Incremental hierarchical clustering for pattern discovery to optimize on-farm milk processing

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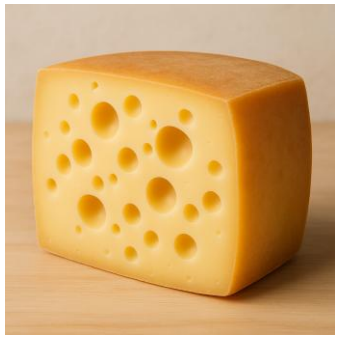
On-farm milk processing

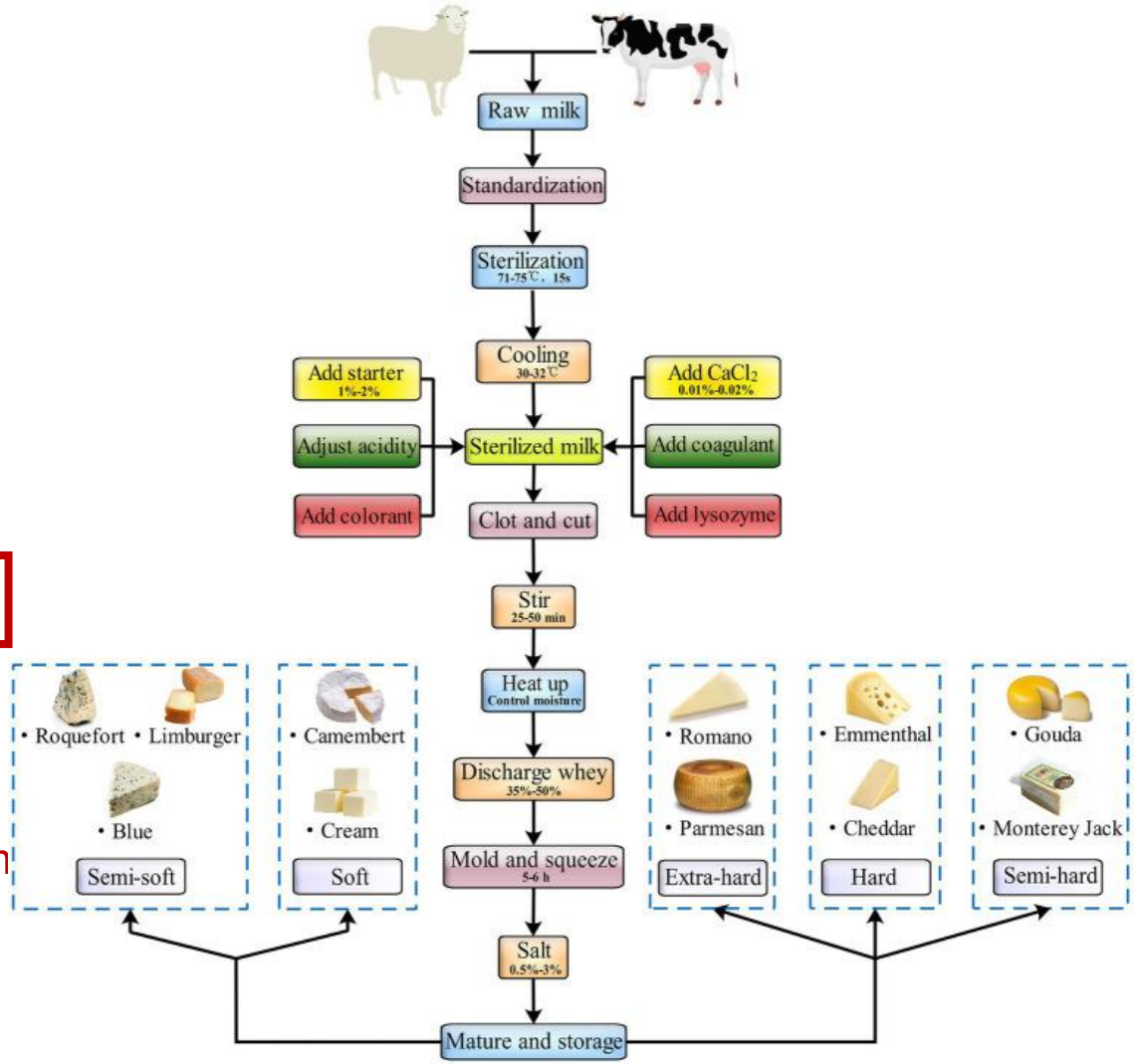


How to optimize milk processing

Process optimization

Milk quality optimization

Classifying milk based on th



(Zheng et al., 2021)

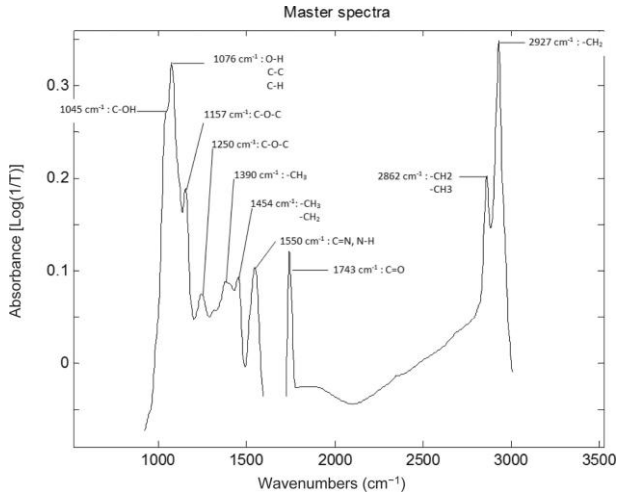
Zheng, X., X. Shi, and B. Wang. 2021. A Review on the General Cheese Processing Technology, Flavor Biochemical Pathways and the Influence of Yeasts in Cheese. Front. Microbiol. 12. doi:10.3389/fmicb.2021.703284.

