

CloudSim: A Tutorial

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Course:

Simulation and Modeling Techniques

Instructor:

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Agenda

- Introduction to CloudSim
- Reasons for Learning CloudSim
- Prerequisites
- How to use CloudSim with Eclipse
- Sample example on CloudSim

CloudSim

- Motivation
 - provides a generalized and extensible simulation framework that enables modeling, simulation, and experimentation of emerging Cloud computing infrastructures and application services
- CloudSim is developed in the CLOUDS Laboratory, at the Computer Science and Software Engineering Department of the University of Melbourne.
- CloudSim Toolkit 3.0 released at Jan 13, 2012

CloudSim Feature

- Support for modeling and simulation of large scale Cloud computing data centers
- Energy-aware computational resources
- Support for data center network topologies and message-passing applications
- Support for dynamic insertion of simulation elements, stop and resume of simulation
- Support for user-defined policies for allocation of hosts to virtual machines and policies for allocation of host resources to virtual machines

CloudSim Architecture

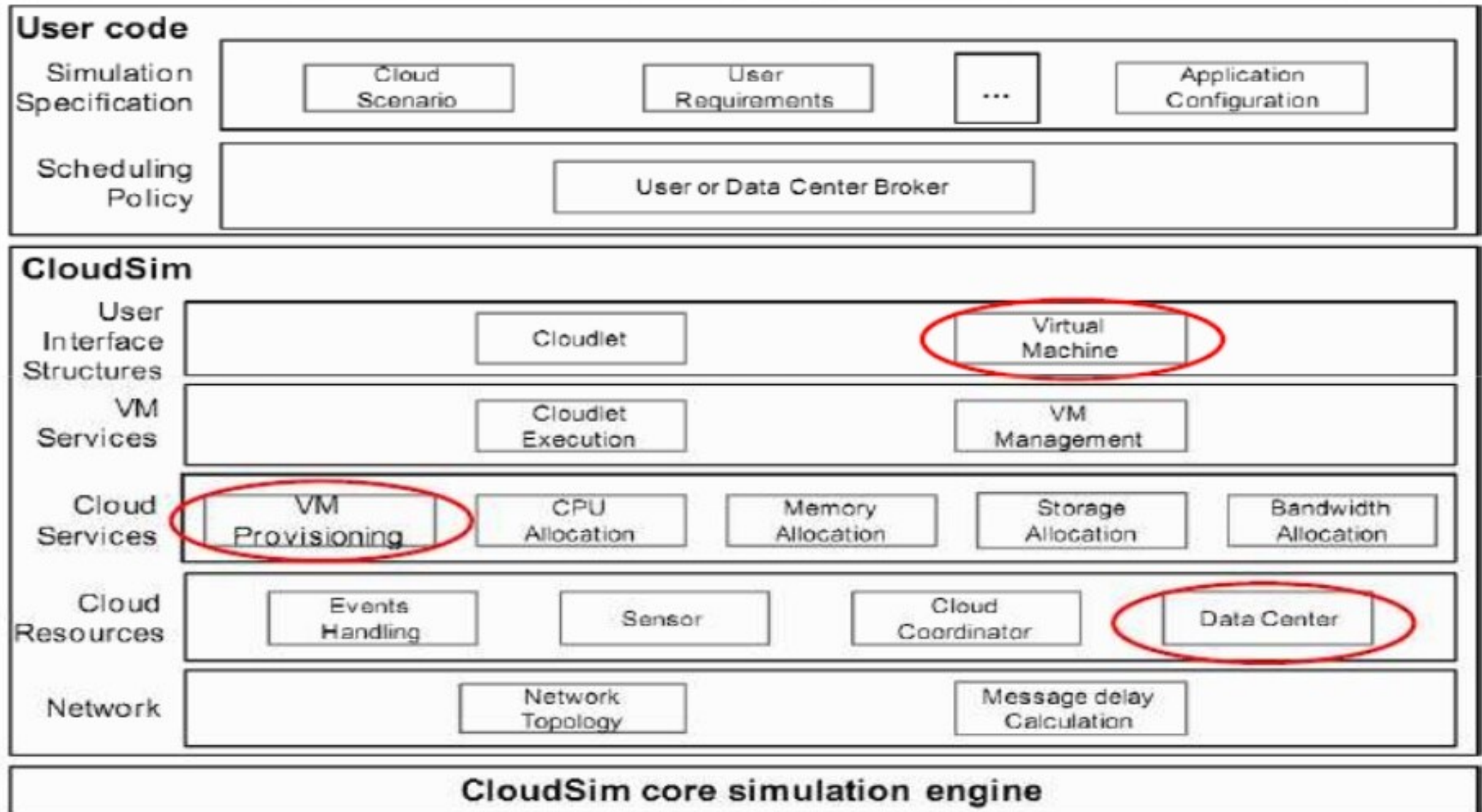


Figure 3. Layered CloudSim architecture.

Reasons for Learning CloudSim

- Cloud resource provisioning
- Energy-efficient management of data center resources
- Optimization of cloud computing
- Research activities
- Limitation: No Graphical User Interface (GUI)

Prerequisites

- We'll need at least basic understanding of how to program in Java
- We'll need some basic OOP concept

How to use CloudSim with Eclipse

- Part 1

- Setting up Development Environments

- Part 2

- Use Eclipse with CloudSim

- Part 3

- Run sample example using CloudSim

Part 1: Setting up Development Environments

- Supported OS

- Windows XP (32-bit), Vista (32- or 64-bit), or Windows 7 (32- or 64-bit)
- Mac OS X 10.5.8 or later (x86 only)
- Linux (tested on Ubuntu Linux, Lucid Lynx)

- Development environment (Eclipse based)

- Eclipse Classic (versions 3.5.1 and higher)
- JDK 1.6 or later
- CloudSim tool kit

Part 1: Setting up Development Environments (cont.)

To set up the development environment, we need:

- Java Development Kit (1.6 is preferable)
- Eclipse IDE (classic)

Part 1: Setting up Development Environment(cont.)

- Java Development Kit (JDK) Download Link:
<http://www.oracle.com/technetwork/java/javase/downloads/index.html>

<p>Java SE 6 Update 33 This release includes security enhancements and bug fixes. Learn more ➔</p>	<p>JDK DOWNLOAD ➔</p> <p>JDK 6 Docs</p> <ul style="list-style-type: none">▪ Installation Instructions▪ ReadMe▪ ReleaseNotes▪ Oracle License▪ Java SE Products▪ Third Party Licenses▪ Certified System Configurations	<p>JRE DOWNLOAD ➔</p> <p>JRE 6 Docs</p> <ul style="list-style-type: none">▪ Installation Instructions▪ ReadMe▪ ReleaseNotes▪ Oracle License▪ Java SE Products▪ Third Party Licenses▪ Certified System Configurations
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Download JDK from here and Install JDK

Setting up Development Environment(cont.)

