CENTER FOR COMPUTATION
& TECHNOLOGY

SAGA

A Simple API for Grid Applications

SAGA API Examples: Shell, Python and C++

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Outline

- SAGA command line tools
- SAGA Python API
- SAGA C++ API
- Examples

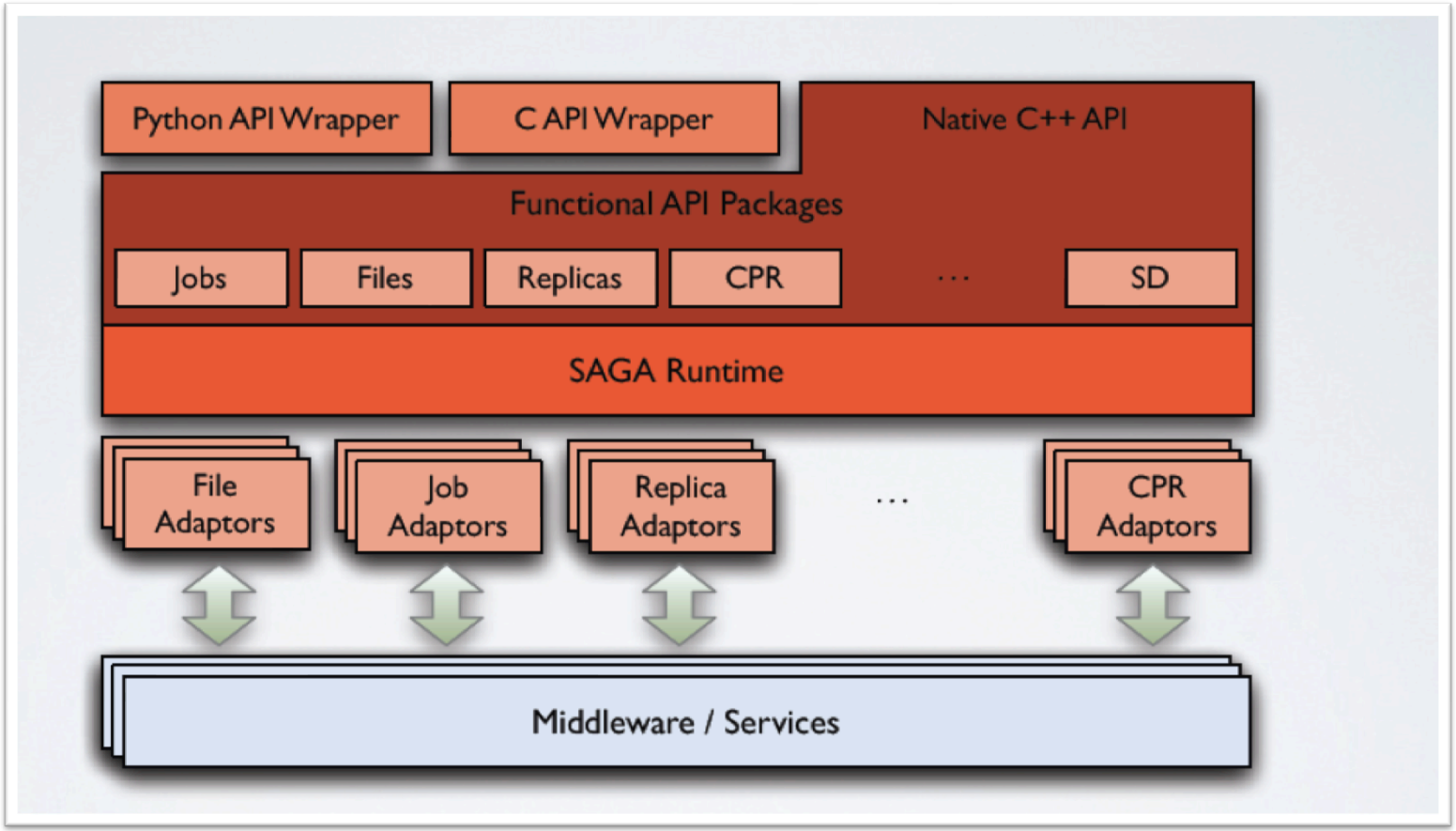
Documentation

- General information
  - https://svn.cct.lsu.edu/repos/saga-projects/tutorial/general_tutorial
  - http://saga.cct.lsu.edu/software/cpp/documentation/tutorials/loni-training-2010
- API documentation
  - Python
    - http://static.saga.cct.lsu.edu/apidoc/python/latest/
  - C++
    - http://static.saga.cct.lsu.edu/apidoc/cpp/latest/
- Programmers manual
  - http://static.saga.cct.lsu.edu/docs/programming_guide/saga_programming_guide.pdf
- Example Code:
  - https://svn.cct.lsu.edu/repos/saga/core/trunk/examples/

