SAGA

Introduction to the API and Hands-On Tutorial

http://faust.cct.lsu.edu/trac/saga/wiki/ADSSS2009

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SAGA

A Simple API for Grid Applications [http://saga.cct.lsu.edu]

- Introduction to the API

- Requirements and Installation

- Tutorial Infrastructure

- Command Line Utilities

- Code Examples (C++)

  - Hello (Distributed) World

  - Chaining Jobs

  - Depending Jobs

- Python Language Bindings

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Monday, September 7, 2009

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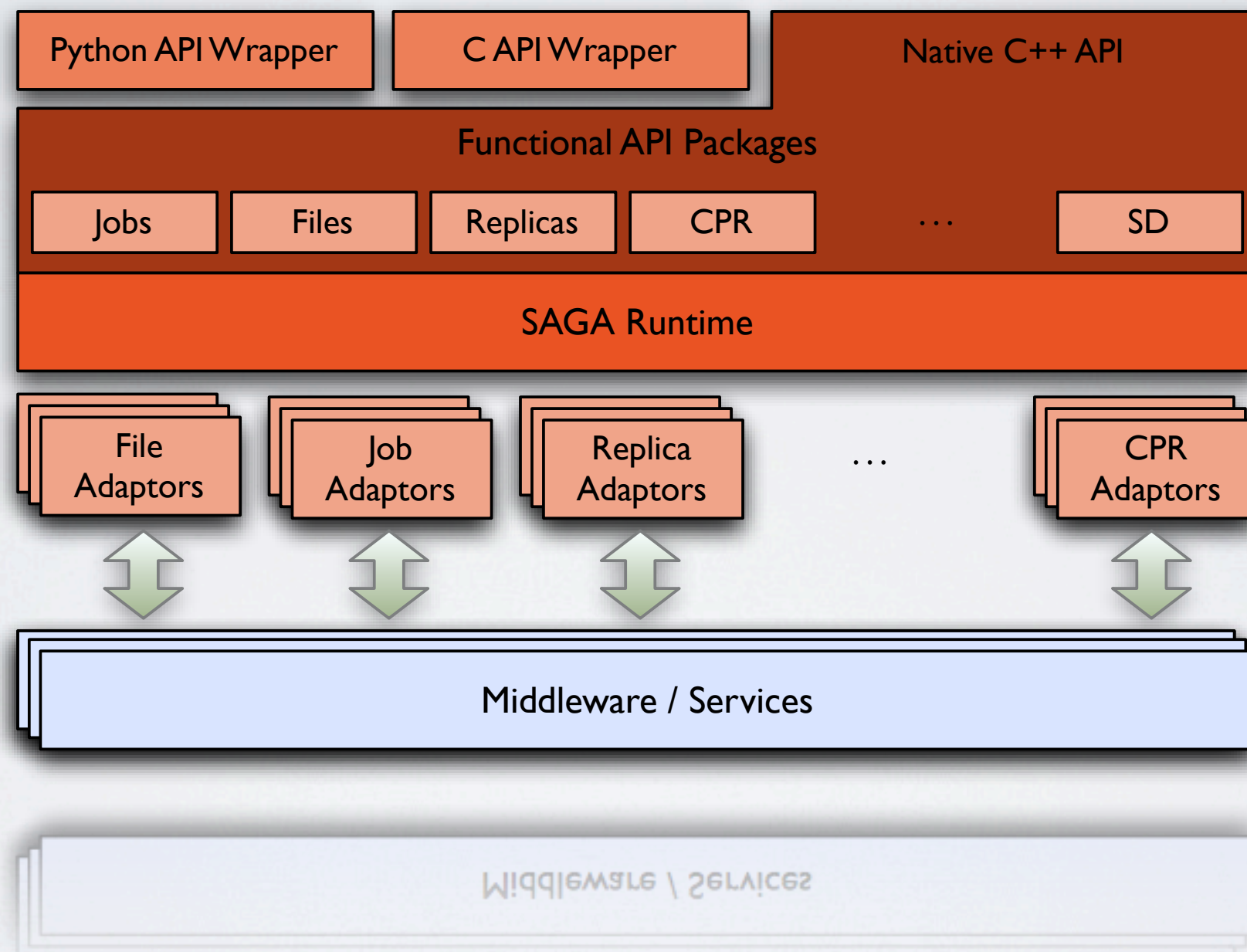
- Allows definition, submission, management and monitoring of interactive and batch jobs

