

Cloud Computing Assignment 2

Student ID: A0178511E

Name: Maddi Kamal Divya

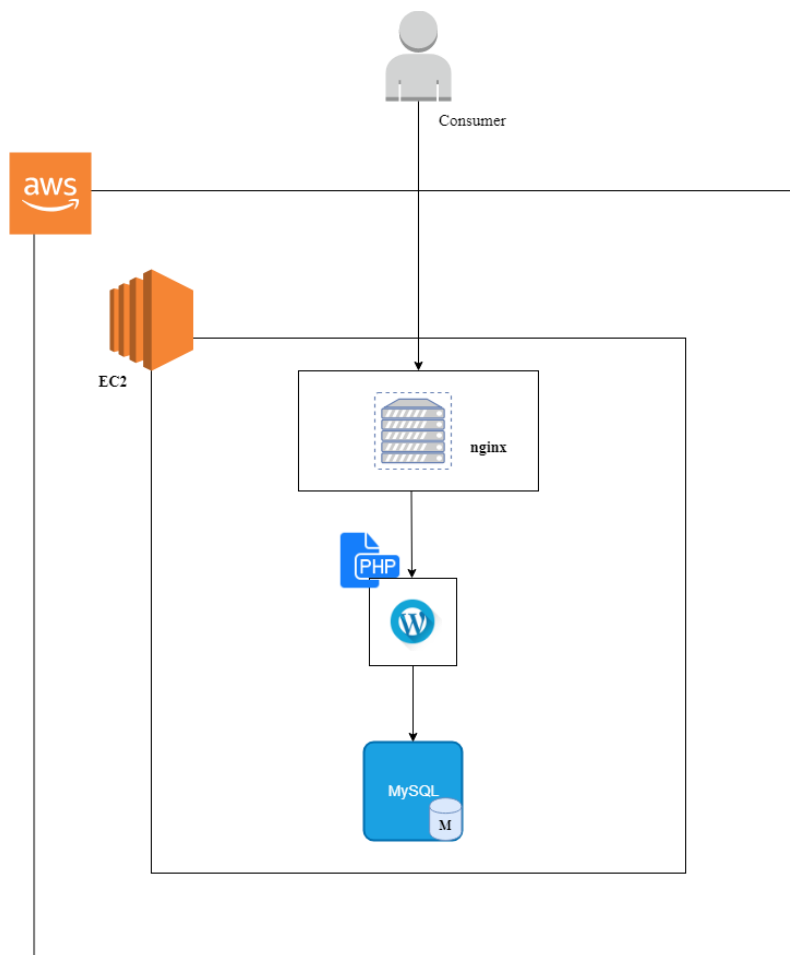
Email: E0267822@u.nus.edu

1. What are the purposes of configuring security groups? (1 mark)

Ans: A security group acts as a virtual firewall to controls inbound and outbound traffic for multiple instances. Default security group is applied if there is no explicit definition of security group and rules can be added to each security group to allow inbound and outbound traffic to/from its associated instances. All the rules from all the security groups that are associated with the instance are evaluated to allow traffic to reach an instance. Rules for a security group can be modified at any time and the new rules are automatically applied to all instances within the security group.

2. Build a WordPress server using EC2 instance (5 marks)

a) Draw a diagram to show your WordPress application consisting of EC2 instance, Linux, database, Apache/Nginx, php, WordPress and other services if any. (1 mark)



b) Configure the security group setting of your EC2 instance. (1 mark)

Ans: Allowing port 80 and 22 in inbound rule to access the website and SSH access respectively.

The screenshot shows the AWS Management Console interface for configuring a security group. At the top, there's a 'Create Security Group' button and an 'Actions' dropdown. Below this is a search bar and a table listing existing security groups. The table has columns: Name, Group ID, Group Name, VPC ID, Owner, and Description. The security group 'sg-078bbd482895d65f9' is selected, which is named 'launch-wizard-3' and belongs to VPC 'vpc-4edd5334'. Below the table, the details for this security group are shown. The 'Inbound' tab is active, displaying a table of inbound rules. The rules table has columns: Type, Protocol, Port Range, Source, and Description. There are three rules: HTTP (TCP, Port 80, Source 0.0.0.0/0), HTTP (TCP, Port 80, Source ::/0), and SSH (TCP, Port 22, Source 0.0.0.0/0).

