HTCondor's Python API – The Python Bindings

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HTCondor Clients in 2013

Command Line Clients

Fully Featured!

Requires fork/exec and process handling

Outputs in multiple formats

Something Missing In The Middle

SOAP Clients

Features! (Some)

Language agnostic (everyone hates XML equally?)

Caveats with respect to scalability, security.

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SOAP Clients

Language (everyone

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scalability, security.

Command Line Clients

Fully Featured!

Requires fork/exec and process handling

Outputs in multiple formats

RESTful clients, workflow managers, monitoring tools

Features! (Some)

Language agnostic (everyone feels better w/ JSON?)

Caveats with respect to scalability, security.

Design Philosophy

ClassAds: Everything based on ClassAds; make these the “core” of the bindings.

Pythonic: Semantics and APIs should feel natural to a Python programmer.

- Use iterators, exceptions, guards.
- ClassAds behave as much like a dict as reasonable.

Backward compatible: APIs are here to stay for as long as possible.

- When we absolutely must, use standard Python `DeprecationWarning` techniques.

- Yes, this means that we keep even design warts for far longer than we’d like!

Native code: Call same HTCondor library code as CLI; identical in performance.

Complete: If you can do it with the command line tools, you should be able to do it with Python.

Pythonic!

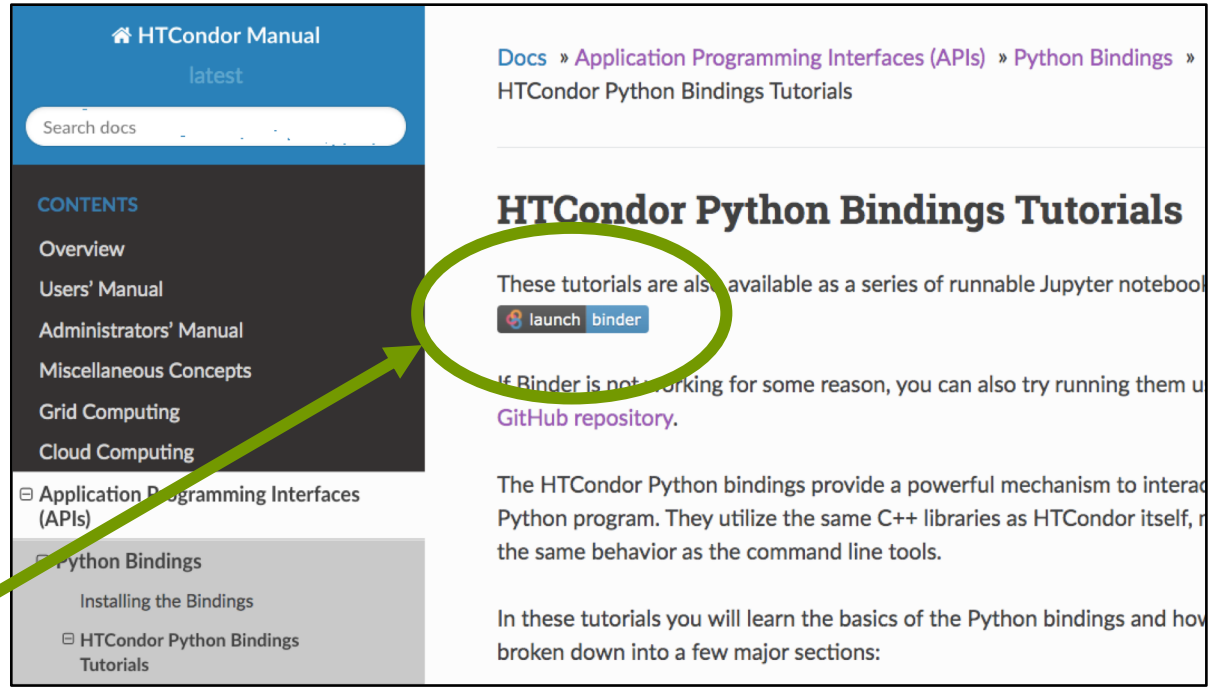
Since *pythonic* is in our design philosophy, the education tools should use the tools favored by the Python community:

- Sphinx-based documentation. Hosted on ReadTheDocs; looks / feels / smells like Python documentation.

