Using Stork

An Introduction

Condor Week 2006

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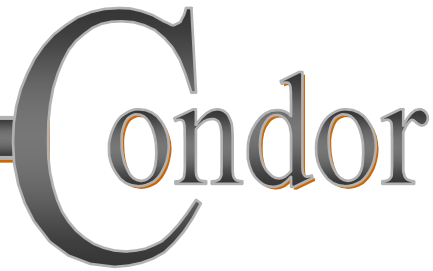
Audience

- Users already familiar with Condor, DAGMan, who need advanced data placement capabilities.
- This tutorial makes an excellent extension to this morning's Condor User's tutorial.

Tutorial Outline

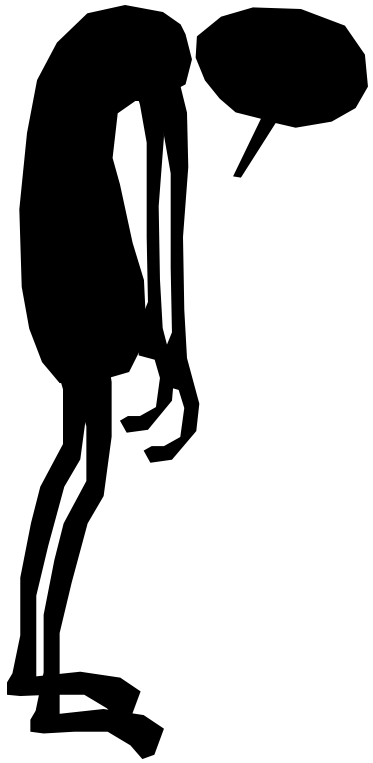
- Classical data transfer problems
- Stork solutions
- Stork data placement job management
- Managing mixed data, CPU job work flows with DAGMan



Meet Friedrich*:

He is a scientist. But he has a big problem.

*Frieda's twin brother

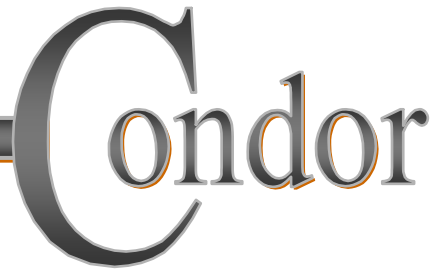


I have a *LOT* of data to process.

Where can I get help?

Friedrich's problem …

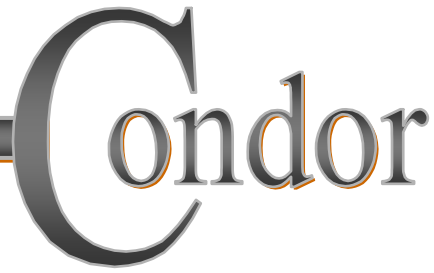
- Many large data sets to process. For each data set:
  - stage in data from remote server
  - run CPU data processing job
  - stage out data to remote server



"Classic" Data Transfer Job

```
#!/bin/sh
globus-url-copy  source  dest
```

Scripts often works fine for short, simple data transfers, but…

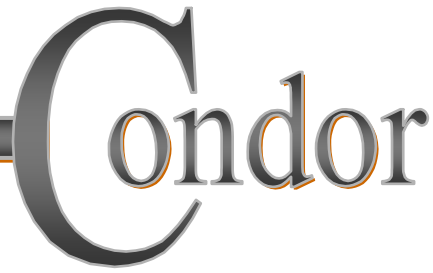


Many things can go wrong!

- Errors are more likely with large data sets:
  - "The network was down."
  - "The data server was unavailable."
  - "The transferred data was corrupt."
  - "My workflow didn't know the data was bad."

Enter Stork:

- Creates notion of a ***data placement*** job: managed, scheduled just like a Condor CPU job.
- Friedrich will benefit from:
  - Built-in fault tolerance
  - Compatible with Condor DAGMan workflow manager