How to do it ?

Rapid and cost-effective method, generate phenotypes at large scale

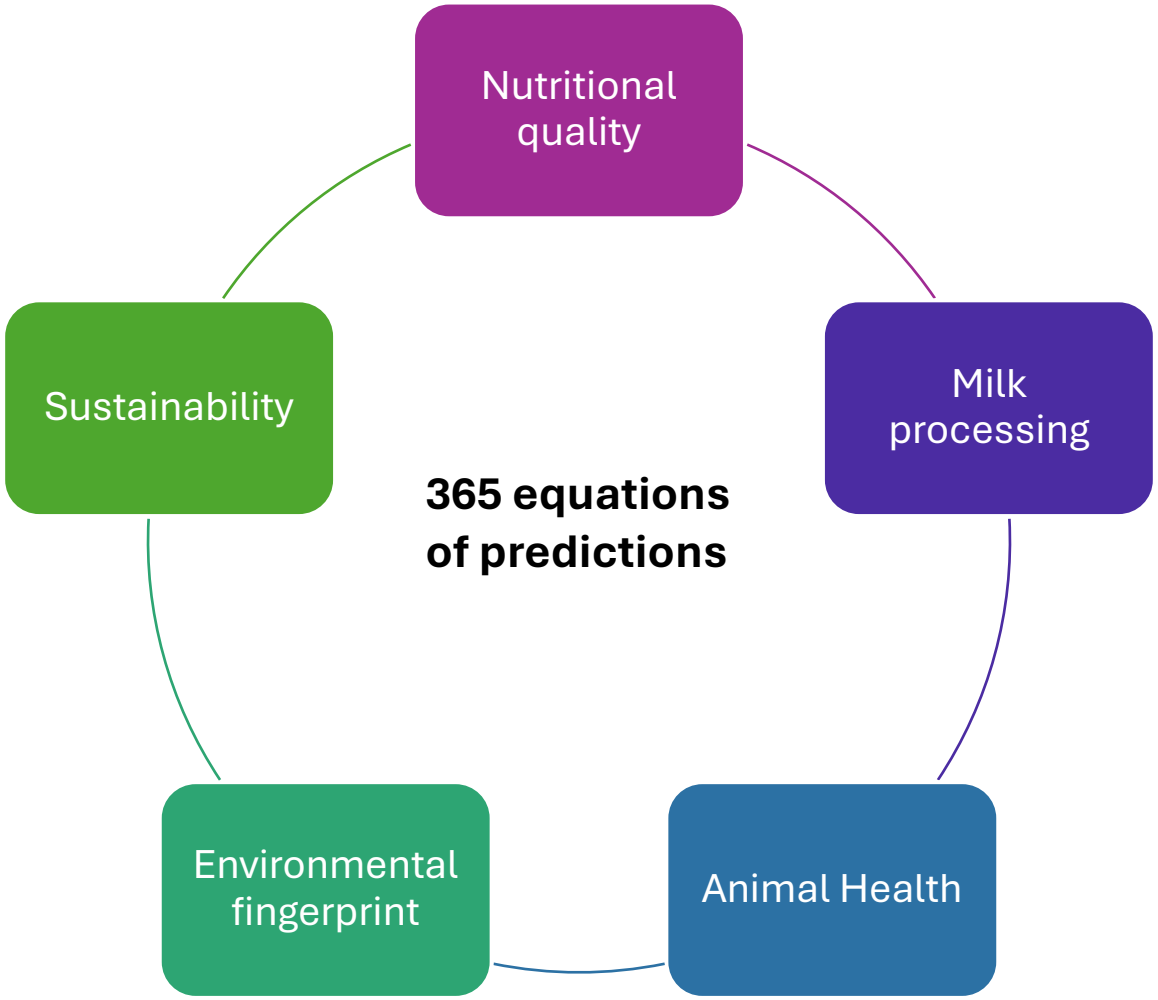
Reference laboratory measurements

Time-consuming, expensive, and often impractical



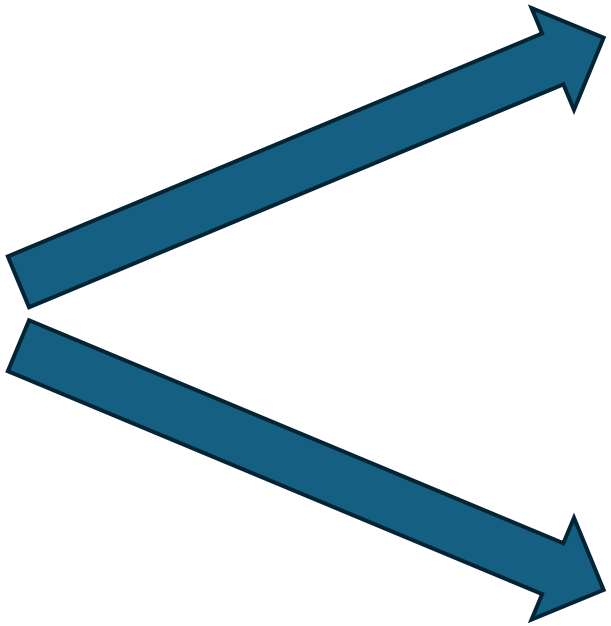
Milk spectrum

Equations of predictions


Nutritional quality
Milk processing
Animal Health
Environmental fingerprint
Sustainability
365 equations of predictions