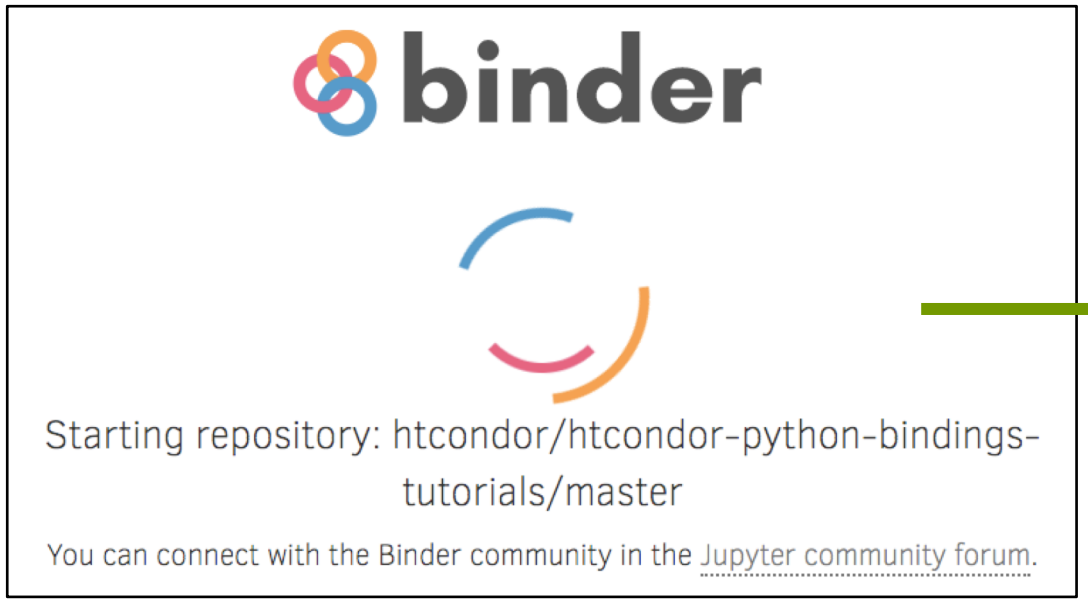
- Jupyter-based tutorials. Use Binder.org service to spawn a Docker container with a private HTCondor instance (or use Docker locally). Interact via your browser.

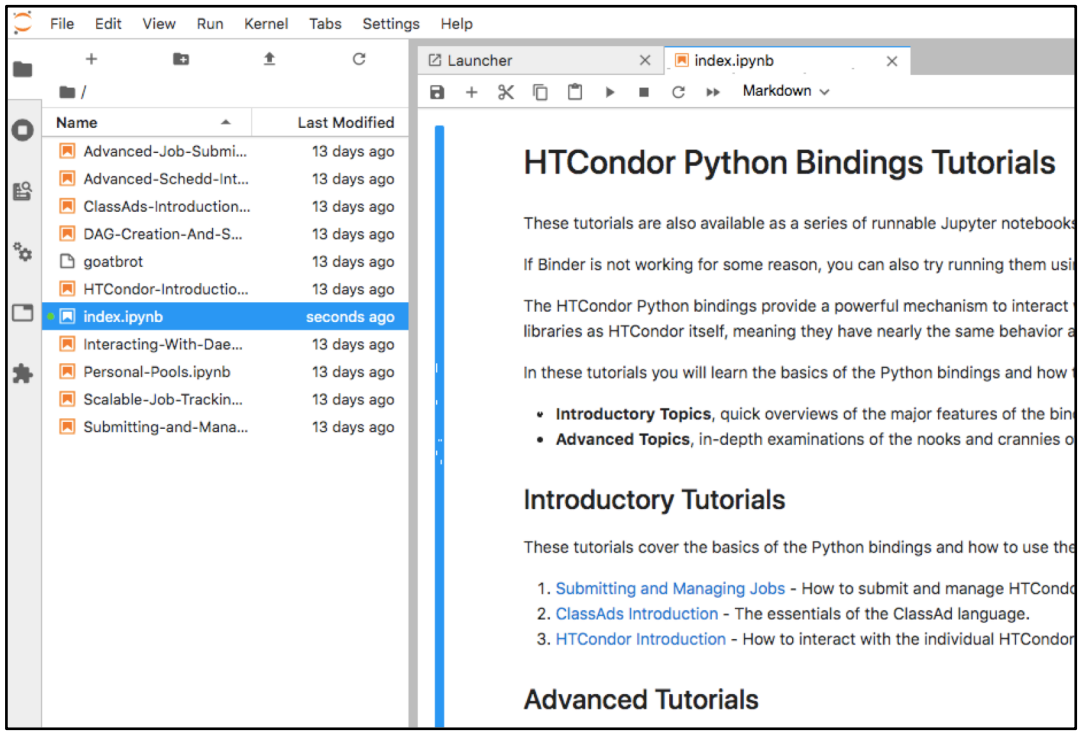
Tutorial

- Head over to the HTCondor documentation https://htcondor.readthedocs.io
- Application Programming Interfaces
  > Python Bindings
  > HTCondor Python Bindings Tutorials
  > Launch Binder



