ESCAPE

European Science Cluster of Astronomy & Particle physics ESFRI research Infrastructures

Task 4.3 Summary and Status

Martino Romaniello – ESO

On behalf of Task 4.3

ESCAPE - The European Science Cluster of Astronomy & Particle Physics ESFRI Research Infrastructures has received funding from the European Union's Horizon 2020 research and innovation programme under the Grant Agreement n° 824064.

WP4 Tasks

Task 4.1 Integration of astronomy VO data and services into the EOSC

Lead: Marco Molinaro (INAF)

Task 4.2 Implementation of FAIR principles for ESFRI data through the Virtual Observatory

Lead: Françoise Genova (CNRS-ObAS)

Task 4.3 Adding value to trusted content in astronomy archives

Co-leads: Mark Allen (CNRS-ObAS) & Martino Romaniello (ESO)

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Task 4.3 Adding value to trusted content in astronomy archives

*Next generation functionalities for creation and publication of **high-level, value-added data products** from ESFRIs*

- Assessment and application of **new techniques** – machine learning analytics. (connection to WP3)
  - *Specific example applied to ESO archives data products: spectra, cubes, source catalogues*
- Identification of **stewardship best practices**
  - *Curation and publication of next-generation data products via ESFRI archives*
  - *Technical and human aspects*

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Major milestones

D4.5 Release of prototype machine learning enabled archive services providing value-added content to archives (Demonstration)	Month 30 July 2021
D4.8 Final analysis report on use of IVOA standards for FAIR ESFRI and community data and best stewardship practices for value-added data (Report) *(includes report of feedback on prototype services developed for D4.5)*	Month 40 May 2022

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Deep Learning & Data Archives

- Scope: provide archive users with novel ways to identify data
  - Beyond traditional approach of specifying query parameters
  - Revolutionary extension of recent move from instrument to data keywords (e.g. exposure time to signa-to-noise)
- Target: the different data types in the ESO Archives
  - Spectra
  - Cubes
  - Source catalogues
- Let the data speak … on a massive scale

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Deep Learning on 1D spectra: HARPS

- Scope: Deep Learning analysis of the entire HARPS archive
  - High-resolution, high-stability spectrograph
  - Main science case: discovery and characterization of exoplanets
  - ~270,000 spectra, ~300,000 wavelengths channels each
  - 1D spectra, pipeline-reduced to high accuracy
- Different approaches
  - HITS: fully-connected autoencoder with 2 latent dimensions, down sampled spectral resolution
    - Agile architecture for speed and interactivity
  - ESO: combination of convolutional and fully-connected layers with between 4 to 8192 latent dimensions, full spectral resolution
    - Find minimal representation which preserves all the relevant information

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So now, how to turn this into user services?

- These techniques have the potential of being a game-changer, BUT:
  - The results have to be meaningful
  - Interaction with the results has to be user-friendly

- In practice:
  - What makes spectra similar?
    - What are the uses and limitations of a similarity service?
  - Can spectra be tagged with some physical properties of the celestial object?
    - If so, what are they?
    - What are the uses and limitations?
  - What is the best way to present and interact with the results?

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