Milk processing

26 MIR traits



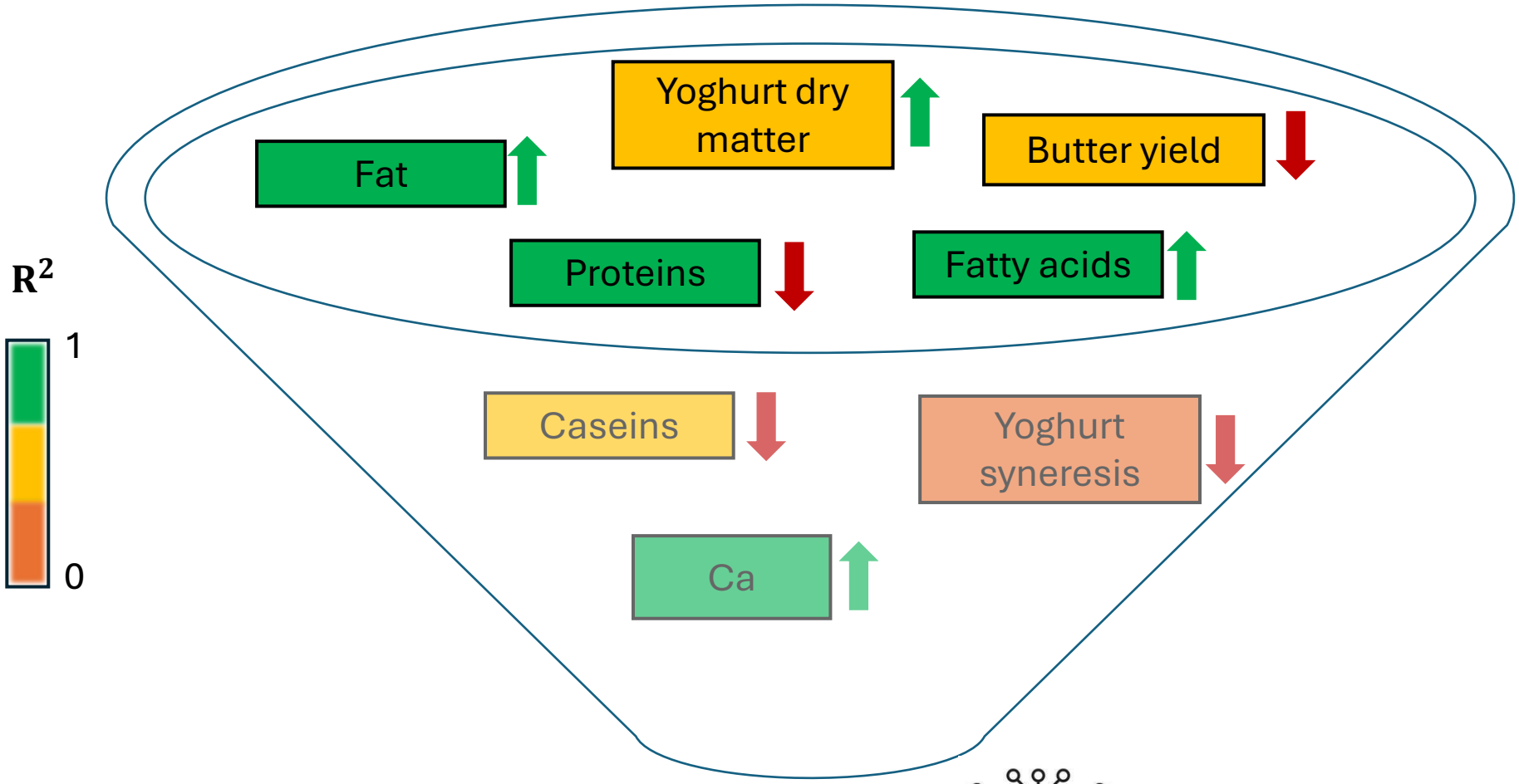
Chemical composition

Fat, protein, fatty acids, Ca, …

Technological properties

Milk coagulation properties, butter yield, yoghurt syneresis, …

Too many MIR traits



Summarized indicator – easy tool for farmers

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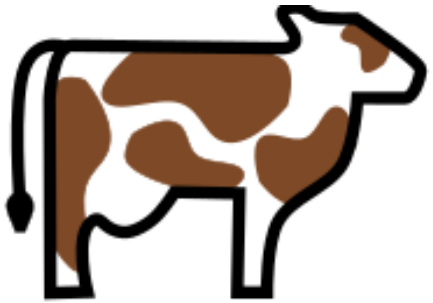
