“Module 5: Activity 4”

Harsh Siddhapura

“Ira A. Fulton Schools of Engineering, Arizona State University”

“IFT 520: Advanced Information Systems Security”

“Dr. Jim Helm, Prof. Upakar Bhatta”

“September 22, 2023”

“Creating Datacenter with One Host and Run One Cloudlet”

Introduction/Overview

The rapid advancement of technology in recent years has transformed the way we approach computing and data management. Cloud computing has emerged as a game-changer, redefining the landscape of IT infrastructure. It offers organizations unprecedented opportunities to scale their operations, reduce costs, and enhance flexibility. However, with these benefits come significant challenges, particularly in the realm of security. Ensuring the protection of sensitive data, maintaining service availability, and managing resources efficiently are paramount concerns in the cloud environment.

In this context, our journey begins with an in-depth exploration of CloudSim, a robust and versatile simulation tool tailored to the world of cloud computing. CloudSim serves as a vital bridge between theory and practice, providing a hands-on platform for understanding the intricacies of cloud-based systems and their security aspects. The primary aim of this laboratory activity is to familiarize you with CloudSim's capabilities by guiding you through the process of constructing a virtual datacenter comprising a single host and orchestrating the execution of a cloudlet within this simulated environment. This exercise is not merely an academic endeavor; it is a practical, experiential journey into the heart of cloud computing and security.

Throughout this activity, we will meticulously present each step of the process, accompanied by screenshots and code snippets. Our objective is to empower you with the knowledge and skills needed to navigate cloud simulations effectively. By the end of this exercise, you will possess not only theoretical insights but also practical experience, making you better prepared to tackle advanced concepts in cloud computing and security. As we venture into the virtual clouds with CloudSim, we invite you to embark on this educational odyssey. Together, we will unlock the vast potential of CloudSim as a tool for learning, experimentation, and gaining a deeper understanding of the dynamic world of cloud computing and its ever-evolving security paradigms.

Discussion

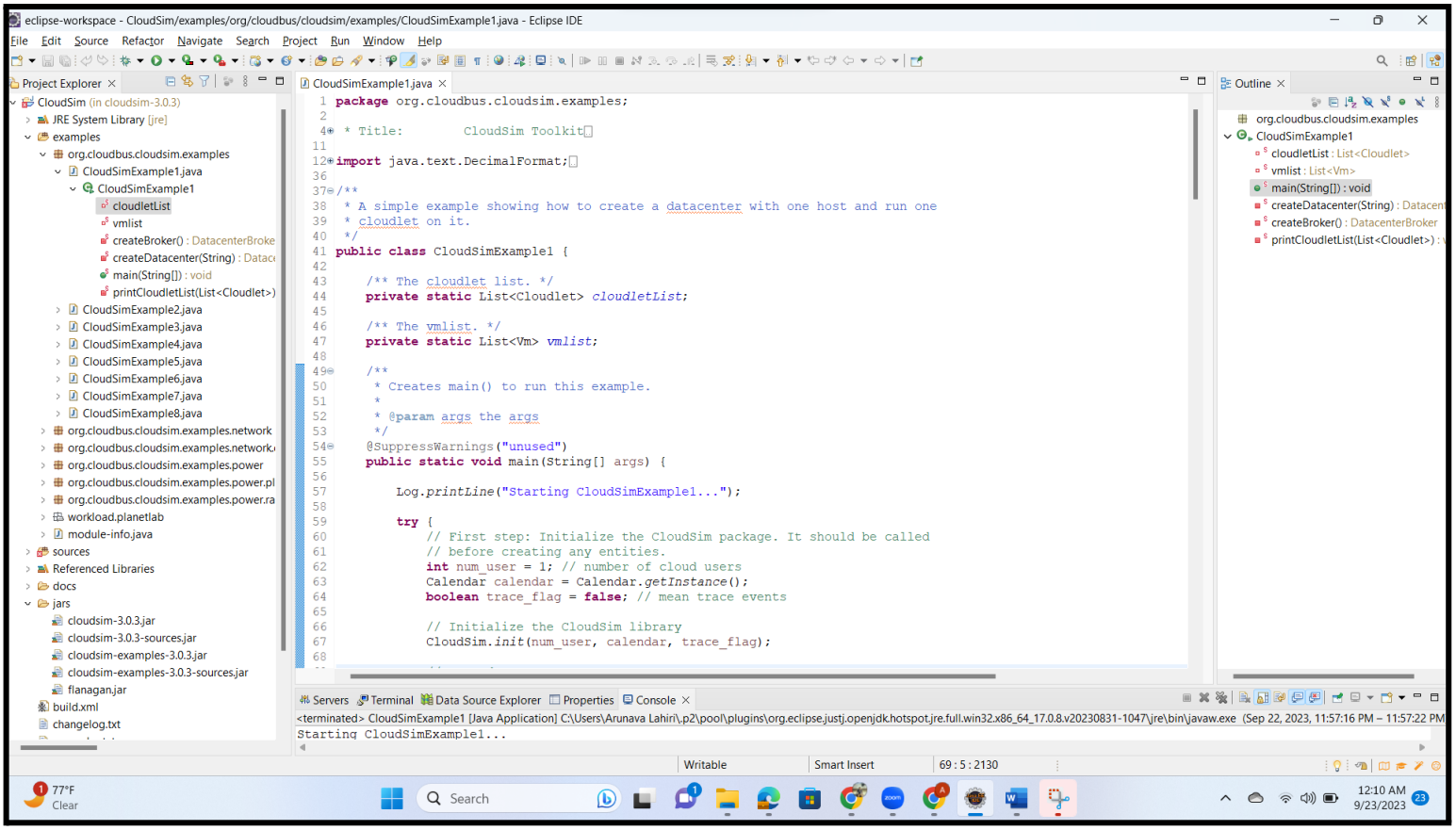
The activity of learning cloud computing and security through CloudSim simulation is an invaluable educational experience for anyone looking to delve into the world of cloud computing and understand its security implications. The activity encourages hands-on learning, a crucial approach for comprehending complex topics like cloud computing. By following the step-by-step instructions and engaging with CloudSim, participants gain practical insights into how cloud environments are configured and how various components interact.

