# Rubin Observatory

## Algorithms and Pipelines, The Stack, and Tasks

Yusra AlSayyad Oct 14 2020

NSF AURA U.S. DEPARTMENT OF ENERGY | Office of Science SLAC CHARLES AND LISA SIMONYI FUND FOR ARTS AND SCIENCES LSST CORPORATION

# What? 150min of Notebooks/Talks today and tomorrow

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- **Today PDT**
- 10:00 Intro to Pipelines; What is a Task? (Yusra AlSayyad)
- 10:25 How to write and run a `Pipeline` and `PipelineTask` and (Nate Lust)
- 11:10 Developing the Science Pipelines software (Tim Jenness)

- **Tomorrow PDT**
- 8:00 Live Demo. Interacting with Data Products with the Gen3 Butler and debugging a Pipeline (Jim Bosch)

**We know this is not sufficient to get up to speed.**

## No time for Pair Coding or hands-on projects this week ☹

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- If you are currently on the Algorithms and Pipelines team. **Come join us for Pair coding Wednesdays 11am-1pm PDT**
- Learning will continue throughout the year via **code reviews**.


- Get in touch with your team lead on what you need to learn

# The basics

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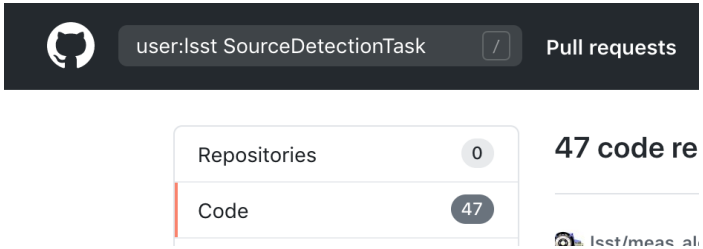
- Bootcamp from last year:
  - https://community.lsst.org/t/dm-boot-camp-2019/3887
- What you need to start developing:
  - Shared stack: https://developer.lsst.io/services/software.html
  - eups https://developer.lsst.io/stack/eups-tutorial.html
- Where to ask questions:
  - How LSST Communicates -- Jonathan Sick
- What are science pipelines plans for astrometry/PSF-estimation etc?
  - Algorithms workshop videos/slides present understanding of state of the art and plans as of March 2020: ls.st/law
- How do I do X in the codebase? (assuming you've already consulted pipelines.lsst.io)
  - Search Slack, Github, Ask
- What is the procedure for… ?
  - developer.lsst.io
- How do I play nice with others?



developer.lsst.io/work/flow.html

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# DM Development Workflow with Git, GitHub, JIRA and Jenkins

This page describes our procedures for collaborating on LSST DM software and documentation with Git, GitHub and JIRA:

1. Configuring Git for DM development.
2. Using JIRA for agile development.
3. DM GitHub organizations.
4. Policies for naming and using Git branches.
5. Preparing code for review.
6. Reviewing and merging code.

In appendices, we suggest some *best practices* for maximizing the usefulness of our Git development history:

- Commit organization best practices.
- Commit message best practices

# The Stack: github.com/lsst

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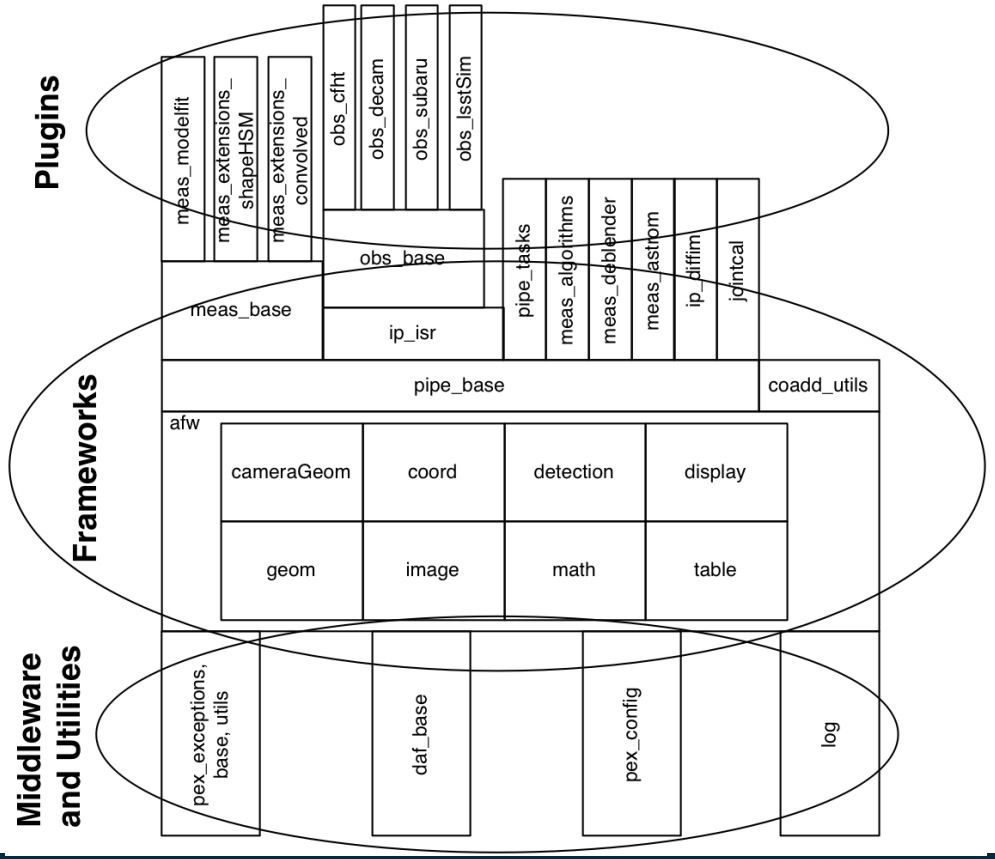