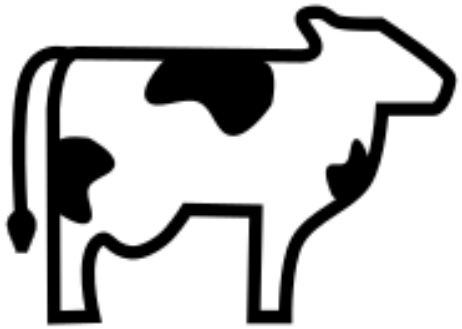
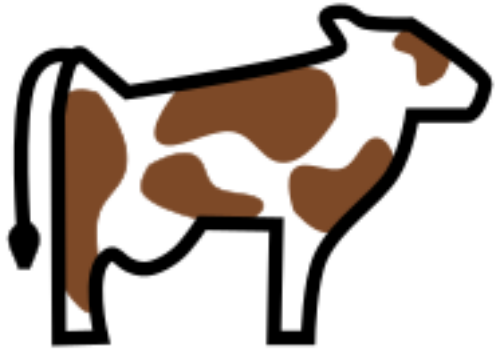
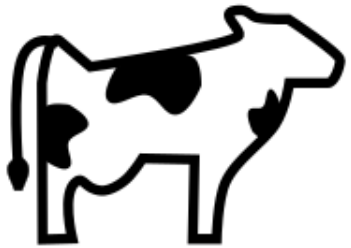
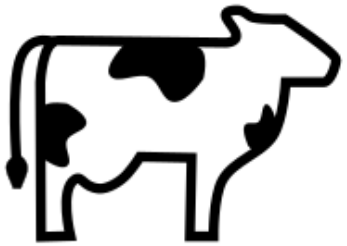
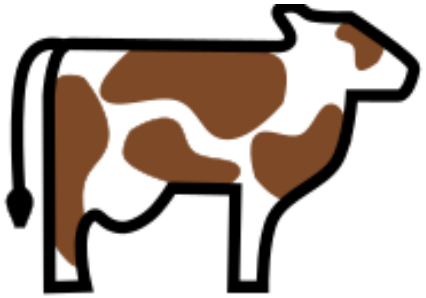
Incremental hierarchical clustering

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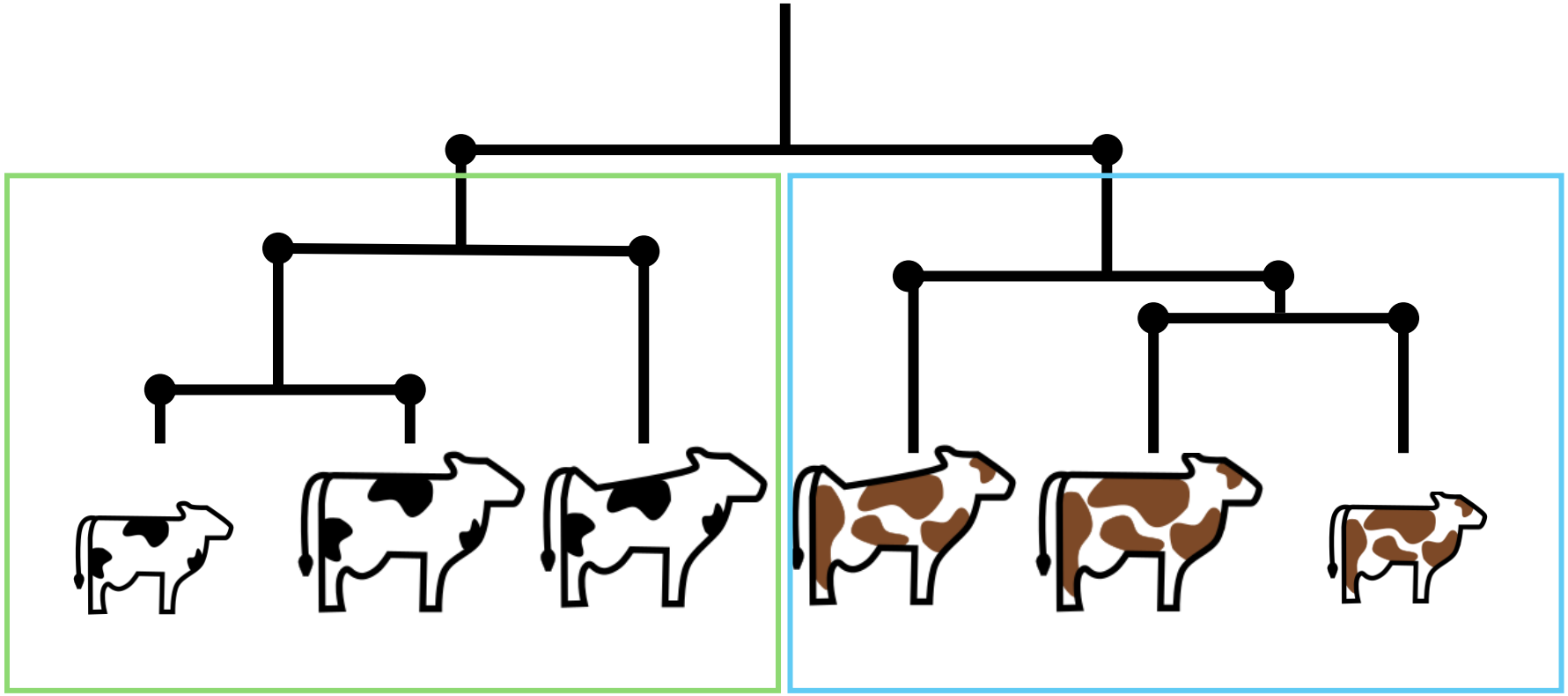