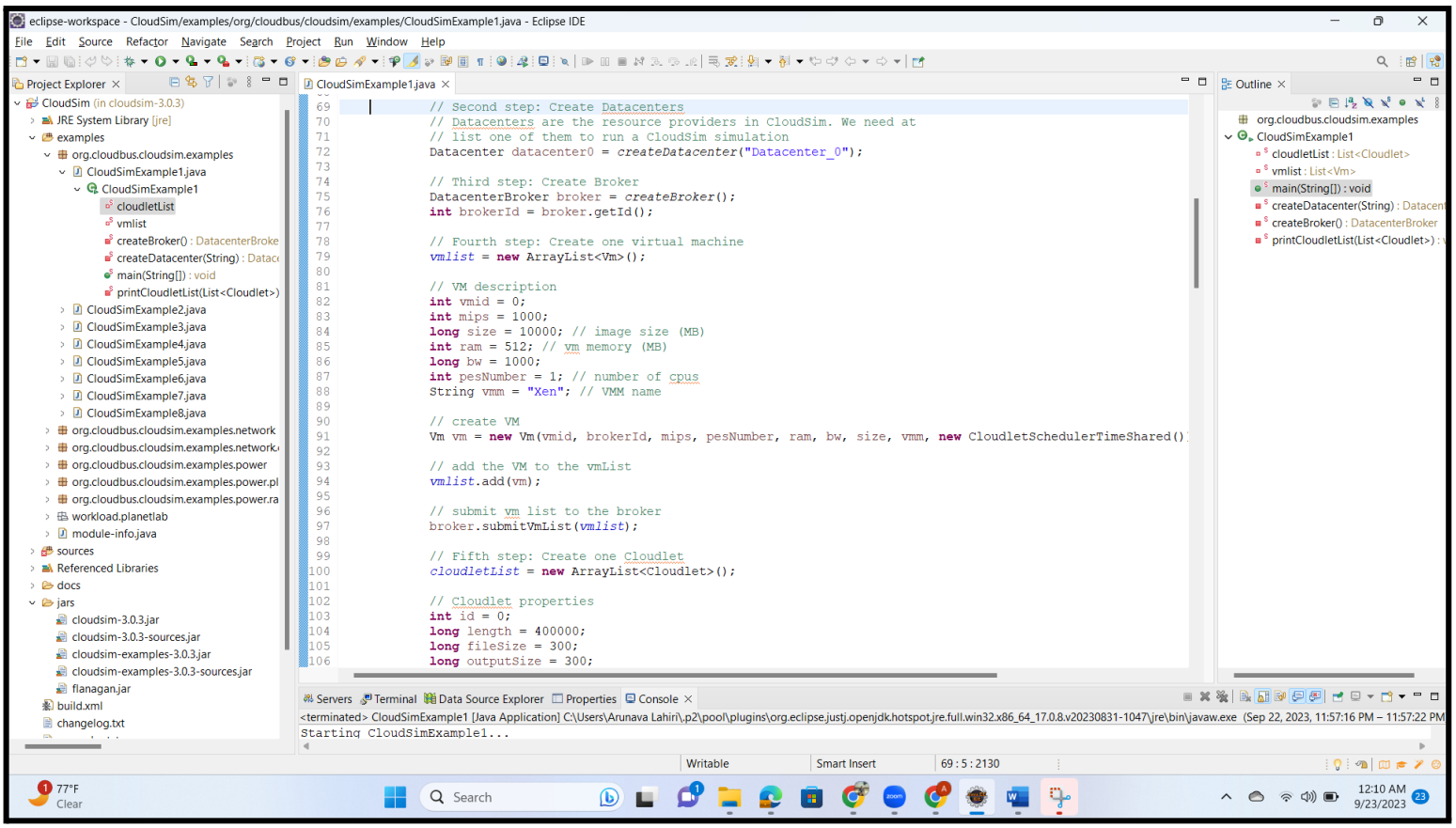
Through the process of creating a virtual datacenter with a single host and executing a cloudlet, participants grasp the foundational elements of cloud infrastructure. They learn about data centers, hosts, and cloudlets - the building blocks of cloud computing - and how they work together to provide scalable and efficient computing resources. CloudSim's simulation capabilities provide a safe and controlled environment for experimenting with various cloud scenarios. Participants can simulate different workloads, resource allocations, and network configurations to understand how these factors impact performance, cost, and security.

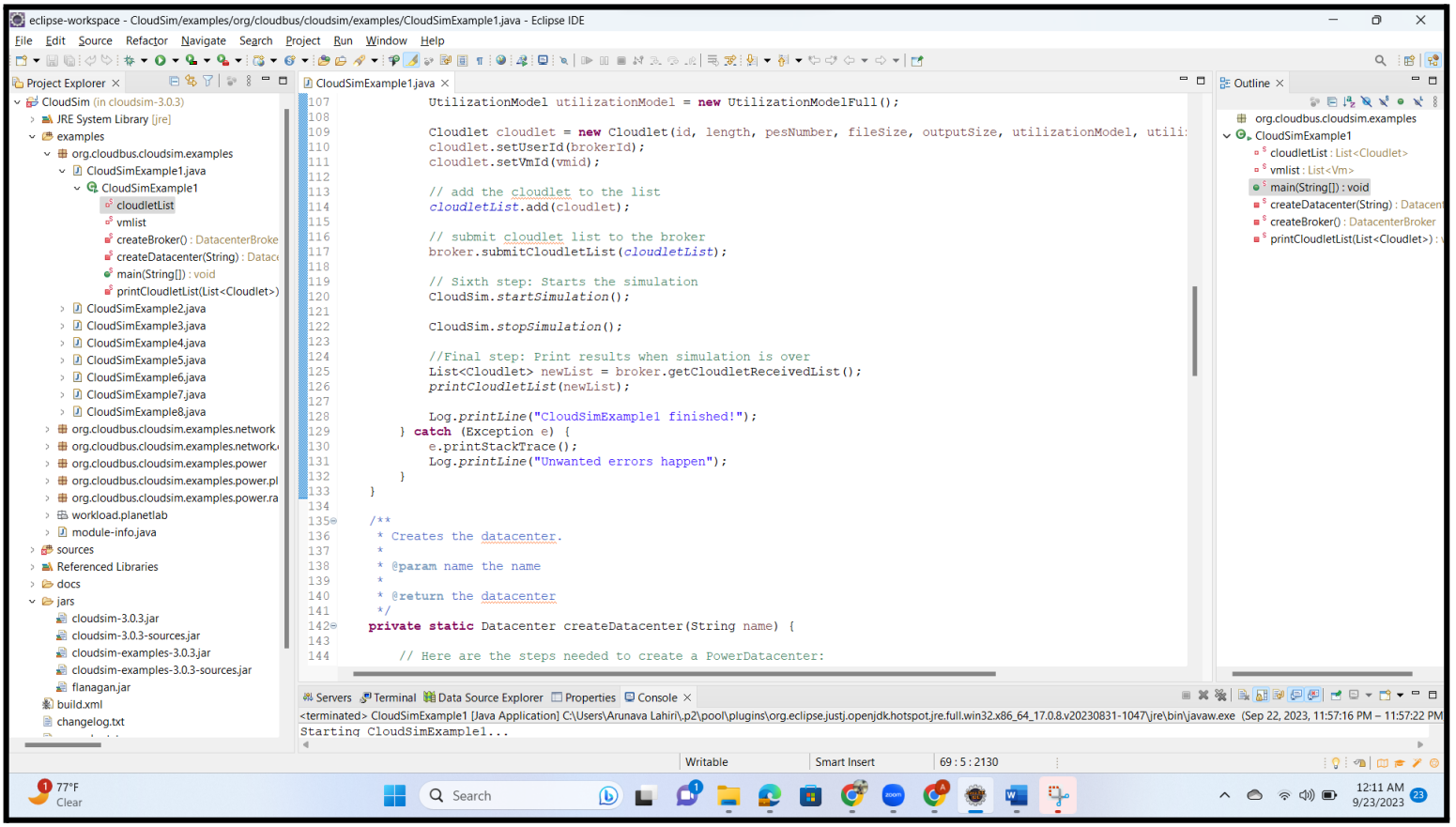
The activity emphasizes the importance of security in cloud computing. Participants are encouraged to consider security aspects when setting up their simulated cloud environment. This includes access controls, data protection, and measures to prevent unauthorized access or data breaches. Understanding security challenges in a simulated setting prepares individuals for real-world cloud security concerns. Cloud computing is a multidisciplinary field, and this activity reflects that. Participants not only gain technical knowledge but also develop problem-solving skills, critical thinking, and an awareness of ethical and privacy considerations. This holistic approach is valuable in today's technology landscape.

