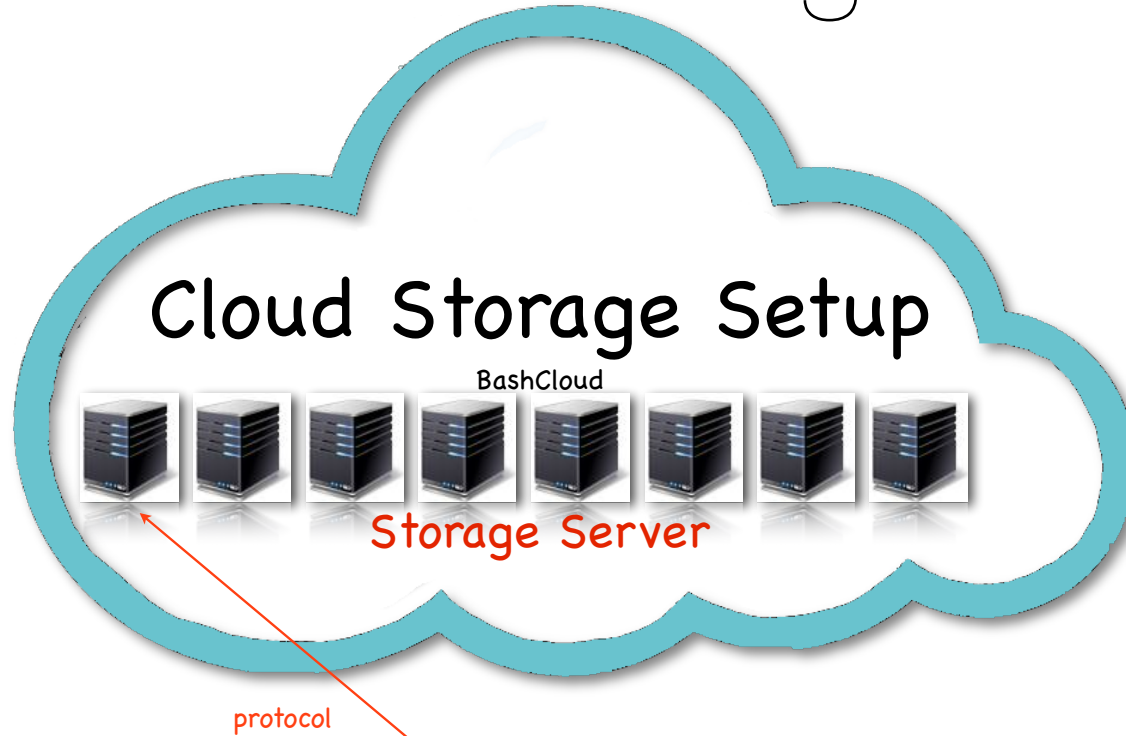




Cloud Storage



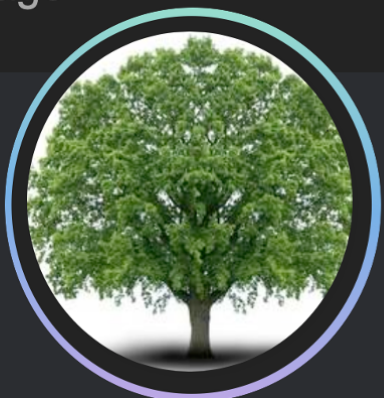
Storage Logic: 🤖
→ implemented in client
by you !



scalable &
fault tolerant

Big Data Storage

Hierarchical vs. Flat



How to find a file or on object?