Cluster 1

Black cows

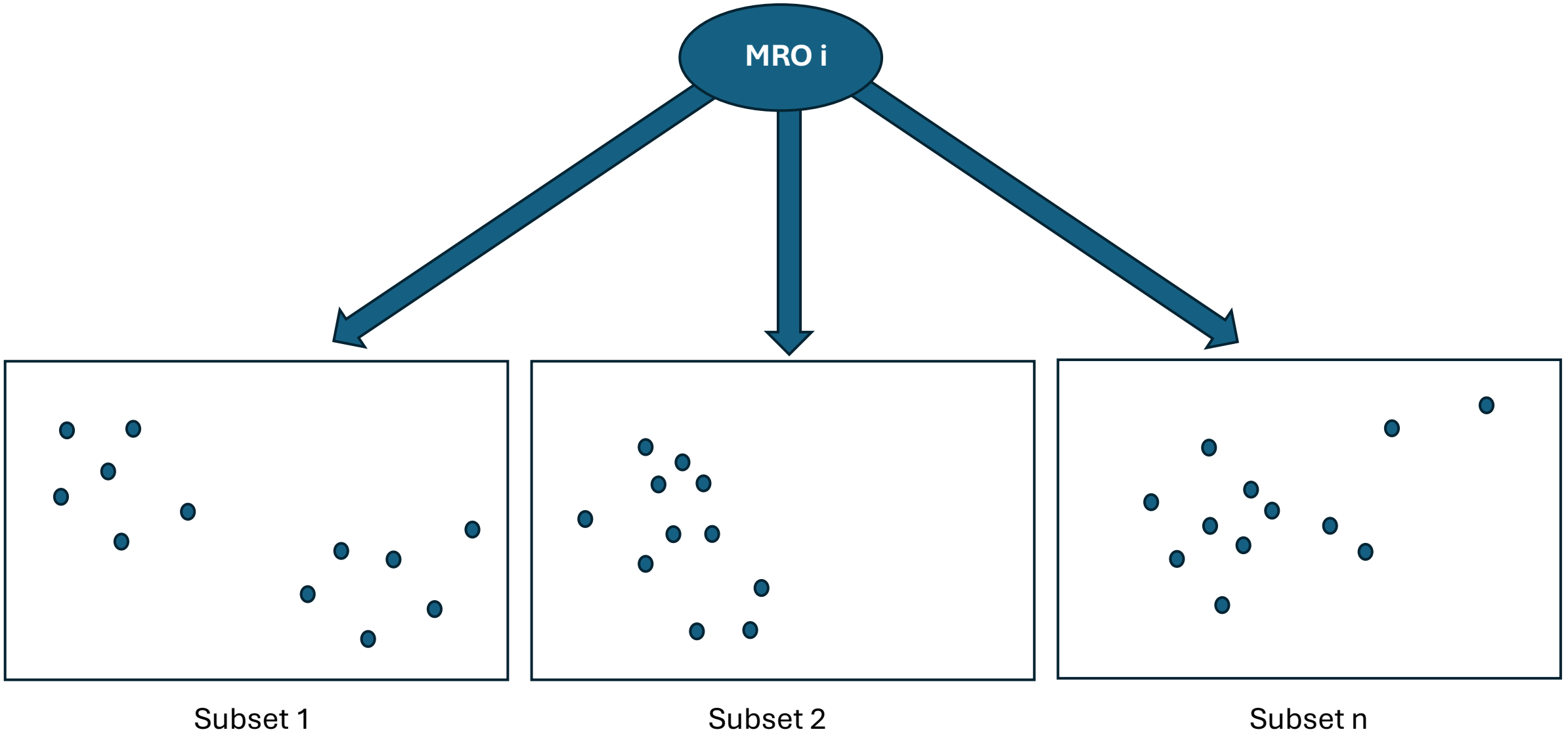
Cluster 2

Brown cows

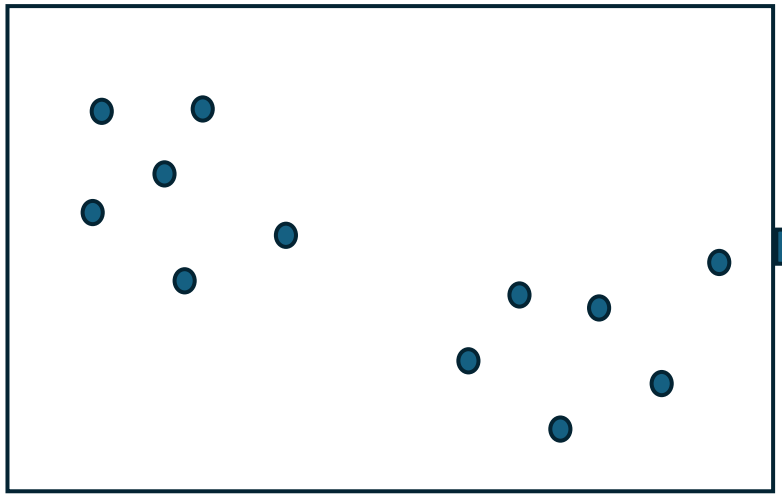
How to implement it on the entire database ?

