Module 3

Hadoop Distributed File System (HDFS) and Google Cloud Storage (GCS)

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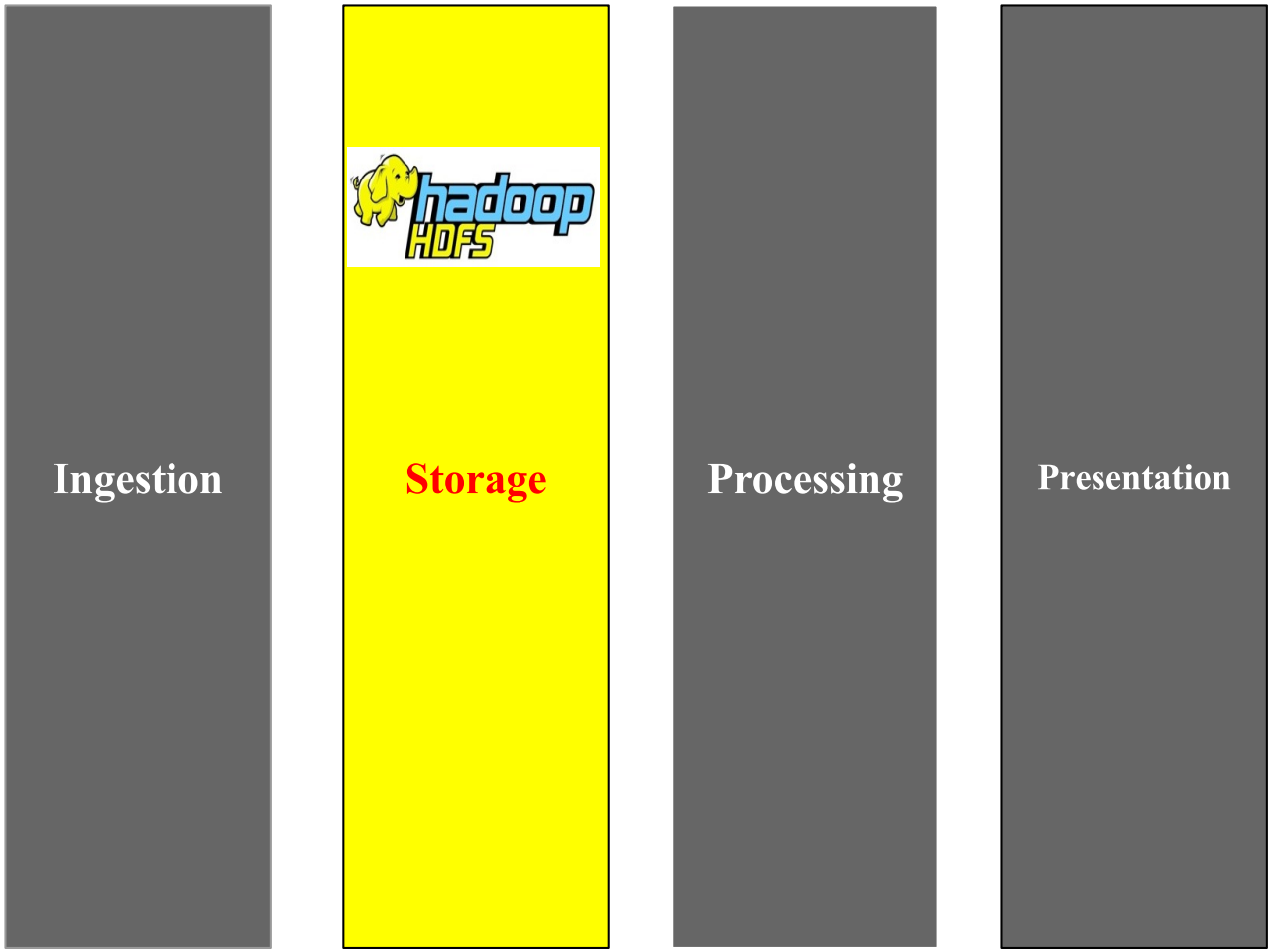
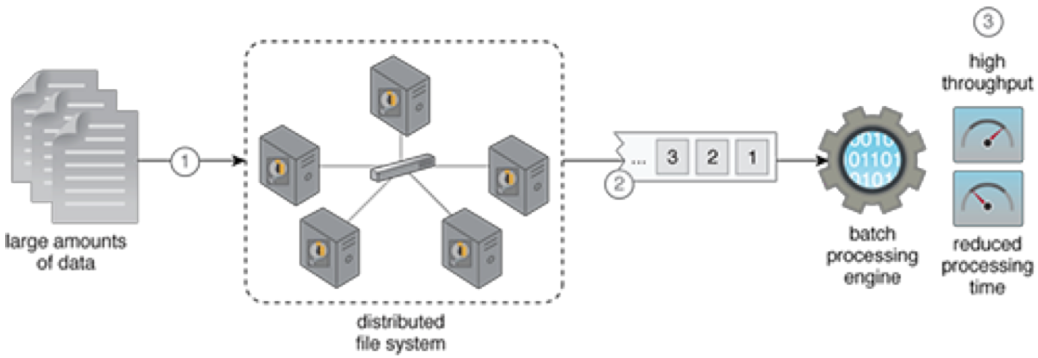
Big Data Ecosystem

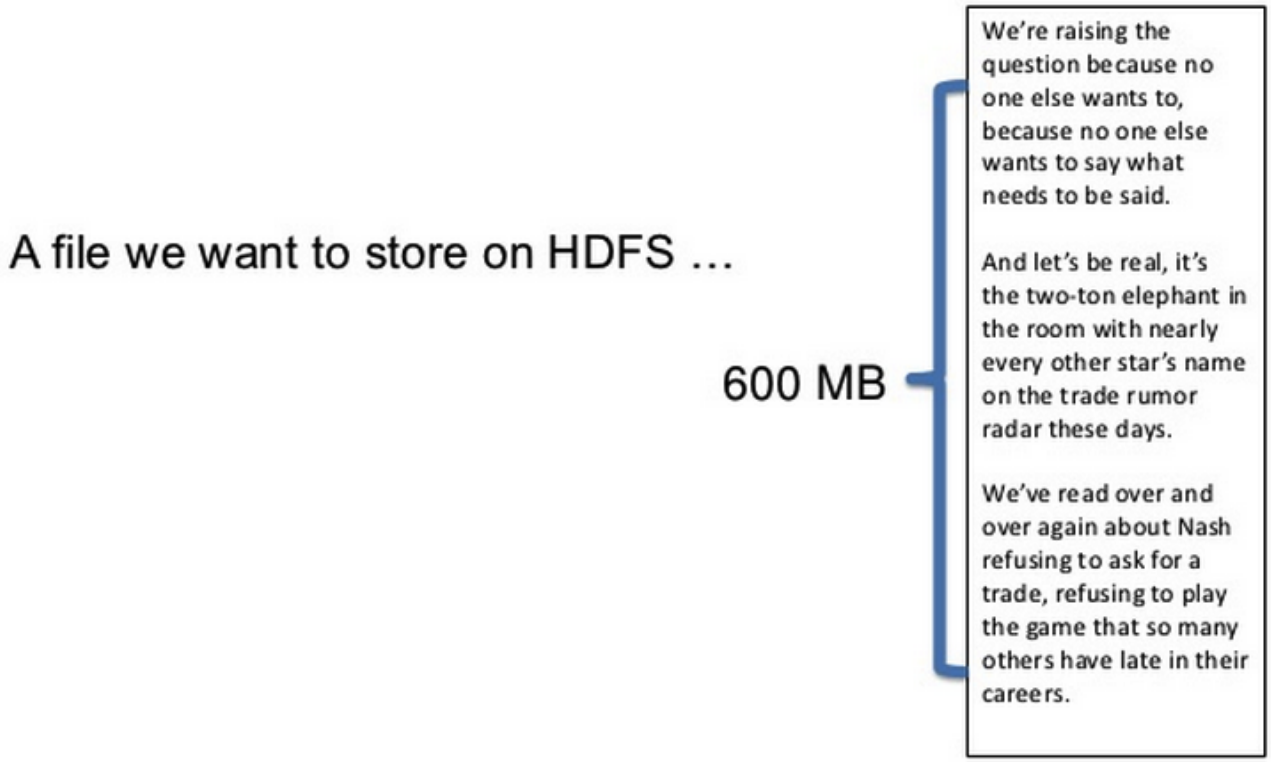


HDFS: Hadoop Distributed File System

- Reliability
  - Detection of faults and quick, automatic recovery from them is a core architectural goal of HDFS.
- Fault-tolerance
  - Replication
- Streaming Data Access
  - To store datasets for non-random, simple sequential access, which achieves higher data transfer throughput. (but may be high latency)
- Large Data Sets
- “Moving Computation is Cheaper than Moving Data”

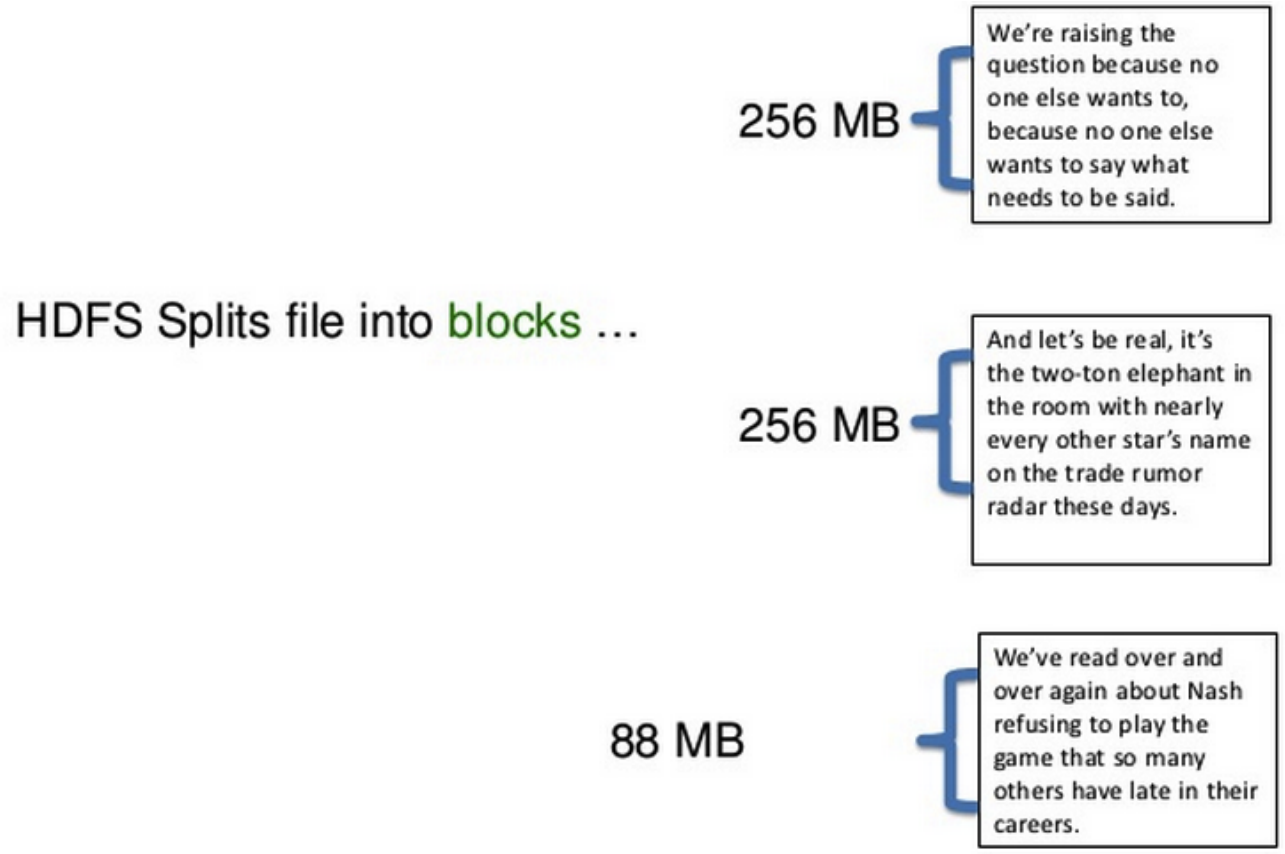


How does HDFS work?