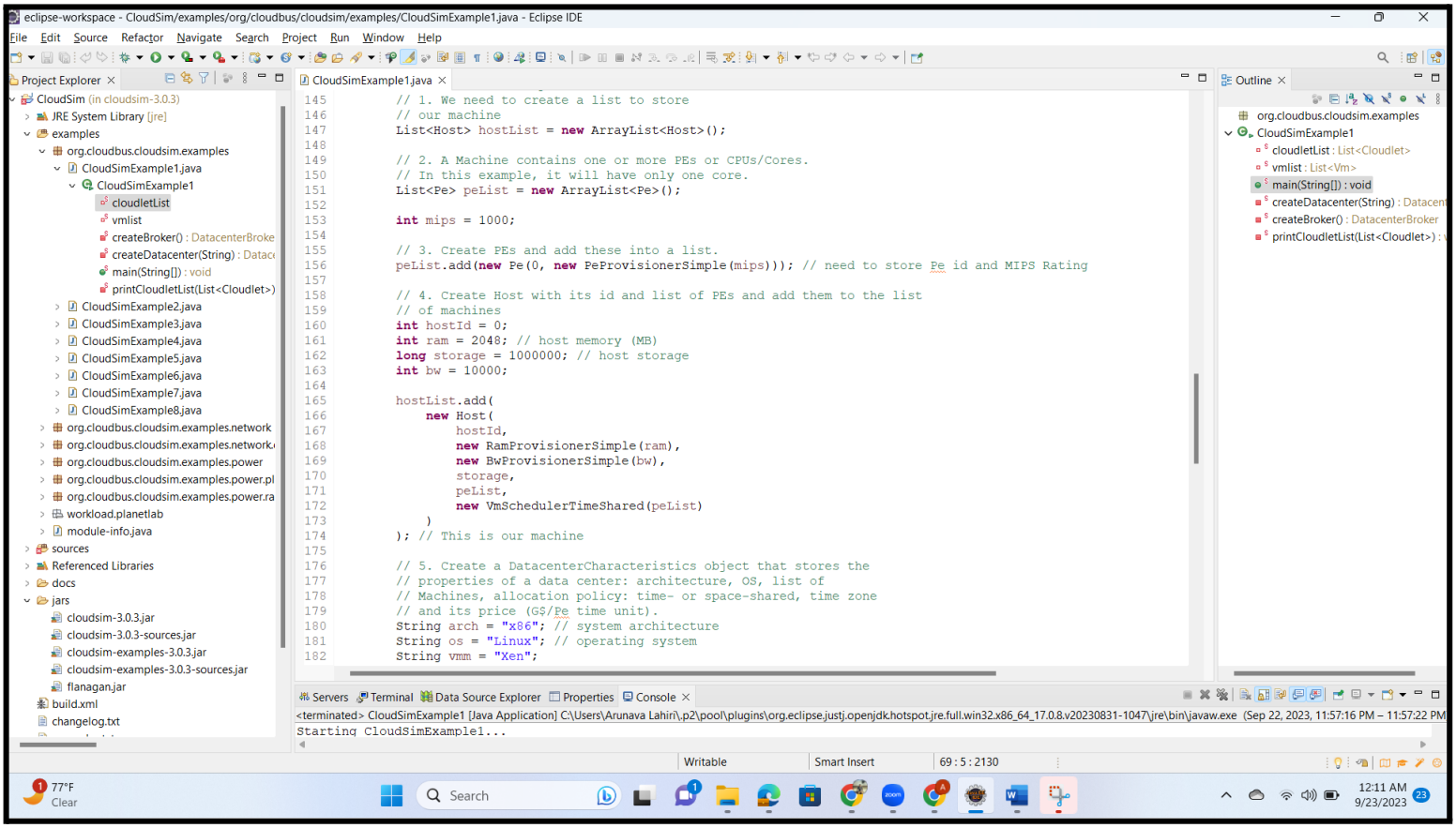
The requirement to attach screenshots and code with explanations is essential. It promotes thorough documentation, which is crucial for understanding the steps taken and for future reference. It also encourages us to articulate their thought processes and the rationale behind their choices, enhancing the learning experience.