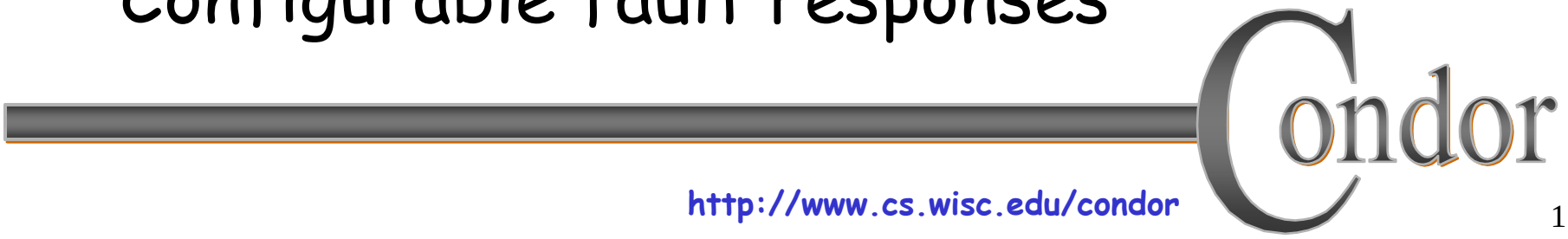


Supported Data Transfers

- local file system
- GridFTP
- FTP
- HTTP
- SRB
- NeST
- SRM
- modular extensible to other protocols

Fault Tolerance

- Retries failed jobs
- Can also retry failed job using alternate protocol, e.g. "first try GridFTP, then try FTP"
- Retry "stuck" jobs
- Configurable fault responses



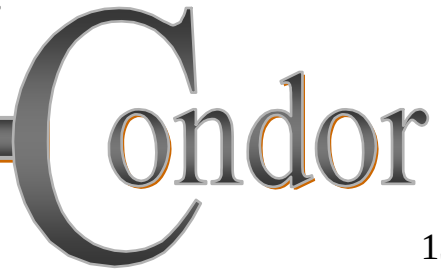
Getting Stork

- Stork is bundled with Condor 6.7, and all future releases
- Available as a free download from

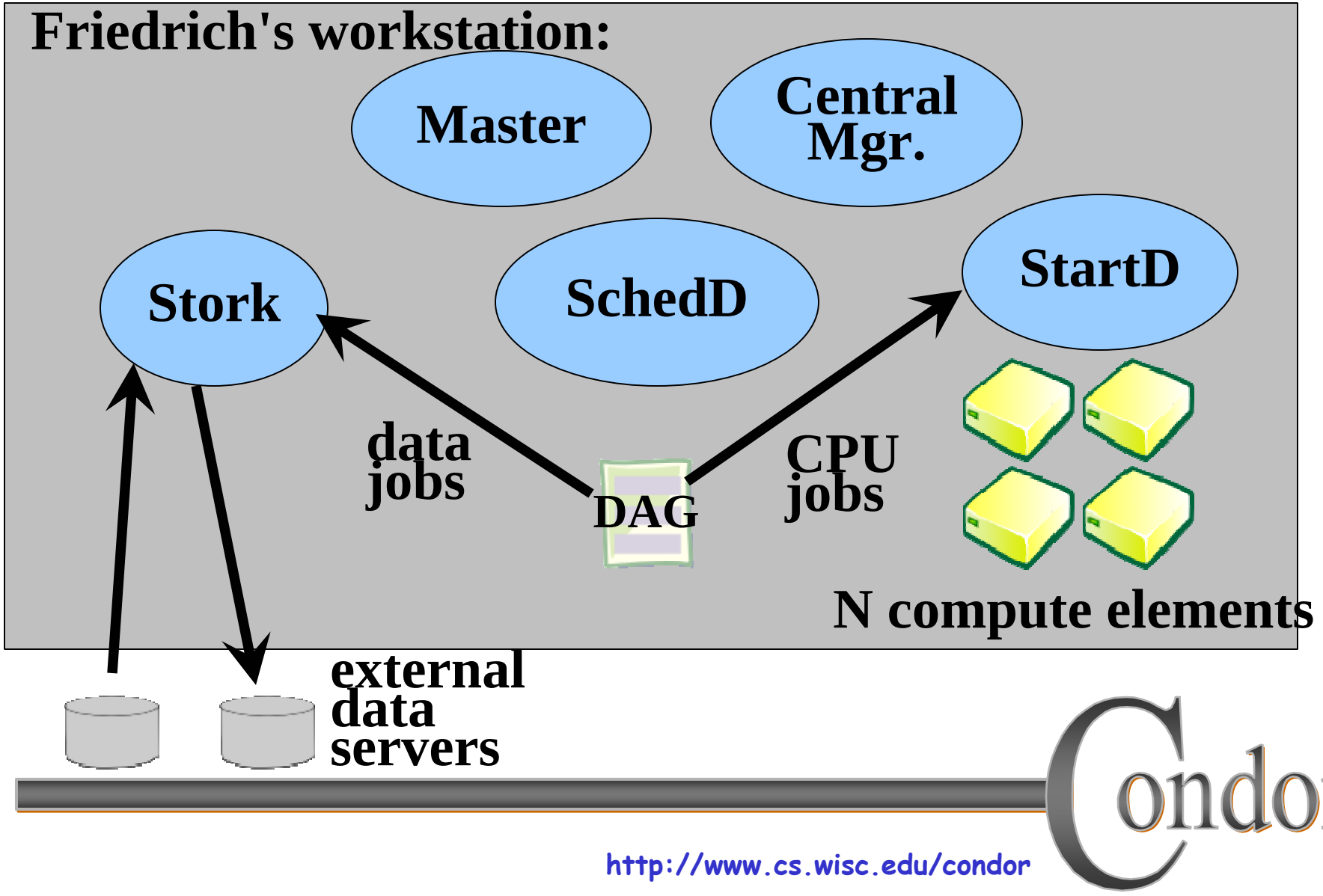
  http://www.cs.wisc.edu/condor
- Currently available for Linux platforms

