

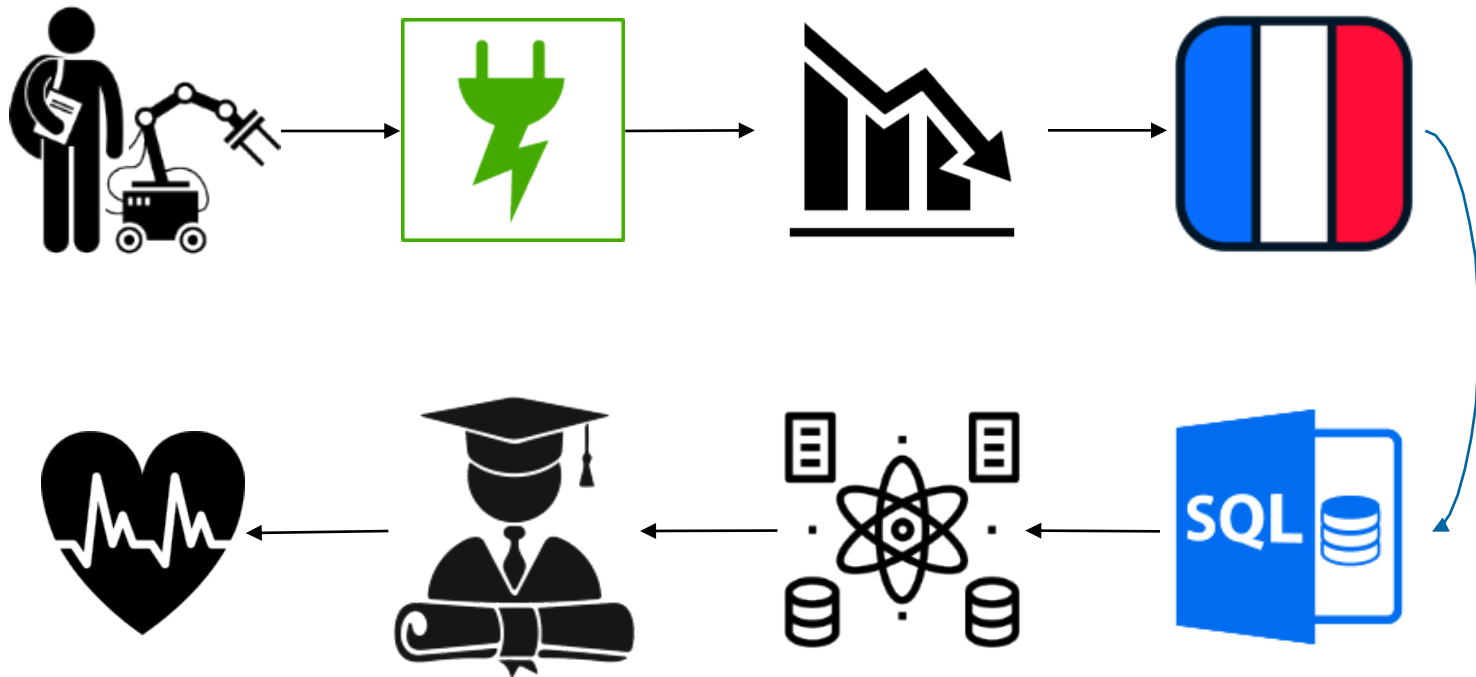
MACHINE LEARNING EN CARDIOLOGÍA



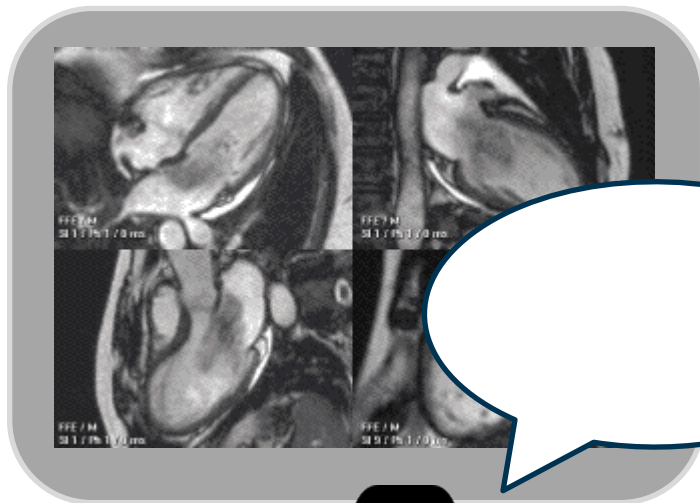
Víctor Vicente Palacios PhD (Data Scientist)
@victorvicpal



