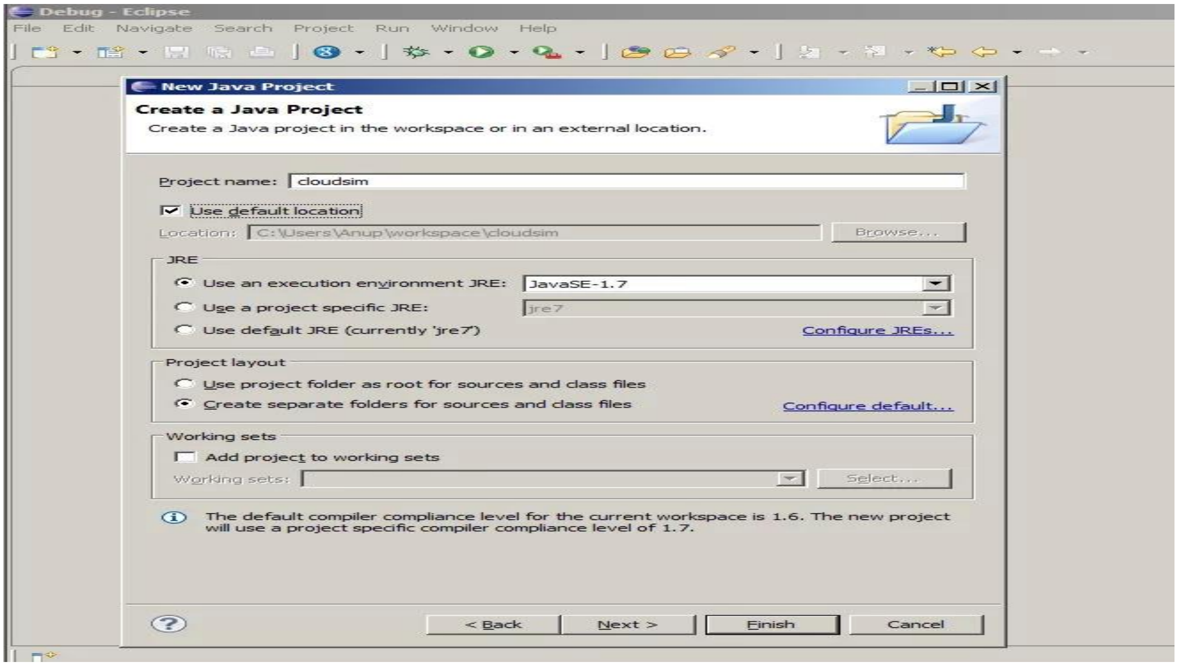
Create a Java project

Wizards:

- UML Lab Java Project
- General
  - Project
- CVS
- Eclipse Modeling Framework
- Google
  - Web Application Project
- Java
  - Java Project
  - Java Project from Existing Ant Buildfile
- JavaScript
- Maven
- UML Lab
- Examples

Now a detailed new project window will open, here you will provide the project name and the path of the CloudSim project source code, which will be done as follows:

- Project Name: CloudSim.



Create a Java Project

Create a Java project in the workspace or in an external location.

Project name: cloudsim

☑ Use default location

Location: C:\Users\Anup\workspace\cloudsim

JRE

● Use an execution environment JRE: JavaSE-1.7

○ Use a project specific JRE: jre7

○ Use default JRE (currently 'jre7')

Project layout

○ Use project folder as root for sources and class files

● Create separate folders for sources and class files

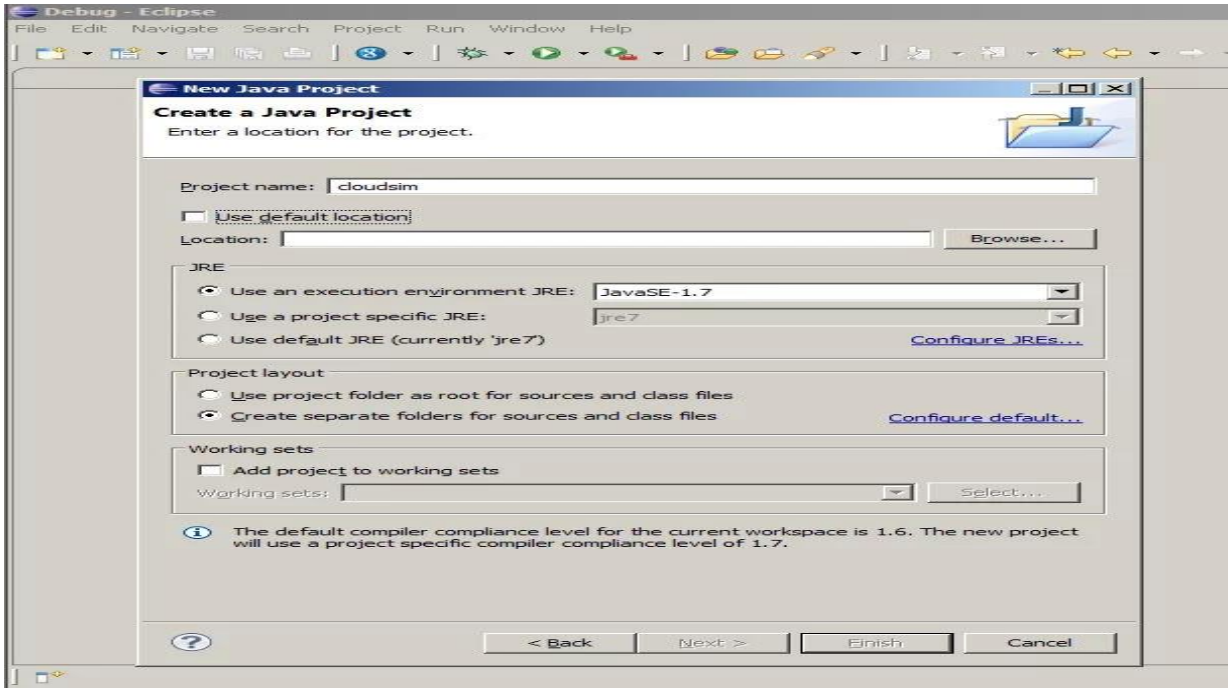
Working sets

□ Add project to working sets

Working sets:

The default compiler compliance level for the current workspace is 1.6. The new project will use a project specific compiler compliance level of 1.7.

Unselect the *'Use default location'* option and then click on *'Browse'* to open the path where you have unzipped the Cloudsim project and finally click Next to set project settings.



New Java Project

Create a Java Project

Enter a location for the project.

Project name: cloudsim

□ Use default location

Location: Browse...

JRE

● Use an execution environment JRE: JavaSE-1.7

○ Use a project specific JRE: jre7

○ Use default JRE (currently 'jre7') Configure JREs...

Project layout

○ Use project folder as root for sources and class files

● Create separate folders for sources and class files Configure default...

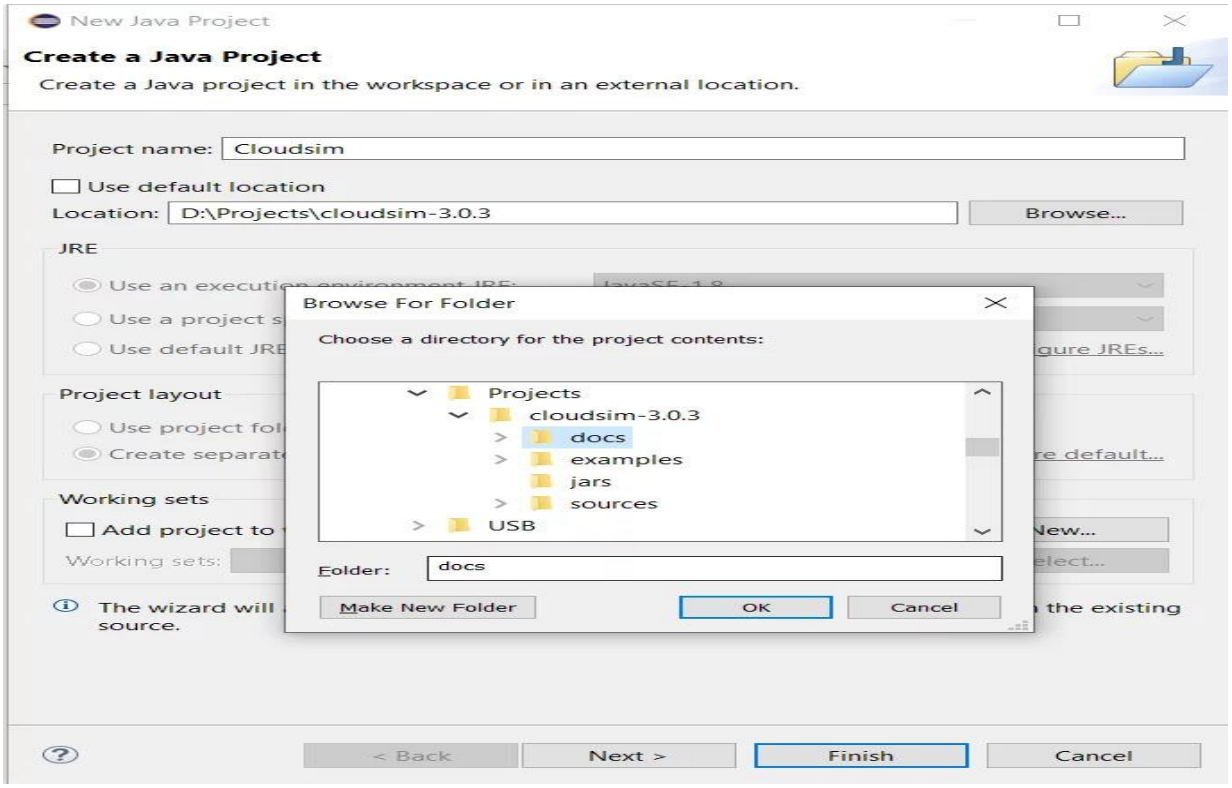
Working sets

□ Add project to working sets

Working sets: Select...

The default compiler compliance level for the current workspace is 1.6. The new project will use a project specific compiler compliance level of 1.7.

Make sure you navigate the path till you can see the bin, docs, examples, etc folder in the navigation plane.



New Java Project

Create a Java Project

Create a Java project in the workspace or in an external location.

Project name: Cloudsim

□ Use default location

Location: D:\Projects\cloudsim-3.0.3 Browse...

JRE

Use an executi... JavaSE-1.8

Use a project s...

Use default JRE ... ...gure JREs...

Project layout

Use project fol...

Create separat... ...re default...

Working sets

□ Add project to ...

Working sets:

The wizard will ... the existing source.

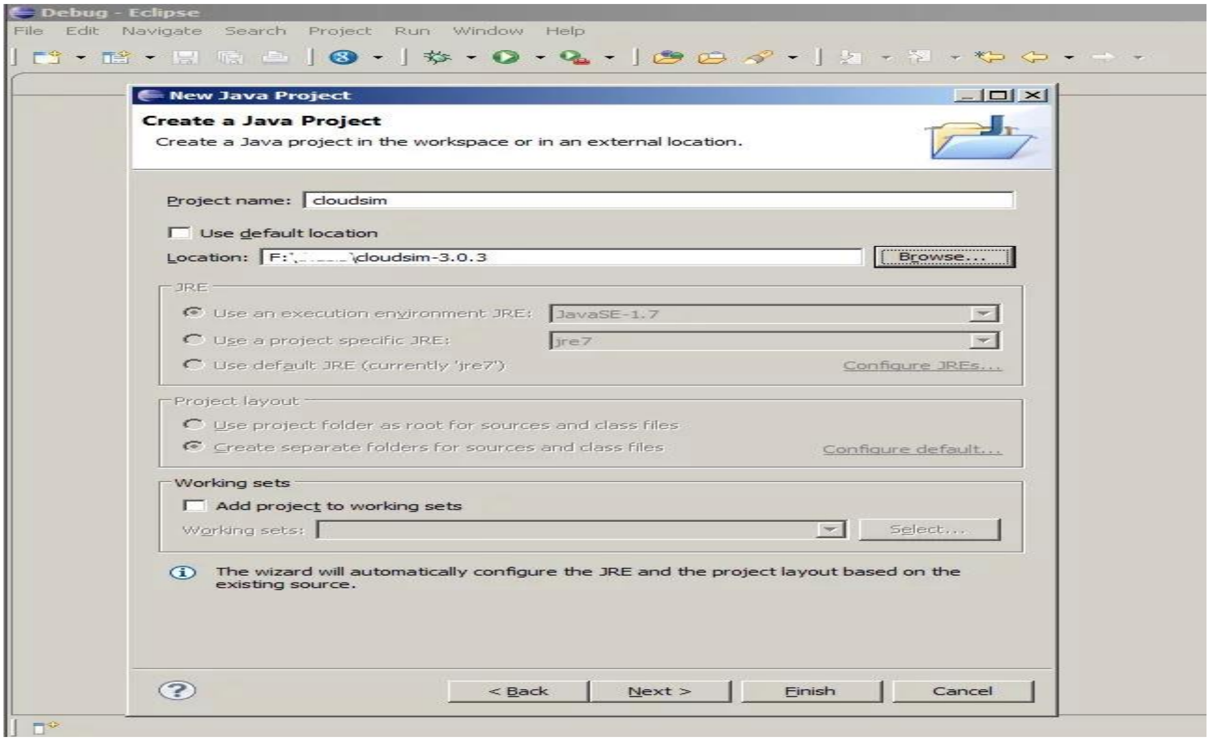
Browse For Folder

Choose a directory for the project contents:

- Projects
  - cloudsim-3.0.3
    - docs
    - examples
    - jars
    - sources
- USB

Folder: docs

finally, click ‘Next’ to go to the next step i.e. setting up of project settings



Debug - Eclipse

New Java Project

Create a Java Project

Create a Java project in the workspace or in an external location.

Project name: cloudsim

□ Use default location

Location: F:\[redacted]\cloudsim-3.0.3

JRE

● Use an execution environment JRE: JavaSE-1.7

○ Use a project specific JRE: jre7

○ Use default JRE (currently 'jre7')

Project layout

○ Use project folder as root for sources and class files

● Create separate folders for sources and class files

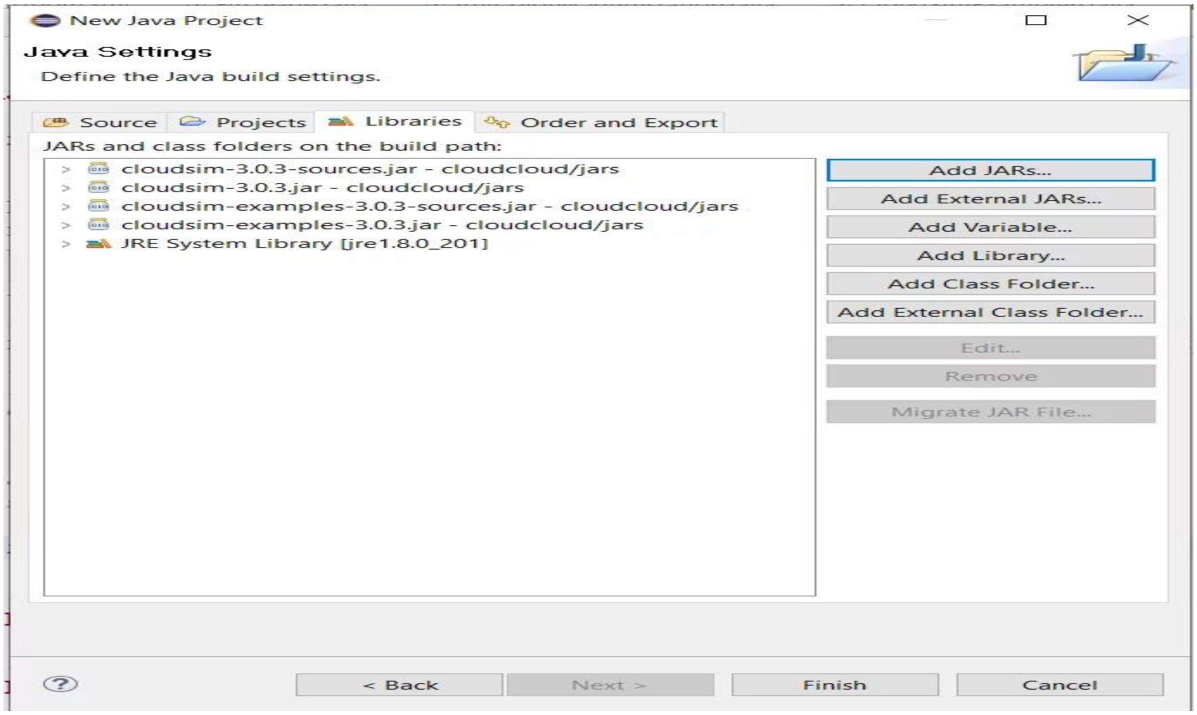
Working sets

□ Add project to working sets

Working sets:

The wizard will automatically configure the JRE and the project layout based on the existing source.

Now open the *‘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’* (commons-math3-3.x.jar will be included in the project from this step)



New Java Project

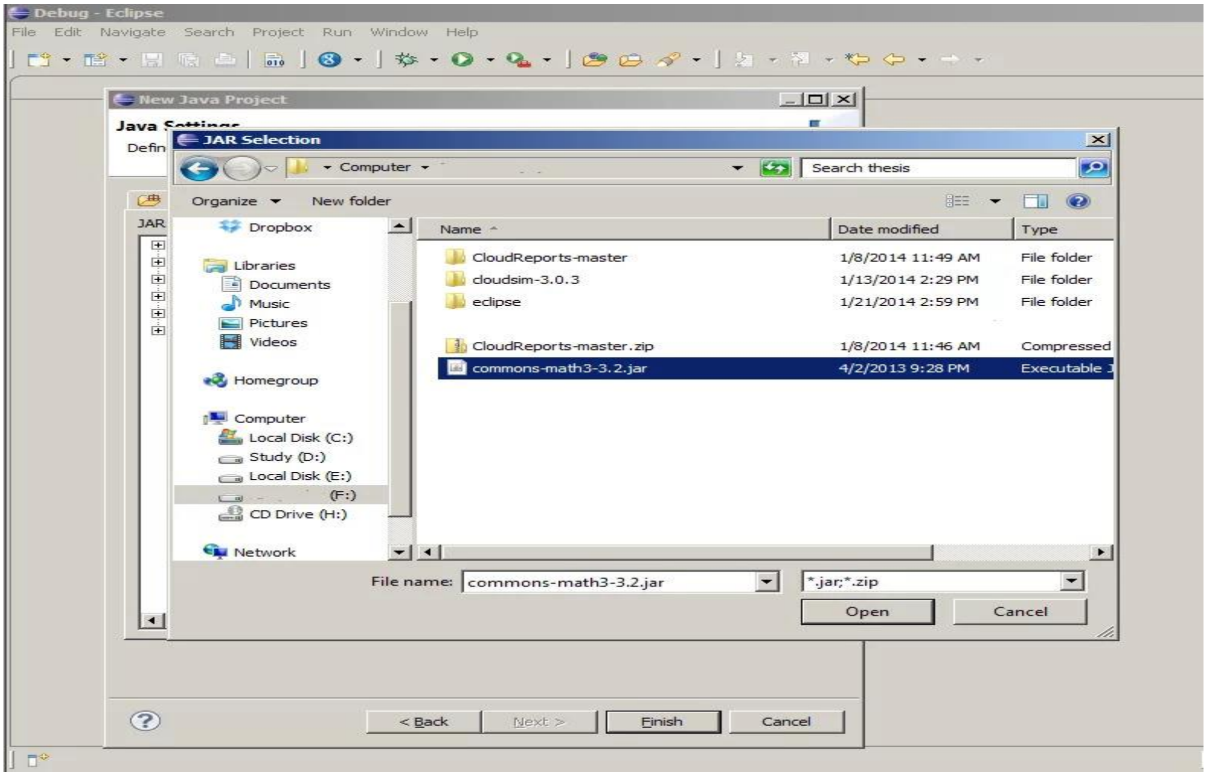
Java Settings

Define the Java build settings.

JARs and class folders on the build path:

- cloudsim-3.0.3-sources.jar - cloudcloud/jars
- cloudsim-3.0.3.jar - cloudcloud/jars
- cloudsim-examples-3.0.3-sources.jar - cloudcloud/jars
- cloudsim-examples-3.0.3.jar - cloudcloud/jars
- JRE System Library [jre1.8.0_201]

Once you have clicked on ‘*Add External JAR’s*‘ Open the path where you have unzipped the commons-math binaries and select ‘*Commons-math3-3.x.jar*’ and click on Open.

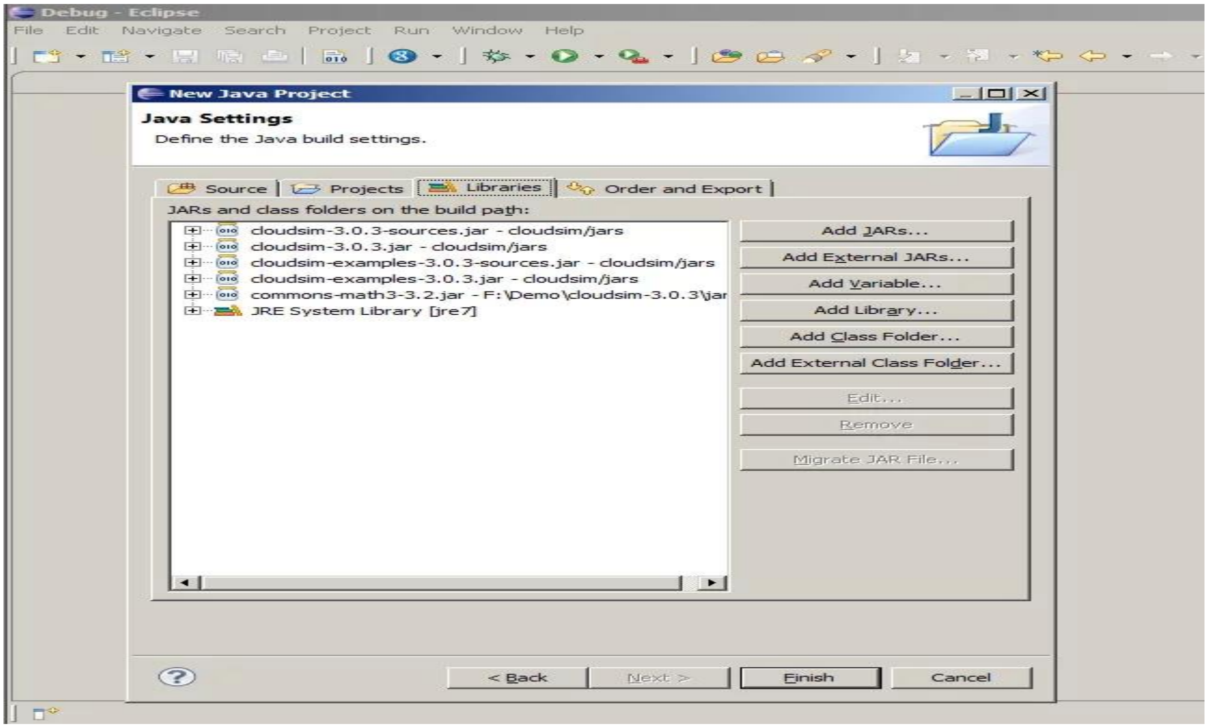


Name	Date modified	Type
CloudReports-master	1/8/2014 11:49 AM	File folder
cloudsim-3.0.3	1/13/2014 2:29 PM	File folder
eclipse	1/21/2014 2:59 PM	File folder
CloudReports-master.zip	1/8/2014 11:46 AM	Compressed
commons-math3-3.2.jar	4/2/2013 9:28 PM	Executable J

File name: commons-math3-3.2.jar

.jar;.zip

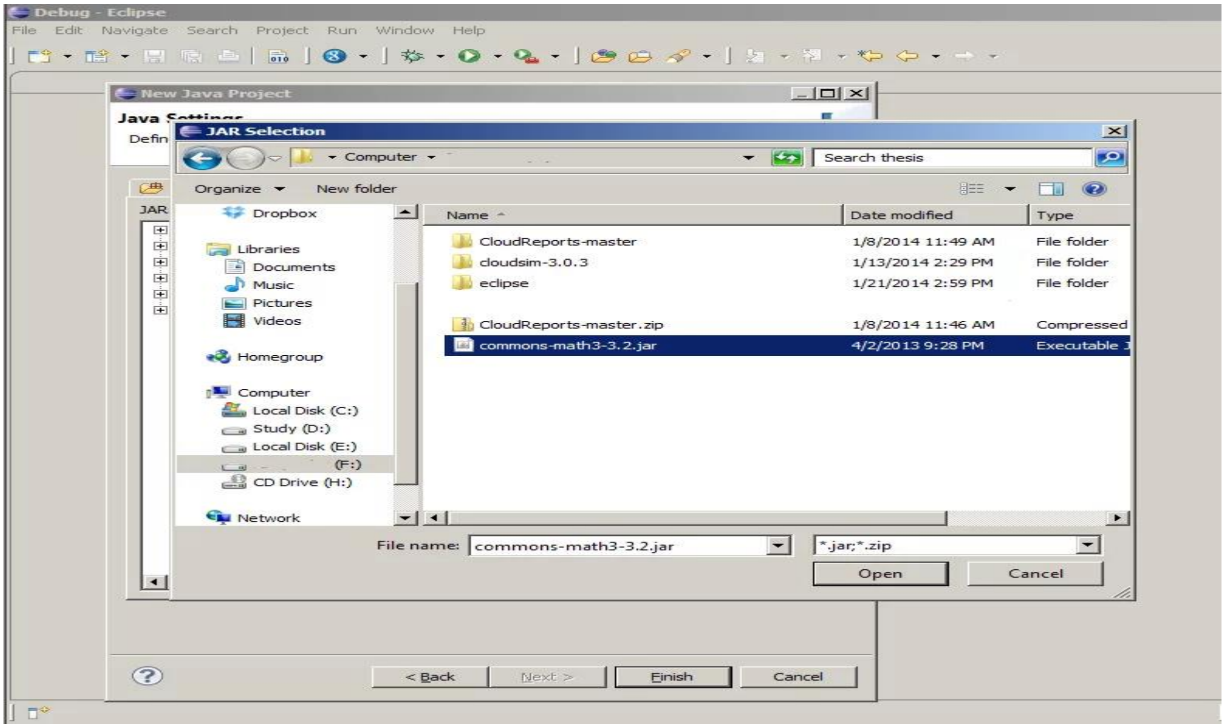
Ensure the external jar that you opened in the previous step is displayed in the list and then click on '*Finish*' (your system may take 2-3 minutes to configure the project)



JARs and class folders on the build path:

- cloudsim-3.0.3-sources.jar - cloudsim/jars
- cloudsim-3.0.3.jar - cloudsim/jars
- cloudsim-examples-3.0.3-sources.jar - cloudsim/jars
- cloudsim-examples-3.0.3.jar - cloudsim/jars
- commons-math3-3.2.jar - F:\Demo\cloudsim-3.0.3\jar
- JRE System Library [jre7]

Once you have clicked on '***Add External JAR's***' Open the path where you have unzipped the commons-math binaries and select '***Commons-math3-3.x.jar***' and click on Open.

