

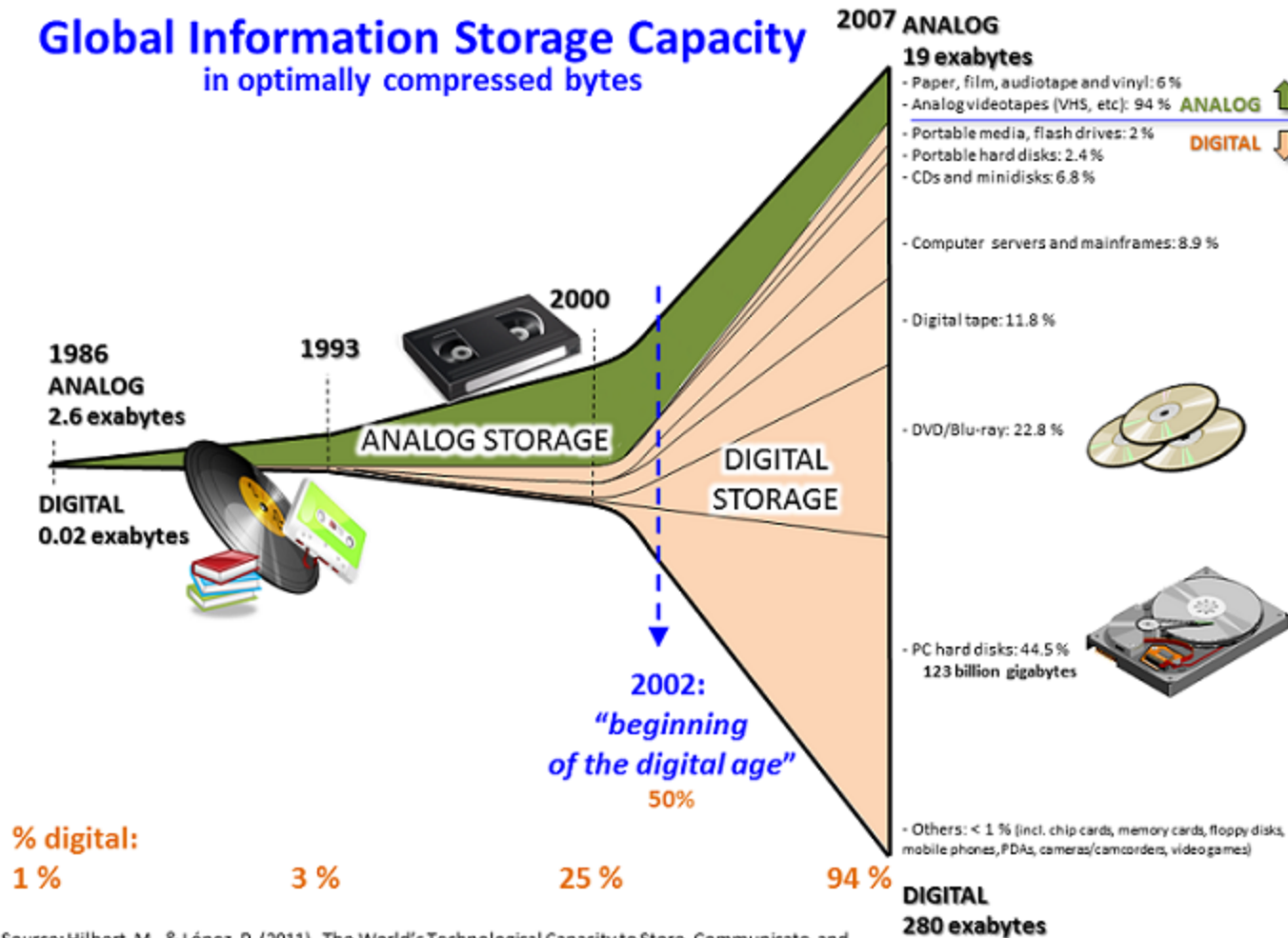
Introduction à la Big Data



Concept et historique

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Augmentation des capacités de stockage