- Eclipse IDE Download Link:
<http://www.eclipse.org/downloads/>



The screenshot shows the 'Eclipse Downloads' page. At the top, there's a purple header with the text 'Eclipse Downloads'. Below it, there are tabs for 'Packages' and 'Projects'. A dropdown menu shows 'Eclipse Juno (4.2) Packages for Windows'. The main content area lists several download options:

Package Name	Size	Download Count	Details	Other Downloads	Download Link
Eclipse IDE for Java EE Developers	221 MB	341,878 Times	Details		Windows 32 Bit Windows 64 Bit
Eclipse Classic 4.2	182 MB	254,204 Times	Details	Other Downloads	Windows 32 Bit Windows 64 Bit
Eclipse IDE for Java Developers	149 MB	137,146 Times	Details		Windows 32 Bit Windows 64 Bit
Actuate BIRT iServer					Promoted Download Download
Eclipse IDE for C/C++ Developers	143 MB	52,126 Times	Details		Windows 32 Bit Windows 64 Bit

Download the highlighted version of Eclipse IDE

Setting up Development Environment(cont.)

- CloudSim Tool Kit Download Link:

<http://code.google.com/p/cloudsim/downloads/detail?name=cloudsim-3.0.zip>



The screenshot shows the Google Code project page for CloudSim. The page has a header with the project name 'cloudsim' and a tagline 'CloudSim: A Framework For Modeling And Simulation Of Cloud Computing Infrastructures And Services'. Below the header is a navigation bar with links for 'Project Home', 'Downloads', 'Wiki', 'Issues', and 'Source'. The 'Downloads' link is highlighted. The main content area is divided into two columns. The left column contains 'Project Information' with links for 'Project feeds', 'Code license' (GNU Lesser GPL), 'Labels' (CloudComputing, CloudSim, Simulation, Cloud, Virtualization, VirtualMachine), 'Members' (anton.be...@gmail.com, rodrigo.calheiros...@gmail.com, rhu...@gmail.com, saurabh...@gmail.com, williamv...@gmail.com), and 'Featured' (Downloads, cloudsim-3.0.tar.gz, cloudsim-3.0.zip). The right column contains the project title 'CloudSim: A Framework For Modeling And Simulation Of Cloud Computing Infrastructures And Services', a description of cloud computing and the project's goal, the development location (University of Melbourne), and a list of 'Main features'.

cloudsim
CloudSim: A Framework For Modeling And Simulation Of Cloud Computing Infrastructures And Services

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[GNU Lesser GPL](#)

Labels
CloudComputing, CloudSim, Simulation, Cloud, Virtualization, VirtualMachine

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Downloads
[cloudsim-3.0.tar.gz](#)
[cloudsim-3.0.zip](#)

CloudSim: A Framework For Modeling And Simulation Of Cloud Computing Infrastructures And Services

Cloud computing is the leading technology for delivery of reliable, secure, fault-tolerant, sustainable, and scalable computational services. For assurance of such characteristics in cloud systems under development, it is required timely, repeatable, and controllable methodologies for evaluation of new cloud applications and policies before actual development of cloud products. Because utilization of real testbeds limits the experiments to the scale of the testbed and makes the reproduction of results an extremely difficult undertaking, simulation may be used.

CloudSim goal is to provide a generalized and extensible simulation framework that enables modeling, simulation, and experimentation of emerging Cloud computing infrastructures and application services, allowing its users to focus on specific system design issues that they want to investigate, without getting concerned about the low level details related to Cloud-based infrastructures and services.

CloudSim is developed in [the Cloud Computing and Distributed Systems \(CLOUDS\) Laboratory](#), at [the Computer Science and Software Engineering Department](#) of [the University of Melbourne](#).

More information can be found on the [CloudSim's web site](#).

CloudSim is powered by [jProfiler](#).

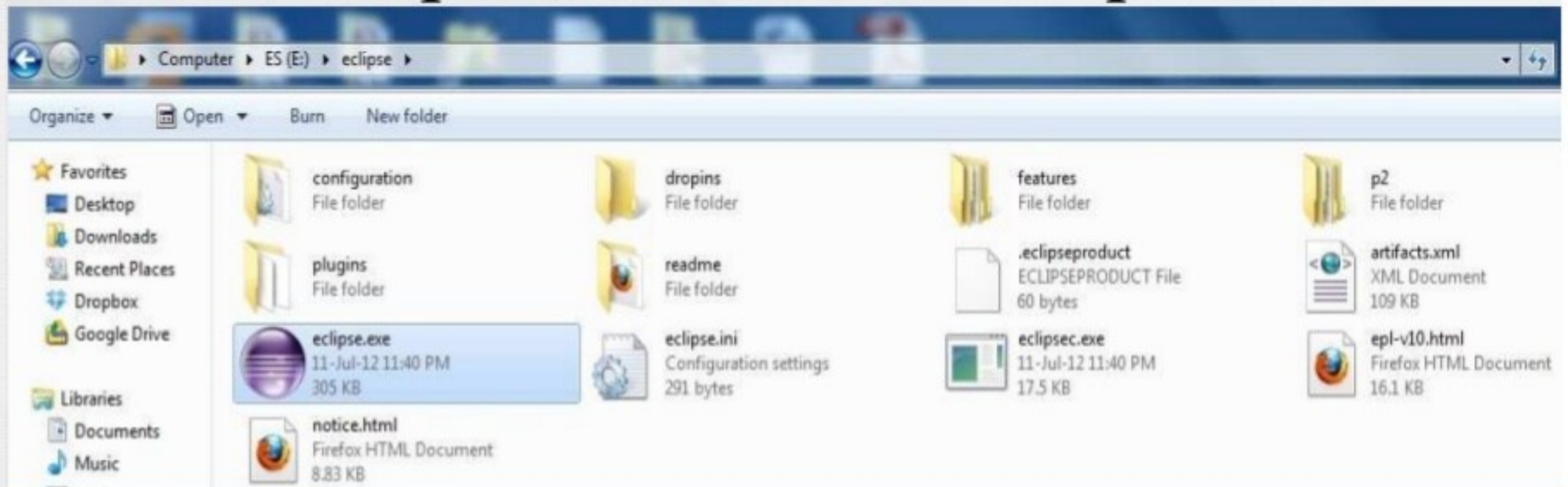
Main features

- support for modeling and simulation of large scale Cloud computing data centers
- support for modeling and simulation of virtualized server hosts, with customizable policies for provisioning host resources to virtual machines
- support for modeling and simulation of energy-aware computational resources