Name	Group ID	Group Name	VPC ID	Owner	Description
sg-029fe0ab3aae1557f	sg-029fe0ab3aae1557f	launch-wizard-1	vpc-4edd5334	011451122647	launch-wizard-1 created 2019-03-28T16:19:28.343+08:00
sg-078bbd482895d65f9	sg-078bbd482895d65f9	launch-wizard-3	vpc-4edd5334	011451122647	launch-wizard-3 created 2019-04-07T20:09:20.786+08:00
sg-079cda66dcb68d52	sg-079cda66dcb68d52	ElasticMapReduce-master	vpc-4edd5334	011451122647	Master group for Elastic MapReduce created on 2019-03-28
sg-0be90730f2c25b375	sg-0be90730f2c25b375	launch-wizard-2	vpc-4edd5334	011451122647	launch-wizard-2 created 2019-04-07T19:53:26.783+08:00
sg-0fda2189ef24ae8dc	sg-0fda2189ef24ae8dc	ElasticMapReduce-slave	vpc-4edd5334	011451122647	Slave group for Elastic MapReduce created on 2019-03-29
sg-22194265	sg-22194265	default	vpc-4edd5334	011451122647	default VPC security group

Type	Protocol	Port Range	Source	Description
HTTP	TCP	80	0.0.0.0/0	
HTTP	TCP	80	::/0	
SSH	TCP	22	0.0.0.0/0	

c) Set up environment mentioned in (a) and show how to setup a HelloWorld blog using WordPress that you have set up. (submit screenshots for executing -v or -version command eg. mysql -v, php -version, apache2l -v or other environments you are using) (1 mark)

Ans:

Install nginx and MySQL Server and Word Press Site. Change the configuration to setup Word Press. Login to the Word Press Site and post the article Hello World.

The screenshot shows a web browser displaying a WordPress blog post. The address bar shows 'cs5224.example.com/2019/04/07/hello-world-2/'. The WordPress dashboard is visible, with a sidebar menu containing 'Dashboard', 'Themes', 'Widgets', and 'Menus'. The main content area shows the title 'Hello World' in a large, bold font. Below the title, there's a metadata line showing 'divya' as the author, 'April 7, 2019' as the date, and options to 'Leave a comment' and 'Edit'. Below this, another line shows 'divya' as the author, 'April 7, 2019' as the date, 'Uncategorized' as the category, and an 'Edit' option. The post content area is empty.

