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Apache Cassandra

Overview

History

- Apache Cassandra was developed at Facebook
- It was released as an open source project on Google code in 2008
- In March 2009, it became an Apache project.

Main features

- NoSQL
- Performance
- Scalability
- Replication

Aaaaa!!! Exadata MONSTER!!!

http://flashdba.com/2014/01/09/oracle-exadata-x4-part-2-the-all-flash-database-machine/

Exadata Database Machine X4-2 Key

Metric	Full Rack	
Maximum SQL flash bandwidth [2]	100 GB/s	
Maximum SQL flash read IOPS [3]	2,660,000	
Maximum SQL flash write IOPS [4]	1,960,000	
Flash data capacity (raw) [5]	44.8 TB	
Effective Flash cache capacity [7]	Up to 448 TB	
	HC[1] Disks	HP[1] Disks
Maximum SQL disk bandwidth [2]	20 GB/s	24 GB/s
Maximum SQL disk IOPS [3]	32,000	50,000
Disk data capacity (raw) [5]	672 TB	200 TB
Disk data capacity (usable) [6]	300 TB	90 TB
Maximum data load rate [8]	20 TB/hour	

https://blogs.oracle.com/sarecz/entry/5_gener%C3%A1ci%C3%B3s_exadata

$1,100,000

http://www.oracle.com/us/corporate/pricing/exadata-pricelist-070598.pdf

Meh… ☹ Theory ☺

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RDB

ACID

- ATOMICITY
- CONCISTENCY
- ISOLATION
- DURABILITY

DISTRIBUTED SYSTEM

CAP

- CONSISTENCY
- AVAILABILITY
- PARTITION TOLERANCE

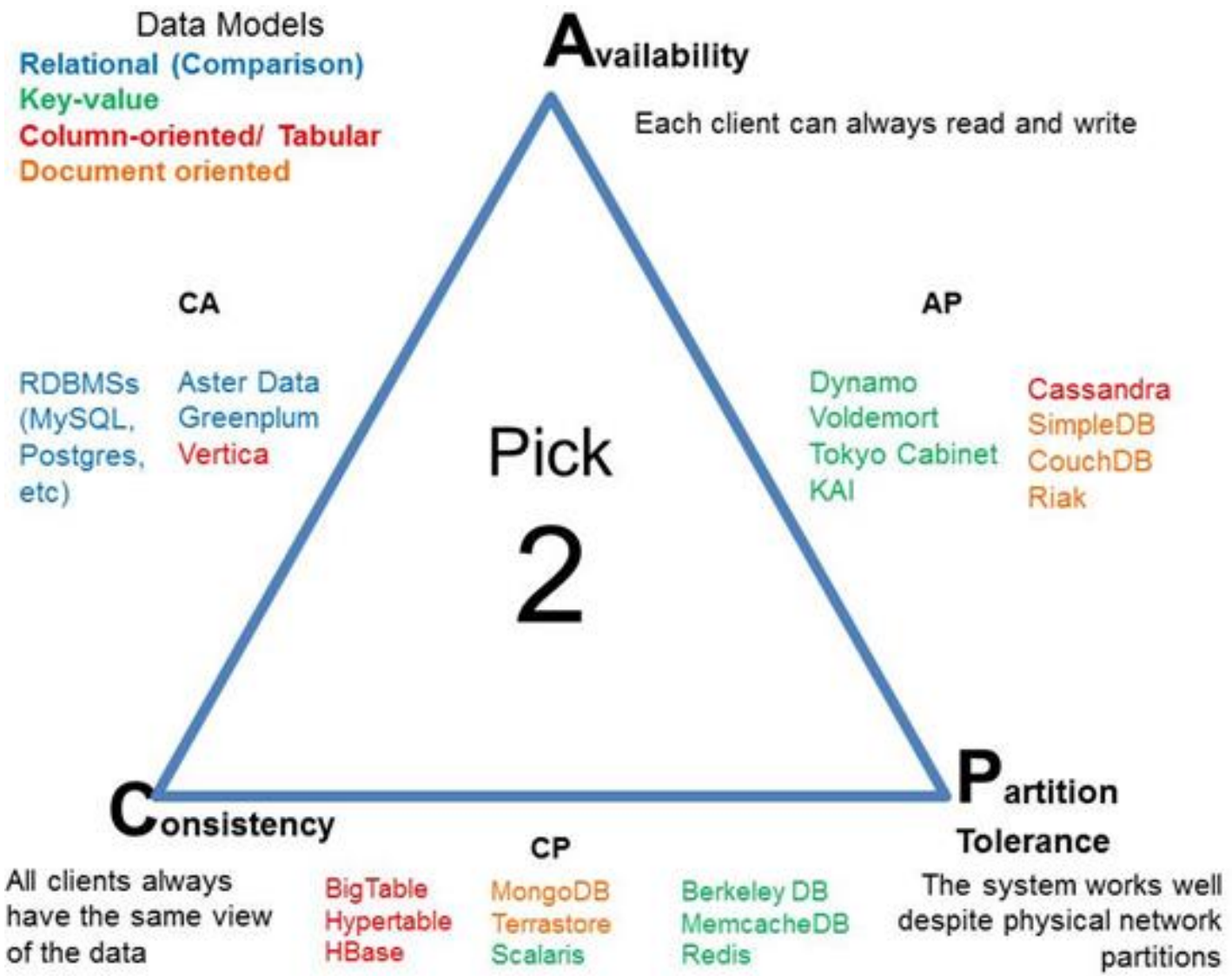
NoSQL

BaSE

- BASICALLY AVAILABLE
- SOFT STATE
- EVENTUALLY CONSISTENT

http://highscalability.com/blog/2009/5/5/drop-acid-and-think-about-data.html
http://architects.dzone.com/articles/big-data-beyond-mapreduce

CAP: orientation



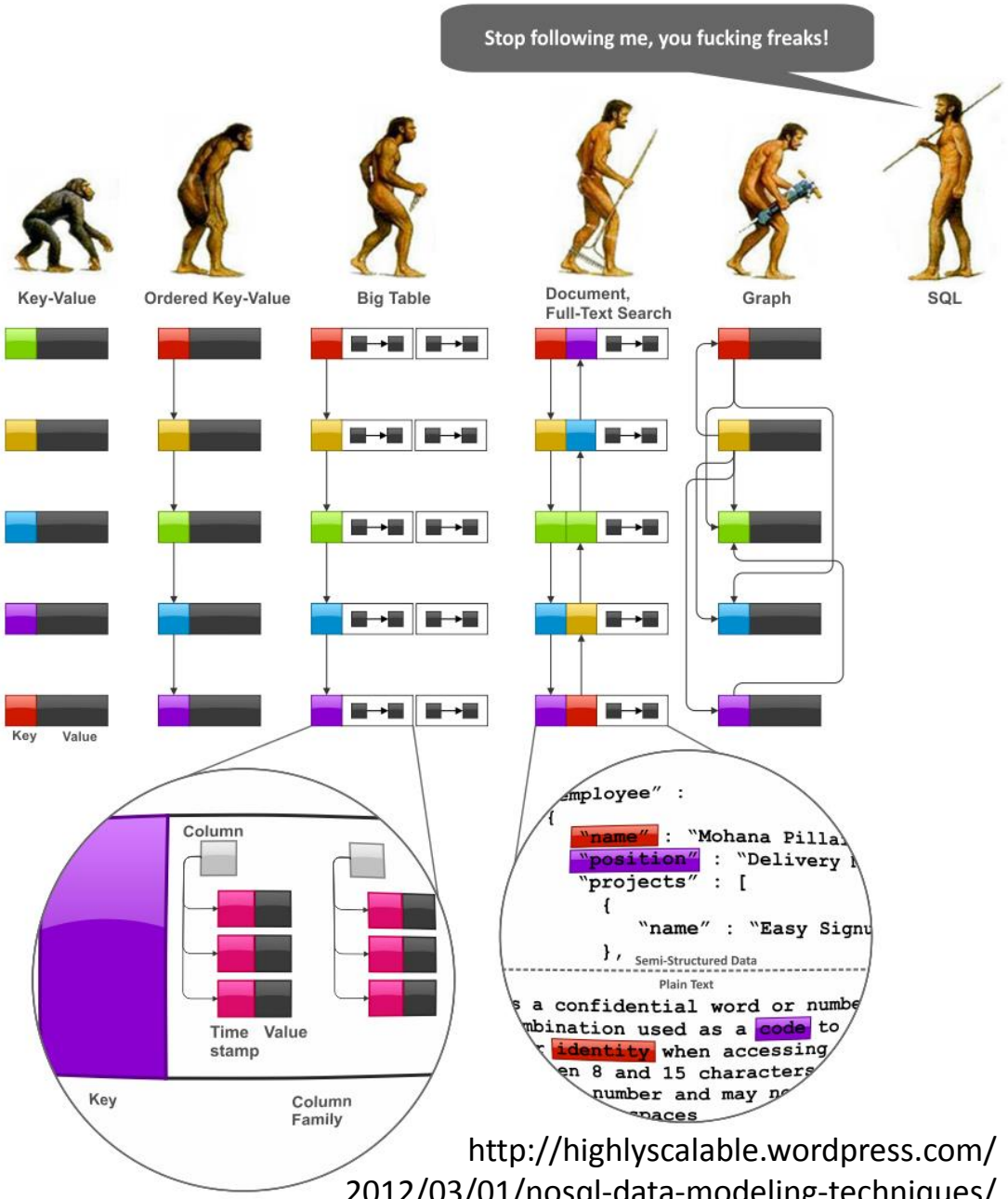
http://flux7.com/blogs/nosql/cap-theorem-why-does-it-matter/