Docs: pipelines.lsst.io

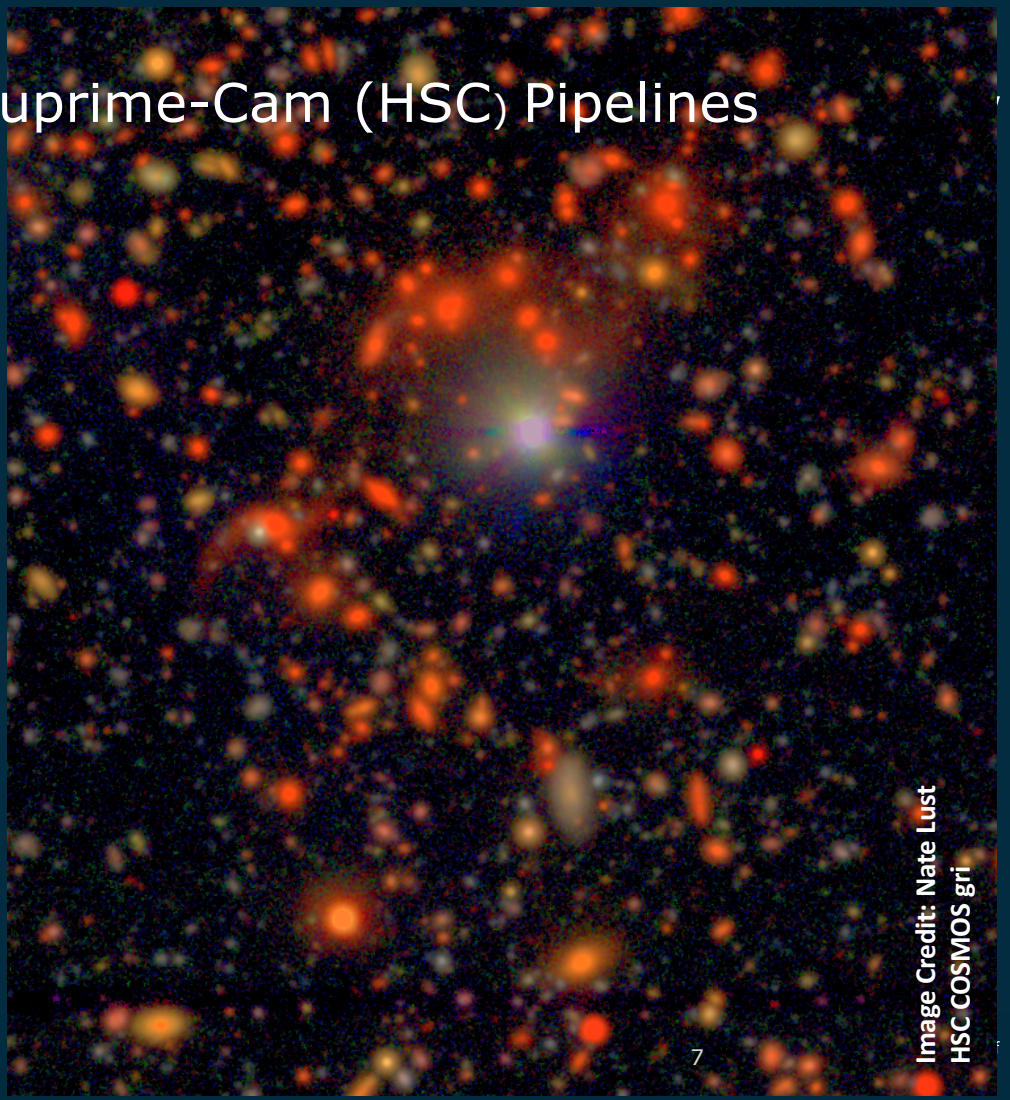
**Value: The whole stack is owned by the whole team**

If you see something you don't like: File a ticket and fix it. If its a change of existing behavior, file an RFC and fix it.

