MOPV036

Porting Control System Software from Python 2 to 3

A. F. Joubert, M.T. Ockards, S. Wai, SARAO, Cape Town, South Africa

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MeerKAT radio telescope

- Developed by South Africa as a precursor to the Square Kilometre Array
- Array of 64 interlinked antennas, fully operational since 2018
- 48 antennas concentrated in the core area, approximately 1 km in diameter
- 8 km maximum baseline (longest distance between any two antennas)
- 13.5 m diameter main reflector, and a 3.8 m diameter sub-reflector per antenna
- 2.2 Tbit/s combined data from all antennas
- 170 km of fibre connect to the central processing building in the Karoo, with the maximum length being 12 km.
- 120k sensors managed by the control and monitoring system

www.sarao.ac.za

The South African Radio Astronomy Observatory (SARAO) is a National Facility managed by the National Research Foundation and incorporates all national radio astronomy telescopes and programmes. SARAO is responsible for implementing the Square Kilometre Array (SKA) in South Africa.

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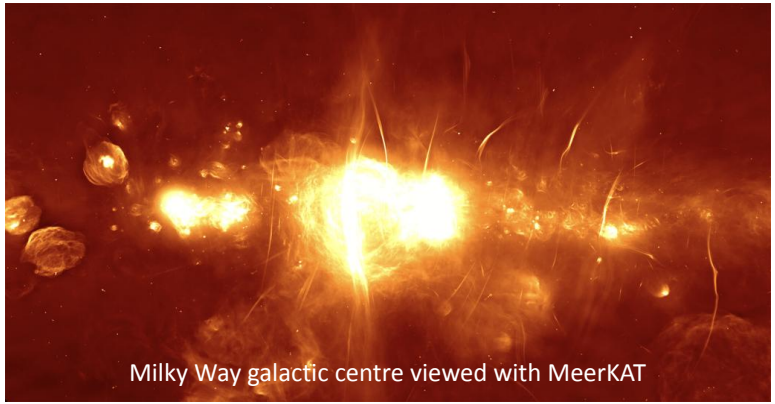
Our issue

MeerKAT control and monitoring system software needs to be ported, 20+ packages

Python 2 end-of-life on 1 January 2020

Possible strategies

- **Separate branches for Python 2 and Python 3**
  - Expensive to maintain
- **Single source Python 2, autogenerate Python 3**
  - Need “fixers” for 2to3 conversion
  - Python 3 code isn’t seen by developers
  - Need to verify autogenerated code
- **Single source Python 3, auto-generate Python 2**
  - Need to convert all to Python 3 first
  - Need “fixers” for 3to2 conversion
  - Need to verify autogenerated code
- **Single source Python 2 and 3 compatible (wrapper)**
  - Code will have some special cases
  - No autogeneration, so developers see the code that is used

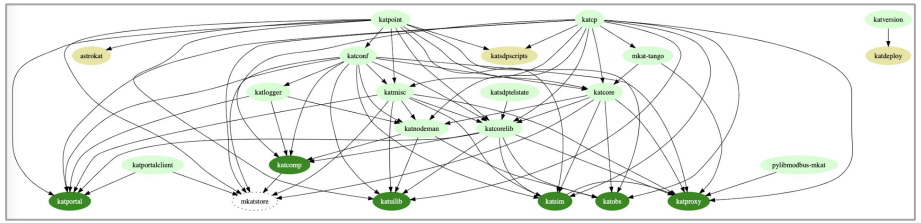

Milky Way galactic centre viewed with MeerKAT

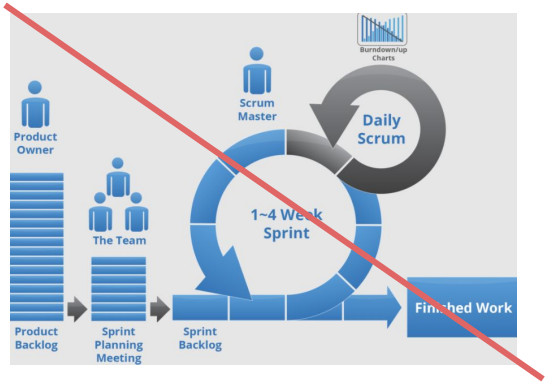
Selected

Wrapper:
python-future

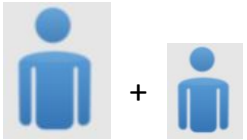
Approach

Work top-down according to dependency tree





Tried scrum, but too much specialised knowledge required, and estimation impossible



Switched to single developer, focussed on porting, plus one reviewer

Evaluate
- Review the repository to provide context for the developer

Clean up
- Delete unused code and scripts to simplify the porting effort

Update CI
- Add python3 tests to Continuous Integration
- Allow failure

Futurize (python2)
- Futurize stage 1 (modernize python2 code only, no compatibility with python3)
- Auto code format (chance to clean-up, with Black code formatter)
- Futurize stage 2: use the python-future wrapper to add (broken) python3 support

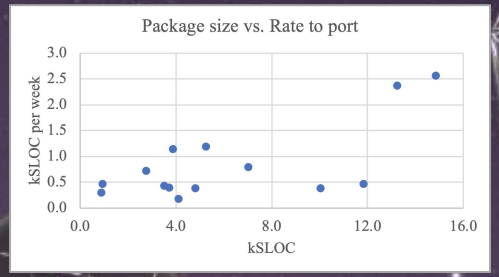
Futurize (python3)
- Update dependencies, fix conversion issues
- Get tests passing under python3

Update CI
- Fail if python3 tests fail
- Publish python3 package

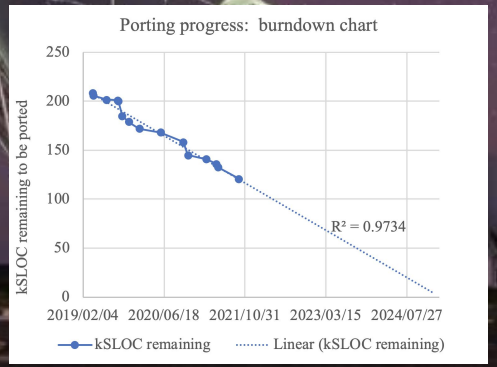
Verify
- Downstream packages still pass python2 tests
- System integration tests still pass

Results

Estimation is very difficult.
No correlation with lines of code in a package



Progress has been made, but still require a significant effort.



Conclusion

Porting a codebase is a significant undertaking, and needs to be carefully managed. Prioritisation and dedicated resources are important.
Success is not guaranteed.