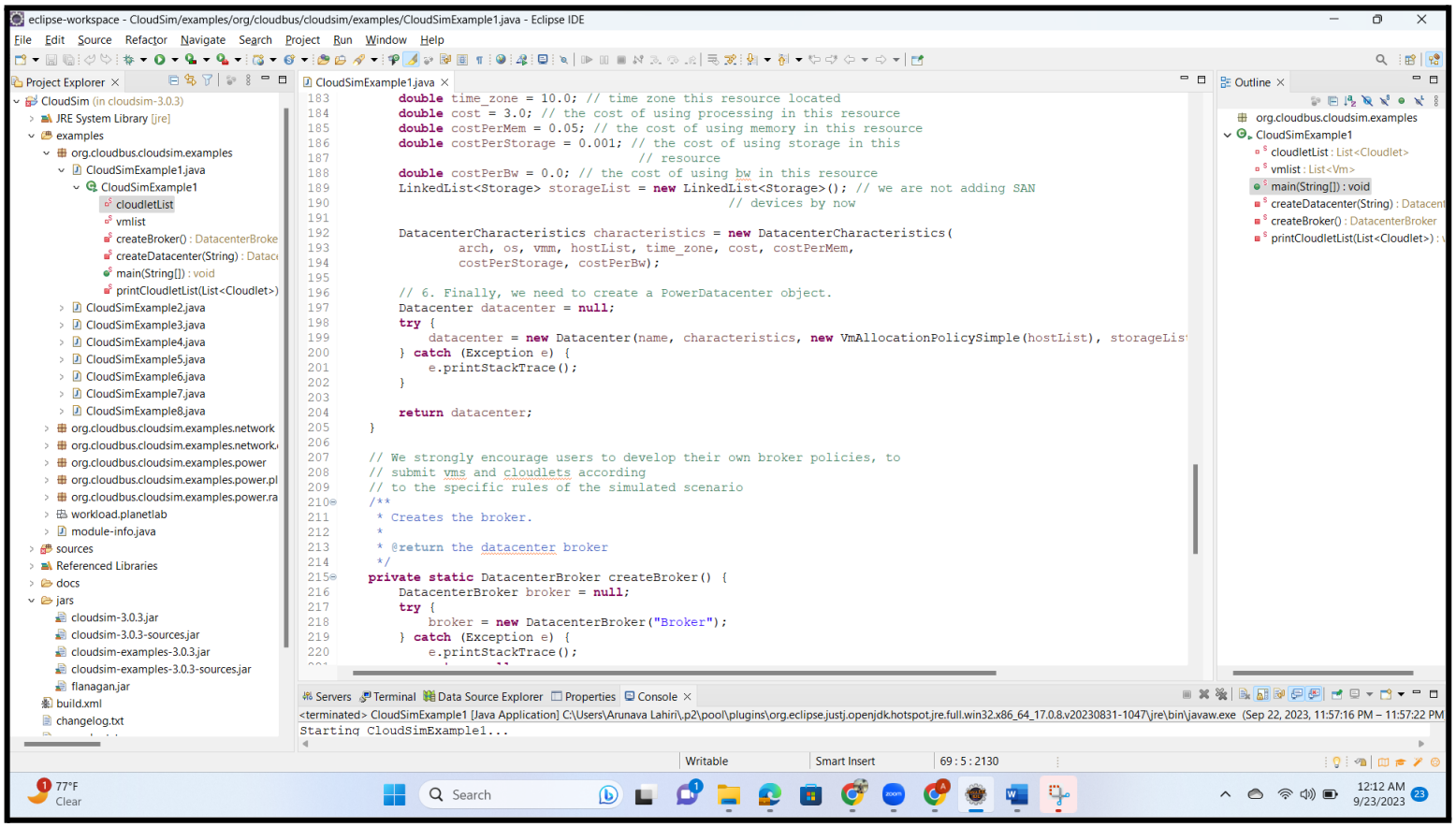
Code Screenshots

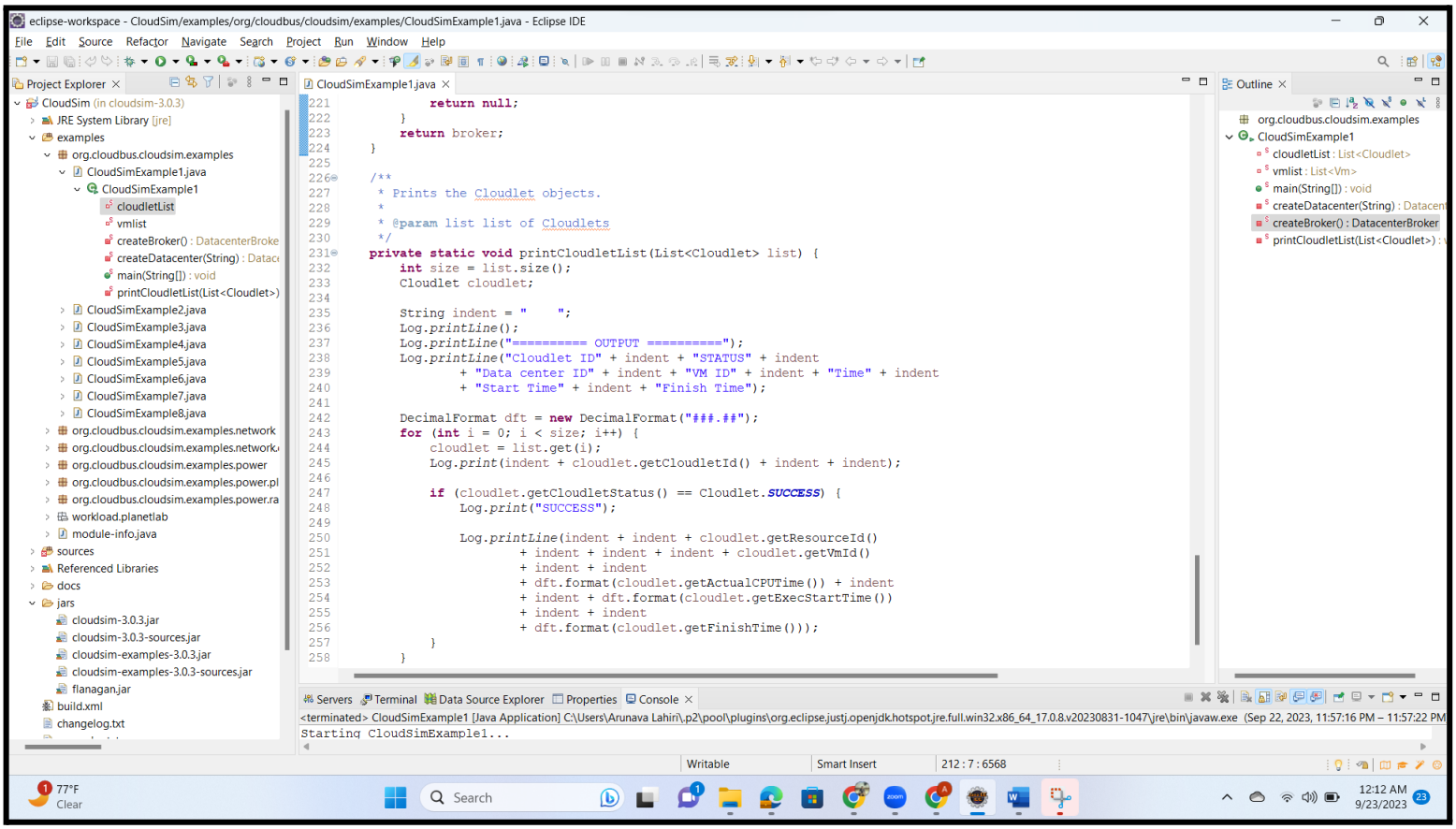


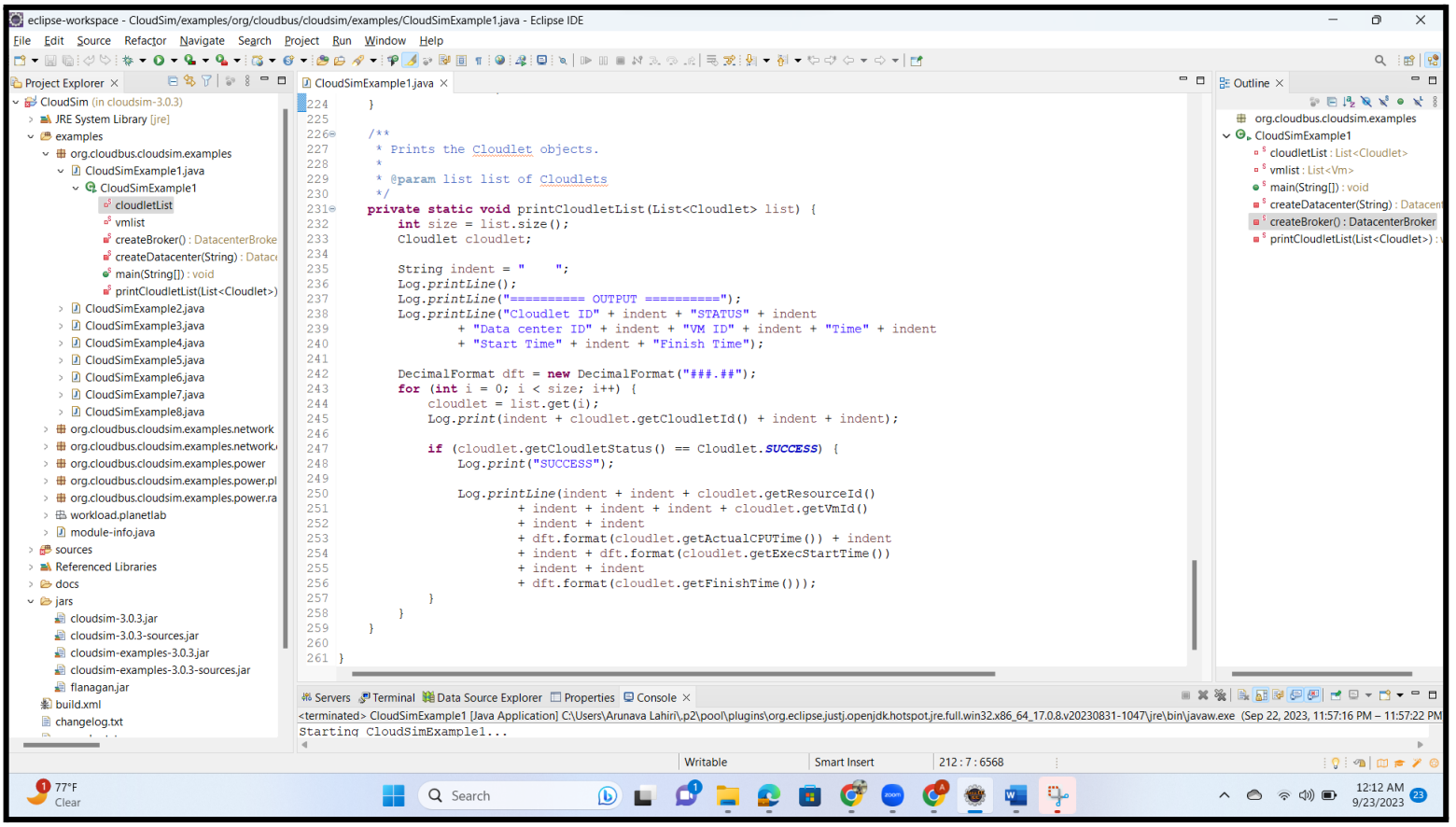



eclipse-workspace - CloudSim/examples/org/cloudbus/cloudsim/examples/CloudSimExample1.java - Eclipse IDE
File Edit Source Refactor Navigate Search Project Run Window Help
Project Explorer
CloudSim (in cloudsim-3.0.3)
JRE System Library [jre]
examples
org.cloudbus.cloudsim.examples
CloudSimExample1.java
CloudSimExample1
cloudletList
vmlist
createBroker() : DatacenterBroke
createDatacenter(String) : Datac
main(String[]) : void
printCloudletList(List<Cloudlet>)
CloudSimExample2.java
CloudSimExample3.java
CloudSimExample4.java
CloudSimExample5.java
CloudSimExample6.java
CloudSimExample7.java
CloudSimExample8.java
org.cloudbus.cloudsim.examples.network
org.cloudbus.cloudsim.examples.network
org.cloudbus.cloudsim.examples.power
org.cloudbus.cloudsim.examples.power.pl
org.cloudbus.cloudsim.examples.power.ra
workload.planetlab
module-info.java
sources
Referenced Libraries
docs
jars
cloudsim-3.0.3.jar
cloudsim-3.0.3-sources.jar
cloudsim-examples-3.0.3.jar
cloudsim-examples-3.0.3-sources.jar
flanagan.jar
build.xml
changelog.txt
CloudSimExample1.java