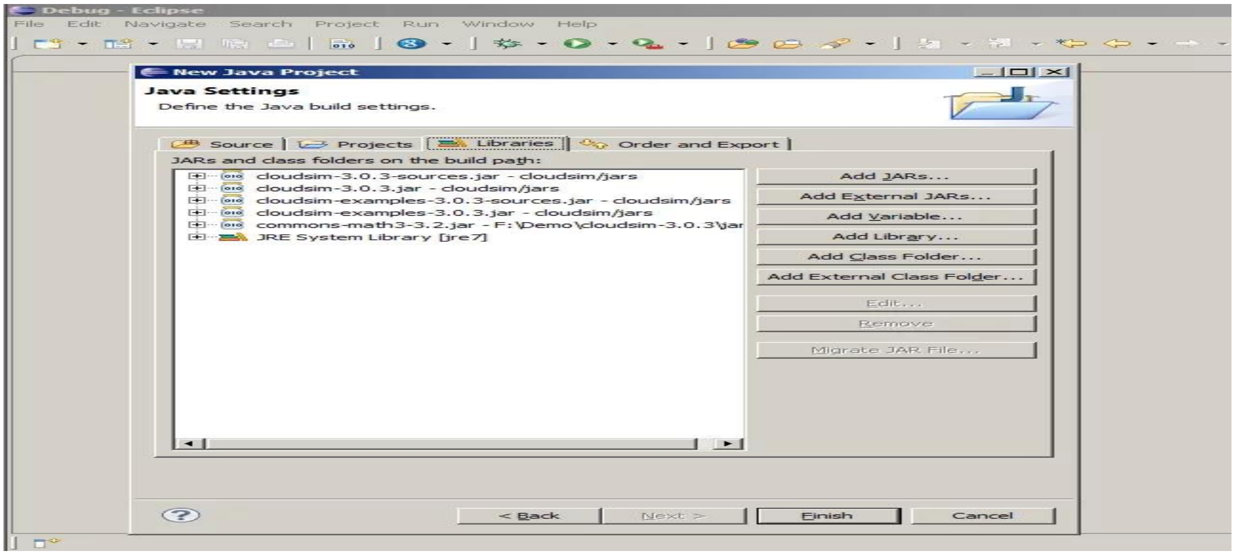


Name	Date modified	Type
CloudReports-master	1/8/2014 11:49 AM	File folder
cloudsim-3.0.3	1/13/2014 2:29 PM	File folder
eclipse	1/21/2014 2:59 PM	File folder
CloudReports-master.zip	1/8/2014 11:46 AM	Compressed
commons-math3-3.2.jar	4/2/2013 9:28 PM	Executable J

File name: commons-math3-3.2.jar

.jar;.zip

Ensure the external jar that you opened in the previous step is displayed in the list and then click on ‘***Finish***’ (your system may take 2-3 minutes to configure the project)

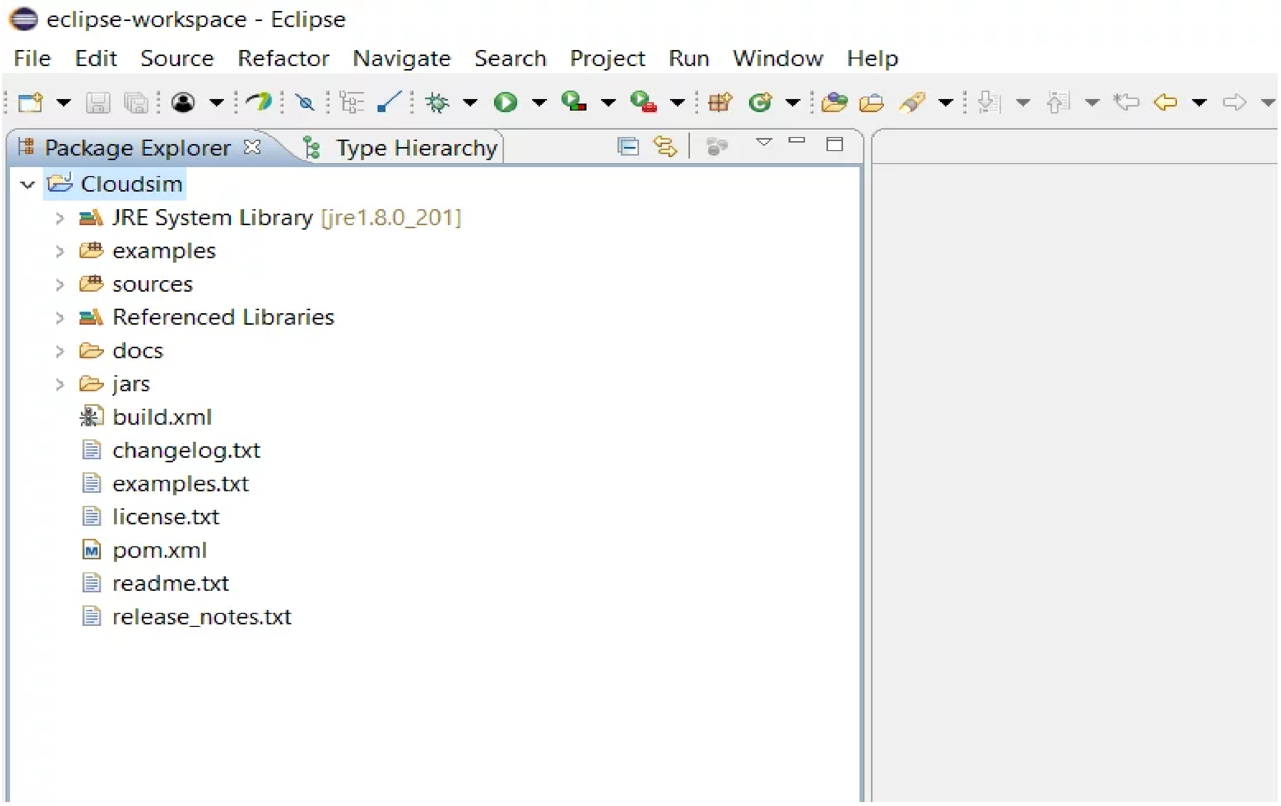


JARs and class folders on the build path:

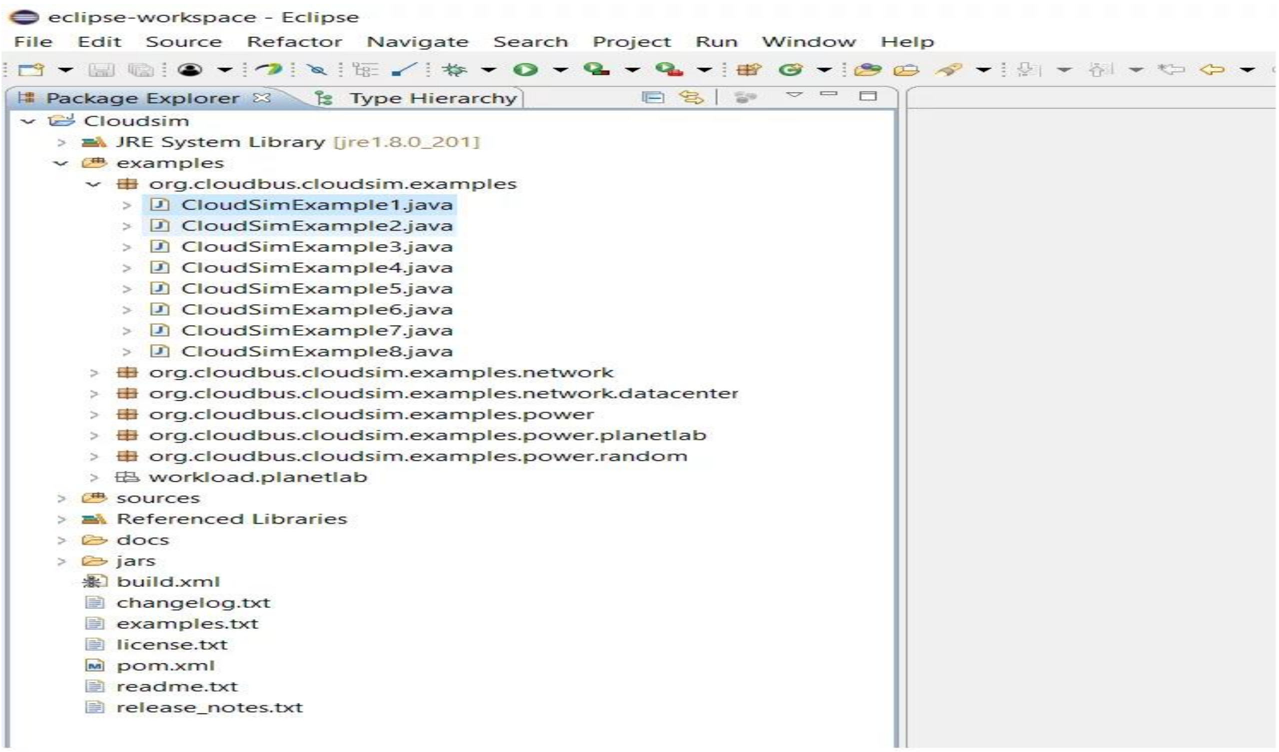
- cloudsim-3.0.3-sources.jar - cloudsim/jars
- cloudsim-3.0.3.jar - cloudsim/jars
- cloudsim-examples-3.0.3-sources.jar - cloudsim/jars
- cloudsim-examples-3.0.3.jar - cloudsim/jars
- commons-math3-3.2.jar - F:\Demo\cloudsim-3.0.3\jar
- JRE System Library [jre7]

Once the project is configured you can open ‘Project Explorer’ and start exploring the Cloudsim project. Also for the first time eclipse automatically start building the workspace for the newly configured Cloudsim project, which may take some time depending on the configuration of the computer system.

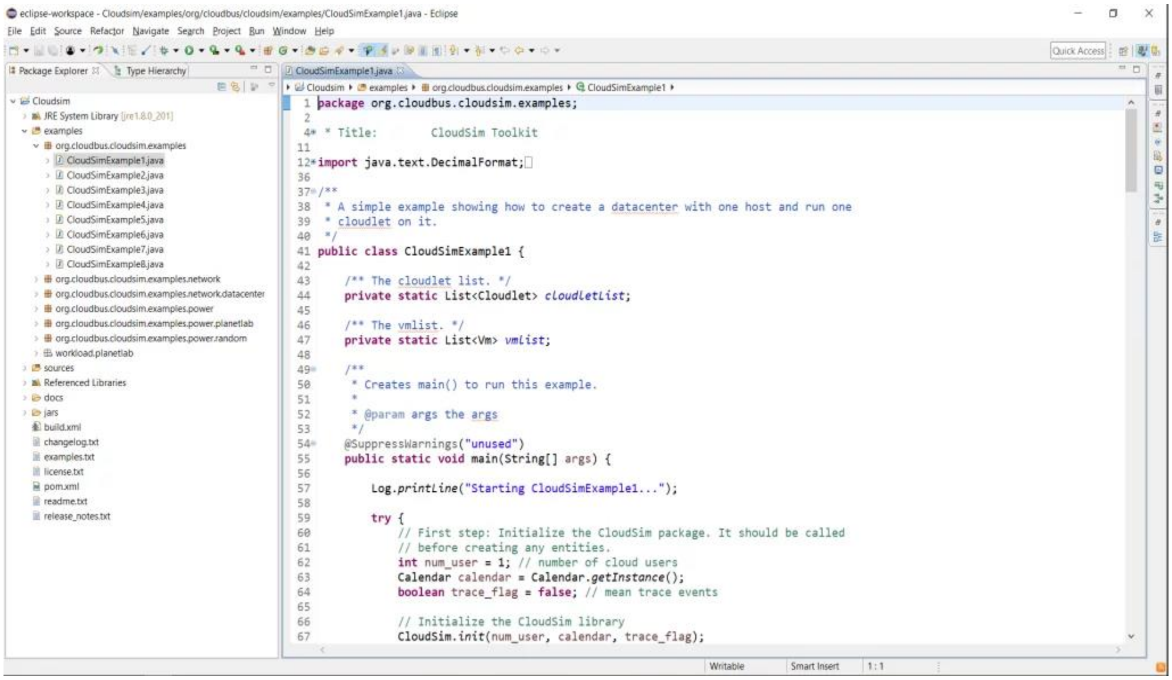
Following is the final screen which you will see after Cloudsim is configured.


eclipse-workspace - Eclipse
File Edit Source Refactor Navigate Search Project Run Window Help
Package Explorer
Type Hierarchy

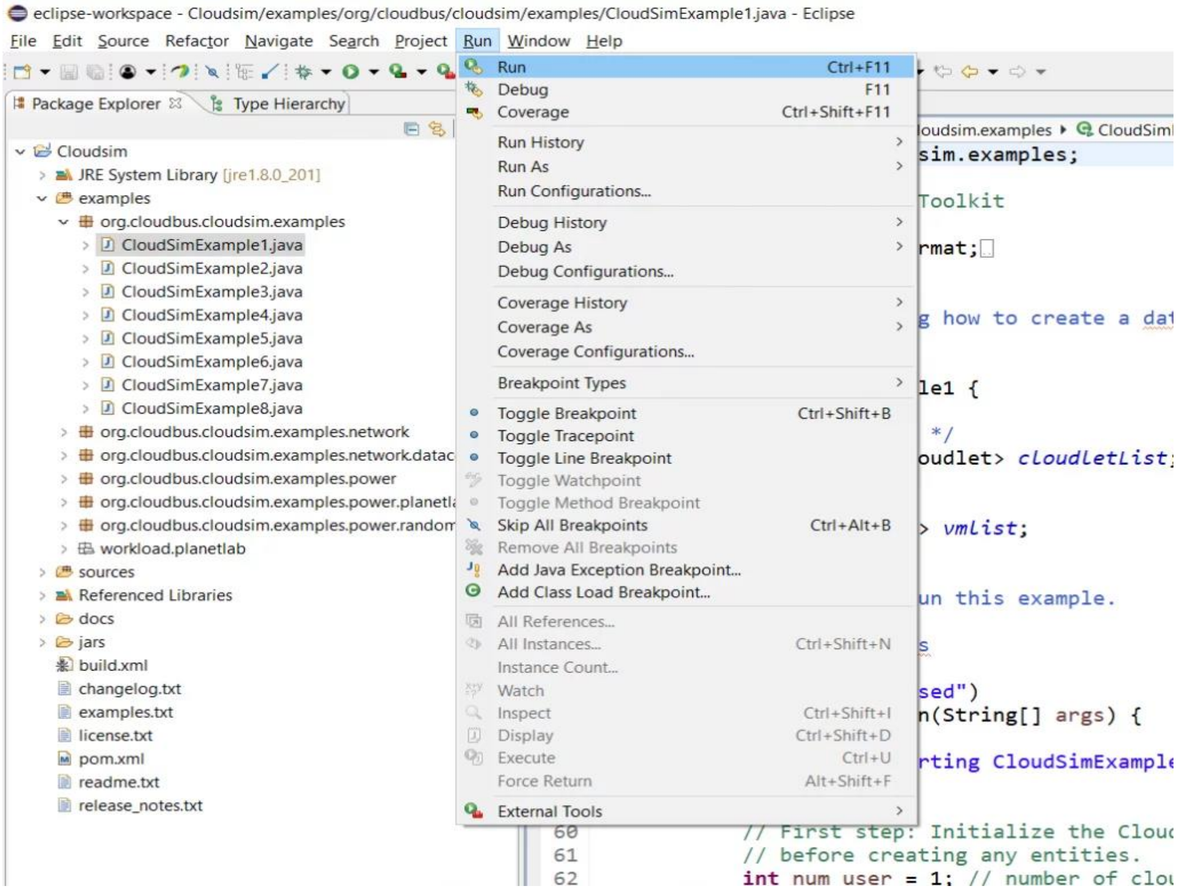
```
Cloudsim
  JRE System Library [jre1.8.0_201]
  examples
  sources
  Referenced Libraries
  docs
  jars
  build.xml
  changelog.txt
  examples.txt
  license.txt
  pom.xml
  readme.txt
  release_notes.txt
```

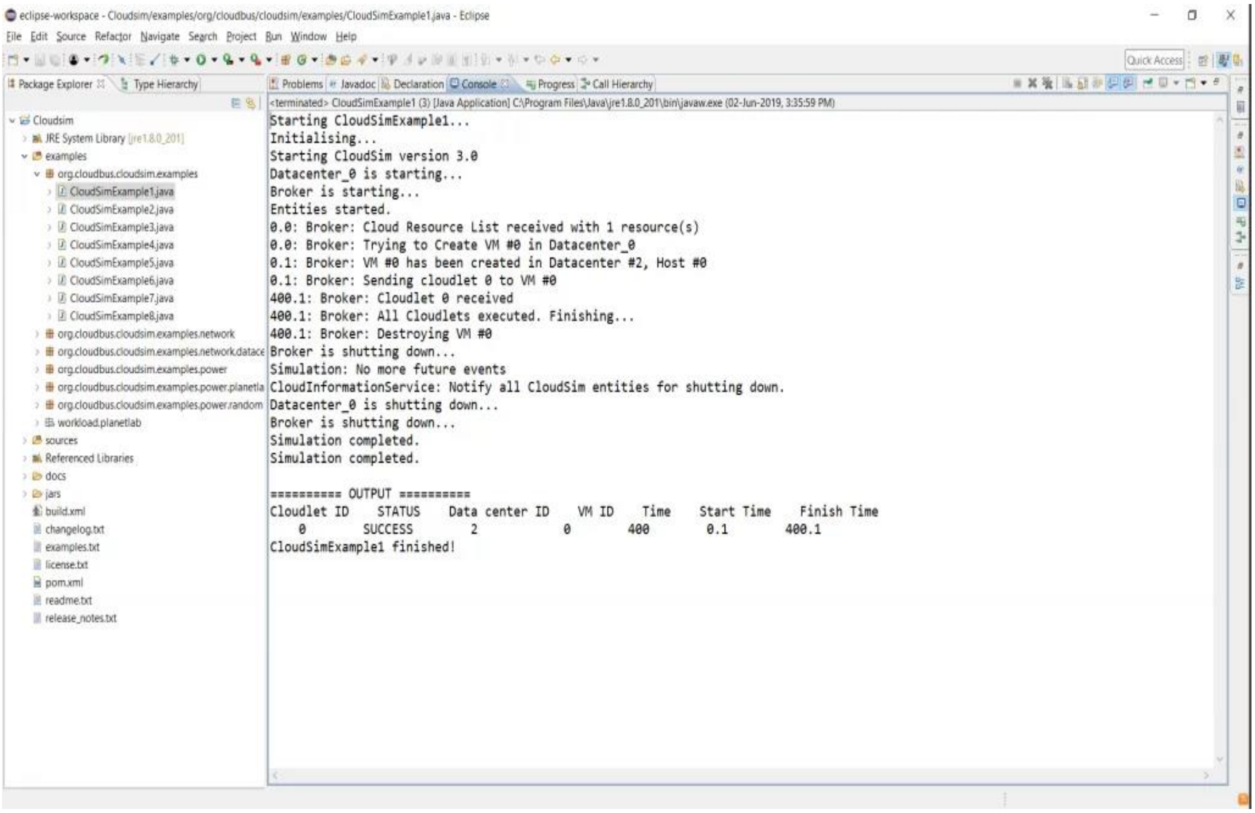

eclipse-workspace - Eclipse
File Edit Source Refactor Navigate Search Project Run Window Help
Package Explorer
Type Hierarchy

```
Cloudsim
  JRE System Library [jre1.8.0_201]
  examples
    org.cloudbus.cloudsim.examples
      CloudSimExample1.java
      CloudSimExample2.java
      CloudSimExample3.java
      CloudSimExample4.java
      CloudSimExample5.java
      CloudSimExample6.java
      CloudSimExample7.java
      CloudSimExample8.java
    org.cloudbus.cloudsim.examples.network
    org.cloudbus.cloudsim.examples.network.datacenter
    org.cloudbus.cloudsim.examples.power
    org.cloudbus.cloudsim.examples.power.planetlab
    org.cloudbus.cloudsim.examples.power.random
    workload.planetlab
  sources
  Referenced Libraries
  docs
  jars
  build.xml
  changelog.txt
  examples.txt
  license.txt
  pom.xml
  readme.txt
  release_notes.txt
```


eclipse-workspace - Cloudsim/examples/org/cloudbus/cloudsim/examples/CloudSimExample1.java - Eclipse
File Edit Source Refactor Navigate Search Project Run Window Help
Quick Access
Package Explorer
Type Hierarchy
CloudSimExample1.java
Cloudsim ▸ examples ▸ org.cloudbus.cloudsim.examples ▸ CloudSimExample1 ▸
Cloudsim
JRE System Library [jre1.8.0_201]
examples
org.cloudbus.cloudsim.examples
CloudSimExample1.java
CloudSimExample2.java
CloudSimExample3.java
CloudSimExample4.java
CloudSimExample5.java
CloudSimExample6.java
CloudSimExample7.java
CloudSimExample8.java
org.cloudbus.cloudsim.examples.network
org.cloudbus.cloudsim.examples.network.datacenter
org.cloudbus.cloudsim.examples.power
org.cloudbus.cloudsim.examples.power.planetlab
org.cloudbus.cloudsim.examples.power.random
workload.planetlab
sources
Referenced Libraries
docs
jars
build.xml
changelog.txt
examples.txt
license.txt
pom.xml
readme.txt
release_notes.txt
Writable
Smart Insert
1 : 1

```java
package org.cloudbus.cloudsim.examples;

 * Title:        CloudSim Toolkit

import java.text.DecimalFormat;

/**
 * A simple example showing how to create a datacenter with one host and run one
 * cloudlet on it.
 */
public class CloudSimExample1 {

    /** The cloudlet list. */
    private static List<Cloudlet> cloudletList;

    /** The vmlist. */
    private static List<Vm> vmlist;

    /**
     * Creates main() to run this example.
     *
     * @param args the args
     */
    @SuppressWarnings("unused")
    public static void main(String[] args) {

        Log.printLine("Starting CloudSimExample1...");

        try {
            // First step: Initialize the CloudSim package. It should be called
            // before creating any entities.
            int num_user = 1; // number of cloud users
            Calendar calendar = Calendar.getInstance();
            boolean trace_flag = false; // mean trace events

            // Initialize the CloudSim library
            CloudSim.init(num_user, calendar, trace_flag);
```




eclipse-workspace - Cloudsim/examples/org/cloudbus/cloudsim/examples/CloudSimExample1.java - Eclipse
File Edit Source Refactor Navigate Search Project Run Window Help
Quick Access
Package Explorer
Type Hierarchy
Cloudsim
JRE System Library [jre1.8.0_201]
examples
org.cloudbus.cloudsim.examples
CloudSimExample1.java
CloudSimExample2.java
CloudSimExample3.java
CloudSimExample4.java
CloudSimExample5.java
CloudSimExample6.java
CloudSimExample7.java
CloudSimExample8.java
org.cloudbus.cloudsim.examples.network
org.cloudbus.cloudsim.examples.network.datace
org.cloudbus.cloudsim.examples.power
org.cloudbus.cloudsim.examples.power.planetla
org.cloudbus.cloudsim.examples.power.random
workload.planetlab
sources
Referenced Libraries
docs
jars
build.xml
changelog.txt
examples.txt
license.txt
pom.xml
readme.txt
release_notes.txt
Problems
Javadoc
Declaration
Console
Progress
Call Hierarchy

```
<terminated> CloudSimExample1 (3) [Java Application] C:\Program Files\Java\jre1.8.0_201\bin\javaw.exe (02-Jun-2019, 3:35:59 PM)
Starting CloudSimExample1...
Initialising...
Starting CloudSim version 3.0
Datacenter_0 is starting...
Broker is starting...
Entities started.
0.0: Broker: Cloud Resource List received with 1 resource(s)
0.0: Broker: Trying to Create VM #0 in Datacenter_0
0.1: Broker: VM #0 has been created in Datacenter #2, Host #0
0.1: Broker: Sending cloudlet 0 to VM #0
400.1: Broker: Cloudlet 0 received
400.1: Broker: All Cloudlets executed. Finishing...
400.1: Broker: Destroying VM #0
Broker is shutting down...
Simulation: No more future events
CloudInformationService: Notify all CloudSim entities for shutting down.
Datacenter_0 is shutting down...
Broker 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        400       0.1        400.1
CloudSimExample1 finished!
```

Result:

Thus the simple application was created successfully.