Tutorial


binder
Starting repository: htcondor/htcondor-python-bindings-tutorials/master
You can connect with the Binder community in the Jupyter community forum.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Personal-Pools.ipynb 13 days ago
Scalable-Job-Trackin... 13 days ago
Submitting-and-Mana... 13 days ago
HTCondor Python Bindings Tutorials
These tutorials are also available as a series of runnable Jupyter notebooks
If Binder is not working for some reason, you can also try running them usi
The HTCondor Python bindings provide a powerful mechanism to interact
libraries as HTCondor itself, meaning they have nearly the same behavior a
In these tutorials you will learn the basics of the Python bindings and how
Introductory Topics, quick overviews of the major features of the bin
Advanced Topics, in-depth examinations of the nooks and crannies o
Introductory Tutorials
These tutorials cover the basics of the Python bindings and how to use the
1. Submitting and Managing Jobs - How to submit and manage HTCondo
2. ClassAds Introduction - The essentials of the ClassAd language.
3. HTCondor Introduction - How to interact with the individual HTCondor
Advanced Tutorials

You can help!

The contents of the tutorials and documentation are kept on GitHub:

- https://github.com/htcondor/htcondor-python-bindings-tutorials
- JupyterLab & Binder integration developed by Josh Karpel.
- Find a bug? Spot some missing content?
  - Send a pull request; Travis-CI will test and update the static content once merged.

Installing Python Bindings

- On Linux
  - Included in RPM and DEB packages for the system Python(s)
  - Available in PyPI on Linux:
    - `pip install htcondor`
    - For a specific version: `pip install htcondor==8.8.10`
  - Available in Anaconda (via conda-forge) on Linux:
    - `conda install -c conda-forge python-htcondor`
- On Windows
  - Windows MSI installs bindings for both Python 2.7 and Python 3.6
- On Mac
  - Included in the HTCondor tarball for the system Python

Key Concept #1: ClassAds
The *lingua franca* of HTCondor

Simple Example

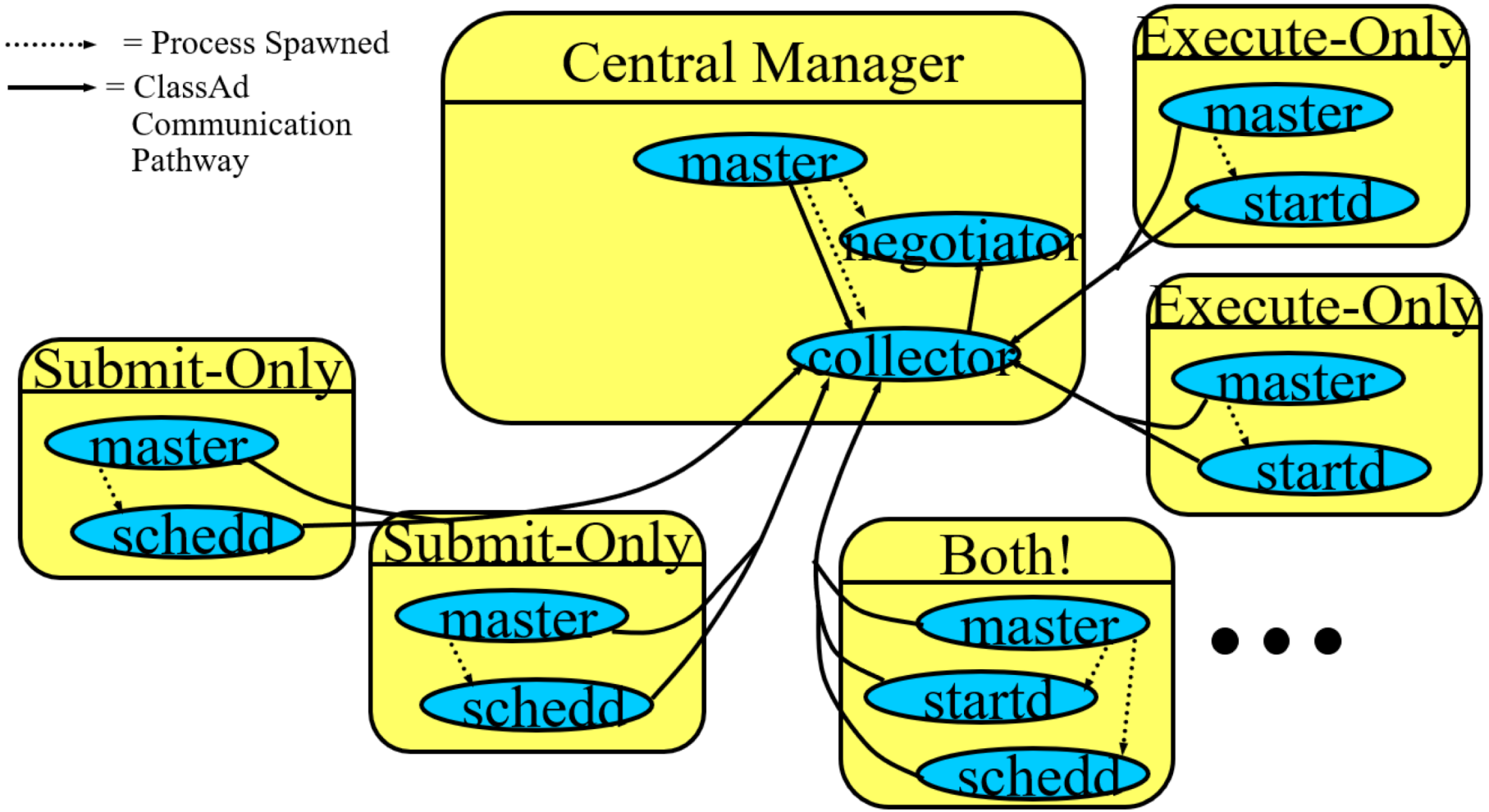
Job Ad

```
Type   = "Job"
Requirements =
    HasMatlabLicense
      == True &&
    Memory >= 1024
Rank = kflops + 1000000
  * Memory
Cmd= "/bin/sleep"
Args = "3600"
Owner = "gthain"
NumJobStarts = 8
KindOfJob = "simulation"
Department = "Math"
```