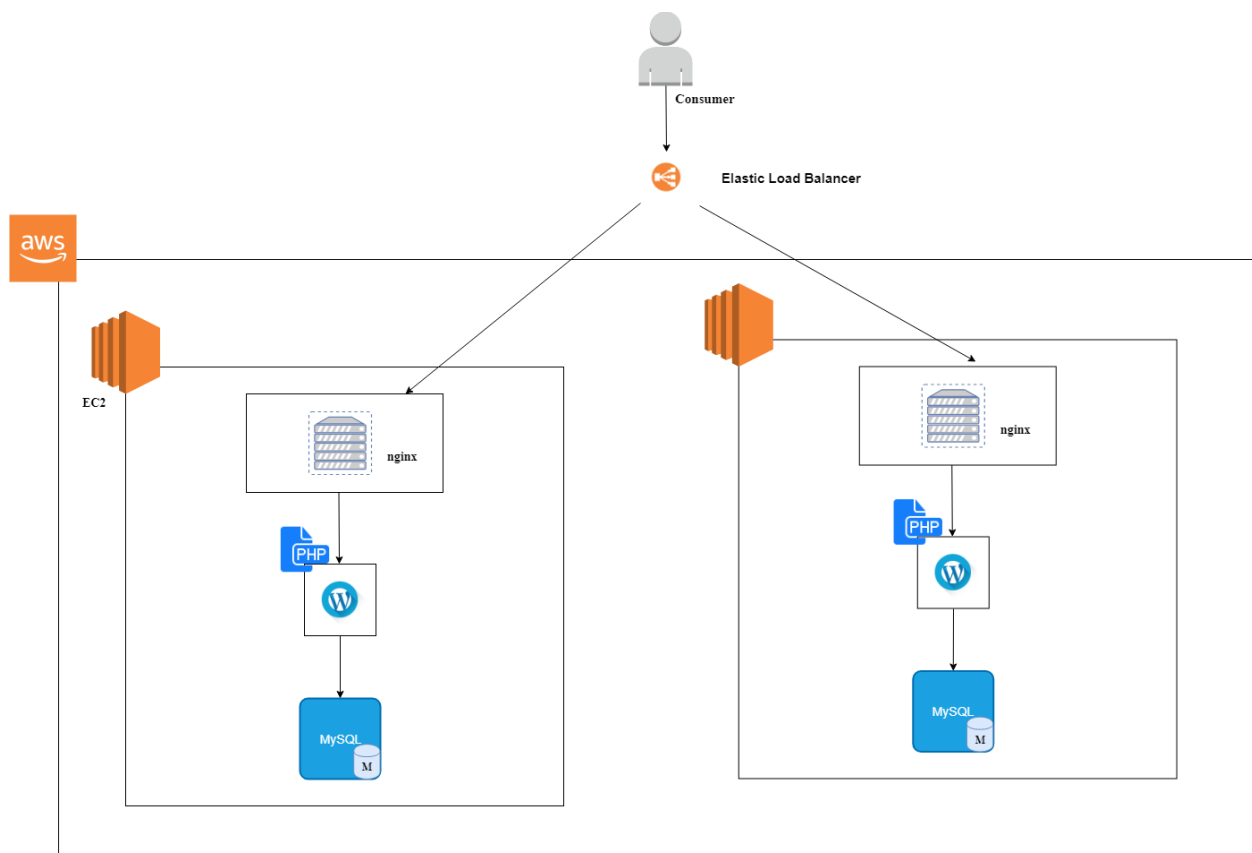
—Previous Post
Hello world!

Below is the versions of MySQL, php and nginx installed.

```
ubuntu@ip-172-31-82-164:/$ mysql --version
mysql Ver 14.14 Distrib 5.7.25, for Linux (x86_64) using EditLine wrapper
ubuntu@ip-172-31-82-164:/$ php --version
PHP 7.2.15-0ubuntu0.18.04.2 (cli) (built: Mar 22 2019 17:05:14) ( NTS )
Copyright (c) 1997-2018 The PHP Group
Zend Engine v3.2.0, Copyright (c) 1998-2018 Zend Technologies
    with Zend OPcache v7.2.15-0ubuntu0.18.04.2, Copyright (c) 1999-2018, by Zend Technologies
ubuntu@ip-172-31-82-164:/$ nginx -v
nginx version: nginx/1.14.0 (Ubuntu)
ubuntu@ip-172-31-82-164:/$
```

d) To provision for blogging traffic, you are given two EC2 instances to host you WordPress site. Briefly explain how you would reconfigure your WordPress setup with two EC2 instances (hint: modify the diagram in (a)). Next, setup the WordPress site with two EC2 instances and show that it works (submit the screenshots). (2 mark)

Ans: Create two instances and install an Elastic Load Balancer to balance the traffic between two instances. Here, the consumer reaches the load balancer to access word press and load balance will send the traffic.



Step1: Configure the databases in both the instances.

