Machine Learning Techniques for Light Curves Analysis. Variable stars.

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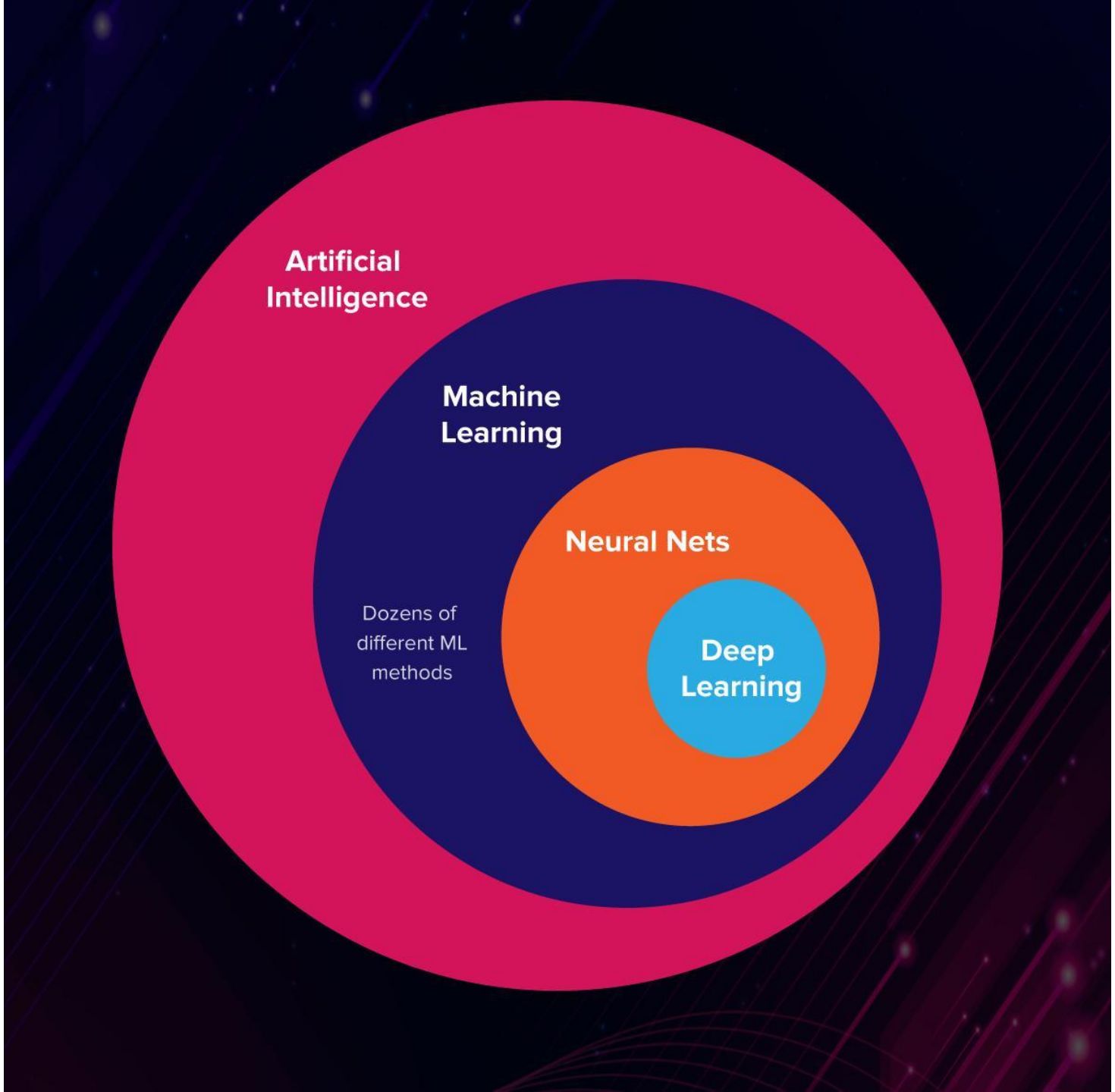
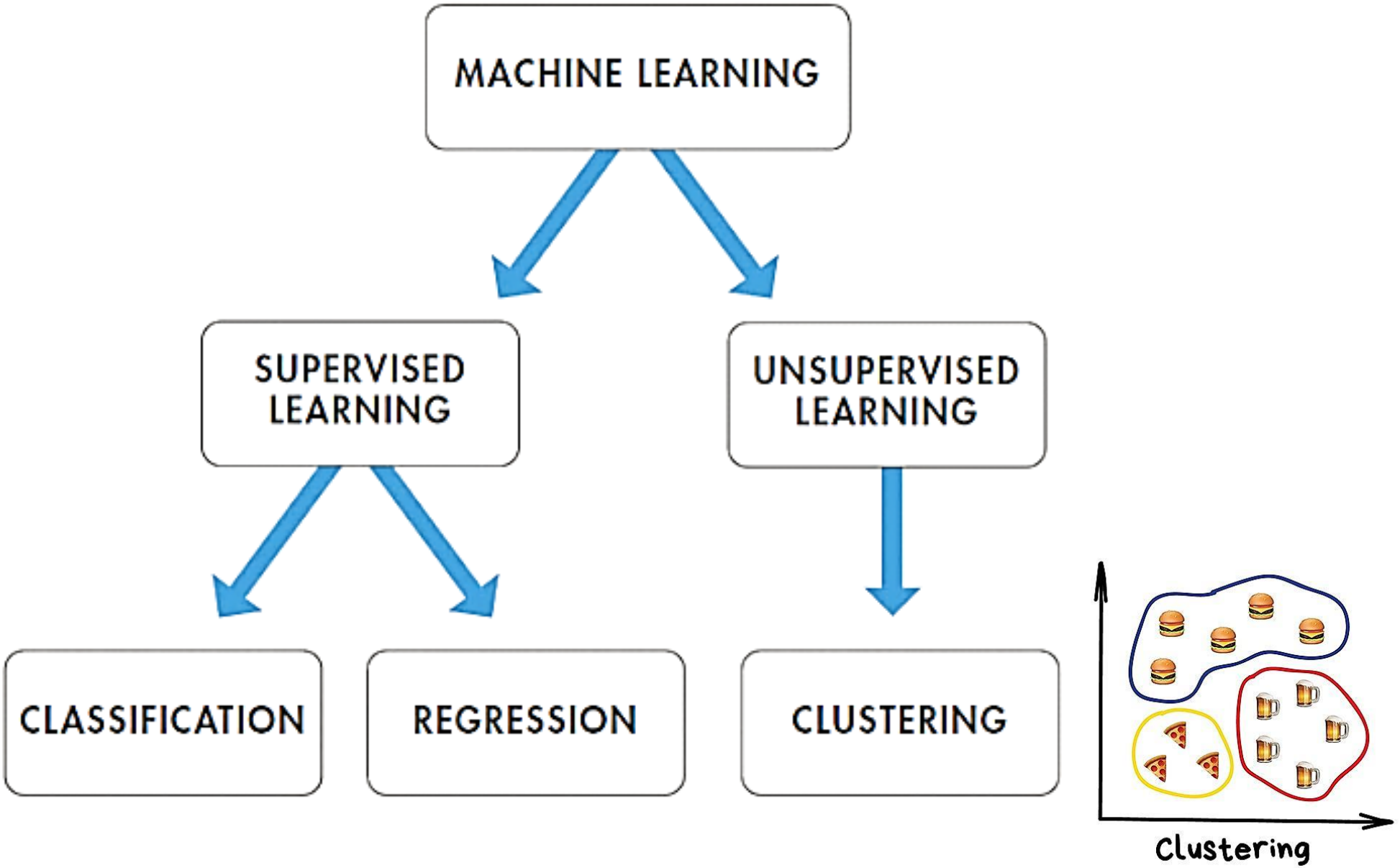
Some Real-World Applications of Machine Learning

