Key-value Stores: Practice

Seminar 2 of *NoSQL Databases* (PA195)

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Agenda

- Key-value stores: properties and representatives
- Riak
  - Mission, types of communication, HTTP API
  - Riak Links & Riak Search
  - Java client
    - Example
  - Internal features
- Infinispan
  - Mission, basic features
  - Example with embedded cache store

Technologies Used

- OpenNebula - private cloud at FI
  - Infrastructure as a Service
- SSH private/public key pairs
- SSH tunneling
- curl to communicate with HTTP REST API

- Java
  - IDE

Practical Work with Riak

Riak: Basic Information

- Developer: Basho, open source community
  - there is a company behind
- Initial release date: 2009
  - it is not a new (shaky) technology
- License: Apache 2 + commercial enterprise
  - for free but with option to have a paid support
- Language: Erlang, C, C++, some parts in JavaScript
  - Efficient; not possible to embed to e.g. Java application
- Server OS: Linux, BSD, Mac OS X, Solaris

basic info: http://db-engines.com/en/system/Riak website: https://riak.com/products/riak-kv/

Test Environment

localhost

Accessible from outside the FI net

- Private cloud at FI: https://stratus.fi.muni.cz/
  - tech info: link
  - log in with your **faculty credentials** (user/password)
- User -> settings -> Public SSH Key
  - create an ssh public-private key pair **(if you do not have any)**:

    `nymfe$ ssh-keygen` OR `aisa$ ssh-keygen`
    - by default stored in `.ssh/id_rsa`
    - store the text from .ssh/id_rsa.pub in the settings at Stratus account
- Create new VM from template "PA152 CentOS 7"

```
nymfe$ ssh root@172.26.1.ddd
OR
     $ ssh -t <LOGIN>@aisa.fi.muni.cz ssh root@172.26.1.ddd
```

ID 648

Test Environment (2)

- **Use the VM @Stratus (so skip this slide)**
- ...or install Riak from packages on your machine
  - http://docs.basho.com/riak/latest/downloads/
  - Requires admin rights (sudo)

- ...or compile (on nymfe)

```
mkdir /var/tmp/$USER
cd /var/tmp/$USER
wget https://goo.gl/raFdZM -O riak-2.2.1.tar.gz
tar xf riak-2.2.1.tar.gz
cd riak-2.2.1/
make rel
cd rel/riak/bin
./riak start
```

Basic Riak Commands

stratus

Edit the Riak config: (nodename and internal cluster connection)

```
[root@centos7 ~]# nano /etc/riak/riak.conf
```

change:

```
nodename = <your_name>@<your_IP>
listener.protobuf.internal = <your_IP>:8087

[root@centos7 ~]# riak start
[root@centos7 ~]# riak ping
[root@centos7 ~]# riak-admin test
[root@centos7 ~]# riak stop
```

documentation: https://docs.riak.com/riak/kv/2.2.1/

Admin Web GUI

localhost

- Admin GUI for a running Riak instance
  - http://localhost:8098/admin

- To access the Admin GUI from localhost, use ssh tunneling

```
nymfe$ ssh root@172.26.1.ddd -L 8098:localhost:8098
```

OR

```
$ ssh -L 8098:172.26.1.ddd:8098 -t <login>@aisa.fi.muni.cz ssh root@172.26.1.ddd
```

Riak: HTTP API

- Riak HTTP API - simple HTTP Restful service
- HTTP API uses different HTTP methods
  - for different operations
  - GET (retrieve), PUT (update), POST (create), DELETE (delete)
  - https://docs.riak.com/riak/kv/2.2.1/developing/api/http/

- We will use curl (curl --help)
  - a command line tool to communicate with server (http(s),...)

localhost

  - HTTP REST examples can be accessed on 172.26.1.ddd using

```
$ curl http://localhost:8098/…
```

Riak: Example 1 - Buckets

localhost

- List all the buckets

```
curl http://localhost:8098/buckets?buckets=true -s | json_pp
```