Step 2: Observe the Master Status in both instances.

```
1 asgn2 x 2 instance2 x +
Send keyboard input to all sessions.

ubuntu@ip-172-31-82-164:/$
ubuntu@ip-172-31-82-164:/$
ubuntu@ip-172-31-82-164:/$ mysql -u root -p
Enter password:
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 5
Server version: 5.7.25-0ubuntu0.18.04.2-log (Ubuntu)

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affiliates. Other names may be trademarks of their respective
owners.

Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

mysql> SHOW MASTER STATUS;
+-----+-----+-----+-----+-----+
| File           | Position | Binlog_Do_DB | Binlog_Ignore_DB | Executed_Gtid_Set |
+-----+-----+-----+-----+-----+
| mysql-bin.000003 |      1058 |              |                  |                  |
+-----+-----+-----+-----+-----+
1 row in set (0.00 sec)
```

```
1 asgn2 x 2 instance2 x +
Send keyboard input to all sessions.

ubuntu@ip-172-31-90-132:~$
ubuntu@ip-172-31-90-132:~$
ubuntu@ip-172-31-90-132:~$ mysql -u root -p
Enter password:
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 4
Server version: 5.7.25-0ubuntu0.18.04.2-log (Ubuntu)

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affiliates. Other names may be trademarks of their respective
owners.

Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

mysql> SHOW MASTER STATUS;
+-----+-----+-----+-----+-----+
| File           | Position | Binlog_Do_DB | Binlog_Ignore_DB | Executed_Gtid_Set |
+-----+-----+-----+-----+-----+
| mysql-bin.000004 |      1058 |              |                  |                  |
+-----+-----+-----+-----+-----+
1 row in set (0.00 sec)
```

Step 3: In Instance 2:

- STOP SLAVE;
- CHANGE MASTER TO master_host='172.31.88.53', master_port=3306, master_user='replication', master_password='cs5224-replication', master_log_file='mysql-bin.000001', master_log_pos=4998;

- START SLAVE;
- SHOW MASTER STATUS;

```
mysql> STOP SLAVE;
Query OK, 0 rows affected (0.00 sec)

mysql> CHANGE MASTER TO master_host='172.31.90.132', master_port=3306, master_user='replication', master_password='cs5224-replication', master_log_file='mysql-bin.000004', master_log_pos=1058;
Query OK, 0 rows affected, 2 warnings (0.04 sec)

mysql> START SLAVE;
Query OK, 0 rows affected (0.00 sec)

mysql>
mysql>
mysql> SHOW MASTER STATUS;
+-----+-----+-----+-----+-----+
| File           | Position | Binlog_Do_DB | Binlog_Ignore_DB | Executed_Gtid_Set |
+-----+-----+-----+-----+-----+
| mysql-bin.000004 | 1058     |              |                  |                   |
+-----+-----+-----+-----+-----+
1 row in set (0.00 sec)

mysql> CREATE DATABASE cs5224_wordpress DEFAULT CHARACTER SET utf8 COLLATE utf8_unicode_ci;
Query OK, 1 row affected (0.00 sec)

mysql> GRANT ALL ON cs5224_wordpress.* TO 'cs5224'@'localhost' IDENTIFIED BY 'cs5224-wordpress';
Query OK, 0 rows affected, 1 warning (0.00 sec)

mysql> FLUSH PRIVILEGES;
Query OK, 0 rows affected (0.00 sec)
```

Step4: Instance 1:

- STOP SLAVE;
- CHANGE MASTER TO master_host='172.31.93.213', master_port=3306, master_user='replication', master_password='cs5224-replication', master_log_file='mysql-bin.000002', master_log_pos=154;
- START SLAVE;

```
mysql> STOP SLAVE;
Query OK, 0 rows affected, 1 warning (0.00 sec)

mysql> SHOW MASTER STATUS;
+-----+-----+-----+-----+-----+
| File | Position | Binlog_Do_DB | Binlog_Ignore_DB | Executed_Gtid_Set |
+-----+-----+-----+-----+-----+
| mysql-bin.000004 | 1058 | | | |
+-----+-----+-----+-----+-----+
1 row in set (0.00 sec)

mysql>
mysql> CHANGE MASTER TO master_host='172.31.82.164', master_port=3306, master_user='replication', master_password='cs5224-replication', master_log_file='mysql-bin.000003', master_log_pos=1058;
Query OK, 0 rows affected, 2 warnings (0.10 sec)

mysql> START SLAVE;
Query OK, 0 rows affected (0.01 sec)

mysql> SHOW MASTER STATUS;
+-----+-----+-----+-----+-----+
| File | Position | Binlog_Do_DB | Binlog_Ignore_DB | Executed_Gtid_Set |
+-----+-----+-----+-----+-----+
| mysql-bin.000004 | 1058 | | | |
+-----+-----+-----+-----+-----+
1 row in set (0.00 sec)
```