- Real-time Gravitational Wave Detection (George & Huerta, 2017)
- Identifying Exoplanets (Shallue & Vanderburg, 2018),
- Classification of light curves (Charnock & Moss, 2017 ; Mahabal et al., 2017 ; Protopapas 2017; Naul et al., 2018)
- Automated Star / Galaxy Discrimination (Odewahn et al., 1992)
- Classification of galaxy spectra (Folkes et al., 1996)
- Estimating Photometric Redshifts (Collister & Lahav, 2004)
- Anomaly detection for high-resolution X-ray spectroscopy (Ichinohe & Yamada, 2019)
- Detrending time series for astronomical variability surveys (Dae-Won Kim, et.al, 2009)
- …
- …


Artificial Intelligence
Machine Learning
Neural Nets
Deep Learning
Dozens of different ML methods


MACHINE LEARNING
SUPERVISED LEARNING
UNSUPERVISED LEARNING
CLASSIFICATION
REGRESSION
CLUSTERING
Clustering

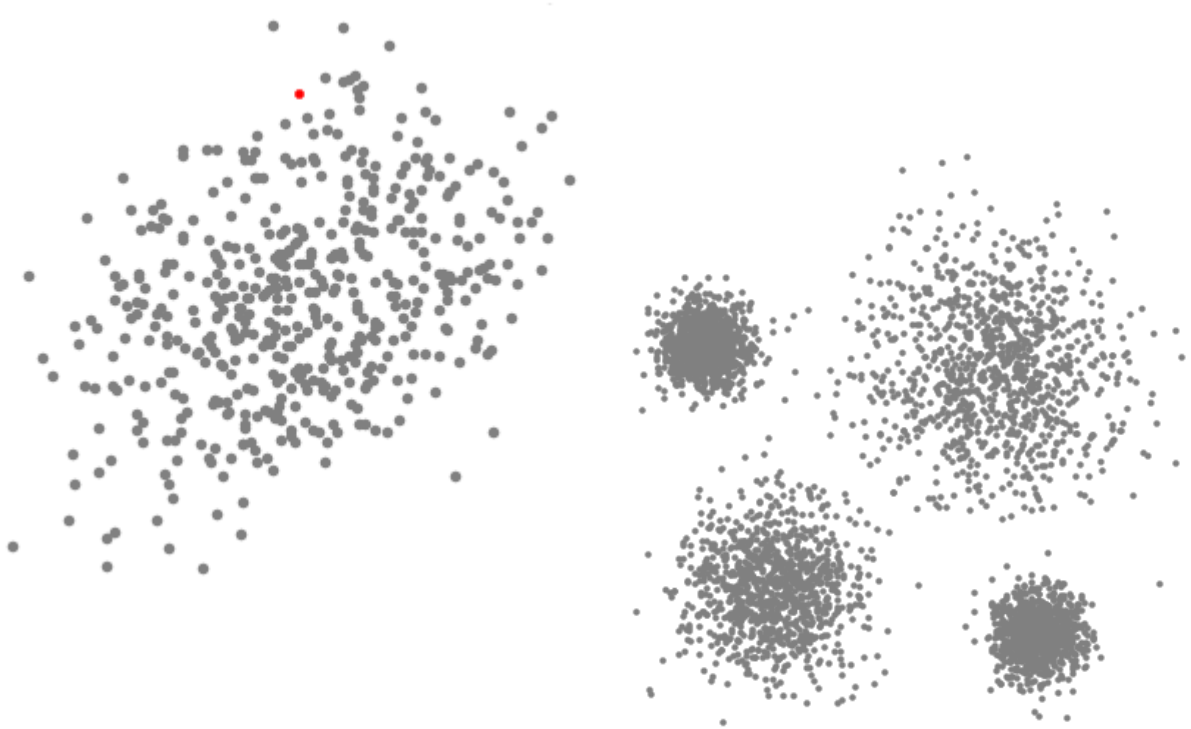
Clustering

Clustering is the task of dividing the population or data points into a number of groups such that data points in the same groups are more similar to other data points in the same group and dissimilar to the data points in other groups. It is basically a collection of objects on the basis of similarity and dissimilarity between them.