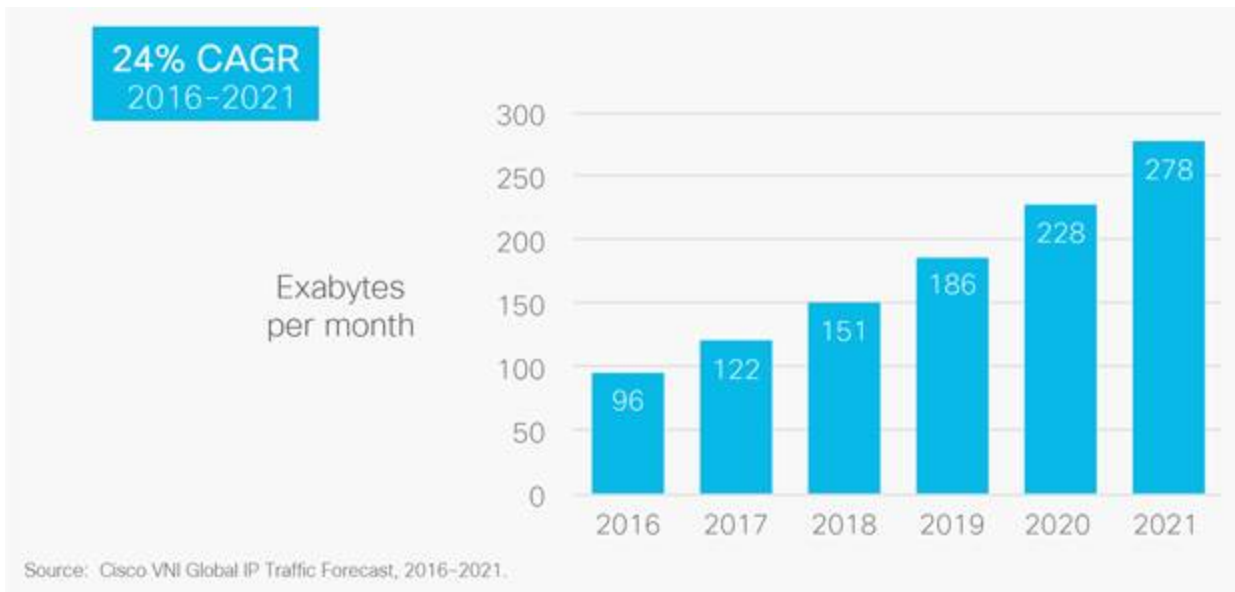
Source: Hilbert, M., & López, P. (2011). The World's Technological Capacity to Store, Communicate, and Compute Information. *Science*, 332(6025), 60–65. <http://www.martinhilbert.net/WorldInfoCapacity.html>

Concept : les 3V

- **Volume :**
téra (10^{12}), péta (10^{15}), exa (10^{18}), zetta (10^{21}), yotta (10^{24})
- **Variété :**
Profil, activité, interaction, statistique, image, voix, ...
- **Vélocité :**
Temps réel, milliseconde, haute fréquence, ...