Step 5: Instance 1:

- SHOW DATABASES;
- SELECT * FROM mysql.user;

[illegible]

Observe the databases in both the instance. Both have the same DB instances.

```

mysql> show databases;
+-----+
| Database                |
+-----+
| information_schema      |
| cs5224_wordpress        |
| mysql                   |
| performance_schema      |
| sys                     |
+-----+
5 rows in set (0.00 sec)

```

```
mysql>
mysql>
mysql> show databases;
+-----+
| Database |
+-----+
| information_schema |
| cs5224_wordpress |
| mysql |
| performance_schema |
| sys |
+-----+
5 rows in set (0.02 sec)
```

Register and Install the WordPress in the browser

Not secure | cs5224.example.com/wp-admin/install.php?step=1

Dashboard Outlook IVLE isis TalentConnect gmail e-lib Libraries NUSync Academic Calendar Java - Objects a

Welcome

Welcome to the famous five-minute WordPress installation process! Just fill in the information below and you'll be on your way to using the most extendable and powerful personal publishing platform in the world.

Information needed

Please provide the following information. Don't worry, you can always change these settings later.

Site Title

Username
Usernames can have only alphanumeric characters, spaces, underscores, hyphens, periods, and the @ symbol.

Password
Strong

Important: You will need this password to log in. Please store it in a secure location.

Your Email
Double-check your email address before continuing.

Search Engine Visibility ☐ Discourage search engines from indexing this site
It is up to search engines to honor this request.

cs5224-instance2d New Howdy, divya

Welcome to WordPress!

We've assembled some links to get you started:

Get Started

[Customize Your Site](#)

or, change your theme completely

Next Steps

- [Write your first blog post](#)
- [Add an About page](#)
- [Set up your homepage](#)
- [View your site](#)

More Actions

- [Manage widgets or menus](#)
- [Turn comments on or off](#)
- [Learn more about getting started](#)

At a Glance

1 Post 1 Page

1 Comment

WordPress 5.1.1 running Twenty Nineteen theme.

Activity

Recently Published

Today, 6:22 am [Hello world!](#)

Recent Comments

From A WordPress Commenter on Hello world!
Hi, this is a comment. To get started with moderating, editing, and deleting comments, please visit the Comments screen in...

Quick Draft

Title

What's on your mind?

[Save Draft](#)

WordPress Events and News

Attend an upcoming event near you.

[WordPress Meetup \(April 2019\)](#) Monday, Apr 15, 2019 7:00 pm
Singapore, Singapore

WordPress 5.2 Beta 2

Drag boxes here

In the load balancer created below, identify the DNS Name of the load balancer.

The screenshot displays the AWS Management Console interface for an Elastic Load Balancing (ELB) instance. At the top, there is a 'Create Load Balancer' button and an 'Actions' dropdown menu. Below this is a search bar with the placeholder text 'Filter by tags and attributes or search by keyword'. A table lists the ELB instances, with the following columns: Name, DNS name, State, VPC ID, and Availability Zones. The table contains one entry: 'wordpresslb' with a DNS name of 'wordpresslb-701274116.us-east-1.elb.amazonaws.com', a state of 'active', a VPC ID of 'vpc-4edd5334', and availability zones of 'us-east-1c, us-east-1d'. Below the table, the 'Basic Configuration' section is expanded, showing the following details: Name: wordpresslb, ARN: arn:aws:elasticloadbalancing:us-east-1:011451122647:loadbalancer/app/wordpresslb/c88744292f3f2f6f, DNS name: wordpresslb-701274116.us-east-1.elb.amazonaws.com (A Record), State: active, Type: application, Scheme: internet-facing, and IP address type: ipv4.