NoSQL: You have your options

Graph	Column	Document	Persistent Key/Value	Volatile Key/Value
neo4j	BigTable (Google)	MongoDB (~BigTable)	Dynamo (Amazon)	memcached
FlockDB (Twitter)	HBase (BigTable)	CouchDB	Voldemort (Dynamo)	Hazelcast
InfiniteGraph	Cassandra (Dynamo + BigTable)	Riak (Dynamo)	Redis	
	Hypertable (BigTable)		Membase (memcached)	
	SimpleDB (AmazonAWS)		Tokyo Cabinet	

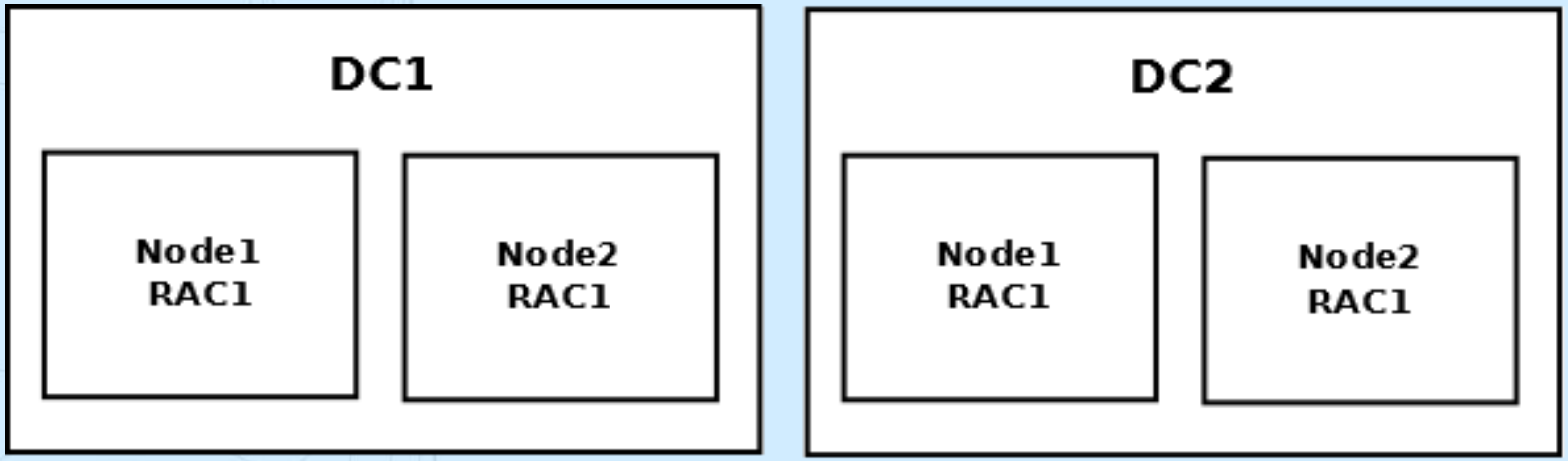
http://bigdatanerd.wordpress.com/2012/01/04/why-nosql-part-2-overview-of-data-modelrelational-nosql/