This stack is your stack

# We say "HSC" frequently because the LSST Pipelines **are** the Hyper Suprime-Cam (HSC) Pipelines

| **Survey Comparison** | **LSST** | **HSC (Subaru Strategic Program)** |
|---|---|---|
| Effective Aperture | 6.5m | 8.2m |
| Filters | ugrizy | grizy + narrow |
| Exposure time per visit | ~30s | ~240s |
| Field of View | 10 $deg^2$<br>3.5 deg diam | 1.8 $deg^2$<br>1.5 deg diam |
| Num CCDs | 189 (4k x 4k) | 103 (4k x 2k) |



# The DRP and AP pipelines are constructed from the same algorithmic components

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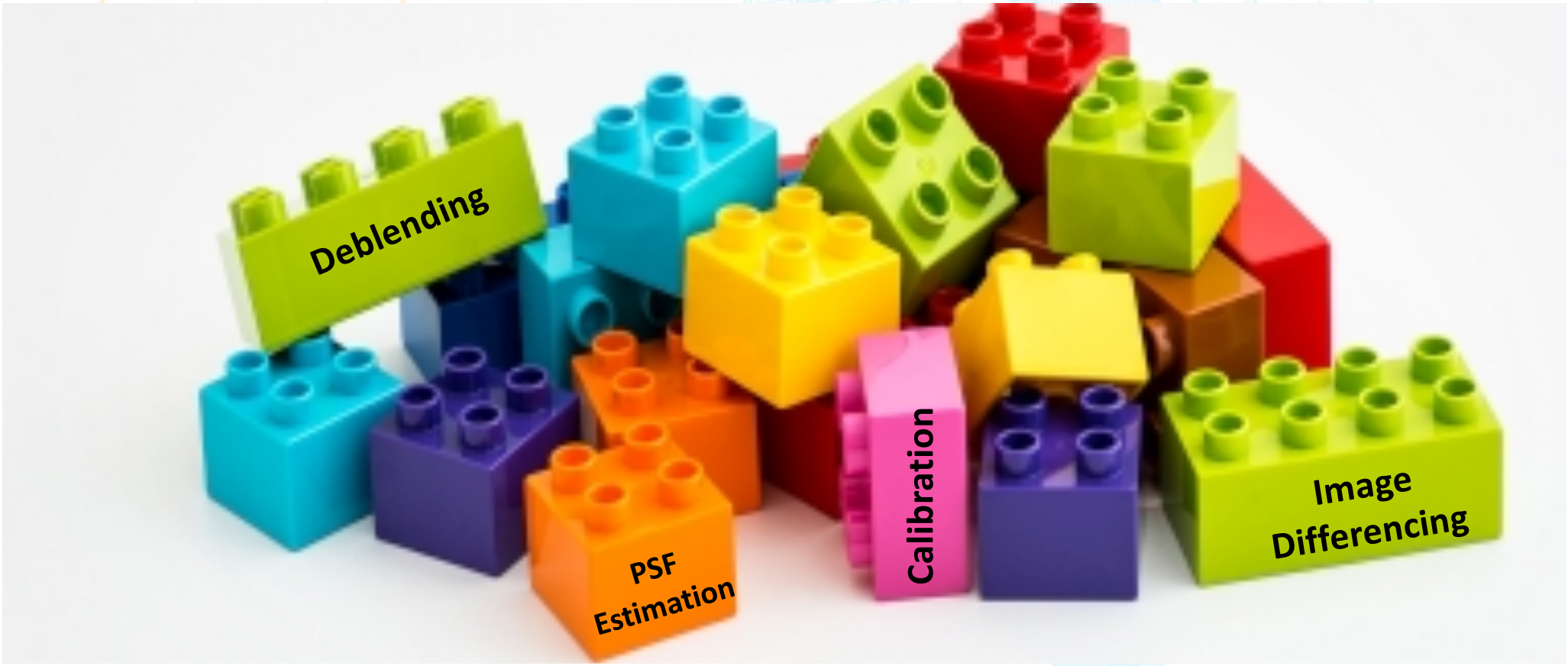

# High level overview of the a Data Release Production

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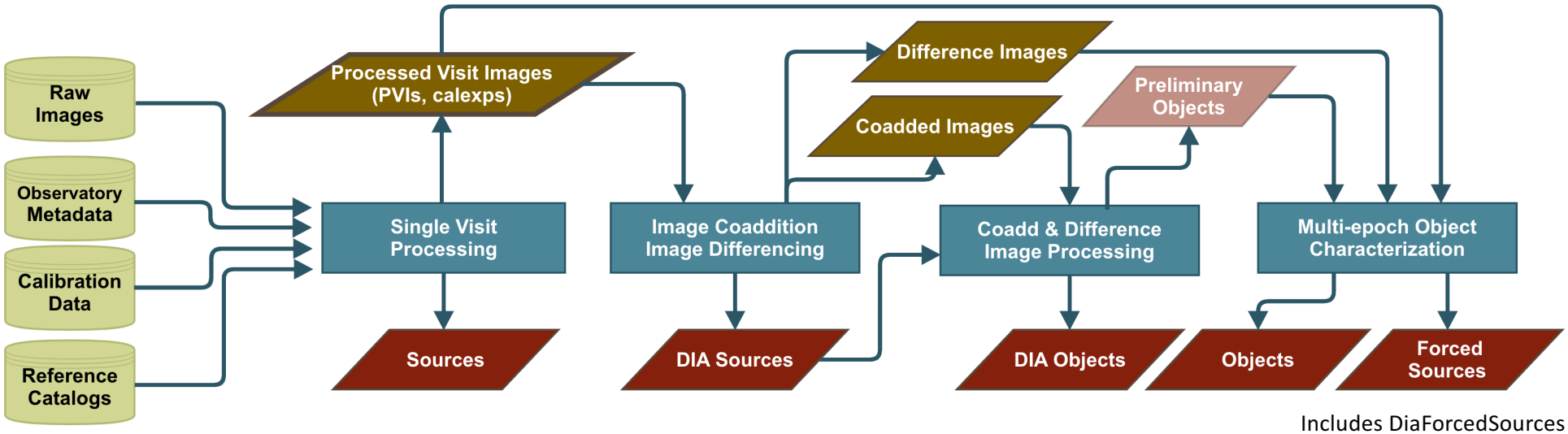

