MapReduce application support on MTA Cloud

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Topics

• Hadoop advantages
• Main goals
• Occopus
• Occopus descriptors
• Usage
• Experiences on MTA Cloud
MapReduce usage

Many scientific applications, such as
• weather forecasting
• DNA sequencing
• and molecular dynamics
have now been parallelized using Hadoop.

To run MapReduce application in an efficient way it needs Hadoop cluster.

However, the deployment of a fully functional Hadoop cluster is not a trivial task, it is currently not in line with the capabilities of the data scientists, and therefore there is still a significant barrier for this technology to spread among data scientists.
Hadoop - 5 major advantages

- Fast
- Flexible
- Resilient to failure
- Cost effective
- Scalable
Main goals

Motivation:
• MTA Cloud provides easy to create Linux and Windows machine images, however complex infrastructures are not supported yet
• Hadoop cluster as a complex infrastructure should be supported by MTA Cloud (since Hadoop cluster is highly needed by Big Data application)

Goals:
1. Usability and flexibility
2. Easy to use
3. Scalable
4. Does not require any prepared image
Occopus

• Hybrid, cloud orchestrator tool
• Developed by MTA SZTAKI
• Multi-cloud solution (can be used in private and in public cloud too)
• Contextualization with cloud-init
• Enable scaling manually
• No vendor lock-in (portable)
Occopus descriptors

- Nodes
- Variables
- Scaling
- Dependencies

Node definition
- Resource definition
- Contextualisation
- Health check
- Config management

Cloud-init files
- Account management
- Deploy files
- Commands
```
'node_def: hadoop_master_node ':
    resource:
      type: nova
      endpoint: https://sztaki.cloud.mta.hu...
      image_id: ...
      network_id: ...
      flavor_name: ...
      security_groups:...
    contextualisation:
      type: cloudinit
      context_template: !yaml_import
          url: file://cloud_init_hadoop_master.yaml
    health_check:
      ports:
      - 50070

'node_def: hadoop_slave_node ':
    resource:
      type: nova
      endpoint: https://sztaki.cloud.mta.hu...
      project_id: ...
      image_id: ...
      flavor_name: ...
      security_groups:...
```
Occopus descriptors – infra description

```
nodes:
  - &M
    name: hadoop_master
    type: hadoop_master_node
  - &S
    name: hadoop_slave
    type: hadoop_slave_node
    scaling:
      min: 2
      max: 10

dependencies:
  - connection: [ *S, *M ]
```
Occopus descriptors cloud-init files

Cloud-init files:
- Download binaries (Consul, Hadoop, Java, SSH)
- Deploy configuration files
- Create Hadoop user
- Configure SSH, Hadoop
- Start Hadoop deamons
- Start Consul template and service

Infra description
- Nodes
- Variables
- Scaling
- Dependencies

Node definition
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Cloud-init files
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- Commands
Levels of usability

Level 1: Creation of Occopus (done by SZTAKI)

Level 2: Creation of Occopus descriptors for Hadoop (done by SZTAKI)

Level 3: User personalisation of Occopus descriptors (institutional IT experts based on Hadoop Tutorial on Occopus webpage)

Level 4: Build Hadoop cluster (end-user scientists using personalized descriptors and Occopus)

Level 5: Execution of MapReduce application in the Hadoop cluster (end-user scientists)
Hadoop Tutorial
(Showing result of Level 2 action)

Visit: http://occopus.lpds.sztaki.hu

- Users’ guide - Tutorial
  - Tutorials on building clusters
  - Hadoop cluster
- Download descriptors
- Step-by-step tutorial
Personalizing descriptors (Level 3 action)

1. Authentication information
   • Users have to set their authentication information correctly in their authentication file (auth_data.yaml) for the resource they would like to use.