Download the highlighted version of CloudSim

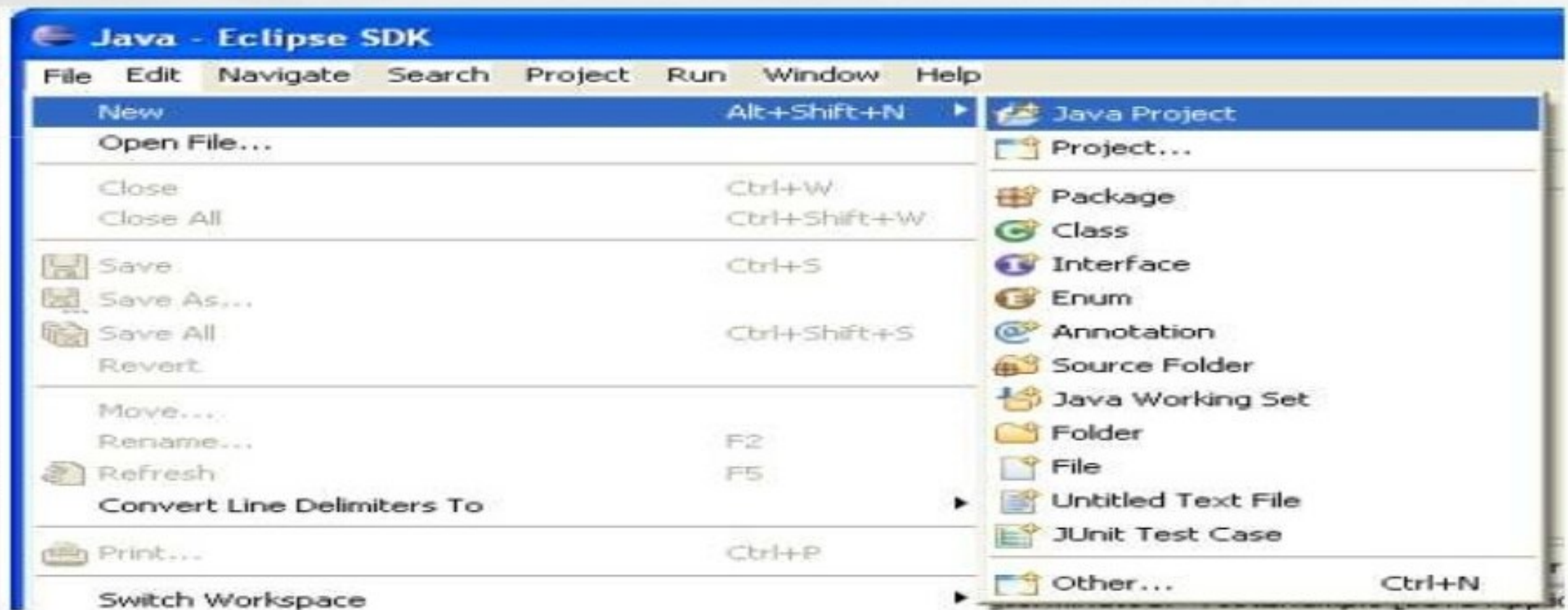
Part 2: How to use Eclipse with CloudSim

- Extract Eclipse (in my case: D:\eclipse)
- Extract cloudsim-3.0.zip (in my case C:\Users\Habib\Downloads)
- To run Eclipse, double click eclipse.exe



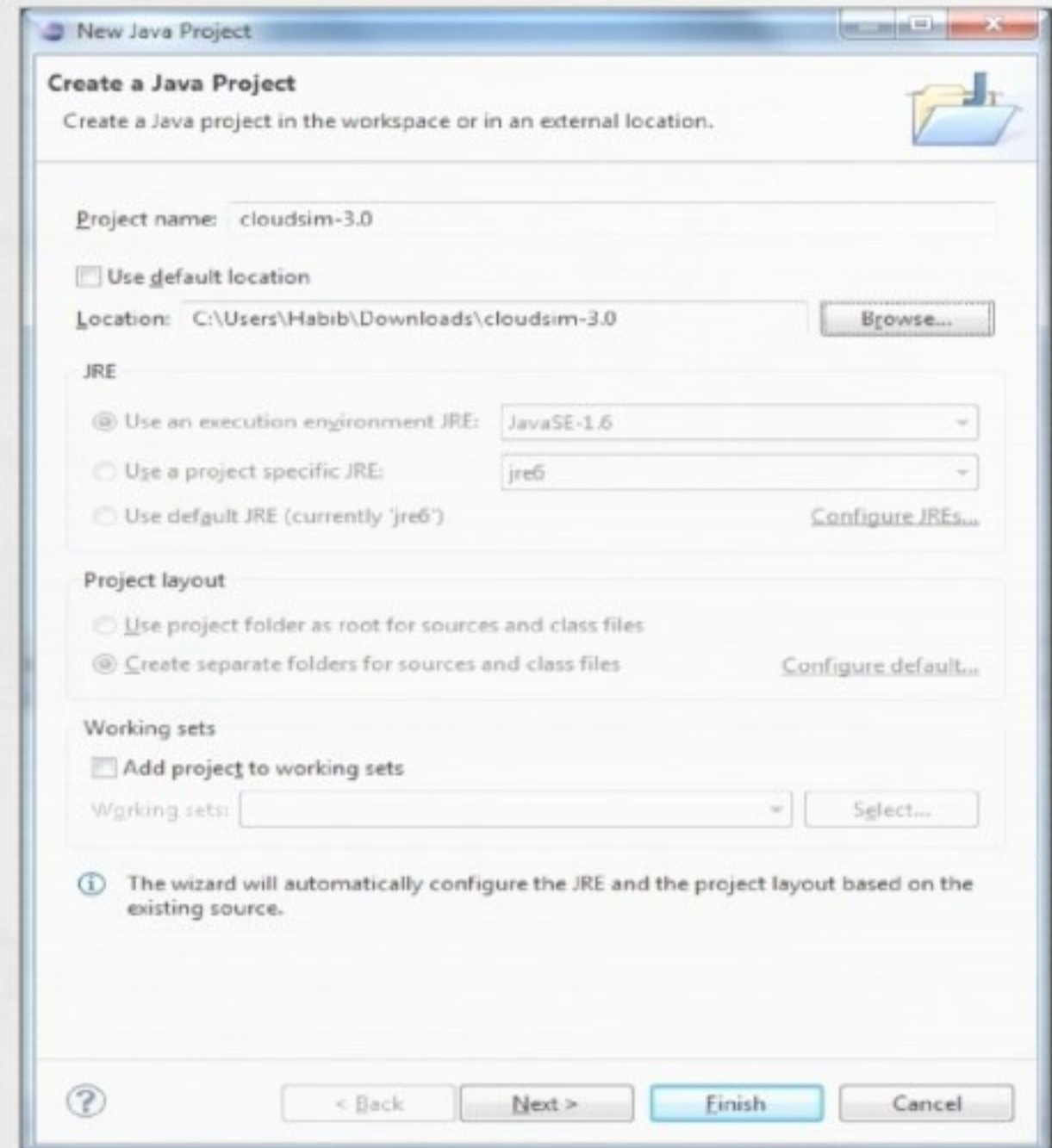
Part 2: How to use Eclipse with CloudSim