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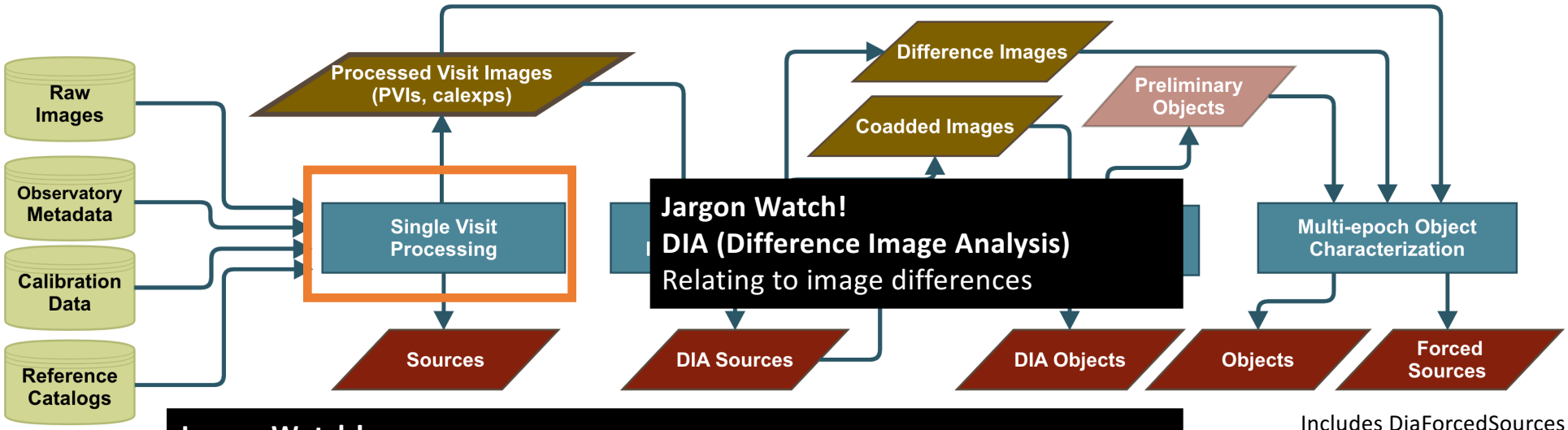


**Jargon Watch!**
**DIA (Difference Image Analysis)**
Relating to image differences

**Jargon Watch!**
**Sources:** Measurements from a single observation
**Objects:** Measurements utilizing many (typically all) observations. The logical aggregate (incl. motion, color, variability, deep). **Not matched Sources!**

# Jargon watch: Visits, CCDs, Exposures

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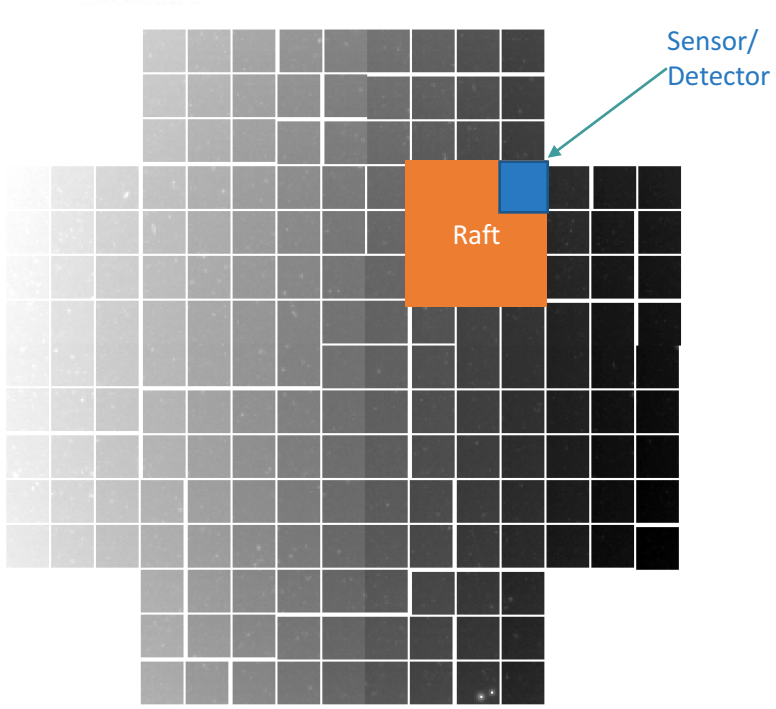


Exposure: A software Object that contains an image plane, mask plane, variance plane, PSF model, WCS, photoCalib and visit metadata. Stored in FITS format