Source Introduction to Apache Hadoop-Pig: PrashantKommireddi

How does HDFS work? (Cont.)



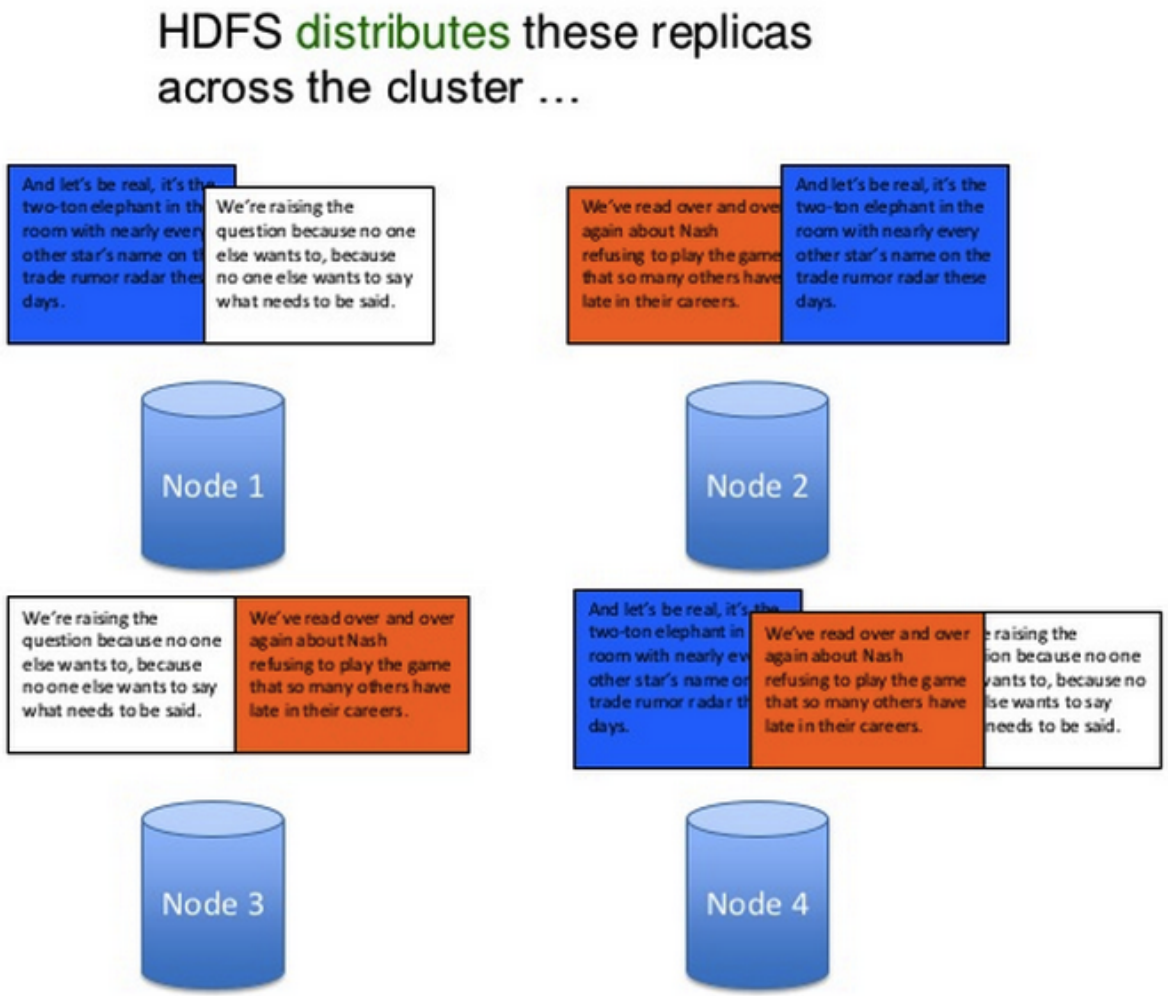
Source Introduction to Apache Hadoop-Pig: PrashantKommireddi

How does HDFS work? (Cont.)

HDFS will create 3replicas of each block …

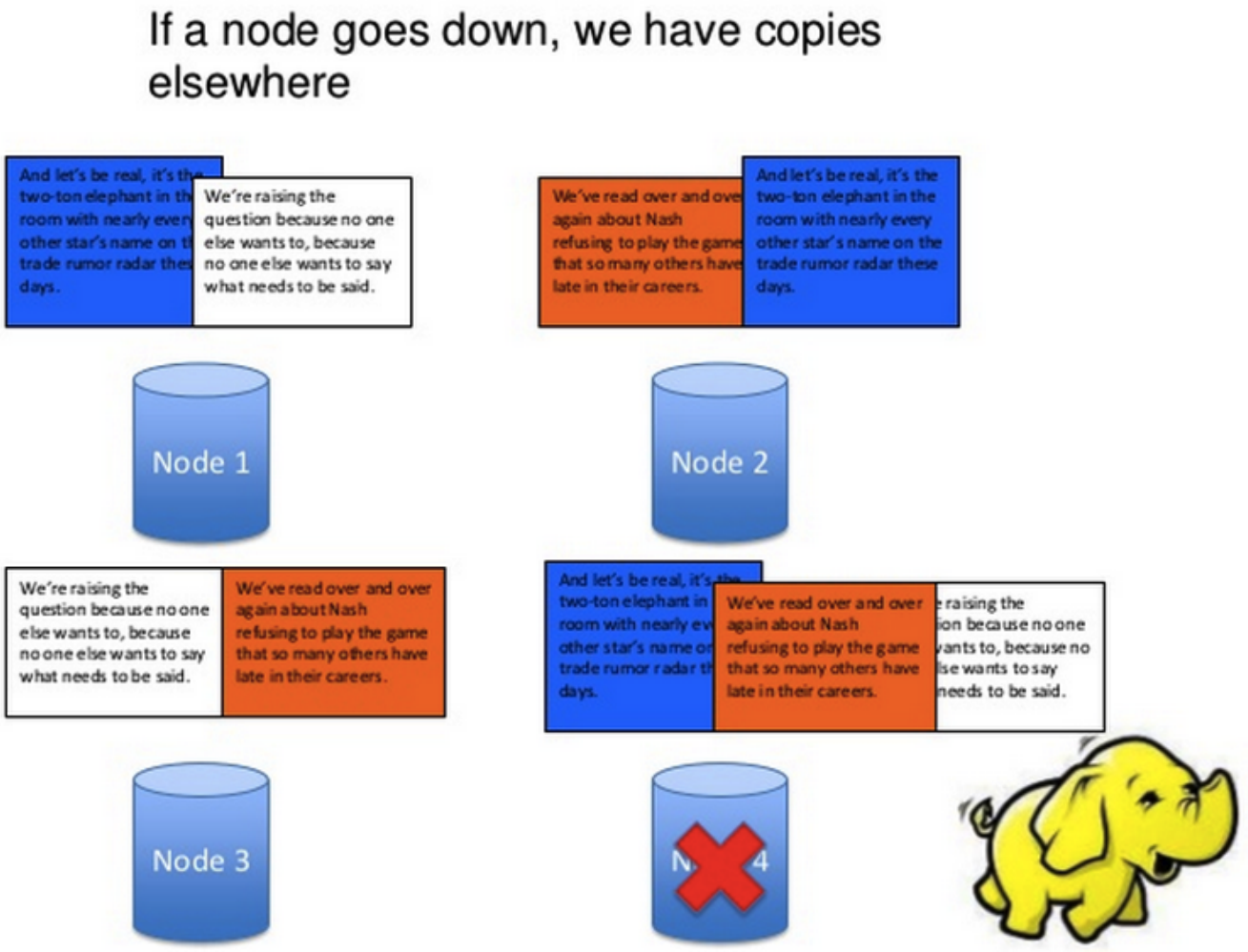
Source Introduction to Apache Hadoop-Pig: PrashantKommireddi

How does HDFS work? (Cont.)



