ilifu Online Training – Advanced #3

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ilifu

IDIA Inter-University Institute for Data Intensive Astronomy

WESTERN SYDNEY UNIVERSITY

Data Transfers

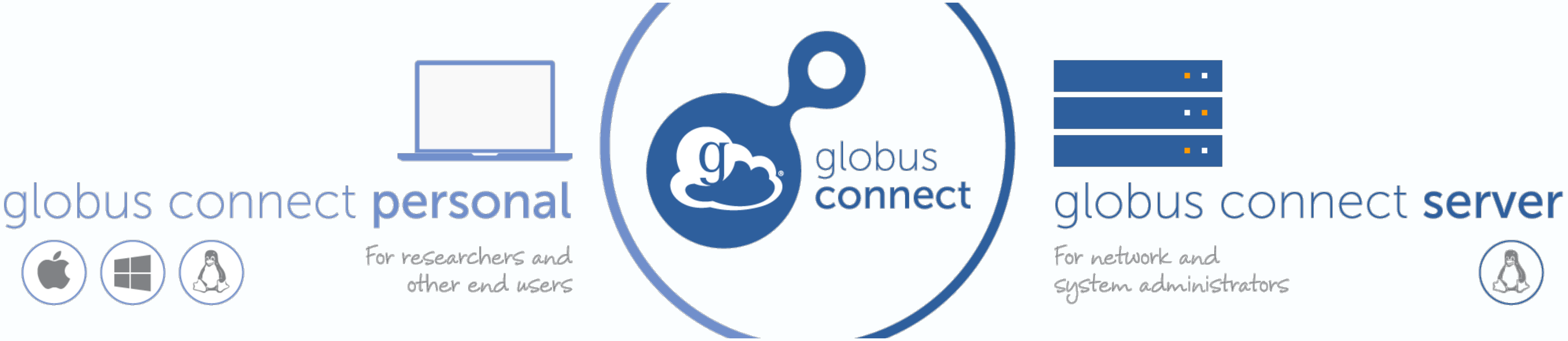
- http://docs.ilifu.ac.za/#/data/data_transfer
- **Do not use login node!**
- transfer.ilifu.ac.za
  - For cp, wget, scp, rsync (internal ilifu transfers / external transfers) – e.g.

    -
      ```
      $ cp -a /users/$USER/scripts/ /idia/users/$USER/
      ```

    -
      ```
      $ scp /path/to/file/<filename> <username>@transfer.ilifu.ac.za:/idia/users/$USER/scripts/
      ```
- Globus
  - Much faster than scp and rsync
    - A few to 10 Gbps locally (e.g. SARAO archive, CHPC, local server)
    - 1.2 Gbps to Perth, 5 Gbps to Netherlands (compared to 10s Mbps)
  - Uses dedicated data transfer node (DTN)
  - Checks file integrity and includes similar functionality to rsync

Data Transfers: Globus

- http://docs.ilifu.ac.za/#/data/data_transfer?id=transfer-using-globus-online (two authentication steps)
- User-friendly globus connect built on top of GridFTP
  - GUI/web app or CLI
- Can connect any arbitrary end points
  - Server (DTN), desktop, etc for Mac OS X, Windows & Linux
  - Offers user-friendly but computationally efficient transfer service


globus connect personal
For researchers and other end users
globus connect
globus connect server
For network and system administrators

Data Transfers: Globus

- Globus recommended for larger or more frequent transfers
  - Run background job from user-friend web app with file browser
  - Avoids fiddling with scp, keeping active connection, and long wait times
- Symbolic links (symlinks) aren't included
  - http://docs.ilifu.ac.za/#/data/data_transfer?id=configuring-a-transfer
  - e.g. CASA Multi-MS (MMS)
  - Can be repaired with rsync and "preserve source file modification times"
- Demo!

globus connect personal
For researchers and other end users
globus connect
globus connect server
For network and system administrators

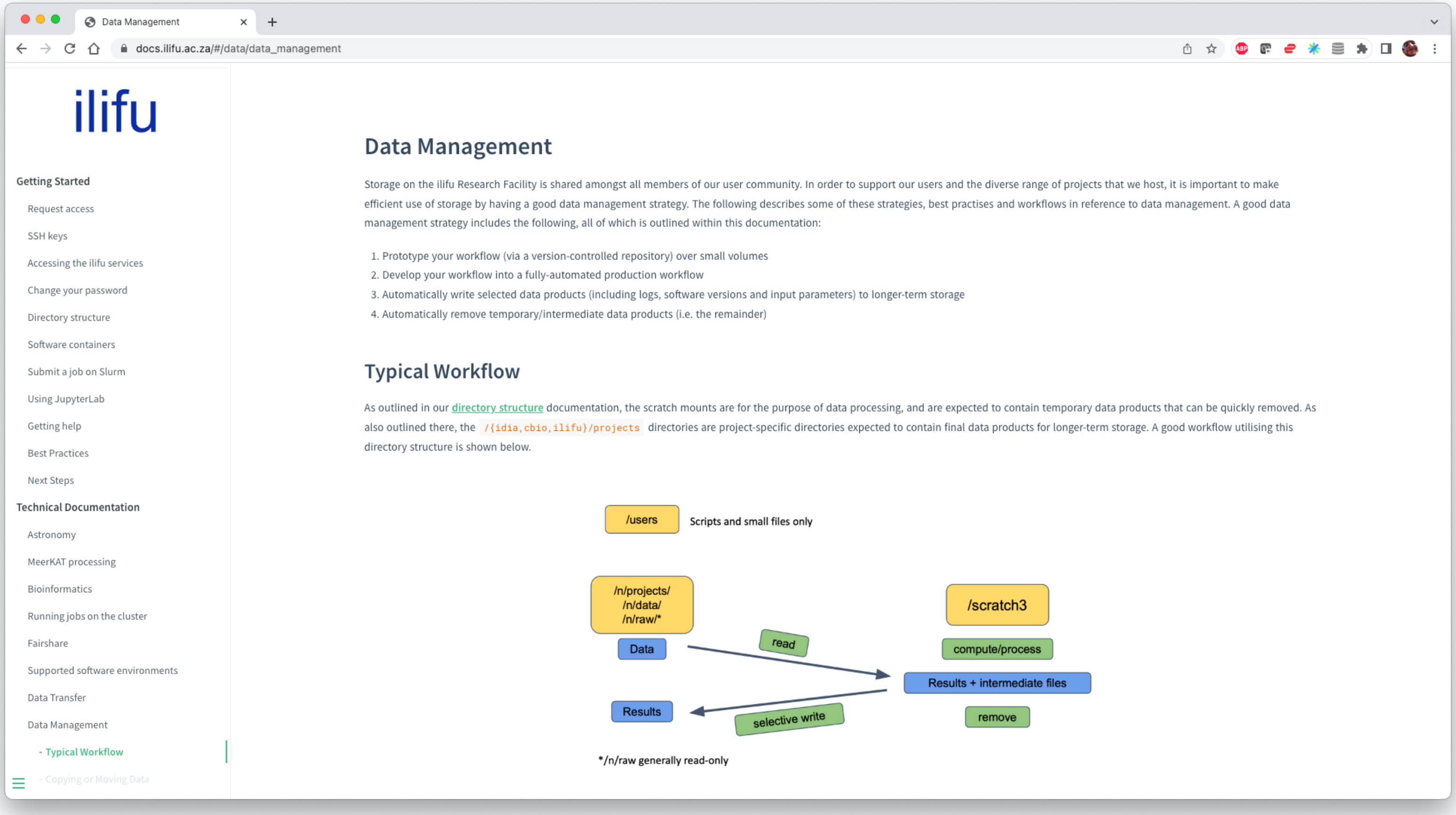
ilifu: a shared resource-limited cluster

- ilifu
  1. Supports a diverse range of projects
     - Astronomy and Bioinformatics
     - Varying resource requirements
  2. Shared environment
  3. Storage-limited

- Efficient use of storage essential
  - Achieved via a data management plan
  - Practices laid out in data management guide
    - Strategies, best practices and workflows

Data Management Guidelines

- https://docs.ilifu.ac.za/#/data/data_management



Data Management

Storage on the ilifu Research Facility is shared amongst all members of our user community. In order to support our users and the diverse range of projects that we host, it is important to make efficient use of storage by having a good data management strategy. The following describes some of these strategies, best practises and workflows in reference to data management. A good data management strategy includes the following, all of which is outlined within this documentation:

1. Prototype your workflow (via a version-controlled repository) over small volumes
2. Develop your workflow into a fully-automated production workflow
3. Automatically write selected data products (including logs, software versions and input parameters) to longer-term storage
4. Automatically remove temporary/intermediate data products (i.e. the remainder)

Typical Workflow

As outlined in our directory structure documentation, the scratch mounts are for the purpose of data processing, and are expected to contain temporary data products that can be quickly removed. As also outlined there, the `/{idia,cbio,ilifu}/projects` directories are project-specific directories expected to contain final data products for longer-term storage. A good workflow utilising this directory structure is shown below.

