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COLLEGE OF ENGINEERING & TECHNOLOGY ANGUCHETTYPALYAM, PANRUTI – 607110.

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING



CS6712 GRID AND CLOUD COMPUTING LABORATORY

PREPARED BY

S.MANAVALAN, AP/CSE

LIST OF EXPERIMENTS:

GRID COMPUTING LAB

Use Globus Toolkit or equivalent and do the following:

- 1. Develop a new Web Service for Calculator.
- 2. Develop new OGSA-compliant Web Service.
- 3. Using Apache Axis develop a Grid Service.
- 4. Develop applications using Java or C/C++ Grid APIs
- 5. Develop secured applications using basic security mechanisms available in Globus Toolkit.

6. Develop a Grid portal, where user can submit a job and get the result. Implement it with and without GRAM concept.

CLOUD COMPUTING LAB

Use Eucalyptus or Open Nebula or equivalent to set up the cloud and demonstrate.

1. Find procedure to run the virtual machine of different configuration. Check how many virtual machines can be utilized at particular time.

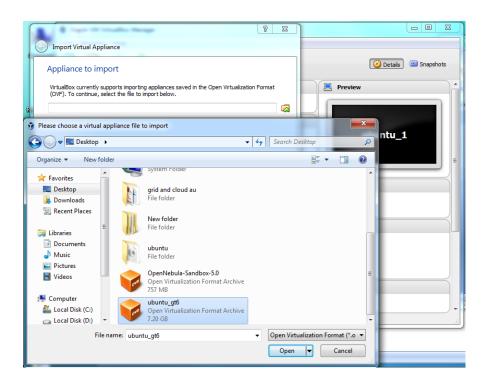
2. Find procedure to attach virtual block to the virtual machine and check whether it holds the data even after the release of the virtual machine.

- 3. Install a C compiler in the virtual machine and execute a sample program.
- 4. Show the virtual machine migration based on the certain condition from one node to the other.
- 5. Find procedure to install storage controller and interact with it.
- 6. Find procedure to set up the one node Hadoop cluster.
- 7. Mount the one node Hadoop cluster using FUSE.
- 8. Write a program to use the API's of Hadoop to interact with it.
- 9. Write a wordcount program to demonstrate the use of Map and ReducetasksInstall

GRID COMPUTING LAB

UBUNTU_GT6 INSTALLATION:

- 1. Open Virtual box
- 2. File \rightarrow 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.



EX.NO:1 Develop a new Web Service for Calculator. DATE:

OBJECTIVE:

To build a new web service for calculator.

PROCEDURE:

Steps:

- 1. Open Netbeans IDE 8.1.
- 2. Click File →New Project, then select Maven in the categories then select web application in the projects.
- 3. Enter the name of the project. For example Calculator
- 4. Then Click next and choose Glassfish as server then click on finish.
- 5. Next Right click on project name then select New→web service, enter the name of the web service and choose the packages from list or enter com.mycompany.calculator/me.org.calculator then click on finish.
- 6. Then Right click on created web service and select Add Operation
- 7. Now Pop window will display on that enter operation name as Addition then return type as int and Add parameters 'a' and 'b' as int.
- 8. Now goto the coding file . On that coding file delete hello operation coding.

And Add the following code

```
@WebMethod(operationName = "add")
```

```
publicint add(@WebParam(name = "a") int a, @WebParam(name = "b") int b) {
```

int c=a+b;

return c; }

- 9. And repeat the steps 6,7,8 for operation Subtraction, Multiplication and Division then save the coding file.
- 10. Next Run the project. After successfully Running of project select the web service and Right click on that and select test web service.

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APPLICATIONS:

Using calculator for mathematical operations.

RESULT:

Thus build a new web service calculator is successfully executed.

EX.NO.2 Develop new OGSA-compliant Web Service. DATE:

OBJECTIVE:

To build a newOGSA- Compliant web service.

PROCEDURE:

Steps:

- Setup the Development Environment for PATH,JAVA_HOME,TOMCAT_HOME.(My computer → Properties → Advanced System Setting → Environment variables)
- 2. Open the Eclipse then select windows \rightarrow preferences \rightarrow webservice
- 3. Then select Axis2 preferences and choose Axis2 runtime tab.
- 4. Then browse the Axis2 path.
- 5. File \rightarrow New \rightarrow Dynamic web project
- 6. Name the project name eg.Myfirstwebservice ,select the Target run time environment as Apache Tomcat v6.0
- 7. Then choose custom on configuration and click on Modify button
- 8. Then project facets window will popup.
- 9. On that check-in the Axis2 Web Services, clickoK then Next
- 10. Right Click on MyFirstWebService in Project Explorer and select New --> Class and give suitable package name and class name. I have given com.sencide as package name and FirstWebService as class name.
- 11. Type the following code on class file

packagecom.sencide; public class FirstWebService { public int addTwoNumbers(int firstNumber, int secondNumber){ return firstNumber + secondNumber; } }

- 12. Then, select File --> New --> Other and choose Web Service
- 13. Select the FirstWebService class as service implementation and to make sure that the Configuration is setup correctly click on Server runtime.
- 14. There set the Web Service runtime as Axis2 (Default one is Axis) and click Ok.
- 15. Click Next and make sure Generate a default service.xml file is selected.
- 16. Click Next and Start the Server and after server is started you can Finish if you do not want to publish the Web service to a test UDDI repository
- 17. You can go to http://localhost:8080/MyFirstWebService/services/listServices to see your running service which is deployed by Axis2. You can see the WSDL by clicking the link FirstWebService.
- 18. Select File --> New --> Other... and choose Web Service Client

- 19. Set he newly created Axis2 Web service (http://localhost:8080/axis2/services/FirstWebService?wsdl) as the Service definition. Then configure the Server runtime as previously and click finish.
- 20. This will generate two new classes called FirstWebServiceStub.java and FirstWebServiceCallbackHandler.java. Now we can create test class for client and use our web service. Create new class called TestClient.java and paste following code.

```
packagecom.sencide;
importjava.rmi.RemoteException;
importcom.sencide.FirstWebServiceStub.AddTwoNumbers;
importcom.sencide.FirstWebServiceStub.AddTwoNumbersResponse;
publicclassTestClient {
    publicstaticvoidmain(String[] args) throwsRemoteException {
        FirstWebServiceStub stub = newFirstWebServiceStub();
        AddTwoNumbersatn = newAddTwoNumbers();
        atn.setFirstNumber(5);
        atn.setSecondNumber(7);
        AddTwoNumbersResponse res = stub.addTwoNumbers(atn);
        System.out.println(res.get_return());
    }
}
```

21. Now you can run the above code as java application and you will get the output as 12 since we are adding 7 and 5.

OUTPUT:

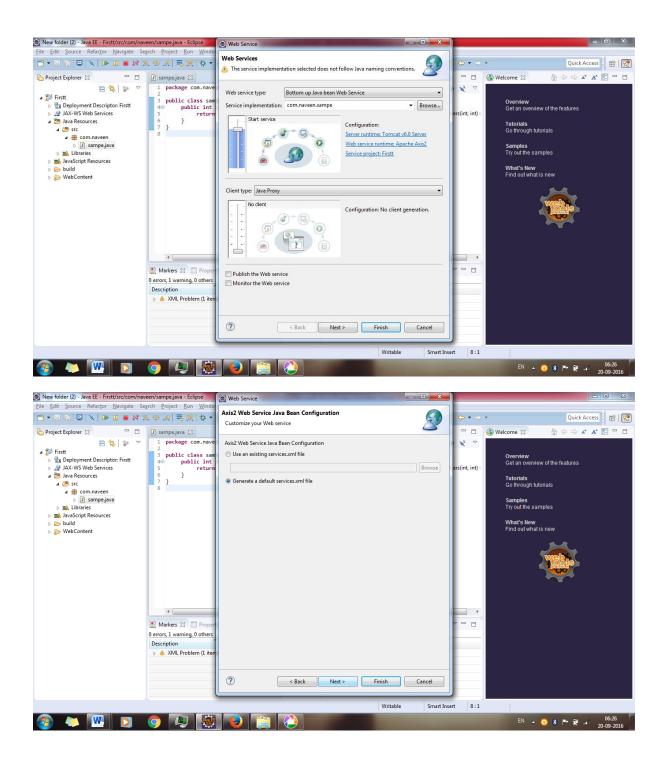
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	System		
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	Rating:	4.7 Windows Experience Index	
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	Installed memory (RAM):	4.00 GB	
	System type:	64-bit Operating System	
	Pen and Touch:	No Pen or Touch Input is available for this Display	
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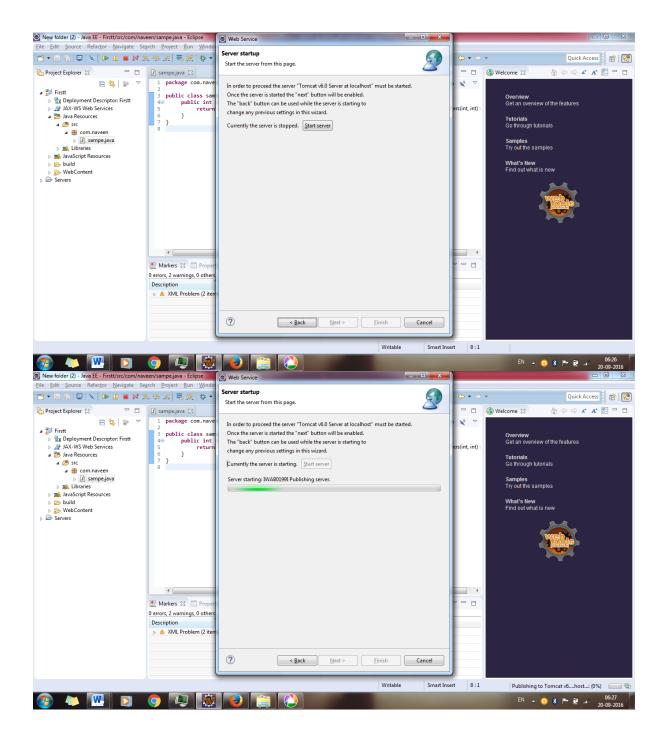
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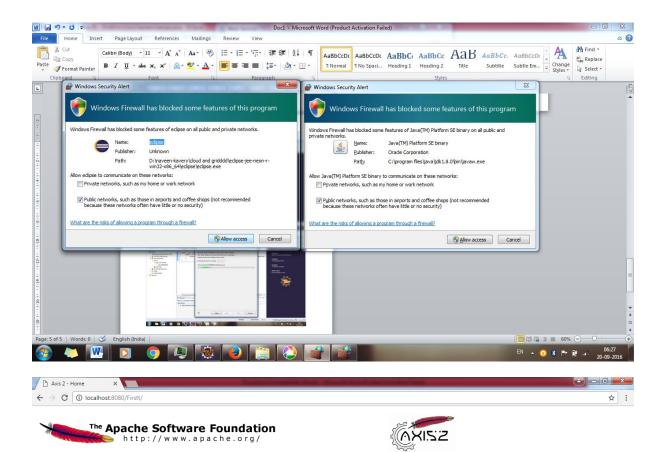
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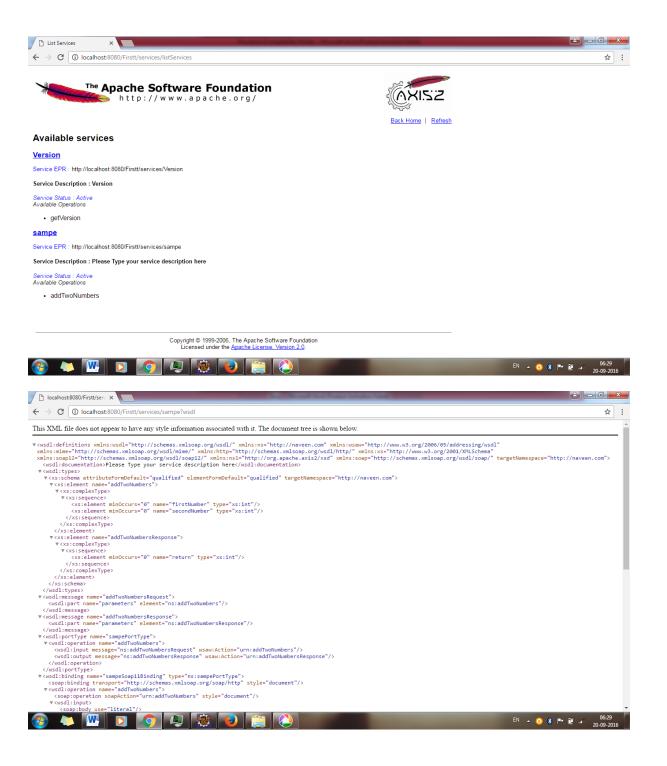