# Single Visit Processing:
## IsrTask, CharImageTask, CalibrateTask …

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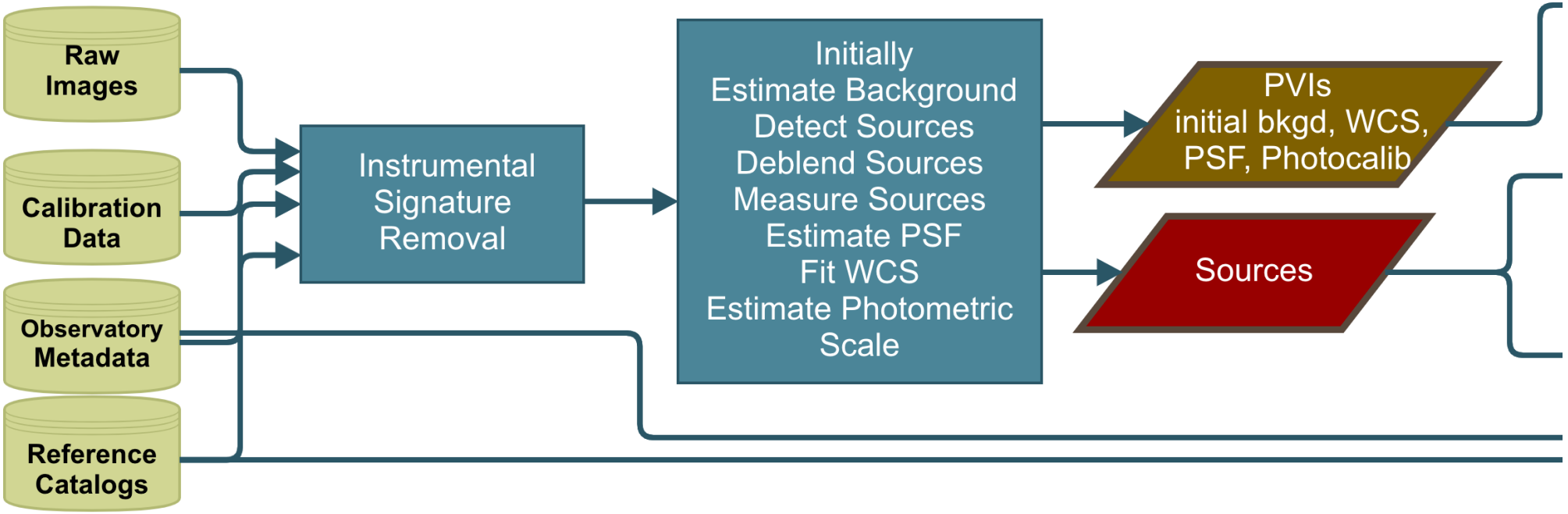

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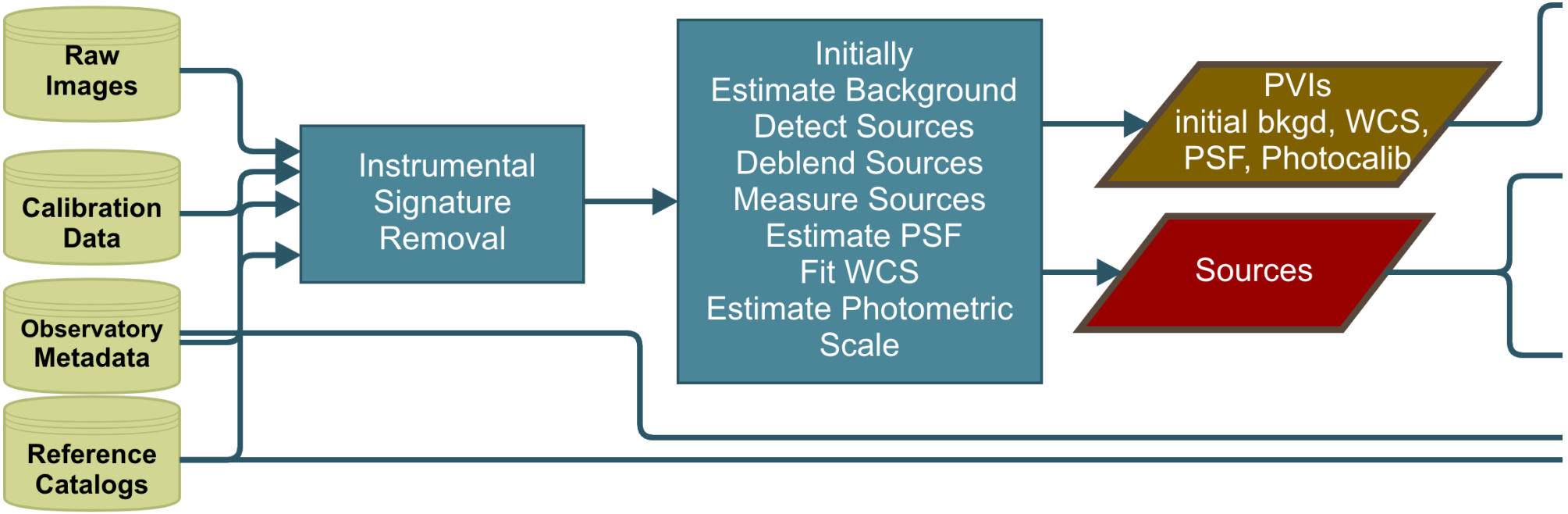