NoSQL: You have your options (2)



http://highlyscalable.wordpress.com/2012/03/01/nosql-data-modeling-techniques/

Cassandra cluster



Configuration files

cassandra-rackdc.properties

```
dc=DC1
rack=RAC1
```

Configuration files

cassandra.yaml

```
cluster_name: 'CLUSTER_NAME'

num_tokens: 256

authenticator: org.apache.cassandra.auth.PasswordAuthenticator

authorizer: org.apache.cassandra.auth.CassandraAuthorizer

partitioner: org.apache.cassandra.dht.Murmur3Partitioner
```

Configuration files

cassandra.yaml

```
data_file_directories:
    - /srv/qad/cassandra/data

commitlog_directory: /srv/qad/cassandra/commitlog

saved_caches_directory: /srv/qad/cassandra/saved_caches

seed_provider:
        …
         # seeds is actually a comma-delimited list of addresses.
         # Ex: "<ip1>,<ip2>,<ip3>"
         - seeds: "192.168.209.12"
```

Configuration files

cassandra.yaml

```
listen_address: 192.168.209.11

rpc_address: 192.168.209.11

endpoint_snitch: GossipingPropertyFileSnitch
```

Configuration and Deployment

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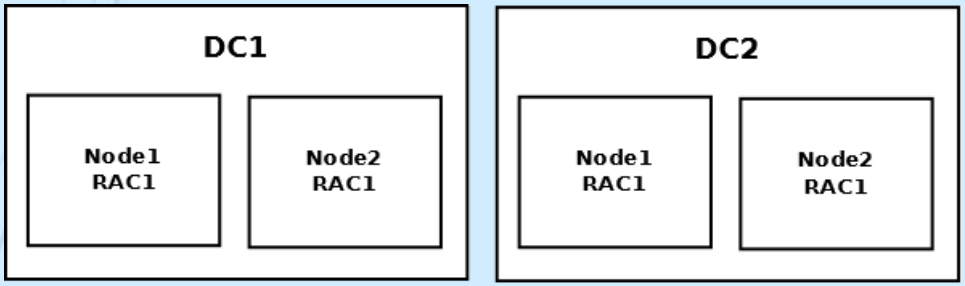
In case we use GossipingPropertyFileSnitch we need:

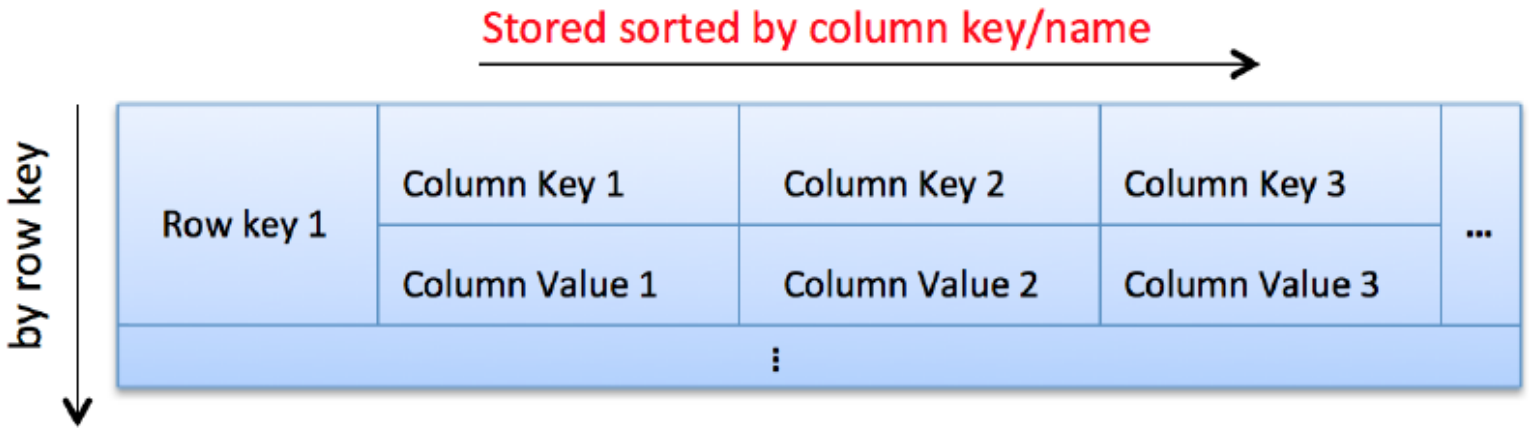
- Create keyspace
- Set Replication

```
cassandra/bin/cqlsh

CREATE KEYSPACE keyspace1 WITH REPLICATION =
      {'class' : 'NetworkTopologyStrategy', 'DC1' : 2, 'DC2' : 2};

ALTER KEYSPACE system_auth WITH REPLICATION =
      {'class' : 'NetworkTopologyStrategy', 'DC1' : 2, 'DC2' : 2};
```



Datamodel she has

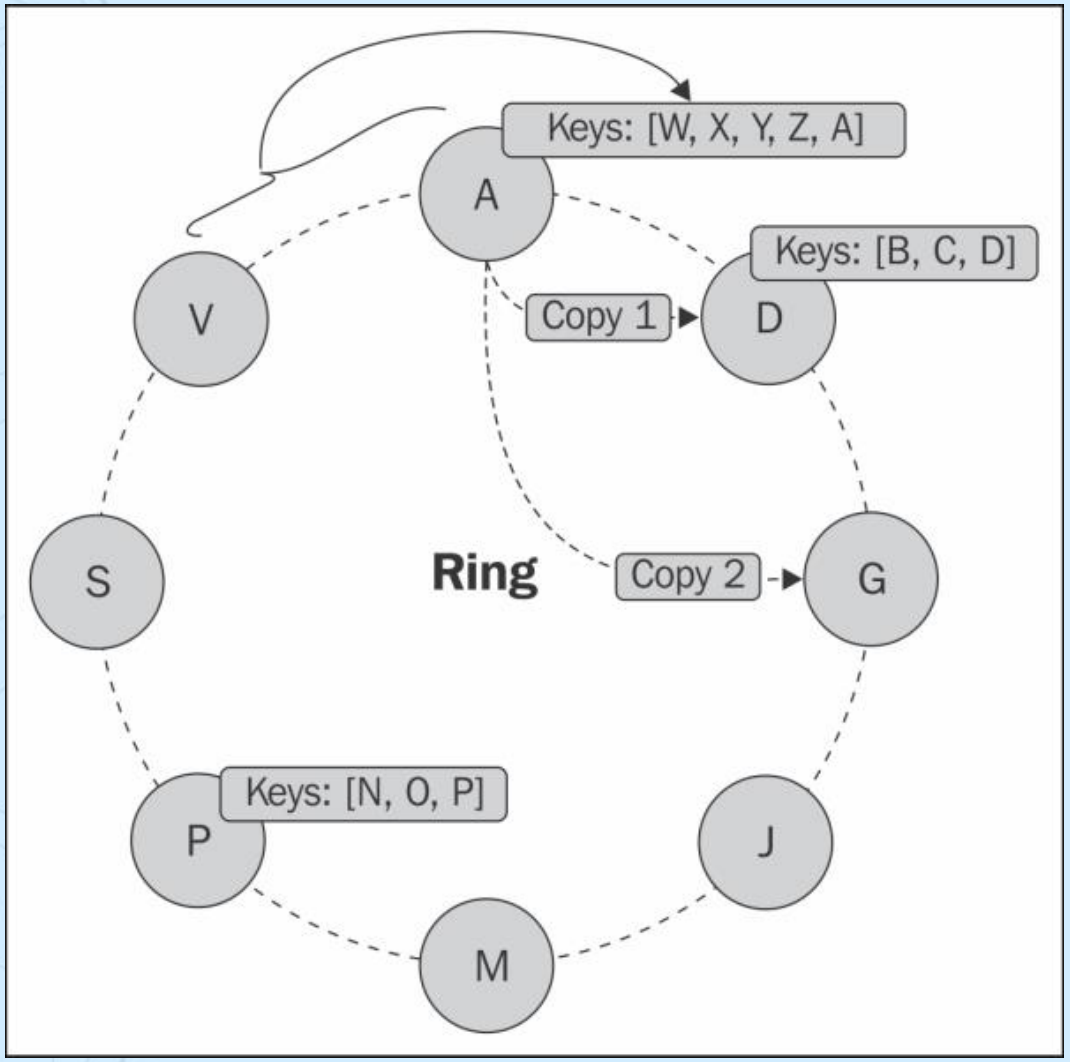
Non-relational, sparse model designed for high scale distributed storage



