

Configuration Manual

MSc Research Project Cloud Computing

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> School of Computing National College of Ireland

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National College of Ireland



MSc Project Submission Sheet

School of Computing

Student Name:	Vamshi Goutham Akabote			
Student ID:	X22203010			
Programme:	MSCCLOUD	Year:	2023-2024	
Module:	MSCCLOUD Research Project			
Lecturer: Submission Due Date:	Yasantha Samarawickrama			
		-		

Project Title:GreenStream Routing: Dynamic Data Allocation from Edge Devices
to Multi-Cloud Based on Renewable Energy Utilization.

Word Count: 773 Page Count: 10

I hereby certify that the information contained in this (my submission) is information pertaining to research I conducted for this project. All information other than my own contribution will be fully referenced and listed in the relevant bibliography section at the rear of the project.

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Signature: Vamshi Goutham Akabote

Date: 12/08/2024

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Configuration Manual

Vamshi Goutham Akabote Student ID: X22203010

1 Requirements

In this research, the implementation of Greenstream routing has been successfully achieved through simulation, with the Adaptive Renewable Energy Resource Allocation (ARERA) algorithm serving as the core component of the system. Various Integrated Development Environment (IDE) tools such as Eclipse, IntelliJ, and Visual Studio can be utilized for performing the simulation and building the ARERA API. This document provides a comprehensive guide to each step required to implement the Greenstream routing engine. Specifically, it details the setup process using Eclipse as the chosen development tool for the simulation environment and IntelliJ for the development of the ARERA API.

1. Download and install eclipse IDE (2023) and IntelliJ IDEA (2023). Once downloaded open the IDE and you will see the loading page like in figure 1 and 2.



Figure1: Eclipse



Find Actions #3

Figure 3: Creating new workspace for this research.

- 2. Now, in the Eclipse create a relevant workspace name for this research as you can see in the figure 2.
- 3. Once the workspace is created and opened, download the iFogSim 2 tool from GitHub. After downloading, unzip the folder and import the project into Eclipse.

/2.0.0 (Latest)		Compare -
mgoudarzi90 released this Apr 25, 2022 - 5 commits to main since this release 🛇 v2.0.0	-≎ 643c433 ⊘	
Nobility Management, Microservice Management, and Dynamic Distributed Clustering are	added and tested correctly.	
Assets 3		
𝔅iFogSim-main.zip	19.9 MB	Apr 25, 2022
Source code (zip)		Apr 25, 2022
_		

Figure 4: iFogSim 2 from Github

4. Click on the directory and select the ifogsim which you have downloaded. Now, click on finish.

					Im	nport Proj	ects fron	n File Syster	or Arc	hive					
mport Projects This wizard ana	s fro alyze	m File	tent of yo	or Arch	i ve r or archiv	ve file to find	d projects a	and import the	n in the I	DE.					~
Import source:	[/	sers/av	mshigou	ham/Do	vnloads/X	K22203010_	Greenstrea	am				Director	у	Archive.	
type filter text														Select All	
Folder									Imp	ort as				Deselect All	
✓ X222030	10_G	eenstre	am						Ecli	pse project					
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Figure 5: Import Project.

5. Once sucufully imported, you will be able to see package explore like the one shown in figure 5. Click on iFogSim-2.0.0, select 'src'. Click on 'org.fog.test.perfeval' and select x22203010_Greenstream java file.