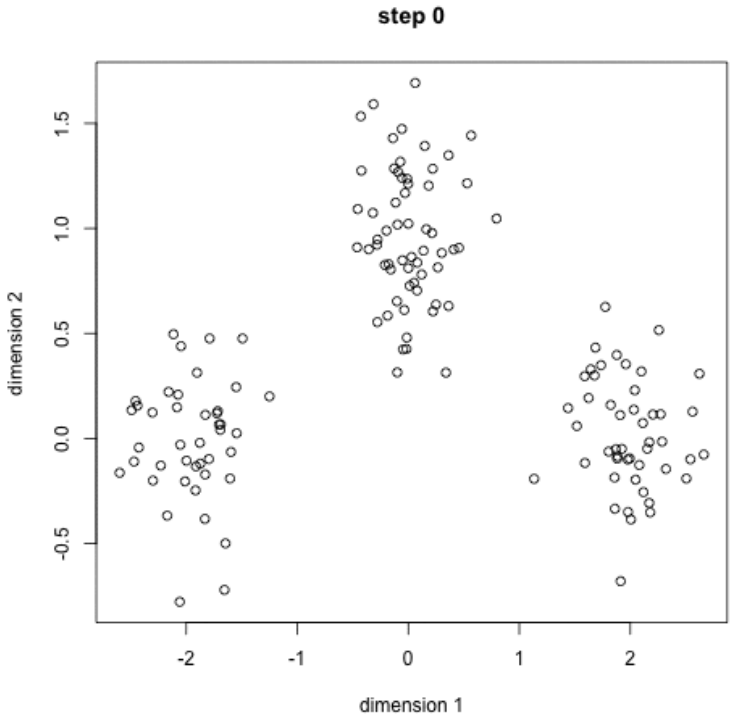
- **Classification**. In Supervised learning our model learns a method for predicting the instance class from a pre-labeled (classified) instances.
- **Clustering**. In unsupervised learning our model tries to find "**natural**" grouping of instances for a given unlabeled data.

Unsupervised learning (clustering)