A good data management plan

Prototype

- Prototype your workflow over small volumes
  - via a version-controlled repository

Develop

- Develop workflow into fully-automated production workflow

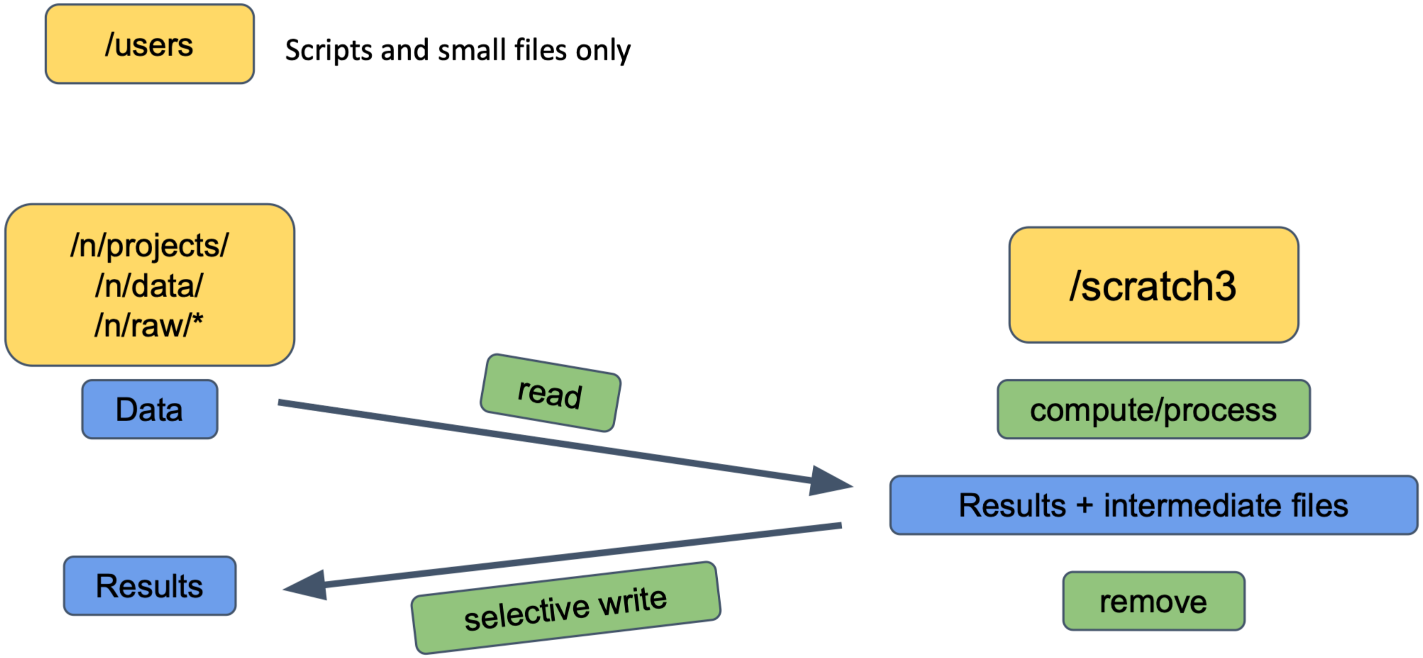
Write

- Automatically write selected products to longer-term storage
  - Including logs, software versions and input parameters

Remove

- Automatically remove temporary/intermediate data products (i.e. the remainder)

Typical workflow


/users

Scripts and small files only

/n/projects/
/n/data/
/n/raw/*

Data

read

/scratch3

compute/process

Results + intermediate files

Results

selective write

remove

*/n/raw generally read-only

Typical workflow

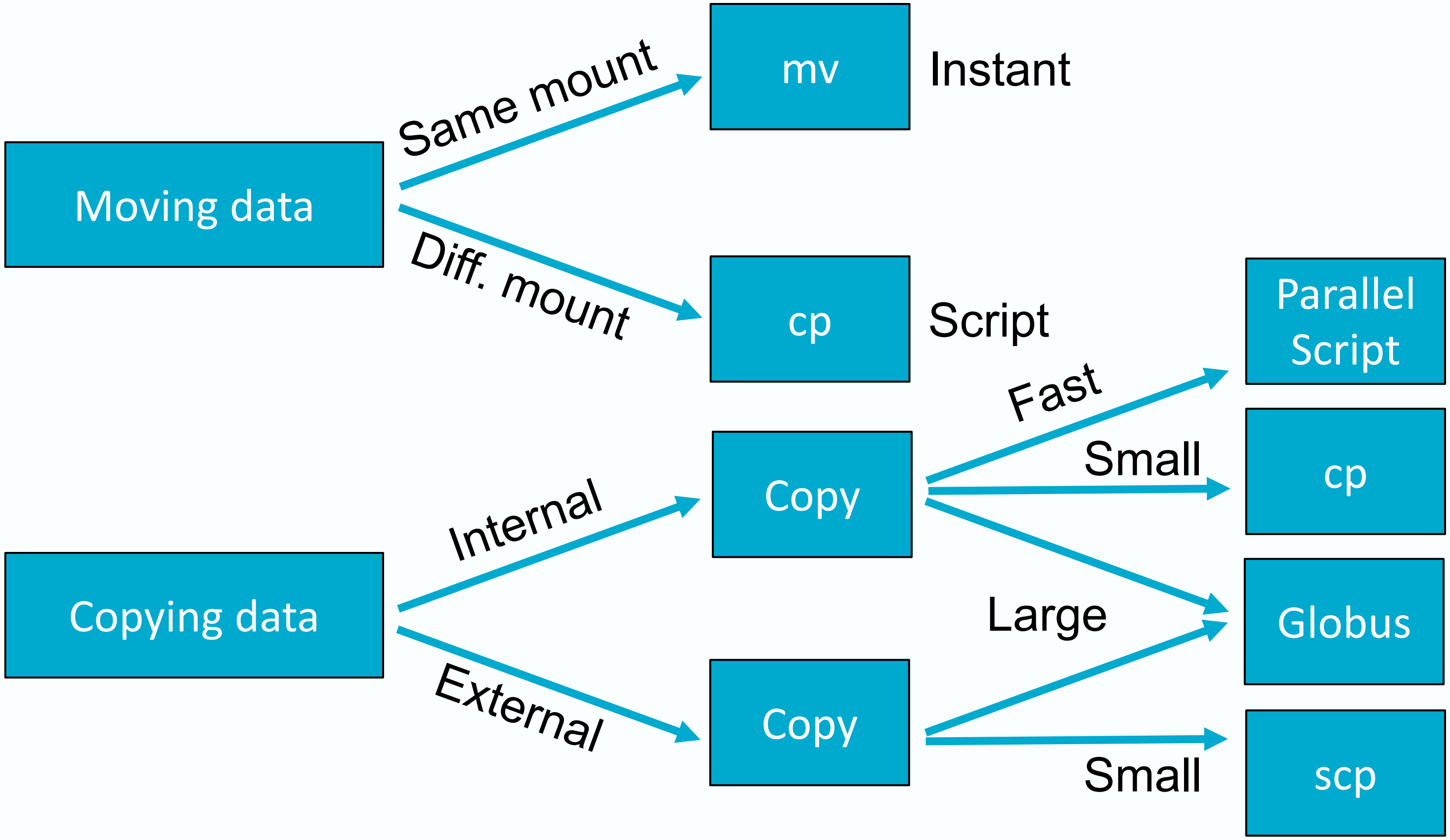
- Directory structure
  - scratch mounts for data processing
    - expected to contain temporary data that can be quickly removed
  - Project directories /{idia,cbio,ilifu}/projects/ project-specific directories
    - expected to contain final data products for longer-term storage
- Scripts and config files stored in /users used to run processing workflow or pipeline
- Reading (e.g. raw) data from read-only directory
  - /n/raw, /n/projects or /n/data
- Writing temporary/intermediate data products to scratch mount
  - /scratch3