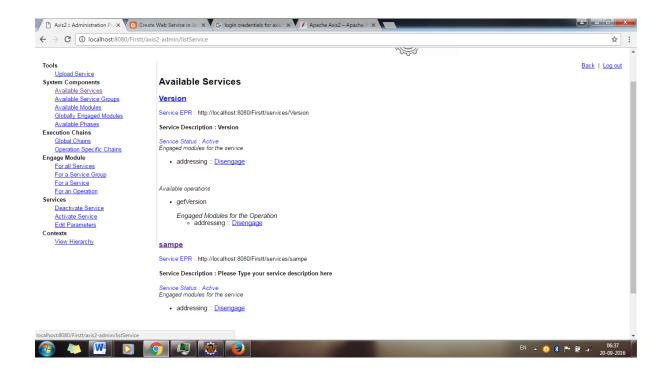
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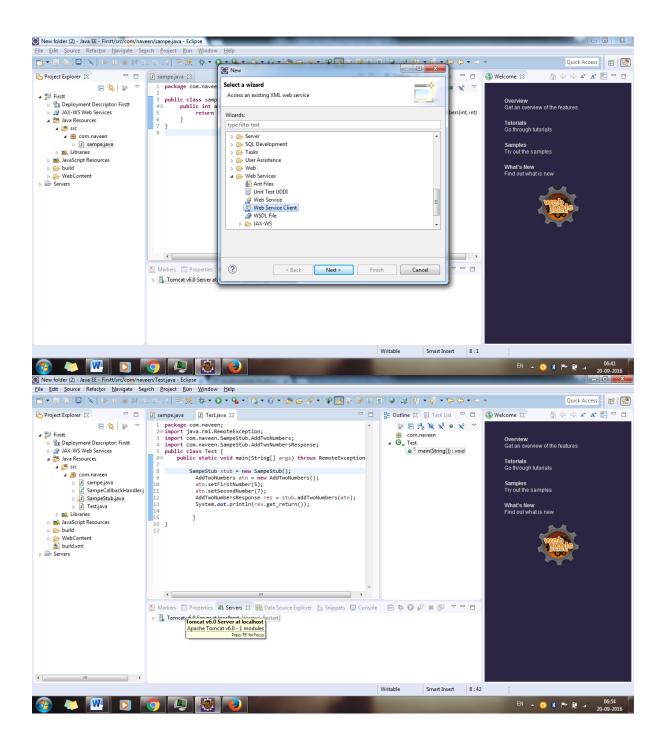
Welcome to the new generation of Axis. If you can see this page you have successfully deployed the Axis2 Web Application. However, to ensure that Axis2 is properly working, we encourage you to click on the validate link.

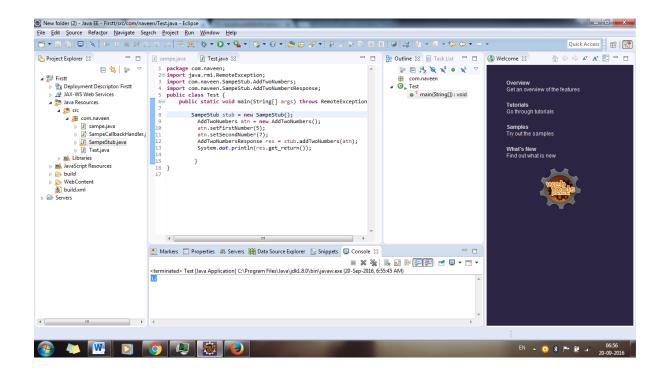
- Services
 View the list of all the available services deployed in this server.
 <u>Validate
 Check the system to see whether all the required libraries are in place and view the system information.
 <u>Administration
 Console for administering this Axis2 installation.
 </u></u>











APPLICATIONS:

OGSA has contributed to projects and organisations around the world, in sectors including medical research, geographical information systems, meteorology, transport, computer-aided design, engineering and astronomy.

RESULT: Thus build a new OGSA- Compliant web service is successfully executed.

EX.NO.3 Using Apache Axis develop a Grid Service.

DATE:

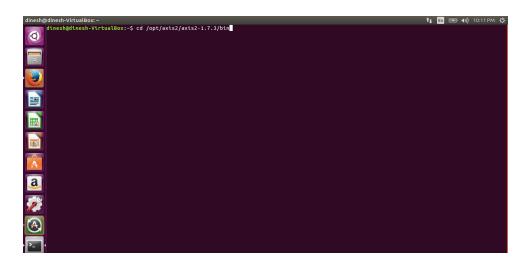
OBJECTIVE:

To develop a Grid service using Apache Axis.

PROCEDURE:

Steps:

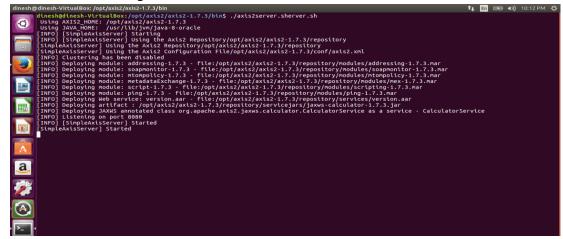
- 1. Open the terminal
- 2. Type cd /opt/axis2/axis2-1.7.3/bin then press enter
- 3. Type chmod 500 axis2server.sh
- 4. Type ./axis2server.sh
- 5. Then open browser on ubuntu type the URL as localhost:8080/axis2/services
- 1. Type cd /opt/axis2/axis2-1.7.3/bin then press enter



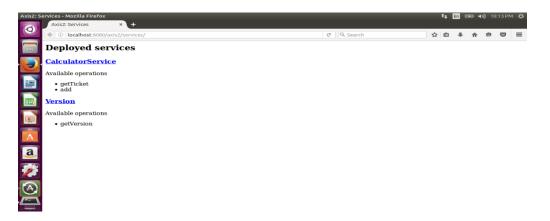
2. Type chmod 500 axis2server.sh & Type ./axis2server.sh



3. Axis2 server running



4. Then open browser on ubuntu type the URL as localhost:8080/axis2/services



5. Click on version to check



APPLICATIONS:

It contributed to projects and organisations around the world, in sectors including medical research, geographical information systems, meteorology, transport, computer-aided design, engineering and astronomy.

RESULT:

Thus develop a Grid service using Apache Axis is successfully executed.