Incremental hierarchical clustering

41,000,000 records in 48 milk recording organizations files (MRO)

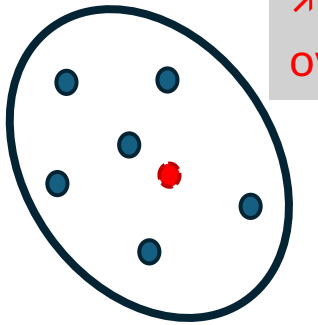


↗ Variability explained over interpretability



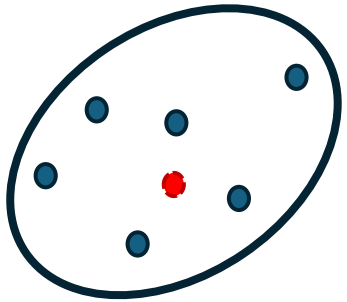
Subset 1

Hierarchical clustering



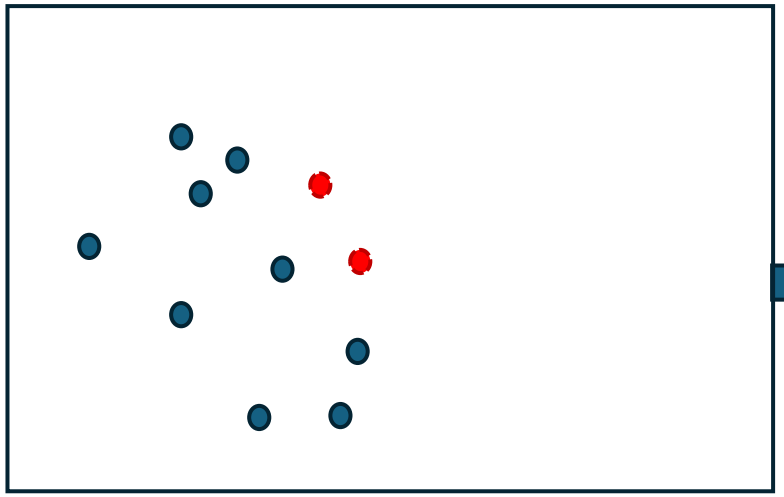
Cluster 1

Centroids



Cluster 2

> 95 % variance explained



Subset 2

Hierarchical clustering

etc.

800 centroids

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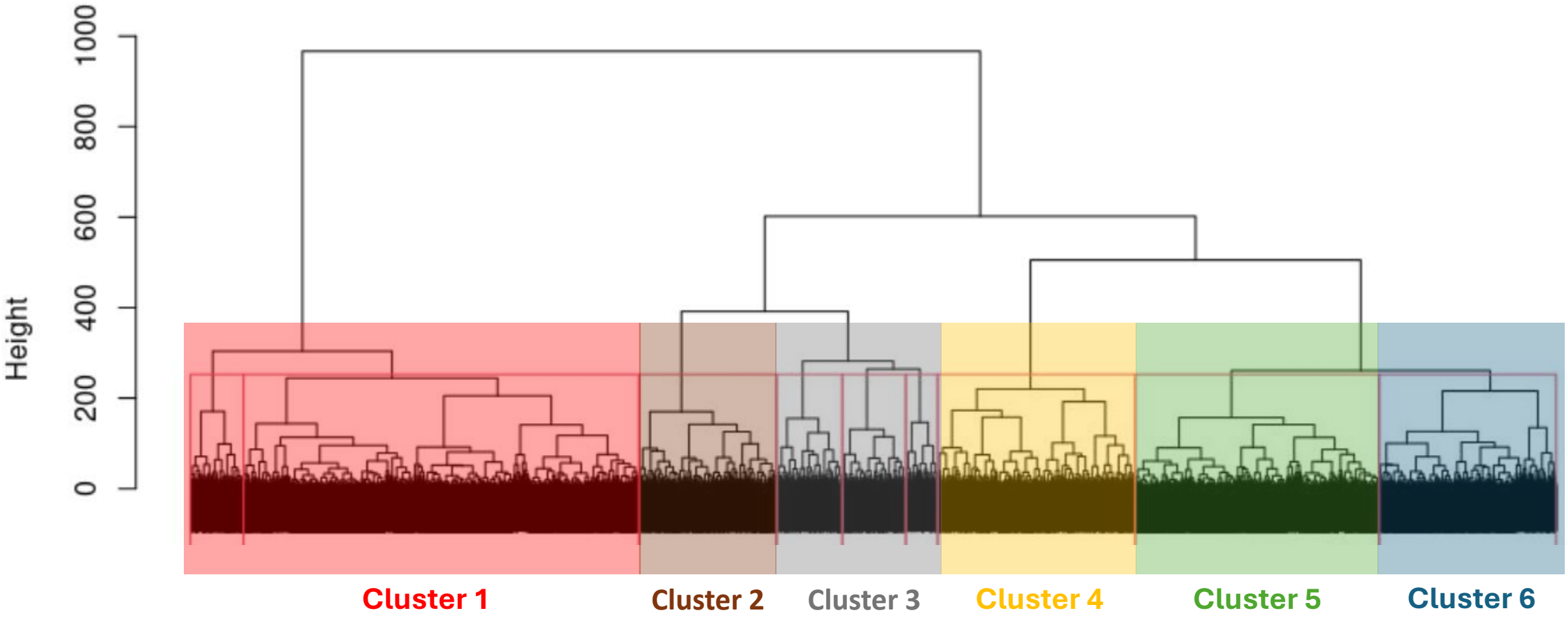
800 centroids x 48 MRO = **38,400 centroids**