- OPEN ECLIPSE -> NEW -> JAVA PROJECT



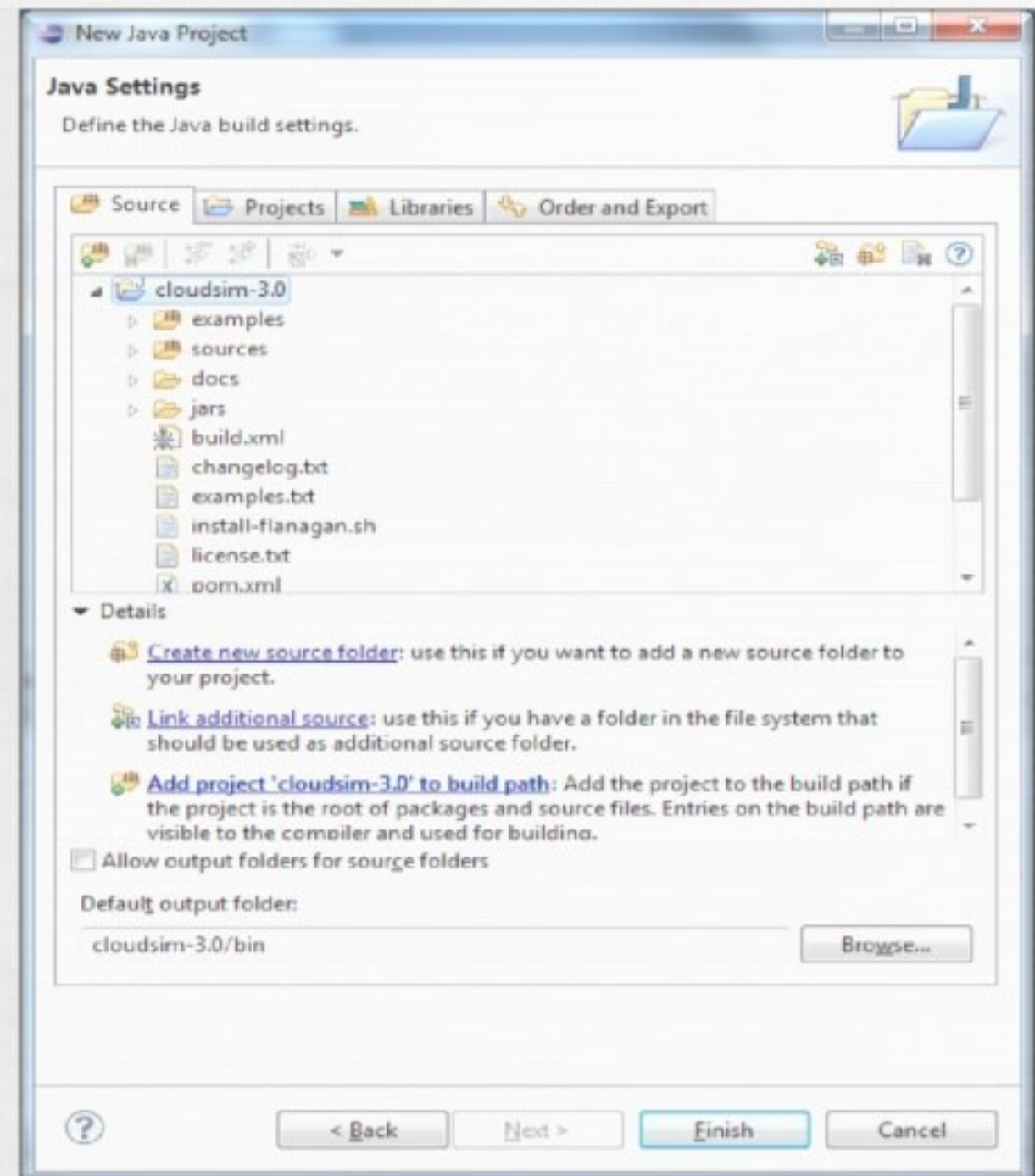
Part 2: How to use Eclipse with CloudSim

- Write the Project Name
- Untick the USE Default Location
- Browse and target it to where you extracted the CloudSim-3.0
- On JRE Select JavaSE-1.6 or JavaSE-1.7
- Project Layout second option
- Click Next