Friedrich Installs a "Personal Stork" on his workstation…

- What do we mean by a "Personal" Stork?
  - Condor/Stork on your own workstation, no root access required, no system administrator intervention needed
- After installation, Friedrich submits his jobs to his Personal Stork…



Friedrich's Personal Stork



Your Personal Stork will ...

- Keep an eye on your data and CPU jobs, and will keep you posted on their progress
- Throttle maximum jobs running
- Keep a log of your job activities
- Add fault tolerance to your jobs
  - Detect and retry failed data placement jobs
- Enforce data placement, CPU job order dependencies

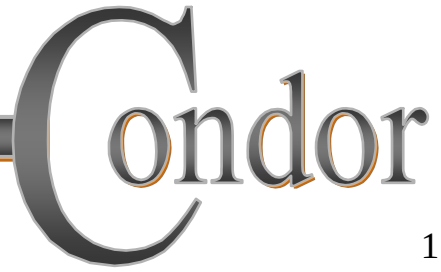
Creating a Submit Description File

- A plain ASCII text file
- Neither Stork nor Condor care about file extensions, nor statement order.
- Tells Stork about your job:
  - data placement type, source/destination location/protocol, proxy location, input, output, error and log files to use, command-line arguments, etc.

Simple Submit File

```
// c++ style comment lines
[
  dap_type   = "transfer";
  src_url    = "gsiftp://server/path”;
  dest_url   = "file:///dir/file";
  x509proxy  = "default";
  log        = "stage-in.out.log";
  output     = "stage-in.out.out";
  err        = "stage-in.out.err";
]
```

Note: different format from Condor submit files

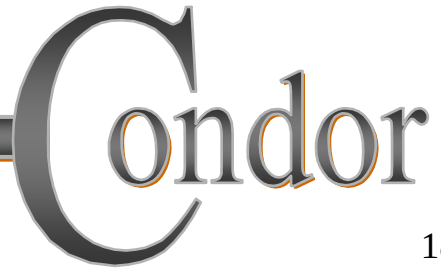


Running stork_submit

- You give **stork_submit** the name of the submit file you have created:

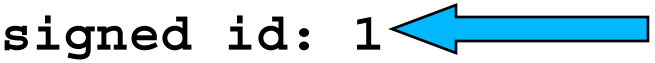
```
# stork_submit  stage-in.stork
```

- **stork_submit** parses the submit file, checks for it errors, and sends job to Stork server.
- **stork_submit** returns the new job id: the job "handle"



Sample stork_submit

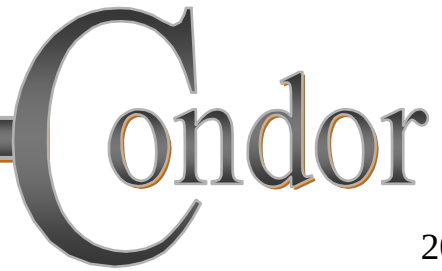
```
# stork_submit stage-in.stork
using default proxy: /tmp/x509up_u19100
================
Sending request:
    [
        dest_url = "file:///dir/file";
        src_url = "gsiftp://server/path";
        err = "path/stage-in.out.err";
        output = "path/stage-in.out.out";
        dap_type = "transfer";
        log = "path/stage-in.out.log";
        x509proxy = "default"
    ]
================

Request assigned id: 1
#
```



returned job id

The Job Queue

- **`stork_submit`** sends your job to the Stork server:
  - Manages the local job queue
- View the queue with **`stork_q`**, *or* **`stork_status`** …