Mean Shift

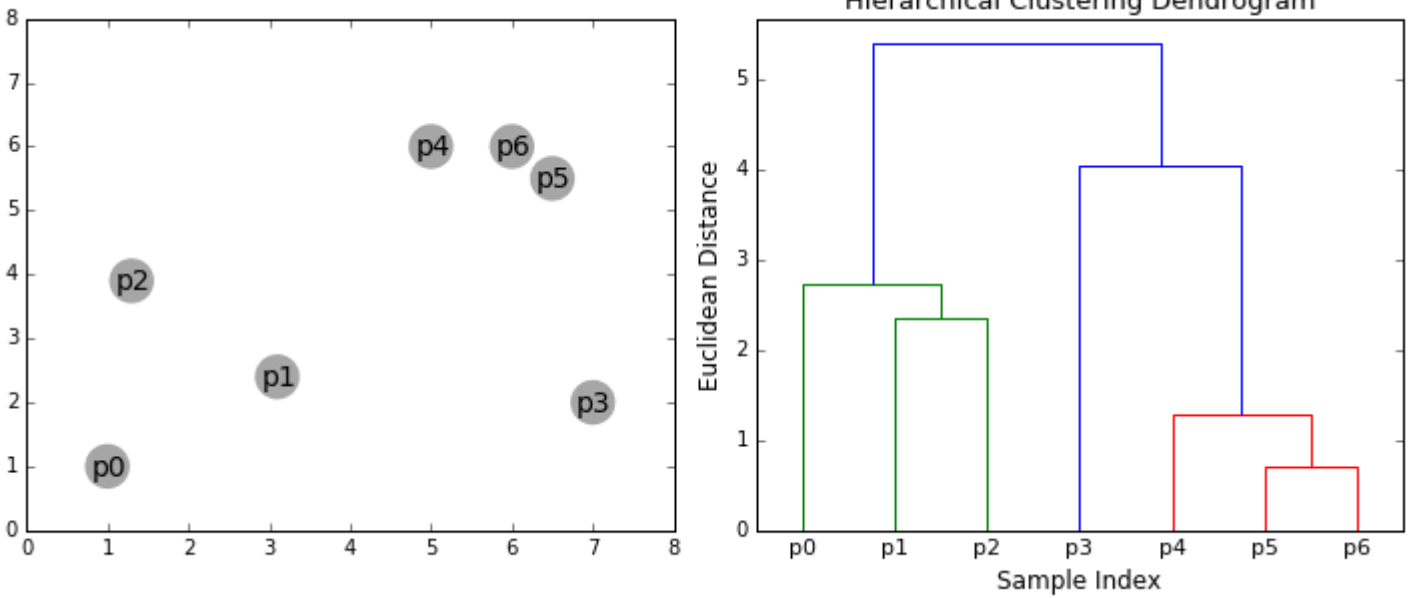


Kmeans

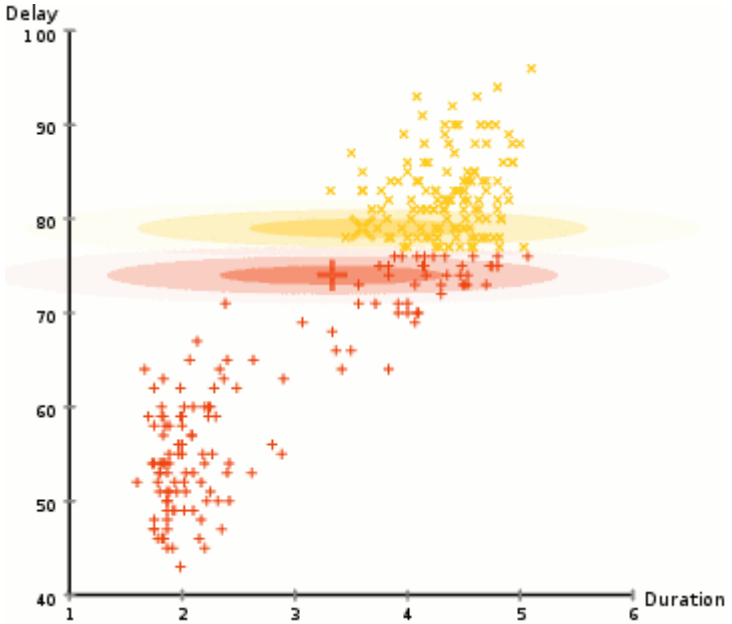


Unsupervised learning (clustering)

Hierarchical Clustering



GMM

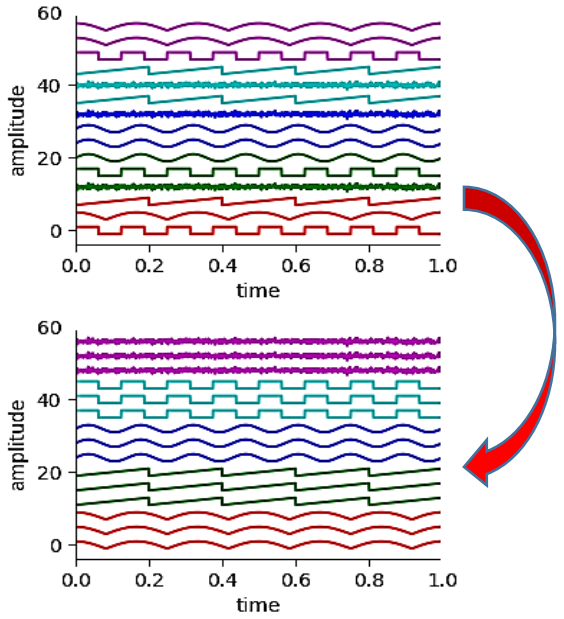


Do not disturb …
Machine is learning

scikit-learn

(Scikit-learn: Machine Learning in Python, Pedregosa et al., JMLR, 12, pp. 2825-2830, 2011)

