UPOV
International Union for the Protection of New Varieties of Plants

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Technical Working Party on Testing Methods and Techniques **TWM/1/25**

First Session
Virtual meeting, September 19 to 23, 2022

Original: English
Date: September 19, 2022

MACHINE LEARNING INNOVAR PROJECT

Document prepared by experts from Maynooth University

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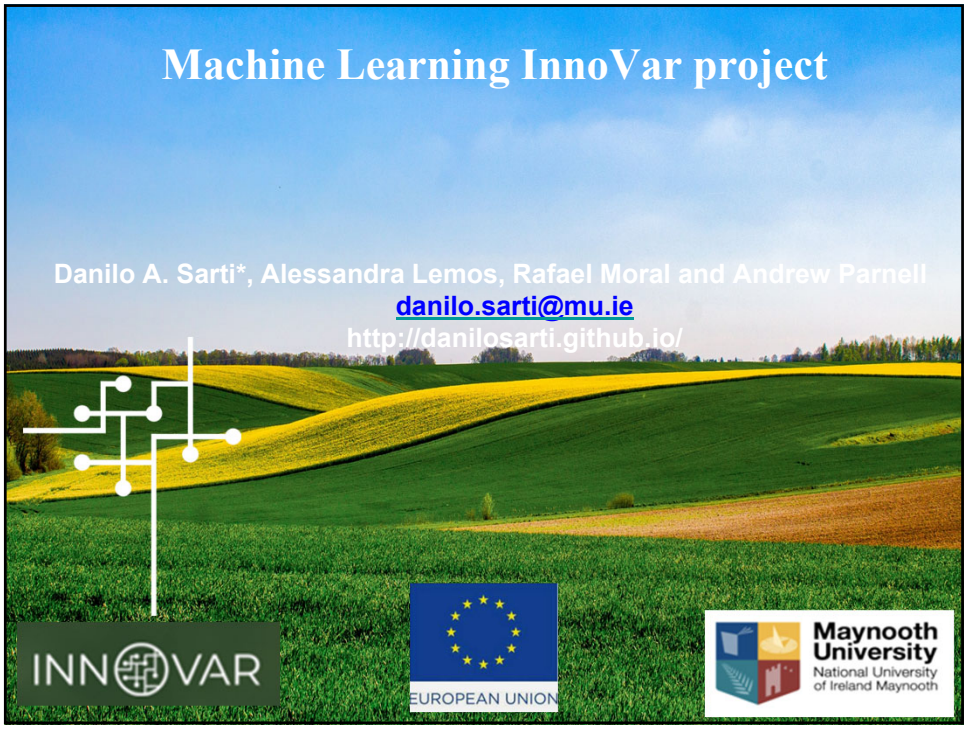
The Annex to this document contains a copy of a presentation on “Machine Learning InnoVar project”, prepared by experts from Maynooth University, to be made at the first session of the TWM.

[Annex follows]

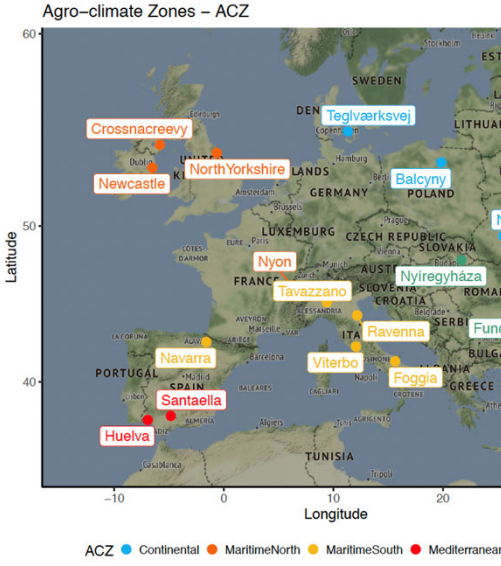


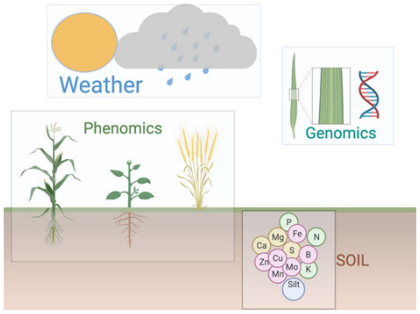
AGENDA

- InnoVar project
- Machine Learning
- Machine Learning in InnoVar
- Achievements
- Next steps