EX`NO.4 Develop applications using Java or C/C++ Grid APIs

DATE:

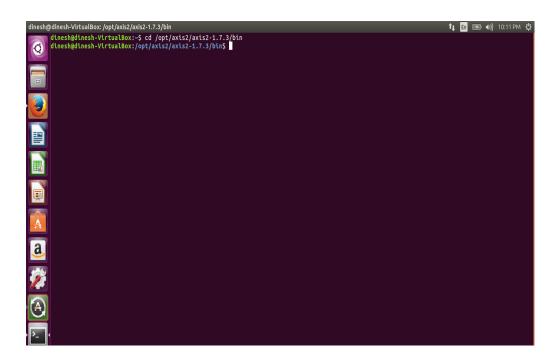
OBJECTIVE:

To develop applications using Java or C/C++ Grid APIs

PROCEDURE:

Steps:

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



2. Type geditfirst.c



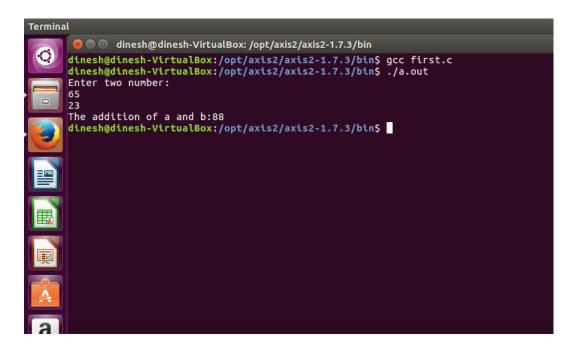
3. Type the c program

first.c (~/) - gedit		🏦 🖪 📧 🕪	9:55 PM 🔱
Open ▼ ₽ #include <stdio.h></stdio.h>			Save
<pre>#include<conio.h> void main() { int a;</conio.h></pre>			
<pre>clrscr(); printf("Enter the number to find Even Or Not"); scanf("%d",&a);</pre>			
<pre>if(a%2==0) printf("The Entered number is Even"); else printf("The Entered number is Odd");</pre>			
a			
Saving file '/home/dinesh/first.c'	C 🔻 Tab Width: 8 🔻	Ln 13, Col 2	▼ INS

4. Running the C program

dinesh@dinesh-VirtualBox: /opt/axis2/axis2-1.7.3/bin	tu En 💷 🖘)) 10:23 PM 🔱
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	
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5. Display the output:



APPLICATIONS:

Simply running all programs in grid environment.

EX.NO.5Develop secured applications using basic security mechanisms available in
GlobusDATE:GlobusToolkit.

OBJECTIVE:

To develop secured applications using basic security mechanisms available in Globus Toolkit.

PROCEDURE:

Steps:

1. Follow these command to install basic security

Installing GRID Essential

wget http://www.globus.org/ftppub/gt6/installers/repo/globus-toolkit-repo_latest_all.deb

```
sudodpkg -i globus-toolkit-repo_latest_all.deb
```

sudo apt-get update

sudo apt-get install globus-data-management-client

sudo apt-get install globus-gridftp

sudo apt-get install globus-gram5

sudo apt-get install globus-gsi

sudo apt-get install globus-data-management-server

sudo apt-get install globus-data-management-client

sudo apt-get install globus-data-management-sdk

sudo apt-get install globus-resource-management-server

sudo apt-get install globus-resource-management-client

sudo apt-get install globus-resource-management-sdk

sudo apt-get install myproxy

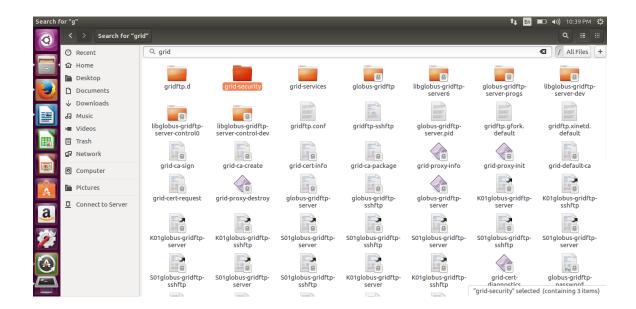
sudo apt-get install gsi-openssh

<u>sudo apt-get install globus-gridftp globus-gram5 globus-gsimyproxymyproxy-server</u> <u>myproxy-admin</u>

- 2. After installing like myproxy, gsi-openssh and Globus GRAM file
 - a. Click the file \rightarrow computer
 - b. Then Search Grid security folder
 - c. Then see the gsi.conf, sshftp.(This indicate the basic security mechanisms are configured)

dinesh@dinesh-VirtualBox: ~	1 ↓ [in 🗆	D 🜒)	10:36 PM 🔱
dinesh@dinesh-VirtualBox:-\$ sudo apt-get install myproxy [sudo] password for dinesh: Reading package lists Done Building dependency tree Building dependency tree				
Reading state information Done myproxy is already the newest version (6.1.18-1+gt6.xenial). 0 upgraded, 0 newly installed, 0 to remove and 88 not upgraded.				
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grid-security 👔 🖬 💷 🕬						En 💷 🕪) 1	0:39 PM 🔱		
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gsi.conf [Read-Only] (/etc/grid-security) - gedit	🏚 🖪 💷 🜒) 10:39 PM 🔱
	Save
# Flag to choose SSL or TLS for GSSAPI protocol.	
# Set to true to disable SSLv3, or false to allow either to be # negotiated. The value of the GLOBUS_GSSAPI_FORCE_TLS environment	
Force TLS=false	
# GSSÄPI Name compatibility mode when trying to determine # if a host certificate is legitimate. GSI predates RFC2818.	
<pre># so there are some old, less-secure, practices by default. # he different modes are:</pre>	
■ # STRICT_GT2:	
<pre># Strictly backward-compatible with GT 2.0 name matching. # X.509 subjectAltName values are ignored. Names with</pre>	
<pre># hyphens are treated as wildcarded such that # host-ANYTHING.example.com will match a certificate named</pre>	
<pre># host.example.com. The name matching will rely on canonical # host (as resolved via getnameinfo) name associated with</pre>	
<pre># a connection's IP addresses. # STRICT RFC2818:</pre>	
<pre># Support RFC 2818 server identity processing. Hyphen # characters are treated as normal part of a host name.</pre>	
dnsName and ipAddress subjectAltName extensions are matched	
<pre># against the host and port passed to GSSAPI. If subjectAltName # is present, X.509 SubjectName is ignored.</pre>	
<pre>a, # HYBRID: # HYBRID: # Support a hybrid of the two previous name matching algorithms,</pre>	
<pre># liberally matching both hyphen wildcards, canonical names associated with IP addresses, and subjectAltName extensions.</pre>	
<pre># This has been the default since GT 4.2 NAME COMPATIBILITY=STRICT RFC2018</pre>	
# OpenSSL Cipher List. This is an preference-ordered list of OpenSSL cipher # openSSL Cipher List. This is an preference-ordered list of OpenSSL cipher	
CIPHERS=HIGH	
# If true, when choosing a cipher, a server will use its own preferred # order instead of the cipher order presented by the client. When not set, the	
Plain Text 🝷 Tab	o Width: 8 🔻 🛛 Ln 1, Col 1 🔍 INS



APPLICATIONS:

Using authentications and authorization purpose for grid user.

RESULT:

Thus develop secured applications using basic security mechanisms available in Globus

Toolkit is successfully executed.

Ex.No.6Develop a Grid portal, where user can submit a job and get the result.DATE:Implement it with and without GRAM concept

OBJECTIVE:

To develop a Grid portal, where user can submit a job and get the result and to implement it with and without GRAM concept.

PROCEDURE:

1. Opening the workflow editor

The editor is a Java Webstart application download and installation is only a click.

Address 🗃 http://hgportal.hpcc.sztaki.hu:9080/gridsphere/gridsphere?gs_action=gs_logout&cid=logout&JavaScript=enable	d 🔄 🔂 Go 🛛 Links 🏾
	English 💌
GridSphere	
Home	Login
	User Name
	Password
	□ Remember my login
	Forget your password?
	Spowered by gridsphere
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2. Java Webstart application

Download and install

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3. Job property window:

Merkflow Edit Options Help	_P properties	
	Name Job Type Job Executable	LM_P SEQ MPI O PVM LM_5.bin File Browser
	Process Number Attributes	7
	Grid Monitor	SEE-GRID -
	Resource	n40.bpcc.sztaki.bu:jobmanager-fork ce01.grkt.acad.bg:jobmanager-fork grid-ce.il.edu.mk:jobmanager-fork grid1.irb.hr:jobmanager-fork grid1.netmode.ece.ntua.gr:jobmanag

4. The information system can query EGEE and Globus information systems

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CosmoGrid	Para	Free	Usage		Waiting	Loa	d	Total	Available	Us	age		
egis01-phy-doms	32	10	69%	12	0		0%	106.971 GB	79.263 GB		26%		
Iberta-log2 dech	2 50	0	100%	0	0		0%	1.221 TB	308.592 GB	_	75%		
eljing-chic-log2- a64	32	32	0%	0	0		0%	62.87 GB	56.992 GB	1	996		
eijing-log2	8	8	0%	0	0		0%	2 KB	1 KB		50%		
elgrid-ucl	12	12	0%	0	0		0%	N/A	N/A	-			
ig-inme	20	20	0%	0	0	1	0%	37.355 G8	37.299 G8		0%		
q01-ipp	19	1	95%	13	5		28%	N/A	N/A		- Colles		
g02-im	4	4	0%	0	0		0%	32.944 GB	20.169 G8		39%		
g04-acad	11	11	0%	0	0		0%	32.844 GB	27.149 GB		17%		
ham-log2	132	107	19%	0	0		0%	1.639 TB	1.518 TB	1	7%		
affi	2	2	0%	0	0		0%	103.52 G8	98.274 G8		5%		
itiabgs	101	99	2%	0	4		100%	417.777 GB	407.123 GB	1	396		
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HUNGRID	LCG2	grid152.kfki.hu	2170	mds-vo- name=local,o=grid	Resour
SEE-GRID	LCG2	bdii.phy.bg.ac.yu	2170	mds-vo- name=local,o=grid	Resour
SZTAKI-GRID	MDS2	n0.hpcc.sztaki.hu	2135	mds-vo- name=SzuperGRID, o=Grid	Resour
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hungrid_LCG_2_BROKER		1	4/A	No. Contraction of Contraction Contraction	Resour
Default visualization size	2				