Typical workflow

- At end of process, specific data products (e.g. final results) selected and written into project directory
- All remaining data removed from workspace on scratch
- Two approaches:
  1. Identify products to selectively write (longer-term); remove the rest
  2. Remove what isn't needed; write remainder to longer-term storage
- Typically many more temporary products than final products
- First approach significantly easier
- Following directory structure, expected to remove old files on scratch mounts
  - To start, helpful to identify and remove large files no longer needed

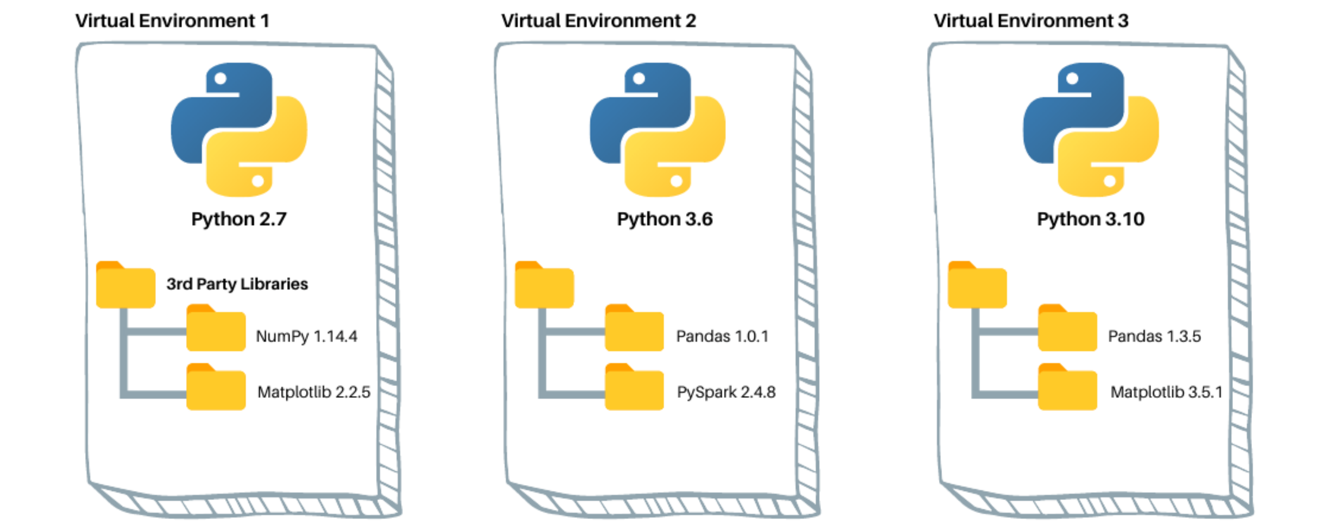
Copying or moving data

- Data can be moved or copied between directories on the same or different mounts / filesystems, or externally



Copying or moving data

- Python virtual environments (venv) should not be moved
  - path associated with environments hard-coded
  - environment can’t be activated after changing its location
  - Rather rebuild, and use `pip freeze` to identify the venv packages
  - Generally recommend building venv in personal workspace
    - e.g. /idia/users/$USER/software



Copying or moving data

- Can also mv between mounts
  - Really copy then remove (cp + rm)
  - Slow and may result in data loss if interrupted
- Rather copy (cp), then verify file integrity before removal
  - Archive mode (-a) preserves timestamps, ownership & other metadata
    - Includes the recursive -r option
      - Needed when copying a directory rather than a single file
- Don’t run copy on login node!
  - Best in sbatch script, run on compute node (least volatile)
  - Alternatively run on transfer.ilifu.ac.za
  - Or run interactively on compute node with persistent terminal (screen/tmux/mosh)

Copying or moving data

- Moving within same mount (instant)
  - `mv /idia/users/$USER/run1 /idia/projects/my-project/processed`
- Small copy
  - `cp -a /scratch3/projects/my-project/final-run /cbio/projects/my-project/processed`

Large Transfers with Globus

- Globus recommended for large transfers
- Internal Globus transfers may not perform optimally
  - compared to transfers between two well-configured end-points
- But features contained within Globus ("Transfer & Timer Options") make it useful for internal transfers – e.g.
  - "sync" option to only transfer new or changed files
  - verifying of file integrity
  - schedule regular transfers within particular directories
- Recommend generally enabling sync option, and option to "preserve source file modification times"
  - e.g. when having to repair symbolic links (symlinks) with rsync

Fast Transfers with Parallel Copy Script

- GNU parallel task recommended for efficient internal copy on ilifu, to simultaneously transfer many large files
- First identify directories with many large files / directories
  - Approach performs poorly when run over a small number of files
- e.g. run 16 parallel calls of `cp -a` over 16 files/subdirectories located in /scratch3/users/$USER/my-data directory
-
  ```
  #!/bin/bash
  shopt -s dotglob #Include hidden files with '*'
  mkdir /ilifu/astro/projects/my-project/my-data
  cd /scratch3/users/$USER/my-data
  printf '%s\n' * | parallel -j 16 cp -a {}
  /ilifu/astro/projects/my-project/my-data
  ```

Fast Transfers with Parallel Copy Script

- Make it executable and create logs directory

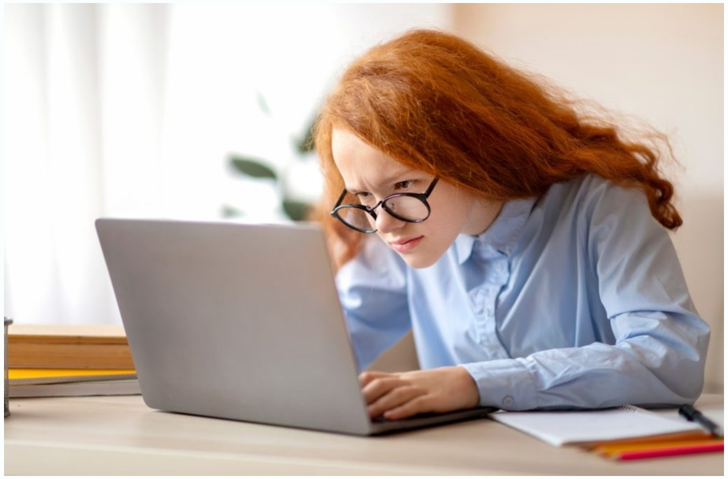
  -
    ```
    chmod +x parallel_copy.sh
    mkdir logs
    ```
- Write sbatch script and run it (`sbatch parallel_copy.sbatch`)!

-
  ```
  #!/bin/bash
  #SBATCH --cpus-per-task=16
  #SBATCH --mem=16GB
  #SBATCH --job-name=parallel_copy
  #SBATCH --output=logs/%x-%j.out
  #SBATCH --error=logs/%x-%j.err
  #SBATCH --partition=Main
  #SBATCH --time=02:00:00


  export OMP_NUM_THREADS=$SLURM_CPUS_PER_TASK
  ./parallel_copy.sh
  ```

Checking File Integrity

- Important to check integrity of data before removing it from original location
- md5sum or sha256sum
- For individual files, outputs a checksum
  - Checksum identical for each file if transferred intact



Checking File Integrity

- Example: check integrity of all files within directory **from which** (source) and **to which** (destination) you've copied

-
  ```
  cd /scratch3/projects/my-project/final-run
  find -type f -exec md5sum '{}' \; > md5sum.txt
  cd /cbio/projects/my-project/processed
  find -type f -exec md5sum '{}' \; > md5sum.txt
  ```
- Example: produce checksum for entire set of output checksums, and compare two to ensure they're the same