Concept : les 3V

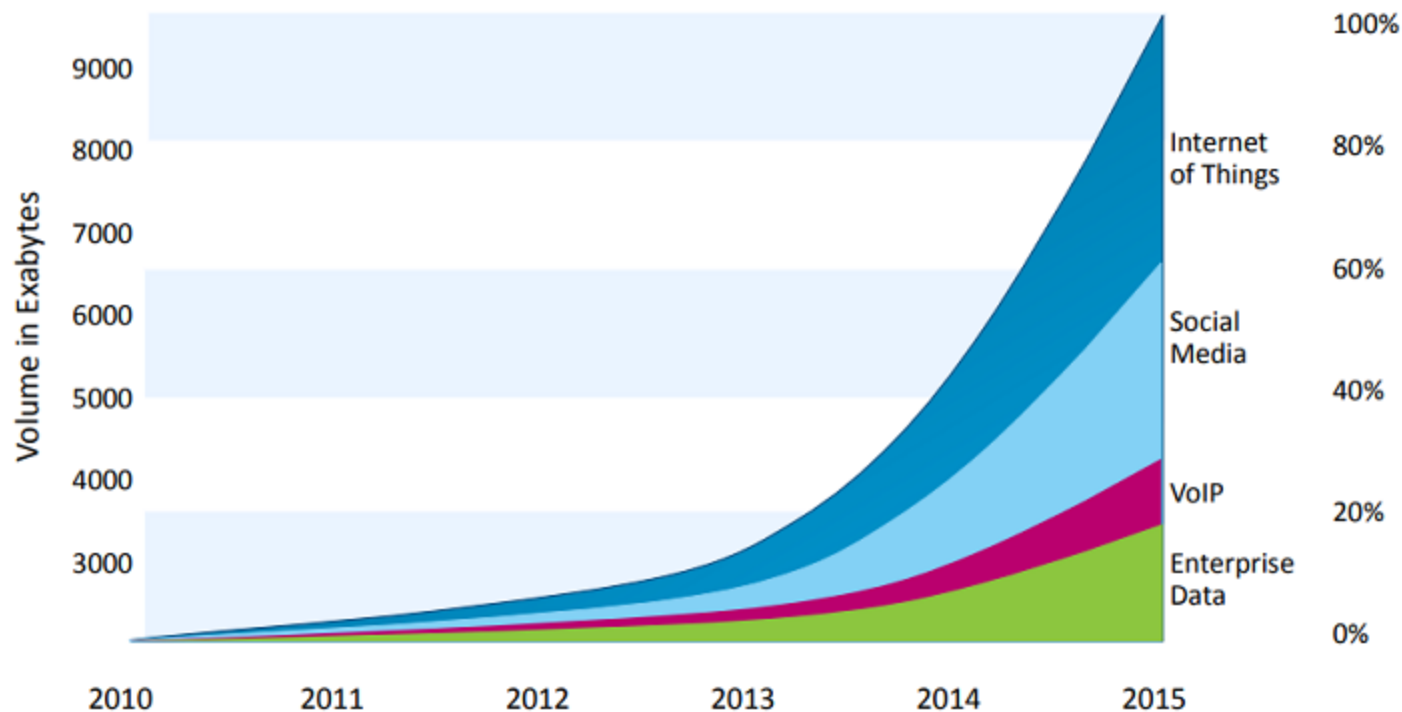
Volume



The Zettabyte Era: Trends and Analysis

Concept : les 3V

Volume



Source: IBM Global Technology Outlook

Be a Smarter Business by Unlocking your Internet of Things

Concept : les 3V

Variété

Produit

```
{
  "_id": {
    "$oid": "5968dd23fc13ae04d9000001"
  },
  "product_name": "sildenafil citrate",
  "supplier": "Wisozk Inc",
  "quantity": 261,
  "unit_cost": "$10.47"
}
```

10 Example JSON Files

Concept : les 3V

Variété

GeolP

```
{  
  "as": "AS16509 Amazon.com, Inc.",  
  "city": "Boardman",  
  "country": "United States",  
  "countryCode": "US",  
  "isp": "Amazon",  
  "lat": 45.8696,  
  "lon": -119.688,  
  ...  
  "regionName": "Oregon",  
  "status": "success",  
  "timezone": "America\\Los_Angeles",  
  "zip": "97818"  
}
```

Concept : les 3V

Variété

Twitter

```
{
  "created_at": "Thu Jun 22 21:00:00 +0000 2017",
  "id": 877994604561387500,
  "id_str": "877994604561387520",
  "text": "...",
  "entities": {
    "hashtags": [{
      ...
    }],
    "user_mentions": [],
    "urls": [{
      "url": "https://t.co/xFox78juL1",
      ...
    }]
  }
}
```


Concept : les 3V

Variété

WordPress

```
{  
  "id": 157538,  
  "date": "2017-07-21T10:30:34",  
  "date_gmt": "2017-07-21T17:30:34",  
  "guid": {  
    "rendered": "https://www.sitepoint.com/?p=157538"  
  },  
  "modified": "2017-07-23T21:56:35",  
  "modified_gmt": "2017-07-24T04:56:35",  
  "slug": "why-the-iot-threatens-your-wordp..",  
  "status": "publish",  
  "type": "post",  
  "link": "https://www.sitepoint.com/why-the-io...",  
}
```

Concept : les 3V

Vélocité



Et les autres

- Variabilité
- Véracité
- Visualisation
- Valeur

Hadoop

La démocratisation de la "Big Data"



- 2004
- Doug Cutting
- Framework
- Java
- Doudou

Hadoop

En résumé

Hadoop est un *framework* libre et *open source* écrit en Java destiné à faciliter la création d'applications distribuées (au niveau du stockage des données et de leur traitement) et échelonnables (scalables) permettant aux applications de travailler avec des milliers de nœuds et des pétaoctets de données.

[...] *Hadoop* a été inspiré par la publication de *MapReduce*, *GoogleFS* et *BigTable* de Google

[Wikipedia](#)