Viva Voce:

1. What is cloud computing?
2. Explain the essential characteristics of cloud computing.
3. Differentiate between traditional hosting and cloud hosting.
4. Describe the three main service models in cloud computing.
5. Explain the differences between Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS).
6. What are the common deployment models in cloud computing?
7. Compare and contrast public, private, and hybrid clouds.
8. How does virtualization play a role in cloud computing?
9. Explain the benefits of virtualization in the context of cloud services.
10. What are the key security concerns in cloud computing?
11. Describe measures to ensure data security in the cloud.
12. Define scalability and elasticity in the context of cloud services.
13. How does the cloud facilitate scalability and elasticity?
14. Name some major cloud service providers.
15. Compare the services offered by different cloud providers.

Experiment No 4

Aim: Use of GAE launcher to launch the web applications.

Steps:

Making your First Application

Now you need to create a simple application. We could use the "+"option to have the launcher make us an application – but instead we will do it by hand to get a better sense ofwhat is going on.

Make a folder for your Google App Engine applications. I am going to make the Folderon my Desktop called "**apps**" – the path to this folder is:

C:\Documents and Settings\csev\Desktop\apps

And then make a sub-folder in within apps called "ae-01-trivial" — the path to this folder would be:

C:\ Documents and Settings \csev\Desktop\apps\ae-01-trivial

Using a text editor such as JEdit (www.jedit.org), create a file called app.yaml in the ae-01-trivial folder with the following contents:

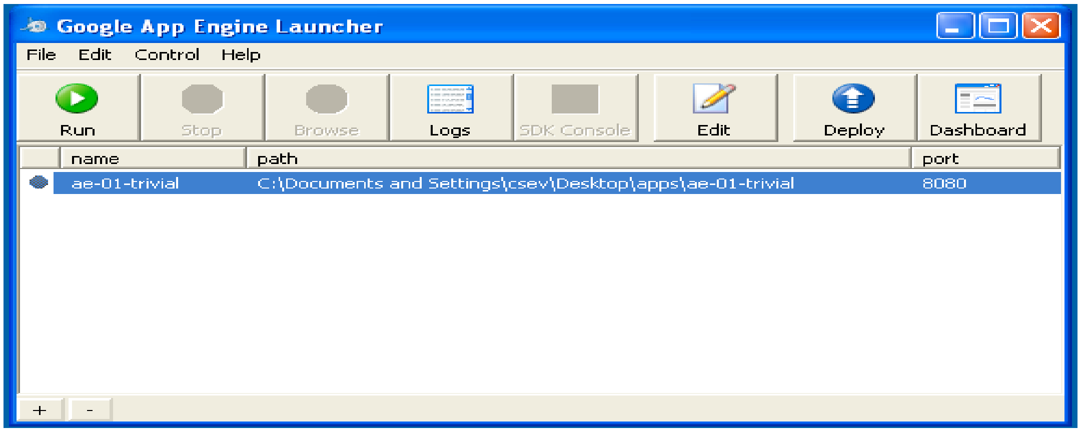
```
application:  ae-01-trivial
    version: 1
runtime: python api_version: 1
handlers:- url: /.*
script: index.py
```

Note: Please do notcopyandpaste these lines into yourtexteditor– youmightend up with strange characters – simply type them into your editor.

Then create a file in the ae-01-trivial folder called index.py with three lines in it:

```
print 'Content-Type: text/plain'
  print ' '
print 'Hello there Chuck'
```

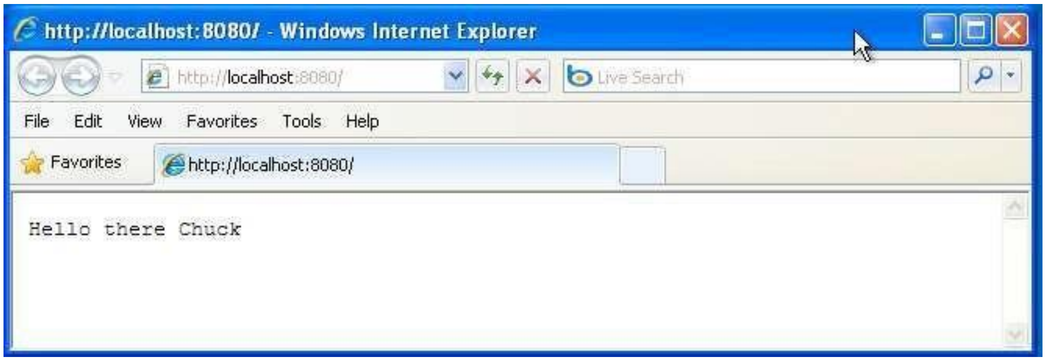
Then start the GoogleAppEngineLauncher program that can be found under Applications. Use the File -> Add Existing Application command and navigate into the apps directory and select the ae-01-trivial folder. Once you have added the application, select it so that youcancontrolthe application usingthelauncher.



name	path	port
ae-01-trivial	C:\Documents and Settings\csev\Desktop\apps\ae-01-trivial	8080

Once you have selected your application and press Run. After a few moments your application will start and the launcher will show a little green icon next to your application. Then press Browse to open a browser pointing at your application which is running at http://localhost:8080/

Paste http://localhost:8080 into your browser and you should see your application as follows:



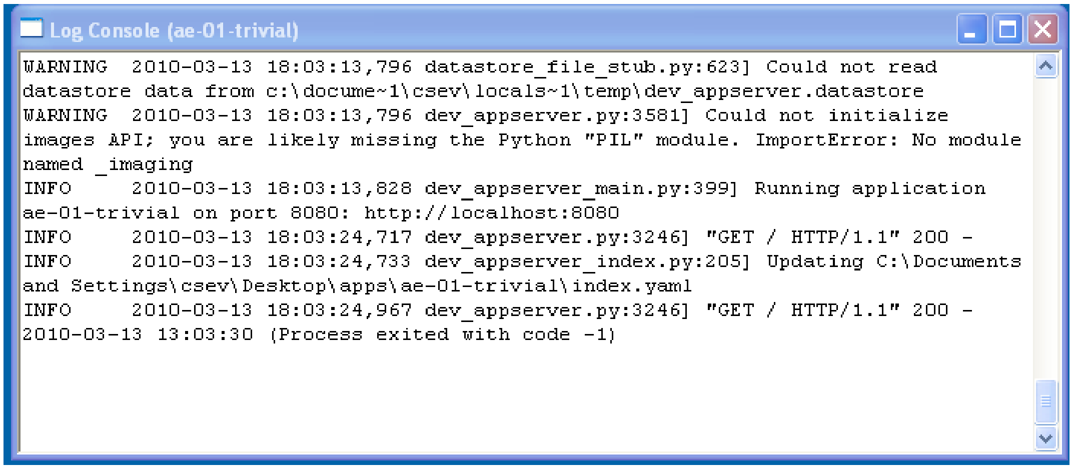
```
Hello there Chuck
```

Just for fun, edit the index.py to change the name "Chuck" to your own name and press Refresh in the browser to verify your updates.

Watching the Log

You can watch the internal log of the actions that the webserver is performing when you are interacting with your application in the browser. Select your application in the Launcher and press the Logs button to bring up a log window:

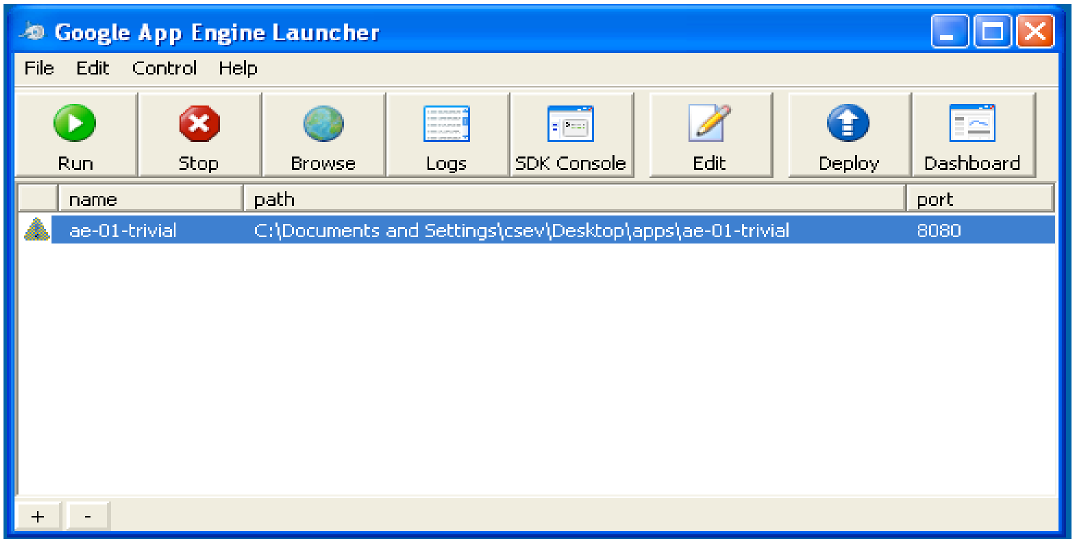
Each time you press refreshes in your browser–you can see it retrieving the output with a GET request.



```
WARNING  2010-03-13 18:03:13,796 datastore_file_stub.py:623] Could not read
datastore data from c:\docume~1\csev\locals~1\temp\dev_appserver.datastore
WARNING  2010-03-13 18:03:13,796 dev_appserver.py:3581] Could not initialize
images API; you are likely missing the Python "PIL" module. ImportError: No module
named _imaging
INFO     2010-03-13 18:03:13,828 dev_appserver_main.py:399] Running application
ae-01-trivial on port 8080: http://localhost:8080
INFO     2010-03-13 18:03:24,717 dev_appserver.py:3246] "GET / HTTP/1.1" 200 -
INFO     2010-03-13 18:03:24,733 dev_appserver_index.py:205] Updating C:\Documents
and Settings\csev\Desktop\apps\ae-01-trivial\index.yaml
INFO     2010-03-13 18:03:24,967 dev_appserver.py:3246] "GET / HTTP/1.1" 200 -
2010-03-13 13:03:30 (Process exited with code -1)
```

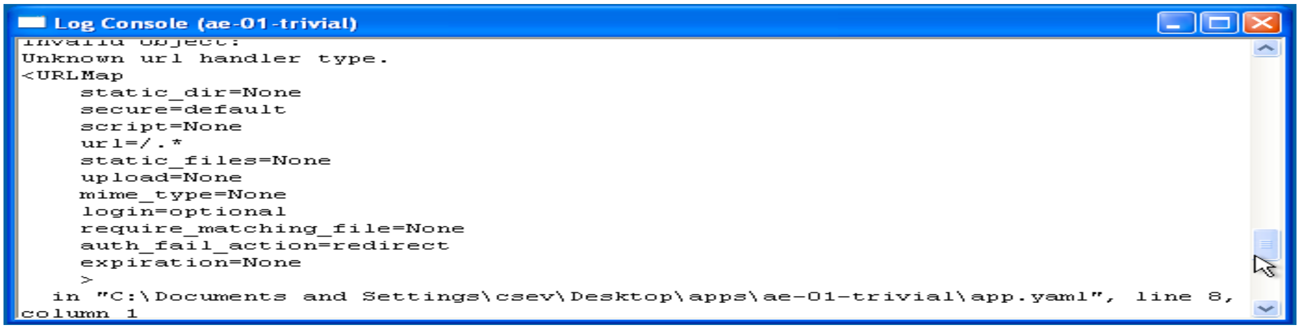
Dealing With Errors

With two files to edit, there are two general categories of errors that you may encounter. If you make a mistake on the app.yaml file, the App Engine will not start and your launcher will show a yellow icon near your application:



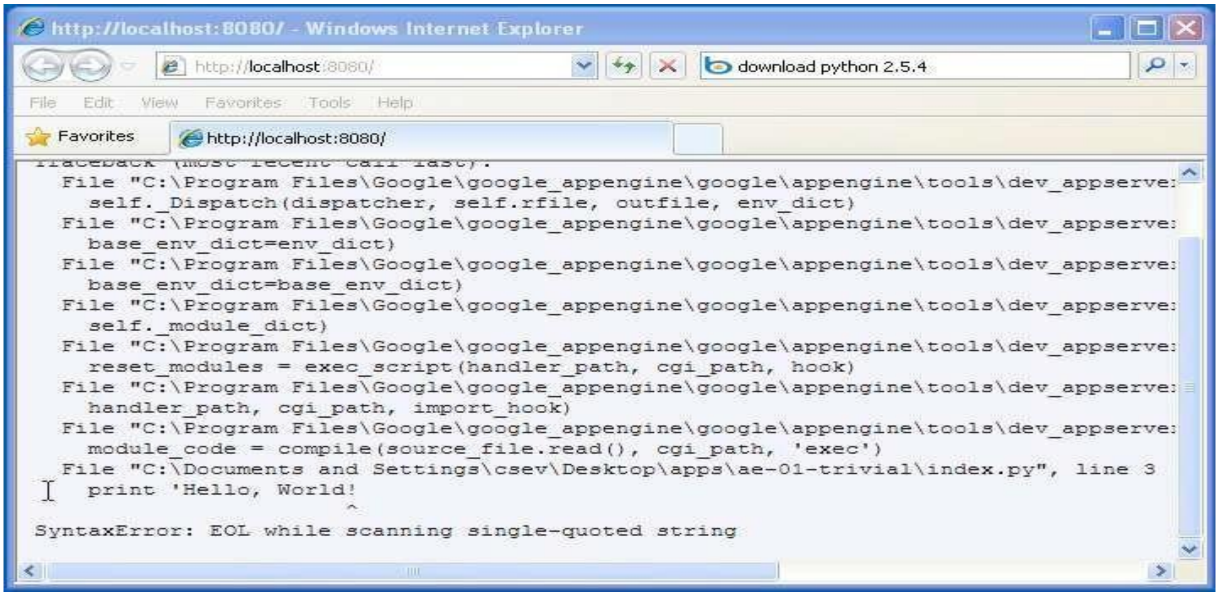
name	path	port
ae-01-trivial	C:\Documents and Settings\csev\Desktop\apps\ae-01-trivial	8080

To get more detail on what is going wrong, take a look at the log for the application:



```
Invalid object:
Unknown url handler type.
<URLMap
    static_dir=None
    secure=default
    script=None
    url=/.*
    static_files=None
    upload=None
    mime_type=None
    login=optional
    require_matching_file=None
    auth_fail_action=redirect
    expiration=None
    >
  in "C:\Documents and Settings\csev\Desktop\apps\ae-01-trivial\app.yaml", line 8,
column 1
```

In this instance – the mistake is mis indenting the last line in the app.yaml (line 8). If you make a syntax error in the index.py file, a Python trace back error will appear inyour browser.


http://localhost:8080/ - Windows Internet Explorer
http://localhost:8080/
download python 2.5.4
File Edit View Favorites Tools Help
Favorites
http://localhost:8080/

```
Traceback (most recent call last):
  File "C:\Program Files\Google\google_appengine\google\appengine\tools\dev_appserve:
    self._Dispatch(dispatcher, self.rfile, outfile, env_dict)
  File "C:\Program Files\Google\google_appengine\google\appengine\tools\dev_appserve:
    base_env_dict=env_dict)
  File "C:\Program Files\Google\google_appengine\google\appengine\tools\dev_appserve:
    base_env_dict=base_env_dict)
  File "C:\Program Files\Google\google_appengine\google\appengine\tools\dev_appserve:
    self._module_dict)
  File "C:\Program Files\Google\google_appengine\google\appengine\tools\dev_appserve:
    reset_modules = exec_script(handler_path, cgi_path, hook)
  File "C:\Program Files\Google\google_appengine\google\appengine\tools\dev_appserve:
    handler_path, cgi_path, import_hook)
  File "C:\Program Files\Google\google_appengine\google\appengine\tools\dev_appserve:
    module_code = compile(source_file.read(), cgi_path, 'exec')
  File "C:\Documents and Settings\csev\Desktop\apps\ae-01-trivial\index.py", line 3
    print 'Hello, World!
                       ^

SyntaxError: EOL while scanning single-quoted string
```

The error you need to see is likely to be the last few lines of the output – in thiscase, a Python syntax error on line one of our one-line application.

Reference: http://en.wikipedia.org/wiki/Stack_trace

When you make a mistake in the app.yaml file – you must the fix the mistakeand attempt to start the application again.

If you make a mistake in a file like index.py, you can simply fix the file andpress refresh in your browser – there is no need to restart the server.

Shutting Down the Server

To shut down the server, use the Launcher, select your application and press the Stop button.

Result:

Thus the GAE web application was created.

Viva Voce:

1. How can organizations optimize costs in a cloud environment?
2. Explain the pay-as-you-go model and its advantages.
3. Containers and Micro services:
4. What are containers, and how do they relate to cloud computing?
5. Explain the concept of microservices in cloud architecture.
6. Define serverless computing.

7. Discuss the benefits and challenges of serverless computing.
8. What is a distributed system?
9. Explain the advantages of distributed systems.
10. Communication in Distributed Systems:
11. How do processes communicate in a distributed system?
12. Discuss message-passing and remote procedure calls in distributed systems.
13. What is the CAP theorem, and how does it apply to distributed systems?
14. Explain the trade-offs between consistency, availability, and partition tolerance.
15. Discuss the characteristics of distributed file systems.

Experiment No. 5

Aim: Simulate a cloud scenario using Matlab and run a scheduling algorithm.

Matlab:

Simulating a cloud scenario and running scheduling algorithms can be a complex task, a basic example using MATLAB is taken for example, create a simple cloud environment with tasks and implement a basic scheduling algorithm, such as First Come First Serve (FCFS).

Code:

```
 % Cloud Simulation Parameters
numTasks = 10;       % Number of tasks
taskExecutionTime = randi([1, 10], 1, numTasks);  % Random execution time for tasks
cloudCapacity = 5;    % Maximum number of tasks that can be executed simultaneously

% Initialize simulation variables
taskQueue = 1:numTasks;  % Task queue representing the order of arrival
% Simulate First Come First Serve (FCFS) scheduling algorithm
completionTime = zeros(1, numTasks);
for i = 1:numTasks
taskID = taskQueue(i);          % Check if there is available capacity in the cloud
if i <= cloudCapacity        % Task starts execution immediately
completionTime(taskID) = taskExecutionTime(taskID);
else         % Wait for previous tasks to complete before starting execution
completionTime(taskID) = completionTime(taskQueue(i - cloudCapacity)) +
taskExecutionTime(taskID);
 end
fprintf('Task %d started at time %d and completed at time %d\n',
taskID, completionTime(taskID) - taskExecutionTime(taskID), completionTime(taskID));
end
% Display completion times fprintf('\nTask Completion Times:\n'); disp(completionTime);
% Display average completion time avgCompletionTime = mean(completionTime);
fprintf('\nAverage Completion Time: %.2f\n', avgCompletionTime);
```

This MATLAB script simulates a cloud scenario with a given number of tasks, each with a random execution time. The tasks are scheduled using the FCFS algorithm, and the completion times are displayed, along with the average completion time.