41,000,000 records → 38,400 centroids

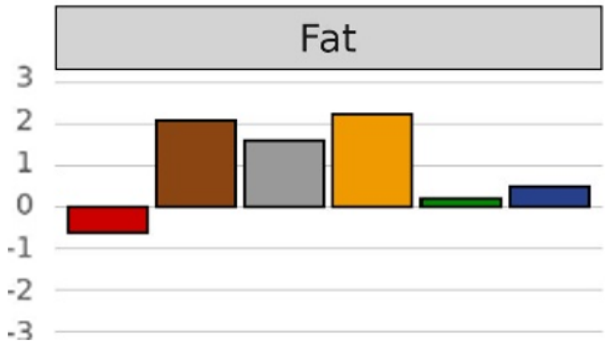
Hierarchical clustering

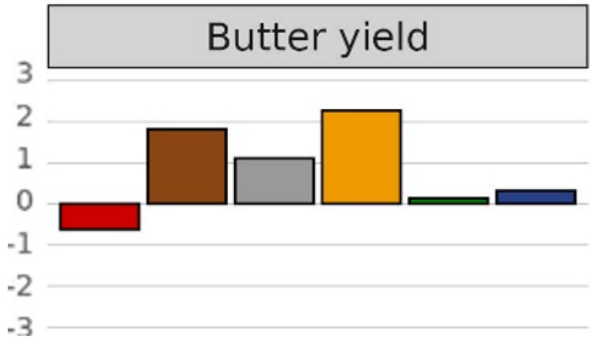
6 clusters

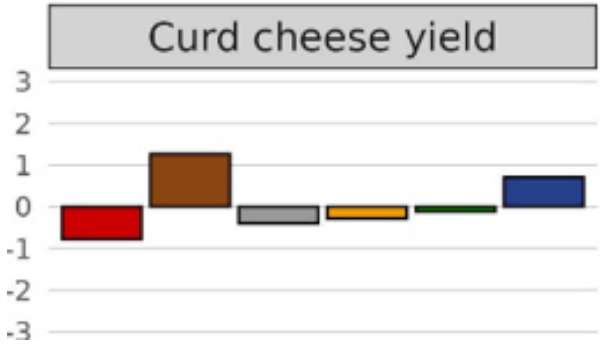
↗ Interpretability

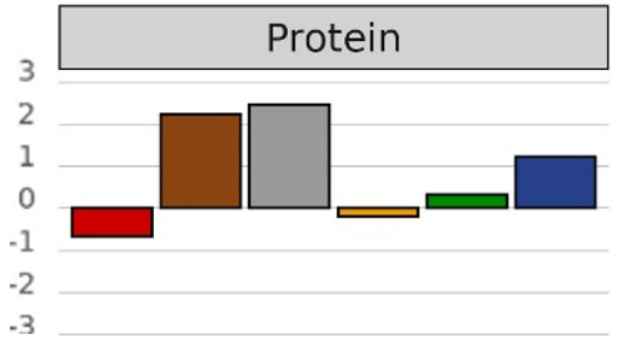

Height
0
200
400
600
800
1000
Cluster 1
Cluster 2
Cluster 3
Cluster 4
Cluster 5
Cluster 6

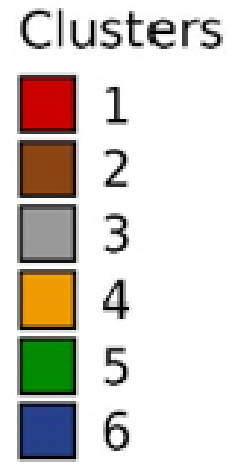
Clusters interpretation











On 38,400 centroids !