- Everyone will use their own bucket

```
$ export ARTISTS=${USER}_artists
```

Then, the bucket URL is: `http://localhost:8098/buckets/$ARTISTS`

- Buckets are created on the fly
  - Only when needed

Riak: Example 2 - Basic Operations

localhost

- Store a plain text using a generated key (POST)

```
curl -X POST http://localhost:8098/buckets/$ARTISTS/keys/ -d
'text'
```

- List all keys within a bucket
  - not recommended for production (slow and not reliable)

```
curl http://localhost:8098/buckets/$ARTISTS/keys?keys=true
```

- Get an object:

```
curl http://localhost:8098/buckets/$ARTISTS/keys/<key>
```

Riak: Example 3 - Buckets properties

localhost

- Store a JSON object with key *Bruce*

```
curl -X PUT -H "Content-Type: application/json" -d '{"name":
"Bruce Springsteen", "nationality": "USA"}'
http://localhost:8098/buckets/$ARTISTS/keys/Bruce
```

- Get properties of your bucket:

```
curl http://localhost:8098/buckets/$ARTISTS/props  | json_pp
```

- Change properties of the bucket:
  - Set replication factor to “2”

```
curl -X PUT http://localhost:8098/buckets/$ARTISTS/props -H
"Content-Type: application/json" -d '{"props": {"n_val": 2}}'
```

Riak: Example 4 - Updates

- Update an object = store a new value

```
curl -X PUT -H "Content-Type: application/json" -d '{"name":
"Bruce Springsteen", "nationality": "USA", "date-of-birth":
"1949-Sep-23"}'
http://localhost:8098/buckets/$ARTISTS/keys/Bruce
```

- Check the updated object (with headers):

```
curl -i http://localhost:8098/buckets/$ARTISTS/keys/Bruce
```

- Delete an object:

```
curl -X DELETE
http://localhost:8098/buckets/$ARTISTS/keys/Bruce
```

Riak: Links

localhost

- Allow to create relationships between objects
  - Like foreign keys in RDBMS or associations in UML
- Attached to objects via HTTP header "Link"
- Add an album and link to its performer:

```
export ALBUMS=${USER}_albums
curl -H "Content-Type: application/json" -H "Link:
</buckets/$ARTISTS/keys/Bruce>; riaktag=\"performer\"" -d
'{"title": "The River", "year": 1980}'
http://localhost:8098/buckets/$ALBUMS/keys/TheRiver
```

check:

```
curl -i http://localhost:8098/buckets/$ALBUMS/keys/TheRiver
```

Riak: Link Walking

- Locate a key and then continue by link(s)
  - target specification: /bucket,linktype,[0/1]

- Find the artist who performed album The River

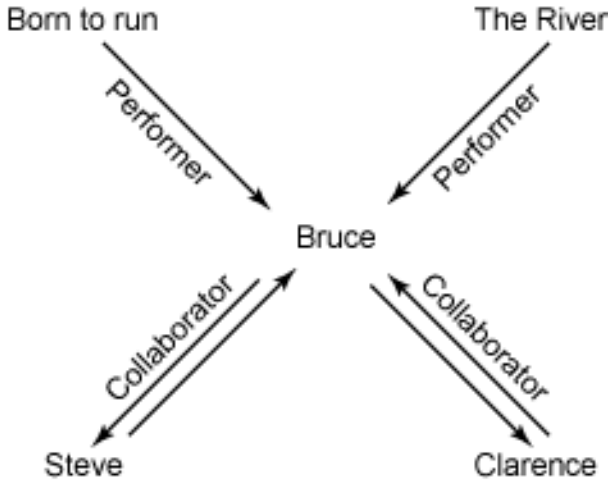
localhost

```
curl
http://localhost:8098/buckets/$ALBUMS/keys/TheRiver/$ARTISTS,performer,1
```