Machine Ad

```
Type = "Machine"
Cpus   = 40
Memory = 2048
Requirements =
  (Owner == “gthain”)   ||
  (KindOfJob ==
  “simulation”)
Rank = Department == "Math"
HasMatlabLicense = true
MaxTries = 4
kflops = 41403
```

Key Concept #2: HTCondor Daemons!



Two key Concepts, two modules

- `import classad`
  - Provides two classes: `ClassAd` and `ExprTree`
  - The ClassAd Python class behaves a lot like a Python dictionary (key-value pairs, though the values may be `ExprTrees` that refer to other keys!)
- `import htcondor`
  - Provides explicit classes for most daemon types (e.g. Schedd, Collector, Startd) and methods to perform operations against them
  - Provides a Submit class for condor_submit type functionality
  - Lots of other stuff (job event reader, config reader)

Daemon Classes

- `import htcondor`
  - `htcondor.Collector()`
    - `query, locate, advertise : condor_status, advertise`
  - `htcondor.Schedd()`
    - `query, xquery, history : condor_q, history`
    - `act, edit : condor_rm, hold, qedit`
    - `transaction, spool, retrieve : job submission (*)`

* Explicit user-controlled transactions to be deprecated in favor of `htcondor.Schedd.submit()` in the near future.

Submit Class

- `htcondor.Submit()`
  - Takes a submit file-like dict or string and hands back a Submit object containing queuing methods
  - Submit objects can be queued using a transaction via:
    - `submit_obj.queue(txn, n)`
    - `submit_obj.queue_with_itemdata(txn, n, itemdata)`
      - `itemdata` is an iterable containing dicts
      - Keys in the dicts represent variables in the submit object
      - `itemdata = iter([{“foo”: “bar”}, {“foo”: “baz”}])`
        `queue_with_itemdata(2, itemdata) # == “queue 2 foo in bar, baz"`

TIME FOR TUTORIAL DEMO?

Python API – Big Changes

- New features
  - Security Management (i.e. `htcondor.Credd` bindings)
  - `htcondor.Submit.from_dag()`
    - Creates a Submit object from a DAG file (must still be `queued`)
  - `htcondor.dags`
    - Creates DAG files using child-parent objects
  - `htcondor.htchirp`
    - condor_chirp functionality without having to leave Python
    - Also installable separately via `pip` or `conda-forge` (`htchirp` package)
  - (See more in the release notes)

Python API – Big Changes

- Deprecations
  - All the previous exceptions; new exceptions inherit from `htcondor.HTCondorException` or `classad.ClassAdException`
  - Non-standard argument names for many functions (e.g. `requirements`, `attr_list`)
  - Many classes and functions related to reading events/logs that are not `htcondor.JobEventLog`
  - User-controllable Schedd transactions not deprecated yet but will be soon, check the release notes and docs closely!
  - (See more in the release notes)

Questions?

- Python bindings API developers and users alike are active on the HTCondor Users mailing list
- (I will not be responsive to emails soon and for the next few weeks after… 👶)