UtilizationModel utilizationModel = new UtilizationModelFull();
Cloudlet cloudlet = new Cloudlet(id, length, pesNumber, fileSize, outputSize, utilizationModel, utili
cloudlet.setUserId(brokerId);
cloudlet.setVmId(vmid);
// add the cloudlet to the list
cloudletList.add(cloudlet);
// submit cloudlet list to the broker
broker.submitCloudletList(cloudletList);
// 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");
}
}
/**
* Creates the datacenter.
*
* @param name the name
*
* @return the datacenter
*/
private static Datacenter createDatacenter(String name) {
// Here are the steps needed to create a PowerDatacenter:
Outline
org.cloudbus.cloudsim.examples
CloudSimExample1
cloudletList : List<Cloudlet>
vmlist : List<Vm>
main(String[]) : void
createDatacenter(String) : Datacent
createBroker() : DatacenterBroker
printCloudletList(List<Cloudlet>) :
Servers Terminal Data Source Explorer Properties Console
<terminated> CloudSimExample1 [Java Application] C:\Users\Arunava Lahiri\.p2\pool\plugins\org.eclipse.justj.openjdk.hotspot.jre.full.win32.x86_64_17.0.8.v20230831-1047\jre\bin\javaw.exe (Sep 22, 2023, 11:57:16 PM – 11:57:22 PM
Starting CloudSimExample1...
Writable
Smart Insert
69 : 5 : 2130
77°F
Clear
Search
12:11 AM
9/23/2023