🚦 Package Explorer 🗙	F 😓 🗊 🕴 🗖
✓ [™] iFogSim-2.0.0	
> = JRE System Libra	arv [JRE [17.0.10]]
✓ → src	
> 📇 images	
> 🚠 org.cloudbus.c	cloudsim
> 🖶 org.cloudbus.o	cloudsim.core
> 🖶 org.cloudbus.o	cloudsim.core.predicates
> 🖶 org.cloudbus.c	cloudsim.distributions
> 🖶 org.cloudbus.c	cloudsim.lists
> 🖶 org.cloudbus.	cloudsim.network
> Hord org.cloudbus.cloudbu	cloudsim.network.datacenter
> Hord org.cloudbus.cloudbu	cloudsim.power
> 🖶 org.cloudbus.	cloudsim.power.lists
> 🖶 org.cloudbus.	cloudsim.power.models
> 🖶 org.cloudbus.	cloudsim.sdn
> 🔠 org.cloudbus.d	cloudsim.sdn.example
> 🌐 org.cloudbus.o	cloudsim.sdn.example.policies
> 🔠 org.cloudbus.d	cloudsim.sdn.example.topogenerators
> 🔠 org.cloudbus.d	cloudsim.sdn.graph.core
> 🔠 org.cloudbus.d	cloudsim.sdn.graph.dialog
> 🔠 org.cloudbus.c	cloudsim.sdn.graph.example
> org.cloudbus.c	cloudsim.sdn.overbooking
> org.cloudbus.c	ciouasim.san.power
> m org.cloudbus.c	cioudsim.san.request
> m org.cloudbus.c	
> He org fog entitie	
> H org fog gui co	20 20
> 👍 org fog gui dia	log
> 🛲 org.fog.gui.ex	ample
> 🔠 ora.foa.mobilit	zvdata
> 🚠 org.fog.placen	nent
> 🚠 org.fog.policy	
> 🚠 org.fog.sched	uler

- > 🖶 org.fog.test
- > 🚠 org.fog.test.perfeval
- > 🚠 org.fog.utils
- > 🖶 org.fog.utils.distribution
- > 🔁 topologies
 - executeTuple.png

E executeTuple.used Figure 6: This is package explore

🚺 X2	2203010_Greenstream.java 🗙		
1	package org.fog.test.p	erfeval;	
2			
30	∋import java.util.Array	List;	
44			
45	public class X22203010	_Greenstream {	
40	static List-FogDev	ices for Devices - new Arrow ista ():	
48	private static fin	al Random RANDOM = new Random():	
49			
500	public static void	<pre>main(String[] args) {</pre>	
51	try {		
52	Log.enable	0;	
53	int num_use	er = 1;	
54	ClaudSim i	alendar = Calendar.gerinstance();	
55	C COUDSIN. 1	nit(num_user, catendar, facse);	
57	String app	Id = "Greenstream":	
58	FogBroker	broker = new FogBroker("broker");	
59	5		
60	Applicatio	n application = createApplication(appId, broker.getId());	
61			
62	createFogDe	evices(broker.getId(), appId);	
63	MadulaMana	ing and levering - MeduleManning another duleManning().	
65	for (EogDer	ing modutemapping = modutemapping.createmodutemapping();	
66	module	Vice device : ///////////////////////////////////	
67	}	happing.additional terobevice(data_anatyzer , device.getName()),	
68	,		
69	Controller	controller = new Controller("master-controller", <i>foqDevices</i> , new ArrayList<>(), new ArrayList<>());	
70	controller	.submitApplication(application, new ModulePlacementEdgewards(<i>fogDevices</i> , new ArrayList<>(), new ArrayList<>(), applicat	ion,🗖
71			-
72	TimeKeeper	.getInstance().setSimulationStartTime(Calendar.getInstance().getTimeInMillis());	
73	C		
74	System.out	.printn("Starting API Call");	
75	System out	printing ("API call completed "):	
77	CloudSim.s:	tarts multion ():	
78	e coddo i m b		
79	// Adding a	a short delay to ensure API response is processed	
80	Thread.slee	ep (5000);	
81			
82	CloudSim.s	topSimulation();	
83	Log printle	ins(UDstail approximate Simulation SimishedUU).	
04		Iner Recarc_management Simulation Finished: /;	
@ Ja	vadoc 🗙 😣 Declaration	(+ -> 🔁 🗃 🛱	
as ve	oid org fog test perfeval X222030	10. Greenstream main(String[] args)	
• •			

Figure 7: Greenstream code landing page*

6. In figure 6 you can see Greenstream code and right click on x22203010_Greenstream.java file and select run as java application.