2. Node definition file (nodes/node_definitions.yaml)
   • you must select an Occopus compatible resource plugin
   • you can find and specify the relevant list of attributes for the plugin

For more help:
• Visit http://occopus.lpds.sztaki.hu
  • you may follow the help on collecting the values of the attributes for the plugin
  • you may find a resource template for the plugin in the resource plugin tutorials
• Alternatively, you can ask your institutional IT experts
Personalizing descriptors (Level 3 action)

For nova resources:

In case of username/password authentication:

resource:

- type: nova
  auth_data:
    username: your_username
    password: your_password
Personalizing descriptors (Level 3 action)

'node_def: hadoop_master_node ':

    resource:
      type: nova
      endpoint: https://sztaki.cloud.mta.hu...
      image_id: ...
      network_id: ...
      flavor_name: ...
      security_groups: ...

    contextualisation:
      type: cloudinit
      context_template: !yaml_import
        url: file://cloud_init_hadoop_master.yaml

    health_check:
      ports:
        - 50070

'node_def: hadoop_slave_node ':

    resource:
      type: nova
      endpoint: https://sztaki.cloud.mta.hu...
      project_id: ...
How to build a Hadoop cluster with Occopus? (Level 4 action)

Step 0: Create a VM in MTA Cloud (recommended)

Step 1: Install Occopus
http://occopus.lpds.sztaki.hu
Follow the steps below: Get started → Install Manual

Step 2: Download descriptors
Visit: http://occopus.lpds.sztaki.hu
Users’ guide - Tutorial - Tutorials on building clusters

Step 3: Personalize descriptors (Level 3 action)

Step 4: Make sure Occopus is activated:
$ source ~/occopus/bin/activate

Step 5: Import node definitions:
$ occopus-import nodes/node_definitions.yaml

Step 6: Start building process:
$ occopus-build --parallelize infra-hadoop-cluster.yaml
Scale-up or down

Scaling is a two-phase operation: first we register the scaling request, and after that we scale up/down the selected infrastructure by building new nodes /destroying old ones

1. `$occopus-scale`
   Registers scaling requests
   Usage: occopus-scale -n hadoop_slave -c COUNT -i INFRA_ID
   Count: positive/negative number expressing the direction and magnitude of scaling

2. `$occopus-maintain`
   Requests are handled and realized by this command
   Usage: occopus-maintain –i INFRA_ID

For more information visit: http://occopus.lpds.sztaki.hu
How to run a Hadoop MapReduce job?

1. Inputs – on Hadoop Master node

After building-up a virtual Hadoop infrastructure we can run MapReduce job on it, follow these steps:

**Step 1:** Copy input files to Hadoop Master node

**Step 2:** Log in to HadoopMaster node (SSH)

**Step 3:** Import inputs to HDFS (use commands as hduser):

$HADOOP_HOME/bin/hadoop fs -mkdir /input

$HADOOP_HOME/bin/hadoop fs -put /home/hduser/input/file01.txt /input
How to run a Hadoop MapReduce job?

2. Run a Hadoop job – on Hadoop Master node

- Use this command as **hduser** on Hadoop Master node:
- `$HADOOP_HOME/bin/hadoop jar /home/hduser/input/application.jar org.myorg.Application /input /output`
- To check, read console or visit: [http://HadoopMasterIP:8088](http://HadoopMasterIP:8088)
How to run a Hadoop MapReduce job?

2. Run a Hadoop job – on Hadoop Master node

To check the output of the MapReduce job visit web UI of the NameNode: http://HadoopMasterIP:50070

Choose: Utilities -> Browse the file system -> select /output -> download part-r-00000
Conclusion

Advantages of the solution:

• If you have a MapReduce application you would like to run on MTA Cloud you can easily build the required Hadoop cluster on MTA Cloud (see the steps we showed before)

• This Hadoop Cluster will be
  • Portable,
  • Scalable

• Building the Hadoop cluster does not require any specially prepared image, a simple Ubuntu image is enough

New features coming soon:

• Tutorial on automatic scaling of Hadoop cluster with Prometheus
Experiences on MTA Cloud

- Although I experienced small operational problems during my work the administrators responded rapidly fixed the problem or gave me assistance, for example:
  - Moving to another project (Oktatas → Occopus)
  - Quota lifting (more floating IP)
  - Help with NOVA plugin during Occopus development (code review)
  - VM slow start → they immediately began looking for the error and repaired it
Thank you for your attention!

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