Demo Machine

- For this tutorial, we have set up a demo machine.
  - Accounts: {text01,…,test20}@faust.cct.lsu.edu
  - Passwords: **test1234**
- Feel free to log-in an look around. SAGA is installed in /opt/saga-1.5.3-pre/ (core, python, default adaptors)
- You can try to reproduce the examples if you want

SAGA: Architecture



Three Ways to Use SAGA

	Local Adaptors	Globus Adaptors	SSH Adaptors	…
	file://localhost/... any://localhost/...	gram://remotehost/... any://remotehost/…	ssh://remotehost/… any://remotehost/…	
Shell	saga-file copy src dest			
	saga-job run rm cmd			
Python	import saga.filesystem dir.copy(src, dest)			
	import saga.job js.run(cmd)			
C++	using saga::filesystem::directory; dir.copy(src, dest)			
	using saga::job::job; job.run(cmd);			

Command line tools

- SAGA comes with simple command line tools that allow to access basic package functionality.
- The source code is very simple and a great starting point to explore the SAGA package APIs:
  - saga-file $SAGA_ROOT/tools/clutils/filesystem/
  - saga-job $SAGA_ROOT/tools/clutils/job/
  - saga-advert $SAGA_ROOT/tools/clutils/advert/
  - saga-shell $SAGA_ROOT/tools/shell/

Command line tool: saga-file

- Supported protocols
  - Depends on SAGA adaptors
  - Also available: Globus GridFTP, Curl (subset), KFS, Amazon EC2, Opencloud (Sector/Sphere), Hadoop (HDFS)
- Supported commands:

Command	Arguments
copy	<url from> <url to>
move	<url from> <url to>
remove	<url>
cat	<url>
list_dir	<url>

Command line tool: saga-job

- Supported protocols
  - Depends on SAGA adaptors
  - Also available: Globus Gram, Condor, OMII-GridSAM, LSF, Amazon EC2, Opencloud (Sector/Sphere)
- Supported commands:

Command	Arguments
run	<rm url> <command> <arguments>
submit	<rm url> <command> <arguments>
state	<rm url> <jobid>
suspend	<rm url> <jobid>
resume	<rm url> <jobid>
cancel	<rm url> <jobid>

Command line tool: saga-advert

- What is it?
  - Central data store with
    - Hierachical keys
    - Attributes
  - Filesystem like structure
- Supported protocols
  - Depends on SAGA adaptors
  - Local adaptor:
    - Local backend: SQLite3
    - Remote backend: PostgreSQL
  - Also available: Hadoop H-Base, Hypertable

Command line tool: saga-advert

Command	Arguments
list_directory	<advert-url> <pattern>
add_directory remove_directory	<advert-url>
add_entry remove_entry	<advert-url>
store_string	<advert-url> <string>
retrieve_string	<advert-url>
list_attributes	<advert-url>
set_attribute	<advert-url> <key> <value>
remove_attribute	<advert-url> <key>

Command line tool: saga-shell

- All in one of all command line tools as mentioned earlier
- Keeps context in between commands
- Navigate (remote) filesystems (advert, replica too!)
- Launch (remote) jobs, uses io redirection to access in/out
- All commands are implemented using SAGA

Command line tool: saga-shell

Type	Commands
File system navigation	pwd, ls, mv, cp, cd, mkdir, rmdir, touch, cat
Job package	run, suspend, resume, kill, status, ps
replica	rep_find, rep_list, rep_add, rep_remove, rep_update, rep_replicate
environment	setenv, getenv, env
permissions	add_proxy, remove_proxy

Python API Example: File Package

- Copy a file

```
import saga
src = saga.url("file://localhost/etc/passwd")
dst = saga.url("file://localhost/tmp/passwd-copy")
f = saga.filesystem.file(src, saga.filesystem.Read)
f.copy(dst)
```

Python API Example: File Package

- Get a directory file listing

```
import saga
src = saga.url("file://localhost/opt/")
d = saga.filesystem.directory(src)
names = d.list('*')
for name in names:
    ns = saga.name_space.entry(name)
    if ns.is_dir():    print 'd ',  name
    elif ns.is_link(): print '->', ns.read_link()
    else:              print '  ', name
```

Python API Example: Job Package #1

- Submit a job

```
import saga

js_url = saga.url("fork://localhost/")
job_service = saga.job.service(js_url)
job_desc = saga.job.description()
job_desc.executable = "/bin/touch"
job_desc.arguments = ["-a", "touche"]
my_job = job_service.create_job(job_desc)
my_job.run()
```