-
  ```
  cat /scratch3/projects/my-project/final-run/md5sum.txt | sort -k 2 | md5sum
  cat /cbio/projects/my-project/processed/md5sum.txt | sort -k 2 | md5sum
  ```

Checking File Integrity

- If output identical, data has been copied intact
  - i.e. all checksums between source and destination identical
- If not identical, difference can be investigated using `diff`
- `diff /scratch3/projects/my-project/final-run/md5sum.txt /cbio/projects/my-project/processed/md5sum.txt`
- If any files missed or skipped, or partially transferred and incomplete, they will be output when running diff
  - If so, wait until copy completed and run checksum again, or remove the data from destination and re-run the copy of that file
- Files only present in destination directory but not source directory will also be displayed with this diff command
  - Can be ignored to verify the integrity of only files copied from source

Checking File Integrity

- When multiple files missing or have different checksum, use rsync to find difference between them
  - Run final rsync to ensure source and destination identical
  - Include trailing slash (/) for source path, and exclude for destination path
- File integrity checked automatically during Globus transfers
  - Option can be switched off if necessary

Workflow Maturity

Important to identify maturity of workflow during processing

Stage or type

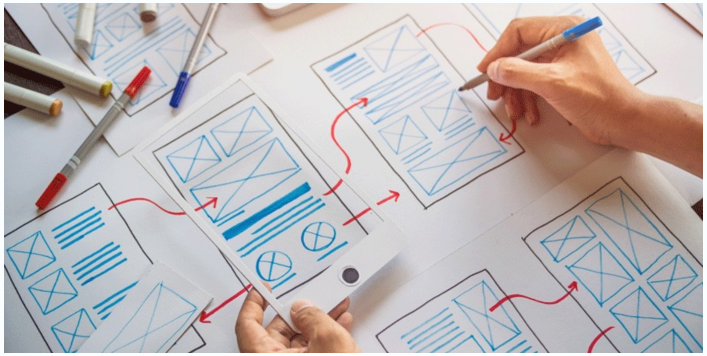
Affects processing and data management strategy followed

In general, you will be:

1. Prototyping or developing your workflow
2. Running a production workflow

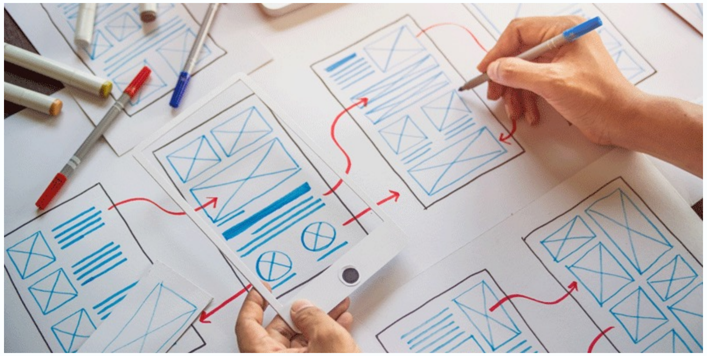
Prototyping

- Involves experimentation
  - Create or optimise workflow
  - Identification of optimal parameters, data products, etc.
- May include
  - Manual processing/disconnected custom scripts manually run one-by-one
  - Significant amount of interactivity
  - Running fully automated pipeline
    - Experimenting with different parameters to optimise results



Prototyping

- Intermediate/temporary data products may be retained
  - For comparison, or input to experimentation
- Best practises
  - Experiment with small volumes of temporary products
  - Avoid prototyping / development over large volumes, unless necessary
  - Verify outputs and identify optimal parameters

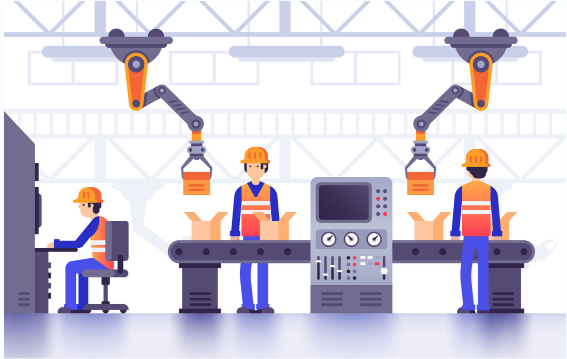


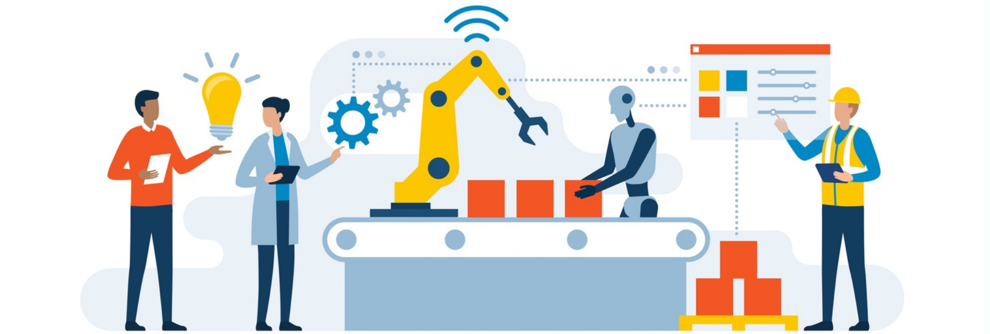
Production

- Workflows where little to no development, experimentation or interactivity expected to occur
- No interest in retaining intermediate / temporary products
- Generally run as pipeline
  - Contained within series of end-to-end steps
    - i.e. the output of one step is used as input to the next step
  - Often automated and configured before launch
  - Often scheduled to run in advance (e.g. via Slurm and/or Nextflow)
  - Often managed by a single wrapper software package
- Pipeline may be run for prototyping, when workflow or parameters not optimised

Production

- Best practises include:
  - Capture software / pipelines versions and input parameters
    - Results can be reproduced
  - Automate/pipeline removal of temporary data products
  - Automate/pipeline selective write of final products to long-term storage
- Temporary data products can be regenerated at any point via running the same workflow with the same inputs
  - Safe/ideal to remove products automatically during production workflow





General Best Practices

Prototyping should develop into production workflows

Backup your scripts, workflow or pipeline, ideally by uploading to a version-controlled repository such as GitHub

We recommend resources from the Software Carpentry website

For each processing run, keep record of

Software versions of workflow/pipeline

Its input parameters

Products to Retain

- For typical workflow, **final data products** retained for longer-term storage, as produced by your workflow
- Also retain from your workflow
  - Parameters
  - Inputs
  - Versions
  - Logs (e.g. sbatch standard out / error)
- For the purpose of reproducibility and posterity
- More radio astronomy-specific data products to retain later

Products to Remove

- Recommend first selectively writing data products you wish to retain for longer-term storage
- Then remove everything else from processing run
  - Will include temporary / inflated data products
- In some cases, better/easier to identify which products to remove, and write remainder to longer-term storage
- Helpful start is identifying large data products that don't need to be retained, and removing those
  - Can run large rm within interative Slurm session, or transfer node
- More radio astronomy-specific data products to remove later

IDIA Inter-University Institute for Data Intensive Astronomy

Break for Q&A

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Radio Astronomy Data Management

When processing [Multi-] MeasurementSet ([M]MS)

Important to retain final calibrated data

A few to 10s TB in size for MeerKAT data

Ideally with single data column
(e.g. corrected data)

Additionally important to retain following data products

Calibration tables (typically MB in size)

Flag versions (typically GB in size)

Final images (typically MB in size)
or cubes (typically GB in size)

Possible to store only calibration tables and flag versions

Remove calibrated data, which can be regenerated at any point

i.e. apply calibration (applycal) and flags (flagmanager) to raw MS

Find and Remove MeasurementSets

- Expected to remove old files on scratch mounts
- As a start, helpful to identify & remove large files not needed
- e.g. remove (M)MSs from a completed processing run
  - Takes up bulk of storage from processing run
- IDIA pipeline: `cleanup.sh` and `allSPW_cleanup.sh` scripts
  - Remove temporary MMSs, and final calibrated MMSs, respectively

Find and Remove MeasurementSets

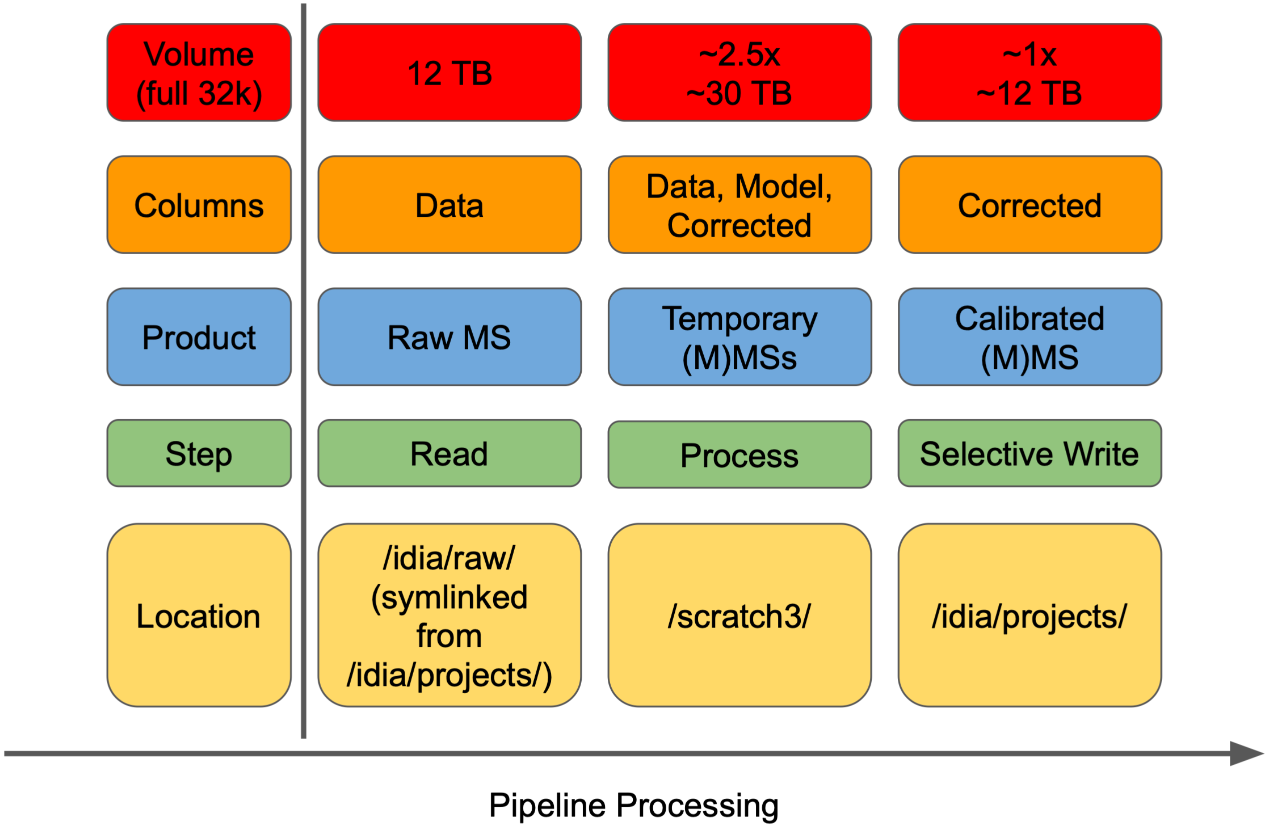
- General workflow: find and remove (M)MSs