Part 2: How to use Eclipse with CloudSim

- Finally you got the RIGHT screen
- Select Finish

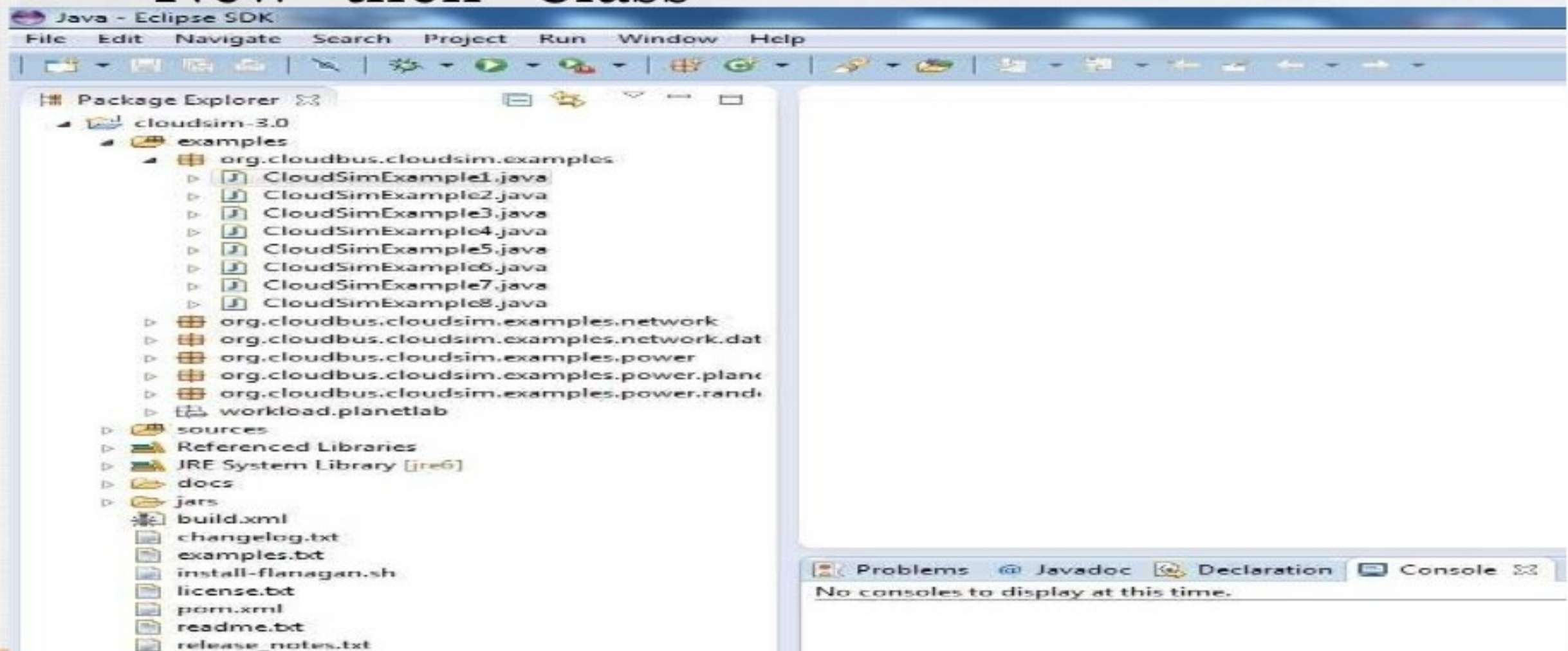


Part 3: Simulation Example

- CloudSimExample1.java : shows how to create a datacenter with one host and run one cloudlet on it
- CloudSimExample2.java : shows how to create a datacenter with one host and run two cloudlets on it

Step1: Run example using CloudSim

- To create class just right click from “org.cloudbus.cloudsim.examples”, select “New” then “Class”



Step2: Run example using CloudSim

- Write Class name and click “Finish”

New Java Class

Create a new Java class.

Source folder:

Package:

☐ Enclosing type:

Name:

Modifiers: ☒ public ☐ default ☐ private ☐ protected
☐ abstract ☐ final ☐ static

Superclass:

Interfaces:

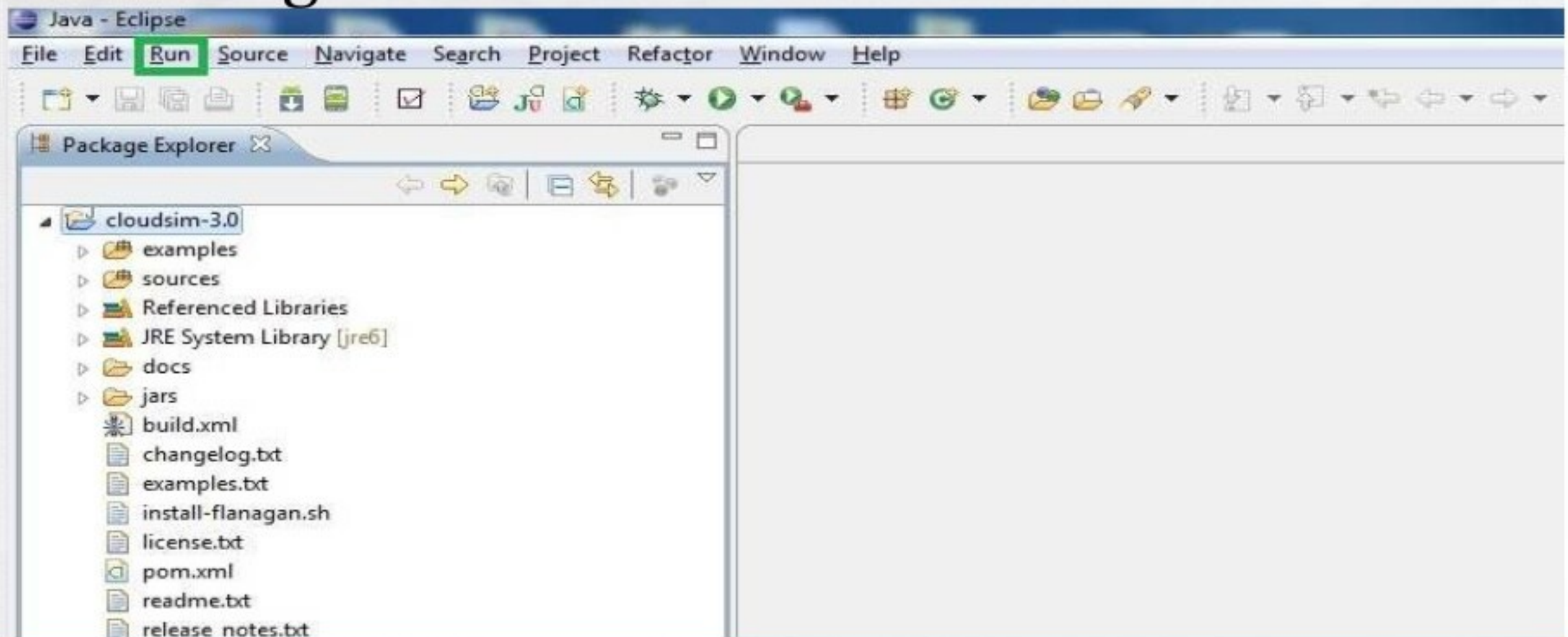
Which method stubs would you like to create?

☐ public static void main(String[] args)
☐ Constructors from superclass
☒ Inherited abstract methods

Do you want to add comments? (Configure templates and default value [here](#))
☐ Generate comments