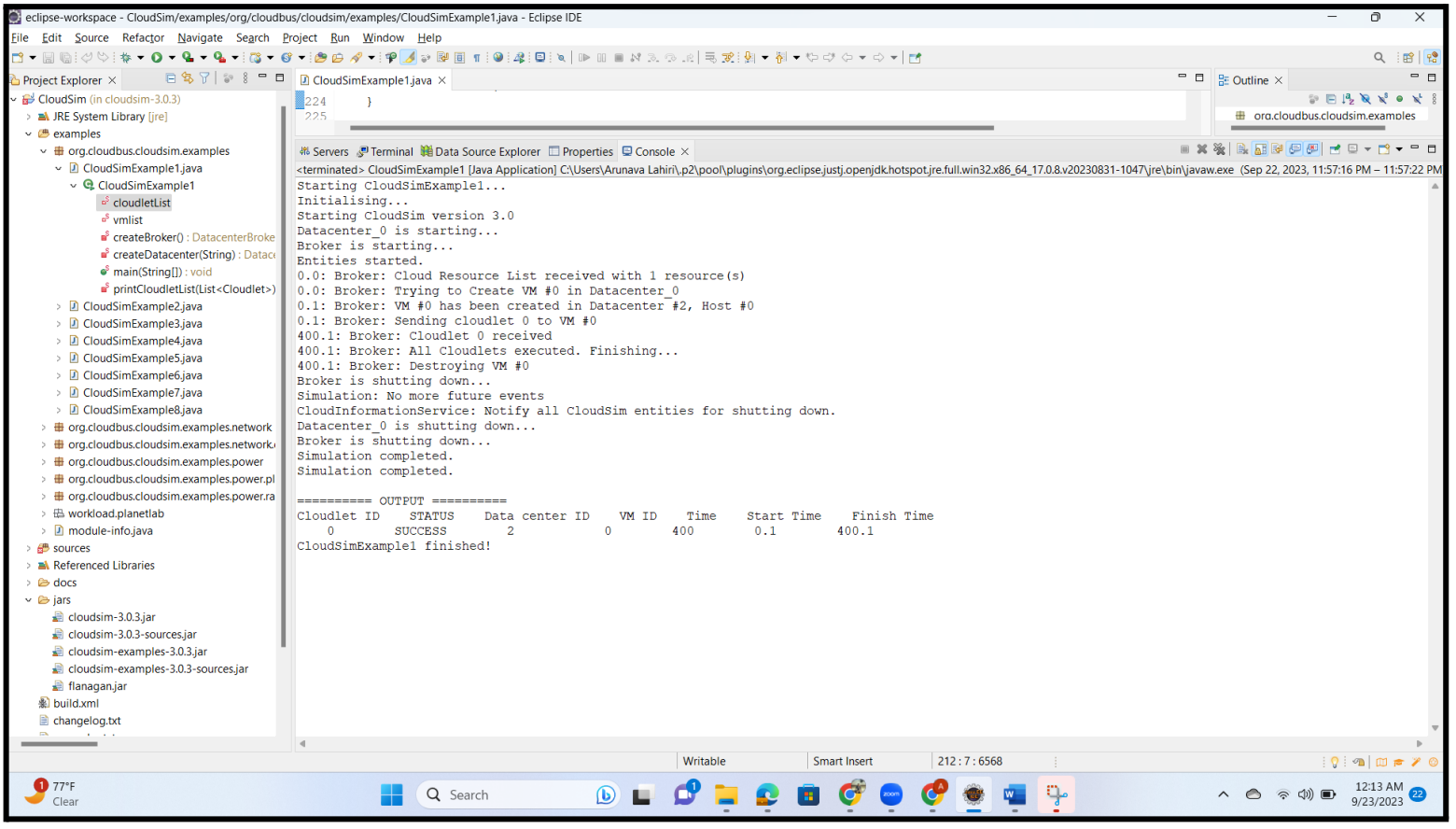

eclipse-workspace - CloudSim/examples/org/cloudbus/cloudsim/examples/CloudSimExample1.java - Eclipse IDE
File Edit Source Refactor Navigate Search Project Run Window Help
Project Explorer
CloudSim (in cloudsim-3.0.3)
JRE System Library [jre]
examples
org.cloudbus.cloudsim.examples
CloudSimExample1.java
CloudSimExample1
cloudletList
vmlist
createBroker() : DatacenterBroke
createDatacenter(String) : Datac
main(String[]) : void
printCloudletList(List<Cloudlet>)
CloudSimExample2.java
CloudSimExample3.java
CloudSimExample4.java
CloudSimExample5.java
CloudSimExample6.java
CloudSimExample7.java
CloudSimExample8.java
org.cloudbus.cloudsim.examples.network
org.cloudbus.cloudsim.examples.network
org.cloudbus.cloudsim.examples.power
org.cloudbus.cloudsim.examples.power.pl
org.cloudbus.cloudsim.examples.power.ra
workload.planetlab
module-info.java
sources
Referenced Libraries
docs
jars
cloudsim-3.0.3.jar
cloudsim-3.0.3-sources.jar
cloudsim-examples-3.0.3.jar
cloudsim-examples-3.0.3-sources.jar
flanagan.jar
build.xml
changelog.txt
CloudSimExample1.java
// 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.
peList.add(new Pe(0, new PeProvisionerSimple(mips))); // need to store Pe id and MIPS Rating
// 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";
Outline
org.cloudbus.cloudsim.examples
CloudSimExample1
cloudletList : List<Cloudlet>
vmlist : List<Vm>
main(String[]) : void
createDatacenter(String) : Datacent
createBroker() : DatacenterBroker
printCloudletList(List<Cloudlet>) :
Servers Terminal Data Source Explorer Properties Console
<terminated> CloudSimExample1 [Java Application] C:\Users\Arunava Lahiri\.p2\pool\plugins\org.eclipse.justj.openjdk.hotspot.jre.full.win32.x86_64_17.0.8.v20230831-1047\jre\bin\javaw.exe (Sep 22, 2023, 11:57:16 PM – 11:57:22 PM
Starting CloudSimExample1...
Writable
Smart Insert
69 : 5 : 2130
77°F
Clear
Search
12:11 AM
9/23/2023