Relational Model	Cassandra Model
Database	Keyspace
Table	Column Family (CF)
Primary key	Row key
Column name	Column name/key
Column value	Column value

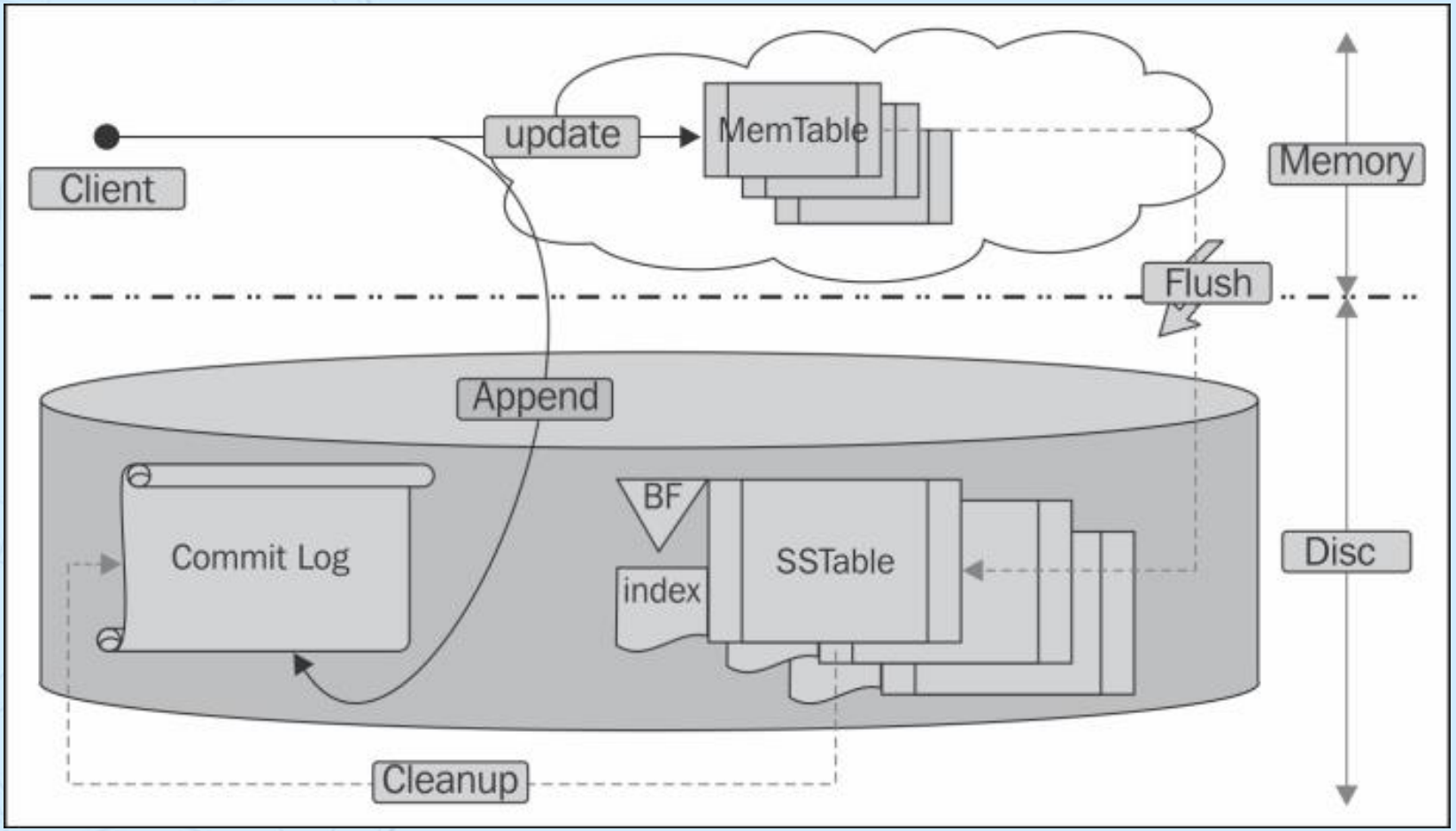
http://www.slideshare.net/jaykumarpatel/cassandra-data-modeling/best-practices