InnoVar

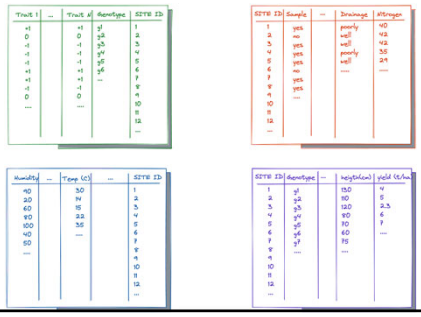
* 21 Partners
* 15 Locations - 5 Agroclimatic zones
* Integration of new science into DUS and VCU testing processes
* Combine VCU and DUS characters
* Incorporate variety information into decision making on farm.
* *Triticum durum* and *Triticum aestivum*



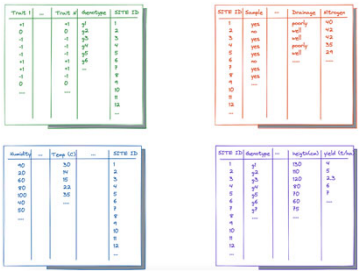


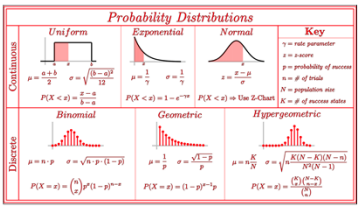
* Multi Environmental Trials
* Phenomics, DUS and VCU
* Genomics
* Weather
* Soil
* Drone images

*Data collected will be stored in a database.
*Data will be used to create models and systems.
***COVID** delays



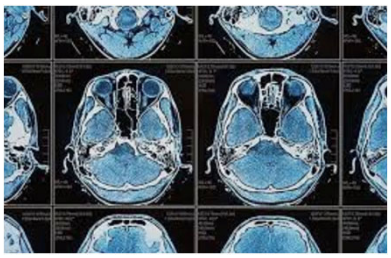
Machine Learning





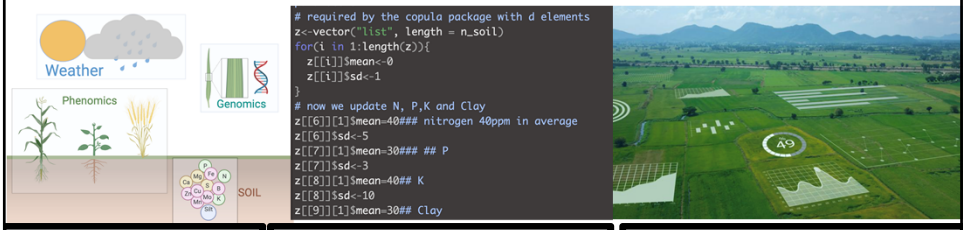
Study of computer algorithms that can improve automatically through experience and use of data.

Machine Learning Applications

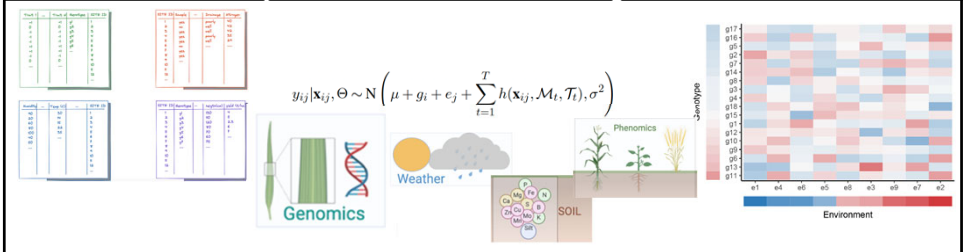


Social Media
Streaming platforms
Precision medicine
Precision agriculture
Now: MET, DUS and VCU

Machine Learning in InnoVar



Data Collection	Computational Solutions	Decision Support Systems

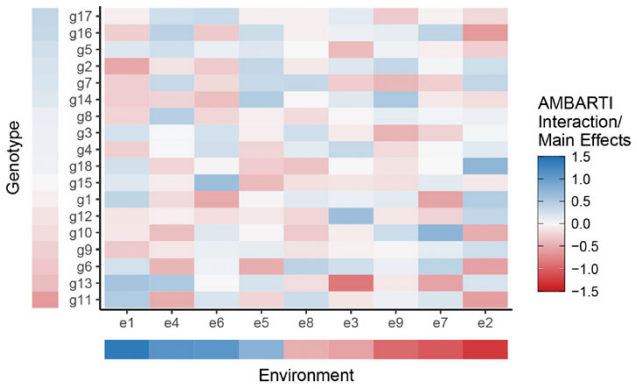


Comprehend and predict the behaviour of DUS and VCU attributes considering interactions (G by E and G by E by T)