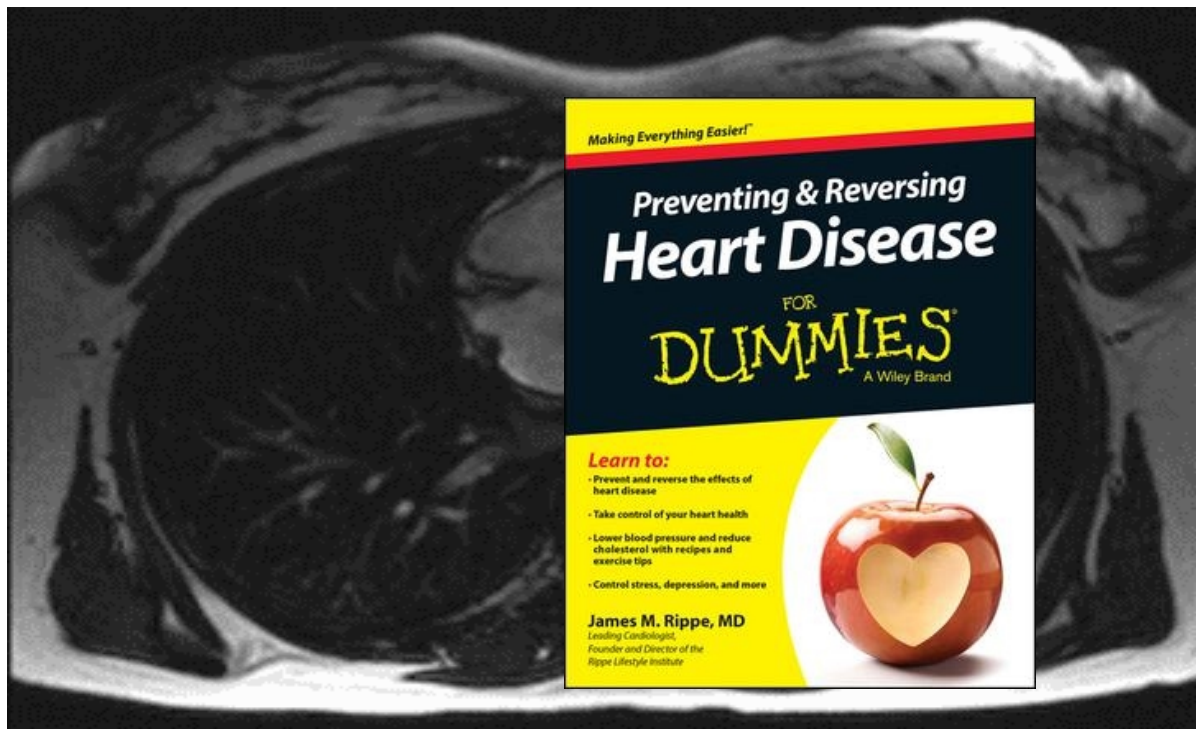
¿Quién soy?