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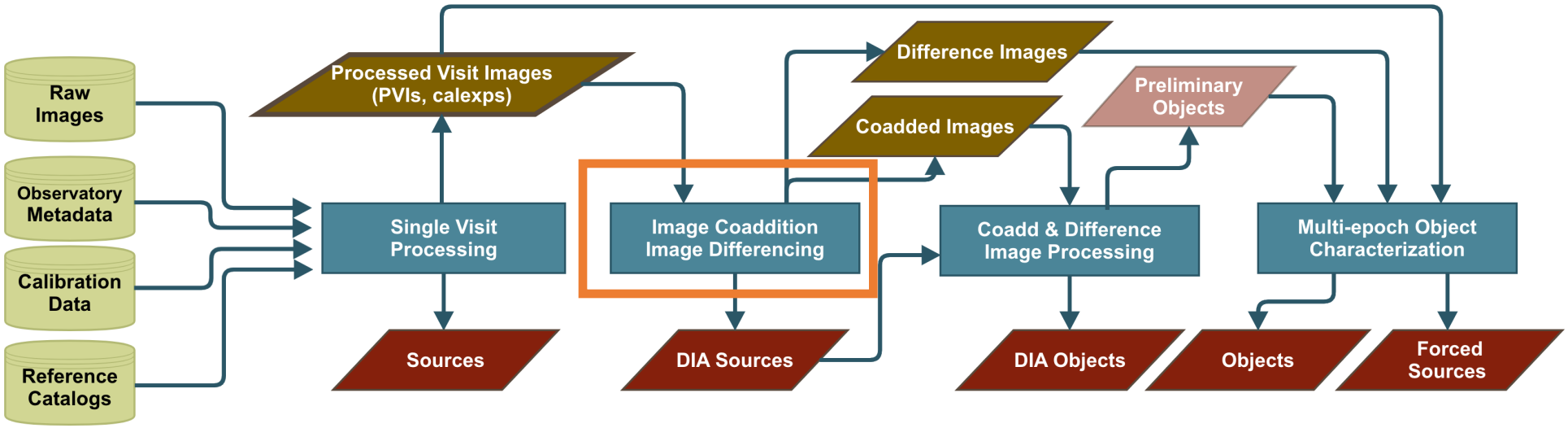
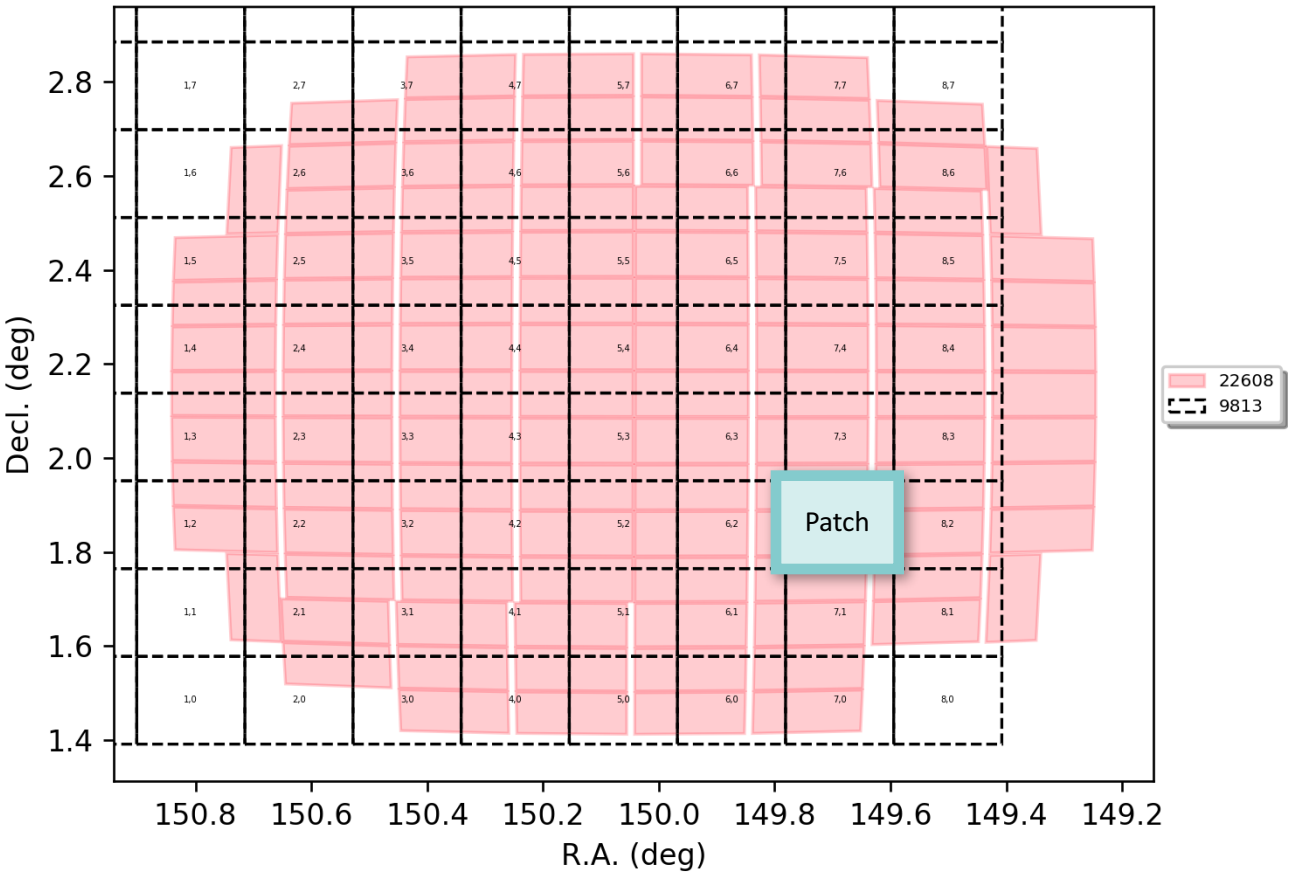