7. Figure 7 shows the output of Greenstream code.

Creating data_analyzer on device dc2 Creating data_analyzer on device dc3 Creating data_analyzer on device dc4 Starting API calus. Preparing API calus. Response from ARERA API ("carbonfootprint": 248.365, "data on for the former of
"currentLoadScore": 0.16524195194990812, "renewableEnergyScore": 0.156000000000000, "distanceScore": 0.022857142857142857
"fighestScore": 0.36790090519294905, "energyUsageDetails": { "totalEnergyKWh": 8093, "nonRenewabLeEnergyKWh": 4936.73, "renewabLeEnergyKWh": 3156.27
} } Data sent to the selected data center. API call completed.
Starting CloudSim version 3.0 cloud is starting proxy-server is starting
dc2 is starting dc3 is starting dc4 is starting
0.0 Submitted application Greenstream Entities started. Simulation completed.
EXECUTION TIME : 1294
APPLICATION LOOP DELAYS
Cloud : Energy Consumed = 2626/85.714285/15 proxy-server : Energy Consumed = 208571.42857142855 dc1 : Energy Consumed = 202857.14285714275 dc2 : Energy Consumed = 2242857.14285714275 dc3 : Energy Consumed = 2242857.14285714275
Cost of execution in cloud = 4000.0

Figure 8: Output can be seen in the console. *

2 ARERA Requirements (Optional)

1. Go to github, and click on code and download the x22203010_ARERA zip file or you can clone the repo by below command on the terminal. *git clone https://github.com/vamshigoutham/X22203010_ARERA.git*

T X22203010_ARERA Public		☆ Pin
ి main 👻 ి 1 Branch 🛇 0 Tags	Q Go to file	t Add file - Code - About
👩 vamshigoutham first commit		bec7907 · 5 minutes ago ூ 1 Commit No description, website, or topics provided.
🖿 .idea	first commit	5 minutes ago 🕹 Activity
node_modules	first commit	☆ 0 stars 5 minutes ago ⊙ 1 watching
src	first commit	5 minutes ago 😵 0 forks
DS_Store	first commit	5 minutes ago
ARERA.iml	first commit	5 minutes ago No releases published
C Archive.zip	first commit	5 minutes ago
Procfile	first commit	5 minutes ago Packages
🗋 app.js	first commit	5 minutes ago No packages published Publish your first package
🗋 package-lock.json	first commit	5 minutes ago
🗋 package.json	first commit	5 minutes ago
		JavaScript 99.7% Procfile 0.3%
		Suggested workflows Based on your tech stack

Figure 9: ARERA API repo

2. Unzip the file and open it on any IDE, for this research I have selected IntelliJ (Figure 2). Open the terminal and run.

npm install and then run npm sto	ırt
----------------------------------	-----

3. ARERA API will be running locally.

http://localhost:" portnumber"

in	C							
-£	RE:	30,	с:	19845,	D:		CL:	8335, id: 'dc1' },
-£	RE:		с:		D:		CL:	655, id: 'dc2' },
-€	RE:	99,	с:	14624,	D:	49,	CL:	1725, id: 'dc3' },
-€	RE:	72,	с:	18930,	D:	3, 0	: : :	2009, id: 'dc4' }
3								
in	E							
-£	RE:	56,	с:		D:		CL:	2584, id: 'dc1' },
-£	RE:	8, 0	> = = =	11828, [): :	20, 0	CL: :	2914, id: 'dc2' } ,
-£	RE:		с:	16543,	D:	1, 0	CL:	5319, id: 'dc3' },
-£	RE:		с:	15874,	D:	50,	CL:	1301, id: 'dc4' }
3								
in	E							
-€	RE:	60,	с:	13482,	D:	60,	CL:	6415, id: 'dc1' },
-€	RE:	83,	с:	15751,	D:	29,	CL:	5690, id: 'dc2' },
-€	RE:	25,	с:	19512,	D:	26,	CL:	6304, id: 'dc3' },
-£	RE:	56,	с:	14930,	D:	61,	CL:	1070, id: 'dc4' }
J								
in	C							
-£	RE:	96,	с:	15326,	D:	15,	CL:	9182, id: 'dc1' },
-£	RE:	33,	с:	18850	D:	27.	CL:	722, id: 'dc2' },
-€	RE:	54.	с:	16769.	D:	36.	CL:	3873, id: 'dc3' },
-€	RE:	81.	с:	17180	D:	31	CL:	4502. id: 'dc4' }
י ר								
Ē								
_								
ERA	> sr		serv	ices > [ıs aı	reraS	ervice	e.js