Getting Job Status

- **stork_q** queries *all* active jobs

```
# stork_q
```

- **stork_status** queries the named job id, which may be active, or complete

```
# stork_status 12
```

Removing jobs

- If you want to remove a job from the job queue, you use **stork_rm**
- You can only remove jobs that you own (you can't run **stork_rm** on someone else's jobs unless you are root)
- You must give a specific job ID:

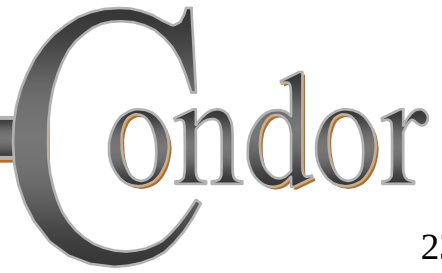
```
# stork_rm 21
```

·Removes a single job

More information about jobs

- Controlled by submit file `log` setting
- Stork creates a log file (user log)
  - **"The Life Story of a Job"**
  - Shows all events in the life of a job
  - ***Always*** have a log file
  - To turn it on in submit file:

```
log = "filename";
```



Sample Stork User Log

```
000 (001.-01.-01) 04/17 19:30:00 Job submitted from host: <128.105.121
...
001 (001.-01.-01) 04/17 19:30:01 Job executing on host: <128.105.121.5
...
008 (001.-01.-01) 04/17 19:30:01 job type: transfer
...
008 (001.-01.-01) 04/17 19:30:01 src_url: gsiftp://server/path
...
008 (001.-01.-01) 04/17 19:30:01 dest_url: file:///dir/file
...
005 (001.-01.-01) 04/17 19:30:02 Job terminated.
    (1) Normal termination (return value 0)
        Usr 0 00:00:00, Sys 0 00:00:00  -  Run Remote Usage
        Usr 0 00:00:00, Sys 0 00:00:00  -  Run Local Usage
        Usr 0 00:00:00, Sys 0 00:00:00  -  Total Remote Usage
        Usr 0 00:00:00, Sys 0 00:00:00  -  Total Local Usage
    0   -  Run Bytes Sent By Job
    0   -  Run Bytes Received By Job
    0   -  Total Bytes Sent By Job
    0   -  Total Bytes Received By Job
...
```

My jobs have have dependencies…

Can Stork help solve my dependency* problems?

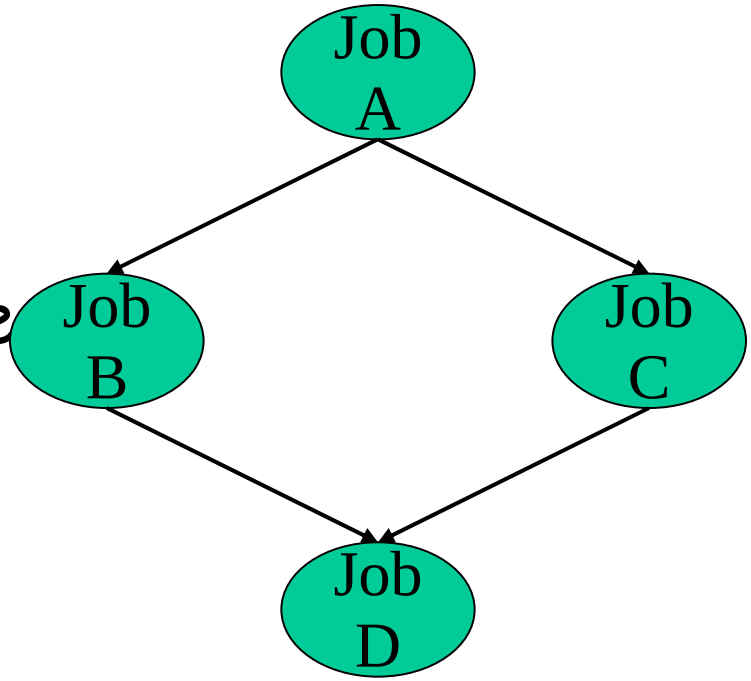
* Not your personal problems!

Friedrich learns DAGMan

- **Directed Acyclic Graph Manager**
- DAGMan allows you to specify the *dependencies* between your jobs, so it can *manage* them automatically for you.
- (e.g., "Don't run job "B" until job "A" has completed successfully.")

What is a DAG?