You have to run this Java program on your Eclipse IDE after extracting CloudSim 3.0.3 and Apache Commons Math 3.6.1 zip file. Only then will the code run properly.

```java
import java.text.DecimalFormat;
import java.util.ArrayList;
import java.util.Calendar;
import java.util.LinkedList;
import java.util.List;
import org.cloudbus.cloudsim.Cloudlet;
import org.cloudbus.cloudsim.CloudletSchedulerTimeShared;
import org.cloudbus.cloudsim.Datacenter;
import org.cloudbus.cloudsim.DatacenterBroker;
import org.cloudbus.cloudsim.DatacenterCharacteristics;
import org.cloudbus.cloudsim.Host;
import org.cloudbus.cloudsim.Log;
import org.cloudbus.cloudsim.Pe;
import org.cloudbus.cloudsim.Storage;
import org.cloudbus.cloudsim.UtilizationModel;
import org.cloudbus.cloudsim.UtilizationModelFull;
import org.cloudbus.cloudsim.Vm;
import org.cloudbus.cloudsim.VmAllocationPolicySimple;
import org.cloudbus.cloudsim.VmSchedulerTimeShared;
import org.cloudbus.cloudsim.core.CloudSim;
import org.cloudbus.cloudsim.provisioners.BwProvisionerSimple;
import org.cloudbus.cloudsim.provisioners.PeProvisionerSimple;
import org.cloudbus.cloudsim.provisioners.RamProvisionerSimple;

// A simple example showing how to create a data center
// with one host and run eight cloudlets on it
public class CloudSimExample1 {
    // The cloudlet list
    private static List<Cloudlet> cloudletList;

    // The vmlist
    private static List<Vm> vmlist;

    @SuppressWarnings("unused")
    public static void main(String[] args)
    {
        Log.printLine("Starting CloudSimExample2...");

        try {
            // First step: Initialize the CloudSim package.
            // It should be called before creating any
            // entities. number of cloud users
            int num_user = 1;

            // Calendar whose fields have been initialized
            // with the current date and time.
            Calendar calendar = Calendar.getInstance();

            // trace events
            boolean trace_flag = false;

            CloudSim.init(num_user, calendar, trace_flag);

            // Second step: Create Datacenters
            // Datacenters are the resource providers in
            // CloudSim. We need at list one of them to run
            // a CloudSim simulation
            Datacenter datacenter0
                = createDatacenter("Datacenter_0");

            // Third step: Create Broker
            DatacenterBroker broker = createBroker();
            int brokerId = broker.getId();

            // Fourth step: Create four virtual machine
            vmlist = new ArrayList<Vm>();

            // VM description
            int vmid = 0;
            int mips = 1000;
            long size = 10000; // image size (MB)
            int ram = 512; // vm memory (MB)
            long bw = 1000; // bandwidth
            int pesNumber = 1; // number of cpus
            String vmm = "Xen"; // VMM name

            // create 4 VMs
            Vm vm1
                = new Vm(vmid, brokerId, mips, pesNumber,
                        ram, bw, size, vmm,
                        new CloudletSchedulerTimeShared());
            vmid++;
            Vm vm2 = new Vm(
                vmid, brokerId, mips * 2, pesNumber,
                ram - 256, bw, size * 2, vmm,
                new CloudletSchedulerTimeShared());
            vmid++;
            Vm vm3 = new Vm(
                vmid, brokerId, mips / 2, pesNumber,
                ram + 256, bw, size * 3, vmm,
                new CloudletSchedulerTimeShared());
            vmid++;
            Vm vm 4
                = new Vm(vmid, brokerId, mips * 4,
                        pesNumber, ram, bw, size * 4, vmm,
                        new CloudletSchedulerTimeShared());
            vmid++;

            // add the VM to the vmList
            vmlist.add(vm1);
            vmlist.add(vm2);
            vmlist.add(vm3);
            vmlist.add(vm4);

            // submit vm list to the broker
            broker.submitVmList(vmlist);

            // Fifth step: Create eight Cloudlets
            cloudletList = new ArrayList<Cloudlet>();

            // Cloudlet properties
            int id = 0;
            long length = 400000;
            long fileSize = 300;
            long outputSize = 300;
            UtilizationModel utilizationModel
                = new UtilizationModelFull();

            Cloudlet cloudlet1 = new Cloudlet(
                id, length, pesNumber, fileSize, outputSize,
                utilizationModel, utilizationModel,
                utilizationModel);
            cloudlet1.setUserId(brokerId);
            id++;
            Cloudlet cloudlet2 = new Cloudlet(
                id, length * 2, pesNumber, fileSize * 2,
                outputSize / 3, utilizationModel,
                utilizationModel, utilizationModel);
            cloudlet2.setUserId(brokerId);
            id++;
            Cloudlet cloudlet3 = new Cloudlet(
                id, length / 2, pesNumber, fileSize * 3,
                outputSize * 3, utilizationModel,
                utilizationModel, utilizationModel);
            cloudlet3.setUserId(brokerId);
            Cloudlet cloudlet4 = new Cloudlet(
                id, length / 3, pesNumber, fileSize / 3,
                outputSize / 2, utilizationModel,
                utilizationModel, utilizationModel);
            cloudlet4.setUserId(brokerId);
            Cloudlet cloudlet5 = new Cloudlet(
                id, length * 3, pesNumber, fileSize / 2,
                outputSize / 4, utilizationModel,
                utilizationModel, utilizationModel);
            cloudlet5.setUserId(brokerId);
            Cloudlet cloudlet6 = new Cloudlet(
                id, length / 4, pesNumber, fileSize * 4,
                outputSize * 4, utilizationModel,
                utilizationModel, utilizationModel);
            cloudlet6.setUserId(brokerId);
            Cloudlet cloudlet7 = new Cloudlet(
                id, length * 4, pesNumber, fileSize,
                outputSize * 2, utilizationModel,
                utilizationModel, utilizationModel);
            cloudlet7.setUserId(brokerId);
            Cloudlet cloudlet8 = new Cloudlet(
                id, length, pesNumber, fileSize / 4,
                outputSize / 3, utilizationModel,
                utilizationModel, utilizationModel);
            cloudlet8.setUserId(brokerId);

            // add the cloudlet to the list
            cloudletList.add(cloudlet1);
            cloudletList.add(cloudlet2);
            cloudletList.add(cloudlet3);
            cloudletList.add(cloudlet4);
            cloudletList.add(cloudlet5);
            cloudletList.add(cloudlet6);
            cloudletList.add(cloudlet7);
            cloudletList.add(cloudlet8);
```

```
        // submit cloudlet list to the broker
        broker.submitCloudletList(cloudletList);

        // bind the cloudlets to the vms,This way the
        // broker will submit the bound cloudlets only
        // to the specific VM
        broker.bindCloudletToVm(
            Cloudlet1.getCloudletId(), vm1.getId());
        broker.bindCloudletToVm(
            Cloudlet2.getCloudletId(), vm2.getId());
        broker.bindCloudletToVm(
            Cloudlet3.getCloudletId(), vm3.getId());
        broker.bindCloudletToVm(
            Cloudlet4.getCloudletId(), vm4.getId());
        broker.bindCloudletToVm(
            Cloudlet5.getCloudletId(), vm1.getId());
        broker.bindCloudletToVm(
            Cloudlet6.getCloudletId(), vm2.getId());
        broker.bindCloudletToVm(
            Cloudlet7.getCloudletId(), vm3.getId());
        broker.bindCloudletToVm(
            Cloudlet8.getCloudletId(), vm4.getId());

        // Sixth step: Starts the simulation
        CloudSim.startSimulation();

        CloudSim.stopSimulation();

        // Final step: Print results when simulation is
        // over
        List<Cloudlet> newList
            = broker.getCloudletReceivedList();
        printCloudletList(newList);

        Log.printLine("CloudSimExample1 finished!");
    }
    catch (Exception e) {
        e.printStackTrace();
        Log.printLine("Unwanted errors happen");
    }
}
```

```
private static Datacenter createDatacenter(String name)
{

    // Here are the steps needed to create a
    // PowerDatacenter:
    // 1. We need to create a list to store
    // our machine
    List<Host> hostList = new ArrayList<Host>();

    // 2. A Machine contains one or more PEs or
    // CPUs/Cores. In this example, it will have only
    // one core.
    List<Pe> peList = new ArrayList<Pe>();

    int mips = 1000;

    // 3. Create PEs and add these into a list.
    // need to store Pe id and MIPS Rating
    peList.add(
        new Pe(0, new PeProvisionerSimple(mips)));

    // 4. Create Host with its id and list of PEs and
    // add them to the list of machines
    int hostId = 0;
    int ram = 2048; // host memory (MB)
    long storage = 1000000; // host storage
    int bw = 10000;

    hostList.add(new Host(
        hostId, new RamProvisionerSimple(ram),
        new BwProvisionerSimple(bw), storage, peList,
        new VmSchedulerTimeShared(
            peList))); // This is our machine

    // 5. Create a DatacenterCharacteristics object that
    // stores the properties of a data center:
    // architecture, OS, list of Machines, allocation
    // policy: time- or space-shared, time zone and its
    // price (G$/Pe time unit).
    String arch = "x86"; // system architecture
    String os = "Linux"; // operating system
    String vmm = "Xen";
    double time_zone
```

```
            = 10.0; // time zone this resource located
        double cost = 3.0; // the cost of using processing
                           // in this resource
        double costPerMem = 0.05; // the cost of using
                                  // memory in this resource
        double costPerStorage
            = 0.001; // the cost of using storage in this
                     // resource
        double costPerBw
            = 0.0; // the cost of using bw in this resource
        LinkedList<Storage> storageList
            = new LinkedList<Storage>(); // we are not
                                         // adding SAN
                                         // devices by now

        DatacenterCharacteristics characteristics
            = new DatacenterCharacteristics(
                arch, os, vmm, hostList, time_zone, cost,
                costPerMem, costPerStorage, costPerBw);

        // 6. Finally, we need to create a PowerDatacenter
        // object.
        Datacenter datacenter = null;
        try {
            datacenter = new Datacenter(
                name, characteristics,
                new VmAllocationPolicySimple(hostList),
                storageList, 0);
        }
        catch (Exception e) {
            e.printStackTrace();
        }

        return datacenter;
    }

    private static DatacenterBroker createBroker()
    {
        DatacenterBroker broker = null;
        try {
            broker = new DatacenterBroker("Broker");
        }
        catch (Exception e) {
```

```
        e.printStackTrace();
        return null;
    }
    return broker;
}

private static void
printCloudletList(List<Cloudlet> list)
{
    int size = list.size();
    Cloudlet cloudlet;

    String indent = "    ";
    Log.printLine();
    Log.printLine("========== OUTPUT ==========");
    Log.printLine("Cloudlet ID" + indent + "STATUS"
                  + indent + "Data center ID" + indent
                  + "VM ID" + indent + "Time" + indent
                  + "Start Time" + indent
                  + "Finish Time");

    DecimalFormat dft = new DecimalFormat("###.##");
    for (int i = 0; i < size; i++) {
        cloudlet = list.get(i);
        Log.print(indent + cloudlet.getCloudletId()
                  + indent + indent);

        if (cloudlet.getCloudletStatus()
            == Cloudlet.SUCCESS) {
            Log.print("SUCCESS");

            Log.printLine(
                indent + indent
                + cloudlet.getResourceId() + indent
                + indent + indent + cloudlet.getVmId()
                + indent + indent
                + dft.format(
                    cloudlet.getActualCPUTime())
                + indent + indent
                + dft.format(
                    cloudlet.getExecStartTime())
                + indent + indent
                + dft.format(cloudlet.getFinishTime()));
            }
        }
    }
}
```

Result: Simulation done using cloud scenario

Viva Voce:

1. Provide examples of distributed file systems.
2. How is concurrency control handled in distributed databases?
3. Explain the challenges of maintaining consistency in a distributed database.
4. Why is fault tolerance important in distributed systems?
5. Describe techniques for achieving fault tolerance in distributed systems.
6. What are distributed transactions?
7. Discuss the challenges of ensuring transactional consistency in a distributed environment.
8. Explain the role of middleware in distributed systems.
9. Provide examples of middleware technologies.
10. Why is load balancing essential in distributed systems?
11. Describe different load balancing strategies.
12. Compare and contrast different models of distributed computing (e.g., client-server, peer-to-peer).
13. Discuss the advantages and disadvantages of each model.
14. Explain the trade-offs between consistency, availability, and partition tolerance.
15. Discuss the characteristics of distributed file systems.

Experiment No. 6

Aim: To Find a procedure to transfer the files from one virtual machine to another virtual machine.

Steps:

1. You can copy few (or more) lines with *copy & paste* mechanism.

For this you need to share clipboard between host OS and guest OS, installing Guest Addition on both the virtual machines (probably setting *bidirectional* and restarting them). You *copy* from *guest OS* in the clipboard that is shared with the *host OS*.

Then you *paste* from the *host OS* to the second *guest OS*.

2. You can enable drag and drop too with the same method (Click on the machine, settings, general, advanced, drag and drop: set to *bidirectional*)

3. You can have common *Shared Folders* on both virtual machines and use one of the directory shared as buffer to copy.

Installing Guest Additions you have the possibility to set Shared Folders too. As you put a file in a shared folder from *host OS* or from *guest OS*, is immediately visible to the other. (Keep in mind that can arise some problemsfor date/time of the files when there are different clock settings on the different virtual machines).

If you use the same folder shared on more machines you can exchange files directly copying them in this folder.

4. You can use usual method to copy files between 2 different computer with client-server application. (e.g. scp with sshd active for linux, winscp... you can get some info about SSH servers e.g. here)

You need an active server (sshd) on the receiving machine and a client on the sending machine. Of course you need to have the authorization setted(via password or, better, via an automatic authentication method).

Note: many Linux/Ubuntu distribution install sshd by default: you can see if it is running with pgrep sshd from a shell. You can install with sudo apt-get install openssh-server.

5. You can mount part of the file system of a virtual machine via NFS or SSHFS on the other, or you can share file and directory with Samba. You may find interesting the article Sharing files between guest and host without VirtualBox shared folders with detailed step by step instructions.

You should remember that you are dialling with a little network of machines with different operative systems, and in particular:

- Each virtual machine has its own operative system running on and actsas a physical machine.
- Each virtual machine is an instance of a program *owned* by an *user* in the hosting operative system and should undergo the restrictions of the *user* in the*hosting OS*.

E.g Let we say that Hastur and Meow are users of the hosting machine, but they did not allow each other to see their directories (no read/write/execute authorization). When each of them run a virtual machine, for the hosting OS those virtual machine are two normal programs owned by Hastur and Meow and cannot see the private directory of the other user. This is a restriction due to the *hosting OS*. It's easy to overcame it: it's enough to give authorization to read/write/execute to a directory or to chose a different directory in which bothusers can read/write/execute.

- Windows likes mouse and Linux fingers. :-)

I mean I suggest you to enable *Drag & drop* to be cosy with the Windows machines and the *Shared folders* or to be cosy with Linux.

When you will need to be fast with Linux you will feel the need of ssh-keygen and to Generate once SSH Keys to copy files on/from a remote machine without writing password anymore. In this way it functions bash auto-completion remotely too!

PROCEDURE:
Steps:

1. Open Browser, type localhost:9869
2. Login using username: oneadmin, password: opennebula
3. Then follow the steps to migrate VMs

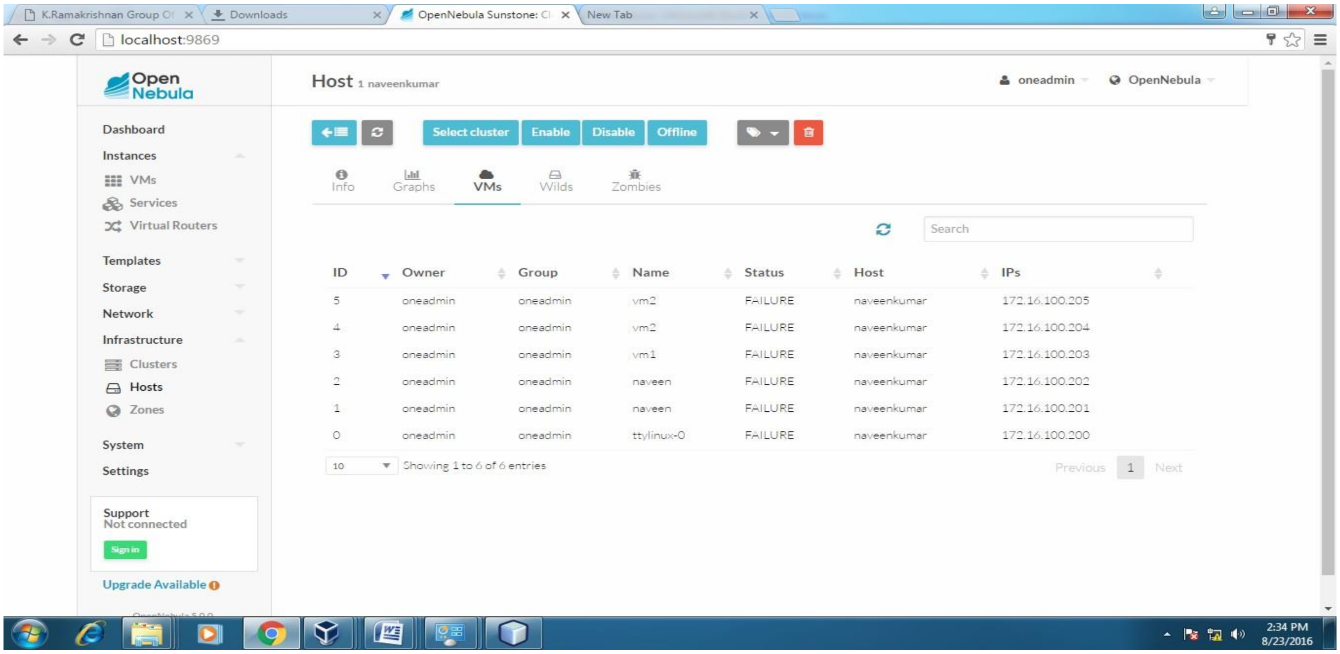
a. Click on infrastructure
b. Select clusters and enter the cluster name
c. Then select host tab, and select all host
d. Then select Vnets tab, and select all vnet
e. Then select datastores tab, and select all datastores
f. And then choose host under infrastructure tab
g. Click on + symbol to add new host, name the host then click on create.

4. on instances, select VMs to migrate then follow the stpes

a. Click on 8th icon ,the drop down list display
b. Select migrate on that ,the popup window display
c. On that select the target host to migrate then click on migrate.

Before migration

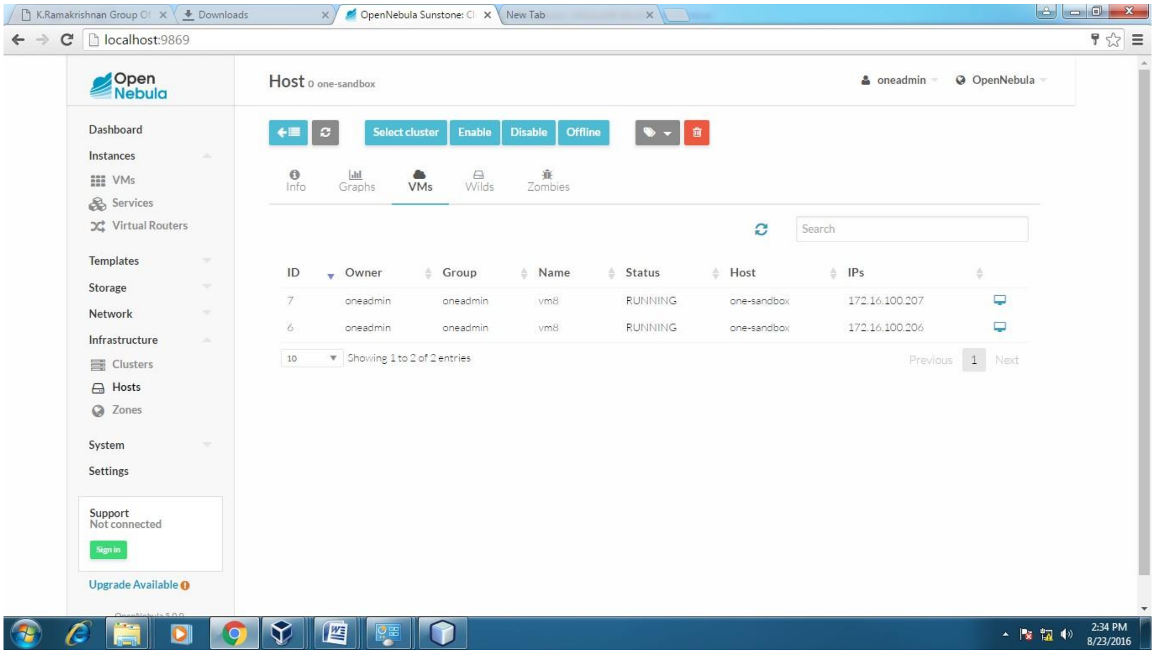
Host:SACET



ID	Owner	Group	Name	Status	Host	IPs
5	oneadmin	oneadmin	vm2	FAILURE	naveenkumar	172.16.100.205
4	oneadmin	oneadmin	vm2	FAILURE	naveenkumar	172.16.100.204
3	oneadmin	oneadmin	vm1	FAILURE	naveenkumar	172.16.100.203
2	oneadmin	oneadmin	naveen	FAILURE	naveenkumar	172.16.100.202
1	oneadmin	oneadmin	naveen	FAILURE	naveenkumar	172.16.100.201
0	oneadmin	oneadmin	ttylinux-0	FAILURE	naveenkumar	172.16.100.200

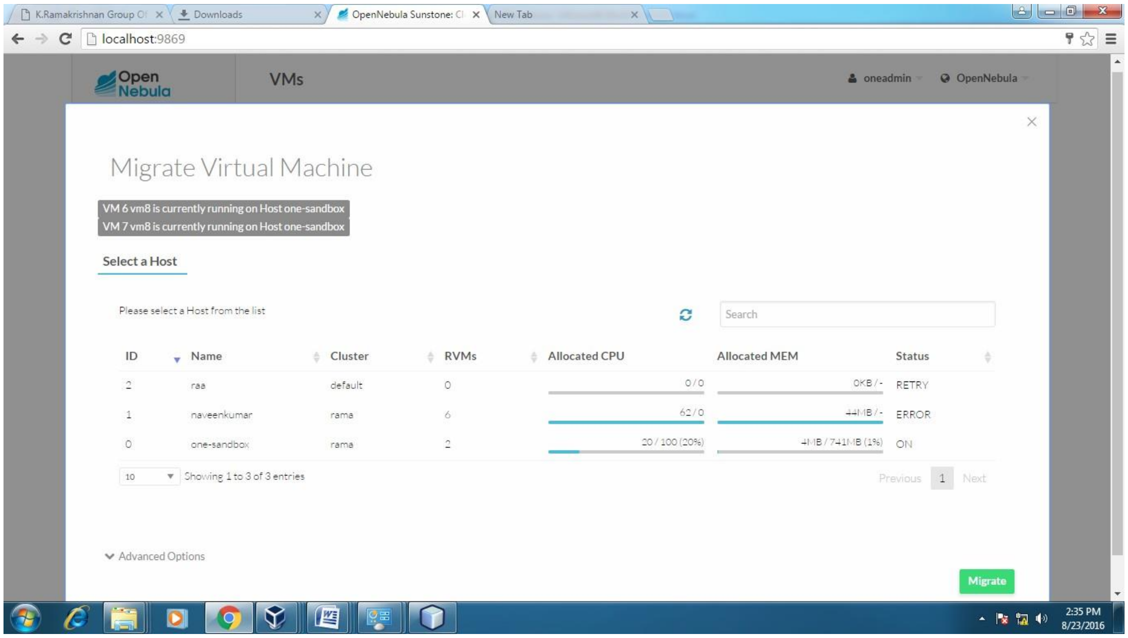
10 Showing 1 to 6 of 6 entries Previous 1 Next

Host:one-sandbox



ID	Owner	Group	Name	Status	Host	IPs
7	oneadmin	oneadmin	vm8	RUNNING	one-sandbox	172.16.100.207
6	oneadmin	oneadmin	vm8	RUNNING	one-sandbox	172.16.100.206

10 Showing 1 to 2 of 2 entries Previous 1 Next



Migrate Virtual Machine

VM 6 vm8 is currently running on Host one-sandbox

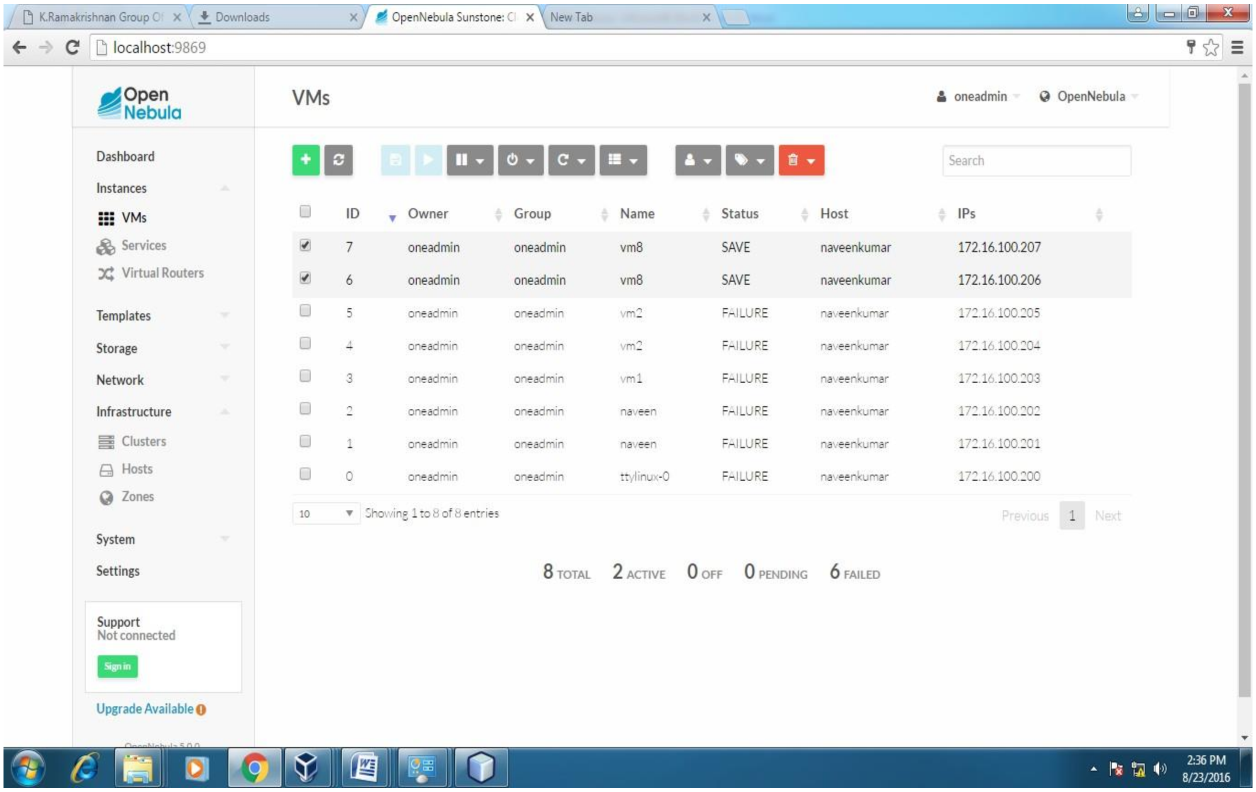
VM 7 vm8 is currently running on Host one-sandbox

Select a Host

Please select a Host from the list

ID	Name	Cluster	RVMs	Allocated CPU	Allocated MEM	Status
2	raa	default	0	0 / 0	0KB / -	RETRY
1	naveenkumar	rama	6	62 / 0	44MB / -	ERROR
0	one-sandbox	rama	2	20 / 100 (20%)	4MB / 741MB (1%)	ON