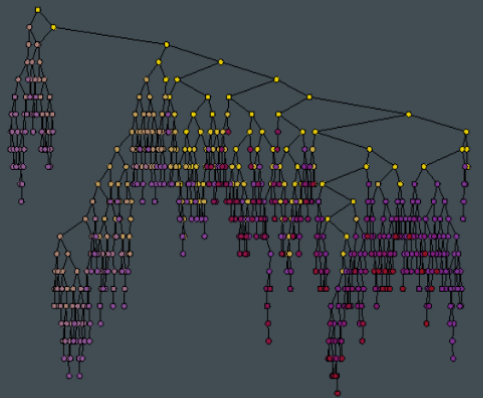
Filesystem:
tree search

Object Storage:
consistent hashing

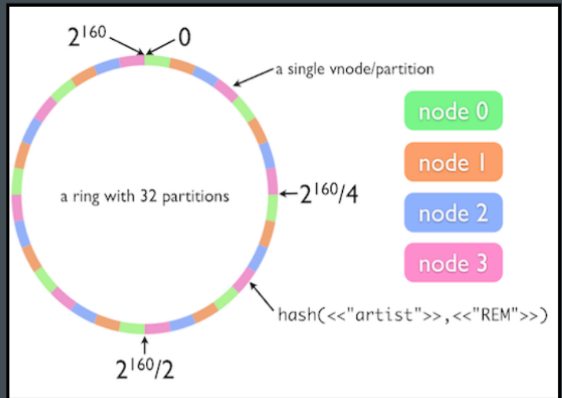
Search Effort **Tree Organization & Location Index**

$$O(\log n)$$

n = number of nodes



Direct Lookup by **Consistent Hashing**





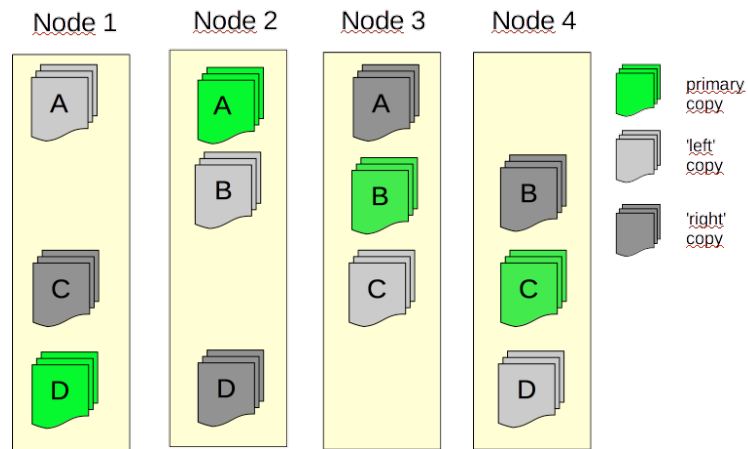
Cloud / Object Storage

- basic principles for the exercise
 - **sharding**: files are placed and located using a **distributed hash table (DHT)**
 - the DHT can be changed to change the storage configuration
 - files are located computing the SHA1 **checksum of their filename** in hex representation
 - files get **replicated** to each neighbouring node e.g. every file has 3 copies
 - files can be **listed** using a 'bucket'





Locating files with consistent hashing



File Location Table = „Recipe to find a file by name“

Hash Value	Node Name
A	2
B	3
C	4
D	1

Consistent Hashing

- 160-bit integer keyspace
- divided into fixed number of evenly-sized partitions
- partitions are claimed by nodes in the cluster
- replicas go to the N partitions following the key

node 0
node 1
node 2
node 3

N=3

hash("meetups/nycdevops")

μαζη(„wεεfηbε\υλcεεlobε„)





Cloud Storage Buckets

flat namespaces

- buckets are represented by a set of file names e.g.

```
ls /  
1.jpg  
2.jpg  
3.jpg
```

- a set is more suitable than a list because it does not allow duplicated file names
- one can also shard buckets for scalability purposes - we don't do this
 - to list a directory one combines the listing of all participating servers





Basic Ingredients of Cloud Storage

- 🌐 **Objects:**

 - K-V Store API

 - UPLOAD DOWNLOAD DELETE LIST

- 🌐 **Collections:**

 - SET API

 - ADD DELETE LIST MEMBERS

- 🌐 **Scalability:**

 - Sharding of Objects and Collections

- 🌐 **Redundancy:**

 - Replication & Erasure Encoding

 - (RS Encoding)





Exercises

<https://cern.ch/setcp>