  -
    ```
    #!/bin/bash

    find $1 \( -name "*.ms" -o -name "*.mms" -o -name
    "*flagversions" \) -exec ls -d {} \; >
    vis_and_flags_tmp.txt
    du -hsc $(cat vis_and_flags_tmp.txt)
    read -p "Press return to remove data... "
    rm -r $(cat vis_and_flags_tmp.txt)
    rm vis_and_flags_tmp.txt
    ```
- Finds and displays volume (and total sum) of the (M)MSs
- `read -p` forces return key to remove data, or ctrl+C to cancel
  - e.g. if (M)MS displayed you don’t wish to remove

General Radio Astronomy Workflow

MS inflation via processing workflow



Volume (full 32k)	12 TB	~2.5x ~30 TB	~1x ~12 TB
Columns	Data	Data, Model, Corrected	Corrected
Product	Raw MS	Temporary (M)MSs	Calibrated (M)MS
Step	Read	Process	Selective Write
Location	/idia/raw/ (symlinked from /idia/projects/)	/scratch3/	/idia/projects/

Pipeline Processing

General Radio Astronomy Workflow

- Typical MeerKAT 32k MS (8-hr, 64 antennas, 4 polarisations)
- Recommended to average or select data wherever possible
  - During SARAO archive transfers (see upcoming demo)
  - Reduces disk volumes and significantly improves data processing time
  - Contact support@ilifu.ac.za to request averaging previous raw data

General Radio Astronomy Workflow

- By default, raw data:
  - Contains single DATA column
  - Stored as read-only MS in /idia/raw (symlinked from /idia/projects)
    - Can be read during initial processing steps (e.g. mstransform / split / partition), ideally on a scratch mount
    - Recommended creating a symbolic link (symlink) to the raw MS
      - For pipelines requiring MS within working directory, or where you wish to give the raw MS a different name:
      - `cd /scratch3/projects/my-project/processing/`
      - `ln -s /idia/raw/my-project/SCI-YYYYMMDD-PI-01/0123456789/0123456789_sdp_l0.ms my-raw-data.ms`
      - `/scratch3/projects/my-project/processing/my-raw-data.ms` will point to raw read-only MS

General Radio Astronomy Workflow

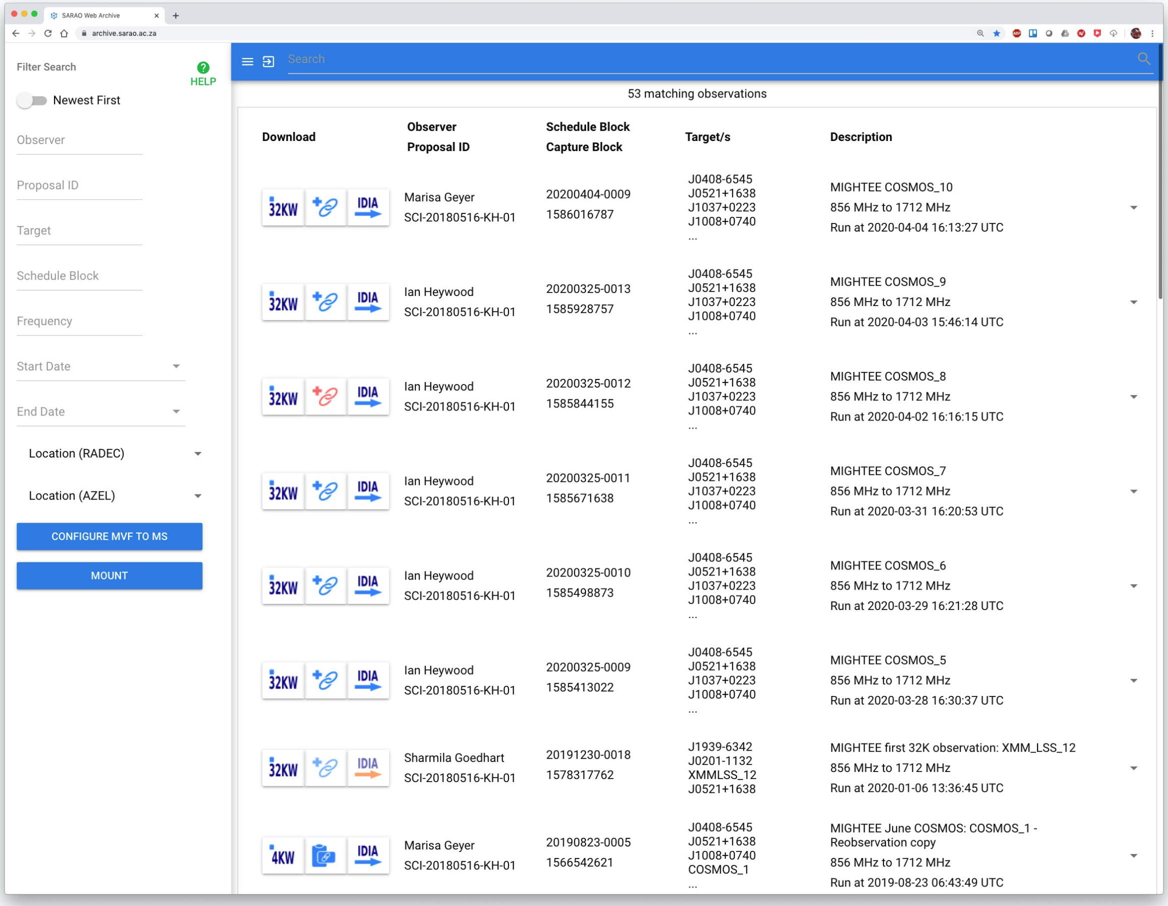
- (M)MSs will inflate by ~2.5 times from single DATA column
  - Adds MODEL_DATA (e.g. setjy) & CORRECTED_DATA (e.g. applycal)
  - Often initial cross-calibration will produce these temporary (M)MSs, split out corrected data for target(s), then self-calibrate, further inflating this separate (M)MS with three data columns
- Final calibrated data should contain single corrected data
- Roughly equal to raw data (or smaller with averaging)
  - Selectively written back to project directory for longer-term storage
- All other temporary inflated products should be removed