- Consists of three main classes

  - saga::job::description - used to describe a saga job

  - saga::job::service - represents a (remote) computing resource

  - saga::job::job - represents the job itself

- Currently the following job package adaptors are available:

  - Fork (local), Globus GRAM2, SSH, OMII GridSAM, Condor, Amazon EC2, Platform LSF

```cpp
try {

    saga::url js_url ("gram://gatekeeper.lonestar.tacc.teragrid.org:2119/jobmanager-lsf");

    saga::job::description jd;
    jd.set_attribute (attributes::description_executable, "/home/oweidner/tests/heat_transfer");
    jd.set_attribute (attributes::description_number_of_processes, "2");
    jd.set_attribute (attributes::description_queue, "checkpoint");

    saga::job::service js (js_url);
    saga::job::job my_job = js.create_job (jd);

    my_job.run();

    std::cout << "Job ID    : " << my_job.get_job_id() << std::endl;
    std::cout << "Job STATE : " << my_job.get_state() << std::endl;

    my_job.suspend();
    my_job.resume();

    my_job.cancel();
}

catch (saga::exception const & e) {

    std::cerr << "Ooops: " << e.what() << std::endl;
}
```

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- Can be used to traverse, modify, read and write local and remote filesystems

- Consists of two main classes:

  - saga::filesystem::directory

  - saga::filesystem::file

- Currently the following job package adaptors are available:

  - Local FS, Globus GridFTP, SSH, Hadoop Distributed Filesystem (HDFS), CloudStore KFS, OpenCloud Sector-Sphere

```cpp
try {

    saga::url file_url ("gsiftp://queenbee.loni-lsu.teragrid.org:2811//home/oweidner/.bashrc");
    saga::filesystem::file f (file_url, saga::filesystem::Read);

    while ( true )
    {
        saga::size_t const n = 1024*64;
        saga::uint8_t data_buf[n+1];
        for ( unsigned int i = 0; i <= n; ++i ) { data_buf[i] = '\0'; }

        if ( f.read (saga::buffer (data_buf, n), n) )
        {
            // output buffer content
            std::cout << data_buf << std::flush;
        }
        else
        {
            break;
        }
    }
}
catch (saga::exception const & e) {

    std::cerr << "Ooops: " << e.what() << std::endl;
}
```

- An *advert service* can be used for persistent hierarchical storage of application level information and saga objects

- Semantics and usage-mode is defined by the application:

  - e.g. result storage, synchronization of application components, . . .

- API is very similar to the file package:

  - saga::advert::directory - represents the hierarchical structure

  - saga::advert::entry - represents an advert object

- Currently the following advert package adaptors are available:

  - PostgreSQL / SQLite3

```cpp
try {

    saga::url advert_url ("advert://macpro01.cct.lsu.edu//users/oweidner/project01/result");
    saga::advert::entry e (file_url, saga::advert::ReadWrite | saga::advert::Create)

    e.set_attribute("Iteration", "120");
    e.set_attribute("Dataset", "sim_42");

    // You can store just a string
    e.store_string("123.33f");

    // or a saga object, e.g. a file
    saga::url file_url ("gsiftp://queenbee.loni-lsu.teragrid.org:2811//home/oweidner/.bashrc");
    saga::filesystem::file f (file_url, saga::filesystem::Read);
    e.store_object(f);
}
catch (saga::exception const & e) {

    std::cerr << "Ooops: " << e.what() << std::endl;
}
```

- saga::replica - Replica management

  - Adaptors: Globus RLS, PostgreSQL / SQLite3

- saga::stream - Stream client and server

  - Adaptors: BSD Sockets

- saga::sd - Service discovery

  - Adaptors: default SD

- saga::cpr - Checkpoint and recover

  - Adaptors: default CPR / MiGOL

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- Open Source - released under the Boost Software License 1.0

- Implemented as a set of libraries

  - SAGA Core - A light-weight engine / runtime that dispatches calls from the API to the appropriate middle-ware adaptors

  - SAGA functional packages - Groups of API calls for: jobs, files, service discovery, advert services, RPC, replicas, CPR, ... (extensible)

  - SAGA language wrappers - Thin Python and C layers on top of the native C++ API

  - SAGA middle-ware adaptors - Take care of the API call execution on the middle-ware

- Can be configured / packaged to suit your individual needs!

SAGA

- In order to build & install SAGA you need the following:

  - A UNIX operating system (Linux, MacOS, etc.)