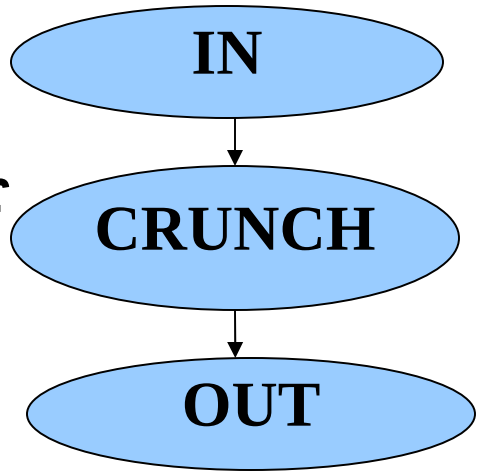
- A DAG is the data structure used by DAGMan to represent these dependencies.
- Each job is a "node" in the DAG.
- Each node can have any number of "parent" or "children" nodes – as long as there are no loops!



Defining Friedrich's DAG

- A DAG is defined by a *text file*, listing each of its nodes and their dependencies:

```
# data-process.dag
Data IN in.stork
Job  CRUNCH crunch.condor
Data OUT out.stork
Parent IN Child CRUNCH
Parent CRUNCH Child OUT
```



- each node will run the Condor or Stork job specified by accompanying submit file

Submitting a DAG

- To start your DAG, just run **condor_submit_dag** with your dag file, and Condor will start a personal DAGMan daemon to begin running your jobs:

```
# condor_submit_dag friedrich.dag
```

- condor_submit_dag submits a Scheduler Universe Job with DAGMan as the executable.
- Thus the DAGMan daemon itself runs as a Condor job, so you don't have to baby-sit it.

In Review

With Stork Friedrich now can…

- Submit his data processing jobs and go home!
- Stork manages the data transfers, including fault detection and retries
- Condor DAGMan manages his job dependencies.

Additional Resources

- http://www.cs.wisc.edu/condor/stork/
- Condor Manual, Stork sections
- stork-announce@cs.wisc.edu list
- stork-discuss@cs.wisc.edu list

Questions?

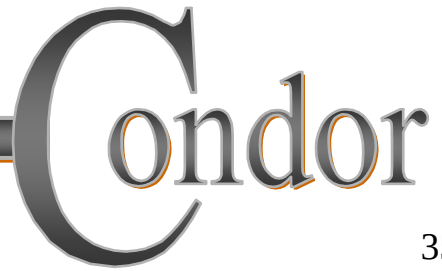
Additional Slides

Important Parameters

- **STORK_MAX_NUM_JOBS** limits number of active jobs
- **STORK_MAX_RETRY** limits job attempts, before job marked as failed
- **STORK_MAXDELAY_INMINUTES** specifies "hung job" threshold

Current Restrictions

- Currently, best suited for "Personal Stork" mode
- Local file paths must be valid on Stork server, including submit directory.
- To share data, successive jobs in DAG must use shared filesystem



Future Work

- Enhance multi-user fair share
- Enhance support for DAGs without shared filesystem
- Enhance scheduling with configurable job requirements, rank
- Add job matchmaking
- Additional platform ports

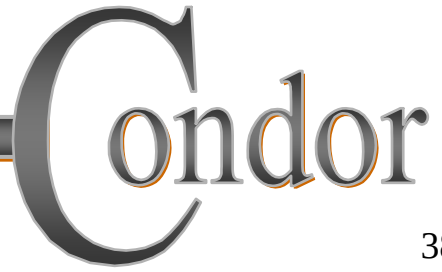
Access to Data in Condor

- Use Shared Filesystem if available
- No shared filesystem?
  - Condor can transfer files
    - Can automatically send back changed files
    - Atomic transfer of multiple files
    - Can be encrypted over the wire
  - Remote I/O Socket
  - Standard Universe can use remote system calls (more on this later)

Condor File Transfer

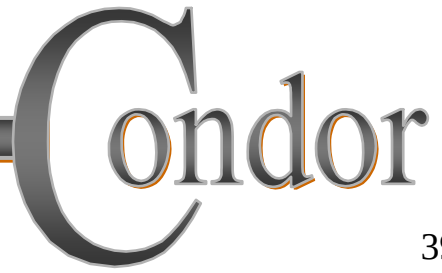
- `ShouldTransferFiles = YES`
  - Always transfer files to execution site
- `ShouldTransferFiles = NO`
  - Rely on a shared filesystem
- `ShouldTransferFiles = IF_NEEDED`
  - Will automatically transfer the files if the submit and execute machine are not in the same FileSystemDomain

```
Universe   = vanilla
Executable = my_job
Log        = my_job.log
ShouldTransferFiles   = IF_NEEDED
Transfer_input_files  = dataset$(Process), common.data
Transfer_output_files = TheAnswer.dat
Queue 600
```