General Radio Astronomy Workflow

- We recommend removing raw MS
  - Read-only, so please contact support@ilifu.ac.za to request this
- Retaining raw MS for longer verification sometimes required
  - Please contact support@ilifu.ac.za to motivate for this
- Raw data can be transferred again from the SARAO archive
  - If older than 200 days, first restaged from tape
- May be possible to recover raw data from derived (M)MSs
  - e.g. original DATA column exists; run flagmanager to undo flags
- More info about MeerKAT processing and data management strategies in our MeerKAT processing documentation

Data Transfers: SARAO archive

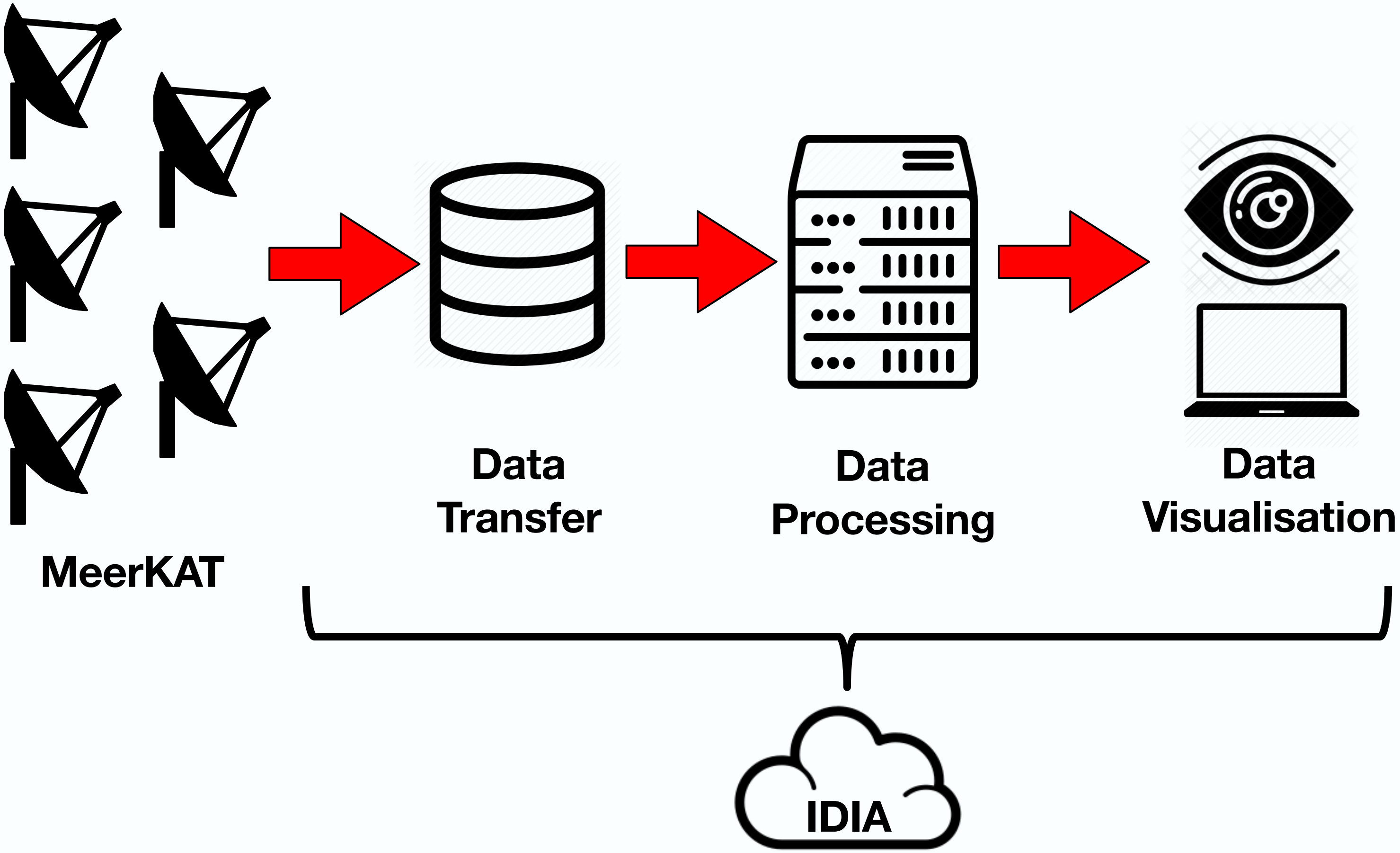
- Documentation
- Can push data to IDIA if given permission by PI
  - First register for archive then PI grant access (or contact service desk)
- Must have an existing ilifu project
  - Contact support@ilifu.ac.za to request