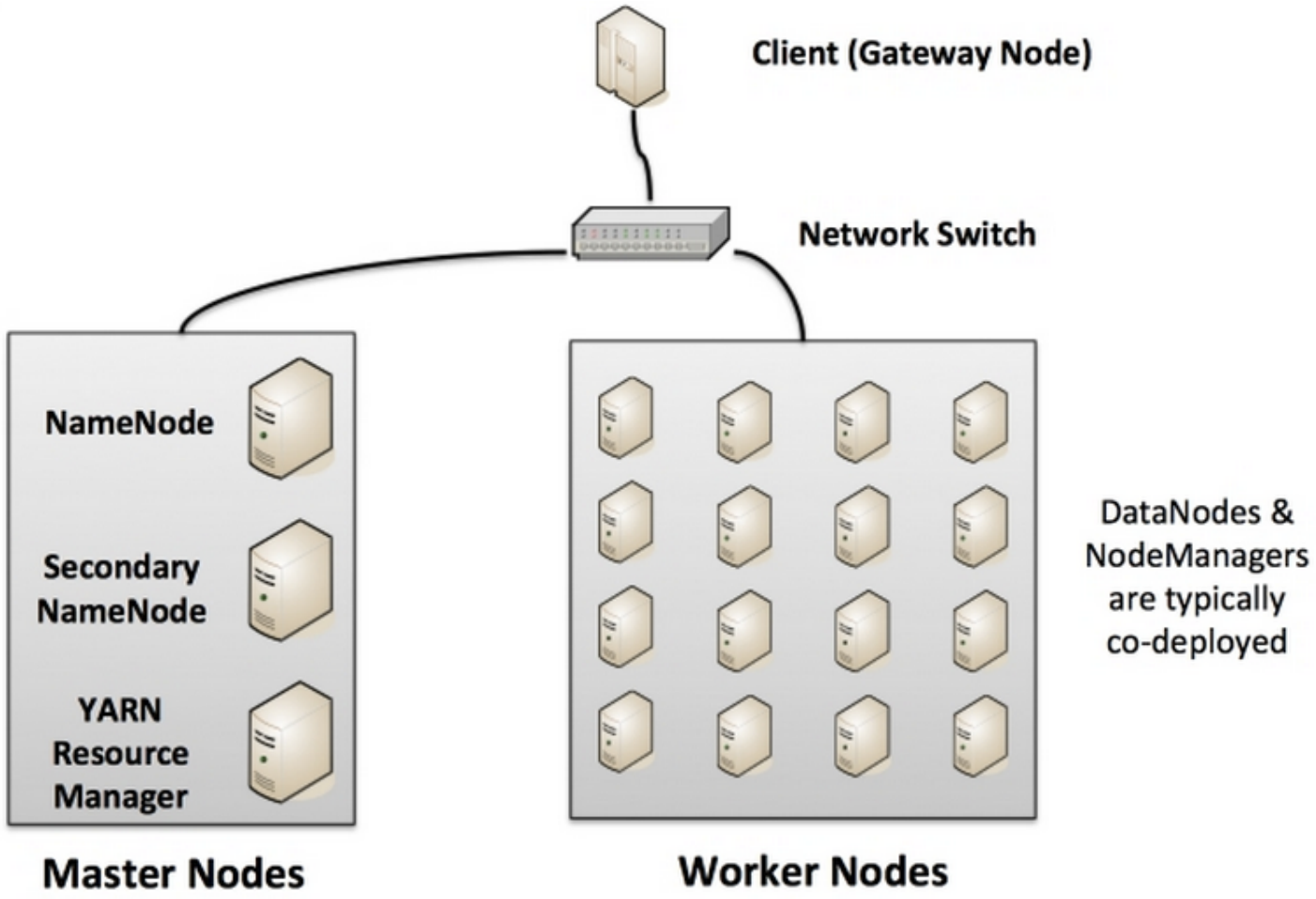
Source Introduction to Apache Hadoop-Pig: PrashantKommireddi

How does HDFS work? (Cont.)



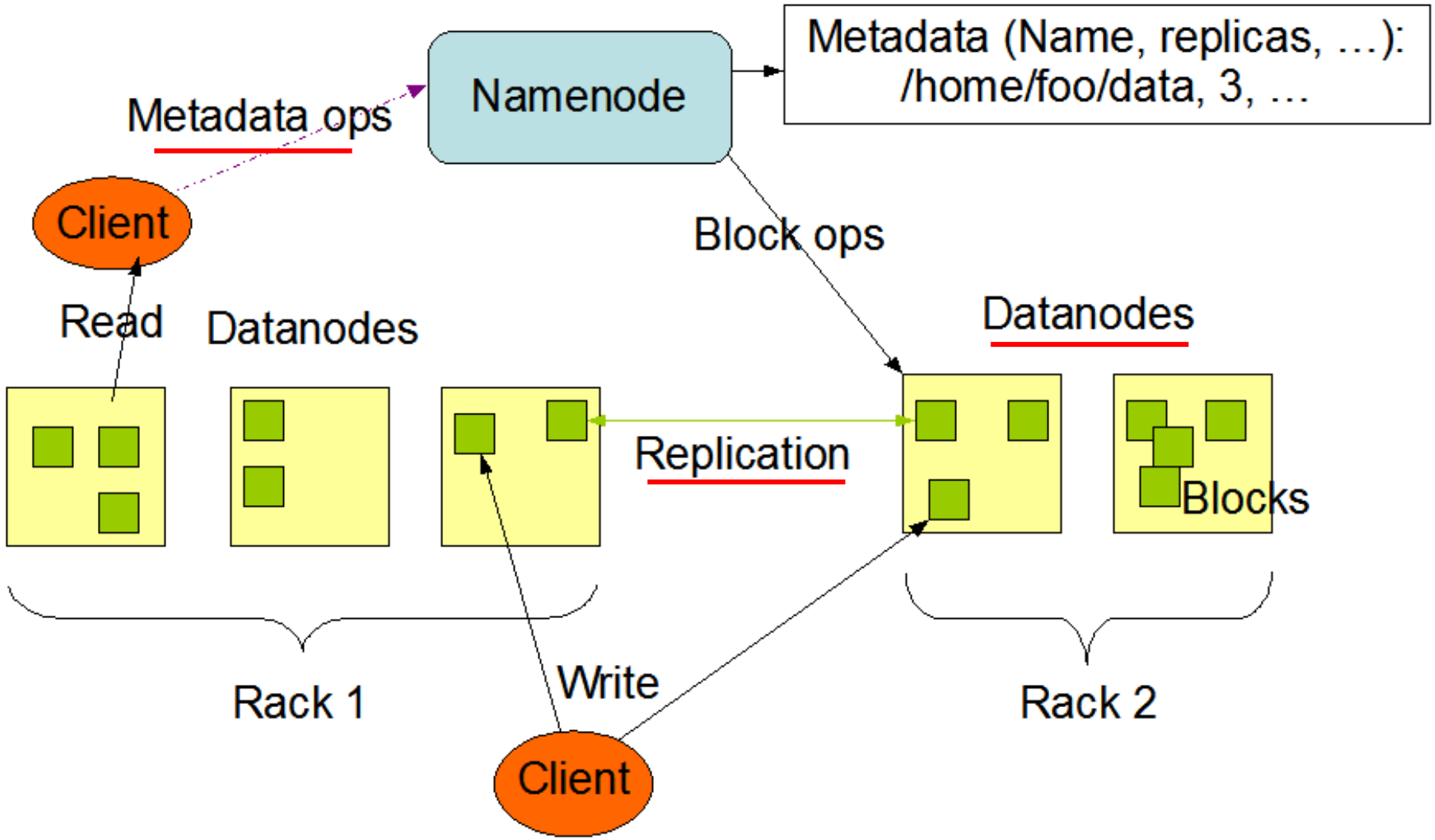
Source Introduction to Apache Hadoop-Pig: PrashantKommireddi

Hadoop Cluster



Source: HDInsight Essentials - Second Edition

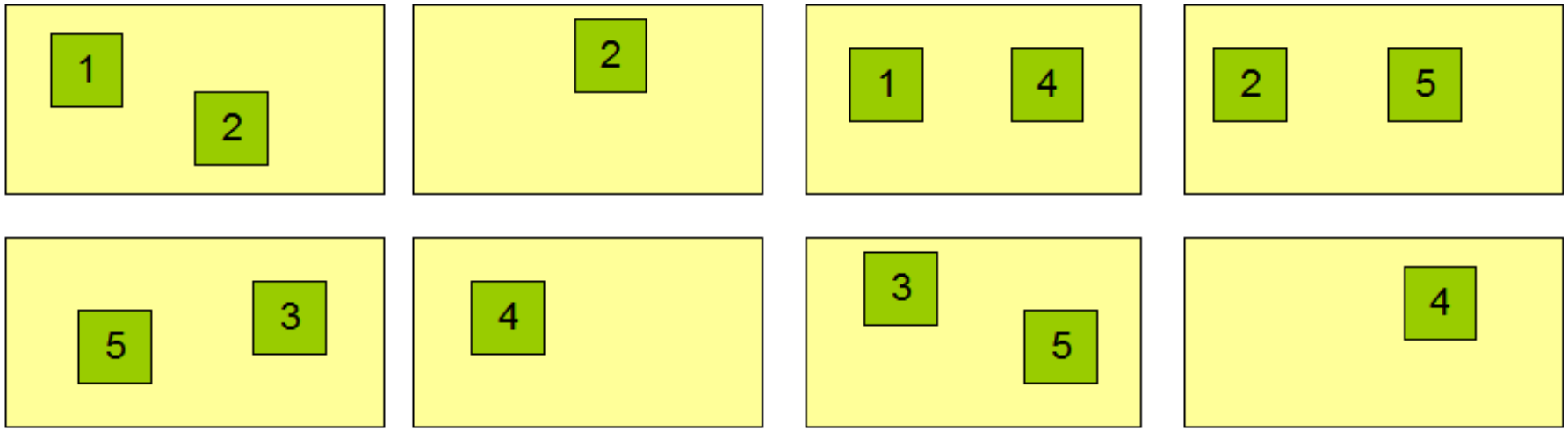
HDFS Architecture



Block Replication

Namenode (Filename, numReplicas, block-ids, …)
/users/sameerp/data/part-0, r:2, {1,3}, …
/users/sameerp/data/part-1, r:3, {2,4,5}, …