# Jargon Watch! Tract, Patch HSC's skyMap:

SkyMap: a Software Object that defines a coadd's:

- WCS/Projection: TAN (gnomonic)
- Pixel Scale: ~Native
- Tract Size: ~FOV
- Patch Size: ~CCD

Modular implementation makes it easy to swap projections and tessellations at runtime



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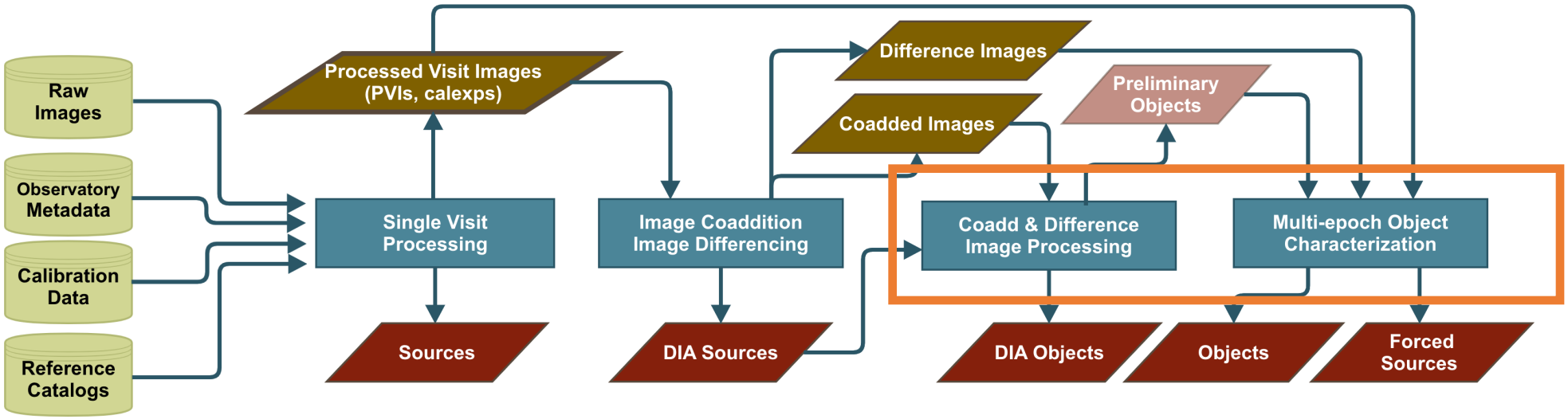

# These abstract processing steps map to `Pipelines`

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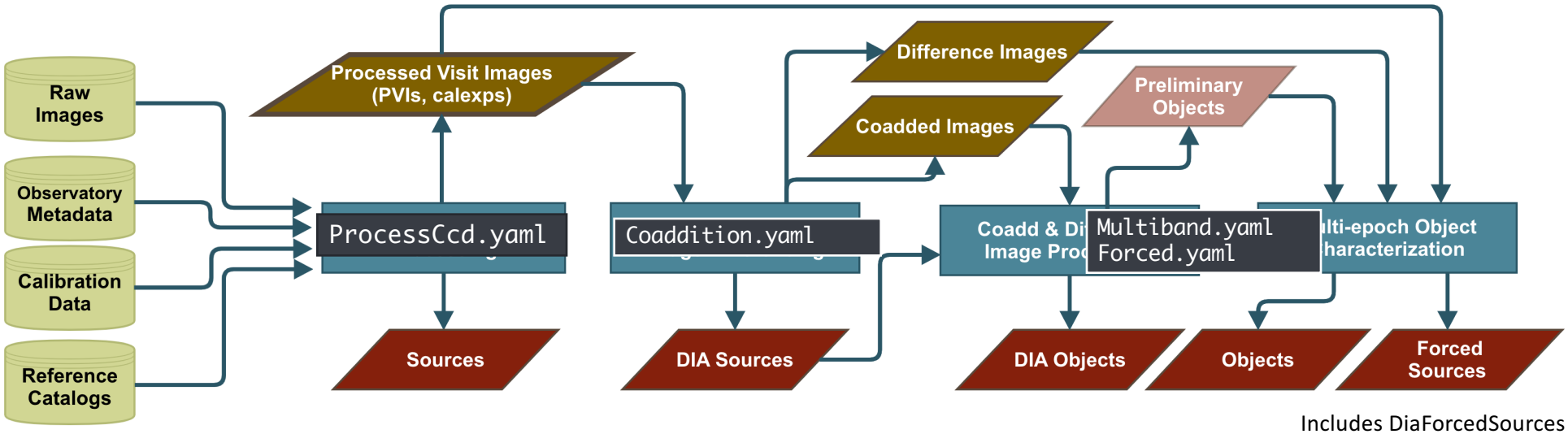


Includes DiaForcedSources

# Tasks:
github.com/lsst-dm/Nov19_bootcamp/blob/master/notebooks/HowToWriteATask.ipynb

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**TL;DR If you take one thing away from this talk, it is go to http://pipelines.lsst.io, then click on lsst.pipe.base.**

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### What is a Task?