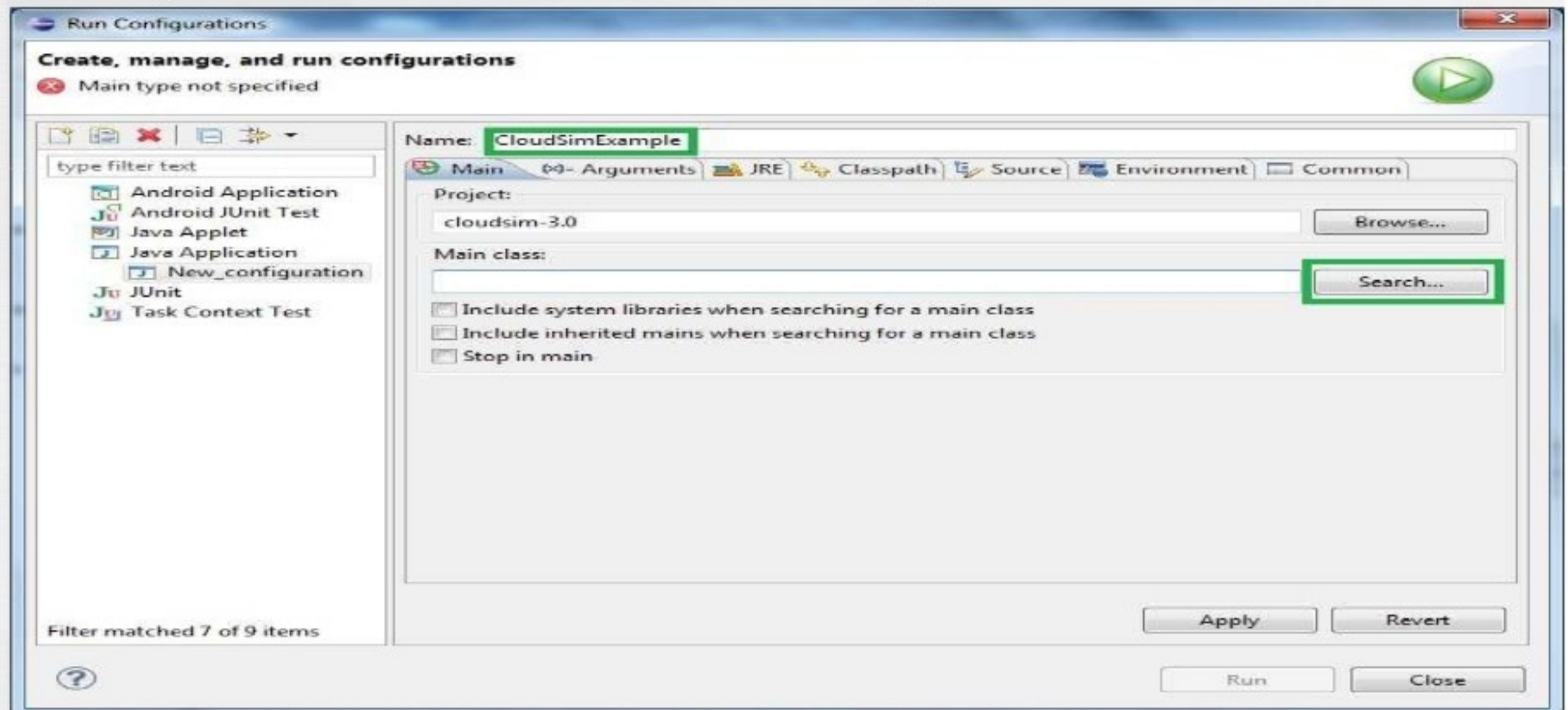
Step3: Run example using CloudSim

- To run simulation Select project
- Click “Run” Menu then select “Run Configurations..”