Name	DNS name	State	VPC ID	Availability Zones
wordpresslb	wordpresslb-701274116.us-east-1.elb.amazonaws.com	active	vpc-4edd5334	us-east-1c, us-east-1d

Basic Configuration

Name: wordpresslb

ARN: arn:aws:elasticloadbalancing:us-east-1:011451122647:loadbalancer/app/wordpresslb/c88744292f3f2f6f

DNS name: wordpresslb-701274116.us-east-1.elb.amazonaws.com (A Record)

State: active

Type: application

Scheme: internet-facing

IP address type: ipv4

Resolve the DNS name using Nslookup. We use this IP to load the website. The load balancer in AWS will send the traffic to any of the instances.

```
C:\Users\Divya>nslookup wordpresslb-701274116.us-east-1.elb.amazonaws.com
Server:  dns0.comp.nus.edu.sg
Address:  192.168.140.2

Non-authoritative answer:
Name:     wordpresslb-701274116.us-east-1.elb.amazonaws.com
Address:  107.23.222.116
```

When the site is loaded, we can observe the Public IP of the Load balancer.

Not secure | cs5224.example.com/wp-admin/

Apps Scholar Dashboard Outlook IVLE isis TalentConnect gmail e-lib Libraries NUSync Academic Calendar Java - Objects and... YouTube

cs5224-instance0d 0 + New Howdy, divya

Dashboard

Screen Options Help

Welcome to WordPress!
We've assembled some links to get you started:

Get Started

Customize Your Site
or, change your theme completely

Next Steps

- Write your first blog post
- Add an About page
- Set up your homepage
- View your site

More Actions

- Manage widgets or menus
- Turn comments on or off
- Learn more about getting started

At a Glance

1 Post 1 Page
1 Comment
WordPress 5.1.1 running Twenty Nineteen theme.

Activity

Recently Published
Today, 6:22 am Hello world!

Recent Comments

Quick Draft

Title
What's on your mind?
Save Draft

WordPress Events and News

Attend an upcoming event near you.

Network

Filter: Hide data URLs

Name	Size
wp-admin/	10000 ms
load-scripts.php?c=1&load%5...	20000 ms
db67be1fc2f7e4619294b2772...	30000 ms
db67be1fc2f7e4619294b2772...	40000 ms
d7a973c7dab26985da5f961be...	50000 ms
load-scripts.php?c=1&load%5...	60000 ms
wp-polyfill.min.js?ver=7.0.0	70000 ms
hooks.min.js?ver=2.0.5	
heartbeat.min.js?ver=5.1.1	
wp-auth-check.min.js?ver=5.1.1	
wplink.min.js?ver=5.1.1	
position.min.js?ver=1.11.4	
menu.min.js?ver=1.11.4	
autocomplete.min.js?ver=1.11.4	
load-styles.php?c=1&dir=ltr&...	
thickbox.css?ver=5.1.1	
editor.min.css?ver=5.1.1	
datafont/woff/base...	
data:application/fo...	
wp-emoji-release.min.js?ver=5...	
loadingAnimation.gif	
data:image/png;base...	
admin-ajax.php	
admin-ajax.php	

23 requests | 17.9 KB transferred ...