  - Restrict to bucket artists
  - Restrict to tag performer
  - 1 = include this step to the result (see below)

Riak: Link Walking (2)

- Which artists collaborated with the one who performed album The River
  - ***We don't have data for this example***



localhost

```
curl
http://localhost:8098/buckets/$ALBUMS/keys/TheRiver/_,performe
r,0/$ARTISTS,collaborator,1
```

  - _ = wildcard (any bucket)
  - 0 = do not include this step to the result

Let us Cluster

- Let us connect our nodes into one cluster
  - https://docs.riak.com/riak/kv/2.2.1/using/running-a-cluster/

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```
# riak-admin cluster join xdohnal@172.26.1.34
# riak-admin cluster plan
# riak-admin cluster commit
```

localhost

- Check in Web GUI http://localhost:8098/admin

Riak Explorer

- GUI data explorer
  - https://github.com/basho-labs/riak_explorer#installation

stratus

- It is downloaded at the Stratus VM
  - # cd /root/riak_explorer

- Optional task: Make it run and connect to our cluster
  - Configure it: # nano etc/riak_explorer.conf
  - Start it: # bin/riak_explorer start

Java Client

- There are clients for many languages
  - Erlang, Java, Python, Ruby, C, PHP, Node.js, …
- Java Library for communication with Riak
  - Uses **Protocol Buffers** for communication (**port 8087**)
- Download a project from the study materials
  - uses https://github.com/basho/riak-java-client

If you are not on nymfe but on your computer, you must tunnel !!!

```
your_computer$ ssh <login>@aisa.fi.muni.cz -L 8087:172.26.1.ddd:8087
```

Java Client (2)

localhost

- Development with InteliJ IDEA

```
$ unzip riak-client.zip
$ module add idea-2019.2-loc
$ idea.sh &
```

Java Client: Test

- Basic communication with our Riak instance

```
RiakClient client = RiakClient.newClient("172.26.1.ddd");
Namespace bucket = new Namespace("<your_name>_artists");
Location location = new Location(bucket, "Bruce");
FetchValue fv = new FetchValue.Builder(location).build();
FetchValue.Response response = client.execute(fv);
String obj = response.getValue(String.class);
System.out.println("result: " + obj);

client.shutdown();
```

Task To Do Individually!

localhost

- Create a database of all students in PA195
  1. Download CSV file with the list of students

https://is.muni.cz/auth/el/fi/podzim2020/PA195/um/seminar-2/seznam_export.csv

  1. Read the file by Java
  2. Store each record into bucket “<your_name>_students”
     - Key is UCO (the second column)
  3. Test the output from both Java and HTTP API

Attendance Check

Copy & paste the output for either and upload it to IS vault:

- Stop your VM in Stratus when you're finished

Practical Work with Infinispan (optional)

Basics

- Developer: Red Hat, open source community
  - Originally developed as a memory-based cache for JBoss
- Initial release date: 2009
- License: Apache version 2
- Language: Java
  - embedding to Java application
  - various APIs (REST service, Memcached protocol, Hotrod)

http://infinispan.org/ http://db-engines.com/en/system/Infinispan

Infinispan: Hello World

- We will use Infinispan as an embedded store
- Create a new Java Maven project
  - And add dependency package infinispan-core-8.1.2

- Or download project from the study materials
  - Development with InteliJ IDEA

Infinispan: Hello World

```
public static void main(String args[]){
    Cache<String, Object> store =
                new DefaultCacheManager().getCache();
    store.put("key1", new MyClass("value1"));
    store.put("key2", "value2");
    if (store.containsKey("key1")) {
        Object result = store.get("key2");
        store.removeAsync("key2");
    }
    store.replaceAsync("key2", "value3");
    store.clear();
}
```

Infinispan: Practical Example

- Students example (from Riak)
  - Memory cache
  - Disk-oriented cache

- Use ispn-config.xml to configure Infinispan

References

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