Showing 1 to 3 of 3 entries

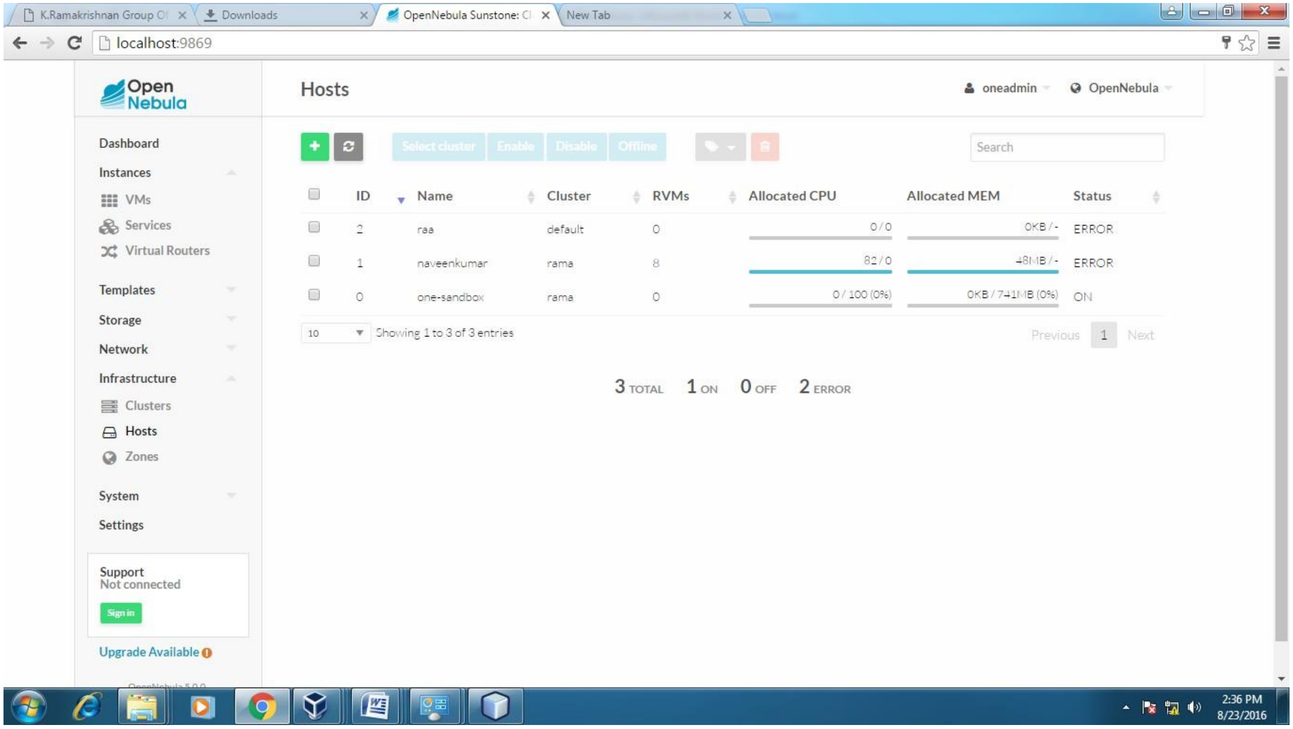


☐	ID	Owner	Group	Name	Status	Host	IPs
☑	7	oneadmin	oneadmin	vm8	SAVE	naveenkumar	172.16.100.207
☑	6	oneadmin	oneadmin	vm8	SAVE	naveenkumar	172.16.100.206
☐	5	oneadmin	oneadmin	vm2	FAILURE	naveenkumar	172.16.100.205
☐	4	oneadmin	oneadmin	vm2	FAILURE	naveenkumar	172.16.100.204
☐	3	oneadmin	oneadmin	vm1	FAILURE	naveenkumar	172.16.100.203
☐	2	oneadmin	oneadmin	naveen	FAILURE	naveenkumar	172.16.100.202
☐	1	oneadmin	oneadmin	naveen	FAILURE	naveenkumar	172.16.100.201
☐	0	oneadmin	oneadmin	ttylinux-0	FAILURE	naveenkumar	172.16.100.200

Showing 1 to 8 of 8 entries

8 TOTAL 2 ACTIVE 0 OFF 0 PENDING 6 FAILED

After Migration:



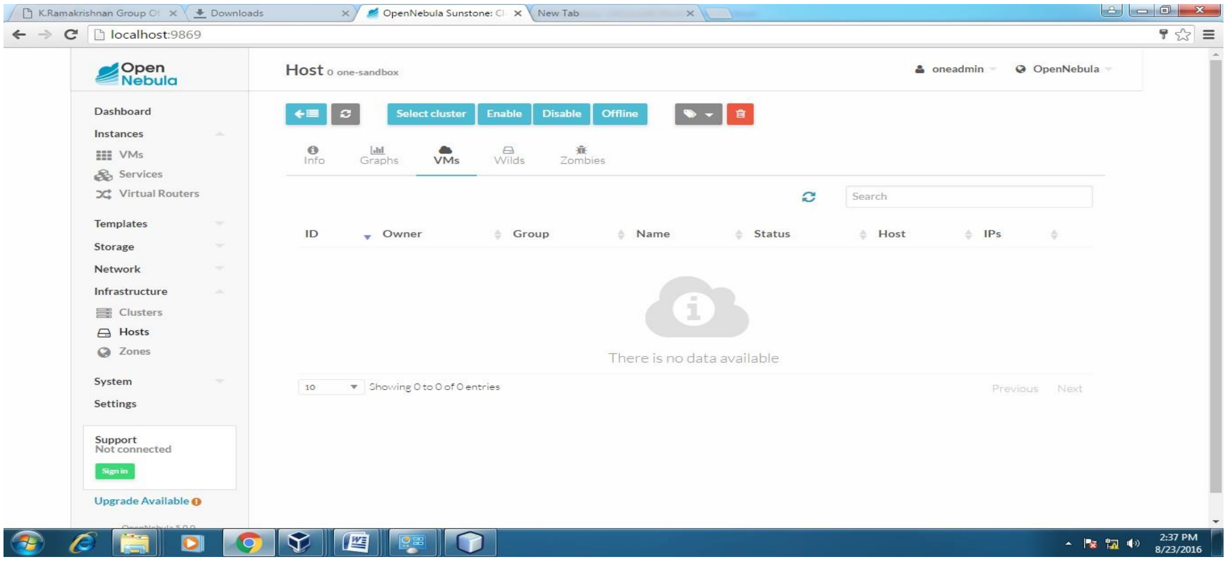
Hosts

ID	Name	Cluster	RVMs	Allocated CPU	Allocated MEM	Status
2	raa	default	0	0 / 0	0KB / -	ERROR
1	naveenkumar	rama	8	82 / 0	48MB / -	ERROR
0	one-sandbox	rama	0	0 / 100 (0%)	0KB / 741MB (0%)	ON

10 Showing 1 to 3 of 3 entries

3 TOTAL 1 ON 0 OFF 2 ERROR

Host:one-sandbox



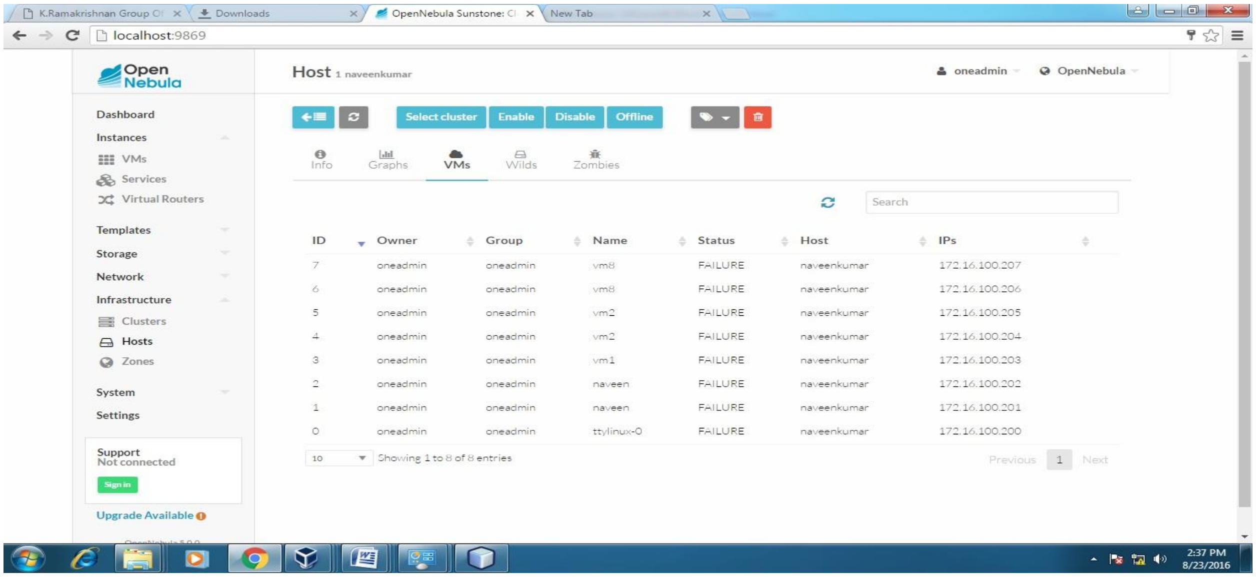
Host 0 one-sandbox

ID	Owner	Group	Name	Status	Host	IPs

There is no data available

10 Showing 0 to 0 of 0 entries

Host:SACET



Host 1 naveenkumar

ID	Owner	Group	Name	Status	Host	IPs
7	oneadmin	oneadmin	vm8	FAILURE	naveenkumar	172.16.100.207
6	oneadmin	oneadmin	vm8	FAILURE	naveenkumar	172.16.100.206
5	oneadmin	oneadmin	vm2	FAILURE	naveenkumar	172.16.100.205
4	oneadmin	oneadmin	vm2	FAILURE	naveenkumar	172.16.100.204
3	oneadmin	oneadmin	vm1	FAILURE	naveenkumar	172.16.100.203
2	oneadmin	oneadmin	naveen	FAILURE	naveenkumar	172.16.100.202
1	oneadmin	oneadmin	naveen	FAILURE	naveenkumar	172.16.100.201
0	oneadmin	oneadmin	ttylinux-0	FAILURE	naveenkumar	172.16.100.200

Showing 1 to 8 of 8 entries

APPLICATIONS:

Easily migrate your virtual machine from one pc to another.

Result:

Thus the file transfer between VM was successfully completed.

Viva Voce:

1. What is virtual machine

Ans: Virtual machine defined

A VM is a virtualized instance of a computer that can perform almost all of the same functions as a computer, including running applications and operating systems. Virtual machines run on a physical machine and access computing resources from software called a hypervisor.

2. What is hypervisor

Ans:A hypervisor, also known as a virtual machine monitor or VMM, is software that creates and runs virtual machines (VMs). A hypervisor allows one host computer to support multiple guest VMs by virtually sharing its resources, such as memory and processing.

3. What is type1 and type 2 hypervirsor.

Ans: Type 1 runs directly on the hardware with Virtual Machine resources provided. Type 2 runs on the host OS to provide virtualization management and other services.

4. What is virtual hardware

Ans:Hardware virtualization: When virtualizing hardware, virtual versions of computers and operating systems (VMs) are created and consolidated into a single, primary, physical server.

5. What is the need to creare ovf file.
Ans: OVF format provides a complete specification of the virtual machine, including the full list of required virtual disks and the required virtual hardware configuration

6. Can we clone the ovf.
Ans: You can clone virtual machines only if you have Fusion Pro. You do not need to find and manually copy the parent virtual machine files. Note: You can access cloning options from the right-click menu, Virtual Machine menu and snapshot manager

7. What is full clone .
Ans: A full clone is a complete and independent copy of a virtual machine. A full clone shares nothing with the parent virtual machine after the cloning operation. Ongoing operation of a full clone is separate from the parent virtual machine

8. What is linked clone.
Ans: A linked clone is a snapshot of a virtual machine that shares virtual disks with the parent VM in an on-going manner. This conserves disk space and allows multiple VMs to use the same software installation. Linked clones make it easier to create unique virtual machines for individual tasks.

9. Difference between type 1 and type 2 hypervisor.
Ans: The main difference between Type 1 vs. Type 2 hypervisors is that Type 1 runs on bare metal and Type 2 runs on top of an operating system. Each hypervisor type also has its own pros and cons and specific use cases.

10. Difference between linked and full clone.
Ans: A full clone is a completely separate copy of a VM that shares no system resources with the parent once it's running. A linked clone, on the other hand, continues to share virtual disks with the parent after it's created. Since it runs independently, a full clone generally has faster performance than a linked one

11. What is snapshot?
Ans: In addition, we look at VM snapshot performance in a vSphere/Kubernetes environment. What is a Snapshot? A snapshot preserves the state and data of a VM at a specific point in time. The state includes the VM's power state (for example, powered on, powered off, suspended).

12. Difference between snapshot and clone in vmware
Ans: A storage snapshot is taking that original picture, and then each subsequent picture is only of the difference from the previous one. So a clone is making a complete copy of something, while snapshots make one initial copy, then just make simple subsequent changes

13. What is guest os.
Ans: A guest operating system is the operating system installed on either a virtual machine (VM) or partitioned disk. It is usually different from the host operating system. Simply put, a host OS runs on hardware, while a guest OS runs on a VM.

Experiment No. 7

Aim: Discover a method for initiating a virtual machine using the TryStack (Online Open Stack Demo Version)

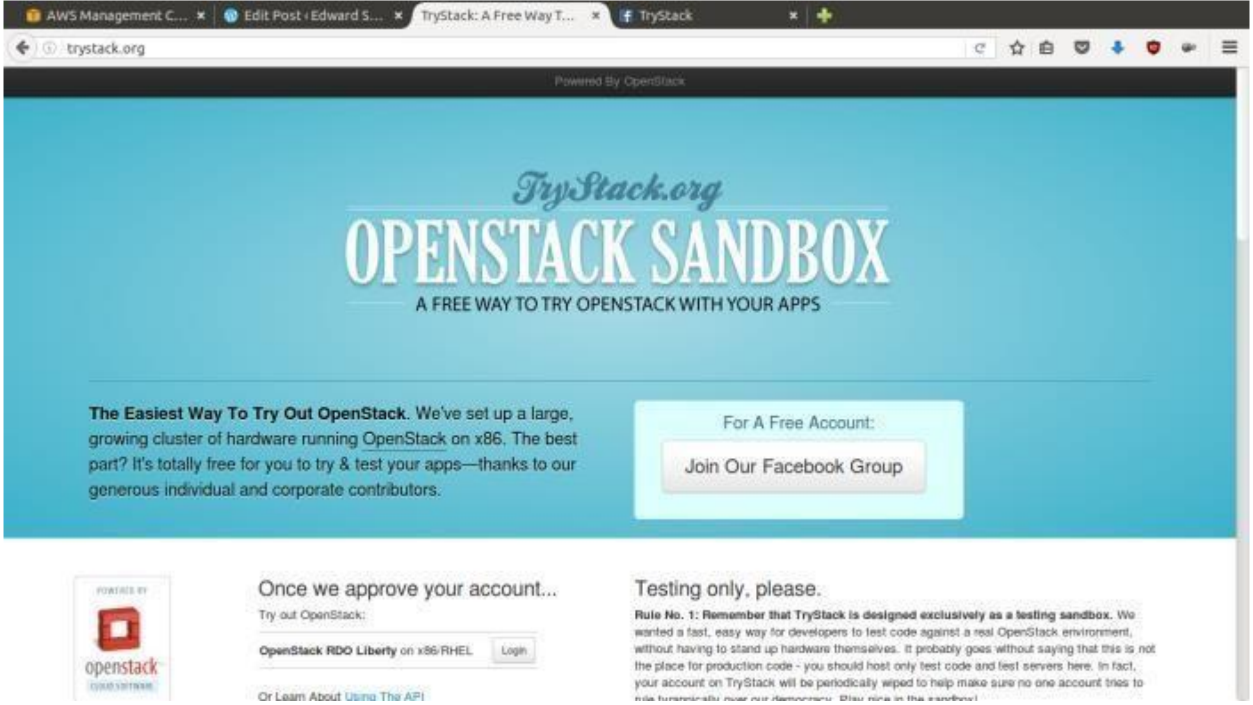
To Find a procedure to launch virtual machine using trystack.

Steps:

OpenStack is an open-source software cloud computing platform.

OpenStack is primarily used for deploying an infrastructure as a service (IaaS) solution like Amazon Web Service (AWS). In other words, you can *make your own AWS* by using OpenStack. If you want to try out OpenStack, **TryStack** is theeasiest and free way to do it.

In order to try OpenStack in TryStack, you must register yourself by joining TryStack Facebook Group. The acceptance of group needs a couple days because it's approved manually. After you have been accepted in the TryStack Group, youcan log in TryStack.



The Easiest Way To Try Out OpenStack. We've set up a large, growing cluster of hardware running OpenStack on x86. The best part? It's totally free for you to try & test your apps—thanks to our generous individual and corporate contributors.

Once we approve your account...

Try out OpenStack:

OpenStack RDO Liberty on x86/RHEL

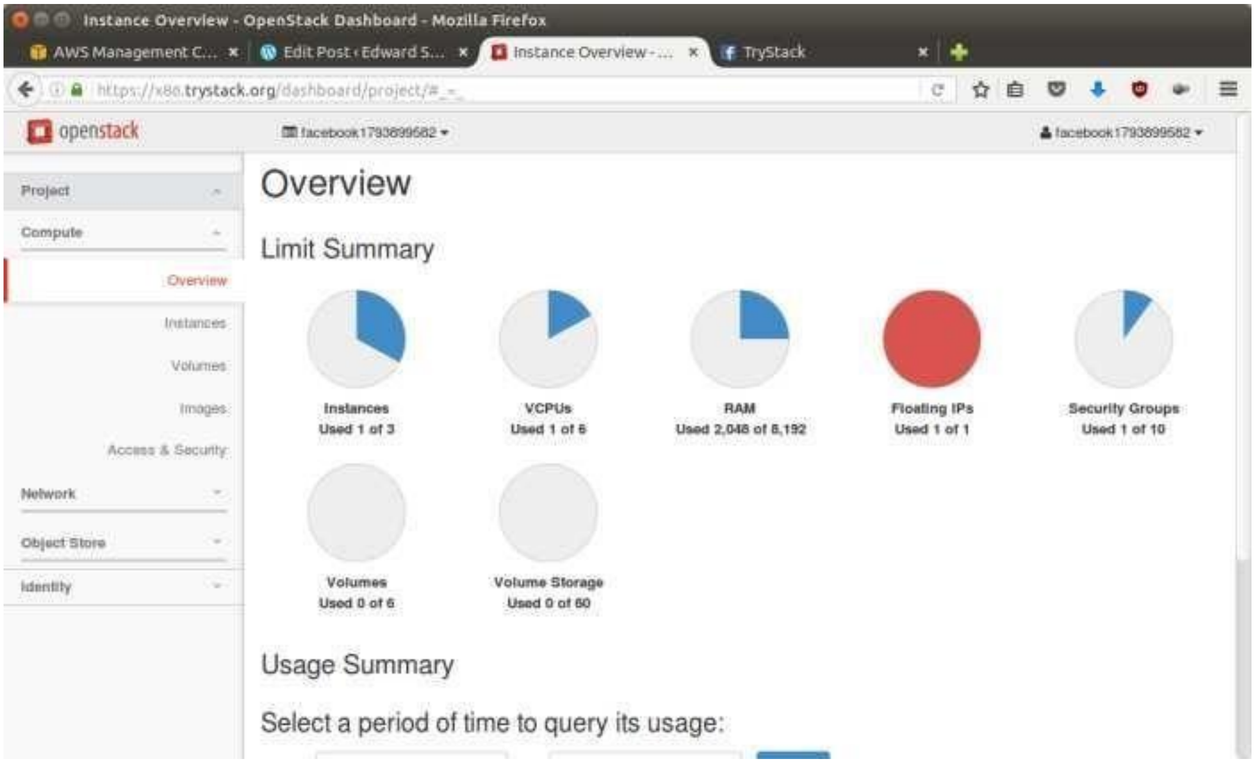
Or Learn About Using The API

Testing only, please.

Rule No. 1: Remember that TryStack is designed exclusively as a testing sandbox. We wanted a fast, easy way for developers to test code against a real OpenStack environment, without having to stand up hardware themselves. It probably goes without saying that this is not the place for production code - you should host only test code and test servers here. In fact, your account on TryStack will be periodically wiped to help make sure no one account tries to rule tyrannically over our democracy. Play nice in the sandbox!

TryStack.org Homepage

I assume that you already join to the Facebook Group and login to the dashboard. After you log in to the TryStack, you will see the Compute Dashboard like:



Overview

Limit Summary

Instances
Used 1 of 3

VCPUs
Used 1 of 6

RAM
Used 2,048 of 8,192

Floating IPs
Used 1 of 1

Security Groups
Used 1 of 10

Volumes
Used 0 of 6

Volume Storage
Used 0 of 60

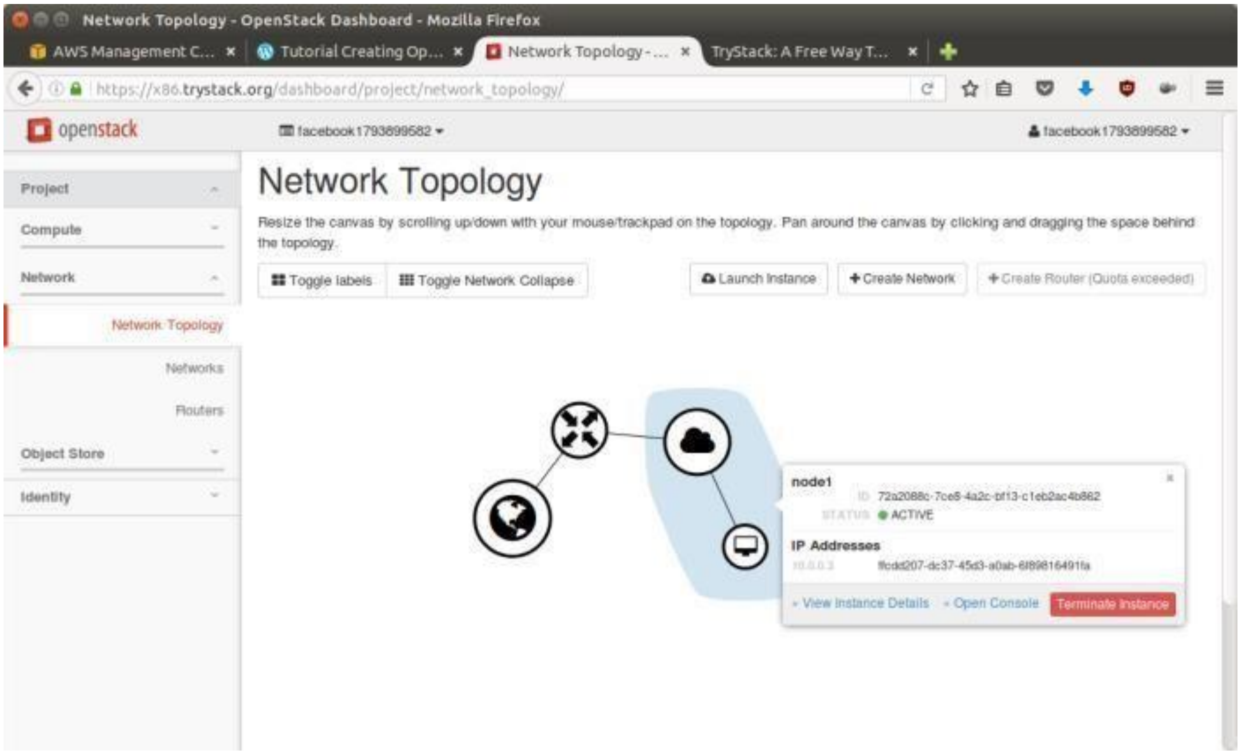
Usage Summary

Select a period of time to query its usage:

OpenStack Compute Dashboard

Overview: What we will do?

In this post, I will show you how to run an OpenStack instance. The instance willbe accessible through the internet (have a public IP address). The final topology will like:



Network Topology

Resize the canvas by scrolling up/down with your mouse/trackpad on the topology. Pan around the canvas by clicking and dragging the space behind the topology.

node1
ID 72a2088c-7ce8-4a2c-bf13-c1eb2ac4b862
STATUS ● ACTIVE

IP Addresses
10.0.0.3 ffcdd207-dc37-45d3-a0ab-6f89816491fa

Network topology
As you see from the image above, the instance will be connected to a localnetwork and the local network will be connected to internet.

Step 1: Create Network

Network? Yes, the network in here is our own local network. So, your instanceswill be not mixed up with the others. You can imagine this as your own LAN (Local Area Network) in the cloud.