  - A C++ Compiler (preferably gcc >= 3.4)

  - The Boost C++ Libraries (>= 1.33.1) from http://boost.org

  - Python (if you want to build the Python language bindings)

- Adaptors may have additional requirements

  - PostgreSQL / SQLite client libraries

  - Globus / Condor / LSF installations

  - etc …

SAGA

WHERE TO GET IT

- Download the latest source release from:

  http://saga.cct.lsu.edu/cpp/download

- Checkout the latest source from Subversion:

  svn co https://svn.cct.lsu.edu/repos/saga/trunk

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- Configure/make - based build system. It's as simple as:

  ./configure --prefix=/usr/local && make install

- Top-level configure/make recursively calls configures/makes for each adaptor, language bindings, etc...

- Fault tolerant: if one of the sub-level packages can't be configured (missing prerequisites, etc...) it is simply skipped

- Sub-level packages can be built individually and even outside the source tree

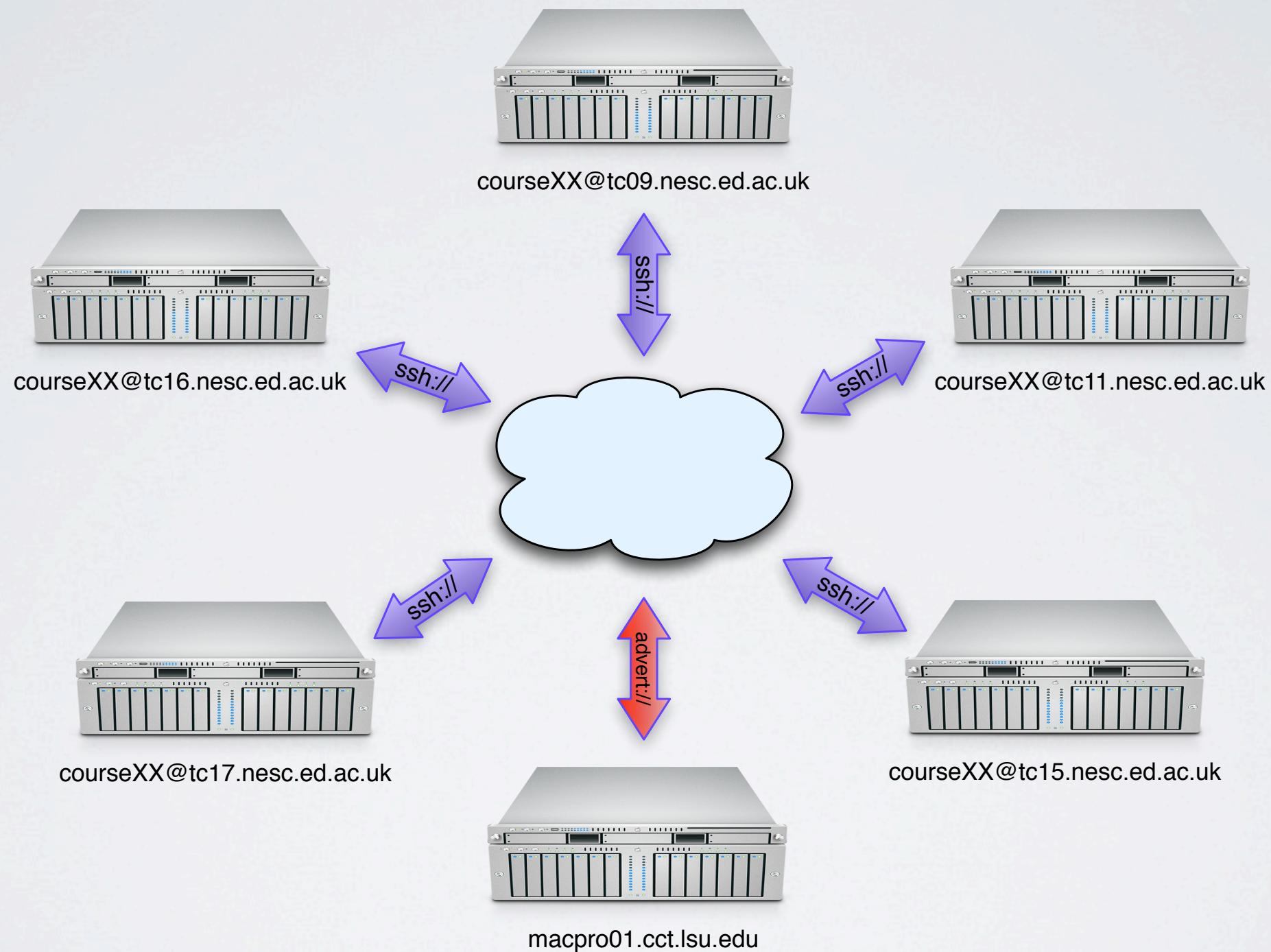- XCode and VisualStudio project files available for developers