5. List of available grids

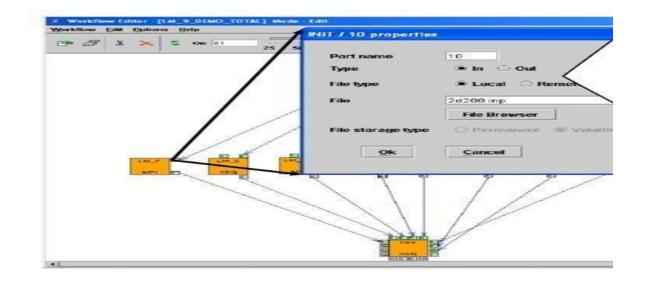
6. Computing resources of such a grid

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n0.hpcc.sztaki.hu	jobmanager-fork	Delete	
n0.hpcc.sztaki.hu	Jobmanager-grd	Delete	[Action
n0.hpcc.sztaki.hu	jobmanager-spe	Delete	
n0.ikpc.iit.bme.hu	jobmanager-fork	Delete	H Resources
n20.hpcc.sztaki.hu	tobmanager-fork	Delete	Resources
n23.hpcc.sztaki.hu	jobmanager-fork	Delete	
parsifal.wmin.ac.uk	tobmanager-fork	Delete	Resources
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ana an	bbA	5.5	
	Load default   Load resources from MDS2   Back	1	d Resources
Default visualization size			Resources
Width: 600			
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( Accept values betw			
Message: Default configuration succ	essfully loaded.		
	August 24, 2005		Diternet

- 7. Broker resource selection
- -> Select a Broker Grid for the job
- Specify extra ranks and requirements for the job in Job description language.
   The broker will find the best resource for your job.

	w Editor - [default*] > Edit Options Help		
	r   ¥ ×   = 0	25 50 75 100 125 150	
Brok	kokerTest properties		× *
	Name Job Type	BrokerTest     SEC O MPI O PUNI	
	Job Executable	D W-TESTICell exe	
		File Browser	
Select a Grid with broker!	Process Number		
	Grid	HUNGROD_LCG_2_B *	
Ignore the resource field!	Monitor		112
5453	Resource	grki 151.kfki.hu	•
If default is not sufficient define	JDL:	JDL Editor	
ranks & requirements using the built- in JDL editor!		Qk Cancel	
-			•

8. Defining input/output data for jobs File type Input: required by the job Output: produced by the job File location: local: my desktop remote: grid storage resource File name: Unique name of the file File storage type: Permanent: final result of WF Volatile: only used for inter-job data transfer



9.	Executing	workflows	with the	P-Grade	portal Downlo	ad
pr	oxies					

File Edit Ven Favorites	
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	- <b>GRADE</b> portal
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e 1	Certificate Mana
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There is no downloa	aded certificate.
Download Commission	d certificate from MyProxy server.) Uploa
Message: [Press a	a button.]
	August 24, 2005
B)	

10. Downloading a proxy

Certificate Manager       Download from MyProxy server       hostname     [vvs.lpds.sztaki.hu     * port     7512       login     [C123455     password     *       Ilfetime (hours)     100     * description     *       *: Cannot be left empty.	
Download from MyProxy server         hostname       cvs.lpds.sztaki.hu       * port       7512         login       *       password       *         lifetime (hours)       100       * description       *         *: Cannot be left empty.       Download       Cancel       Cancel	
Ifetime (hours)     100     * description     *       *: Cannot be left empty.     Download Cancel     Cancel	-
lifetime (hours)	
*: Cannot be left empty.	
Cancel	
Message: Fill in the fields for download!	
August 24, 2005	

11. Associating the proxy with a grid GridSphere Portal - Microsoft Internet Explorer File Edit View Favorites Tools Help 🔇 Back - 🞲 - 💌 🖹 🏠 🔎 Search 👷 Favoration 🥑 🔝 - 😓 💬 🤐 Address 😰 http://higtorial.hpci.ictali.hu/2010/gridiphere/gridiphere/od-700gr.juode-verviligi.gitate-rormaligij.jutor-dolic/higt/hoxy RELEASE 2.2 -srade portal e Workflow Centricates Settings Information System Help web Certificate Manager 1 1 Setting certificate for GRID Certificate details Downloaded from: cvs.lpds.sztaki.hu Issued by: C=HU,O=KFKI RMKI CA,OU=SZTAKI, CN=Hermann Gabor, CN=proxy C=HU,O=KFKI RMKI CA,OU=SZTAKI, CN=Hermann Gabor, CN=proxy, CN Subject: Timeleft: 99:56:12 Proxy type: full legacy globus proxy Strength [bits]: 512 Description: Select GRID

HUNGRID

SZTAKI-GRID UK-NGS

HUNGRD_LCG_2_BROKER SEE-GRID OK.

August 24, 2005

Cancel

Select from the list:

Dune (

Message: Map proxy for an

# 12. Browsing Proxies

PGrade Portal - Nicrosoft Internet Explorer					66		
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workflow Centricates Settings Information System Help							
* 7	Certificate	Manager			20		
	Certifica	te list			1		
Issuer	Set for Grids	Time left	ft [Actions]				
DC=ORG,DC=SEE- GRID,O=People,O=SZTAKI,CN=Jozsef Patvarczki,CN=proxy	SEE- GRID	99:50:24	Details	Set for Grid	Delete		
C=HU,O=KFKI RMKI CA,OU=SZTAKI,CN=Patvarczky Jozsef,CN=proxy	HUNGRID	99:57:25	Details	Set for Grid	Delete		
	efre	sb					
Download (Dowload certificate from MProxy serv	ver.)	Upload (	Upload authen	tication data to MyPn	oxy server.)		
Message: Certificate successfully et for HUNG	RID						
	- 11				8		
Kész				•	rternet		

#### 13. Workflow execution Workflow portlet

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Workflow Editor Refre	sh ]							
			Workflow list					
Workflow	Status	Size	Quota (10 Mb) [	Output ]	[View]	[	Action ]	
/F1	init	26 KB	0.26%	N/A	Details	Submit	Attach	Delate
		26 KB						
								Delete all

14. Observation by the workflow portlet

INIT     SEE-GRID     ce01.grid.acad.bg     Init     -       LM_P     SEE-GRID     n40.hpcc.sztaki.hu     Init     -       LM_S.2     SEE-GRID     n40.hpcc.sztaki.hu     Init     -       LM_S.3     SEE-GRID     n40.hpcc.sztaki.hu     Init     -       LM_S.3     SEE-GRID     n40.hpcc.sztaki.hu     Init     -       LM_S.3     SEE-GRID     n40.hpcc.sztaki.hu     Init     -       LM_S.4     SEE-GRID     n41.netmode.ece.ntua.gr     Init     -       LM_S.5     SEE-GRID     grid1.netmode.ece.ntua.gr     Init     -       LM_S.4     SEE-GRID     grid1.netmode.ece.ntua.gr     Init     -       LM_S.5     SEE-GRID     grid1.netmode.ece.ntua.gr     Init     -       LM_S.4     SEE-GRID     grid1.netmode.ece.ntua.gr     Init     -       LM_S.5     SEE-GRID     grid1.netmode.ece.ntua.gr     Init     -       Seeneet	and the second se											
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INIT     SEE-GRID     cell.grid.acad.bg     Init     -       UM_P     SEE-GRID     n40.hpcc.staki.hu     Init     -       UM_S     SEE-GRID     grid.ce.i.edu.mk     Init     -       UM_S     SEE-GRID     grid.ce.i.edu.mk     Init     -       UM_SS     SEE-GRID     grid.inb.hr     Init     -       UM_SS     SEE-GRID     grid.op.khi.hu     Init     -       Imp     HMNRRID     grid.op.khi.hu     Init     -       See     See     See     See     See       Vorkflow     details     Successfully displayed.	Workflow	Job	Gridname	Hostname	Status	[Logs]	[Output]	[ Visualizati	on]			
LM_P     SEE-GRID     n40,hpcc.sztaki.hu     Init        LM_PZ     SEE-GRID     n40,hpcc.sztaki.hu     Init        LM_S     SEE-GRID     grid:re.i.edu.mk     Init        LM_S     SEE-GRID     grid:rb.hr     Init        LM_S-3     SEE-GRID     grid:rb.hr     Init        LM_S-4     SEE-GRID     grid:rb.hr     Init        LM_S-5     SEE-GRID     grid:rb.hr     Init        LM_S-6     SEE-GRID     grid:rb.hr     Init        LM_S-6     SEE-GRID     grid:rb.hr     Init        LM_S-6     HMNRID     grid:rb.hr     Init        LM_S-6     HMNRID     grid:rb.hr     Init        TIPF     HMNRID     grid:rb.hr     Init        TIPF     HMNRID     grid:rb.rb.hr     Init        Sectors     grid:rb.rb.hr     Init         Sectors     grid:rb.rb.hr     Init         Sectors     Sectors     Sectors     Sectors     Sectors	1_9_DEMO_TOTAL			153 157 15015	submitted		N/A	Visualize	A11	Abo		
LM_P.2       SEE-GRID       n40.hpcc.sztaki.hu       Init           LM_S       SEE-GRID       gnd.res.ii.edu.mk       Init           LM_S.3       SEE-GRID       gnd.ii.b.hr       Init           LM_S.4       SEE-GRID       gnd.ii.b.hr       Init           LM_S.5       SEE-GRID       gnd.ii.b.hr       Init           LM_S.5       SEE-GRID       gnd.ii.b.m       Init           LM_S.5       SEE-GRID       gnd.ii.b.m       Init           LM_S.5       SEE-GRID       gnd.ii.b.m       Init           LM_S.6       SEE-GRID       gnd.ii.b.m       Init           LM_S.6       SEE-GRID       gnd.ii.b.m       Init           LM_S.6       SEE-GRID       gnd.ii.b.m       Init            See       Image:       See       Image:		INIT	SEE-GRID	ce01.grid.acad.bg	Init	1000		2.#3				
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#### 15. Downloading the results

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#### **APPLICATIONS:**

Using the portal to access the grid resources and jobs.