Hadoop

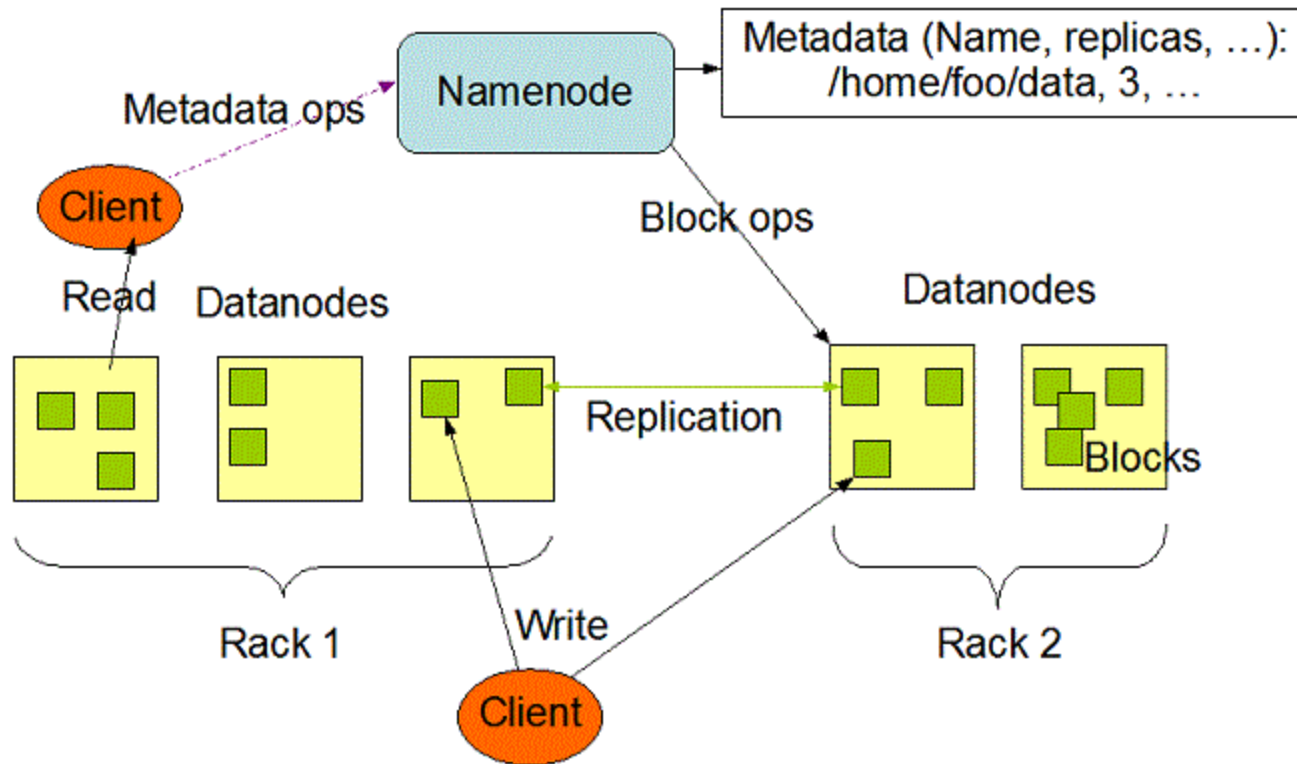
L'architecture

- *Hadoop Distributed File System* (HDFS)
- *YARN*
- *MapReduce*

Hadoop

HDFS

HDFS Architecture



HDFS Architecture Guide

Hadoop

HDFS

- *NameNode* : gestion de l'espace de noms, de l'arborescence et des métadonnées
- *DataNode* : stockage des blocs de données

Hadoop

HDFS - Quelques commandes

```
hadoop fs -mkdir  
hadoop fs -ls  
hadoop fs -put  
hadoop fs -get  
hadoop fs -cp  
hadoop fs -mv  
...
```

Hadoop

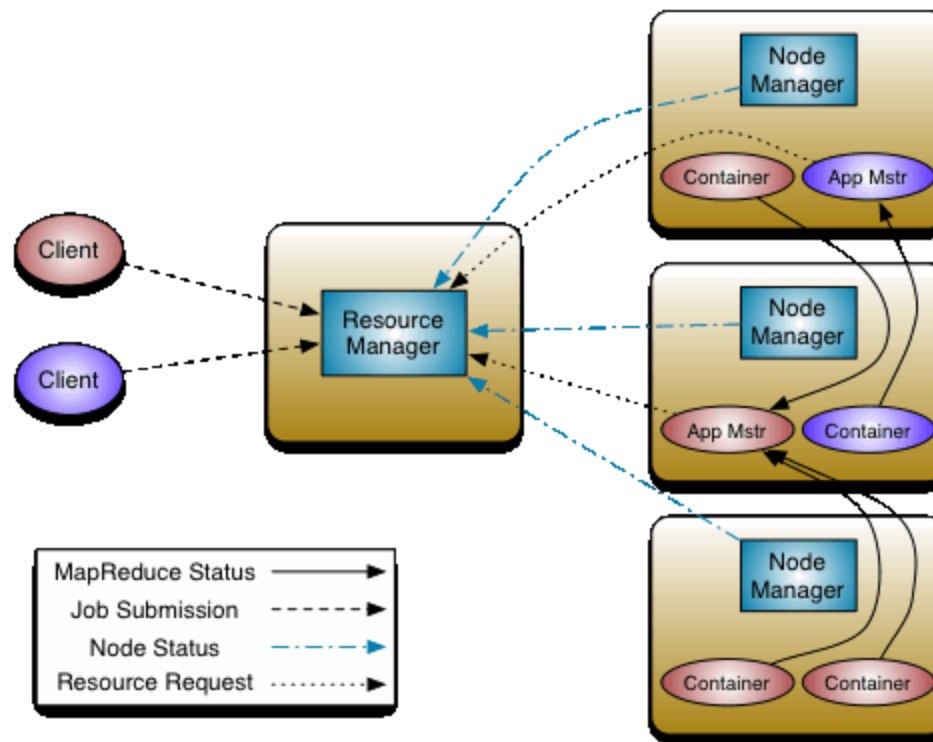
HDFS - Exercice pratique

```
$ docker pull sequenceiq/hadoop-docker:2.7.1
$ docker run -it sequenceiq/hadoop-docker:2.7.1 \
  /etc/bootstrap.sh -bash
bash-4.1# cd $HADOOP_PREFIX
bash-4.1# bin/hadoop version
bash-4.1# bin/hadoop fs -mkdir test
bash-4.1# bin/hadoop fs -ls
bash-4.1# bin/hadoop fs
```

<https://github.com/sequenceiq/hadoop-docker>

Hadoop

YARN



Apache Hadoop YARN

Hadoop

YARN

- ***Resource Manager*** : arbitre la gestion des ressources au sein du cluster
- ***Node Manager*** : fournit les ressources du nœud sous forme de *Container*
- ***Application Master*** : coordonne l'exécution des tâches
- ***Container*** : exécute les tâches