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INFRASTRUCTURE

courseXX@tc09.nesc.ed.ac.uk

ssh://

courseXX@tc16.nesc.ed.ac.uk   ssh://

ssh://   courseXX@tc11.nesc.ed.ac.uk

ssh://

advert://

ssh://

courseXX@tc17.nesc.ed.ac.uk

courseXX@tc15.nesc.ed.ac.uk

macpro01.cct.lsu.edu

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- Login (ssh) to one of the following machines:

  - tc09.nesc.ed.ac.uk

  - tc11.nesc.ed.ac.uk

  - tc15.nesc.ed.ac.uk

  - tc16.nesc.ed.ac.uk

  - tc17.nesc.ed.ac.uk

- Usernames:

  - course01, course02, course03, . . . , course24

- Password: to be announced

- Set up the SAGA environment

source /usr/local/saga/share/saga/saga-env.sh

```bash
#!/bin/bash

export SAGA_LOCATION=/usr/local/saga/
export LD_LIBRARY_PATH=${SAGA_LOCATION}/lib/:${LD_LIBRARY_PATH}
export PATH=${SAGA_LOCATION}/bin:${PATH}

export PYTHONPATH=${SAGA_LOCATION}/lib/python2.6/site-packages/:${PYTHONPATH}
```

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- Provides basic functionality of the file package

- Examples:

  - List the contents of a directory
    saga-file list_dir file://localhost//tmp/

  - Get the size of a file
    saga-file get_size file://localhost//etc/passwd

  - Copy a file
    saga-file copy /etc/passwd ssh://tc11//tmp/courseXX_etcpasswd_copy

  - Print the contents of a file
    saga-file cat /etc/passwd ssh://tc11//tmp/courseXX_etcpasswd_copy

- Provides basic functionality of the job package

- Examples

  - Submit a non-interactive job
    saga-job submit ssh://localhost /bin/touch /tmp/blah

  - Run an interactive job
    saga-job run ssh://tc09 /bin/cat /proc/cpuinfo

- Provides basic functionality of the advert package

- Examples:

  - List the content of an advert directory
    saga-advert list_directory advert://macpro01.cct.lsu.edu//ADSSS09 ?

  - Create an advert entry
    saga-advert add_entry advert://macpro01.cct.lsu.edu//ADSSS09/aloha

  - Attach an attribute
    saga-advert set_attribute advert://macpro01.cct.lsu.edu//ADSSS09/aloha
    Foo Bar

  - List all attributes
    saga-advert list_attributes advert://macpro01.cct.lsu.edu//ADSSS09/aloha

- Try and run command line tools

  - Copy a file, move it, delete it, read its contents (local / remote)

  - Run a job (/bin/sleep 20), monitor its status (local / remote)

  - Use the advert service to create directories, entries, store data, set attributes

    NOTES:
    - Please stay within advert://macpro01.cct.lsu.edu//ADSSS09/
    - Create a sub-directory for your username, e.g. course24

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- We will go over three different examples

- For each example:

  - Create a subdirectory, e.g. ~/ex01 ~/ex02 ~/ex03

  - Download the Makefile from the tutorial wiki

  - Download the source files form the tutorial wiki

  - Compile

  - Run

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- Spawn 3 (remote) jobs (/bin/echo) with the 3 words "Hello", distributed", and "world!" as their arguments.

- You can change these three lines:

```
#define HOST1 "fork://localhost"
#define HOST2 "fork://localhost"
#define HOST3 "fork://localhost"
```

- What do you observe when you run it multiple times?

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EXAMPLE 2

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- Introduces dependencies (ordered execution) between the jobs

- Each job receives the output of the previous job (integer number), increments it by one and passes it to the next job

- Again, change these three lines:

```
#define HOST1 "fork://localhost"
#define HOST2 "fork://localhost"
#define HOST3 "fork://localhost"
```

- Can you come up with other, real-life uses-cases (maybe even from your own field of work/research) for this?

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EXAMPLE 3

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THANKS

Questions / Comments ?