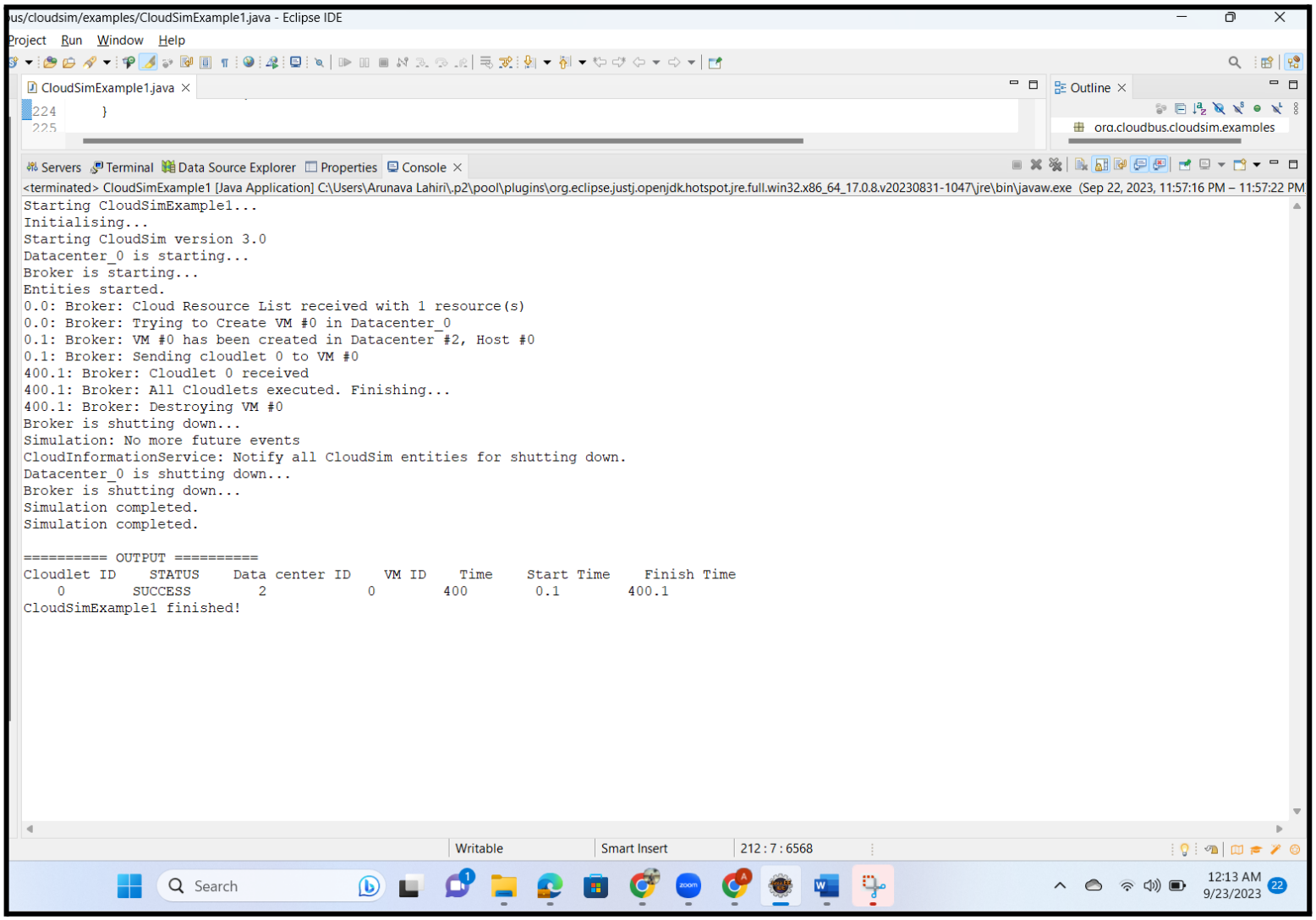

eclipse-workspace - CloudSim/examples/org/cloudbus/cloudsim/examples/CloudSimExample1.java - Eclipse IDE
File Edit Source Refactor Navigate Search Project Run Window Help
Project Explorer
CloudSim (in cloudsim-3.0.3)
JRE System Library [jre]
examples
org.cloudbus.cloudsim.examples
CloudSimExample1.java
CloudSimExample1
cloudletList
vmlist
createBroker() : DatacenterBroke
createDatacenter(String) : Datac
main(String[]) : void
printCloudletList(List<Cloudlet>)
CloudSimExample2.java
CloudSimExample3.java
CloudSimExample4.java
CloudSimExample5.java
CloudSimExample6.java
CloudSimExample7.java
CloudSimExample8.java
org.cloudbus.cloudsim.examples.network
org.cloudbus.cloudsim.examples.power
org.cloudbus.cloudsim.examples.power.pl
org.cloudbus.cloudsim.examples.power.ra
workload.planetlab
module-info.java
sources
Referenced Libraries
docs
jars
cloudsim-3.0.3.jar
cloudsim-3.0.3-sources.jar
cloudsim-examples-3.0.3.jar
cloudsim-examples-3.0.3-sources.jar
flanagan.jar
build.xml
changelog.txt
CloudSimExample1.java
183 double time_zone = 10.0; // time zone this resource located
184 double cost = 3.0; // the cost of using processing in this resource
185 double costPerMem = 0.05; // the cost of using memory in this resource
186 double costPerStorage = 0.001; // the cost of using storage in this
187 // resource
188 double costPerBw = 0.0; // the cost of using bw in this resource
189 LinkedList<Storage> storageList = new LinkedList<Storage>(); // we are not adding SAN
190 // devices by now
191
192 DatacenterCharacteristics characteristics = new DatacenterCharacteristics(
193 arch, os, vmm, hostList, time_zone, cost, costPerMem,
194 costPerStorage, costPerBw);
195
196 // 6. Finally, we need to create a PowerDatacenter object.
197 Datacenter datacenter = null;
198 try {
199 datacenter = new Datacenter(name, characteristics, new VmAllocationPolicySimple(hostList), storageLis
200 } catch (Exception e) {
201 e.printStackTrace();
202 }
203
204 return datacenter;
205 }
206
207 // We strongly encourage users to develop their own broker policies, to
208 // submit vms and cloudlets according
209 // to the specific rules of the simulated scenario
210 /**
211 * Creates the broker.
212 *
213 * @return the datacenter broker
214 */
215 private static DatacenterBroker createBroker() {
216 DatacenterBroker broker = null;
217 try {
218 broker = new DatacenterBroker("Broker");
219 } catch (Exception e) {
220 e.printStackTrace();
Outline
org.cloudbus.cloudsim.examples
CloudSimExample1
cloudletList : List<Cloudlet>
vmlist : List<Vm>
main(String[]) : void
createDatacenter(String) : Datacent
createBroker() : DatacenterBroker
printCloudletList(List<Cloudlet>) :
Servers Terminal Data Source Explorer Properties Console
<terminated> CloudSimExample1 [Java Application] C:\Users\Arunava Lahiri\.p2\pool\plugins\org.eclipse.justj.openjdk.hotspot.jre.full.win32.x86_64_17.0.8.v20230831-1047\jre\bin\javaw.exe (Sep 22, 2023, 11:57:16 PM – 11:57:22 PM
Starting CloudSimExample1...
Writable Smart Insert 69 : 5 : 2130
77°F Clear
Search
12:12 AM 9/23/2023