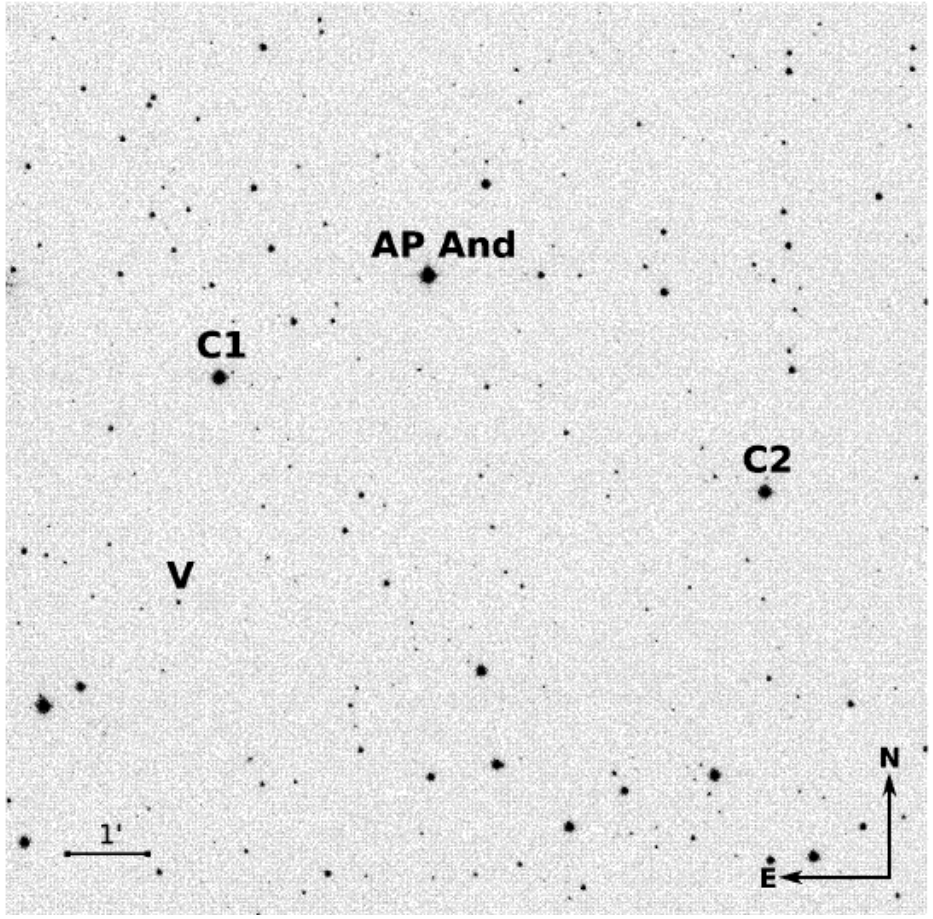
- Agglomerative Hierarchical clustering
- Kmins
- Mean Shift
- Affinity Propagation
- Gaussian mixture models (GMM)
- Spectral Clustering
- BIRCH

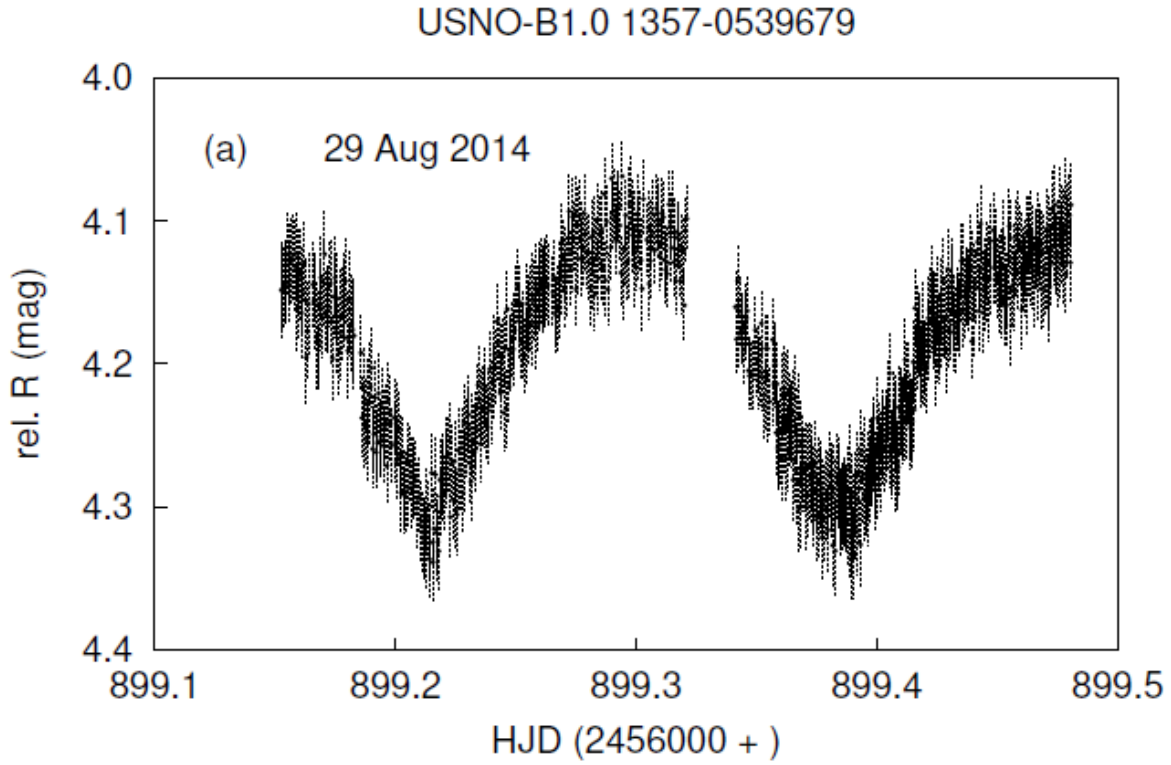


What are the Uses of Clustering?

