CloudSim: A Toolkit for Modeling and Simulation of Cloud Computing Environments

Presented by: Dr. Faramarz Safi
Islamic Azad University, Najafabad Branch,
Esfahan, Iran.

and with special thanks to Mrs. Neda Maleki who prepared the main content of this presentation for the First National Workshop of Cloud Computing, Amirkabir University of Technology.
Outline

• Introduction
• Related Work
• CloudSim Architecture
• CloudSim Modelings
• Design and Implementation
• CloudSim Steps
• Conclusions and Future works
• Green Cloud
Introduction (1/2): Cloud

• Cloud computing delivers: XaaS

• X : {Software, Platform, Infrastructure}

✓ So users can access and deploy applications from anywhere in the Internet driven by demand and QoS requirements.
Introduction(2/2)

Why Simulation?

Cloud Provider Challenges:

• Maintain Quality of Service
• Efficient Resource Utilization
• Dynamic Workload
• Violation of Service Level Agreement
• Difficulties in Testing

It’s not possible to perform benchmarking experiments in repeatable, dispensible, and scalable environment using real-world Cloud.

Possible alternative: Simulation Tool
Related Works

Grid simulators:

- GridSim
- SimGrid
- OptoSim
- GangSim

But none of them are able to isolate the multi-layer service abstractions (SaaS/PaaS/IaaS), differentiation, and model the virtualized resources required by Cloud.

A holistic software framework for modeling Cloud computing environments and Performance testing application services.
CloudSim

Features & Advantages

❖ Features

• Discrete Time Event-Driven
• Support modeling and simulation of large scale Cloud computing environments, including data centers
• Support simulation of network connections among simulated elements

❖ Advantages

• Time effectiveness
• Flexibility and applicability
• Test policies in repeatable and controllable environment
• Tune system bottlenecks before deploying on real clouds
Layered CloudSim Architecture (1/7)
Modeling in Cloudsim (1/5)

- Modeling DataCenter
- Modeling VM Allocation
- Modeling Network Behavior
- Modeling Dynamic Workloads
- Modeling Power Consumption
**CloudSim Steps (1/2)**

(VMs, Apps)

Cloud Information Service (CIS) is registered all datacenters and their characteristics.

Users

broker

Query

Available Datacenters

Allocation

Cloud Datacenter A

Cloud Datacenter B

Cloud Datacenter C
**Allocation Policies: Enough Capacity, Ram, Storage, Bandwidth**

**Scheduling Policies: Sharing of Host mips between VMs**

- **Space Shared**
- **Time Shared**
Datacenter Modeling

- **Number of Hosts, VMs and Cloudlets (tasks)**
  - Host(mips, ram, storage, bandwidth)
  - Datacenter(arch, os, vmm, hostlist, cost mem/bw/storage)

- **VM**
  - MIPS, pesNumber(no. of cpu), Ram(MB), BW(MB/s)

- **Cloudlet**
  - Length (MI), pesNumber, input Size, output Size
Simulation Setup

- 1 datacenter
- 1 dual-core host, each core's mips: 1000
- 2 vm, mips: 1000
- 4 cloudlets, length: 1000mips
- core1 deal with two cloudlets (t1 and t2), and core2 deal with the other two cloudlets (t3 and t4)

<table>
<thead>
<tr>
<th>Cloudlet ID</th>
<th>STATUS</th>
<th>Datacenter ID</th>
<th>VM ID</th>
<th>Time</th>
<th>Start Time</th>
<th>Finish Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>SUCCESS</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>0.1</td>
<td>2.1</td>
</tr>
<tr>
<td>2</td>
<td>SUCCESS</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>0.1</td>
<td>2.1</td>
</tr>
<tr>
<td>1</td>
<td>SUCCESS</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>0.1</td>
<td>2.1</td>
</tr>
<tr>
<td>3</td>
<td>SUCCESS</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>0.1</td>
<td>2.1</td>
</tr>
</tbody>
</table>

*****Datacenter: Datacenter_0*****

<table>
<thead>
<tr>
<th>User id</th>
<th>Debt</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>2051.2</td>
</tr>
</tbody>
</table>
Network Modeling

- Latency Matrix

\[
\begin{bmatrix}
0 & 40 & 120 & 80 & 200 \\
40 & 0 & 60 & 100 & 100 \\
120 & 60 & 0 & 90 & 40 \\
80 & 100 & 90 & 0 & 70 \\
200 & 100 & 40 & 70 & 0
\end{bmatrix}
\]

Delay time from entity \( i \) to entity \( j \)
Dynamic Workload Modeling

- The Strategy is to Vary VM Utilization!

Delay = not all the time, CPU is utilized
Design and Implementation (1/2)

CloudSim Class Design Diagram
Design and Implementation (2/2)

Simulation Data Flow
DESIGN AND IMPLEMENTATION (3/4)

CLOUDSIM SEQUENCE DIAGRAM

1: info(Host)
2: info(VM)
3: info(application)
4: Host(...)
   success
   5: VM(...)
   success
   6: addVM(...)
   success
   7: Application
   success
8: addapp(...)
   success
9: run()
   Log
10: finished
11: shutdown
   success
12: shutdown
   success
13: complete
Conclusion

- Time effectiveness
- Flexibility and applicability
- Test services in repeatable and controllable environment
- Tune system bottlenecks before deploying on real clouds
- Experiment with different workload mix
References