Python API Example: Advert Package

- Create and modify an advert entry

```
# host/process A
import saga
import time

name = saga.url("advert://localhost/myentry")
e = saga.advert.entry(name, saga.advert.ReadWrite|saga.advert.Create)
e.set_attribute("started", time.strftime("%a, %d %b %Y %H:%M:%S +0000", time.gmtime())

# host/process B
import saga
name = saga.url("advert://localhost/myentry")
e = saga.advert.entry(name)
print "started: " + e.get_attribute("started")
```

C++ API Example: File Package

- Copy a file

```
saga::url src (' … ');
saga::url dst (' … ');
saga::filesystem::file f(src, saga::filesystem::ReadWrite);
f.copy(dst);
```

C++ API Example: File Package

- Get a directory file listing

```
saga::url src (' … ');
saga::filesystem::directory d (src);
std::vector<std::string> names = d.list('*');

for (auto it = names.begin(); it != names.end(); ++it) {
      saga::name_space::entry ns (*it);
      if (ns.is_dir())                    cout << 'd ' <<  *it << '\n';
      else if (ns.is_link())    cout << '->' << ns.read_link() <<
'\n';
      else:                               cout << '  ' << *it << '\n';
}
```

C++ API Example : Job Package #1

- Submit a job

```
saga::url js_url("fork://localhost/");
saga::job::service js(js_url);
saga::job::description jd;
js.set_attribute("executable", "touch");

std::vector<std::string> args;
args.push_back("-a");
args.push_back("...filename…");
js.set_vector_attribute("arguments", args);

saga::job::job j = js.create_job(jd);
j.run();
```

C++ API Example : Job Package #2

- Submit a job

```
saga::job::service js;
saga::job::ostream in;
saga::job::istream out, err;

saga::job::job j = js.run_job(
        "/bin/echo -n HELLO SAGA", "fork://localhost/",
        in, out, err);

std::string line;
while (std::getline(line, out))
        std::cout << out << std::endl;
```

C++ API Example: Advert Package

- Create and modify an advert entry

```
// host A
saga::url name = url(' … ')
saga::advert::entry e(name,
        advert.ReadWrite|advert.Create)
e.set_attribute("started", " … " )

// host B
saga::url name = url(' … ')
saga::advert::entry e(name, advert.Read)
std::string started = e.get_attribute("started")
```

Additional Resources: Programmers Guide

- Set of very small and easy examples, one for each package/paradigm
  - file_copy, file_copy (async)
  - Error handling
  - Attributes
  - Stream (server/client)
- http://static.saga.cct.lsu.edu/docs/programming_guide/saga_programming_guide.pdf

Example 1: hello_world

- Hello world
  - Launch 3 jobs on different machines
    - Execute “/bin/echo”
  - No job dependency
  - Each job returns its passed input argument
    - "Hello"
    - "distributed"
    - "world!"
  - Jobs are launched in parallel (in separate threads)
  - As soon as result is collected it's printed on local console

Example 1: hello_world

- Hello world
  - Arbitrary sequence of results
    - Optimally: "Hello distributed world!"
  - Demonstrates
    - How to launch a remote job using SAGA job_service
    - Pass arguments using the command line
    - Collect result by output redirection
- The source code can be found here (see 'Example1'):
  - https://svn.cct.lsu.edu/repos/saga/core/trunk/examples/tutorial
  - The example uses localhost to spawn childs
    - For remote execution change HOST1, HOST2, HOST3 from "localhost" to

Example 2: chaining_jobs

- Launch 3 jobs on 3 different machines
- Output of previous job is needed to launch next job
- Simple sequential execution, but SAGA style
- Demonstrates
  - How to launch a job using SAGA job_service
  - How to feed input to launched job
  - How to collect output
- Launched job: /usr/bin/bc
- Increment the number passed as the argument
  - Pass returned incremented number to next job

Example 3: depending_jobs

- Coordinating information from advert service
- Launch a single job sequentially on a set of remote resources
  - Simulating checkpointing/relaunching on different resource (migration)
- Maintain a single result value in advert service
  - Gets written by one job, and read by the next
- Demonstrates
  - How to launch remote job using SAGA job, while maintaining environment
  - Assembling argument lists
- Result is left in advert service, but accessed afterwards

Questions | Comments ?

- We have covered:
  - SAGA command line tools
  - SAGA Python API
  - SAGA C++ API
  - Examples
- Check out the tutorial website for more details and examples:

  http://saga.cct.lsu.edu/software/cpp/documentation/tutorials/loni-training-2010