#### **RESULT:**

Thus the development of a Grid portal, where user can submit a job and get the result and to implement it with and without GRAM is executed successfully.

# **CLOUD COMPUTING LAB**

#### **Open nebula sandbox:**

- 1. Open Virtual box
- 2. File  $\rightarrow$  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
- 6. Login using username: root, password:opennebula

ile Machine Help			
Preferences	Ctrl+G		🚱 Details 🔟 Snapshot
Import Appliance	Ctrl+I		😳 Details 💿 Snapshot
Export Appliance	Ctrl+E	General	Preview
Virtual Media Manager       Network Operations Manager       Check for Updates	Ctrl+D	Name: ubuntu_1 Operating System: Ubuntu (64-bit)	
<u>R</u> eset All Warnings		Base Memory: 2048 MB Boot Order: Floppy, Opical, Hard Disk Acceleration: VT-X/APO-V, Nested Paging	ubuntu_1
7 Egit	Ctrl+Q	Checce addition of the April of Spring	
		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: NewVirbuBDisk2.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	
port an appliance into VirtualBox		N	

0	Please choose a virtual appliance file to import		
Import Virtual Appliance	🚱 🗢 🖿 Desktop 🕨 👻 🐓	Search Desktop	etails 💿 Snapshots
Appliance to import	Organize 🔻 New folder	÷ - 1 0	
VirtualBox currently supports importing appliances saved in the Open Virtualization For (OVF). To continue, select the file to import below.	Image: Desktop       Network         Image: Desktop       Network         Image: Desktop       System Folder         Image: Desktop       grid and cloud au         Image: Desktop       File folder         Image: Desktop       Nusic         Image: Desktop       Image: Desktop         Image: Desktop	^	tu_1
	Audio lost Driver: Windows DirectSound ontroller: LCH AG97		
	P Network		
	dapter 1: Intel PRO/1000 MT Desktop (NAT)		
	ŷ USB		
	ISB Controller: OHCI vevice Filters: 0 (0 active)		
	Shared folders		
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# EX.NO.1Find procedure to run the virtual machine of different configuration.DATE:<br/>OBJECTIVE:Check how many virtual machines can be utilized at particular time.

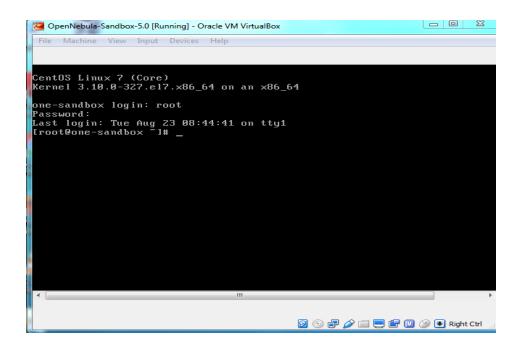
To run the virtual machine of different configuration. Check how manyvirtual machines can be utilized at particular time.

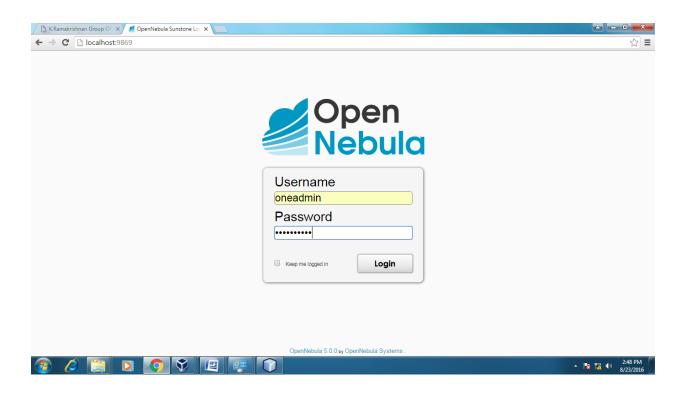
#### **PROCEDURE:**

#### Steps

- 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.

OpenNebula-Sandbox-5.0 [Running] - Oracle VM VirtualBox	
File Machine View Input Devices Help	
CentOS Linux 7 (Core) Kernel 3.10.0-327.el7.x86_64 on an x86_64	
one-sandbox login: _	
۲ III	





C 🖸	ocalhost:9869		Q 🖣 🕁
	Open Nebula	Create Virtual Machine       Generadmin       OpenNebula	
	Dashboard	←≡ Reset Create	
	Instances 🔺		
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	🚓 Services		
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	Templates	0 oneadmin oneadmin tty/inux 15:16:50 15/06/2016	
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#### **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. Check how many virtual machines can be utilized at particular time is successfully executed.

# EX.NO.2Find procedure to attach virtual block to the virtual machine and checkDATE:whether it holds the data even after the release of the virtual machine.

#### **OBJECTIVE:**

To attach virtual block to the virtual machine and check whether it holds the data even after the release of the virtual machine.

#### **PROCEDURE:**

#### Steps:

#### Method 1:

- 1. Open the virtual box
- 2. Power off the VM which you want to add virtual box
- 3. Then right click on that VM, select setting
- 4. Then click on storage, find controller IDE .
- 5. In the top right find add hard disk icon, the pop up window display
- 6. On that window select create new disk, and then click next and next then finish.
- 7. Then find attributes icon ,hard disk as IDE secondary slave.

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		-	Controller: SATA 🛛 Use Host I/O Cache			
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	P	Network	Controller: SCSI			
		Serial Ports	NewVirtualDisk2.vdi			ľ
	Ø	USB				
		Shared Folders				
	=	User Interface				
			Invalid settings detected 🔀 🕅 OK	Cance	ł	

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		System	Storage Tree	Attributes	
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		Audio	Controller: SATA	Type (Format): Virtual Size:	
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		Serial Ports	Controller: SCSI		Dynamically allocated storage
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			Invalid settings detected 🛛 🕅		OK Cancel

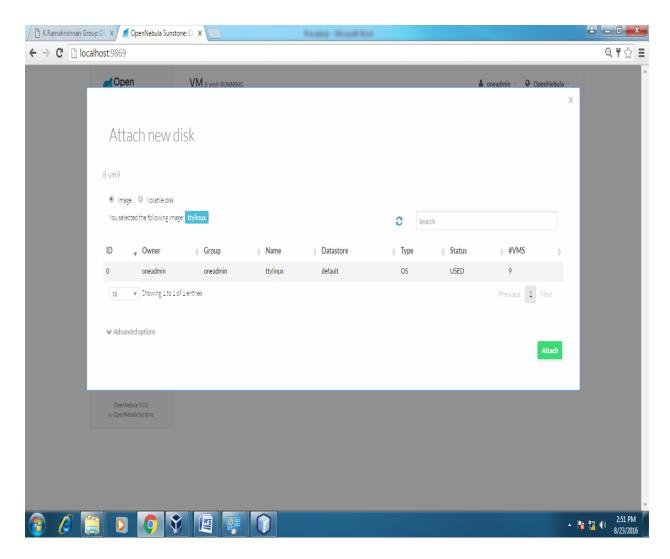
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Documents	💗 NewVirtualDisk6	8/23/2016 2:55 PM	Virtual Disk Image	2,048 KB				
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9 items								

#### Method 2:

- 1. Open Browser, type localhost:9869
- 2. Login using username: oneadmin, password: opennebula
- 3. Click on instances, select VMs then follow the steps to add virtual block
  - a. Select any one VM from the list and power off the VM
  - b. Then click on that VM ,find the storage tab then click on that
  - c. Then find the attach disk button
  - d. Click on that button ,the new pop window display
  - e. On that window select either image or volatile disk
  - f. Click on attach button.

Open Nebula	VM 8 vm9 RUNNING Copent	√ebula ⊤
Dashboard		
WMs Services	no Capacity Storage Network Snapshots Placement Actions Conf Template Log	
C Virtual Routers	ID 🔺 Target 🝦 Image / Size-Format Size 🖕 Persistent Actions Attaché	isk
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Storage	1 hdb Context -/- NO	
Network	10 v Showing 1to 2 of 2 entries Previous 1 N	
Infrastructure	· · · · · · · · · · · · · · · · · · ·	
System	Cost / MByte 0	
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Support Not connected		
Sign in		
Upgrade Available 🕕		
OpenNebula 5.0.0 by OpenNebula Systems.		





#### **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 attach virtual block to the virtual machine and check whether it holds the data even after the release of the virtual machine is successfully executed.

# EX.NO.3Install a C compiler in the virtual machine and execute a sample program.DATE:(Working on ubuntu-gt6)

#### **OBJECTIVE:**

Install a C compiler in the virtual machine and execute a sample program.