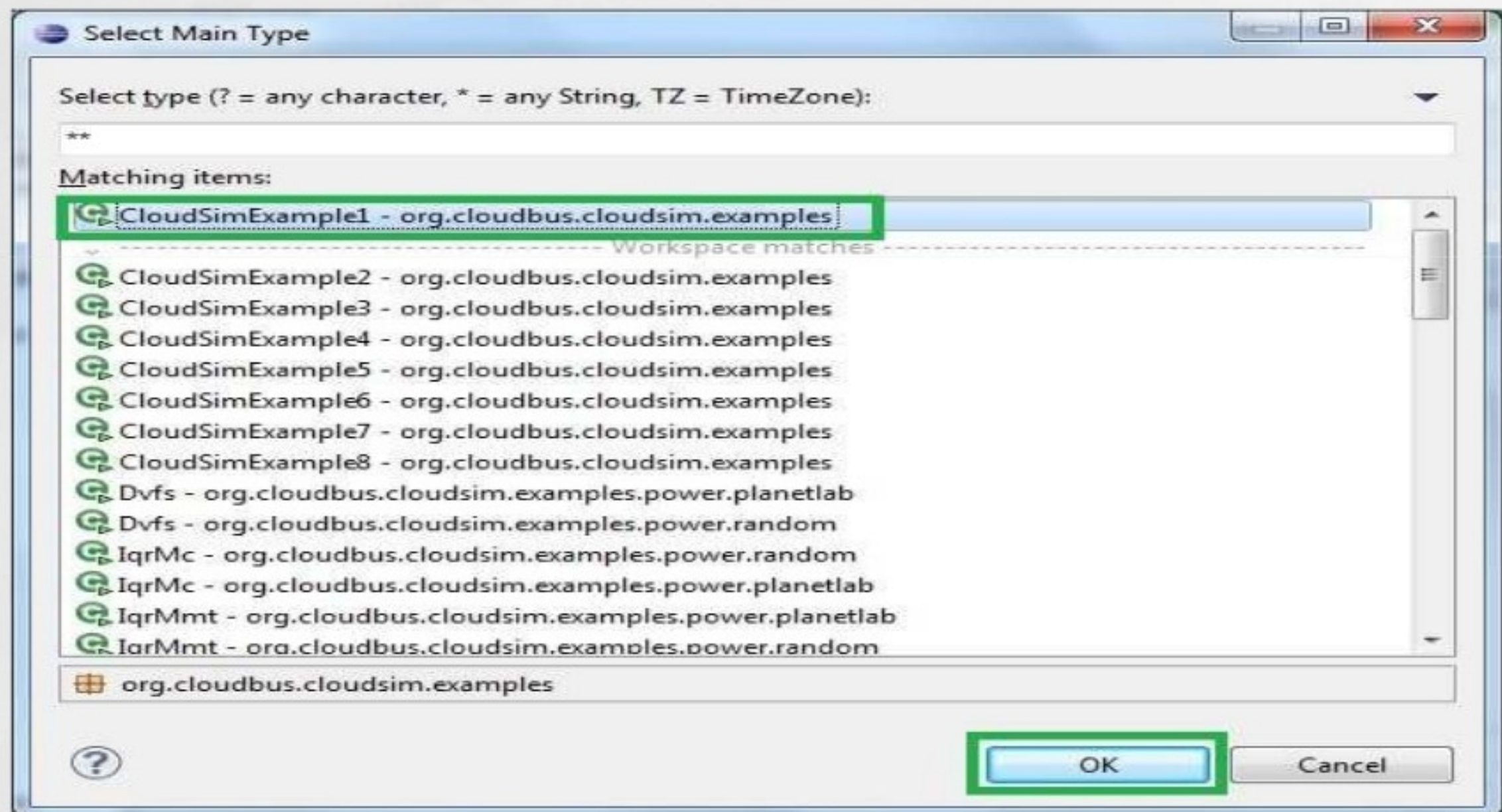
Step4: Run example using CloudSim

- Provide simulation name and select search option to choose an example



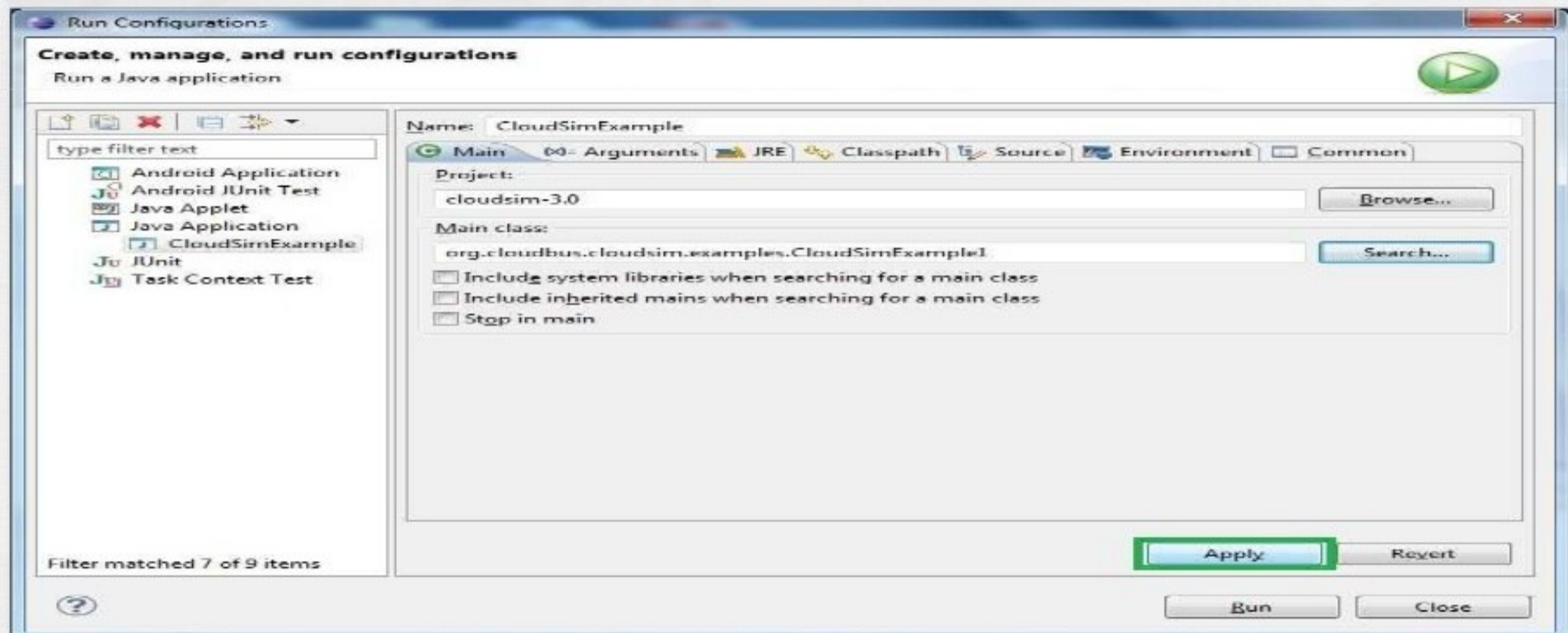
Step5: Run example using CloudSim

- Select specific example and press OK



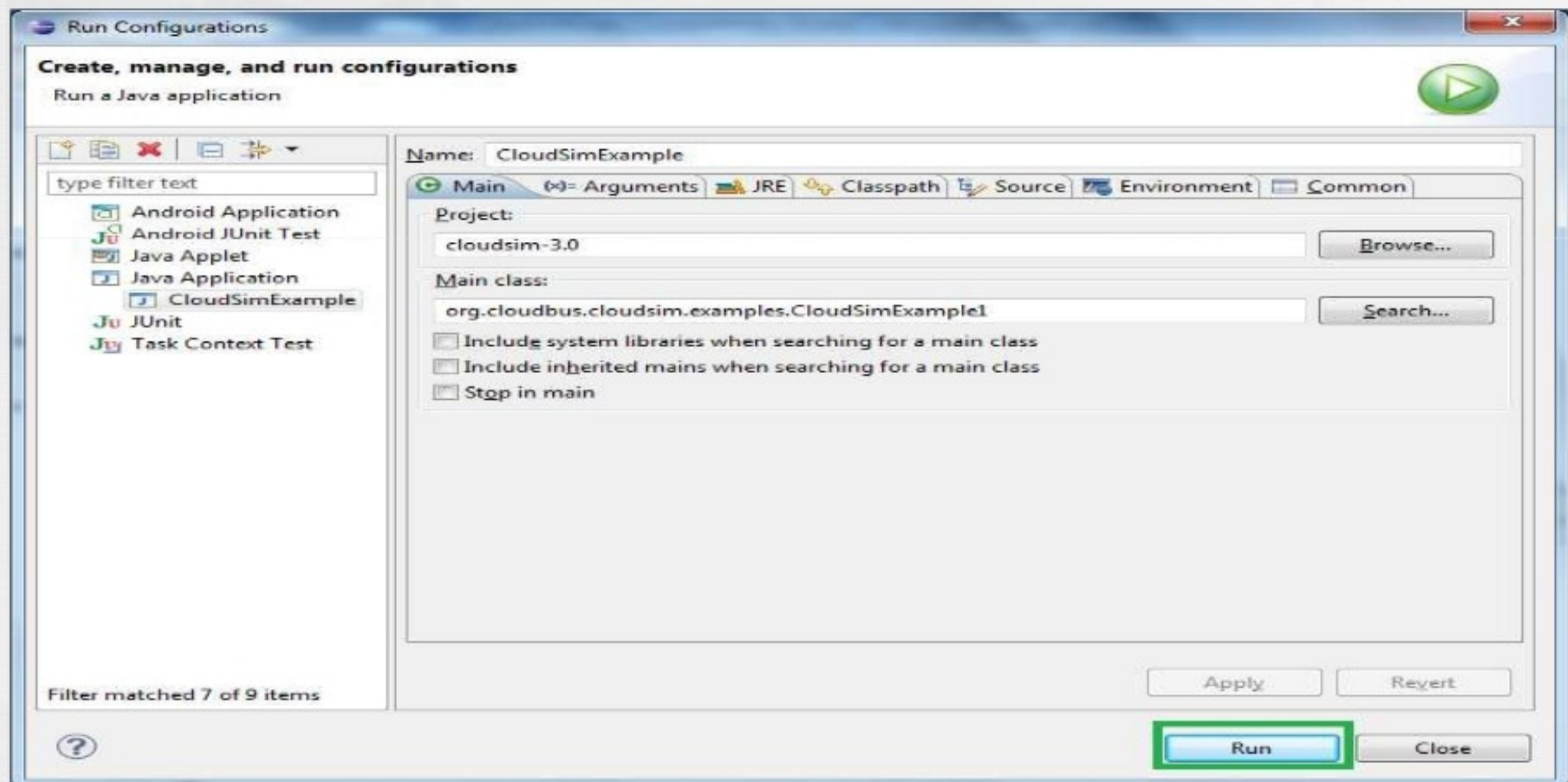
Step6: Run example using CloudSim

- Click “Apply” after select your Main class
- Do Step4 and Step5 if you select another simulation main class for simulation