Hadoop

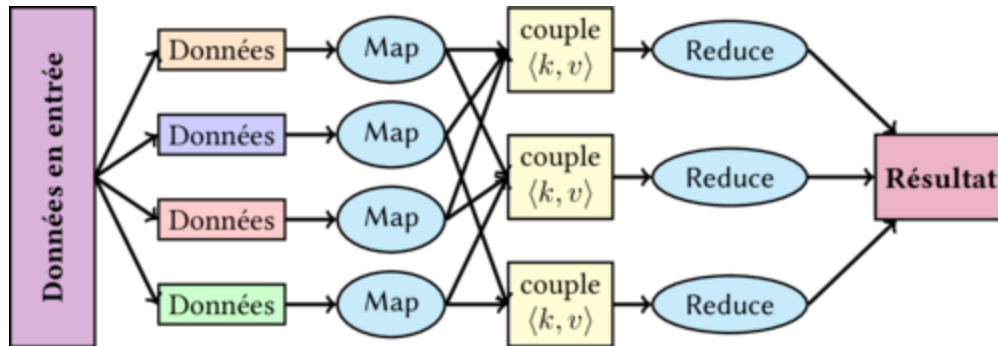
YARN - Web UI

```
$ docker run -p 8088:8088 -it sequenceiq/hadoop-docker:2.7.1 \  
/etc/bootstrap.sh -bash
```

<http://localhost:8088>

Hadoop

MapReduce



Wikipedia

input (k_1, v_1)

-> **map** -> (k_2, v_2)

-> **combine** -> (k_2, v_2)

-> **reduce** -> (k_3, v_3)

output

Hadoop

Par l'exemple : WordCount

Input (flux d'entrée) :

```
Conseil tenu par les rats
```

```
Un chat, nommé Rodilardus,  
Faisait des rats telle déconfiture  
Que l'on n'en voyait presque plus,  
Tant il en avait mis dedans la sépulture.  
Le peu qu'il en restait n'osant quitter son trou  
...
```

Hadoop

Par l'exemple : WordCount

Mapper :

```
import sys

for line in sys.stdin:
    line = line.strip()
    keys = line.split()
    for key in keys:
        value = 1
        print('%s\t%d' % (key, value))
```


Hadoop

Par l'exemple : WordCount

Reducer :

```
import sys

last_key = None
running_total = 0

for input_line in sys.stdin:
    input_line = input_line.strip()
    this_key, value = input_line.split("\t", 1)
    value = int(value)

    if last_key == this_key:
        running_total += value
    else:
        if last_key:
            print("%s\t%d" % (last_key, running_total))
            running_total = value
            last_key = this_key

if last_key == this_key:
    print("%s\t%d" % (last_key, running_total))
```

Hadoop

Par l'exemple : WordCount

```
bash-4.1# cat conseil-tenu-par-les-rats.txt | ./mapper.py \  
| sort | ./reducer.py
```

```
bash-4.1# bin/hadoop fs -mkdir wordcount  
bash-4.1# bin/hadoop fs -put conseil-tenu-par-les-rats.txt \  
wordcount/fable.txt  
bash-4.1# bin/hadoop jar share/hadoop/tools/lib/hadoop-streaming-  
-mapper "python mapper.py" \  
-reducer "python reducer.py" \  
-input "wordcount/fable.txt" \  
-output "wordcount/output"
```

```
bash-4.1# bin/hadoop fs -cat wordcount/output/*
```

Hadoop

Exercice

- Récupérez une source de données sur data.gouv.fr
- Importez ces données en HDFS
- Développez un code *MapReduce* en Python pour en extraire une nouvelle information
- Représentez-là sous forme de graphique

Base de données et Big Data

Les principes fondamentaux

- *Partitioning* : basé sur les colonnes
- *Sharding* : basé sur les clés d'une ligne

Base de données et Big Data

Partitioning

Col1	Col2	Col3	Col4	Col5	Col6
—					

Col1	Col2	Col3	Col4
—			

Col5	Col6
—	

Base de données et Big Data

Sharding - Horizontal partitioning

Key	Col1	Col2	Col3
x			
y			
z			

Key	Col1	Col2	Col3
x			

Key	Col1	Col2	Col3
y			
z			

HBase



- Base de données orientée colonnes
- Installé sur le système de fichier HDFS

HBase

Système de stockage

rowkey1	column family (CF11)						column family (CF12)			
	column111		column112		column113		column121		column122	
	version1111	value1111	version1121	value1121	version1131	value1131	version1211	value1211	version1221	value1221
	version1112	value1112	version1122	value1122					version1222	value1222
			version1123	value1123						
			version1124	value1124						

HBase Schema

HBase

Système de stockage

- Une *table* est une collection de *rows*
- Une *row* est une collection de *columns family*
- Une *column family* est une collection de *columns*
- Une *column* est une collection de clé/valeur

HBase

Système de stockage

```
{
  "row1": {"1": {"color": "green",
                 "size": 25},
           "2": {"weight": 52,
                 "size": 18}
           },
  "row2": {"1": {"color": "blue"},
           "2": {"height": 192,
                 "size": 43}
           }
}
```