#### **PROCEDURE:**

#### Steps:

- **1.** Install the virtual box on windows platform.
- **2.** Now Run a virtual box and create new virtual machine by selecting New and give the virtual machine name then choose Ubuntu16.04.ISO file.
- **3.** Now start the virtual machine Ubuntu16.04 then open a Terminal by press Ctrl+Alt+t
- 4. To Install Gcc Or G++ Compiler, Type the following command in the terminal

#### sudo apt-get install build-essential

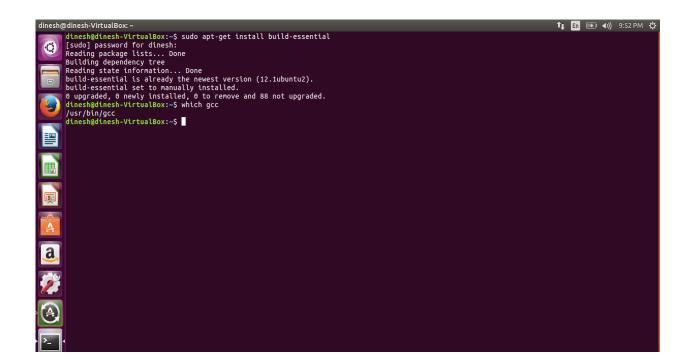
5. heck the information about your compiler that where it is installed, type the following command in the terminal

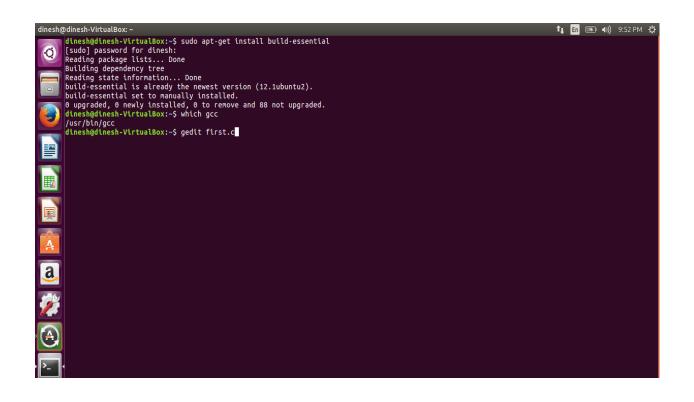
#### whichgccorwhereisgcc

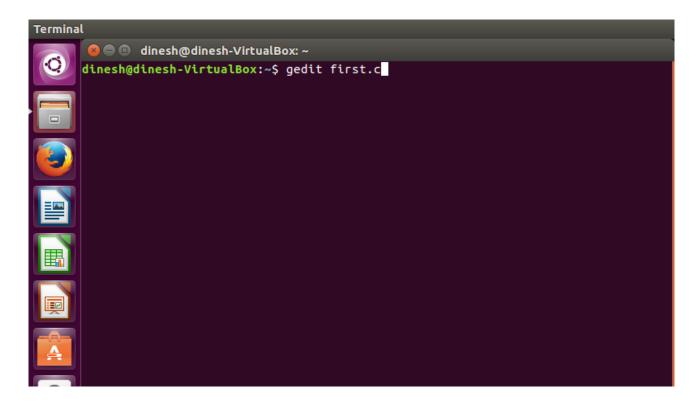
- 6. Then open the terminal and type gedithello.c
- 7. Type the C program and to Run the program type the following command in terminal

gcchello.c

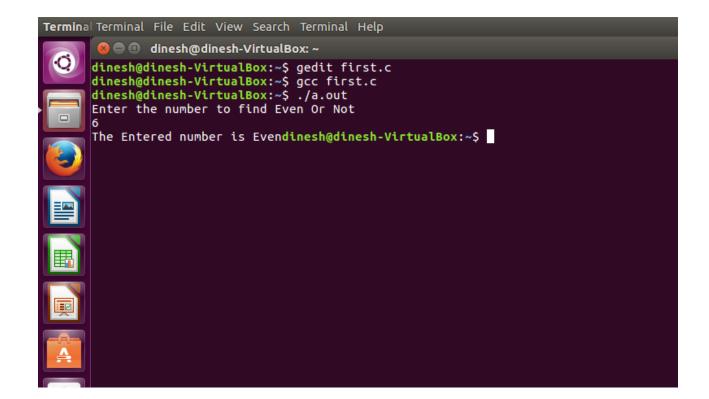
./a.out







)-gedit Open - Fl finclude <stdio.h> roid main()</stdio.h>		t,	En 📧 🕪)		M ∯ Save
nt a; printf("Enter the number to find Even Or Not"); ;canf("%d",&a); .f(a%2==0) printf("The Entered number is Even"); ise					
printf("The Entered number is Odd");					
Loading file '/home/dinesh/first.c'	C 🕶	Tab Width: 8 🔻	Ln 5, Col 1	•	INS



#### **APPLICATIONS:**

Easily run the C programs in virtual machine.

#### **RESULT:**

Thus the procedure to Install a C compiler in the virtual machine and execute a sample program is successfully executed.

# EX.NO.4Show the virtual machine migration based on the certain conditionDATE:from one node to the other.

#### **OBJECTIVE:**

To how the virtual machine migration based on the certain condition from one node to the other.

#### **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**

🗋 localhost:9869							
Open Nebula	Host 1 naveenkumar					🛔 oneadmin 👻	OpenNebula
Dashboard	<b>←</b> ■ <i>C</i> Sele	ct cluster Enable	Disable Offline	<b>∞</b> - <b>≅</b>			
Instances							
VMs	Info Graphs	VMs Wilds	<b>≇</b> Zombies				
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Templates	ID 🗸 Owner	Group	Name	Status	Host	♦ IPs	\$
Network	5 oneadmin	oneadmin	vm2	FAILURE	naveenkumar	172.16.100.205	
	4 oneadmin	oneadmin	vm2	FAILURE	naveenkumar	172.16.100.204	
Infrastructure A	3 oneadmin	oneadmin	vm1	FAILURE	naveenkumar	172.16.100.203	
Hosts	2 oneadmin	oneadmin	naveen	FAILURE	naveenkumar	172.16.100.202	
Zones	1 oneadmin	oneadmin	naveen	FAILURE	naveenkumar	172.16.100.201	
System	0 oneadmin	oneadmin	ttylinux-0	FAILURE	naveenkumar	172.16.100.200	
System v Settings	10 V Showing 1	to 6 of 6 entries				Previous	a Next
Support							
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### Host:one-sandbox

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Storage	7 oneadmin	oneadmin		RUNNING	one-sandbox	172.16.100.207	
Network	6 oneadmin	oneadmin		RUNNING	one-sandbox	172.16.100.206	
nfrastructure 🔺			VINO	KOMMING	one-sandbox		
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#### CS6712 - GRID AND CLOUD COMPUTING LABORATORY

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#### Host:SACET

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#### **APPLICATIONS:**

Easily migrate your virtual machine from one pc to another.

### **RESULT:**

Thus the procedure to Show the virtual machine migration based on the certain condition from one node to the other is successfully executed.

#### EX.NO.5 Find procedure to install storage controller and interact with it`

### DATE: (Working on ubuntu-gt6)

#### **OBJECTIVE:**

To Find procedure to install storage controller and interact with it.

#### **PROCEDURE:**

#### Steps:

- 1. After login plug-in the USB drive
- 2. Right Click on the USB icon at bottom right corner(4th Icon)
- 3. Select your device name like jetflash, sandisketc
- 4. Explorer window open.
- 5. Then do read, write operations on the USB.

#### **APPLICATIONS:**

Attach your memory controller like pendrive,cd,dvd and etc,. to virtual machine.

#### **RESULT:**

Thus the procedure to to install storage controller and interact with it is successfully executed.

#### EX.NO.6 Find procedure to set up the one node hadoop cluster.

#### DATE:

#### **OBJECTIVE:**

Set up the one node Hadoop cluster.

#### **PROCEDURE:**

#### 1) Installing Java

Hadoop is a framework written in Java for running applications on large clusters of commodity

hardware. Hadoop needs Java 6 or above to work.

#### **Step 1: Download tar and extract**

Download Jdk tar.gz file for linux-64 bit, extract it into "/usr/local"

# cd /opt

# sudo tar xvpzf /home/itadmin/Downloads/jdk-8u5-linux-x64.tar.gz

# cd /opt/jdk1.8.0_05

#### **Step 2: Set Environments**

- Open the "/etc/profile" file and Add the following line as per the version
- Set a environment for Java
- $\bullet \Box$  Use the root user to save the /etc/proflie or use gedit instead of vi .
- The 'profile' file contains commands that ought to be run for login shells

# sudo vi /etc/profile

#--insert JAVA_HOME

JAVA_HOME=/opt/jdk1.8.0_05

#--in PATH variable just append at the end of the line

#### PATH=\$PATH:\$JAVA_HOME/bin

#--Append JAVA_HOME at end of the export statement

#### export PATH JAVA_HOME

save the file using by pressing "Esc" key followed by :wq!

#### Step 3: Source the /etc/profile

# source /etc/profile

#### Step 4: Update the java alternatives

1. By default OS will have a open jdk. Check by "java -version". You will be prompt "openJDK"

2. If you also have openjdk installed then you'll need to update the java alternatives:

3. If your system has more than one version of Java, configure which one your system

causes by entering the following command in a terminal window

4. By default OS will have a open jdk. Check by "java -version". You will be prompt

```
"JavaHotSpot(TM) 64-Bit Server"
```

# update-alternatives --install "/usr/bin/java" java "/opt/jdk1.8.0_05/bin/java" 1

# update-alternatives --config java

--type selection number:

# java -version

#### 2) configuressh

•Hadoop requires SSH access to manage its nodes, i.e. remote machines plus your localmachine if you want to use Hadoop on it (which is what we want to do in this exercise).For our single-node setup of Hadoop, we therefore need to configure SSH access to localhostThe need to create a Password-less SSH Key generation based authentication is so thatthe master node can then login to slave nodes (and the secondary node) to start/stopthem easily without any delays for authentication

•If you skip this step, then have to provide passwordGenerate an SSH key for the user. Then Enable password-less SSH access to you **sudo apt-get install openssh-server** 

--You will be asked to enter password,

root@abc []#sshlocalhost

root@abc[]# ssh-keygen

root@abc[]# ssh-copy-id -i localhost

--After above 2 steps, You will be connected without password,

root@abc[]# sshlocalhost

root@abc[]# exit

#### 3) Hadoop installation

•Now Download Hadoop from the official Apache, preferably a stable release version of Hadoop 2.7.x and extract the contents of the Hadoop package to a location of yourchoice.

•For example, choose location as "/opt/"

Step 1: Download the tar.gz file of latest version Hadoop ( hadoop-2.7.x) from the official site .

Step 2: Extract (untar) the downloaded file from this commands to /opt/bigdata

root@abc[]# cd /opt

root@abc[/opt]# sudo tar xvpzf /home/itadmin/Downloads/hadoop-2.7.0.tar.gz

root@abc[/opt]# cd hadoop-2.7.0/

Like java, update Hadop environment variable in /etc/profile

# sudo vi /etc/profile

#--insert HADOOP_PREFIX

HADOOP_PREFIX=/opt/hadoop-2.7.0

#--in PATH variable just append at the end of the line

PATH=\$PATH:\$HADOOP_PREFIX/bin

#--Append HADOOP_PREFIX at end of the export statement

export PATH JAVA_HOME HADOOP_PREFIX

save the file using by pressing "Esc" key followed by :wq!