How she writes?



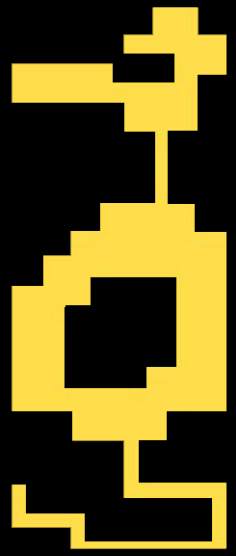
§ Nishant Neeraj. "*Mastering Apache Cassandra*"

How she writes?



§ Nishant Neeraj. "*Mastering Apache Cassandra*" (book)
http://en.wikipedia.org/wiki/Log-structured_merge-tree
§ Patrick O'Neil. The Log-Structured Merge-Tree (article)

Console game



HERE BE DRAGONS

http://sci-fi-ditties.blogspot.ru/2012/08/sci-fi-guilty-pleasures-yars-revenge.html

Cassandra: Bloom filter

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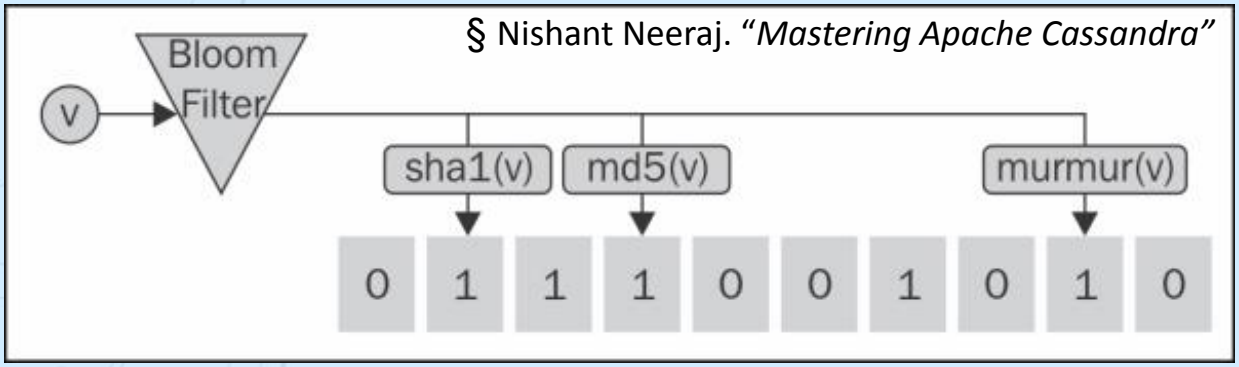
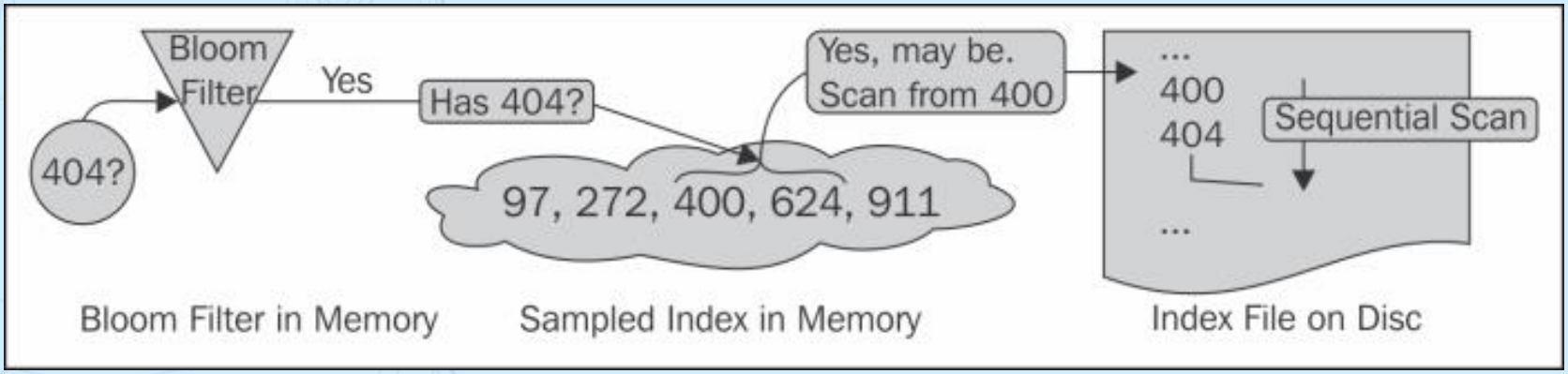
One more game:

http://billmill.org/bloomfilter-tutorial/



Cassandra: How she finds?



§ Nishant Neeraj. "*Mastering Apache Cassandra*"

Is it clear?

http://www.slideshare.net/jaykumarpatel/cassandra-data-modeling/best-practices

Data modeling by example

- Get user by user id
- Get item by item id
- Get all the items that a particular user has liked
- Get all the users who like a particular item

User

UserID	Name	Email
123	Jay	jp@ebay.com
456	John	jh@ebay.com
⋮		

User_Item_Like

ID	UserID <fk>	ItemID <fk>	Timestamp
1	123	111	00000001
2	123	222	00000002
3	456	111	00000003
⋮			

Item

ItemID	Title	Desc