HBase

HBase Shell

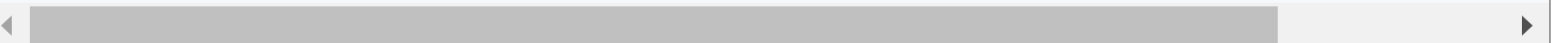
```
$ docker pull dajobe/hbase
$ mkdir data
$ docker run --name=hbase-docker -h hbase-docker -d \
-v $PWD/data:/data dajobe/hbase
$ docker exec -it hbase-docker bash
root@hbase-docker:/# hbase shell
```

HBase

HBase Shell

HBase Tutorial

```
> status  
1 active master, 0 backup masters, 1 servers, 1 dead, 2.0000 av
```



```
> list  
TABLE  
0 row(s) in 0.0820 seconds  
  
=> []
```

HBase

HBase Shell - Création d'une table

```
> create 'emp', 'personal data', 'professional data'  
0 row(s) in 1.3160 seconds  
  
=> Hbase::Table - emp
```

```
> list  
TABLE  
emp  
1 row(s) in 0.0440 seconds  
  
=> ["emp"]
```

HBase

HBase Shell - Désactivation

```
> disable 'emp'  
0 row(s) in 2.3980 seconds
```

```
> is_disabled 'emp'  
true  
0 row(s) in 0.0110 seconds
```

HBase

HBase Shell - Activation

```
> enable 'emp'  
0 row(s) in 1.3110 seconds
```

```
> is_enabled 'emp'  
true  
0 row(s) in 0.0280 seconds
```


HBase

HBase Shell - Ecriture

```
> put 'emp', '1', 'personal data:name', 'raju'  
> put 'emp', '1', 'personal data:city', 'hyderabad'  
> put 'emp', '1', 'professional data:designation', 'manager'  
> put 'emp', '1', 'professional data:salary', '50000'
```

```
> scan 'emp'
```

HBase

HBase Shell - Mise à jour

```
> put 'emp','1','personal data:city','Delhi'
ROW    COLUMN+CELL
 1    column=personal data:city, timestamp=1503511522300, value=
 1    column=personal data:name, timestamp=1503511282272, value=
 1    column=professional data:designation, timestamp=1503511332
 1    column=professional data:salary, timestamp=1503511341265,
1 row(s) in 0.0250 seconds
```

HBase

HBase Shell - Accès

```
> get 'emp', '1'
```

```
COLUMN
```

```
personal data:city
```

```
personal data:name
```

```
professional data:designation
```

```
professional data:salary
```

```
4 row(s) in 0.0610 seconds
```

```
CELL
```

```
timestamp=1503511522300, value
```

```
timestamp=1503511282272, value
```

```
timestamp=1503511332216, value
```

```
timestamp=1503511341265, value
```

HBase

HBase Shell - Accès à une colonne

```
> get 'emp', '1', {COLUMN => 'personal data:name'}  
COLUMN          CELL  
personal data:name    timestamp=1503511282272, value=raju  
1 row(s) in 0.0250 seconds
```

HBase

HBase Shell - Suppression

```
> delete 'emp', '1', 'personal data:city'  
> deleteall 'emp', '1'  
> scan 'emp'
```

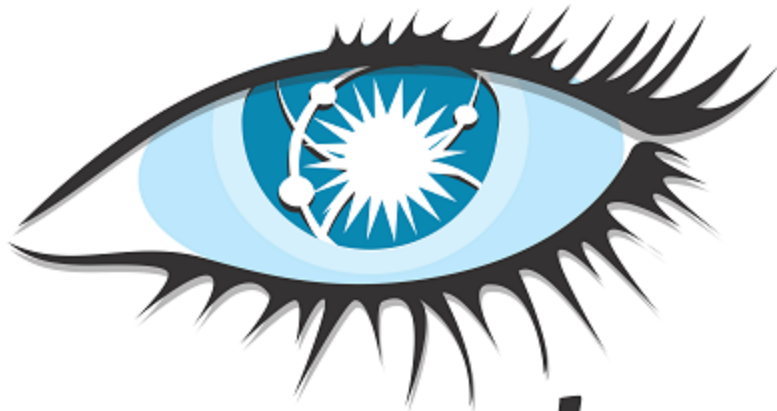
HBase

HBase Shell - Sécurité

- R lecture
- W écriture
- X exécution
- C création
- A admin

```
> grant 'bobsmith', 'RWXCA'  
> revoke 'bobsmith'
```