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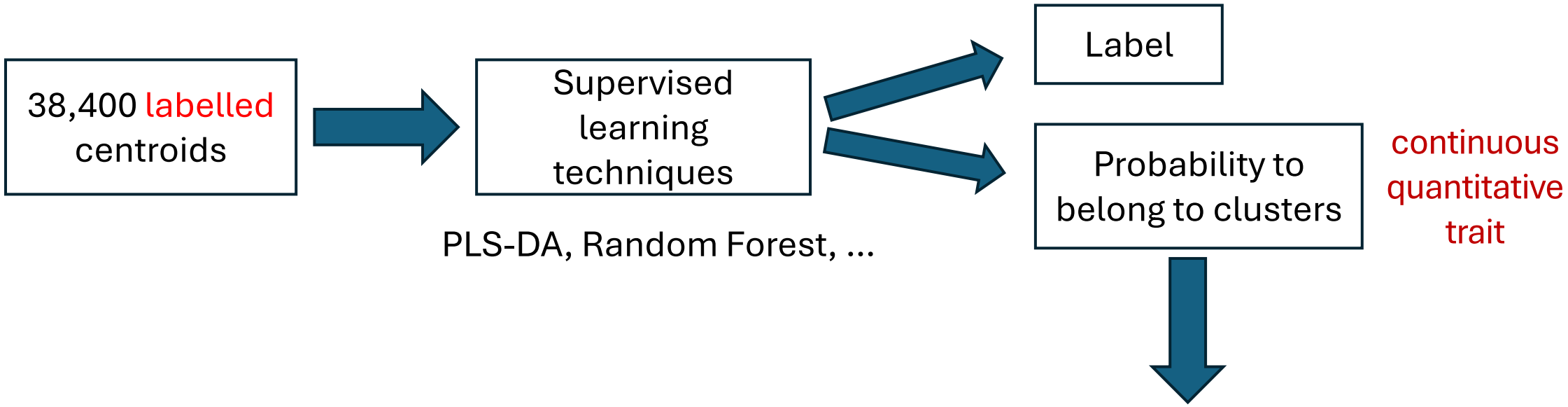
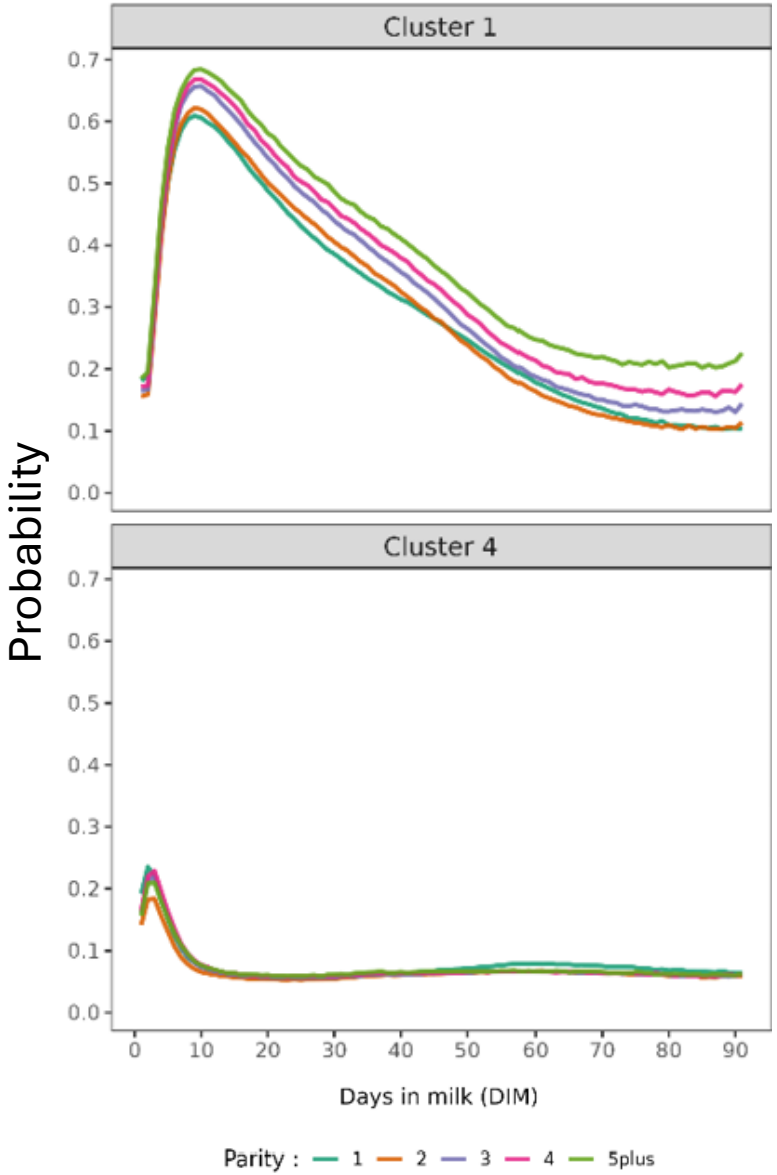
Next step ?

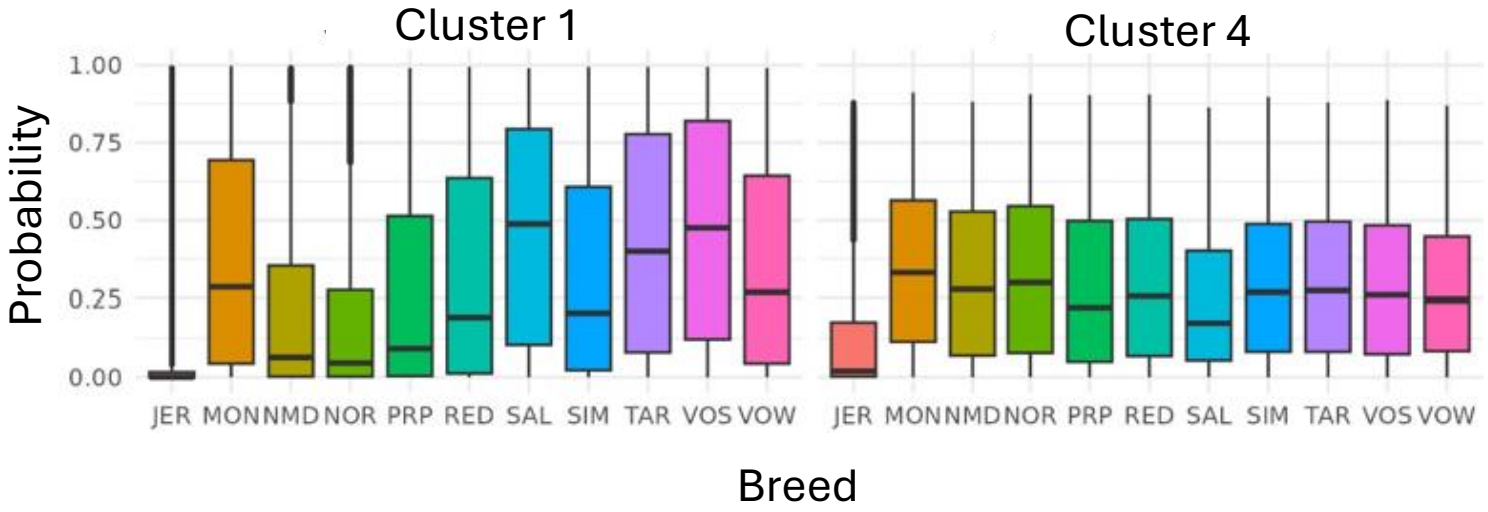
Extend results to the entire database



Days in milk (DIM) and Parity effect



Breed effect



On 41,000,000 records

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Project : https://holicow.nweurope.eu

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