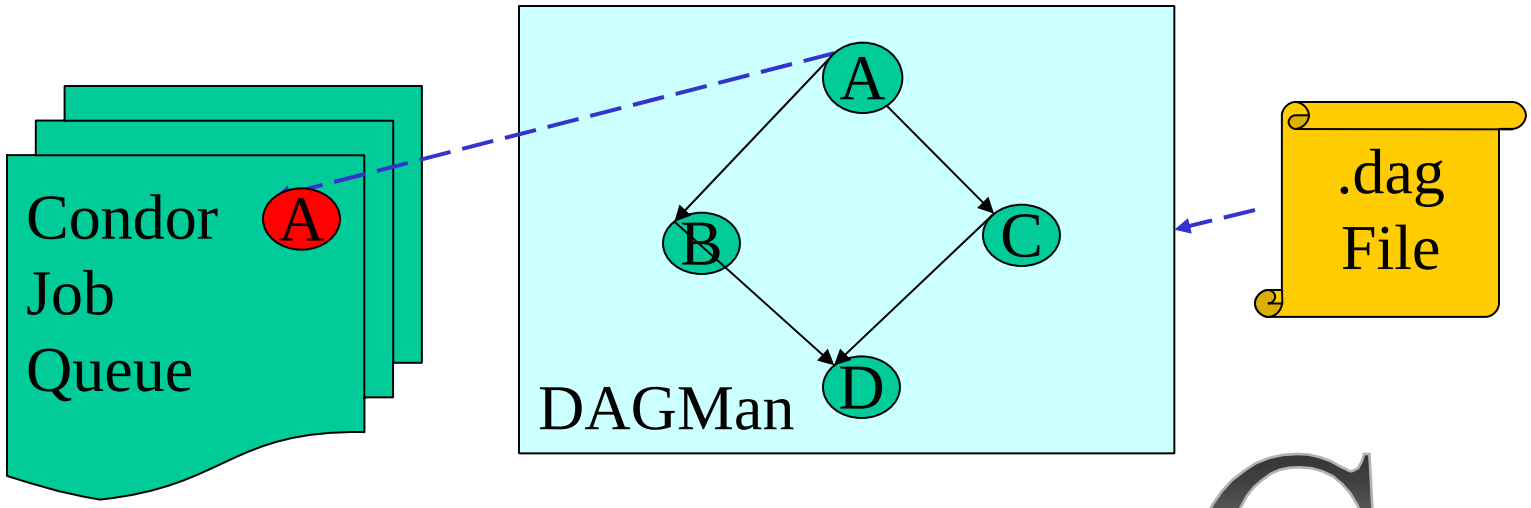
condor_master

- Starts up all other Condor daemons, including Stork
- If there are any problems and a daemon exits, it restarts the daemon and sends email to the administrator
- Acts as the server for many Condor remote administration commands:
  - *condor_reconfig, condor_restart, condor_off, condor_on, condor_config_val*, etc.