1. Go to **Network > Networks** and then click **Create Network**.
2. In **Network** tab, fill **Network Name** for example internal and then click **Next**.
3. In **Subnet** tab,
   1. Fill **Network Address** with appropriate CIDR, for example 192.168.1.0/24. Use private network CIDR block as the best practice.
   2. Select **IP Version** with appropriate IP version, in this case IPv4.
   3. Click **Next**.
4. In **Subnet Details** tab, fill **DNS Name Servers** with 8.8.8.8 (GoogleDNS) and then click **Create**.

Step 2: Create Instance

Now, we will create an instance. The instance is a virtual machine in the cloud,like AWS EC2. You need the instance to connect to the network that we just created in the previous step.

1. Go to **Compute > Instances** and then click **Launch Instance**.
2. In **Details** tab,
   1. Fill **Instance Name**, for example Ubuntu 1.
   2. Select **Flavor**, for example m1.medium.
   3. Fill **Instance Count** with **1**.
   4. Select **Instance Boot Source** with **Boot from Image**.
   5. Select **Image Name** with **Ubuntu 14.04 amd64 (243.7 MB)** if you want install Ubuntu 14.04 in your virtual machine.
3. In **Access & Security** tab,
   1. Click [+] button of **Key Pair** to import key pair. This key pair is a public andprivate key that we will use to connect to the instance from our machine.
   2. In **Import Key Pair** dialog,
      1. Fill **Key Pair Name** with your machine name (for example Edward-Key).
      2. Fill **Public Key** with your **SSH public key** (usually is in ~/.ssh/id_rsa.pub). See description in Import Key Pair dialog box for more information. If you are using Windows, you can use **Puttygen** to generate key pair.
      3. Click **Import key pair**.
   3. In **Security Groups**, mark/check **default**.

4. In **Networking** tab,
    1. In **Selected Networks**, select network that have been created in Step 1, for example internal.
5. Click **Launch**.
6. If you want to create multiple instances, you can repeat step 1-5. I created onemore instance with instance name Ubuntu 2.

Step 3: Create Router

I guess you already know what router is. In the step 1, we created our network, but it is isolated. It doesn't connect to the internet. To make our network has an internet connection, we need a router that running as the gateway to the internet.

1. Go to **Network > Routers** and then click **Create Router**.
2. Fill **Router Name** for example router1 and then click **Create router**.
3. Click on your **router name link**, for example router1, **Router Details** page.
4. Click **Set Gateway** button in upper right:
    1. Select **External networks** with **external**.
    2. Then **OK**.
5. Click **Add Interface** button.
    1. Select **Subnet** with the network that you have been created in Step 1.
    2. Click **Add interface**.
6. Go to **Network > Network Topology**. You will see the network topology. In theexample, there are two network, i.e. external and internal, those are bridged by a router. There are instances those are joined to internal network.

Step 4: Configure Floating IP Address

Floating IP address is public IP address. It makes your instance is accessible fromthe internet. When you launch your instance, the instance will have a private network IP, but no public IP. In OpenStack, the public Ips is collected in a pool and managed by admin (in our case is TryStack). You need to request a public (floating) IP address to be assigned to your instance.

1. Go to **Compute > Instance**.
2. In one of your instances, click **More > Associate Floating IP**.
3. In **IP Address**, click Plus [+].
4. Select **Pool** to **external** and then click **Allocate IP**.
5. Click **Associate**.
6. Now you will get a public IP, e.g. 8.21.28.120, for your instance.

Step 5: Configure Access & Security

OpenStack has a feature like a firewall. It can whitelist/blacklist your in/outconnection. It is called *Security Group*.

1. Go to **Compute > Access & Security** and then open **Security Groups** tab.
2. In **default** row, click **Manage Rules**.
3. Click **Add Rule**, choose **ALL ICMP** rule to enable ping into your instance, and then click **Add**.
4. Click **Add Rule**, choose **HTTP** rule to open HTTP port (port 80), and then click **Add**.
5. Click **Add Rule**, choose **SSH** rule to open SSH port (port 22), and then click **Add**.
6. You can open other ports by creating new rules.

Step 6: SSH to Your Instance

Now, you can SSH your instances to the floating IP address that you got in thestep 4. If you are using Ubuntu image, the SSH user will be ubuntu.

Result:

Thus the openstack demo worked successfully.

Viva Voce:

1. What benefits do cloud computing services offer?
2. Describe the different cloud service models?
3. What are some of the popularly used cloud computing services?
4. Define Hybrid Cloud
5.What distinguishes hybrid cloud technology from hybrid information technology?
6. What does Hybrid Cloud Packaging entail? Which two main types of packaged hybrid cloud are there?
7. What is a Distributed Cloud?
8. Define what MultiCloud is?
9. What is a multi-cloud strategy?
10. What is Cloud-Native
11. What is meant by Edge Computing, & how is it related to the cloud?
12. State some of the key features of Cloud Computing.
13. What are the 4 different deployment models in cloud computing?
14. What are the platforms used for large-scale cloud computing?
15. What are the differences between cloud computing and mobile computing?
16. Explain System integrators in cloud computing?

Experiment No. 8

Aim: Install Hadoop single node cluster and run applications like word count.

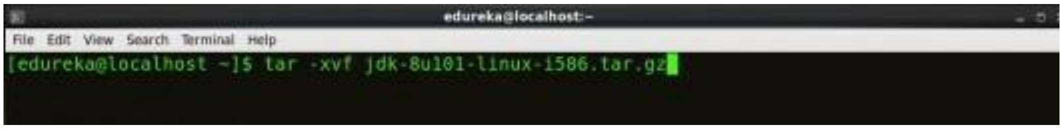
Steps:

Install Hadoop

Step 1: Click here to download the Java 8 Package. Save this file in your home directory.

Step 2: Extract the Java Tar File.

***Command*:** tar -xvf jdk-8u101-linux-i586.tar.gz

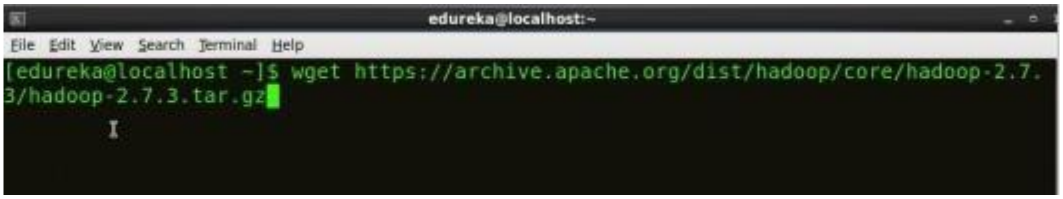


```
[edureka@localhost ~]$ tar -xvf jdk-8u101-linux-i586.tar.gz
```

Fig: Hadoop Installation – Extracting Java Files

Step 3: **Download the Hadoop 2.7.3 Package.**

***Command*:** wget https://archive.apache.org/dist/hadoop/core/hadoop-2.7.3/hadoop-2.7.3.tar.gz

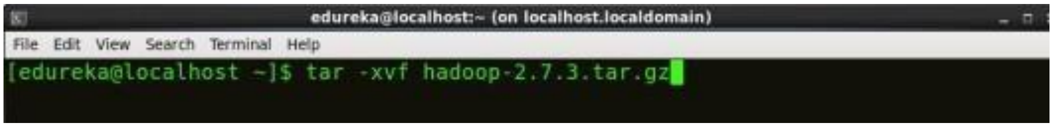


```
[edureka@localhost ~]$ wget https://archive.apache.org/dist/hadoop/core/hadoop-2.7.
3/hadoop-2.7.3.tar.gz
```

Fig: Hadoop Installation – Downloading Hadoop

Step 4: Extract the Hadoop tar File.

***Command*:** tar -xvf hadoop-2.7.3.tar.gz


edureka@localhost:~ (on localhost.localdomain)
File Edit View Search Terminal Help

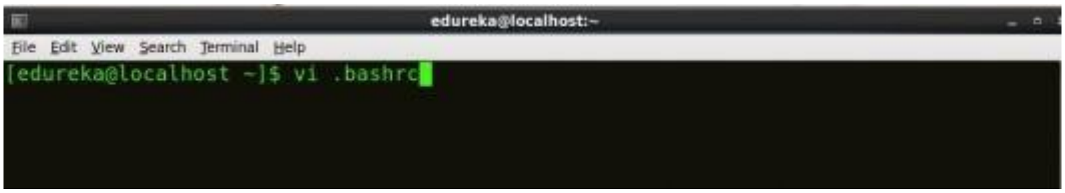
```
[edureka@localhost ~]$ tar -xvf hadoop-2.7.3.tar.gz
```

Fig: Hadoop Installation – Extracting Hadoop Files **Step**

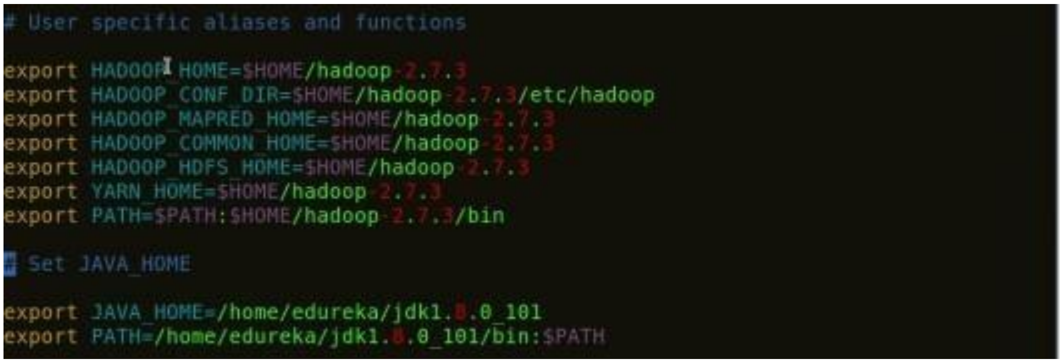
5: Add the Hadoop and Java paths in the bash file (.bashrc). Open**. bashrc**

file. Now, add Hadoop and Java Path as shown below.

***Command*:** vi .bashrc



```
[edureka@localhost ~]$ vi .bashrc
```

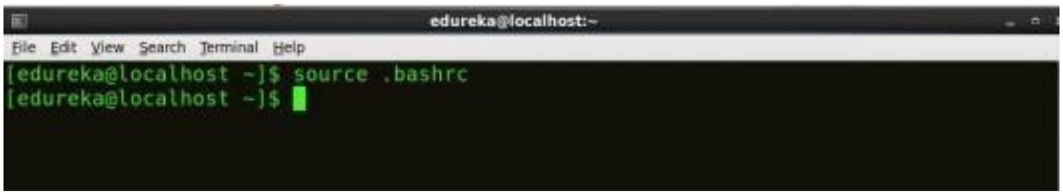


```
# User specific aliases and functions

export HADOOP_HOME=$HOME/hadoop-2.7.3
export HADOOP_CONF_DIR=$HOME/hadoop-2.7.3/etc/hadoop
export HADOOP_MAPRED_HOME=$HOME/hadoop-2.7.3
export HADOOP_COMMON_HOME=$HOME/hadoop-2.7.3
export HADOOP_HDFS_HOME=$HOME/hadoop-2.7.3
export YARN_HOME=$HOME/hadoop-2.7.3
export PATH=$PATH:$HOME/hadoop-2.7.3/bin

# Set JAVA_HOME

export JAVA_HOME=/home/edureka/jdk1.8.0_101
export PATH=/home/edureka/jdk1.8.0_101/bin:$PATH
```

Fig: Hadoop Installation – Setting Environment Variable

Then, save the bash file and close it.

For applying all these changes to the current Terminal, execute the source command.
***Command*:** source .bashrc



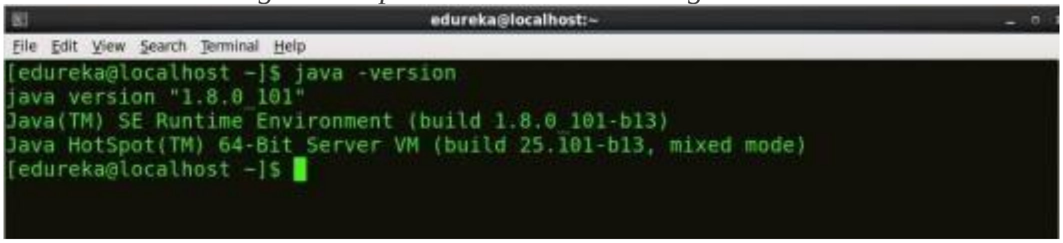
```
[edureka@localhost ~]$ source .bashrc
[edureka@localhost ~]$
```

Fig: Hadoop Installation – Refreshing environment variables

To make sure that Java and Hadoop have been properly installed on your system and can be accessed through the Terminal, execute the java -version and hadoop version commands.

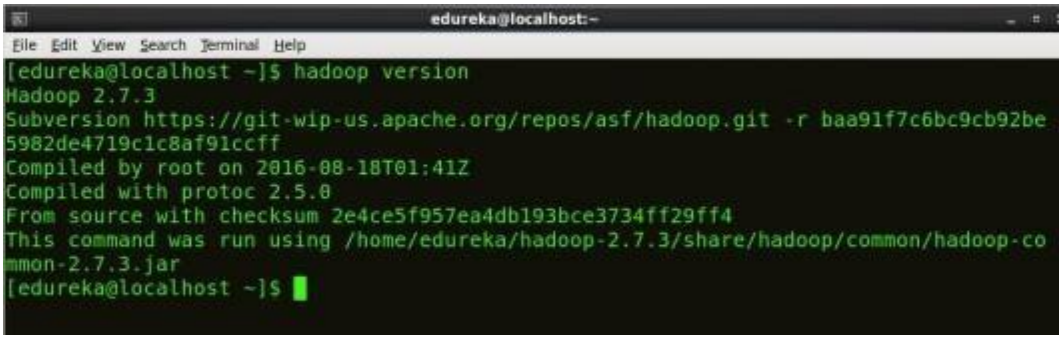
***Command*:** java -version

Fig: Hadoop Installation – Checking Java Version



```
[edureka@localhost ~]$ java -version
java version "1.8.0_101"
Java(TM) SE Runtime Environment (build 1.8.0_101-b13)
Java HotSpot(TM) 64-Bit Server VM (build 25.101-b13, mixed mode)
[edureka@localhost ~]$
```

Command**:** hadoop version



```
[edureka@localhost ~]$ hadoop version
Hadoop 2.7.3
Subversion https://git-wip-us.apache.org/repos/asf/hadoop.git -r baa91f7c6bc9cb92be
5982de4719c1c8af91ccff
Compiled by root on 2016-08-18T01:41Z
Compiled with protoc 2.5.0
From source with checksum 2e4ce5f957ea4db193bce3734ff29ff4
This command was run using /home/edureka/hadoop-2.7.3/share/hadoop/common/hadoop-co
mmon-2.7.3.jar
[edureka@localhost ~]$ 
```

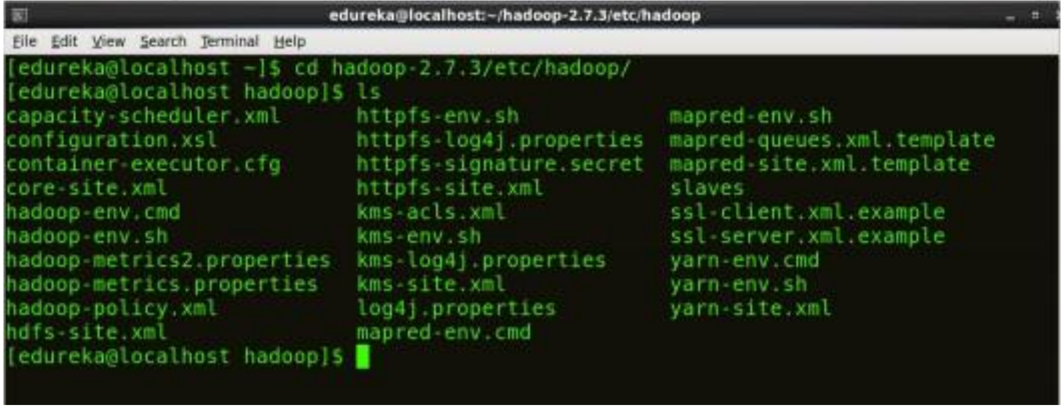
Fig: Hadoop Installation – Checking Hadoop Version

Step 6: Edit the **Hadoop Configuration files**.

Command: cd hadoop-2.7.3/etc/hadoop/

Command: ls

All the Hadoop configuration files are located in **hadoop-2.7.3/etc/hadoop** directory as you can see in the snapshot below:


edureka@localhost:~/hadoop-2.7.3/etc/hadoop
File Edit View Search Terminal Help

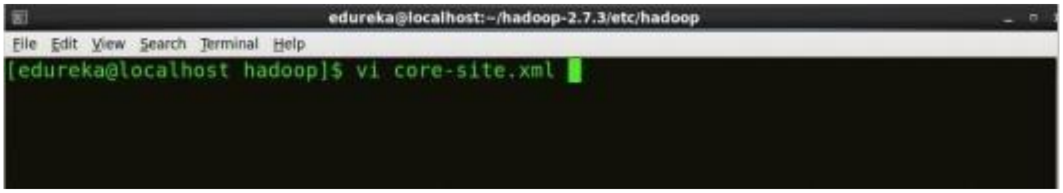
```
[edureka@localhost ~]$ cd hadoop-2.7.3/etc/hadoop/
[edureka@localhost hadoop]$ ls
capacity-scheduler.xml      httpfs-env.sh              mapred-env.sh
configuration.xsl           httpfs-log4j.properties    mapred-queues.xml.template
container-executor.cfg      httpfs-signature.secret    mapred-site.xml.template
core-site.xml               httpfs-site.xml            slaves
hadoop-env.cmd              kms-acls.xml               ssl-client.xml.example
hadoop-env.sh               kms-env.sh                 ssl-server.xml.example
hadoop-metrics2.properties  kms-log4j.properties       yarn-env.cmd
hadoop-metrics.properties   kms-site.xml               yarn-env.sh
hadoop-policy.xml           log4j.properties           yarn-site.xml
hdfs-site.xml               mapred-env.cmd
[edureka@localhost hadoop]$ 
```

Fig: Hadoop Installation – Hadoop Configuration Files

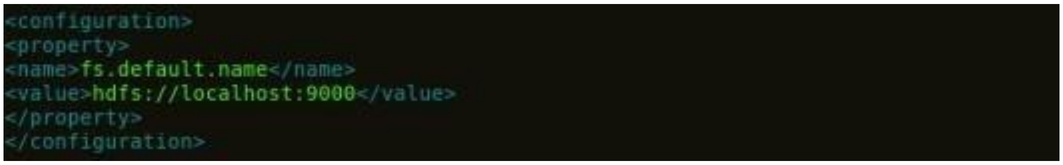
Step 7: Open *core-site.xml* and edit the property mentioned below inside configuration tag:

core-site.xml informs Hadoop daemon where NameNode runs in the cluster. It contains configuration settings of Hadoop core such as I/O settings that are common to HDFS & MapReduce.

***Command*:** vi core-site.xml


edureka@localhost:~/hadoop-2.7.3/etc/hadoop
File Edit View Search Terminal Help

```
[edureka@localhost hadoop]$ vi core-site.xml
```



```
<configuration>
<property>
<name>fs.default.name</name>
<value>hdfs://localhost:9000</value>
</property>
</configuration>
```

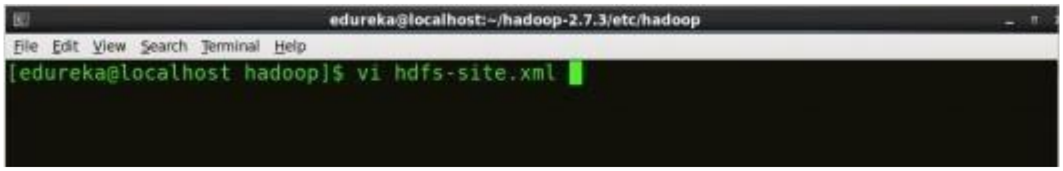
Fig: Hadoop Installation – Configuring core-site.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl" href="configuration.xsl"?>
<configuration>
<property>
<name>fs.default.name</name>
<value>hdfs://localhost:9000</value>
</property>
</configuration>
```

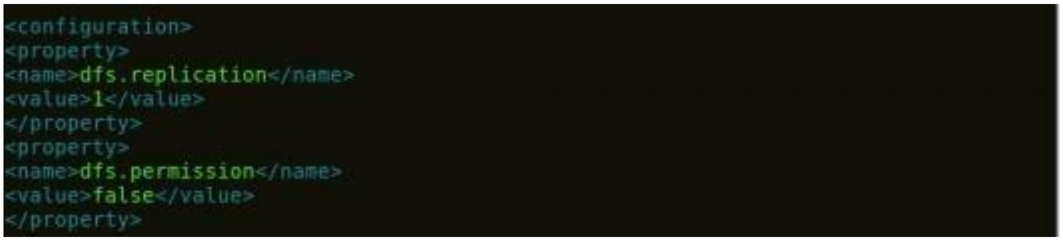
Step 8: Edit *hdfs-site.xml* and edit the property mentioned below inside **configuration tag:**

hdfs-site.xml contains configuration settings of HDFS daemons (i.e. NameNode, DataNode, Secondary NameNode). It also includes the replication factor and block size of HDFS.

***Command*:** vi hdfs-site.xml


edureka@localhost:~/hadoop-2.7.3/etc/hadoop
File Edit View Search Terminal Help

```
[edureka@localhost hadoop]$ vi hdfs-site.xml
```



```
<configuration>
<property>
<name>dfs.replication</name>
<value>1</value>
</property>
<property>
<name>dfs.permission</name>
<value>false</value>
</property>
```

Fig: Hadoop Installation – Configuring hdfs-site.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl" href="configuration.xsl"?>
<configuration>
<property>
<name>dfs.replication</name>
<value>1</value>
</property>
<property>
<name>dfs.permission</name>
<value>false</value>
</property>
</configuration>
```

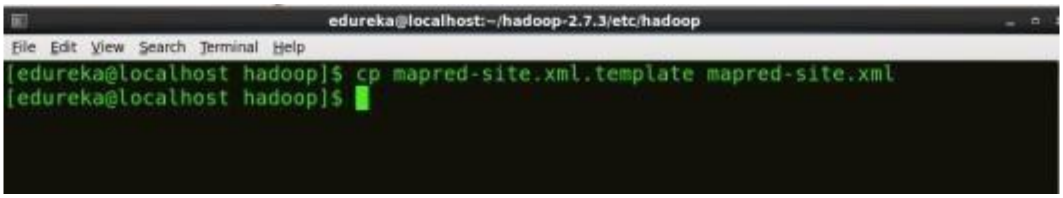
Step 9: Edit the *mapred-site.xml* file and edit the property mentioned below **inside configuration tag:**

mapred-site.xml contains configuration settings of MapReduce application like number of JVM that can run in parallel, the size of the mapper and the reducer process, CPU cores available for a process, etc.

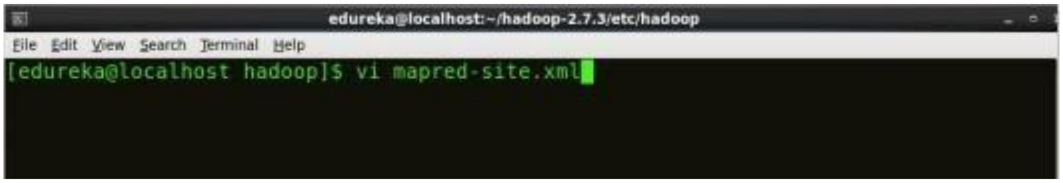
In some cases, mapred-site.xml file is not available. So, we have to create the mapred- site.xml file using mapred-site.xml template.