Headers

General

Request URL: http://cs5224.example.com/wp-admin/
Request Method: GET
Status Code: 200 OK
Remote Address: 107.23.222.116:80
Referrer Policy: strict-origin-when-cross-origin

Response Headers

Cache-Control: no-cache, must-revalidate, max-age=0
Connection: keep-alive
Content-Encoding: gzip
Content-Type: text/html; charset=UTF-8
Date: Tue, 09 Apr 2019 09:26:06 GMT
Expires: Wed, 11 Jan 1984 05:00:00 GMT
Referrer-Policy: strict-origin-when-cross-origin
Server: nginx/1.14.0 (Ubuntu)
Set-Cookie: wp-settings-1=deleted; expires=Thu, 01-Jan-1970 00:00:01 GMT; Max-Age=0; path=/
Set-Cookie: wp-settings-time-1=1554801966; expires=Wed, 08-Apr-2020 09:26:06 GMT; Max-Age=31536000; path=/
Transfer-Encoding: chunked

Elements Console Sources Network Performance

Filter: Hide data URLs

Name	Size
load-scripts.php?c=1&load%5...	20000 ms
db67be1fc2f7e4619294b2772...	40000 ms
db67be1fc2f7e4619294b2772...	60000 ms
d7a973c7dab26985da5f961be...	80000 ms
load-scripts.php?c=1&load%5...	100000 ms
wp-polyfill.min.js?ver=7.0.0	120000 ms
hooks.min.js?ver=2.0.5	140000 ms
heartbeat.min.js?ver=5.1.1	
wp-auth-check.min.js?ver=5.1.1	
wplink.min.js?ver=5.1.1	
position.min.js?ver=1.11.4	
menu.min.js?ver=1.11.4	
autocomplete.min.js?ver=1.11.4	
load-styles.php?c=1&dir=ltr&...	
thickbox.css?ver=5.1.1	
editor.min.css?ver=5.1.1	
datafont/woff/base...	
data:application/fo...	
wp-emoji-release.min.js?ver=5...	
loadingAnimation.gif	
data:image/png;base...	
admin-ajax.php	
admin-ajax.php	

24 requests | 18.4 KB transferred ...

Headers

General

Request URL: http://cs5224.example.com/wp-admin/
Request Method: GET
Status Code: 200 OK
Remote Address: 107.23.222.116:80
Referrer Policy: strict-origin-when-cross-origin

Response Headers

Cache-Control: no-cache, must-revalidate, max-age=0
Connection: keep-alive
Content-Encoding: gzip
Content-Type: text/html; charset=UTF-8
Date: Tue, 09 Apr 2019 09:26:06 GMT
Expires: Wed, 11 Jan 1984 05:00:00 GMT
Referrer-Policy: strict-origin-when-cross-origin
Server: nginx/1.14.0 (Ubuntu)
Set-Cookie: wp-settings-1=deleted; expires=Thu, 01-Jan-1970 00:00:01 GMT; Max-Age=0; path=/
Set-Cookie: wp-settings-time-1=1554801966; expires=Wed, 08-Apr-2020 09:26:06 GMT; Max-Age=31536000; path=/
Transfer-Encoding: chunked

3. What are the benefits of using AWS EMR instead of using a local cluster? (1 marks)

Ans: EMR is hosted framework that allows to run distributed frameworks on AWS. Below are the benefits

1. Scalability and Flexibility: AWS EMR provides flexibility to resize cluster depending on the computing need. The consumer can add instances at peak workload and remove instances when the workloads subside to control costs. EMR leverage multiple data stores.