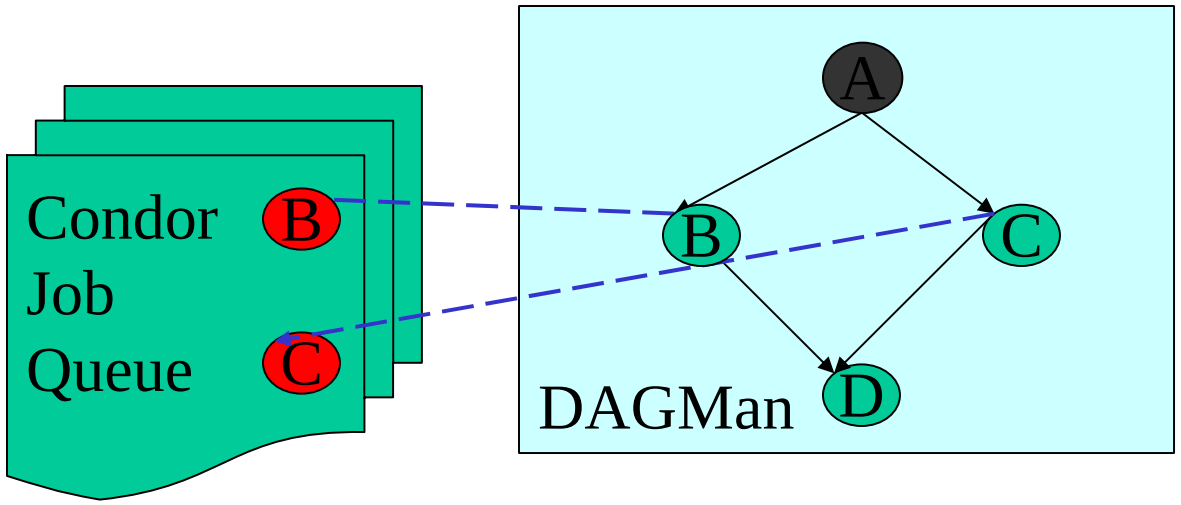
Running a DAG

- DAGMan acts as a "meta-scheduler", managing the submission of your jobs to Condor based on the DAG dependencies.



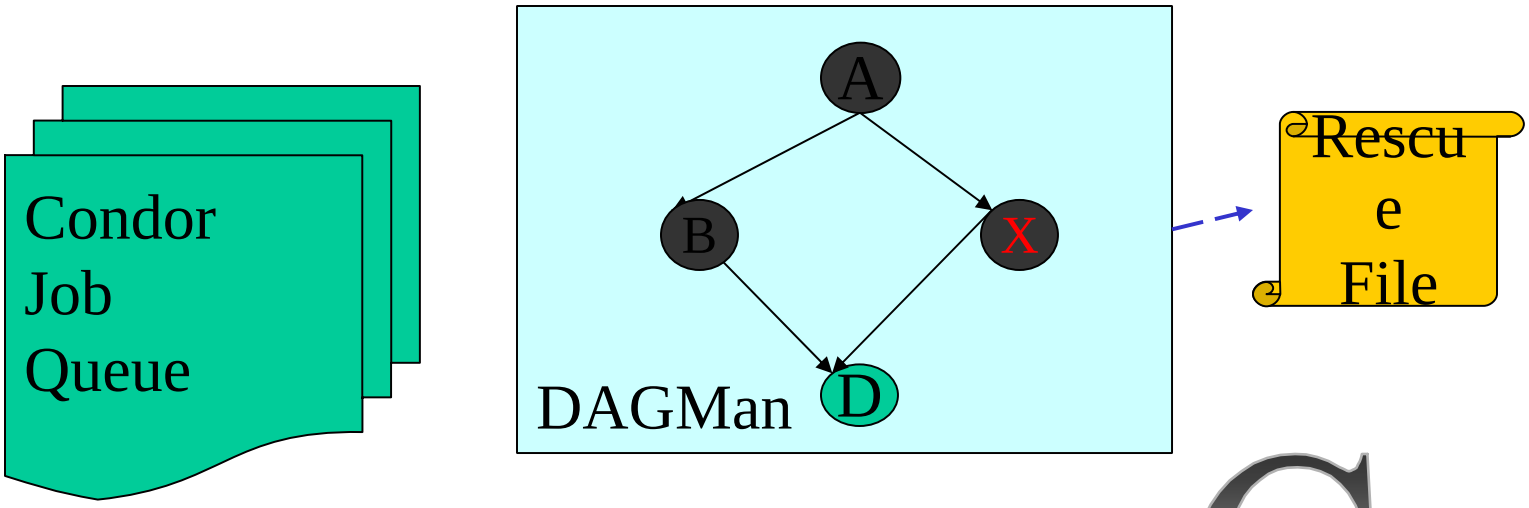
Running a DAG (cont'd)

- DAGMan holds & submits jobs to the Condor queue at the appropriate times.