111	iphone	It's a phone
222	ipad	It's a tablet
⋮		

http://www.slideshare.net/jaykumarpatel/cassandra-data-modeling/best-practices

Data modelling: DENORMALIZE!

User

123	Name	Email
	Jay	jp@ebay.com
⋮		

Item

111	Title	Desc
	iphone	It's a phone
⋮		

User_By_Item

<timeuuid|userid>

111	120101010000 | 123	120101030000 | 456	...
	Jay	John	
⋮			

Item_By_User

123	120101010000 | 111	120101020000 | 456	...
	iphone	ipad	
⋮			

http://www.slideshare.net/jaykumarpatel/cassandra-data-modeling/best-practices

Java-driver

The **Java Driver** 2.0 for Apache Cassandra works exclusively with the Cassandra Query Language version 3 (CQL3) and Cassandra's new binary protocol which was introduced in Cassandra version 1.2.

Java API to connect Cassandra via java-driver

```
Cluster cluster = Cluster.builder().addContactPoint("127.0.0.1").build();

Session session = cluster.connect();
```

Java-driver

Java API to request data via java-driver

```
ResultSet results = session.execute(
        "SELECT * FROM keyspace.table WHERE id = 123" );


for (Row row : results) {
        row.getString("column1");
        row.getString("column2");
}
```

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Questions?