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UNIVERSIDAD POLITÉCNICA DE MADRID

Interfaz genérica de acceso a datos masivos para entornos HPC y Big Data

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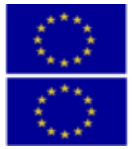

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Motivation

- Nowadays, **most High-Performance Computing (HPC) applications use the POSIX I/O standard** interface to access data.
- There are **multiple problems** with this standard:
  - Handling complex data structures,
  - Lack of control over file system parameters,
  - Dependence on the operating system data layer.
- Currently-used data abstractions **are failing to adapt to the new scalability requirements and needs** of applications.

Objectives

- Design and implementation of a **data container-based solution** for data-intensive applications.
  - **High-level programming interface** that allows synergies between HPC and Big Data domains.
  - Extend the POSIX interface to **hide the complexity of dealing with different storage patterns and sources**.

Solution

- **New data model** based on a series of **activatable plugins** to facilitate its **extension to new storage systems**.
- Optimizations:
  - Memory management using C++ move operators.
  - Template-based generic programming.
  - Simultaneous I/O interference elimination system.

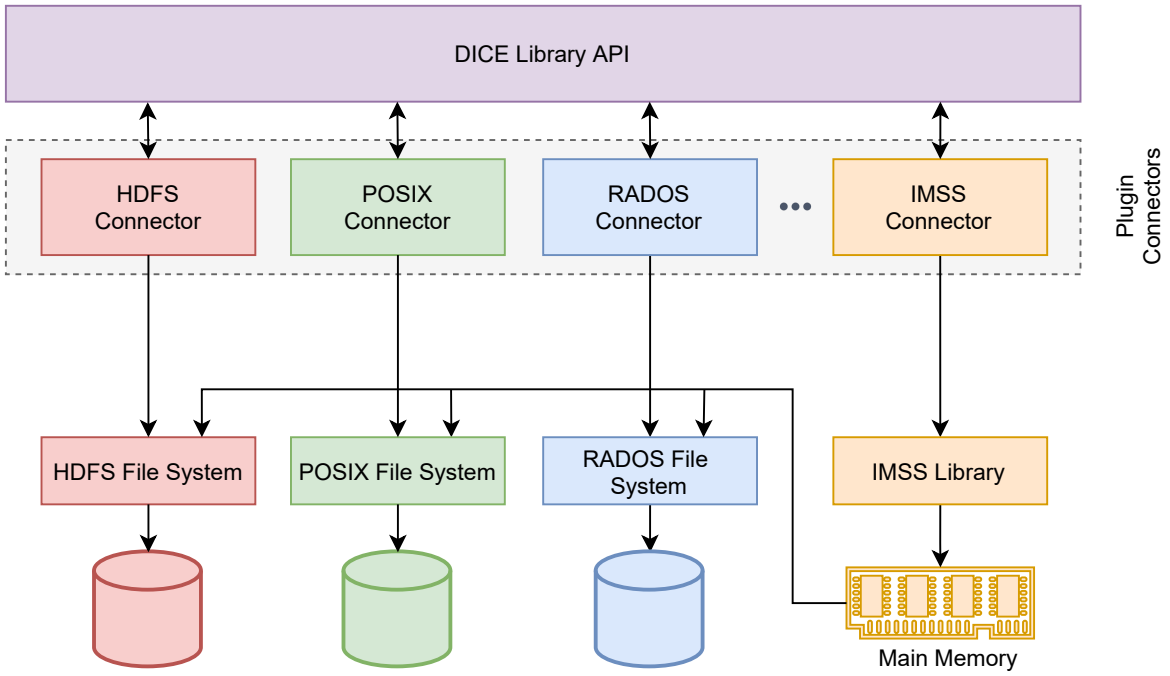
Data containers

- **High-level abstractions:**
  - Hide the complexity of dealing with different storage systems.
  - Offer a standard and easy-to-use operation set.