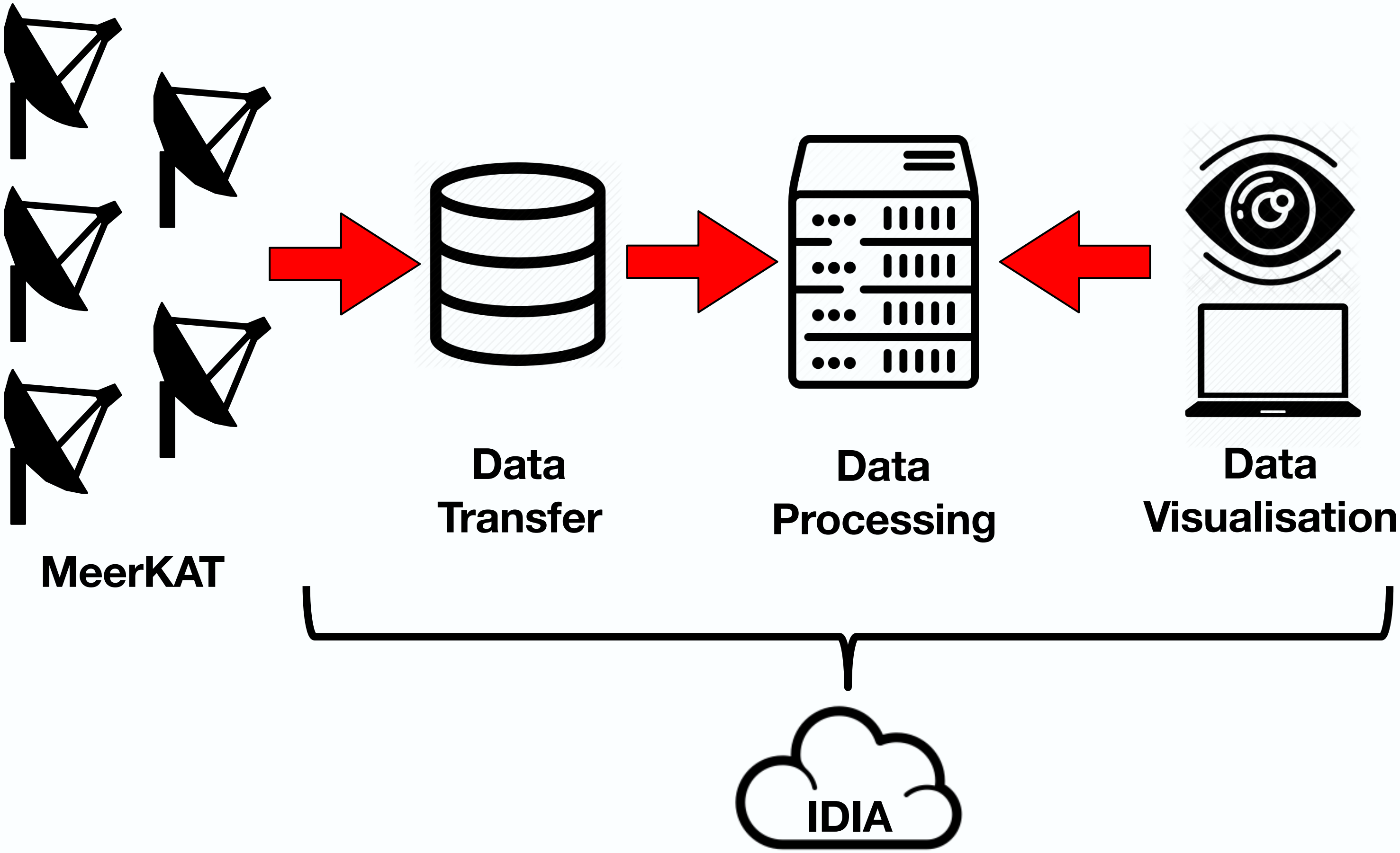
53 matching observations

Download	Observer Proposal ID	Schedule Block Capture Block	Target/s	Description
32KW IDIA	Marisa Geyer SCI-20180516-KH-01	20200404-0009 1586016787	J0408-6545 J0521+1638 J1037+0223 J1008+0740 ...	MIGHTEE COSMOS_10 856 MHz to 1712 MHz Run at 2020-04-04 16:13:27 UTC
32KW IDIA	Ian Heywood SCI-20180516-KH-01	20200325-0013 1585928757	J0408-6545 J0521+1638 J1037+0223 J1008+0740 ...	MIGHTEE COSMOS_9 856 MHz to 1712 MHz Run at 2020-04-03 15:46:14 UTC
32KW IDIA	Ian Heywood SCI-20180516-KH-01	20200325-0012 1585844155	J0408-6545 J0521+1638 J1037+0223 J1008+0740 ...	MIGHTEE COSMOS_8 856 MHz to 1712 MHz Run at 2020-04-02 16:16:15 UTC
32KW IDIA	Ian Heywood SCI-20180516-KH-01	20200325-0011 1585671638	J0408-6545 J0521+1638 J1037+0223 J1008+0740 ...	MIGHTEE COSMOS_7 856 MHz to 1712 MHz Run at 2020-03-31 16:20:53 UTC
32KW IDIA	Ian Heywood SCI-20180516-KH-01	20200325-0010 1585498873	J0408-6545 J0521+1638 J1037+0223 J1008+0740 ...	MIGHTEE COSMOS_6 856 MHz to 1712 MHz Run at 2020-03-29 16:21:28 UTC
32KW IDIA	Ian Heywood SCI-20180516-KH-01	20200325-0009 1585413022	J0408-6545 J0521+1638 J1037+0223 J1008+0740 ...	MIGHTEE COSMOS_5 856 MHz to 1712 MHz Run at 2020-03-28 16:30:37 UTC
32KW IDIA	Sharmila Goedhart SCI-20180516-KH-01	20191230-0018 1578317762	J1939-6342 J0201-1132 XMMLSS_12 J0521+1638	MIGHTEE first 32K observation: XMM_LSS_12 856 MHz to 1712 MHz Run at 2020-01-06 13:36:45 UTC
4KW IDIA	Marisa Geyer SCI-20180516-KH-01	20190823-0005 1566542621	J0408-6545 J0521+1638 J1008+0740 COSMOS_1 ...	MIGHTEE June COSMOS: COSMOS_1 - Reobservation copy 856 MHz to 1712 MHz Run at 2019-08-23 06:43:49 UTC

IDIA and the MeerKAT toolbelt

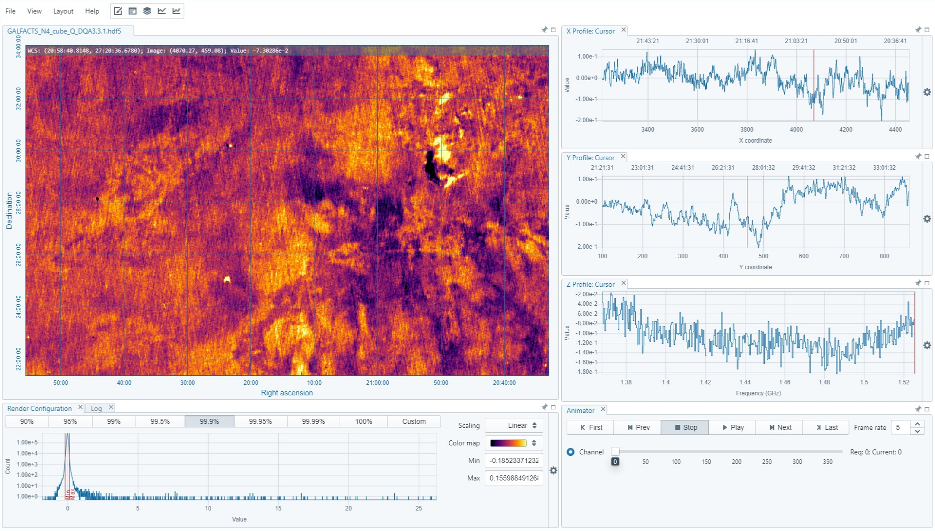


IDIA and the MeerKAT toolbelt



CARTA

- Cube Analysis and Rendering Tool for Astronomy (CARTA)
  - IDIA (South Africa) – NRAO (US) – ASIAA (Taiwan)
  - Cloud-based remote visual analytics of large image cubes
  - Supports many image formats: FITS, CASA, Miriad, and HDF5
  - v4.0 stable release September 2023 – available here: https://cartavis.org
  - Deployed at ALMA Regional Centres and servers around the world



GALFACTS_N4_cube_Q_DQA3.3.1.hdf5

WCS: (20:58:40.8148, 27:20:36.6780); Image: (4070.27, 459.08); Value: -7.30286e-2

Scaling: Linear

Min: -0.18523371232

Max: 0.15598849126

Frame rate: 5

Channel: 0

Req: 0; Current: 0

CARTA at IDIA

- docs.ilifu.ac.za/#/astronomy/astronomy_software?id=carta
- CARTA server hosted on ilifu at https://carta.idia.ac.za
  - Login details same as for Jupyter, emailed to you when ilifu account set up
- Beta (development) server: https://carta-beta.idia.ac.za
  - Routinely updated between major releases
- Both currently running v4.0
  - v4.0 release note and feature highlight is available here
- All astro users (carta-users) have access

CARTA HDF5 format (IDIA schema)

- Strongly recommended for large images/cubes
- Purpose-built HDF5 schema developed at IDIA
  - Efficient FITS to HDF5 converter tool developed at IDIA
- Files go through an “ingestion process”
  - Rotated dataset (XYZ -> ZYX) cached for spectral profile generation
  - Pre-calculated statistics & histogram for image loading (slides & cubes)
  - Pre-calculated tiles for image loading
  - Mipmaps
- Can write IDIA HDF5 file to /carta_share/current/ (SSD) for performance
  - Even for continuum (single channel) image

CARTA HDF5 format (IDIA schema)

- HDF5 converter usage:
  - `srun fits2idia -o {OUTPUT HDF5 file} {INPUT FITS file}`
- Suggested to copy straight into /carta_share subdirectory:
  - `srun fits2idia -o /carta_share/users/$USER/image.hdf5 image.fits`
- Speed-up achieved by increasing CPUs & memory allocation:
  - Up to 251 GB for node in Main partition, and 1508 GB HighMem partition
  - `srun --mem=50GB --time=5 --cpus-per-task=10 fits2idia -p -o /carta_share/users/${USER}/image.hdf5 image.fits`
  - -p shows simple progress bar

CARTA HDF5 format (IDIA schema)