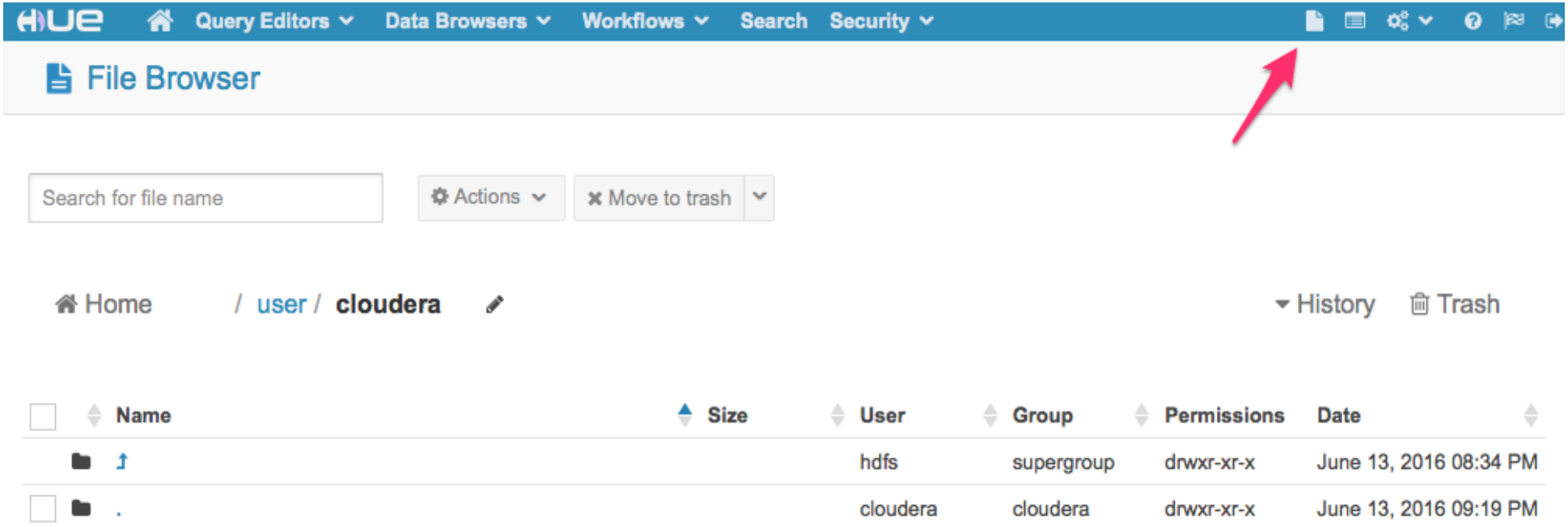
Datanodes



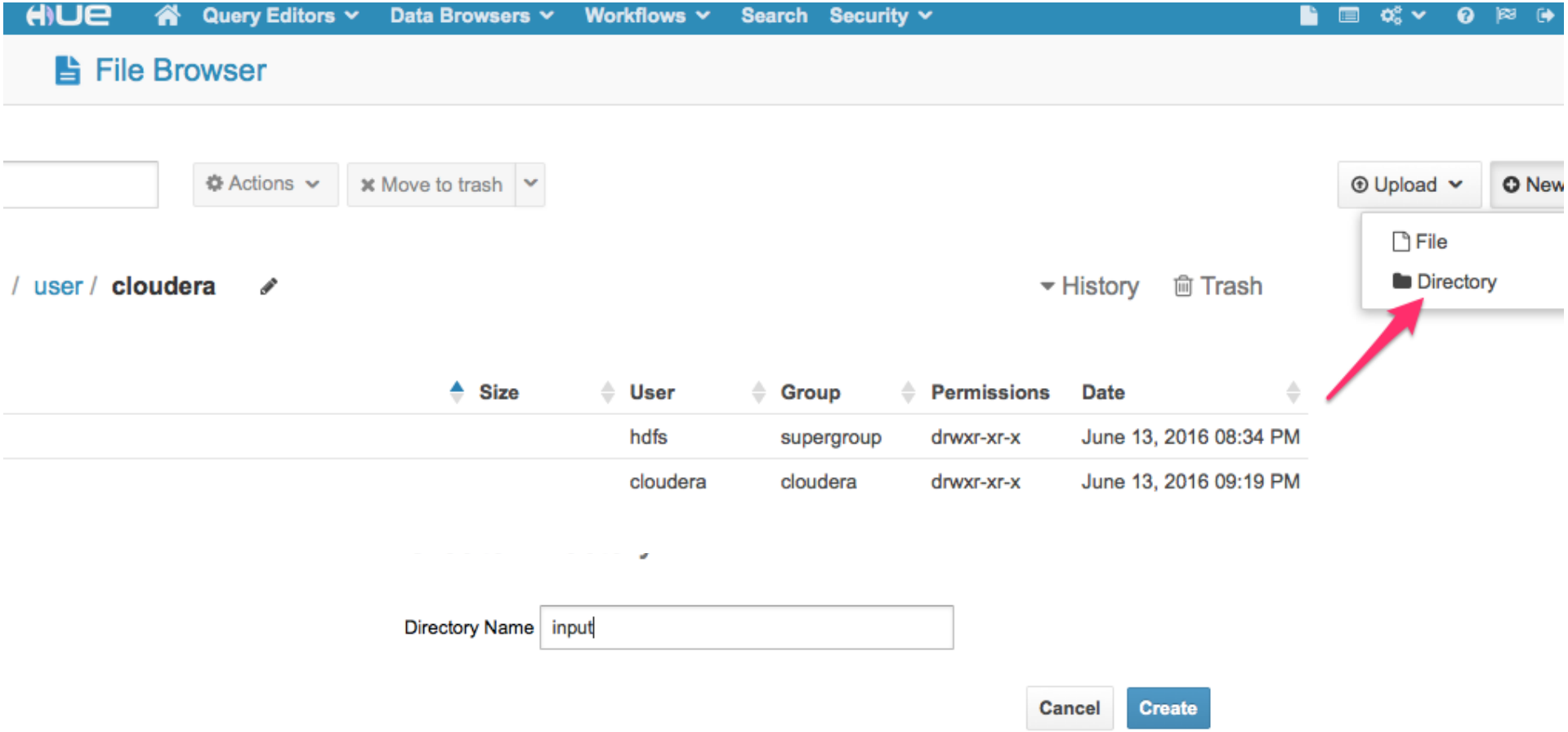
Hands-On: Importing File from Local to HDFS