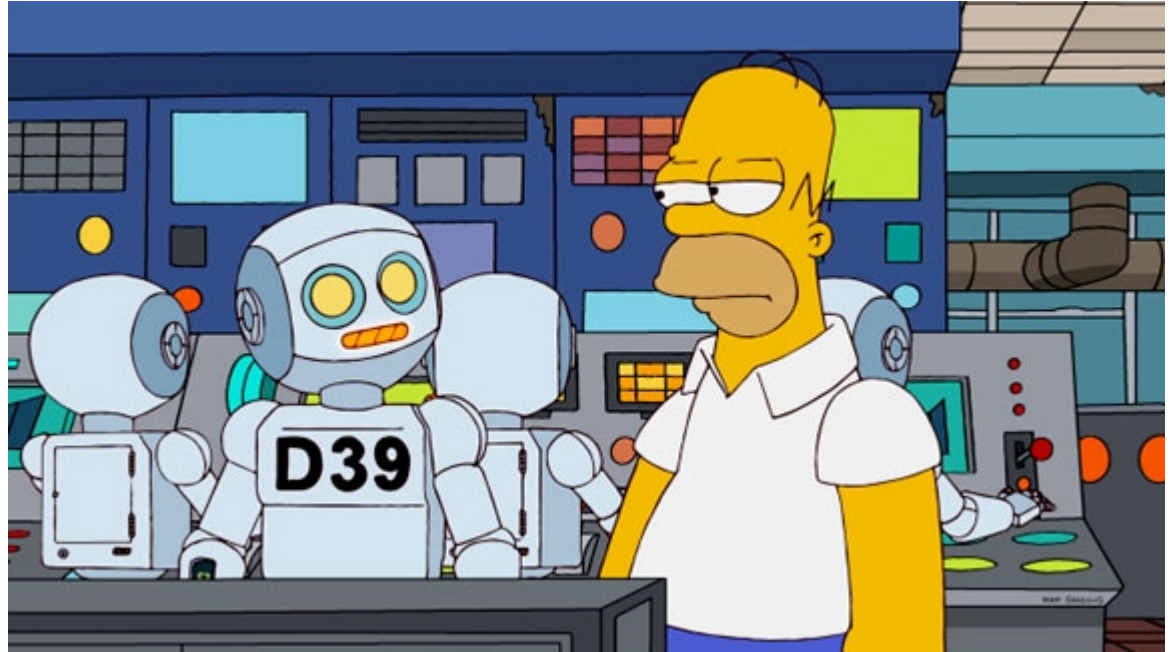
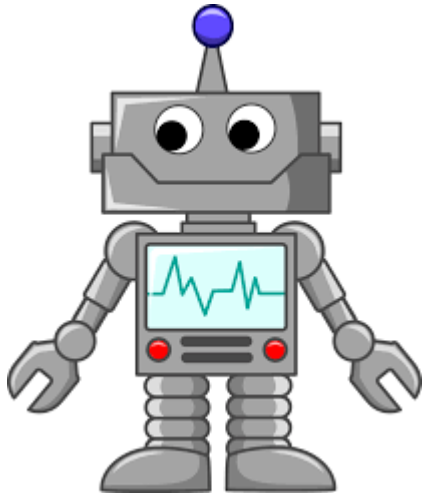
Mi vida en el hospital



¿Cardiología?



¿Machine Learning?



Machine Learning vs Estadística

**Tenéis unos datos increíbles.
Estoy deseando empezar a
ajustar modelos!!**



**Sí, eso está genial. Pero...
¿Puedes darme tablas de
SPSS también, no?**



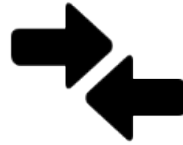
Pregunta Clínica (Modelo PICO)