- Some large FITS cubes will exceed max memory values
  - Unable to convert to HDF5 in default mode
- Option -m will report predicted memory usage and exit:

  -
    ```
    fits2idia -m image.fits
    ```
- If exceeds 1508 GB (or 251 GB if HighMem nodes unavailable):
  - Option -s must be used, using slower but less memory-intensive method
  - Single CPU iterating through a single channel at a time

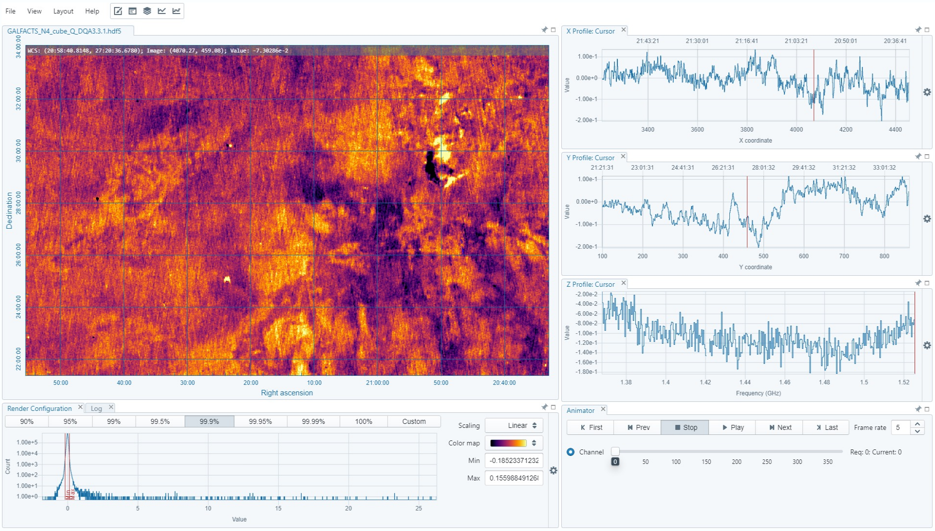
  -
    ```
    srun --mem=10GB --time=01:00:00 --cpus-per-task=1
    fits2idia -s -p -o /carta_share/users/${USER}/image.hdf5
    image.fits
    ```
- Predicted memory usage for slow-mode conversion reported when using both options -s and -m

CARTA at IDIA

- By default, CARTA will browse in /carta_share/users/$USER
- Can access any files or folders in /carta_share, /scratch3, /idia and /ilifu directories that your ilifu user can access
  - /idia and /ilifu mounts read-only, so cannot export files here
    - e.g. region files, FITS cutouts or moment maps
    - Can export to /carta_share or /scratch3
- Many copies of images in /carta_share (HDF5, FITS, CASA or miriad) no longer necessary, unless for performance reasons
  - For large cubes/images, we recommend converting to HDF5 and writing to /carta_share/current (SSDs)
    - Superior performance during visualisation
  - Not necessary for all other images, as visualising directly from /idia, /ilifu or /scratch3 in any format will still result in good performance

CARTA at IDIA

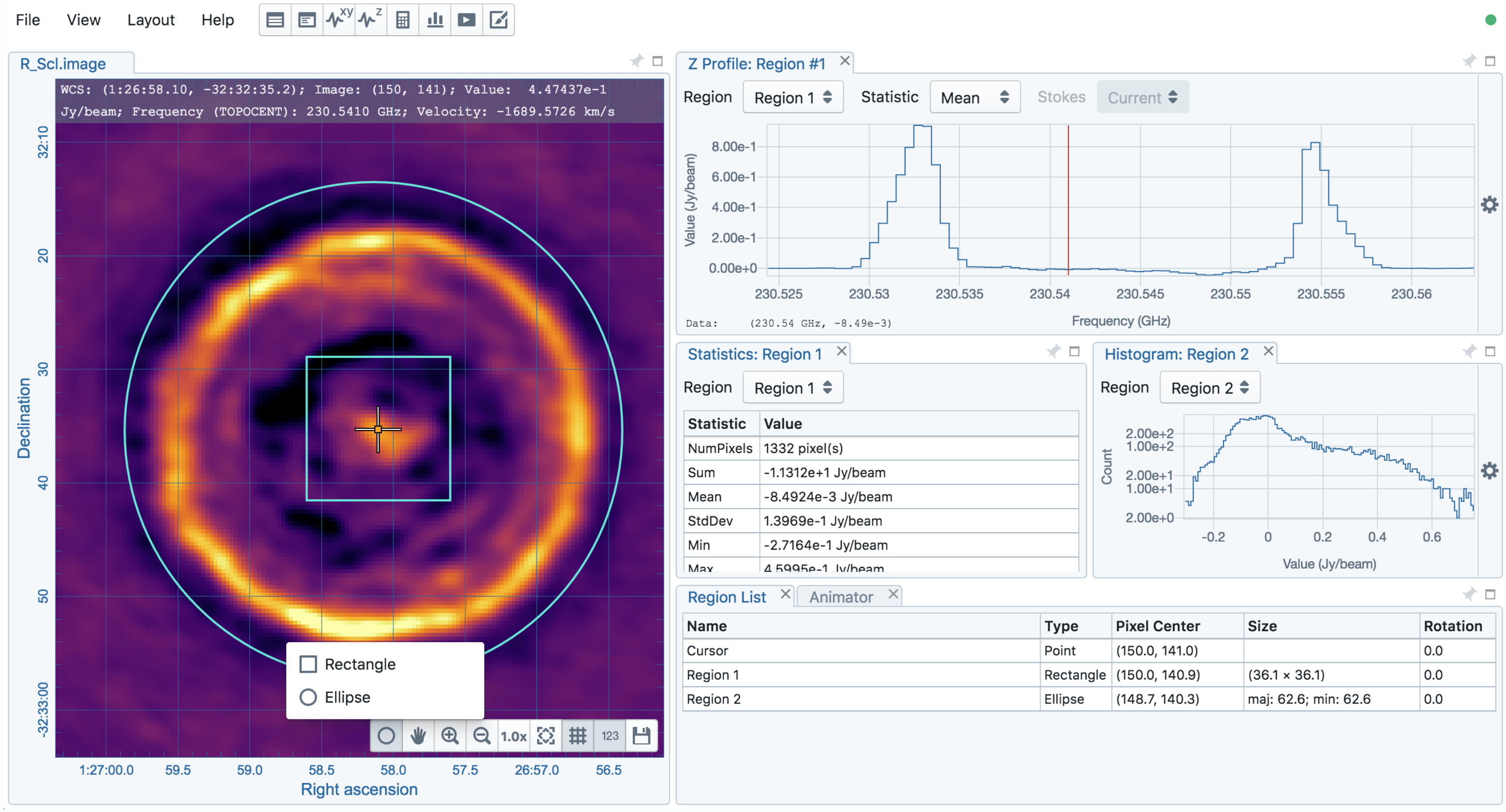
- Can move the files/folders to relevant project directory, within /carta_share/groups/, /scratch3/projects/, or /idia/projects/
  - e.g. for other project members to access specific files
  - Please request support to create relevant project directory if it doesn't exist



CARTA at IDIA: troubleshooting

- Please contact support@ilifu.ac.za if you don’t have access
- For CARTA-specific issues
  - Contact CARTA helpdesk or file GitHub issue
- Restarting your backend
  - e.g. issues starting CARTA, or CARTA session crashes
  - File -> Server -> Restart Service or visit carta.idia.ac.za/dashboard
    - Also accessible via File -> Server -> Dashboard
  - Press the button to “Restart CARTA service”
  - Refresh your CARTA page or press the button for a “New CARTA session”
- Hard-reload white screen
  - e.g. white screen appears on IDIA CARTA server
  - Force reload (e.g. command-shift-R) page to clear cache, often a few times

CARTA demo



```
WCS: (1:26:58.10, -32:32:35.2); Image: (150, 141); Value:  4.47437e-1
Jy/beam; Frequency (TOPOCENT): 230.5410 GHz; Velocity: -1689.5726 km/s
```

Region Region 1 Statistic Mean Stokes Current

```
Data:   (230.54 GHz, -8.49e-3)
```

Region Region 1

Statistic	Value
NumPixels	1332 pixel(s)
Sum	-1.1312e+1 Jy/beam
Mean	-8.4924e-3 Jy/beam
StdDev	1.3969e-1 Jy/beam
Min	-2.7164e-1 Jy/beam
Max	4.5995e-1 Jy/beam

Region Region 2

Name	Type	Pixel Center	Size	Rotation
Cursor	Point	(150.0, 141.0)		0.0
Region 1	Rectangle	(150.0, 140.9)	(36.1 × 36.1)	0.0
Region 2	Ellipse	(148.7, 140.3)	maj: 62.6; min: 62.6	0.0

Jordan Collier | 3 Oct 2023 | ilifu Advanced Training

THANK YOU

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