Step 3: Source the /etc/profile

# source /etc/profile

#### Verify Hadoop installation

#### # cd \$HADOOP_PREFIX

#### # bin/hadoop version

#### 3.1) Modify the Hadoop Configuration Files

• In this section, we will configure the directory where Hadoop will store its configuration files, the network ports it listens to, etc. Our setup will use Hadoop Distributed File System,(HDFS), even though we are using only a single local machine. • Add the following properties in the various hadoop configuration files which is available under \$HADOOP_PREFIX/etc/hadoop/ • core-site.xml, hdfs-site.xml, mapred-site.xml & yarn-site.xml Update Java, hadoop path to the Hadoop environment file # cd \$HADOOP_PREFIX/etc/hadoop # vi hadoop-env.sh Paste following line at beginning of the file export JAVA_HOME=/usr/local/jdk1.8.0_05 export HADOOP_PREFIX=/opt/hadoop-2.7.0 Modify the core-site.xml # cd \$HADOOP_PREFIX/etc/hadoop # vi core-site.xml Paste following between <configuration> tags <configuration> <property> <name>fs.defaultFS</name> <value>hdfs://localhost:9000</value> </property> </configuration>

Modify the hdfs-site.xml # vi hdfs-site.xml Paste following between <configuration> tags <configuration> <property> <name>dfs.replication</name> <value>1</value> </property> </configuration> YARN configuration - Single Node modify the mapred-site.xml # cpmapred-site.xml.template mapred-site.xml # vi mapred-site.xml Paste following between <configuration> tags <configuration> <property> <name>mapreduce.framework.name</name> <value>yarn</value> </property> </configuration> Modiy yarn-site.xml # vi yarn-site.xml Paste following between <configuration> tags <configuration> <property> <name>yarn.nodemanager.aux-services</name> <value>mapreduce_shuffle</value>

</property>

</configuration>

Formatting the HDFS file-system via the NameNode

• The first step to starting up your Hadoop installation is formatting the Hadoop files system which is implemented on top of the local file system of our "cluster" which includes only our local machine. We need to do this the first time you set up a Hadoop cluster.

• Do not format a running Hadoop file system as you will lose all the data currently in the cluster (in HDFS)

root@abc[]# cd \$HADOOP_PREFIX

root@abc[]# bin/hadoopnamenode -format

Start NameNode daemon and DataNode daemon: (port 50070)

root@abc[]# sbin/start-dfs.sh

To know the running daemons jut type jps or /usr/local/jdk1.8.0_05/bin/jps

Start ResourceManager daemon and NodeManager daemon: (port 8088)

root@abc[]# sbin/start-yarn.sh

To stop the running process

root@abc[]# sbin/stop-dfs.sh

To know the running daemons jut type jps or /usr/local/jdk1.8.0_05/bin/jps

Start ResourceManager daemon and NodeManager daemon: (port 8088)

root@abc[]# sbin/stop-yarn.sh

Make the HDFS directories required to execute MapReduce jobs:

\$ bin/hdfsdfs -mkdir /user

\$ bin/hdfsdfs -mkdir /user/mit

• Copy the input files into the distributed filesystem:

\$ bin/hdfsdfs -put <input-path>/* /input

•  $\Box$  Run some of the examples provided:

\$ bin/hadoop jar share/hadoop/mapreduce/hadoop-mapreduce-examples-2.5.1.jar

grep /input /output '(CSE)'

• Examine the output files:

Copy the output files from the distributed filesystem to the local filesystem and examine them:

\$ bin/hdfsdfs -get output output

\$ cat output/* or

• View the output files on the distributed filesystem:

\$ bin/hdfsdfs -cat /output/*

#### **Applications:**

- Who use Hadoop?
  - Amazon/A9
  - AOL
  - Facebook
  - Fox interactive media
  - Google
  - IBM
  - New York Times
  - PowerSet (now Microsoft)
  - Quantcast
  - Rackspace/Mailtrust
  - Veoh
  - Yahoo!

#### **RESULT:**

Thus setting up of one node Hadoop cluster is successfully executed

# EX.NO.7.

# Mount the one node hadoop cluster using fuse.

# DATE:

# **OBJECTIVE:**

To mount the one node Hadoop cluster using FUSE

# **PROCEDURE:**

Hadoop Distributed File System (HDFS) is a distributed, scalable file system developed as the

back-end storage for data-intensive Hadoop applications. As such, HDFS is designed to handle

very large files with "write-once-read-many" access model. As HDFS is not a full-fledged POSIX

compliant file system, it cannot be directly mounted by the operating system, and file access

with HDFS is done via HDFS shell commands.

However, one can leverage FUSE to write a userland application that exposes HDFS via a traditional file system interface. fuse-dfs is one such FUSE-based application which allows you to mount HDFS as if it were a traditional Linux file system. If you would like to mount HDFS on

Linux, you can install fuse-dfs, along with FUSE as follows.

Now, install fuse-dfs and all necessary dependencies as follows.

To install fuse-dfs on Ubuntu 12.04 and higher:

\$ wget http://archive.cloudera.com/one-click-install/maverick/cdh3-repository_1.0_all.deb

\$ sudodpkg -i cdh3-repository_1.0_all.deb

\$ sudo apt-get update

\$ sudo apt-get install hadoop-0.20-fuse

Once fuse-dfs is installed, go ahead and mount HDFS using FUSE as follows.

\$ sudohadoop-fuse-dfs dfs://<name_node_hostname>:<namenode_port><mount_point> Once HDFS has been mounted at <mount_point>, you can use most of the traditional filesystem operations (e.g., cp, rm, cat, mv, mkdir, rmdir, more, scp). However, random write operations such as rsync, and permission related operations such as chmod, chown are not supported in

# **APPLICATIONS:**

- Who use Hadoop?
  - Amazon/A9
  - AOL
  - Facebook
  - Fox interactive media
  - Google
  - IBM
  - New York Times
  - PowerSet (now Microsoft)
  - Quantcast
  - Rackspace/Mailtrust
  - Veoh
  - Yahoo!

# **RESULT:**

Thus mounting the one node Hadoop cluster using FUSE is successfully executed.

## EX.NO.8 Write a program to use the API's of hadoop to interact with it.

DATE:

## **OBJECTIVE:**

Program to use Hadoop's File system API'

## **PROCEDURE:**

Reading data from and writing data to Hadoop Distributed File System (HDFS) can be done in a lot of ways. Now let us start by using the FileSystem API to create and write to a file in HDFS, followed by an application to read a file from HDFS and write it back to the local file system.

Step 1: Once you have downloaded a test dataset, we can write an application to read a file from the local file system and write the contents to Hadoop Distributed File System. packagecom.hadoop.hdfs.writer; importorg.apache.hadoop.conf.Configured; importorg.apache.hadoop.util.Tool; importjava.io.BufferedInputStream; importjava.io.FileInputStream; importjava.io.InputStream; importjava.io.OutputStream; importorg.apache.hadoop.conf.Configuration; importorg.apache.hadoop.fs.FileSystem; importorg.apache.hadoop.fs.Path; importorg.apache.hadoop.io.IOUtils; importorg.apache.hadoop.util.ToolRunner; public class HdfsWriter extends Configured implements Tool { public static final String FS_PARAM_NAME = "fs.defaultFS";

```
publicint run(String[] args) throws Exception {
```

if (args.length< 2) {

System.err.println("HdfsWriter [local input path] [hdfs output path]");

return 1;

}

```
String localInputPath = args[0];
```

```
Path outputPath = new Path(args[1]);
```

Configuration conf = getConf();

```
System.out.println("configured filesystem = " + conf.get(FS_PARAM_NAME));
```

FileSystemfs = FileSystem.get(conf);

```
if (fs.exists(outputPath)) {
```

```
System.err.println("output path exists");
```

return 1;

}

```
OutputStreamos = fs.create(outputPath);
```

```
InputStream is = new BufferedInputStream(new FileInputStream(localInputPath));
```

```
IOUtils.copyBytes(is, os, conf);
```

return 0;

```
}
```

```
public static void main( String[] args ) throws Exception {
```

```
intreturnCode = ToolRunner.run(new HdfsWriter(), args);
```

```
System.exit(returnCode);
```

}

Step 2: Export the Jar file and run the code from terminal to write a sample file to HDFS.

[training@localhost ~]\$ hadoop jar HdfsWriter.jar com.hadoop.hdfs.writer.HdfsWriter

sample.txt /user/training/HdfsWriter_sample.txt Step 3: Verify whether the file is written into HDFS and check the contents of the file. [training@localhost ~]\$ hadoopfs -cat /user/training/HdfsWriter_sample.txt Step 4: Next, we write an application to read the file we just created in Hadoop Distributed File System and write its contents back to the local file system. packagecom.hadoop.hdfs.reader; importjava.io.BufferedOutputStream; importjava.io.FileOutputStream; importjava.io.InputStream; importjava.io.OutputStream; importorg.apache.hadoop.conf.Configuration; importorg.apache.hadoop.conf.Configured; importorg.apache.hadoop.fs.FileSystem; importorg.apache.hadoop.fs.Path; importorg.apache.hadoop.io.IOUtils; importorg.apache.hadoop.util.Tool; importorg.apache.hadoop.util.ToolRunner; public class HdfsReader extends Configured implements Tool {

public static final String FS_PARAM_NAME = "fs.defaultFS";

publicint run(String[] args) throws Exception {

if (args.length< 2) {

System.err.println("HdfsReader [hdfs input path] [local output path]"); return 1;

}

Path inputPath = new Path(args[0]);

String localOutputPath = args[1];

Configuration conf = getConf();

System.out.println("configured filesystem = " + conf.get(FS_PARAM_NAME));

FileSystemfs = FileSystem.get(conf);

InputStream is = fs.open(inputPath);

OutputStream(new FileOutputStream(localOutputPath));

```
IOUtils.copyBytes(is, os, conf);
```

return 0;

```
}
```

public static void main( String[] args ) throws Exception {

intreturnCode = ToolRunner.run(new HdfsReader(), args);

```
System.exit(returnCode);
```

```
}
```

```
}
```

Step 5: Export the Jar file and run the code from terminal to write a sample file to HDFS. [training@localhost ~]\$ hadoop jar HdfsReader.jar com.hadoop.hdfs.reader.HdfsReader /user/training/HdfsWriter_sample.txt /home/training/HdfsReader_sample.txt Step 6: Verify whether the file is written back into local file system. [training@localhost ~]\$ hadoopfs -cat /user/training/HdfsWriter_sample.txt FileSystem is an abstract class that represents a generic file system. Most Hadoop file system implementations can be accessed and updated through the FileSystem object. To create an instance of the HDFS, you call the method FileSystem.get(). The FileSystem.get() method will look at the URI assigned to the fs.defaultFS parameter of the Hadoop configuration files on your classpath and choose the correct implementation of the FileSystem class to instantiate. Thefs.defaultFS parameter of HDFS has the value hdfs://.