Figure 10: When Local endpoint is used in the simulation.

*You can skip the ARERA requirements step as it's already hosted on AWS, specifically on Elastic Beanstalk.

ARERA API Endpoint: 1.elasticbeanstalk.com/arera/route. http://greenstreamarera.us-east-

Environments (1) Info						C	Actions v	Create env	ironment
Q Filter environments								< -	1 > ©
Environment name A He	ealth 🔻	Applica v	Platform ⊽	Domain	⊽	Runnin マ	Tier na ⊽	Date cr ▼	Last m ⊽
RICGreenStream-env) Ok	RICGreen	Node.js 2	GreenStreamARERA.us-east-1		1-3	WebServer	August 4,	August 4,

Figure 9: Greensteam Environment.

Elastic Beanstalk > Environments > RICGreenStream-env											
RICGreenStream-env Info				C Actions Vpload and deploy							
Environment overview			Platform Change versio								
Health 🔗 Ok		Environment ID Platform D e-cqp3s63uta Node,is 20 running on 64bit Amazon Linux 2		3/6.1.8							
Domain GreenStreamARERA.us-east-1.elasticbeanstalk	com 🖸	Application name RICGreenStream	Running version 1-3	Platform state ⊘ Supported							
Events Health Logs Monitoring Alarms Managed updates Tags											
Events (37) Info											
Q Filter events by text, property or value				< 1 2 > ©							
Time	▼ Туре	Details									
August 4, 2024 17:38:35 (UTC+1)	INFO	Removed instance [i-0a22c596d287f5d35] from your environment.									
August 4, 2024 17:38:35 (UTC+1)	() INFO	Environment health has transitioned from No Data to Ok.									
August 4, 2024 17:37:35 (UTC+1)	(i) INFO	Environment health has transitioned from Ok to No Data. None of the instances are sending data.									
August 4, 2024 17:37:35 (UTC+1)	(i) INFO	Added instance [i-04f7e4f481963c453] to your environment.									
August 4, 2024 14:04:39 (UTC+1)	INFO	Deleted log fragments for this environment.									
August 4, 2024 14:02:54 (UTC+1)	(i) INFO	Environment health has transitioned from Info to Ok. Configuration update completed 60 seconds ago and took 52 seconds.									
August 4, 2024 14:01:10 (UTC+1)	INFO	Environment update completed successfully.									
August 4, 2024 14:01:10 (UTC+1)	(i) INFO	Successfully deployed new configuration to environment.									
August 4, 2024 14:00:54 (UTC+1) (INFO) Environment health has transitioned from Warning to Info. Configuration update in progress (running for 13 seconds).											

Figure 11: Details of Greenstream, with health ok.

4. When we integrate the ARERA API endpoint in the ifogsim simulation, X22203010_Greenstream. Java and the java file, all the random value generated by the simulation can be seen in the logs as show in figure 11.