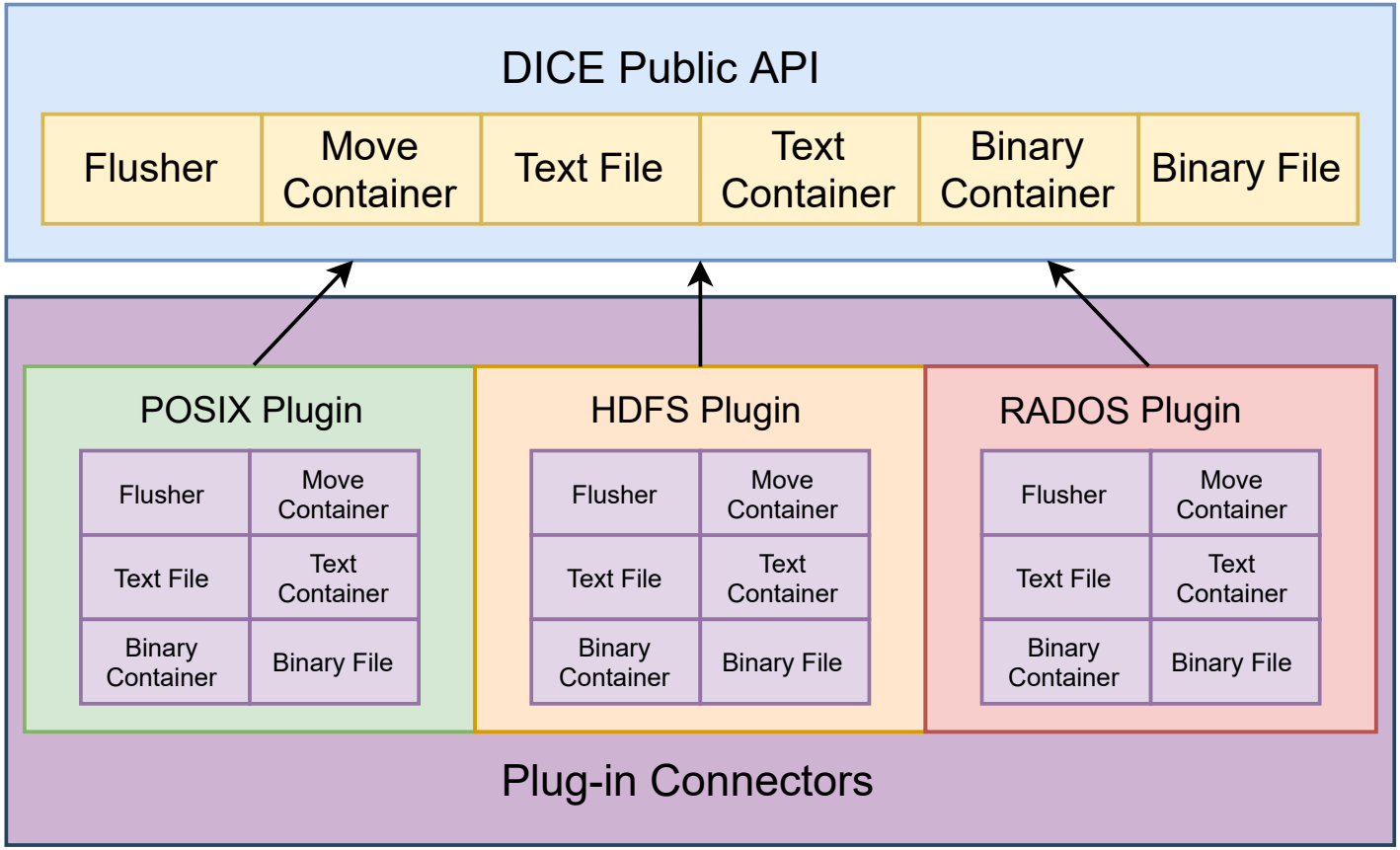
- **Different types:**
  - Depending on their use: input and output.
  - Depending on the type of data: binary and text.

Back-end integration

- Plug-ins that enable access to the different storage systems.
- Four backends initially supported:
  - HDFS,
  - POSIX I/O,
  - RADOS (Ceph)
  - IMSS.