***Command*:** cp mapred-site.xml.template mapred-site.xml

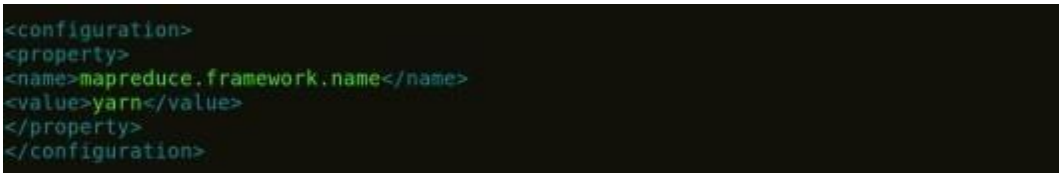
***Command*:** vi mapred-site.xml.


edureka@localhost:~/hadoop-2.7.3/etc/hadoop
File Edit View Search Terminal Help

```
[edureka@localhost hadoop]$ cp mapred-site.xml.template mapred-site.xml
[edureka@localhost hadoop]$ 
```


edureka@localhost:~/hadoop-2.7.3/etc/hadoop
File Edit View Search Terminal Help

```
[edureka@localhost hadoop]$ vi mapred-site.xml
```



```
<configuration>
<property>
<name>mapreduce.framework.name</name>
<value>yarn</value>
</property>
</configuration>
```

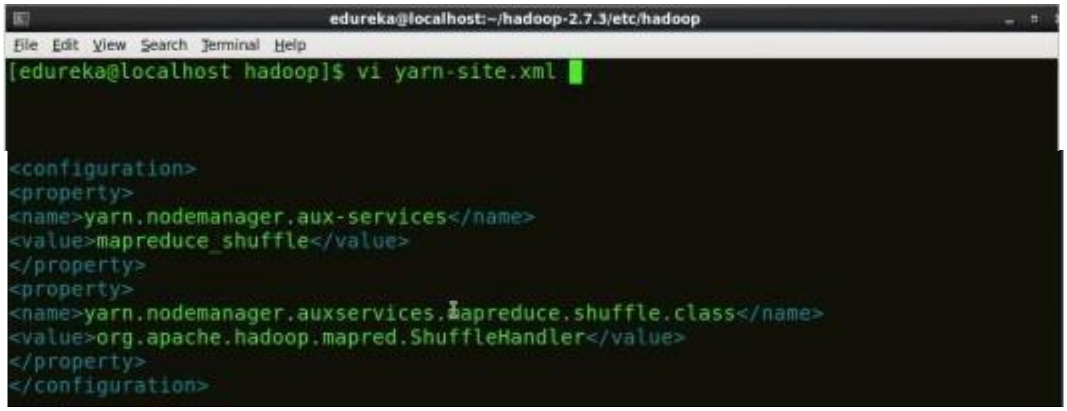
Fig: Hadoop Installation – Configuring mapred-site.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet type="text/xsl" href="configuration.xsl"?>
<configuration>
<property>
<name>mapreduce.framework.name</name>
<value>yarn</value>
</property>
</configuration>
```

Step 10: Edit *yarn-site.xml* and edit the property mentioned below inside configuration tag:

yarn-site.xml contains configuration settings of ResourceManager and NodeManager like application memory management size, the operation needed on program & algorithm, etc.

***Command*:** vi yarn-site.xml


edureka@localhost:~/hadoop-2.7.3/etc/hadoop
File Edit View Search Terminal Help

```
[edureka@localhost hadoop]$ vi yarn-site.xml

<configuration>
<property>
<name>yarn.nodemanager.aux-services</name>
<value>mapreduce_shuffle</value>
</property>
<property>
<name>yarn.nodemanager.auxservices.mapreduce.shuffle.class</name>
<value>org.apache.hadoop.mapred.ShuffleHandler</value>
</property>
</configuration>
```

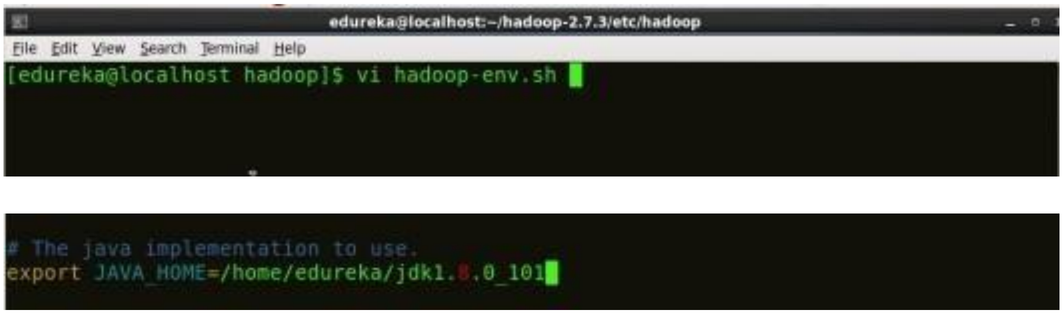
Fig: Hadoop Installation – Configuring yarn-site.xml

Step 11: Edit *hadoop-env.sh* and add the Java Path as mentioned below:

```
<?xml version="1.0">
<configuration>
<property>
<name>yarn.nodemanager.aux-services</name>
<value>mapreduce_shuffle</value>
</property>
<property>
<name>yarn.nodemanager.auxservices.mapreduce.shuffle.class</
name>
<value>org.apache.hadoop.mapred.ShuffleHandler</value>
</property>
```

hadoop-env.sh contains the environment variables that are used in the script to run Hadoop like Java home path, etc.

***Command*:** vi hadoop–env.sh


edureka@localhost:~/hadoop-2.7.3/etc/hadoop
File Edit View Search Terminal Help

```
[edureka@localhost hadoop]$ vi hadoop-env.sh
```

```
# The java implementation to use.
export JAVA_HOME=/home/edureka/jdk1.8.0_101
```

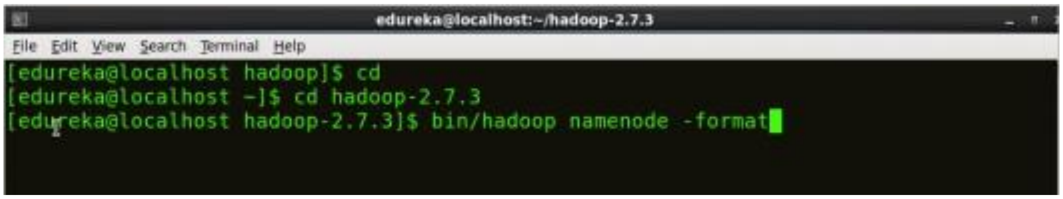
Fig: Hadoop Installation – Configuring hadoop-env.sh **Step**

12: Go to Hadoop home directory and format the NameNode.

***Command*:** cd

***Command*:** cd hadoop-2.7.3

***Command*:** bin/hadoop namenode -format


edureka@localhost:~/hadoop-2.7.3
File Edit View Search Terminal Help

```
[edureka@localhost hadoop]$ cd
[edureka@localhost ~]$ cd hadoop-2.7.3
[edureka@localhost hadoop-2.7.3]$ bin/hadoop namenode -format
```

Fig: Hadoop Installation – Formatting NameNode

This formats the HDFS via NameNode. This command is only executed for the first time. Formatting the file system means initializing the directory specified by the dfs.name.dir variable.

Never format, up and running Hadoop filesystem. You will lose all your data stored in the HDFS.

Step 13: **Once the NameNode is formatted, go to hadoop-2.7.3/sbin directory and start all the daemons.**

Command: cd hadoop-2.7.3/sbin

Either you can start all daemons with a single command or do it individually.

Command: ./start-all.sh

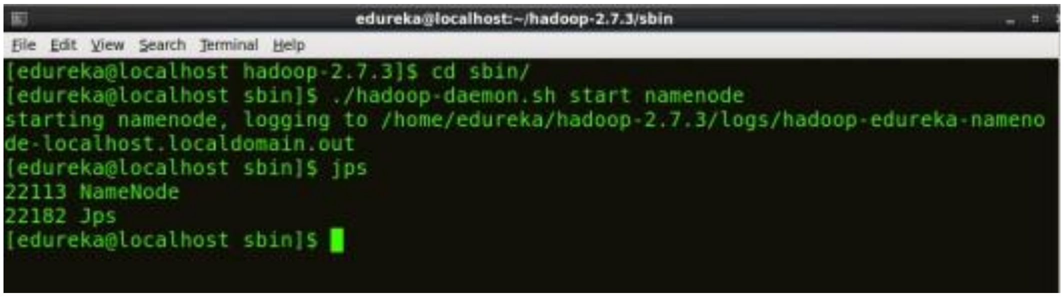
The above command is a combination of ***start-dfs.sh, start-yarn.sh*** & ***mr-jobhistory-daemon.sh***

Or you can run all the services individually as below:

Start NameNode:

The NameNode is the centerpiece of an HDFS file system. It keeps the directory tree of all files stored in the HDFS and tracks all the file stored across the cluster.

Command: ./hadoop-daemon.sh start namenode


edureka@localhost:~/hadoop-2.7.3/sbin
File Edit View Search Terminal Help

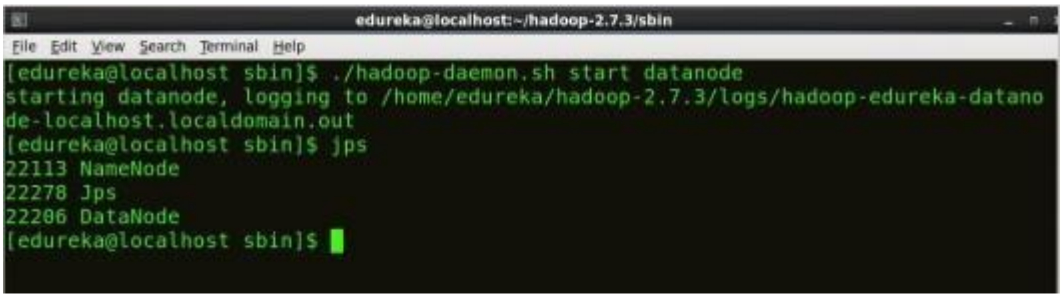
```
[edureka@localhost hadoop-2.7.3]$ cd sbin/
[edureka@localhost sbin]$ ./hadoop-daemon.sh start namenode
starting namenode, logging to /home/edureka/hadoop-2.7.3/logs/hadoop-edureka-nameno
de-localhost.localdomain.out
[edureka@localhost sbin]$ jps
22113 NameNode
22182 Jps
[edureka@localhost sbin]$
```

Fig: Hadoop Installation – Starting NameNode

Start DataNode:

On startup, a DataNode connects to the Namenode and it responds to the requests from the Namenode for different operations.

Command: ./hadoop-daemon.sh start datanode


edureka@localhost:~/hadoop-2.7.3/sbin
File Edit View Search Terminal Help

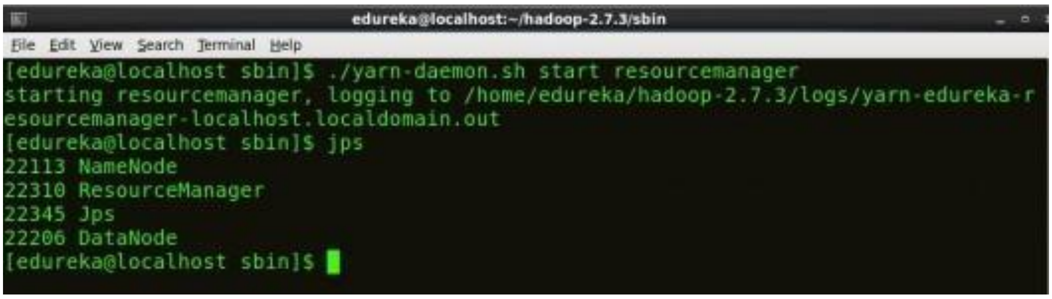
```
[edureka@localhost sbin]$ ./hadoop-daemon.sh start datanode
starting datanode, logging to /home/edureka/hadoop-2.7.3/logs/hadoop-edureka-datano
de-localhost.localdomain.out
[edureka@localhost sbin]$ jps
22113 NameNode
22278 Jps
22206 DataNode
[edureka@localhost sbin]$
```

Fig: Hadoop Installation – Starting DataNode

Start ResourceManager:

ResourceManager is the master that arbitrates all the available cluster resources and thus helps in managing the distributed applications running on the YARN system. Its work is to manage each NodeManagers and the each application's ApplicationMaster.

Command: ./yarn-daemon.sh start resourcemanager


edureka@localhost:~/hadoop-2.7.3/sbin
File Edit View Search Terminal Help

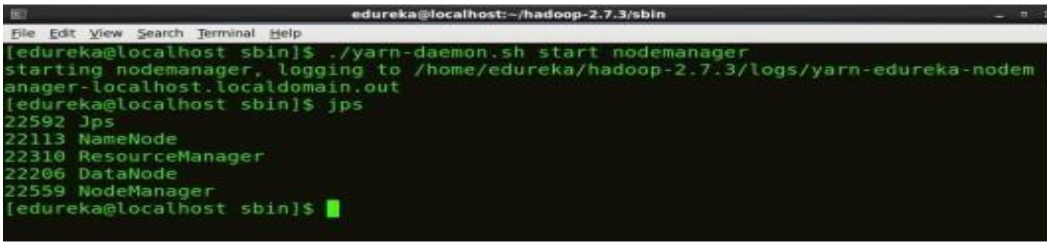
```
[edureka@localhost sbin]$ ./yarn-daemon.sh start resourcemanager
starting resourcemanager, logging to /home/edureka/hadoop-2.7.3/logs/yarn-edureka-r
esourcemanager-localhost.localdomain.out
[edureka@localhost sbin]$ jps
22113 NameNode
22310 ResourceManager
22345 Jps
22206 DataNode
[edureka@localhost sbin]$
```

Fig: Hadoop Installation – Starting ResourceManager

Start NodeManager:

The NodeManager in each machine framework is the agent which is responsible for managing containers, monitoring their resource usage and reporting the same to the ResourceManager.

Command: ./yarn-daemon.sh start nodemanager


edureka@localhost:~/hadoop-2.7.3/sbin
File Edit View Search Terminal Help

```
[edureka@localhost sbin]$ ./yarn-daemon.sh start nodemanager
starting nodemanager, logging to /home/edureka/hadoop-2.7.3/logs/yarn-edureka-nodem
anager-localhost.localdomain.out
[edureka@localhost sbin]$ jps
22592 Jps
22113 NameNode
22310 ResourceManager
22206 DataNode
22559 NodeManager
[edureka@localhost sbin]$
```

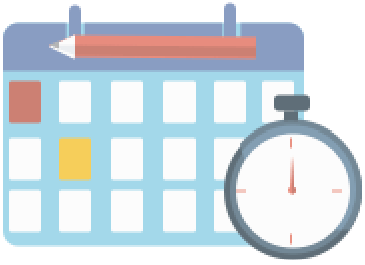


Fig: Hadoop Installation – Starting NodeManager

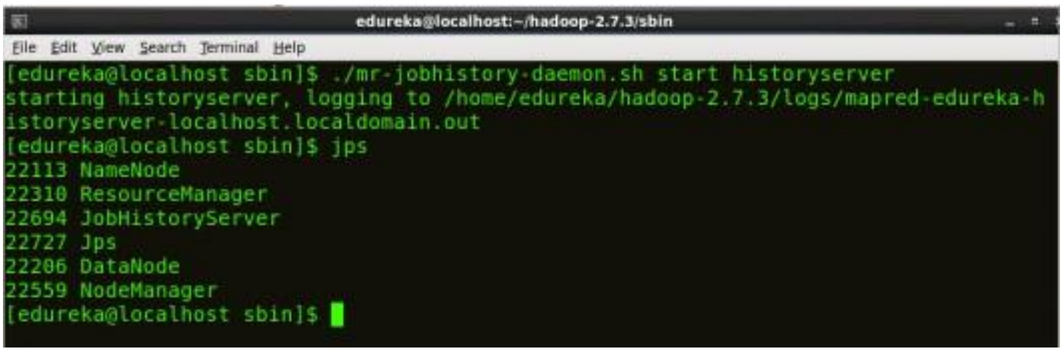
Start JobHistoryServer:

JobHistoryServer is responsible for servicing all job history related requests from client.

Command: ./mr-jobhistory-daemon.sh start historyserver

Step 14: **To check that all the Hadoop services are up and running, run the below command.**

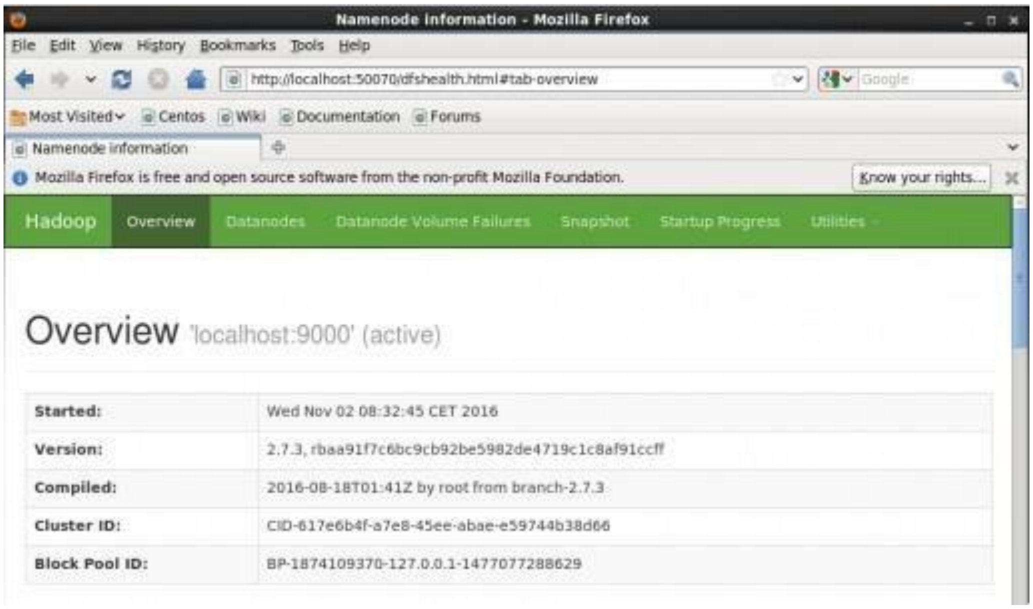
Command: jps