Aug	6 15:21:54	ip-172-31-90-172	web[2115]: ir	Г	
Aug	6 15:21:54	ip-172-31-90-172	web[2115]: {	RE:	: 21. C: 17245. D: 62. CL: 2030. id: 'dc1' }.
Aug	6 15:21:54	ip-172-31-90-172	web[2115]: {	RE:	: 67. C: 18202. D: 27. CL: 8048. id: 'dc2' }.
Aug	6 15:21:54	ip-172-31-90-172	web[2115]: {	RE:	: 98. C: 16506. D: 52. CL: 6133. id: 'dc3' }.
Aug	6 15:21:54	ip-172-31-90-172	web[2115]: {	RE:	45. C: 12446. D: 52. CL: 2658. id: 'dc4' }
Aug	6 15:21:54	ip-172-31-90-172	web[2115]:]		
Aug	6 15:26:06	ip-172-31-90-172	web[2115]: ir	n F	
Aug	6 15:26:06	ip-172-31-90-172	web[2115]: {	BE:	: 91. C: 17172. D: 26. Cl: 3102. id: 'dc1' }.
Aug	6 15:26:06	ip-172-31-90-172	web[2115]: {	RF:	53. C: 15261. D: 7. CL: 5459. id: 'dc2' }.
Aug	6 15:26:06	ip-172-31-90-172	web[2115]: {	RF:	: 2. C: 15786, D: 58, CL: 911, id: 'dc3' }.
Aug	6 15:26:06	ip-172-31-90-172	web[2115]: {	BE:	11. C: 11582. D: 2. Cl: 8260. id: 'dc4' }
Aug	6 15:26:06	ip-172-31-90-172	web[2115]:]		
Aug	6 15:26:15	ip-172-31-90-172	web[2115]: ir	n f	
Aug	6 15:26:15	in-172-31-90-172	web[2115]: {	BE:	: 21. C: 11996. D: 25. Cl: 319. id: 'dc1' }.
Aug	6 15:26:15	in-172-31-90-172	web[2115]: {	BE:	8. C: 11840, D: 10, CL: 2459, id: 'dc2' }.
Aug	6 15:26:15	in-172-31-90-172	web[2115]: {	BE:	51. C: 11029. D: 10. Cl: 2055. id: 'dc3' }.
Aug	6 15:26:15	in-172-31-90-172	web[2115]: {	BE:	78. C: 18950, D: 35, CI: 4039, id: 'dc4' }
Aug	6 15:26:15	in-172-31-90-172	web[2115]: 1		
Aug	6 15:26:29	in-172-31-90-172	web[2115]: ir	n r	
Aug	6 15:26:29	in-172-31-90-172	web[2115]: {	BE:	: 85. C: 17470. D: 53. Cl: 3530. id: 'dc1' }.
Aug	6 15:26:29	ip-172-31-90-172	web[2115]: {	RE:	: 73. C: 11647. D: 37. CL: 7820. id: 'dc2' }.
Aug	6 15:26:29	ip-172-31-90-172	web[2115]: {	RE:	: 21. C: 10226. D: 26. CL: 8857. id: 'dc3' }.
Aug	6 15:26:29	ip-172-31-90-172	web[2115]: {	RE:	: 59. C: 11375. D: 30. CL: 4221. id: 'dc4' }
Aug	6 15:26:29	ip-172-31-90-172	web[2115]:]		
Aug	6 15:26:45	ip-172-31-90-172	web[2115]: ir	Г	
Aua	6 15:26:45	ip-172-31-90-172	web[2115]: {	RE:	: 40. C: 10823. D: 39. CL: 9799. id: 'dc1' }.
Aua	6 15:26:45	ip-172-31-90-172	web[2115]: {	RE:	: 42. C: 18726. D: 16. CL: 3210. id: 'dc2' }.
Aua	6 15:26:45	ip-172-31-90-172	web[2115]: {	RE:	: 41. C: 19482. D: 67. CL: 7975. id: 'dc3' }.
Aug	6 15:26:45	ip-172-31-90-172	web[2115]: {	RE:	: 53. C: 17869. D: 51. CL: 5835. id: 'dc4' }
Aug	6 15:26:45	ip-172-31-90-172	web[2115]:]		
Aug	6 15:30:50	ip-172-31-90-172	web[2115]: ir	1	
Aug	6 15:30:50	ip-172-31-90-172	web[2115]: {	RE:	: 98, C: 11136, D: 62, CL: 4835, id: 'dc1' },