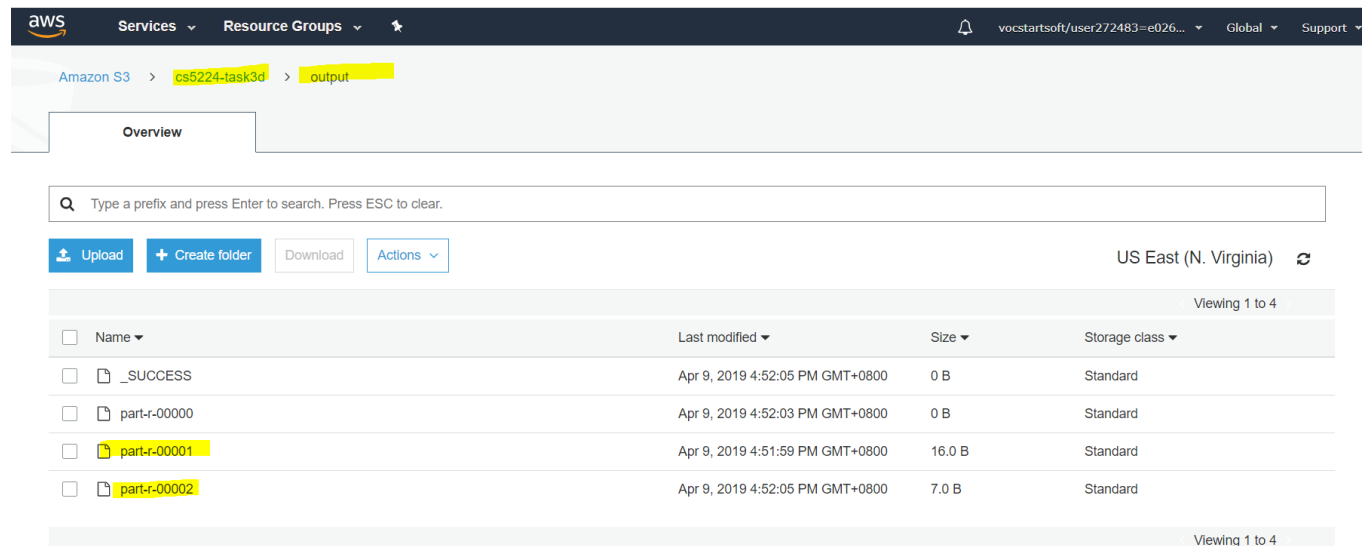
2. Reliability: AWS EMR provides monitoring service to monitor nodes in the cluster and provides configuration options to automatically or manually terminate and replace an instance in case of failure.

3. Security: AWS EMR starts it's instances in two security groups, one for the master node and another for the other cluster nodes. By default, both the security groups are configured to not allow access from any external sources, and these can be fine-tuned according to the requirement. For additional security, customers may prefer to encrypt the data before uploading to AWS and encryption and decryption process occurs in the EMRFS client.

4. Master Instance and Worker Instance: Master program creates data localized tasks to minimize network communication whereas Worker nodes switch between mapper and reducer and they work in parallel.

4. Modify WordCount.java so that it only counts these three words “the”, “a” and “an” in input file. (submit the modified program and screenshots of the output) (3 marks)

Ans: The output is generated in output folder. Download and check the word count.



The screenshot shows the AWS S3 console interface. The breadcrumb navigation indicates the path: Amazon S3 > cs5224-task3d > output. The 'Overview' tab is selected. A search bar is present with the placeholder text 'Type a prefix and press Enter to search. Press ESC to clear.' Below the search bar are buttons for 'Upload', 'Create folder', 'Download', and 'Actions'. The region is set to 'US East (N. Virginia)'. A table displays the contents of the 'output' folder, showing four objects. The first two objects, '_SUCCESS' and 'part-r-00000', have a size of 0 B. The third object, 'part-r-00001', has a size of 16.0 B and is highlighted in yellow. The fourth object, 'part-r-00002', has a size of 7.0 B and is also highlighted in yellow. The table columns are 'Name', 'Last modified', 'Size', and 'Storage class'. The status 'Viewing 1 to 4' is shown at the bottom right of the table.

Name	Last modified	Size	Storage class
_SUCCESS	Apr 9, 2019 4:52:05 PM GMT+0800	0 B	Standard
part-r-00000	Apr 9, 2019 4:52:03 PM GMT+0800	0 B	Standard
part-r-00001	Apr 9, 2019 4:51:59 PM GMT+0800	16.0 B	Standard
part-r-00002	Apr 9, 2019 4:52:05 PM GMT+0800	7.0 B	Standard

Open the folder using Notepad++ to view the output count. Below screenshots for reference.

part-r-00001 (1) x part-r-00002 x

1	an	120
2	the	3091
3		

part-r-00001 (1) x part-r-00002 x

1	a	1454
2		