Cassandra

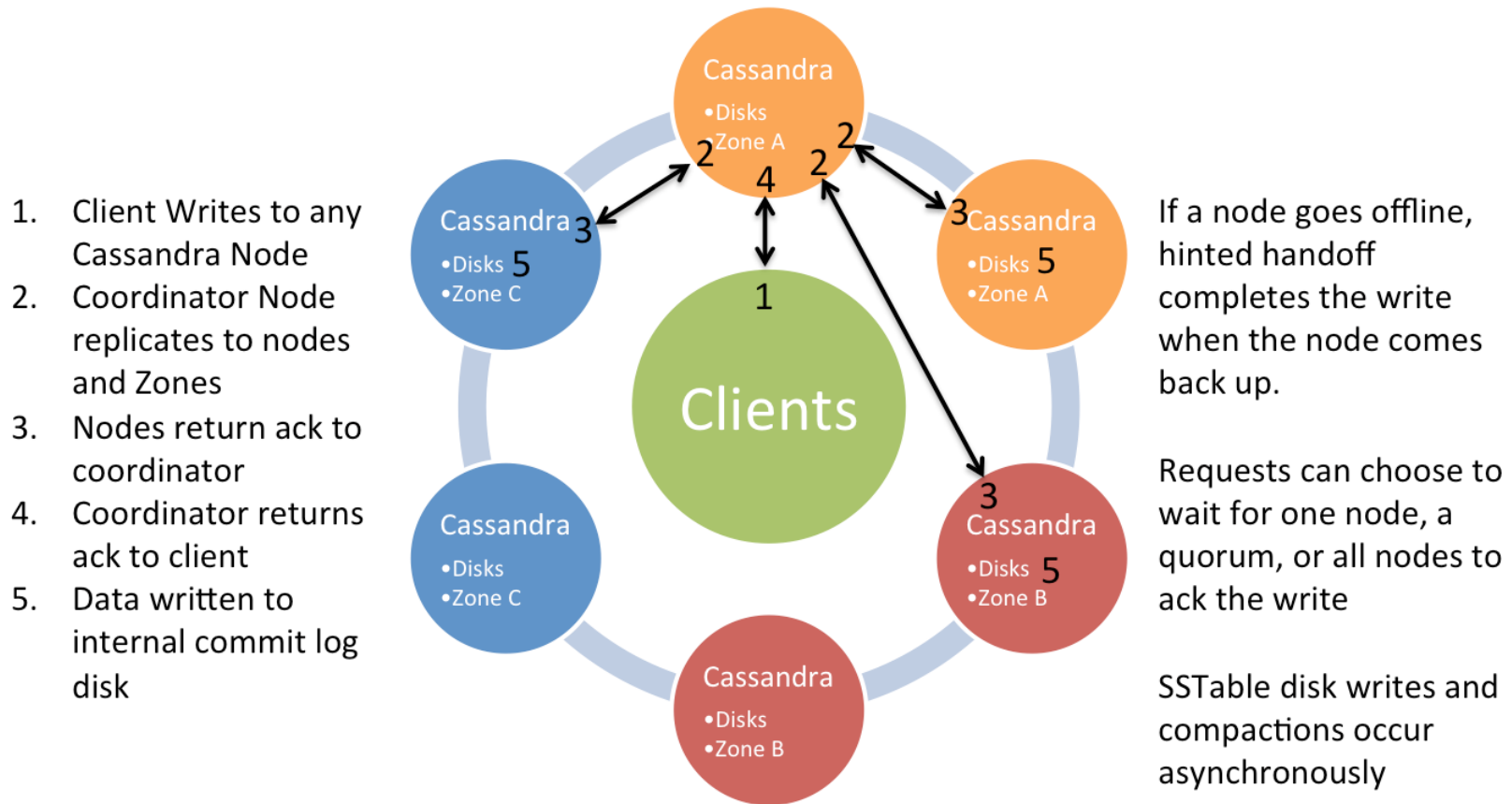


cassandra

- Tolérance à la panne
- Décentralisé
- Scalable

Cassandra Write Data Flows

Single Region, Multiple Availability Zone



Cassandra

Tutorial

```
$ docker pull cassandra  
$ docker run --name=cassandra -d library/cassandra  
$ docker exec -it cassandra bash  
root@a6b74edad198: /#
```

Cassandra Tutorial

Cassandra

cqlsh

```
root@dce317a979a6:/# cqlsh
Connected to Test Cluster at 127.0.0.1:9042.
[cqlsh 5.0.1 | Cassandra 3.11.4 | CQL spec 3.4.4 | Native proto
Use HELP for help.
cqlsh>
```

Cassandra Query Language (CQL)

Cassandra

Keyspace

```
cqlsh> CREATE KEYSPACE tutorialspoint  
WITH replication = {'class':'SimpleStrategy',  
'replication_factor' : 3};  
cqlsh> DESCRIBE keyspaces;
```

Cassandra

Table

```
cqlsh> USE tutorialspoint;  
cqlsh:tutorialspoint> CREATE TABLE emp(  
    emp_id int PRIMARY KEY,  
    emp_name text,  
    emp_city text,  
    emp_sal varint,  
    emp_phone varint  
);  
cqlsh:tutorialspoint> select * from emp;
```