eclipse-workspace - CloudSim/examples/org/cloudbus/cloudsim/examples/CloudSimExample1.java - Eclipse IDE
File Edit Source Refactor Navigate Search Project Run Window Help
Project Explorer
CloudSim (in cloudsim-3.0.3)
JRE System Library [jre]
examples
org.cloudbus.cloudsim.examples
CloudSimExample1.java
CloudSimExample1
cloudletList
vmlist
createBroker() : DatacenterBroke
createDatacenter(String) : Datac
main(String[]) : void
printCloudletList(List<Cloudlet>)
CloudSimExample2.java
CloudSimExample3.java
CloudSimExample4.java
CloudSimExample5.java
CloudSimExample6.java
CloudSimExample7.java
CloudSimExample8.java
org.cloudbus.cloudsim.examples.network
org.cloudbus.cloudsim.examples.power
org.cloudbus.cloudsim.examples.power.pl
org.cloudbus.cloudsim.examples.power.ra
workload.planetlab
module-info.java
sources
Referenced Libraries
docs
jars
cloudsim-3.0.3.jar
cloudsim-3.0.3-sources.jar
cloudsim-examples-3.0.3.jar
cloudsim-examples-3.0.3-sources.jar
flanagan.jar
build.xml
changelog.txt
CloudSimExample1.java
221 return null;
222 }
223 return broker;
224 }
225
226 /**
227 * Prints the Cloudlet objects.
228 *
229 * @param list list of Cloudlets
230 */
231 private static void printCloudletList(List<Cloudlet> list) {
232 int size = list.size();
233 Cloudlet cloudlet;
234
235 String indent = " ";
236 Log.printLine();
237 Log.printLine("========== OUTPUT ==========");
238 Log.printLine("Cloudlet ID" + indent + "STATUS" + indent
239 + "Data center ID" + indent + "VM ID" + indent + "Time" + indent
240 + "Start Time" + indent + "Finish Time");
241
242 DecimalFormat dft = new DecimalFormat("###.##");
243 for (int i = 0; i < size; i++) {
244 cloudlet = list.get(i);
245 Log.print(indent + cloudlet.getCloudletId() + indent + indent);
246
247 if (cloudlet.getCloudletStatus() == Cloudlet.SUCCESS) {
248 Log.print("SUCCESS");
249
250 Log.printLine(indent + indent + cloudlet.getResourceId()
251 + indent + indent + indent + cloudlet.getVmId()
252 + indent + indent
253 + dft.format(cloudlet.getActualCPUTime()) + indent
254 + indent + dft.format(cloudlet.getExecStartTime())
255 + indent + indent
256 + dft.format(cloudlet.getFinishTime()));
257 }
258 }
Outline
org.cloudbus.cloudsim.examples
CloudSimExample1
cloudletList : List<Cloudlet>
vmlist : List<Vm>
main(String[]) : void
createDatacenter(String) : Datacent
createBroker() : DatacenterBroker
printCloudletList(List<Cloudlet>) :
Servers Terminal Data Source Explorer Properties Console
<terminated> CloudSimExample1 [Java Application] C:\Users\Arunava Lahiri\.p2\pool\plugins\org.eclipse.justj.openjdk.hotspot.jre.full.win32.x86_64_17.0.8.v20230831-1047\jre\bin\javaw.exe (Sep 22, 2023, 11:57:16 PM – 11:57:22 PM
Starting CloudSimExample1...
Writable Smart Insert 212 : 7 : 6568
77°F Clear
Search
12:12 AM 9/23/2023



Output Screenshots





Summary

The journey through the CloudSim simulation activity has been a transformative experience, equipping participants with valuable insights into the intricate world of cloud computing and its inseparable companion, security. As we conclude this activity, let's reflect on the key takeaways and the significance of the knowledge gained. Through this hands-on exploration, participants have gained a practical understanding of cloud infrastructure, from datacenters to hosts and cloudlets. They've witnessed how these components interact to deliver the scalability, flexibility, and cost-efficiency that make cloud computing a game-changer in the IT landscape.

Perhaps even more crucially, this activity has emphasized the paramount importance of security in the cloud. Participants have had the opportunity to consider access controls, data protection measures, and safeguards against unauthorized access or data breaches. This awareness of security challenges and the incorporation of security measures into the simulation underscore the real-world relevance of the knowledge gained. The documentation of steps, coupled with explanations, not only serves as a testament to the meticulousness of the participants but also provides a valuable reference for future endeavors in cloud computing. It encourages participants to articulate their reasoning and thought processes, fostering critical thinking and problem-solving skills.

Furthermore, this activity has demonstrated the multidisciplinary nature of cloud computing. Beyond technical know-how, it has encouraged ethical considerations, privacy concerns, and a holistic approach to cloud technology. In an era where technology touches every aspect of our lives, such a comprehensive view is essential. As participants continue to explore cloud computing and security, they are well-prepared for more advanced topics and complex simulations. The foundation laid through this activity empowers them to adapt to the ever-evolving cloud landscape, tackle intricate challenges, and contribute meaningfully to the world of cloud technology.

In summary, this CloudSim-based activity has been an educational journey filled with discovery and growth. It has nurtured practical skills, theoretical knowledge, and a profound appreciation for the vast potential of cloud computing. As we conclude, we recognize that this knowledge is not an endpoint but a springboard for participants to dive deeper into the dynamic and transformative field of cloud computing and its ever-persistent guardian, security.

References

[1] https://www.opensourceforu.com/2014/03/cloudsim-framework-modelling-simulating-cloud-environment/

[2] https://cloudsimplus.org/

[3] https://www.eclipse.org/downloads/

[4] https://code.google.com/archive/p/cloudsim/downloads

[5] https://www.ee.ucl.ac.uk/~mflanaga/java/