Achievements: innovaR

- R programming language package
- Developed to simulate a complete multi environmental trial (soil, genomics, and phenomics), considering dependence between attributes of VCU and DUS.
- Can be used to validate statistical models based on VCU and DUS data.
- Free and open source.
- It will be available at: https://github.com/danilosarti/innovaR

Achievements: AMBARTI



BAYESIAN ADDITIVE REGRESSION TREES FOR GENOTYPE BY ENVIRONMENT INTERACTION MODELS

By Danilo A. Sarti[1], Estevão B. Prado[1,2], Alan N. Inglis[1,2], Antônia A. L. dos Santos[1], Catherine B. Hurley[1], Rafael A. Moral[1], Andrew C. Parnell[1,2]

[1]*Hamilton Institute, Department of Mathematics and Statistics, Maynooth University, Ireland*

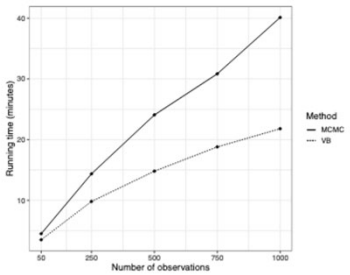
[2]*Insight Centre for Data Analytics, Maynooth University, Ireland*

How a DUS or VCU attribute behaves in Several Environments.

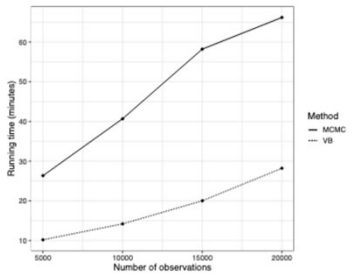
Visual appeal. Could be an app for farmers.

Could we predict the performance of a genotype Considering some genomic attribute?

Achievements: Variational Inference



(a) Comparison of simulation times for y = $\{100, 250, 500, 1000\}$.



(b) Comparison of simulation times for y = $\{5000, 10000, 15000, 20000\}$.

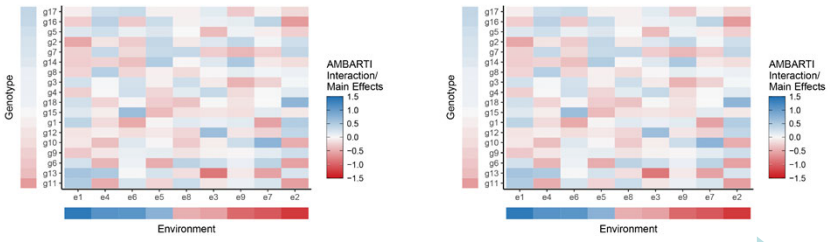
VARIATIONAL INFERENCE FOR ADDITIVE MAIN AND MULTIPLICATIVE INTERACTION EFFECTS MODELS

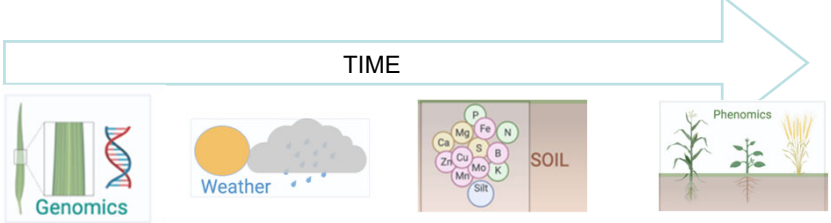
BY ANTÔNIA A. L. DOS SANTOS[1], RAFAEL A. MORAL[1], DANILO A. SARTI[1], ANDREW C. PARNELL[1,2]

[1]*Hamilton Institute, Department of Mathematics and Statistics, Maynooth University, Ireland*

[2]*Insight Centre for Data Analytics, Maynooth University, Ireland*

Other interactions: G by E by T by Soil
How could such models incorporate genomic information … epigenetic markers…





Short Summary

- InnoVar has been collecting massive data from the soil, weather, genomics, and phenomics.
- The data will be used to develop machine learning algorithms and to create decision support systems.
- There is an opportunity for such models to be used to optimize DUS and VCU by allowing the prediction of the genotypes' attributes across environments and time, considering information on genomics and other sources. This could eventually speed up the process of regulation of new varieties.

[End of Annex and of document]