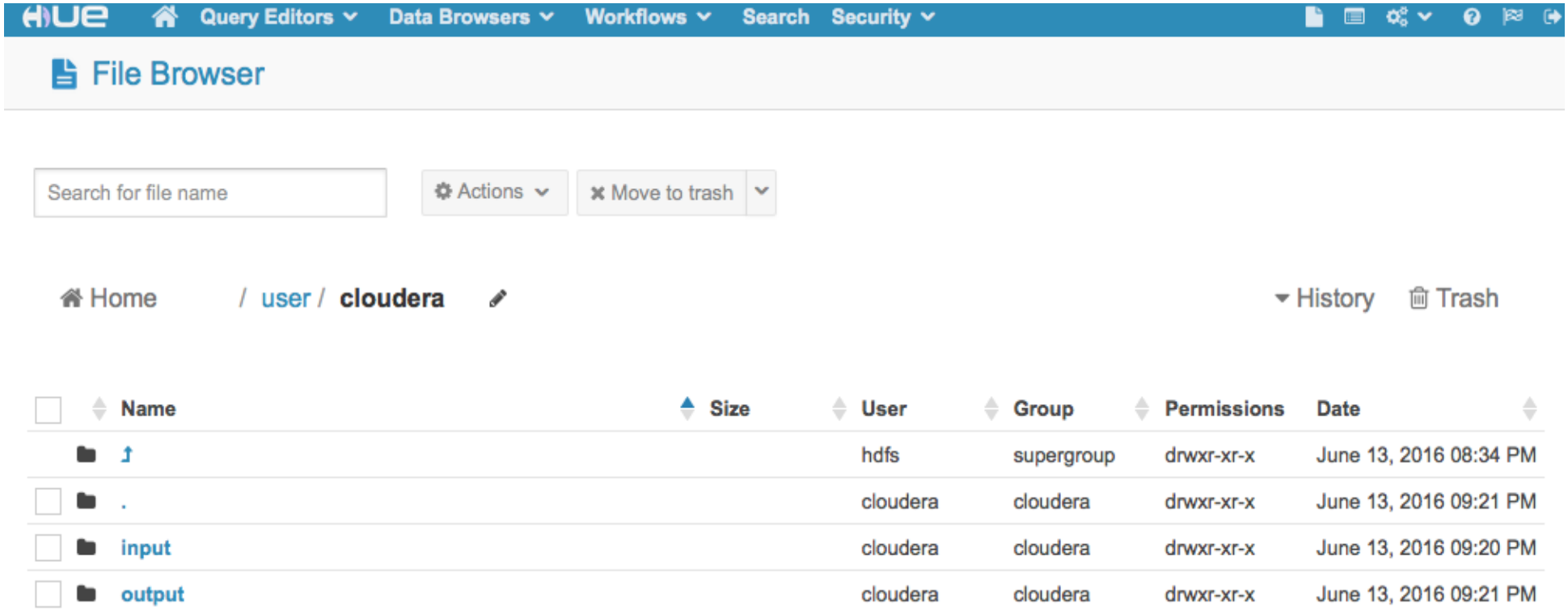
LAB I

Review File in Hadoop HDFS using File Browser

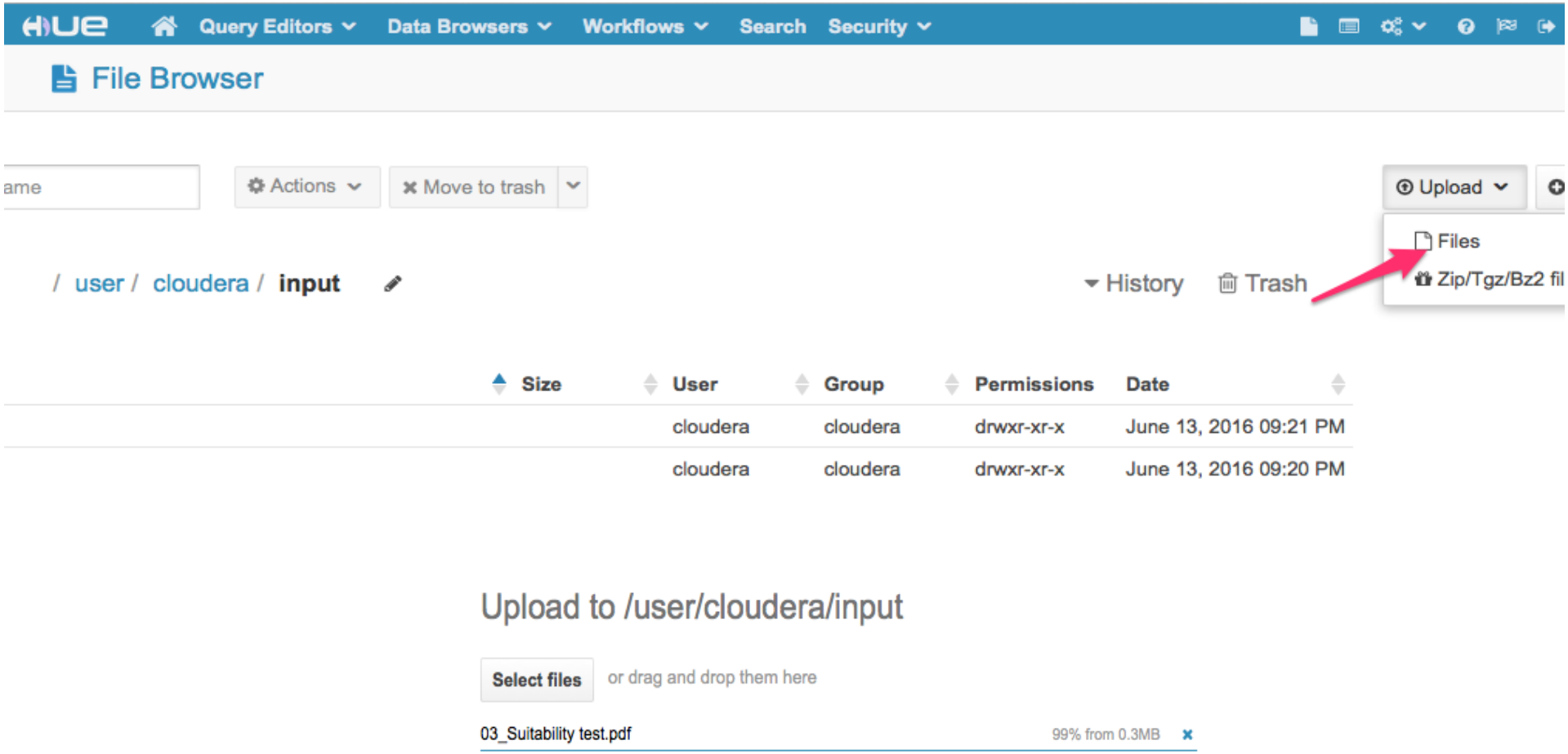


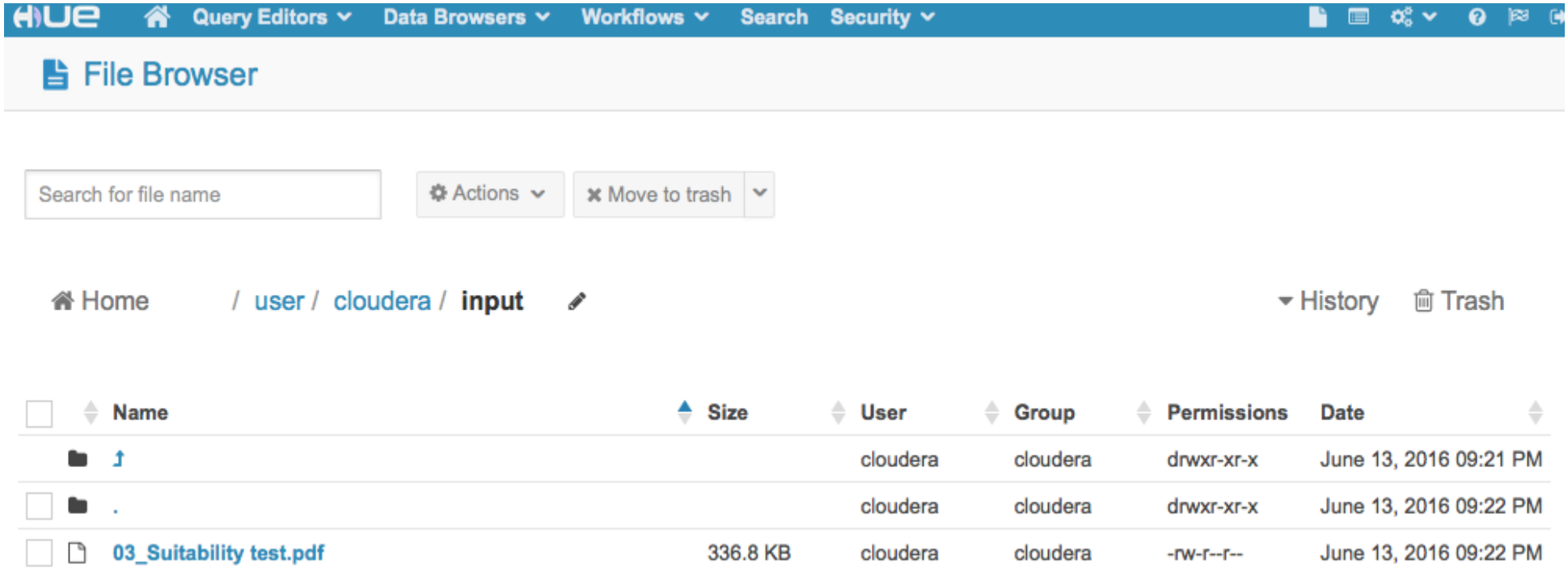
Create a new directory name as: input & output




HUE
Query Editors
Data Browsers
Workflows
Search
Security
File Browser
Search for file name
Actions
Move to trash
Home / user / cloudera
History
Trash
Name
Size
User
Group
Permissions
Date
hdfs supergroup drwxr-xr-x June 13, 2016 08:34 PM
. cloudera cloudera drwxr-xr-x June 13, 2016 09:21 PM
input cloudera cloudera drwxr-xr-x June 13, 2016 09:20 PM
output cloudera cloudera drwxr-xr-x June 13, 2016 09:21 PM

Upload a local file to HDFS




HUE
Query Editors
Data Browsers
Workflows
Search
Security
File Browser
Search for file name
Actions
Move to trash
Home / user / cloudera / input
History
Trash
Name
Size
User
Group
Permissions
Date
cloudera cloudera drwxr-xr-x June 13, 2016 09:21 PM
. cloudera cloudera drwxr-xr-x June 13, 2016 09:22 PM
03_Suitability test.pdf 336.8 KB cloudera cloudera -rw-r--r-- June 13, 2016 09:22 PM

Hadoop syntax for HDFS

Command	Syntax
Listing of files in a directory	`hadoop fs -ls /user`
Create a new directory	`hadoop fs -mkdir /user/guest/newdirectory`
Copy a file from a local machine to Hadoop	`hadoop fs -put C:\Users\Administrator\Downloads\localfile.csv /user/rajn/newdirectory/hadoopfile.txt`
Copy a file from Hadoop to a local machine	`hadoop fs –get /user/rajn/newdirectory/hadoopfile.txt C:\Users\Administrator\Desktop\`

Hadoop syntax for HDFS (Cont.)

Tail last few lines of a large file in Hadoop	`hadoop fs -tail /user/rajn/newdirectory/hadoopfile.txt`
View the complete contents of a file in Hadoop	`hadoop fs -cat /user/rajn/newdirectory/hadoopfile.txt`
Remove a complete directory from Hadoop	`hadoop fs –rm -r /user/rajn/newdirectory`
Check the Hadoop filesystem space utilization	`hadoop fs –du /`

Hands-On: Manage Files/Directories in HDFS

LAB II

Upload Data to HDFS

```
[root@quickstart /]# yum install wget
[root@quickstart /]# yum install unzip
```

Download a file from the Internet

```
[root@quickstart /]# wget https://s3.amazonaws.com/babs-open-data/babs_open_data_year_1.zip
```

```
[root@quickstart /]# unzip babs_open_data_year_1.zip
[root@quickstart /]# cd 201402_babs_open_data/
```

Copy the file to HDFS

```
[root@quickstart /]# hdfs dfs -put 201402_trip_data.csv /user/cloudera
```

List files and directories in HDFS's current directory

```
[root@quickstart /]# hdfs dfs -ls /user/cloudera
```

Create a directory in HDFS

```
[root@quickstart /]# hdfs dfs -mkdir
/user/cloudera/rawdata
```

In HDFS, move the file to the new directory

```
[root@quickstart /]# hdfs dfs -mv
/user/cloudera/201402_trip_data.csv
/user/cloudera/rawdata
```

In HDFS, delete the file

```
[root@quickstart /]# hdfs dfs -rm
/user/cloudera/rawdata/201402_trip_data.csv
```

Exercise

Upload data from the Website :

```
https://s3.amazonaws.com/imcbucket/input/pg2600.txt
```

To HDFS directory :

```
/user/cloudera/input/
```

Use cloud storage as a data lake

- Cheap storage for data archive
- Cost per GB/month
- High availability
- High durability
- Focus on warm/cold data
- Transaction data
- Encrypt data for security

Cloud Storage and Hadoop HDFS

	Cloud Storage	HDFS
Elasticity	Yes	No
Cost/TB/month	$23	$206
Availability	99.99%	99.9% (estimated)
Durability	99.999999999%	99.9999% (estimated)
Transactional writes	Yes with DBIO	Yes

Source: https://databricks.com

Google Cloud Storage

Google Cloud Storage is unified object storage for developers and enterprises, from live data serving to data analytics/ML to data archiving. It provides a unified offering across the availability spectrum: from live data tapped by today's most demanding applications, to cloud archival solutions Nearline and Coldline. Featuring a consistent API, latency, and speed across storage classes

Cloud Storage

- Multi-Regional or Regional storage
- Nearline and Coldline storage solutions
- Offers a unified product offering with consistent access APIs across the entire range of storage classes
- With no minimum fees and a pay-per-use model,