Once an instance of the FileSystem class has been created, the HdfsWriter class calls

the create() method to create a file in HDFS. The create() method return

anOutputStream object, which can be manipulated using normal Java I/O methods.

Similarly HdfsReader calls the method open() to open a file in HDFS, which returns

anInputStream object that can be used to read the contents of the file.

The FileSystem API is extensive. To demonstrate some of the other methods available in the API,

we can add some error checking to the HdfsWriter and HdfsReader classes we created.

To check whether the file exists before we call create(), use:

boolean exists = fs.exists(inputPath);

To check whether the path is a file, use:

booleanisFile = fs.isFile(inputPath);

To rename a file that already exits, use:

boolean renamed = fs.rename(inputPath, new Path("old_file.txt"));

#### **APPLICATIONS:**

- Who use Hadoop?
  - Amazon/A9
  - AOL
  - Facebook
  - Fox interactive media
  - Google
  - IBM
  - New York Times
  - PowerSet (now Microsoft)
  - Quantcast
  - Rackspace/Mailtrust
  - Veoh
  - Yahoo!

#### **RESULT:**

Thus the program to use the Hadoop File System API to interact with it is successfully

executed.

# EX.NO.9 Write A Wordcount Program To Demonstrate The Use Of Map And

# DATE: ReduceTasks

# **OBJECTIVE:**

Word count program to demonstrate the use of Map and Reduce tasks

# **PROCEDURE:**

## **STEPS:**

- 1. Analyze the input file content
- 2. Develop the code
- a. Writing a map function
- b. Writing a reduce function
- c. Writing the Driver class
- 3. Compiling the source
- 4. Building the JAR file
- 5. Starting the DFS
- 6. Creating Input path in HDFS and moving the data into Input path
- 7. Executing the program

## Sample Program:

importjava.io.IOException; importjava.util.StringTokenizer; importorg.apache.hadoop.conf.Configuration; importorg.apache.hadoop.fs.Path; importorg.apache.hadoop.io.IntWritable; importorg.apache.hadoop.io.Text; importorg.apache.hadoop.mapreduce.Job; importorg.apache.hadoop.mapreduce.Mapper; importorg.apache.hadoop.mapreduce.Reducer; importorg.apache.hadoop.mapreduce.lib.input.FileInputFormat; importorg.apache.hadoop.mapreduce.lib.output.FileOutputFormat; importorg.apache.hadoop.util.GenericOptionsParser; public class WordCount { //Step a public static class TokenizerMapper extends Mapper < Object, Text, Text, IntWritable> { //hadoop supported data types private final static IntWritable one = new IntWritable(1); private Text word = new Text(); //map method that performs the tokenizer job and framing the initial key value pairs public void map( Object key, Text value, Context context) throws IOException, InterruptedException

{

//taking one line at a time and tokenizing the same

```
StringTokenizeritr = new StringTokenizer (value.toString());
//iterating through all the words available in that line and forming the key value pair
while (itr.hasMoreTokens())
{
word.set(itr.nextToken());
//sending to the context which inturn passes the same to reducer
context.write(word, one);
}
}
}
//Step b
public static class IntSumReducer extends Reducer < Text, IntWritable, Text, IntWritable>
{
privateIntWritable result = new IntWritable();
// Reduce method accepts the Key Value pairs from mappers, do the aggregation based on keys
// and produce the final output
public void reduce(Text key, Iterable<IntWritable> values, Context context) throws
IOException ,InterruptedException }
int sum = 0;
/*iterates through all the values available with a key and
add them together and give the final result as the key and sum of its values*/
for (IntWritableval: values)
```

```
{
sum += val.get();
}
```

```
result.set(sum);
context.write(key, result);
}
}
//Step c
public static void main( String [] args) throws Exception
{
//creating conf instance for Job Configuration
Configuration conf = new Configuration();
//Parsing the command line arguments
String [] otherArgs = new GenericOptionsParser(conf,args).getRemainingArgs();
if (otherArgs.length < 2)
{
System .err.println("Usage: wordcount<in>[<in>...]<out>" );
System .exit(2);
}
//Create a new Job creating a job object and assigning a job name for identification
//purposes
Job job = new Job(conf, "word count" );
job.setJarByClass(WordCount.class);
// Specify various job specific parameters
job.setMapperClass(TokenizerMapper.class);
job.setCombinerClass(IntSumReducer.class);
job.setReducerClass(IntSumReducer.class);
//Setting job object with the Data Type of output Key
job.setOutputKeyClass(Text.class);
```

```
//Setting job object with the Data Type of output value
job.setOutputValueClass(IntWritable.class);
//the hdfs input and output directory to be fetched from the command line
for (int i = 0; i < otherArgs.length 1; ++i)
{
FileInputFormat.addInputPath(job, new Path(otherArgs[i]));
}
FileOutputFormat.setOutputPath(job, new Path(otherArgs[otherArgs.length 1]));
System .exit(job.waitForCompletion( true ) ? 0 : 1);
}
}
Compiling the source:
bigdata@localhost:$ cd /home/bigdata/Downloads/mrcode/src
bigdata@localhost:/home/bigdata/Downloads/mrcode/src$ javacclasspath
../lib/hadoopcommon2.5.0.jar:../lib/hadoopmapreduceclientcore2.5.0.jar:../lib/commonscli1.2.j
ar d../build/ bigdata/WordCount.java
Building the JAR File:
bigdata@localhost:/home/bigdata/Downloads/mrcode/src$ cd ../build/
bigdata@localhost:/home/bigdata/Downloads/mrcode/build$ jar cvfwc.jar .
Starting the DFS (if not running already)
bigdata@localhost:/home/bigdata/Downloads/hadoop2.5.1$sbin/startdfs.sh
Creating Input path in HDFS and moving the data into Input path
bigdata@localhost:/home/bigdata/Downloads/hadoop2.5.1$bin/hadoopfsmkdir/mrin
bigdata@localhost:/home/bigdata/Downloads/hadoop2.5.1$bin/hadoopfs -copyFromLocal
/home/bigdata/Downloads/mrcode/mrsampledata/* hdfs://localhost:9000/mrin
```

Executing the program

bigdata@localhost:/home/bigdata/Downloads/hadoop2.5.1\$bin/hadoop jar

/home/bigdata/Downloads/mrcode/build/wc.jar bigdata.WordCount /mrin /mrout1

# **APPLICATIONS:**

Use this program to easily count the number of words in your program through map reduce techniques.

# **RESULT:**

Thus the Word count program to use Map and reduce tasks is demonstrated successfully.

# 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:

- $\checkmark$  Concurrency of components
- $\checkmark$  Lack of a global clock
- ✓ Independent failure of components
- ✓ What is cluster?
- ✓ A computing cluster consists of interconnected stand-alone computers which work cooperatively as a single integrated computing resource. In the past,

clustered computer systems have demonstrated

# 5.What is grid computing? (Apr 11)(Nov 10)

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)

- ✓ Grid technology demands new distributed computing models, software/middleware support, network protocols, and hardware infrastructures.
- ✓ National grid projects are followed by industrial grid plat-form development by IBM, Microsoft, Sun, HP, Dell, Cisco, EMC, Platform Computing, and others. New grid service providers (GSPs) and new grid applications have emerged rapidly, similar to the growth of Internet and web services in the past two decades.
- ✓ grid systems are classified in essentially two categories: computational or data grids and P2P grids.

Computing or data grids are built primarily at the national level

## 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
- $\checkmark$  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 selfmanagement

# 8.List some grid computing toolkits and frameworks?

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

# 9.What are Desktop Grids? (A)

# (Apr 11)

✓ 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.

**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.

**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.

**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.

**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."

**Apache Axis** (**Apache** eXtensible Interaction System) is an open-source, XML based Web service framework. It consists of a Java and a C++ implementation of the SOAP server, and various utilities and APIs for generating and deploying Web service applications.

# 11.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.

## 12.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.

## 13. 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.

# 14. What is a Community Cloud ?

A **community cloud** in <u>computing</u> 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

## **15.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.

## **16.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..

## **17.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.

## **18.What is meant by virtualization?**

Virtualization is a computer architecture technology by which multiple virtual machines (VMs) are multiplexed in the same hardware machine. The idea of VMs can be dated back to the 1960s. The purpose of a VM is to enhance resource sharing by many users and improve computer performance in terms of resource utilization and application flexibility.

## 19. What are the implementation levels of virtualization?

The virtualization types are following

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

# **20.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.

## **21.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.

#### 22.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

## 24.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.

## **25.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.

# **26.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

 $\checkmark$ 

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.

## **27.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.

#### **28.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 ApacheTM Hadoop[®].

#### 29.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.

#### **30.Definition of** *Grid Portal*:

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