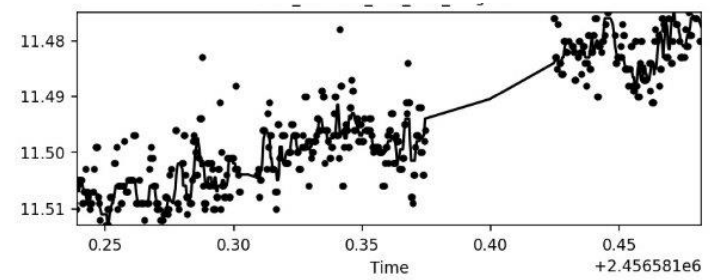
- Removal or modeling of instrumental and stellar noise (improve comparison stars)
- Identifying variable stars
- Classification of variable stars
- Anomaly detection (new variability classes)

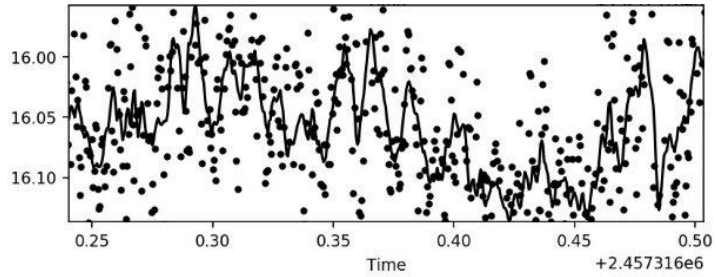
Gaynullina E.R., Khalikova A.V., Serebryanskiy A.V., Karimov R.G., Burkhonov O.A. New variable stars in the fields of AP And and SW Lac//Open European Journal on Variable Stars, 2019, T. 202, C. 1.

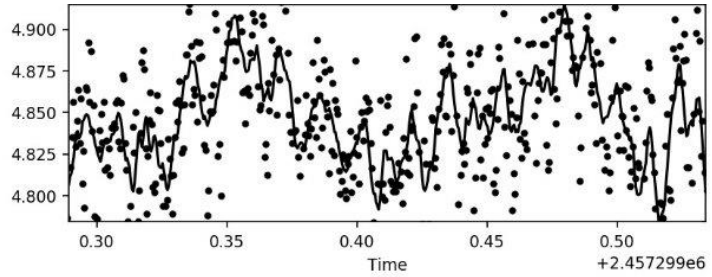


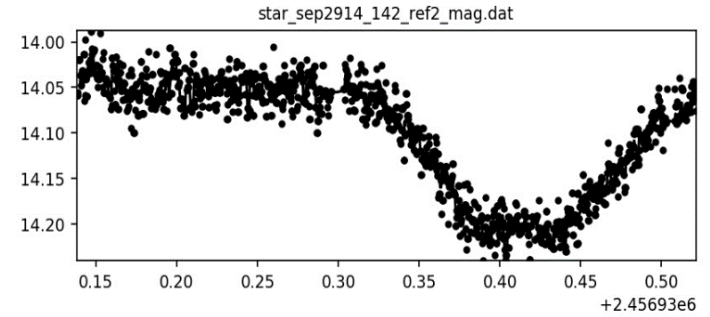


- new variable stars

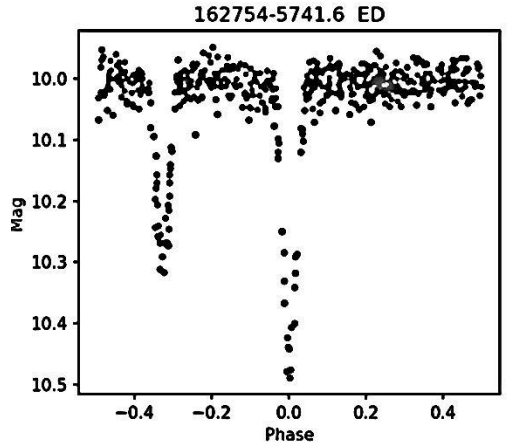








- 19 new candidates of eccentric eclipsing binaries from ASAS-3 survey



Thank you for attention!