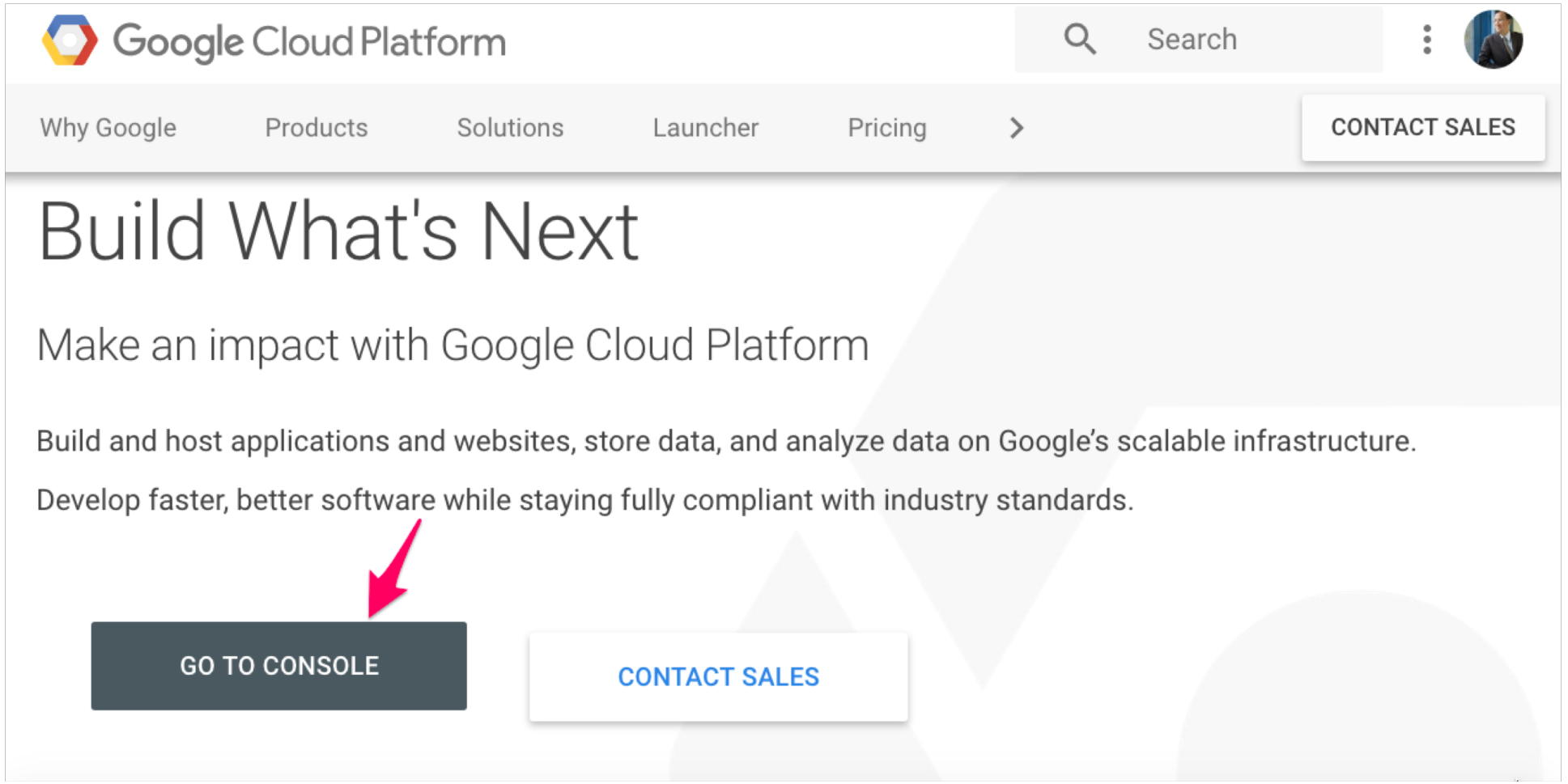
Cloud Storage

General Pricing

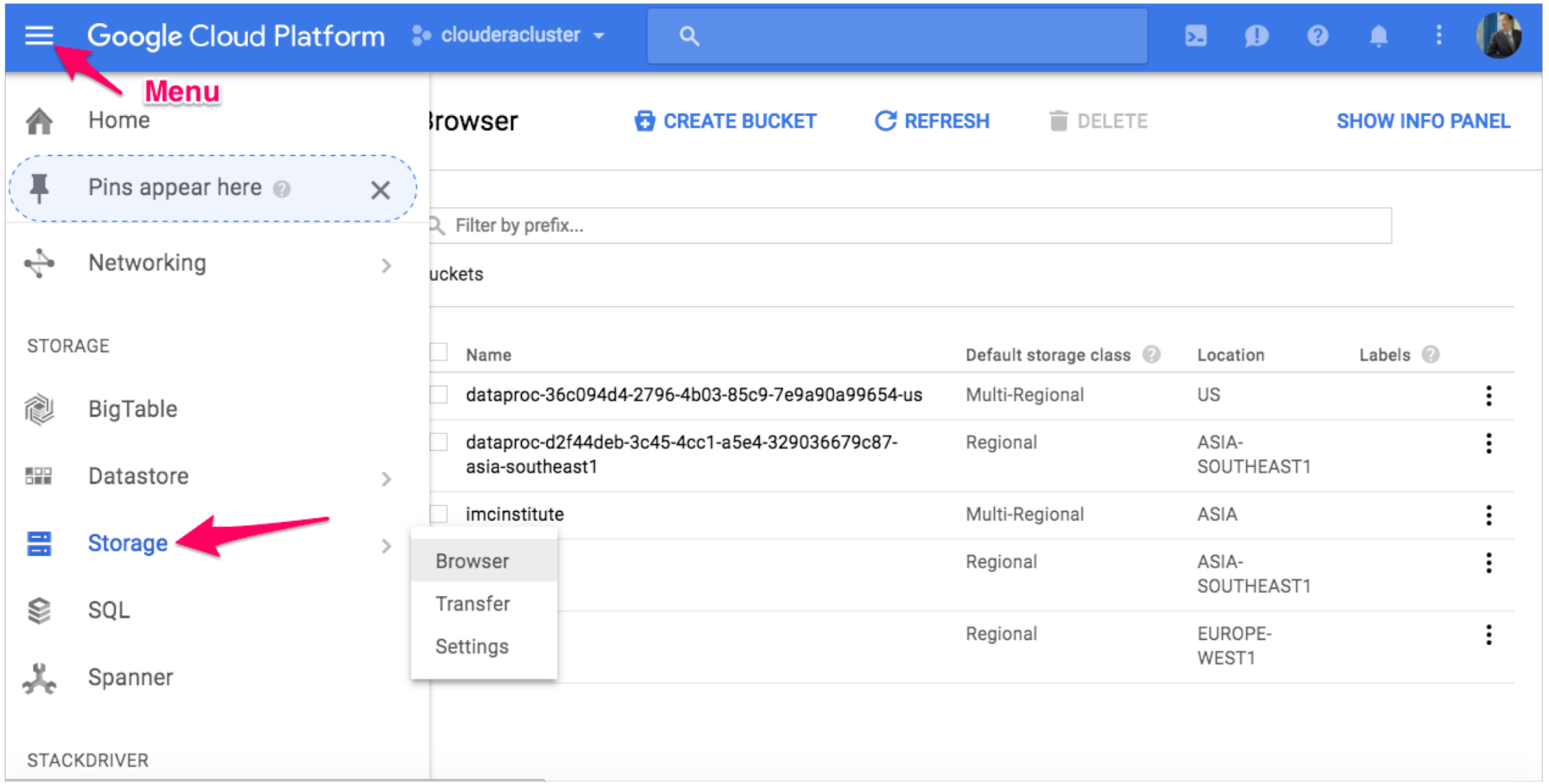
Multi-Regional Storage (per GB per Month)	Regional Storage (per GB per Month)	Nearline Storage (per GB per Month)	Coldline Storage (per GB per Month)
$0.026	$0.02	$0.01	$0.007