Aug	6 15:30:50	ip-172-31-90-172	web[2115]: {	RE:	: 24, C: 18948, D: 15, CL: 4725, id: 'dc2' },
Aug	6 15:30:50	ip-172-31-90-172	web[2115]: {	RE:	: 9, C: 18166, D: 35, CL: 6666, id: 'dc3' },
Aug	6 15:30:50	ip-172-31-90-172	web[2115]: {	RE:	: 34, C: 10311, D: 52, CL: 713, id: 'dc4' }
Aug	6 15:30:50	ip-172-31-90-172	web[2115]:]		
Aug	6 15:33:18	ip-172-31-90-172	web[2115]: ir	1	
Aug	6 15:33:18	ip-172-31-90-172	web[2115]: {	RE:	: 98, C: 19620, D: 42, CL: 14, id: 'dc1' },
Aug	6 15:33:18	ip-172-31-90-172	web[2115]: {	RE:	: 82, C: 12614, D: 11, CL: 1504, id: 'dc2' },
Aug	6 15:33:18	ip-172-31-90-172	web[2115]: {	RE:	: 67, C: 14185, D: 60, CL: 5609, id: 'dc3' },
Aug	6 15:33:18	ip-172-31-90-172	web[2115]: {	RE:	: 47, C: 16643, D: 16, CL: 4816, id: 'dc4' }
Aug	6 15:33:18	ip-172-31-90-172	web[2115]:]		
Aug	6 15:33:29	ip-172-31-90-172	web[2115]: ir	1	
Aug	6 15:33:29	ip-172-31-90-172	web[2115]: {	RE:	: 36, C: 17125, D: 15, CL: 2647, id: 'dc1' },
Aug	6 15:33:29	ip-172-31-90-172	web[2115]: {	RE:	: 95, C: 19647, D: 23, CL: 149, id: 'dc2' },
Aug	6 15:33:29	ip-172-31-90-172	web[2115]: {	RE:	: 26, C: 19456, D: 39, CL: 4958, id: 'dc3' },
Aug	6 15:33:29	ip-172-31-90-172	web[2115]: {	RE:	: 68, C: 18328, D: 60, CL: 5503, id: 'dc4' }
Aug	6 15:33:29	ip-172-31-90-172	web[2115]:]		
Aug	7 11:11:03	ip-172-31-90-172	web[2115]: ir	1 E	
Aug	7 11:11:03	ip-172-31-90-172	web[2115]: {	RE:	: 27, C: 11548, D: 55, CL: 8888, id: 'dc1' },
Aug	7 11:11:03	ip-172-31-90-172	web[2115]: {	RE:	: 51, C: 15264, D: 6, CL: 2337, id: 'dc2' },
Aug	7 11:11:03	ip-172-31-90-172	web[2115]: {	RE:	: 74, C: 16066, D: 63, CL: 7892, id: 'dc3' },
Aug	7 11:11:03	ip-172-31-90-172	web[2115]: {	RE:	: 69, C: 18721, D: 69, CL: 889, id: 'dc4' }
Aug	7 11:11:03	ip-172-31-90-172	web[2115]:]		

Figure 12: Greenstream Logs.

3 Repositories

Repositories 24 🗄 Projects 💮 F	Packages 🏠 Stars			
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Git Reposiroties URL,

X22203010_ARERA- https://github.com/vamshigoutham/X22203010_ARERA.git X22203010_Greenstream- https://github.com/vamshigoutham/X22203010_Greenstream.git

References

Eclipse (2022). Eclipse downloads: The eclipse foundation. URL: https://www.eclipse.org/downloads/

IntelliJ (2023). IntelliJ downloads: JetBrains https://www.jetbrains.com/idea/download/?section=mac

AWS Elastic Beanstalk. https://docs.aws.amazon.com/elastic-beanstalk/?icmpid=docs_homepage_compute

Github. https://github.com/home