```
[edureka@localhost sbin]$ ./mr-jobhistory-daemon.sh start historyserver
starting historyserver, logging to /home/edureka/hadoop-2.7.3/logs/mapred-edureka-h
istoryserver-localhost.localdomain.out
[edureka@localhost sbin]$ jps
22113 NameNode
22310 ResourceManager
22694 JobHistoryServer
22727 Jps
22206 DataNode
22559 NodeManager
[edureka@localhost sbin]$ 
```

Fig: Hadoop Installation – Checking Daemons

Step 15: Now open the Mozilla browser and go to **localhost**:**50070/dfshealth.html** to check the NameNode interface.



Namenode information - Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://localhost:50070/dfshealth.html#tab-overview
Google
Most Visited
Centos
Wiki
Documentation
Forums
Namenode information
Mozilla Firefox is free and open source software from the non-profit Mozilla Foundation.
Know your rights...
Hadoop
Overview
Datanodes
Datanode Volume Failures
Snapshot
Startup Progress
Utilities

Overview 'localhost:9000' (active)

Started:	Wed Nov 02 08:32:45 CET 2016
Version:	2.7.3, rbaa91f7c6bc9cb92be5982de4719c1c8af91ccff
Compiled:	2016-08-18T01:41Z by root from branch-2.7.3
Cluster ID:	CID-617e6b4f-a7e8-45ee-abae-e59744b38d66
Block Pool ID:	BP-1874109370-127.0.0.1-1477077288629

Fig: Hadoop Installation – Starting WebUI

Congratulations, you have successfully installed a single node Hadoop cluster

Result:

Thus the Hadoop one cluster was installed and simple applications executedsuccessfully.

VIVA QUESTIONS AND ANSWERS

1. Define Cloud Computing with example.

Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.

2. What is the working principle of Cloud Computing?

The cloud is a collection of computers and servers that are publicly accessible via the Internet. This hardware is typically owned and operated by a third party on a consolidated basis in one or more data center locations. The machines can run any combination of operating systems.

3. What are the advantages and disadvantages of Cloud Computing?

Advantages

Lower-Cost Computers for Users
Improved Performance
Lower IT Infrastructure Costs
Fewer Maintenance Issues
Lower Software Costs
Instant Software Updates
Increased Computing Power
Unlimited Storage Capacity
Increased Data Safety
Improved Compatibility Between Operating Systems
Improved Document Format Compatibility
Easier Group Collaboration
Universal Access to Documents
Latest Version Availability
Removes the Tether to Specific Devices

Disadvantages

Requires a Constant Internet Connection
Doesn’t Work Well with Low-Speed Connections
Can Be Slow
Features Might Be Limited
Stored Data Might Not Be Secure
If the Cloud Loses Your Data, You’re Screwed

4. What is distributed system?

A *distributed system* is a software system in which components located on networked computers communicate and coordinate their actions by passing messages. The components interact with each other in order to achieve a common goal.

Three significant characteristics of distributed systems are:

- ✓ Concurrency of components
- ✓ Lack of a global clock
- ✓ Independent failure of components
- ✓ What is cluster?
- ✓ Acomputingclusterconsistsofinterconnectedstand-alonecomputerswhichworkcooperativelyasasingleintegratedcomputingresource.Inthepast,clusteredcomputersystemshavedemonstrated

5. What is grid computing?

Grid Computing enables virtuals organizations to share geographically distributed resources as they pursue common goals, assuming the absence of central location, central control, omniscience, and an existing trust relationship.

(or)

- ✓ Gridtechnologydemandsnewdistributedcomputingmodels,software/middlewaresupport,networkp rotocols,andhardwareinfrastructures.
- ✓ Nationalgridprojectsarefollowedbyindustrialgridplat-formdevelopmentbyIBM,Microsoft,Sun,HP,Dell,Cisco,EMC,PlatformCo mputing,andothers. Newgridserviceproviders(GSPs)andnewgridapplicationshaveemergedrapidly,similartothegrowtho fInternetandwebservicesinthepasttwodecades.
- ✓ gridsystemsareclassifiedinessentiallytwocategories:computationalordatagridsandP2Pgrids.

6. What are the business areas needs in Grid computing?

- ✓ Life Sciences
- ✓ Financial services
- ✓ Higher Education
- ✓ Engineering Services
- ✓ Government
- ✓ Collaborative games

7. List out the Grid Applications:

- ✓ Application partitioning that involves breaking the problem into discrete pieces
- ✓ Discovery and scheduling of tasks and workflow
- ✓ Data communications distributing the problem data where and when it is required
- ✓ Provisioning and distributing application codes to specific system nodes
- ✓ Autonomic features such as self-configuration, self-optimization, self-recovery and self-management

8. List some grid computing toolkits and frameworks?

- ✓ Globus Toolkit Globus Resource Allocation Manager(GRAM)
- ✓ Grid Security Infrastructure(GSI)
- ✓ Information Services
- ✓ Legion, Condor and Condor-G
- ✓ NIMROD, UNICORE, NMI.

9. What are Desktop Grids?

These are grids that leverage the compute resources of desktop computers.
Because of the true (but unfortunate) ubiquity of Microsoft® Windows® operating system in corporations, desktop grids are assumed to apply to the Windows environment.
The Mac OS™ environment is supported by a limited number of vendors.

10. What are Server Grids?

- ✓ Some corporations, while adopting Grid Computing , keep it limited to server resources that are within the purview of the IT department.
- ✓ Special servers, in some cases, are bought solely for the purpose of creating an internal “utility grid” with resources made available to various departments.
- ✓ No desktops are included in server grids. These usually run some flavor of the Unix/Linux operating system.

11. Define Opennebula.

OpenNebula is an open source management tool that helps virtualized data centers oversee private clouds, public clouds and hybrid clouds ..... OpenNebula is vendor neutral, as well as platform- and API-agnostic. It can use KVM, Xen or VMware hypervisors.

12. Define Eclipse.

Eclipse is an integrated development environment (IDE) used in computer programming, and is the most widely used Java IDE. It contains a base workspace and an extensible plug-in system for customizing the environment.

13. Define Netbeans.

NetBeans is an open-source integrated development environment (IDE) for developing with Java, PHP, C++, and other programming languages. NetBeans is also referred to as a platform of modular components used for developing Java desktop applications.

14. Define Apache Tomcat.

Apache Tomcat (or Jakarta Tomcat or simply Tomcat) is an open source servlet container developed by the Apache Software Foundation (ASF). Tomcat implements the Java Servlet and the JavaServer Pages (JSP) specifications from Sun Microsystems, and provides a "pure Java" HTTP web server environment for Java code to run."

15. What is private cloud?

The *private cloud* is built within the domain of an intranet owned by a single organization. Therefore, they are client owned and managed. Their access is limited to the owning clients and their partners. Their deployment was not meant to sell capacity over the Internet through publicly accessible interfaces. Private clouds give local users a flexible and agile private infrastructure to run service workloads within their administrative domains.

16. What is public cloud?

A *public cloud* is built over the Internet, which can be accessed by any user who has paid for the service. Public clouds are owned by service providers. They are accessed by subscription. Many companies have built public clouds, namely Google App Engine, Amazon AWS, Microsoft Azure, IBM Blue Cloud, and Salesforce Force.com. These are commercial providers that offer a publicly accessible remote interface for creating and managing VM instances within their proprietary infrastructure.

17. What is hybrid cloud?

A *hybrid cloud* is built with both public and private clouds, Private clouds can also support a *hybrid cloud* model by supplementing local infrastructure with computing capacity from an external public cloud. For example, the *research compute cloud* (RC2) is a private cloud built by IBM.

18. What is a Community Cloud ?

A community cloud in computing is a collaborative effort in which infrastructure is shared between several organizations from a specific community with common concerns (security, compliance, jurisdiction, etc.), whether managed internally or by a third-party and hosted internally or externally. This is controlled and used by a group of organizations that have shared interest. The costs are spread over fewer users than a public cloud (but more than a private cloud

19. Define IaaS?

The IaaS layer offers storage and infrastructure resources that is needed to deliver the Cloud services. It only comprises of the infrastructure or physical resource. Top IaaS Cloud Computing Companies: Amazon (EC2), Rackspace, GoGrid, Microsoft, Terremark and Google.

20. Define PaaS?

PaaS provides the combination of both, infrastructure and application. Hence, organisations using PaaS don’t have to worry for infrastructure nor for services. Top PaaS Cloud Computing Companies: Salesforce.com, Google, Concur Technologies, Ariba, Unisys and Cisco..

21. Define SaaS?

In the SaaS layer, the Cloud service provider hosts the software upon their servers. It can be defined as a in model in which applications and softwares are hosted upon the server and made available to customers over a network. Top SaaS Cloud Computing Companies: Amazon Web Services, AppScale, CA Technologies, Engine Yard, Salesforce and Windows Azure.

22. What is meant by virtualization?

Virtualizationisacomputerarchitecturetechnologybywhichmultiplevirtualmachines (VMs)are multipl exedin the same hardwar emachine.Theideaof VMs canbe dated back to the 1960s. The purpose of a VM is to enhance resource sharing by many users and improve computer performance interms of resource utilization and application flexibility.

23. What are the implementation levels of virtualization?

The virtualization types are following

1. OS-level virtualization
2. ISA level virtualization
3. User-ApplicationLevel virtualization
4. hardware level virtualization
5. library level virtualization

24. List the requirements of VMM?

There are three requirements for a VMM.

First, a VMM should provide an environment for programs which is essentially identical to the original machine.

Second, programs run in this environment should show, at worst, only minor decreases in speed.

Third, a VMM should be in complete control of the system resources.

25. Explain Host OS and Guest OS?

A comparison of the differences between a host system, a guest system, and a virtual machine within a virtual infrastructure.

A host system (host operating system) would be the primary & first installed operating system. If you are using a bare metal Virtualization platform like Hyper-V or ESX, there really isn’t a host operating system besides the Hypervisor. If you are using a Type-2 Hypervisor like VMware Server or Virtual Server, the host operating system is whatever operating system those applications are installed into.

A guest system (guest operating system) is a virtual guest or virtual machine (VM) that is installed under the host operating system. The guests are the VMs that you run in your virtualization platform.

26. Write the steps for live VM migration?

The five steps for live VM migration is

Stage 0: *Pre-Migration*
Active VM on Host A
Alternate physical host may be preselected for migration
Block devices mirrored and free resources maintained
Stage 1: *Reservation*
Initialize a container on the target host
Stage 2: *Iterative pre-copy*
Enable shadow paging
Copy dirty pages in successive rounds.
Stage 3: *Stop and copy*
Suspend VM on host A
Generate ARP to redirect traffic to Host B
Synchronize all remaining VM state to Host B
Stage 4: *Commitment*
VM state on Host A is released
Stage 5: *Activation*
VM starts on Host B
Connects to local devices

Resumes normal operation

27..Define Globus Toolkit: Grid Computing Middleware

- ✓ Globus is open source grid software that addresses the most challenging problmes in distributed resources sharing.
- ✓ The Globus Toolkit includes software services and libraries for distributed security, resource management, monitoring and discovery, and data management.

28. Define Blocks in HDFS

- ✓ A disk has a block size, which is the minimum amount of data that it can read or write. Filesystems for a single disk build on this by dealing with data in blocks, which are an integral multiple of the disk block size. Filesystem blocks are typically a few kilobytes in size, while disk blocks are normally 512 bytes. This is generally transparent to the filesystem user who is simply reading or writing a file—of whatever length.

29. Define Namenodes and Datanodes

- ✓ An HDFS cluster has two types of node operating in a master-worker pattern:
  - ➢ a *namenode* (the master) and
  - ➢ a number of *datanodes*(workers).
- ✓ The namenode manages the filesystem namespace. It maintains the filesystem tree and the metadata for all the files and directories in the tree. This information is stored persistently on the local disk in the form of two files: the namespace image and the edit log.
- ✓ The namenode also knows the datanodes on which all the blocks for a given file are located, however, it does not store block locations persistently, since this information is reconstructed from datanodes when the system starts.

30. Define HADOOP.

Hadoop is an open source, Java-based programming framework that supports the processing and storage of extremely large data sets in a distributed computing environment. It is part of the Apache project sponsored by the Apache Software Foundation.

31. Define HDFS.

Hadoop Distributed File System (HDFS) is a Java-based file system that provides scalable and reliable data storage that is designed to span large clusters of commodity servers. HDFS, MapReduce, and YARN form the core of Apache™ Hadoop®.

32. Write about HADOOP.

Hadoop was created by Doug Cutting and Mike Cafarella in 2005. Cutting, who was working at Yahoo! at the time, named it after his son's toy elephant. It was originally developed to support distribution for the Nutch search engine project.

33. Definition of *Grid Portal*:

A *Grid Portal* provides an efficient infrastructure to put Grid-empowered applications on corporate Intranet/Internet.

34. Define GAE.

Google App Engine (often referred to as GAE or simply App Engine) is a Platform as a Service and cloud computing platform for developing and hosting web applications in Google-managed data centers. Applications are sandboxed and run across multiple servers. App Engine offers automatic scaling for web applications—as the number of requests increases for an application, App Engine automatically allocates more resources for the web application to handle the additional demand.

35. What is Cloudsim?

CloudSim is a simulation toolkit that supports the modeling and simulation of the core functionality of cloud, like job/task queue, processing of events, creation of cloud entities(datacenter, datacenter brokers, etc), communication between different entities, implementation of broker policies, etc. This toolkit allows to:

- Test application services in a repeatable and controllable environment.
- Tune the system bottlenecks before deploying apps in an actual cloud.
- Experiment with different workload mix and resource performance scenarios on simulated infrastructure for developing and testing adaptive application provisioning techniques

36. Core features of CloudSim are:

- The Support of modeling and simulation of large scale computing environment as federated cloud data centers, virtualized server hosts, with customizable policies for provisioning host resources to virtual machines and energy-aware computational resources
- It is a self-contained platform for modeling cloud's service brokers, provisioning, and allocation policies.
- It supports the simulation of network connections among simulated system elements.
- Support for simulation of federated cloud environment, that inter-networks resources from both private and public domains.
- Availability of a virtualization engine that aids in the creation and management of multiple independent and co-hosted virtual services on a data center node.
- Flexibility to switch between space shared and time shared allocation of processing cores to virtualized services.

37. Uses of Cloudsim.

- Load Balancing of resources and tasks
- Task scheduling and its migrations
- Optimizing the Virtual machine allocation and placement policies
- Energy-aware Consolidations or Migrations of virtual machines
- Optimizing schemes for Network latencies for various cloud scenarios

38. Define OpenStack.

OpenStack is a cloud operating system that controls large pools of compute, storage, and networking resources throughout a datacenter, all managed and provisioned through APIs with common authentication mechanisms.A dashboard is also available, giving administrators control while empowering their users to provision resources through a web interface.

39. Define Trystack.

TryStack is a great way to take OpenStack for a spin without having to commit to a full deployment.
This free service lets you test what the cloud can do for you, offering networking, storage and compute instances, without having to go all in with your own hardware.

It's a labor of love spearheaded by three Red Hat OpenStack experts Will Foster, Kambiz Aghaiepour and Dan Radez.

TryStack's set-up must bear the load of anyone who wants to use it, but instead of an equally boundless budget and paid staff, it was originally powered by donated equipment and volunteers from Cisco, Dell, Equinix, NetApp, Rackspace and Red Hat who pulled together for this OpenStack Foundation project.

40. Define Hadoop.

Hadoop is an open-source software framework for storing data and running applications on clusters of commodity hardware. It provides massive storage for any kind of data, enormous processing power and the ability to handle virtually limitless concurrent tasks or jobs.

Experiment No.9

Aim: Case studies on Cloud based machine-learning solutions in healthcare.

Theory:

Cloud-based machine learning (ML) solutions have gained significant traction in healthcare due to their ability to handle large datasets, facilitate collaboration, and provide scalable computing resources. Here are some key ways in which cloud-based machine learning is being applied in healthcare:

1. Diagnostic Imaging:
    - Image Recognition: ML algorithms on the cloud can analyze medical images, such as X-rays, MRIs, and CT scans, to aid in the diagnosis of diseases like cancer, fractures, or neurological disorders.
    - Deep Learning Models: Deep learning models, particularly convolutional neural networks (CNNs), are employed for tasks like tumor detection, segmentation, and classification.
2. Clinical Decision Support Systems:
    - Predictive Analytics: Cloud-based ML models can analyze patient data to predict disease progression, readmission risks, and potential complications.
    - Decision Support: ML algorithms assist healthcare professionals in making more informed decisions based on patient history, current symptoms, and relevant medical literature.
3. Drug Discovery and Development:
    - Virtual Screening: ML algorithms assist in virtual screening of potential drug candidates, saving time and resources in the drug discovery process.
    - Biomarker Discovery: Cloud-based ML tools help identify potential biomarkers for diseases and predict responses to specific treatments.
4. Remote Patient Monitoring:
    - Wearable Devices: ML algorithms analyze data from wearable devices to monitor and predict health conditions, enabling timely interventions and reducing hospital readmissions.
    - Continuous Monitoring: Cloud-based solutions facilitate continuous monitoring of patients with chronic conditions, improving the overall management of health.
5. Natural Language Processing (NLP) in Healthcare:
    - Electronic Health Record (EHR) Analysis: NLP algorithms on the cloud extract valuable information from unstructured clinical notes, aiding in clinical research and decision-making.
    - Voice Recognition: Cloud-based solutions enable voice-activated systems that assist healthcare professionals in documenting patient information efficiently.
6. Collaboration and Data Sharing:
    - Interoperability: Cloud platforms allow for seamless integration and sharing of healthcare data, fostering collaboration among healthcare providers, researchers, and institutions.
    - Multi-Center Studies: Cloud-based solutions facilitate multi-center studies by providing a centralized platform for data storage, processing, and analysis.
7. Security and Compliance:
    - Data Security: Cloud service providers implement robust security measures to protect sensitive healthcare data, often meeting industry-specific compliance standards such as HIPAA (Health Insurance Portability and Accountability Act).
    - Scalability: Cloud infrastructure allows for the scalability of resources based on demand, ensuring that healthcare organizations can adapt to changing computational needs.

It's essential to address privacy and security concerns when implementing cloud-based solutions in healthcare, given the sensitivity of patient data. Additionally, compliance with regulatory standards is crucial to ensure the ethical and legal use of healthcare information.

1st Study:

From electronic health records to medical imaging, healthcare is an industry with an unprecedented amount of data. At Google Cloud, we want to help more healthcare organizations turn this data into health breakthroughs, through better care and more streamlined operations. Over the past year, we've enhanced Google Cloud offerings with healthcare in mind, expanded our compliance coverage, and welcomed new customers and partners. Here's a look at a few milestones along the way.

Welcoming new healthcare customers to Google Cloud

The challenges of healthcare are increasingly data challenges—creating it, storing it, and analyzing it to find meaningful insights. This year we welcomed many new healthcare customers to Google Cloud, and we're continually inspired by how these customers use data to benefit both patients and providers. Here are a few examples:

- National Institutes of Health (NIH) is bringing the power of Google Cloud to biomedical research as a part of their STRIDES (Science and Technology Research Infrastructure for Discovery, Experimentation, and Sustainability) Initiative. As NIH's first industry partner on this initiative, Google Cloud made some of the most important NIH-funded datasets available to users with appropriate privacy controls and have helped to simplify access to these datasets.
- The BARDA DRIVe Solving Sepsis initiative is partnering with a research consortium consisting of Emory University School of Medicine, Massachusetts General Hospital (MGH), University of California San Diego (UCSD) School of Medicine, and Atlanta's Grady Health System to leverage Google Cloud to develop interoperable learning software for early prediction of sepsis in hospital intensive care units. Now DRIVe can help develop and implement that platform to reduce the approximately 270,000 deaths from sepsis in the United States each year.
- Hurley Medical Center is increasing operational efficiencies, reducing costs and improving patient outcomes by moving to G Suite from on-premises productivity software and email. Moving to G Suite has saved the organization $150,000 in annual software costs.
- Hunterdon Healthcare uses G Suite to improve collaboration and efficiency, reclaiming 30% of caregivers' time for patient interactions while reducing costs by $1.3 million over three years.
- Imagia is leveraging GCP in its mission to help predict patient outcomes and detect disease specific markers from imaging data. With GCP, the company has reduced test processing time from 16 hours to one hour, and has improved time to discovery for

researchers.

- Wellframe uses GCP to power their platform that connects people and care teams, helping them build trusted relationships that drive early interventions. Automating care intelligence empowers Wellframe providers to scale care delivery and optimize care strategy, which has already resulted in an 80 percent increase in weekly patient care plan engagement.

We're excited to see how these and other organizations in the healthcare space utilize data to solve their most pressing challenges.

Working with partners for better patient outcomes

Our Google Cloud partners play a critical role in helping healthcare providers and organizations embrace and evolve their cloud strategies. Today, we are pleased to announce several new partnerships established to accelerate our commitment to data interoperability.

- Our relationship with Health Level 7 (HL7), an international standards body for clinical data, builds upon our existing work with the FHIR Foundation to include the broader set of standards managed by the organization. Representatives from Google are joining the standards community.
- By partnering with the SMART Advisory Council, a group designed to facilitate applications integrated directly into electronic health records, Google Cloud developers will be able to share feedback to improve the SMART specification and help maintain a robust set of tools for application designers, engineers, and users.
- As a partner of Rock Health, an industry leader in digital health research and new venture support, we will incorporate integration requirements from novel and fast-growing companies, share best practices for scalable and compliant product development around the world, and consult with investors, industry executives, regulators, legislators, and academics shaping the future of digital health.
- MITRE, a not-for-profit organization that operates federally funded research and development centers, is collaborating with Google Cloud to give developers access to SyntheticMass through Cloud Healthcare API and Apigee Edge. SyntheticMass is a population-level, FHIR-formatted dataset that contains realistic but fictional residents of the state of Massachusetts. It statistically mirrors the real population in terms of demographics, disease burden, vaccinations, medical visits, and social determinants, which makes it a risk-free environment for experimenting and exploring new healthcare solutions. SyntheticMass is generated by Synthea, an open-source, synthetic patient generator that models the medical history of patients. The FHIR dataset will be made publicly available to developers soon.

- Novo Nordisk selected the medical-grade BrightInsight platform, which is hosted on GCP, to build and operate digital health solutions for diabetes patients and securely manage millions of its smart medical devices and the corresponding data within a regulatory-compliant environment.

- Flywheel is integrating Google's Healthcare API, as well as BigQuery and AutoML Vision, with their platform to capture multi-modality images and data, boost the productivity of data classification, and securely collaborate with peers to manage analysis and metadata.

- Life Image and the Athena Breast Health Network at the University of California selected Mammosphere on GCP for its breakthrough WISDOM Study to determine the optimal frequency and methods of breast cancer screening. Life Image is also using our Healthcare API to bridge the gap between care systems and applications built on Google Cloud.

- Our partnership with Imprivata, the healthcare IT security company, makes it possible for Chrome devices to work seamlessly with Imprivata's single sign-on and virtual desktop access platform for healthcare. This will enable secure mobile workstations and patient devices.

- Elastifile launched Elastifile Cloud File Service, a fully-managed file storage service. With scalable, high-performance, pay-as-you-go file storage at their fingertips, healthcare organizations are empowered to burst data-intensive NFS workloads to Google Cloud for accelerated processing.

Unlocking the power of data with our products

At Google Cloud, we're always looking to expand our healthcare product offerings—and help our customers do the same. Many organizations host datathon events as a way to collaboratively tackle data challenges and quickly iterate on new solutions or predictive models. To help, we're announcing the Healthcare Datathon Launcher, which provides a secure computing environment for datathons. And if you want to learn how to do clinical analysis, University of Colorado Anschutz Medical Campus has just launched a Clinical Data Science specialization on Coursera, with 6 online courses, giving you hands-on experience with Google Cloud.

Additionally, we've enhanced our healthcare offerings in numerous ways over the past year, including making radiology datasets publicly available to researchers with the Google Healthcare API, and hosting over 70 public datasets from the Cancer Imaging Archive (TCIA) and NIH. With these datasets, researchers can quickly begin to test hypotheses and conduct experiments by running analytic workloads on GCP—without the need to worry about IT infrastructure and management.

Helping healthcare providers meet their security and compliance needs

Security and compliance are fundamental concerns for healthcare providers, and are among Google Cloud's topmost priorities. To date, more than three dozen Google Cloud Platform products and services enable HIPAA compliance, including Compute Engine, Cloud Storage, BigQuery, and most recently, Apigee Edge and AutoML Natural Language. In addition, Google Cloud Platform and G Suite are HITRUST CSF certified. Google Cloud is also committed to supporting compliance with requirements such as the GDPR, PIPEDA, and more. We recently published a whitepaper on Handling Healthcare Data in the UK that provides an overview of NHS information governance requirements.

2nd Study:

Takeda, a leading global R&D pharmaceutical company, was seeking to improve the accuracy of its prediction models for various disease states. They believed AI could be a powerful tool in this effort, but needed to create a model that could prove their hypothesis. To achieve their goals, they enlisted the help of Deloitte to create a cloud solution. Using a small, proven real world data set on Treatment Resistant Depression and NASH, a severe form of hepatitis, Takeda and Deloitte deployed a scalable, AWS cloud-based machine learning solution called Deep Miner to rapidly test predictive models.

Cloud delivered—accelerating the development of the solution and delivering insights faster. Just as Takeda hoped, the solution generated unprecedented insights their teams can now apply across a range of data to refine drug development and planning of clinical trials. The model proved highly accurate in its predictions, outperforming previously tested traditional analyses. Accuracy jumped almost 40%, which will inform drug development, product pipeline planning, and help Takeda to appreciate unmet needs of patients and improve patient outcomes. And, Cloud made it happen.

3rd Study:

Prescribing ML for new use cases

In our use and exploration of AI/ML in our platform, we go beyond pure AI tools by including human-in-the-loop programs and treatments. For example, we provide coaches, therapists, and dieticians that work with each individual patient, providing tips, strategies, and accountability. Our patient-provider interactions are digitized and stored, giving us a robust training dataset that we can now operationalize using all of the Google tools available. Using these provider interactions, we can track a patient's progress to ensure they've improved their health outcomes, whether it's weight loss, stress reduction, blood sugar management or beyond.

We want to endow our providers with superhuman powers, which means using AI/ML to manage and automate all of the tasks that aren't member-facing, freeing up the providers to focus their time and energy on their patients. We're currently experimenting with our Google tools around transcribing the provider's consultation notes and then applying data analysis to uncover insights that will lead to better health outcomes. Other time-saving solutions on our roadmap for providers include pre-filling standard fields in the chat function and managing end-of-day approvals.

We're currently using BigQuery ML for our "next action recommender," a member-facing feature on our mobile app that recommends the next step a patient can take in their treatment, based on past datasets of information provided by the patient. At the start of their journey, the steps might be basic, such as scheduling a consultation, adding a health tracker, or watching a health video. But the longer a patient uses our platform, the more sophisticated the recommendation system gets.

On the provider side, we have our Vidapedia, a comprehensive list of protocols for treatments that providers can follow. In the past year we've invested in Vidapedia cards, which are distinct sets of clinical protocols that have been codified. We're up to 150 cards, and instead of providers needing to keep all of that information in their heads, we're working on using BigQuery ML to extract the actions a patient has taken so far in their treatment. Using that data, we'll then recommend to the provider the most relevant cards that apply to the specific conditions. Having that information at their fingertips reduces the amount of time they need to spend on each member offline, which helps us build efficiency and lower the cost of delivering care.

We've also used ML in our customer acquisition process, which has traditionally been a costly endeavor for healthcare startups. A company first needs to market and sell to payers and providers, and then understand the total addressable market (TAM) for their patient base before convincing that segment that their platform is the best decision. We've successfully applied ML to this process, sifting through hundreds of different data inputs to better predict who is likely to use our platform, saving us time and money.

Viva Voce:

1. What is Cloud Computing?
2. What are the benefits of Cloud Computing?
3. Give the best example of open source Cloud Computing
4. What are the 4 types of cloud computing?
5. What are the advantages of using cloud computing?
6. Is Gmail IaaS or PaaS?
7. What is PaaS vs. SaaS?
8. Is Amazon IaaS or PaaS?
9. Is API SaaS or PaaS?
10. Is Azure IaaS or PaaS?
11. What are the innovative characteristics of cloud computing?
12. Which are the technologies on which cloud computing relies?
13. Define cloud computing and identify its core features?
14. What are the major advantages of cloud computing?
15. Describe the vision introduced by cloud computing?
16. Explain the cloud ecosystem.
17. What are the disadvantages of virtualization?
18. What does infrastructure-as-a-service refer to?
19. Give the names of some popular software-as-a-service solutions?
20. Give some examples of public cloud?
21. What is Google App Engine?
22. Which is the most common scenario for a private cloud.
23. What are the types of applications that can benefit from cloud computing?
24. What are the most important advantages of cloud technologies for social networking application?
25. What is Windows Azure?
26. Describe Amazon EC2 and its basic features?
27. Discuss the use of hypervisor in cloud computing.
28. Discuss the objective of cloud information security.
29. Describe cloud computing services.
30. Distinguish between authentication and authorization.
31. What are the fundamental principles of cloud security design?
32. Discuss the security challenges in cloud computing.

Experiment No. 10

AIM: LAB BASED MINI PROJECT

Designing a complex mini-project in cloud computing involves selecting a specific problem or application and implementing it using cloud services and technologies.

MAX TEAM SIZE: 5

MAX MARKS: 30 MARKS

TOPICS:

1. Scalable Web Application Deployment: Deploy a web application on a cloud platform (e.g., AWS, Azure, Google Cloud) using scalable and fault-tolerant architecture.
2. Server less Function Deployment: Build and deploy server less functions using platforms like AWS Lambda, Azure Functions, or Google Cloud Functions.
3. Data Analytics with Cloud Services: Perform large-scale data analytics using cloud-based services like AWS EMR (Elastic MapReduce) or Google BigQuery.
4. IoT Data Processing: Create an IoT (Internet of Things) application that collects and processes data from devices using cloud services.
5. ML Model Deployment: Train a machine-learning model and deploy it using cloud-based ML services such as AWS SageMaker or Azure ML.
6. Cloud-Native Mobile App Backend: Develop the backend of a mobile application-using server less and cloud-native services.
7. Block chain Implementation on Cloud: Explore block chain technology by implementing a simple block chain application on a cloud platform.
8. Hybrid Cloud Deployment: Set up a hybrid cloud infrastructure, integrating on-premises resources with a public cloud environment.
9. Real-time Chat Application: Build a real-time chat application using cloud-based services for messaging and data storage.
10. Content Delivery Network (CDN) Setup: Implement a CDN for a website to improve content delivery and reduce latency.
11. Cloud Security Monitoring: Develop a security monitoring system using cloud services like AWS GuardDuty or Azure Security Center.
12. Cloud Automation with Infrastructure as code (IaC): Use tools like AWS Cloud Formation or Terraform to automate the deployment of cloud infrastructure.
13. Serverless RESTful API: Build a serverless RESTful API using platforms like AWS API Gateway andAWS Lambda.
14. Cloud Gaming Platform: Create a cloud-based gaming platform that allows users to play games without the need for high-end local hardware.
15. Disaster Recovery Solution: Design and implement a disaster recovery solution using cloud services for backup and recovery.
16. Container Orchestration with Kubernetes: Set up a Kubernetes cluster on a cloud platform and deploy containerized applications.
17. Voice Recognition System: Build a voice recognition system using cloud-based services like Google Cloud Speech-to-Text or Azure Speech.
18. Multi-Cloud Management Platform: Develop a platform that facilitates the management of resources across multiple cloud providers.
19. Healthcare Data Analytics: Analyze healthcare data using cloud-based services, focusing on data security and compliance.
20. Cloud Cost Optimization Tool: Create a tool that helps organizations optimize their cloud costs by analyzing usage patterns and suggesting improvements.