Lab I: Importing/Exporting data to Google Cloud Storage

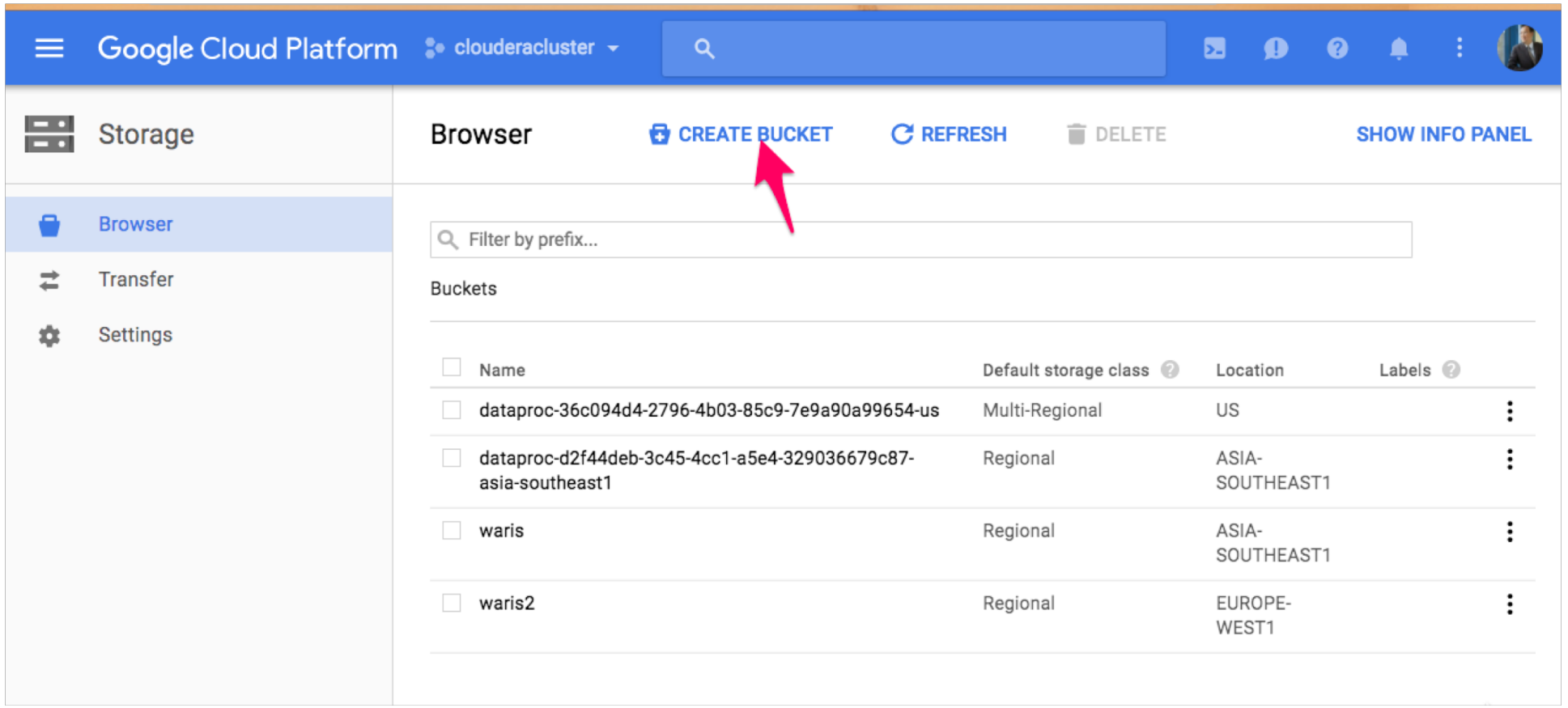
Launch Google Cloud console



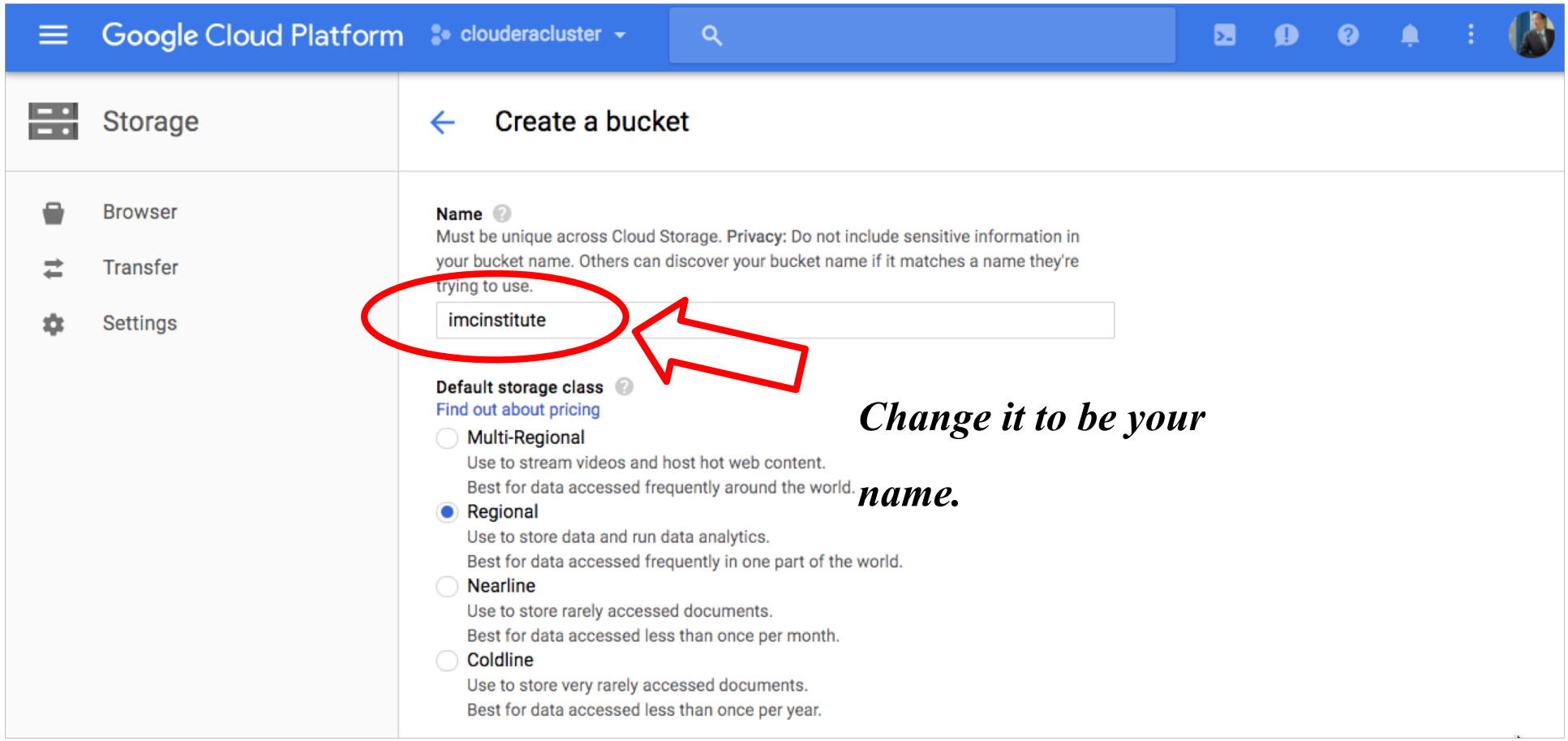
Select Storage



Click on Create Bucket

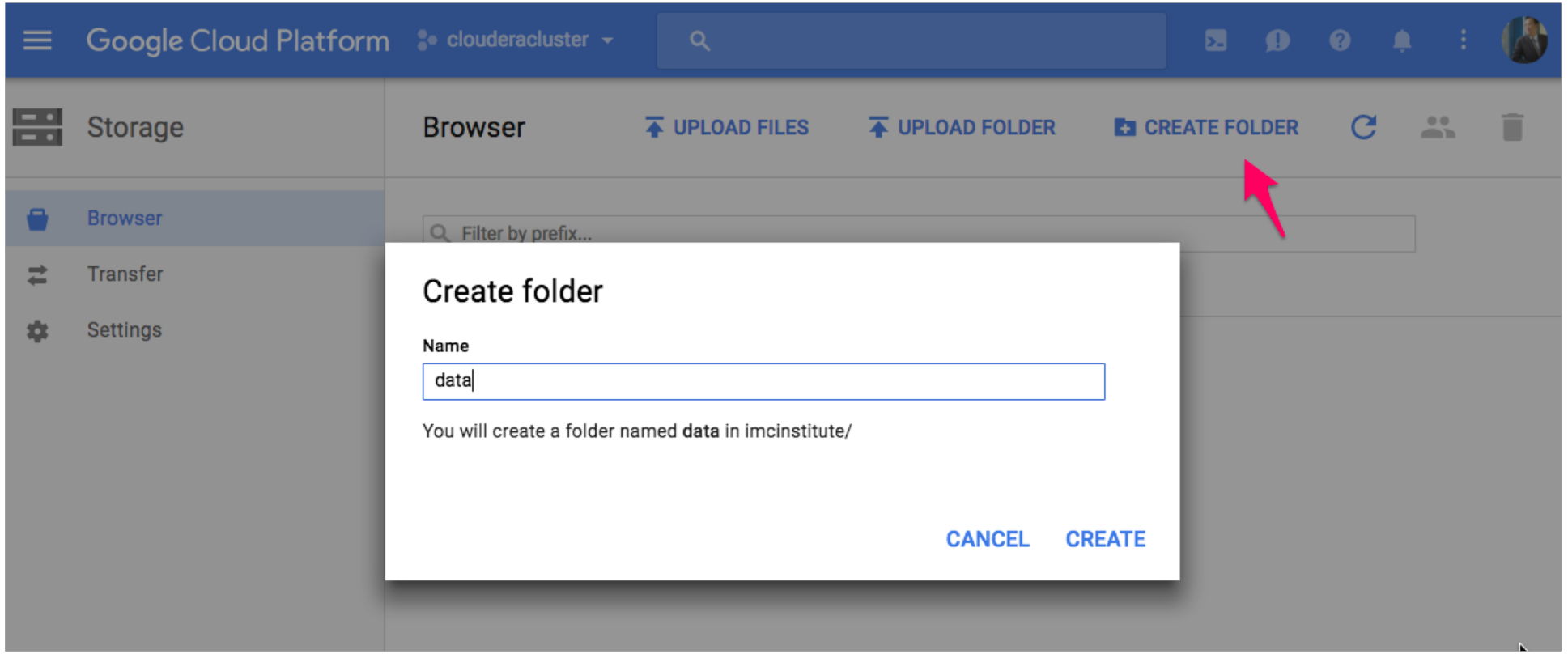


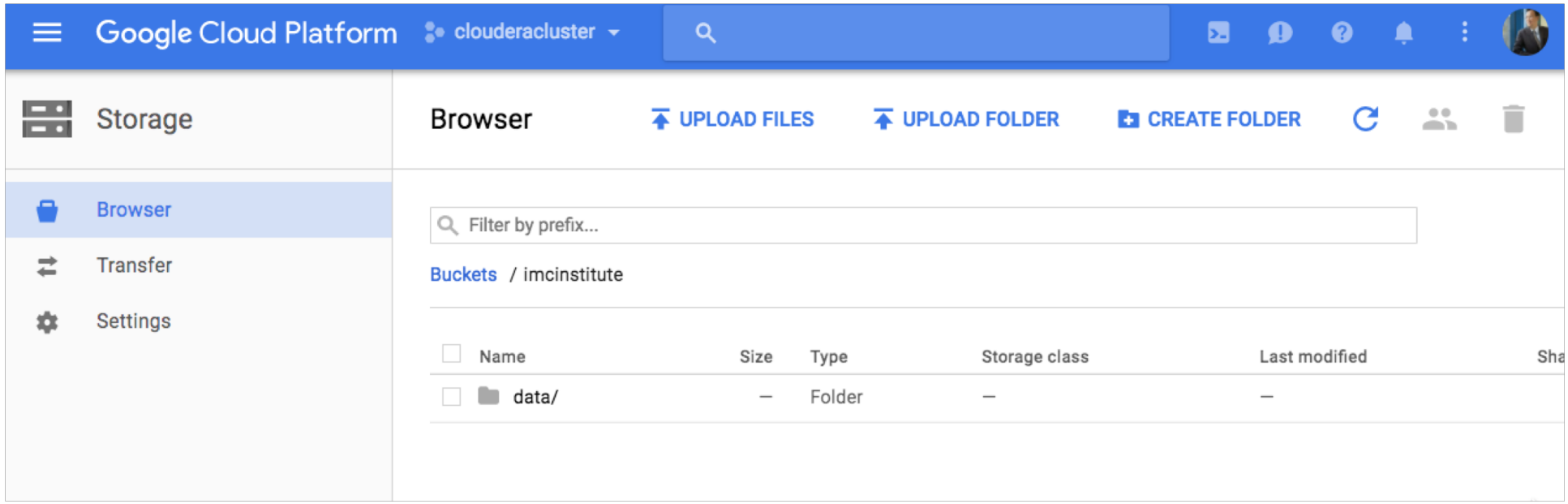
Choose a globally unique bucket name



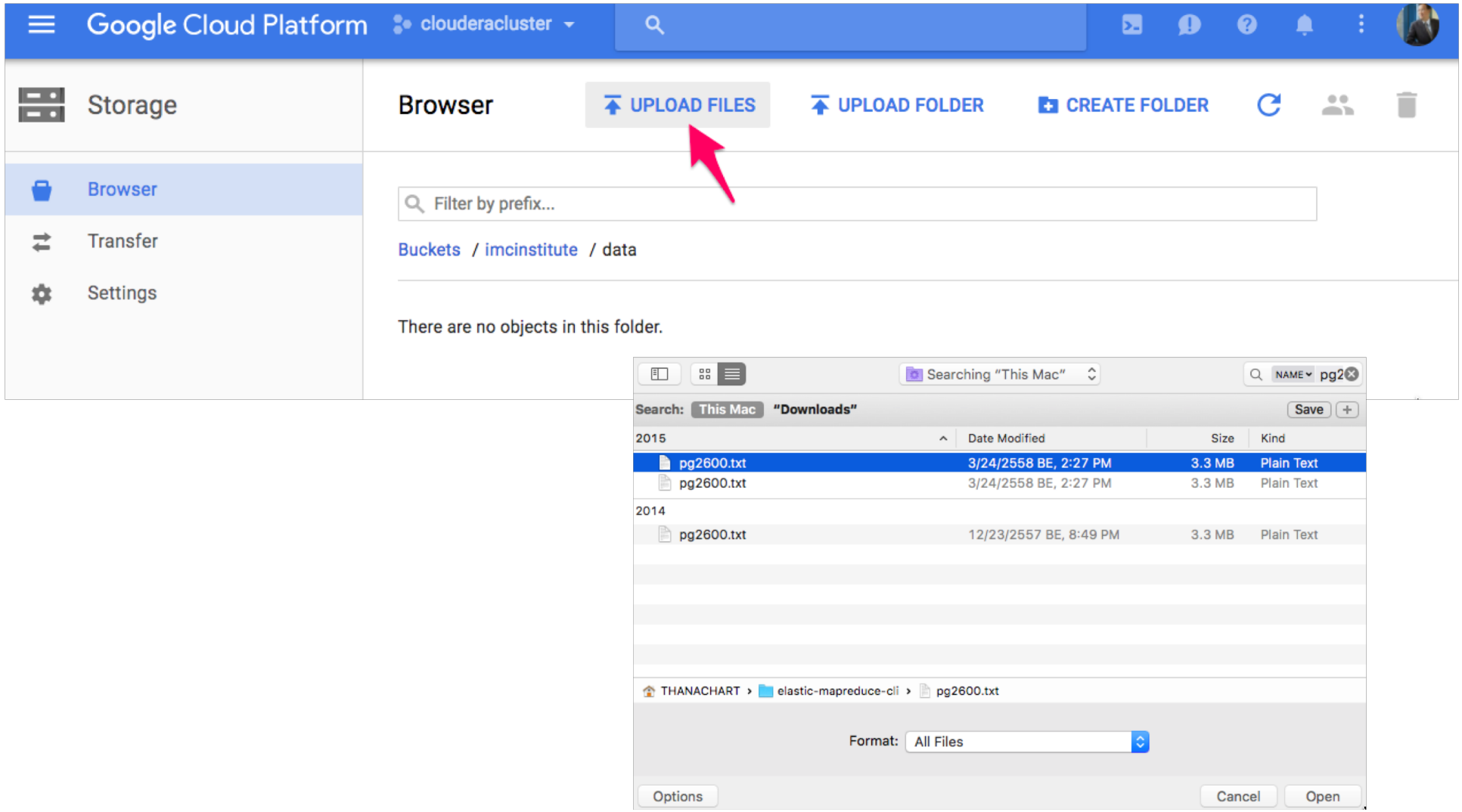
Change it to be your name.