Cassandra

Créer

```
cqlsh:tutorialspoint> INSERT INTO emp
(emp_id, emp_name, emp_city, emp_phone, emp_sal)
VALUES (1,'ram', 'Hyderabad', 9848022338, 50000);
cqlsh:tutorialspoint> INSERT INTO emp
(emp_id, emp_name, emp_city, emp_phone, emp_sal)
VALUES (2,'robin', 'Hyderabad', 9848022339, 40000);
cqlsh:tutorialspoint> INSERT INTO emp
(emp_id, emp_name, emp_city, emp_phone, emp_sal)
VALUES (3,'rahman', 'Chennai', 9848022330, 45000);
cqlsh:tutorialspoint> SELECT * FROM emp;
```

Cassandra

Mettre à jour

```
cqlsh:tutorialspoint> UPDATE emp  
SET emp_city='Delhi',emp_sal=50000  
WHERE emp_id=2;  
cqlsh:tutorialspoint> SELECT * FROM emp;
```

Cassandra

Lire

```
cqlsh:tutorialspoint> SELECT emp_name, emp_sal from emp;  
cqlsh:tutorialspoint> SELECT * FROM emp WHERE emp_sal=50000;  
cqlsh:tutorialspoint> CREATE INDEX ON emp(emp_sal);  
cqlsh:tutorialspoint> SELECT * FROM emp WHERE emp_sal=50000;
```

Cassandra

Supprimer

```
cqlsh:tutorialspoint> DELETE emp_sal FROM emp WHERE emp_id=3;  
cqlsh:tutorialspoint> SELECT * FROM emp;  
cqlsh:tutorialspoint> DELETE FROM emp WHERE emp_id=3;  
cqlsh:tutorialspoint> SELECT * FROM emp;
```

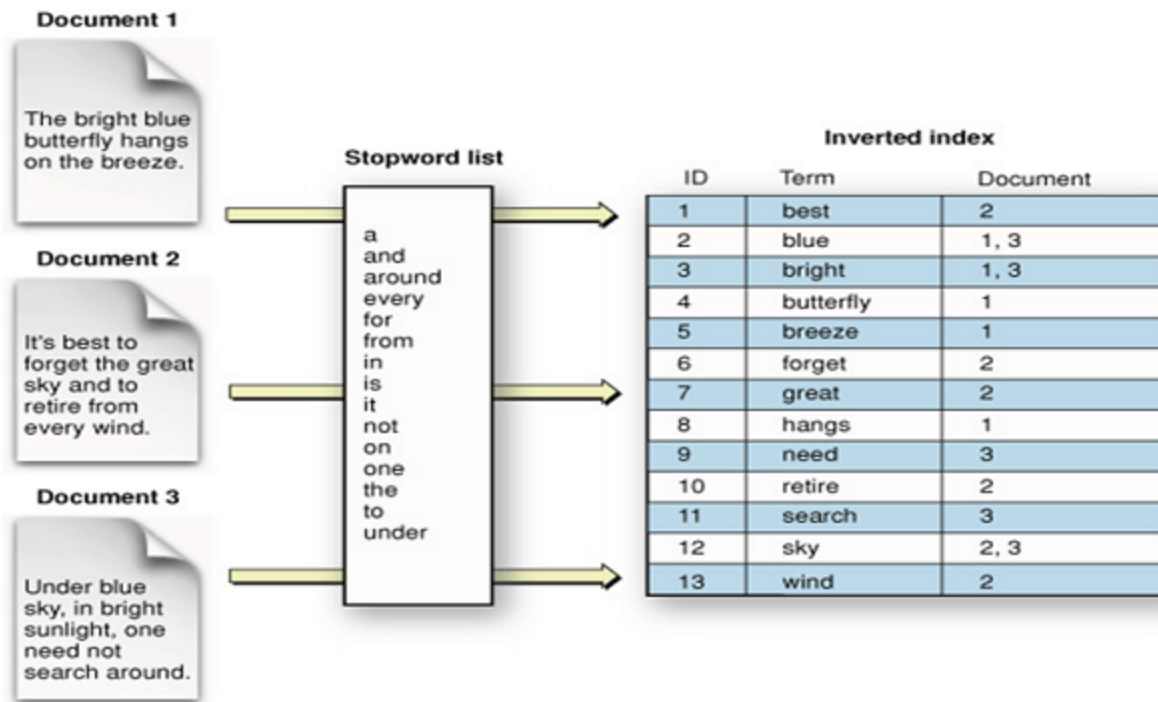

Elasticsearch



elasticsearch

- Indexation et recherche de données
- Moteur [Lucene](#)
- *API HTTP RESTful en JSON*

Elasticsearch



Elasticsearch Tutorial - Elasticsearch Storage Architecture : Analysis and Inverted Indexes

Elasticsearch

Tutorial

```
$ docker pull docker.elastic.co/elasticsearch/elasticsearch:7.2
$ docker run --name=elasticsearch -d -p 9200:9200 \
-e "http.host=0.0.0.0" -e "transport.host=127.0.0.1" \
docker.elastic.co/elasticsearch/elasticsearch:7.2.1
$ curl -u elastic http://127.0.0.1:9200/
```

Utilisateur : elastic

Mot de passe : changeme

[Elasticsearch Tutorial](#)