Patient



Intervention



Control



Outcome

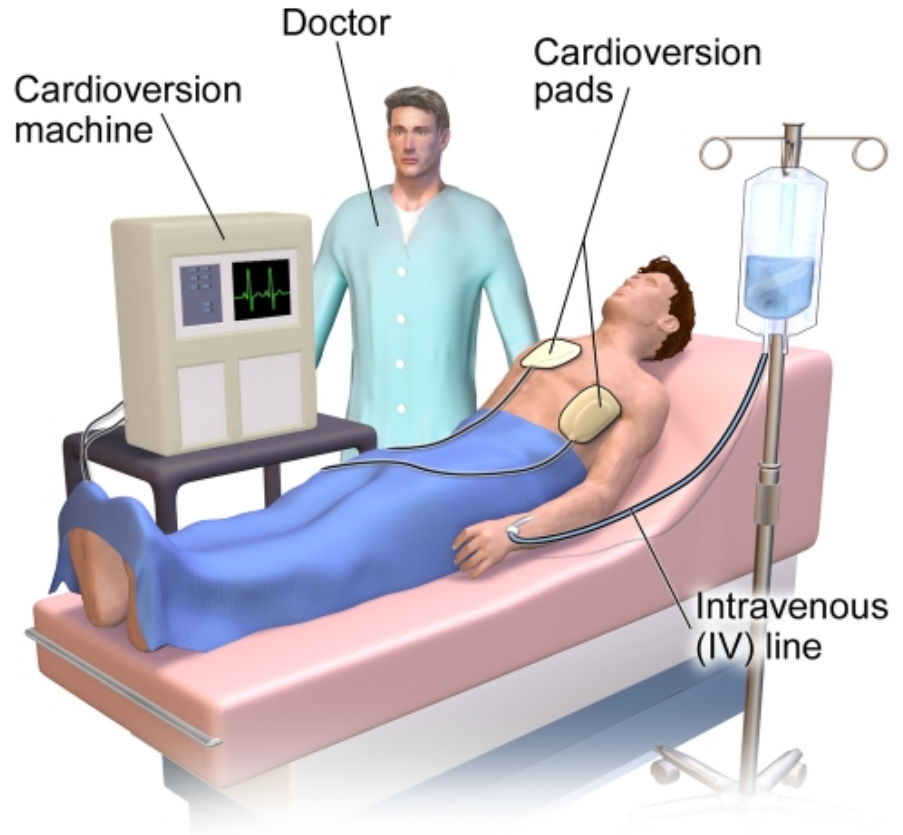
Cardioversión

Revertir arritmias

Terapia de choque eléctrico

¿Efectiva o no?

A los 6 meses de su aplicación no ha habido eventos



Estenosis Aórtica

Prevalencia (España)

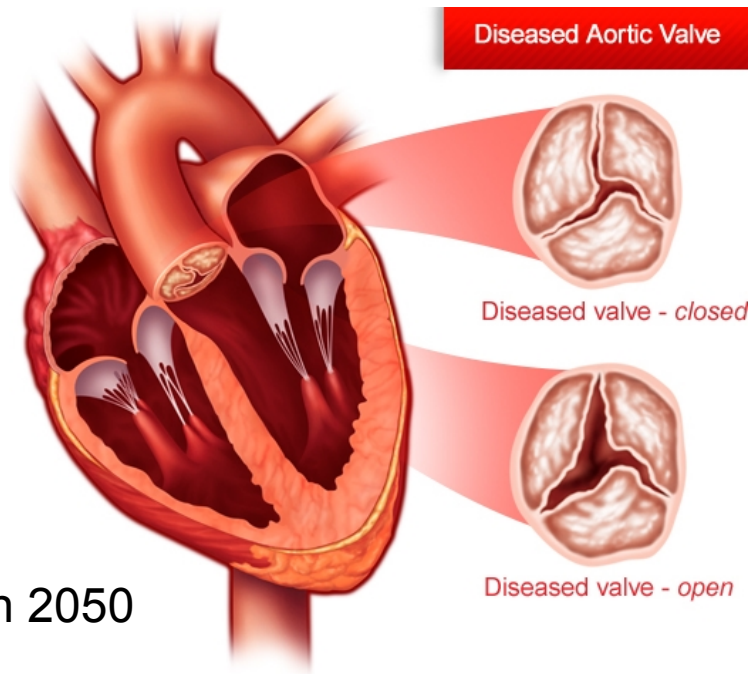
5 % población > 65 (años)

7 % población > 85 (años)