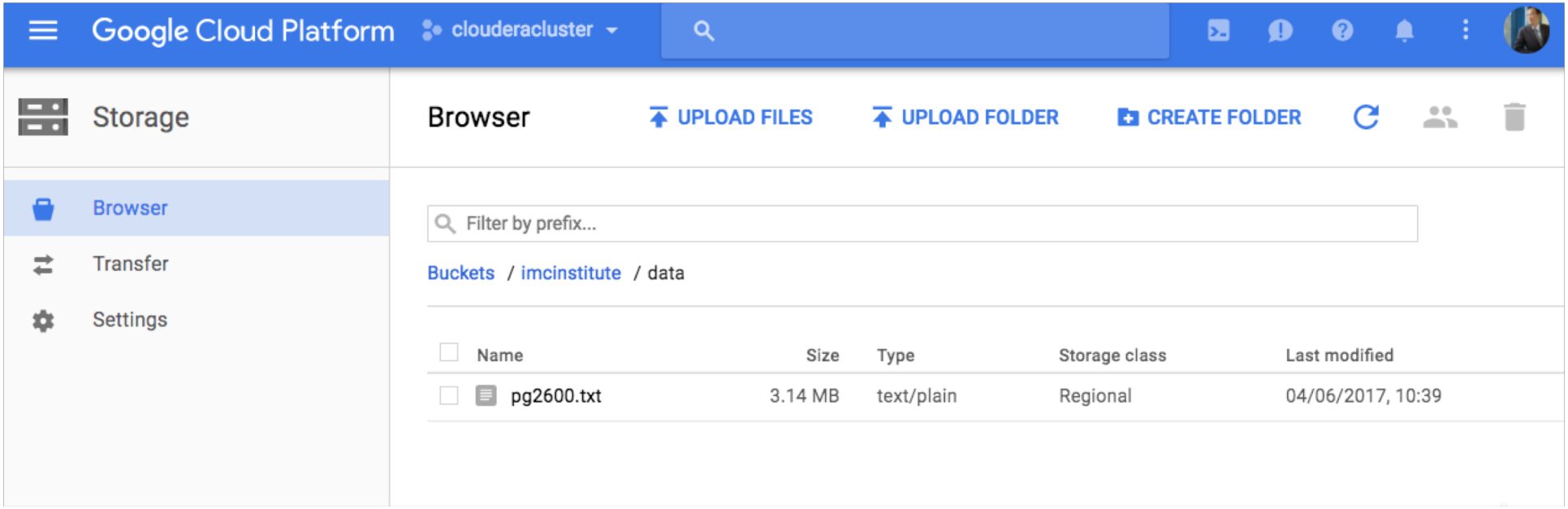
Create a new folder name as: data




Google Cloud Platform
clouderacluster
Storage
Browser
UPLOAD FILES
UPLOAD FOLDER
CREATE FOLDER
Browser
Transfer
Settings
Filter by prefix...
Buckets / imcinstitute
Name
Size
Type
Storage class
Last modified
data/
–
Folder
–
–

Upload a local file to the cloud storage

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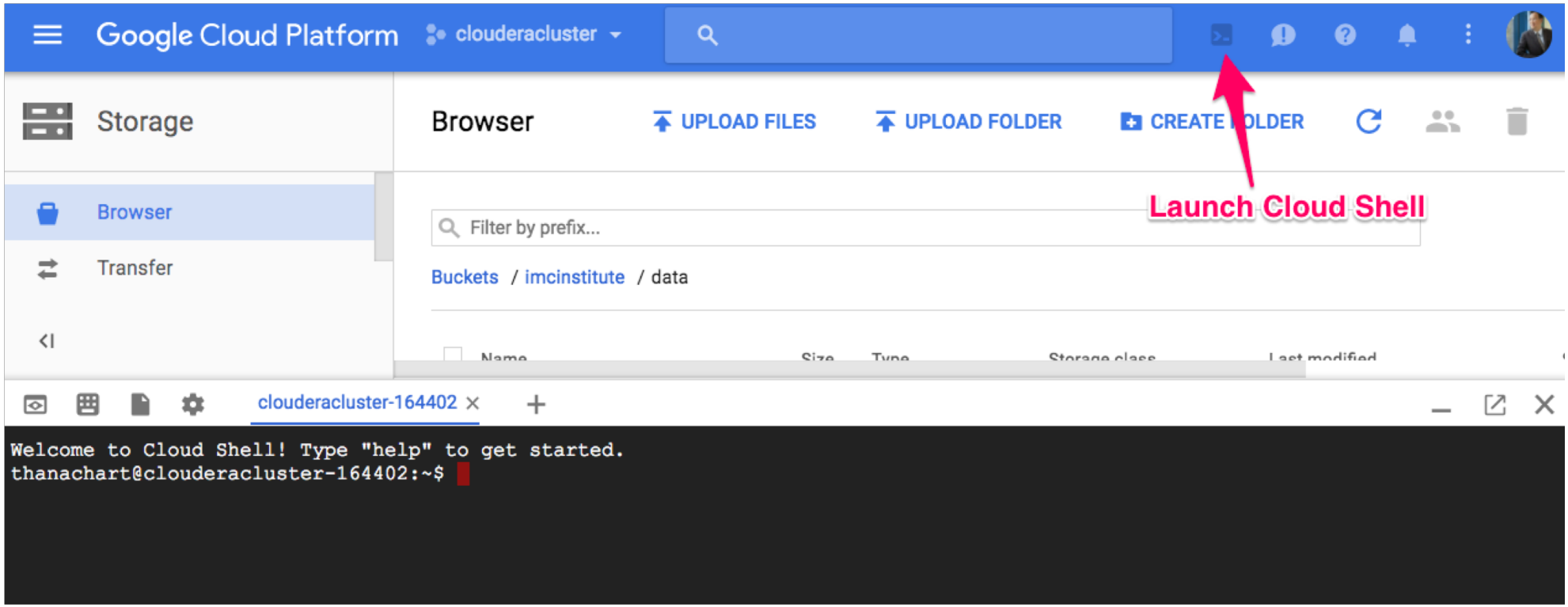
Transfer
Settings
Filter by prefix...
Buckets / imcinstitute / data
Name
Size
Type
Storage class
Last modified
pg2600.txt
3.14 MB
text/plain
Regional
04/06/2017, 10:39

Upload a large file using Cloud shell



Download an example text file using wget command

```
$wget https://s3.amazonaws.com/imcbucket/input/pg2600.txt
```

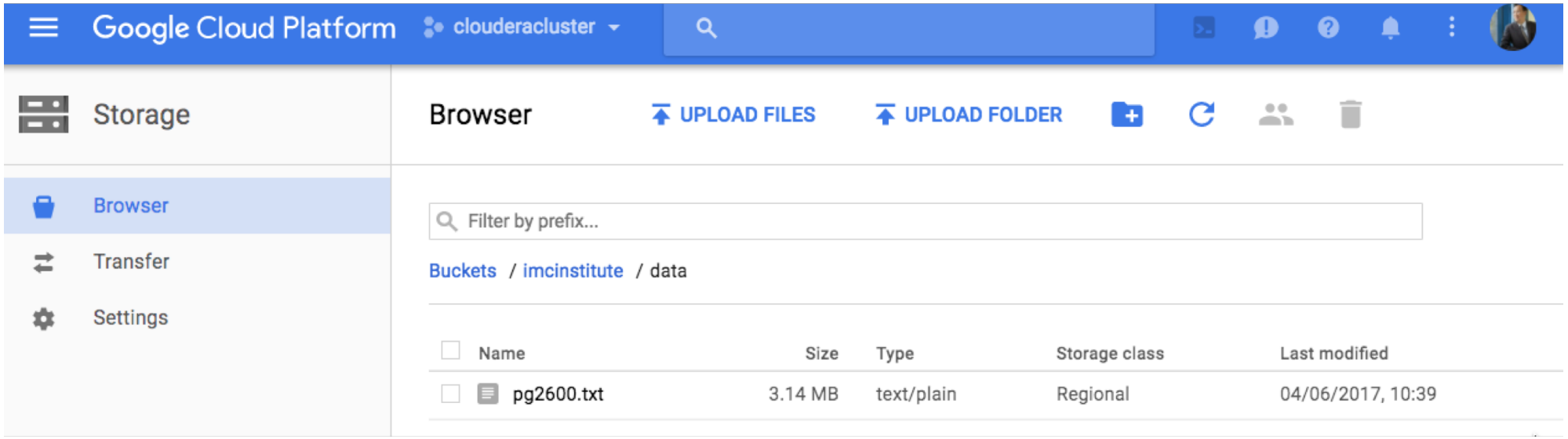
```
Welcome to Cloud Shell! Type "help" to get started.
thanachart@clouderacluster-164402:~$ wget https://s3.amazonaws.com/imcbucket/input/pg2600.txt
--2017-06-04 10:47:06--  https://s3.amazonaws.com/imcbucket/input/pg2600.txt
Resolving s3.amazonaws.com (s3.amazonaws.com)... 52.216.1.3
Connecting to s3.amazonaws.com (s3.amazonaws.com)|52.216.1.3|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 3291648 (3.1M) [text/plain]
Saving to: 'pg2600.txt'

pg2600.txt                      100%[=====================================================>]   3.14M   402KB/s   in 19s

2017-06-04 10:47:27 (165 KB/s) - 'pg2600.txt' saved [3291648/3291648]

thanachart@clouderacluster-164402:~$
```

Upload Data to Google cloud storage

using gsutil command

```
$gsutil cp pg2600.txt gs://<YOUR-BUCKET>/
```

```
thanachart@clouderacluster-164402:~$ gsutil cp pg2600.txt gs://imcinstitute/
Copying file://pg2600.txt [Content-Type=text/plain]...
- [1 files][  3.1 MiB/  3.1 MiB]
Operation completed over 1 objects/3.1 MiB.
thanachart@clouderacluster-164402:~$
```


Google Cloud Platform
clouderacluster
Storage
Browser
UPLOAD FILES
UPLOAD FOLDER
Browser
Transfer
Settings
Filter by prefix...
Buckets / imcinstitute / data
Name
Size
Type
Storage class
Last modified
pg2600.txt
3.14 MB
text/plain
Regional
04/06/2017, 10:39

Resources

- http://www.transtats.bts.gov/DL_SelectFields.asp?Table_ID=236
- http://stat-computing.org/dataexpo/2009/the-data.html
- http://projects.fivethirtyeight.com/flights/
- https://s3.amazonaws.com/imcbucket/data/flights/2016-jan.csv