Step7: Run example using CloudSim

- Click Run to simulate CloudSimExample1



Simulation Result

Problems @ Javadoc Declaration Console X
<terminated> CloudSimExample [Java Application] C:\Program Files (x86)\Java\jre6\bin\javaw.exe (Jul 9, 2012 2:31:18 PM)

```
Starting CloudSimExample1...
Initialising...
Starting CloudSim version 3.0
Datacenter_0 is starting...
Broker is starting...
Entities started.
0.0: Broker: Cloud Resource List received with 1 resource(s)
0.0: Broker: Trying to Create VM #0 in Datacenter_0
0.1: Broker: VM #0 has been created in Datacenter #2, Host #0
0.1: Broker: Sending cloudlet 0 to VM #0
400.1: Broker: Cloudlet 0 received
400.1: Broker: All Cloudlets executed. Finishing...
400.1: Broker: Destroying VM #0
Broker is shutting down...
Simulation: No more future events
CloudInformationService: Notify all CloudSim entities for shutting down.
Datacenter_0 is shutting down...
Broker is shutting down...
Simulation completed.
Simulation completed.
```

===== OUTPUT =====

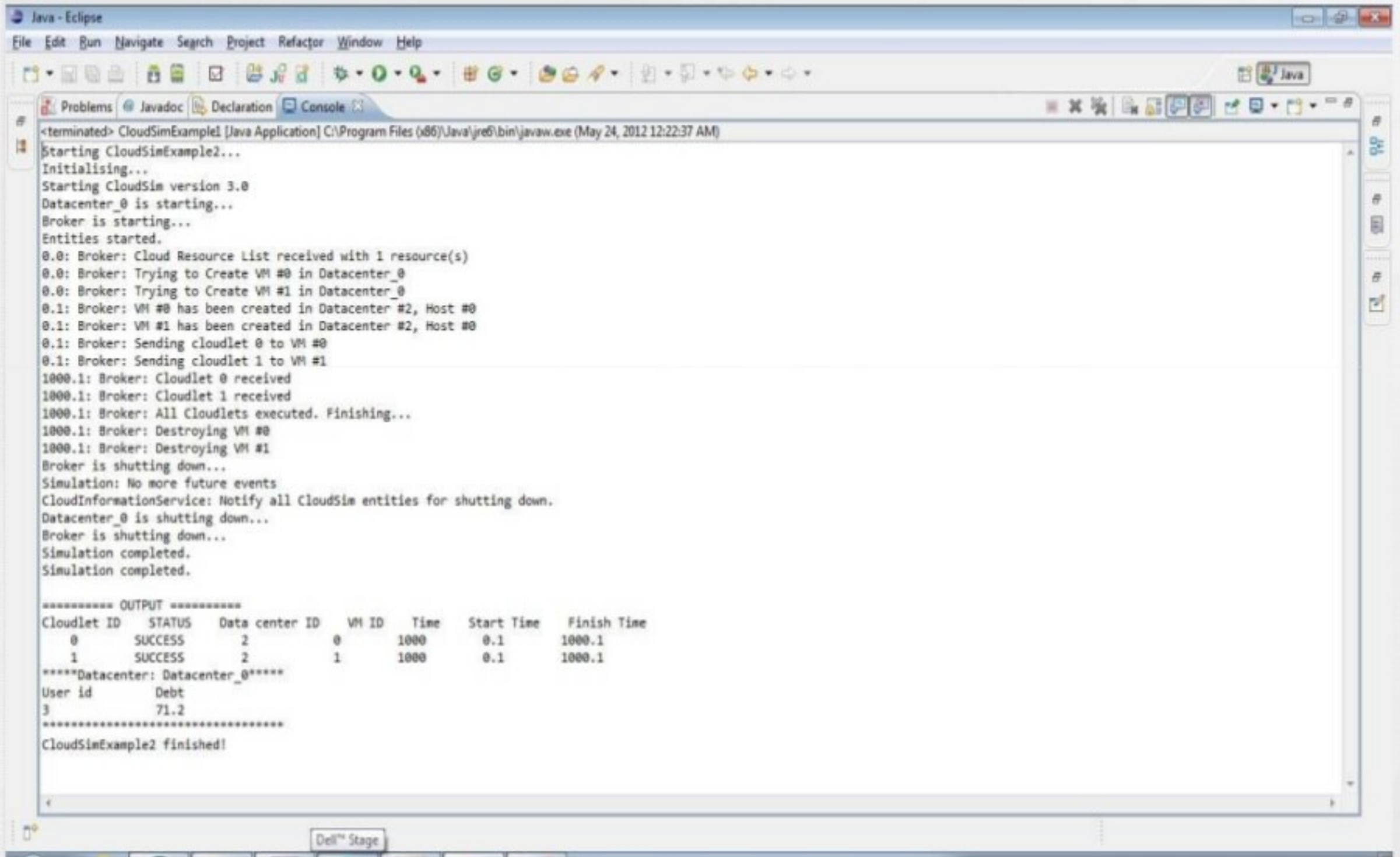
Cloudlet ID	STATUS	Data center ID	VM ID	Time	Start Time	Finish Time
0	SUCCESS	2	0	400	0.1	400.1

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

User id	Debt
3	35.6

CloudSimExample1 finished!

Simulation Result



```
<terminated> CloudSimExample1 [Java Application] C:\Program Files (x86)\Java\jre6\bin\javaw.exe (May 24, 2012 12:22:37 AM)
Starting CloudSimExample2...
Initialising...
Starting CloudSim version 3.0
Datacenter_0 is starting...
Broker is starting...
Entities started.
0.0: Broker: Cloud Resource List received with 1 resource(s)
0.0: Broker: Trying to Create VM #0 in Datacenter_0
0.0: Broker: Trying to Create VM #1 in Datacenter_0
0.1: Broker: VM #0 has been created in Datacenter #2, Host #0
0.1: Broker: VM #1 has been created in Datacenter #2, Host #0
0.1: Broker: Sending cloudlet 0 to VM #0
0.1: Broker: Sending cloudlet 1 to VM #1
1000.1: Broker: Cloudlet 0 received
1000.1: Broker: Cloudlet 1 received
1000.1: Broker: All Cloudlets executed. Finishing...
1000.1: Broker: Destroying VM #0
1000.1: Broker: Destroying VM #1
Broker is shutting down...
Simulation: No more future events
CloudInformationService: Notify all CloudSim entities for shutting down.
Datacenter_0 is shutting down...
Broker is shutting down...
Simulation completed.
Simulation completed.

***** OUTPUT *****
Cloudlet ID   STATUS   Data center ID   VM ID   Time   Start Time   Finish Time
0            SUCCESS    2                0       1000    0.1          1000.1
1            SUCCESS    2                1       1000    0.1          1000.1
*****Datacenter: Datacenter_0*****
User id      Debt
3            71.2
*****
CloudSimExample2 finished!
```


Thank you 😊