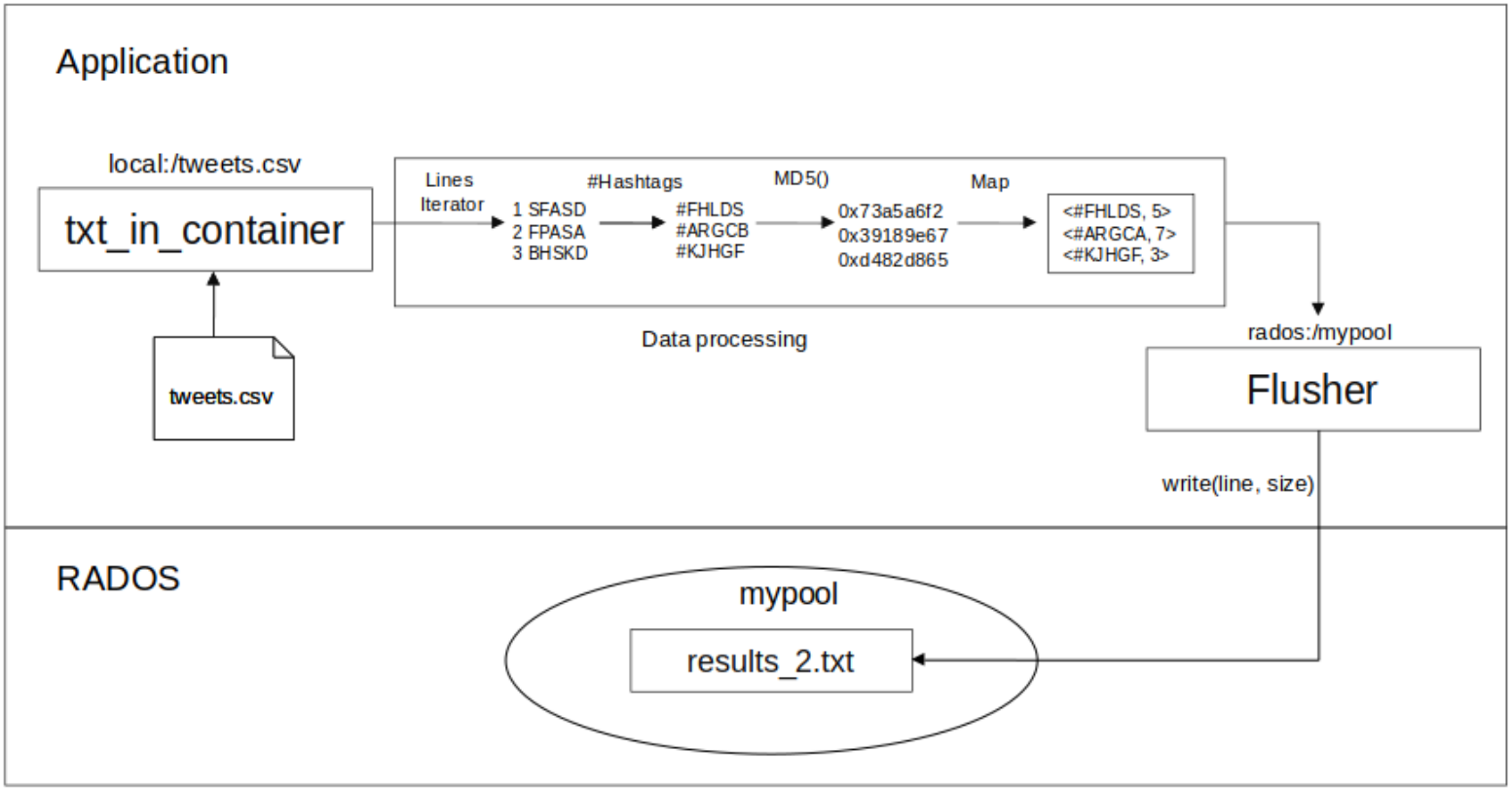
Implementation



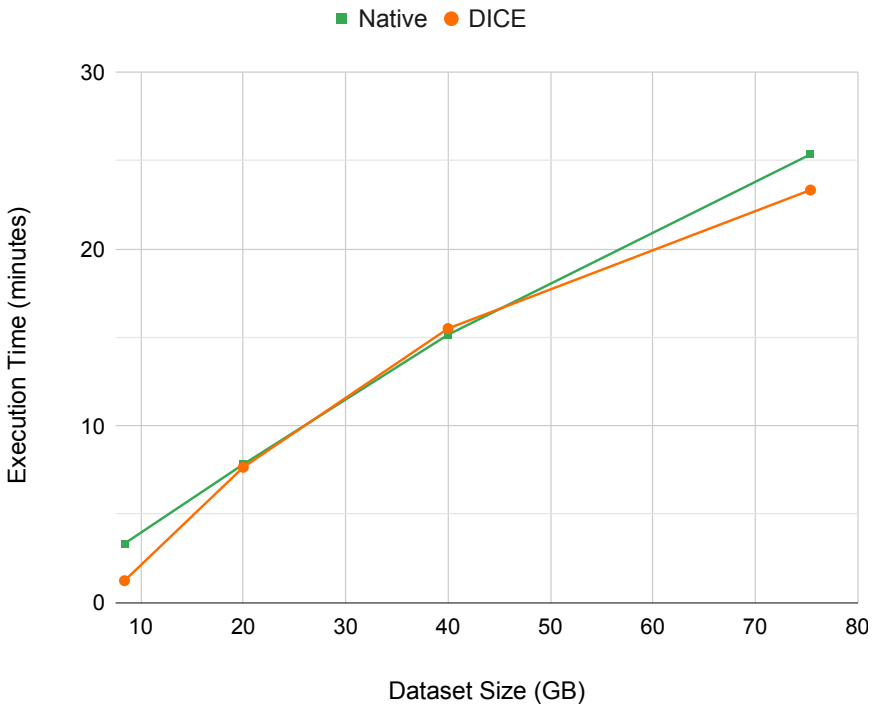
Source code example

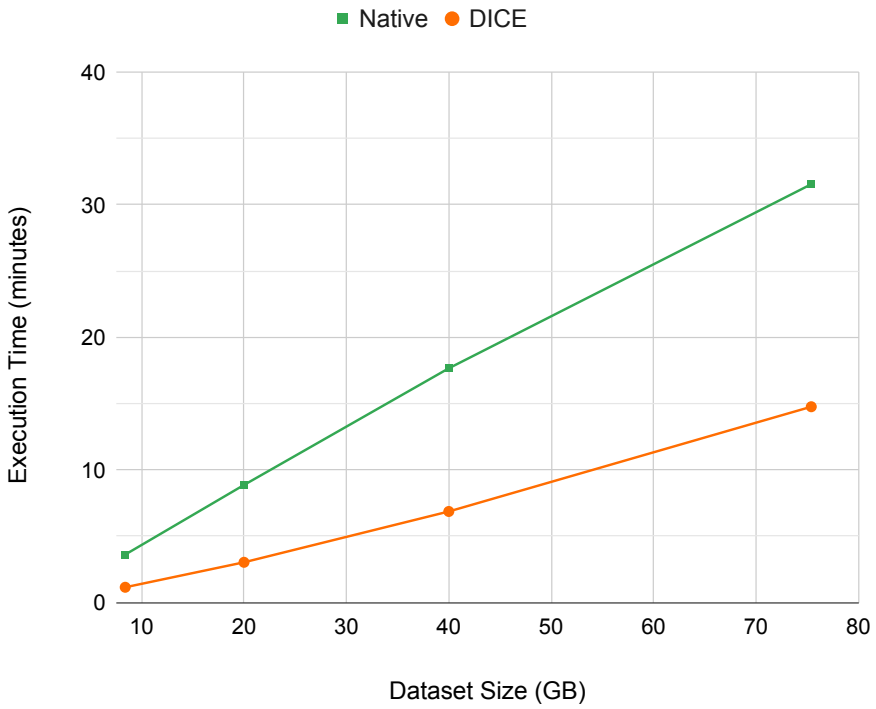
```
text_in_container mytest(argv[1],'\n');

flusher resultsw(argv[2], argv[3]);

regex rgx("\\#\\w+");
map<std::string,int> results;

for(auto line : mytest) {
   //Format the JSON
   auto j_tweet = json::parse(line);
   try{
      string text = j_tweet["text"];
      for( sregex_iterator it(text.begin(), text.end(), rgx), it_end; it != it_end; ++it ) results[(*it)[0]]++;
   }
   catch(const nlohmann::detail::exception& exc){}
}

//For each pair in the map
for (auto& kv: results) {
   std::string out = kv.first + ", " + std::to_string(kv.second) + "\n";
   //Erase the '#' character (which is the first one in the line) from the output before writing.
   resultsw << out.erase(0,1);
}
```

Example


Application
local:/tweets.csv
txt_in_container
tweets.csv
Lines Iterator
1 SFASD
2 FPASA
3 BHSKD
#Hashtags
#FHLDS
#ARGCB
#KJHGF
MD5()
0x73a5a6f2
0x39189e67
0xd482d865
Map
<#FHLDS, 5>
<#ARGCA, 7>
<#KJHGF, 3>
Data processing
rados:/mypool
Flusher
write(line, size)
RADOS
mypool
results_2.txt

Evaluation


Native
DICE
Execution Time (minutes)
0
10
20
30
10
20
30
40
50
60
70
80
Dataset Size (GB)


Native
DICE
Execution Time (minutes)
0
10
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20
30
40
50
60
70
80
Dataset Size (GB)

Results

- DICE, a generic data access abstraction for unifying HPC and Big Data worlds.
- We take advantage of modern C++ features that enable a generic code implementation for different storage systems.
- The solution has proven to be efficient in both Big Data and HPC domains obtaining an overhead under the 2%.
- CABHALA:
  - New interface for the RADOS API.
  - Working progress on a joint publication.

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