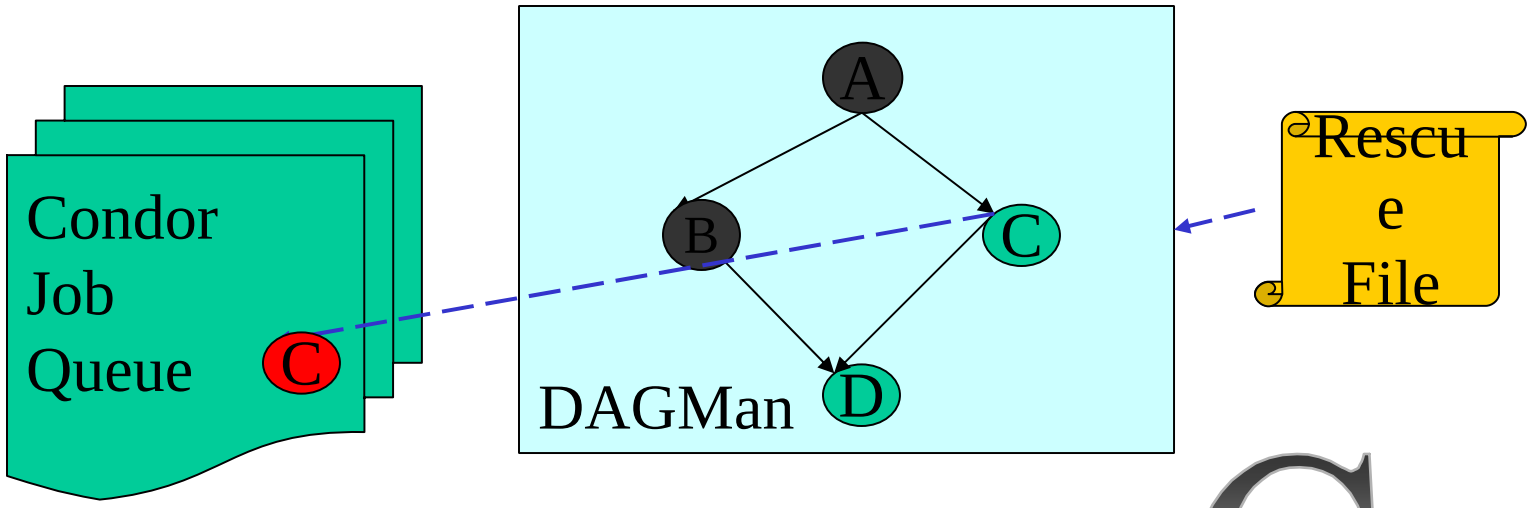
Running a DAG (cont'd)

- In case of a job failure, DAGMan continues until it can no longer make progress, and then creates a *"rescue" file* with the current state of the DAG.



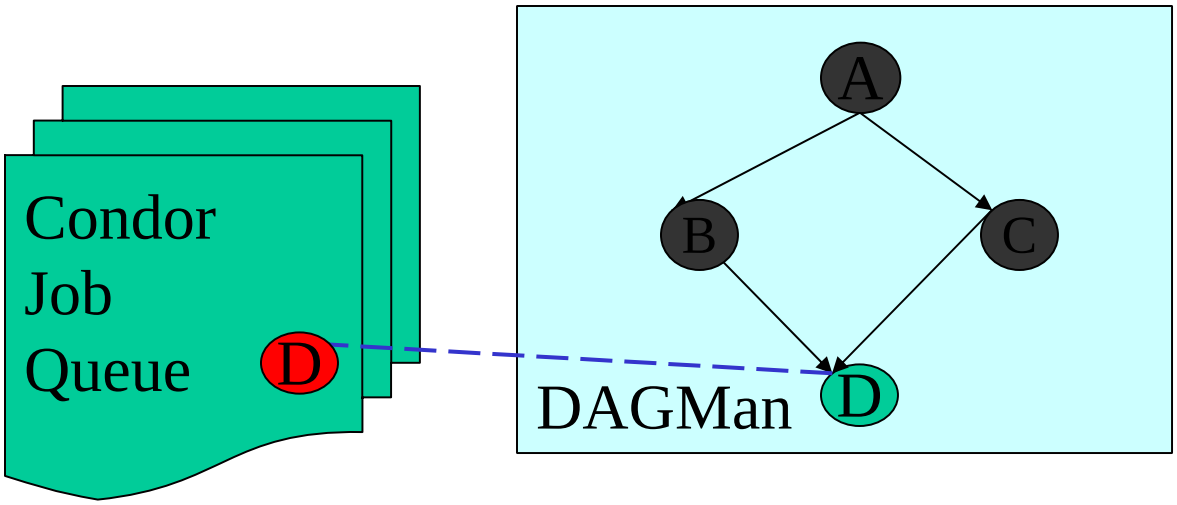
Recovering a DAG

- Once the failed job is ready to be re-run, the rescue file can be used to restore the prior state of the DAG.



Recovering a DAG (cont'd)

- Once that job completes, DAGMan will continue the DAG as if the failure never happened.



Finishing a DAG

- Once the DAG is complete, the DAGMan job itself is finished, and exits.