Tasks implement astronomical data processing functionality. They are:

- **Configurable**: Modify a task's behavior by changing its configuration. Automatically apply camera-specific modifications
- **Hierarchical**: Tasks can call other tasks as subtasks
- **Extensible:** Replace ("retarget") any subtask with a variant. Write your own subclass of a task.

1. https://pipelines.lsst.io/modules/lsst.pipe.base/task-framework-overview.html
2. https://pipelines.lsst.io/modules/lsst.pipe.base/creating-a-task.html

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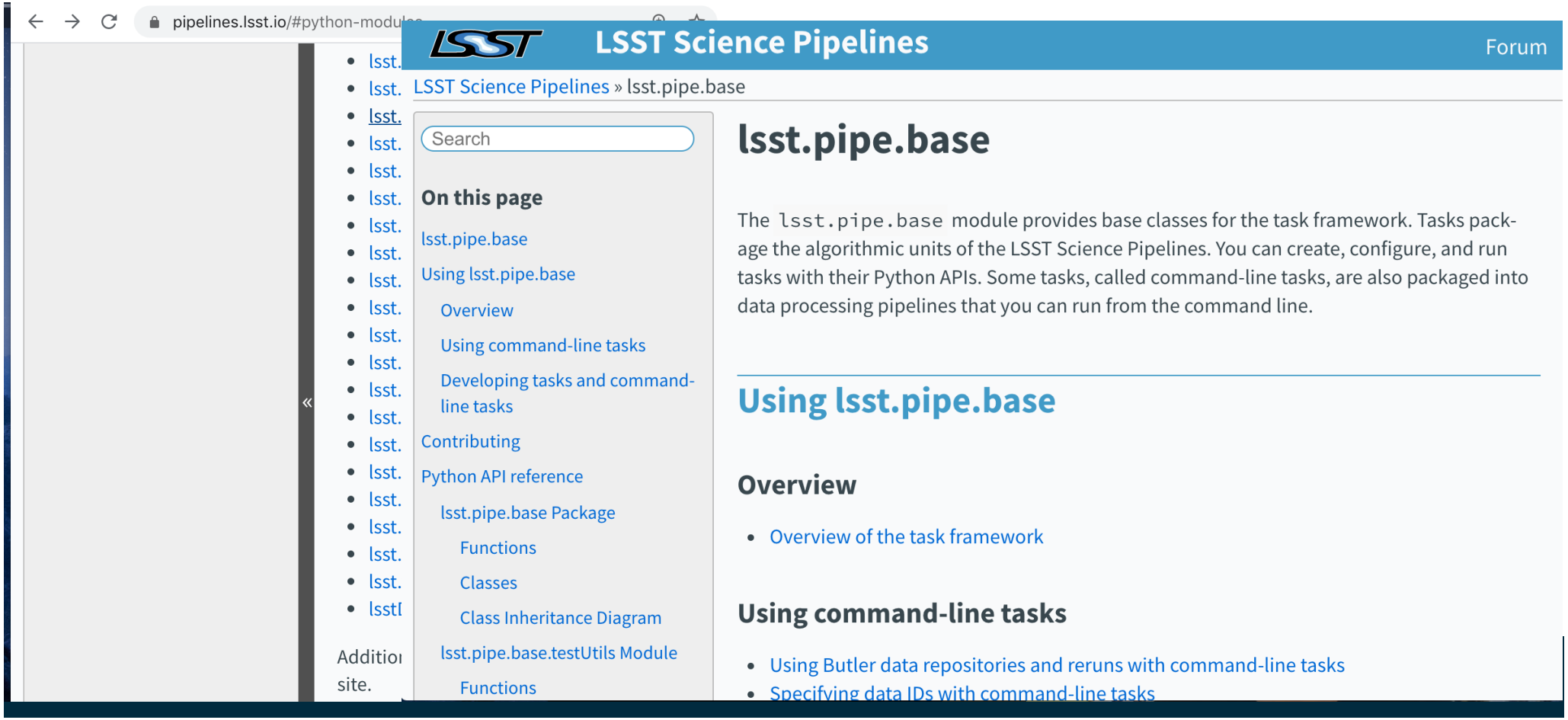

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On the landing page for `lsst.pipe.base` documenation https://pipelines.lsst.io/modules/lsst.pipe.base/index.html, you'll see a number of tutorials on how to use `Tasks` and how to create one.

`CmdlineTask` extends `Task` with commandline driver utils for use with Gen2 Butlers, and will be deprecated soon. However, not all the links under "CommandlineTask" will become obsolete. For example, Retargeting subtasks of command-line tasks will live on.

prerequisites for understanding the `PipelineTask`:

1. https://pipelines.lsst.io/modules/lsst.pipe.base/task-framework-overview.html
2. https://pipelines.lsst.io/modules/lsst.pipe.base/creating-a-task.html