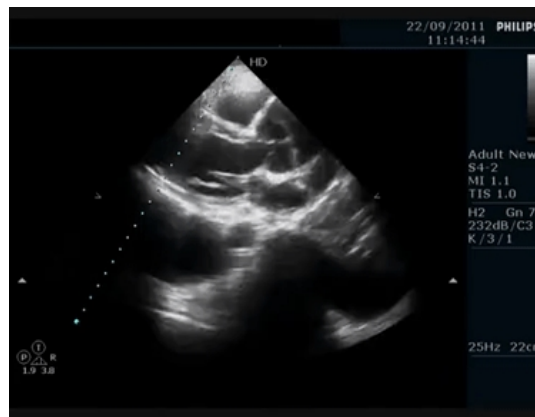
Más de **150,000** pacientes (España)

Envejecimiento de la Población

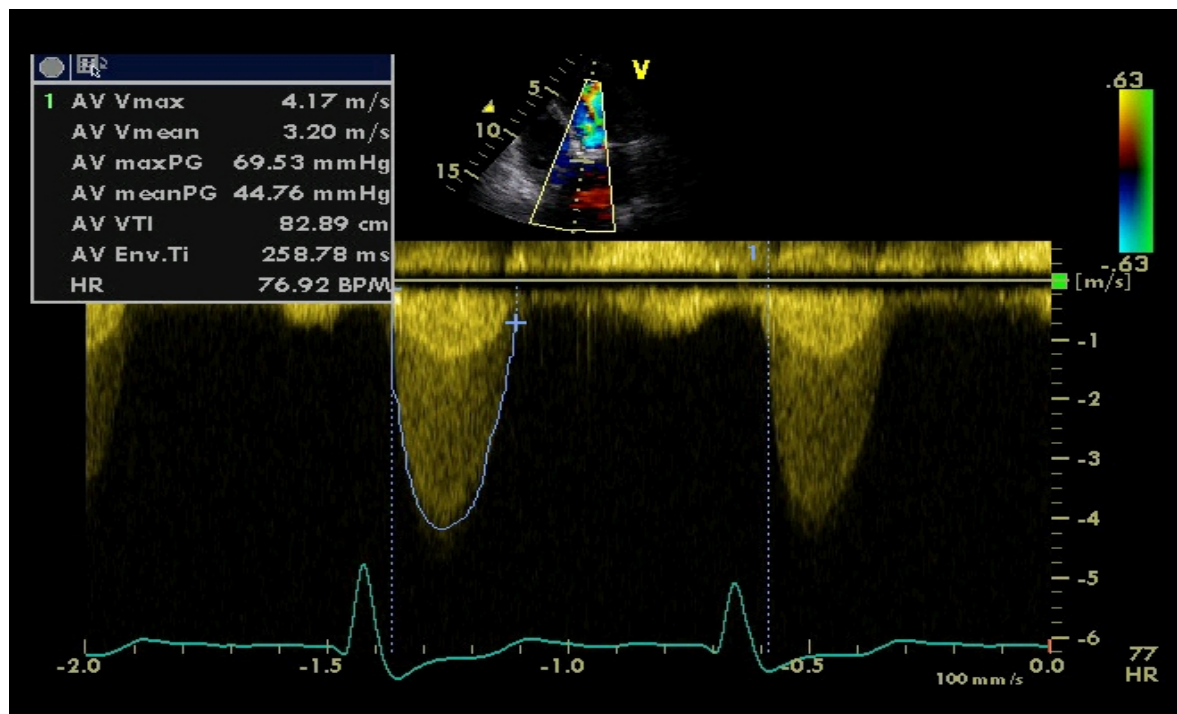
La población de España se reducirá un **11%** en 2050





Ecocardiografía



Ecocardiografía



Guías médicas

| | Velocidad Máx (m/s) | Gradiente medio (mm Hg) | AVA (cm ²) | VISITAS (años) | |
|----------|------------------------|----------------------------|------------------------|---|---|
| | | | |  |  |
| LEVE | 2.5 – 2.9 | <20 | > 1.5 | 1 | 3 |
| MODERADA | 3.0 – 4.0 | 20 – 40 | 1.0 – 1.5 | 1 | 1 |
| GRAVE | > 4.0 | > 40 | < 1.0 | 0,5 | 0,5 |

Objetivos

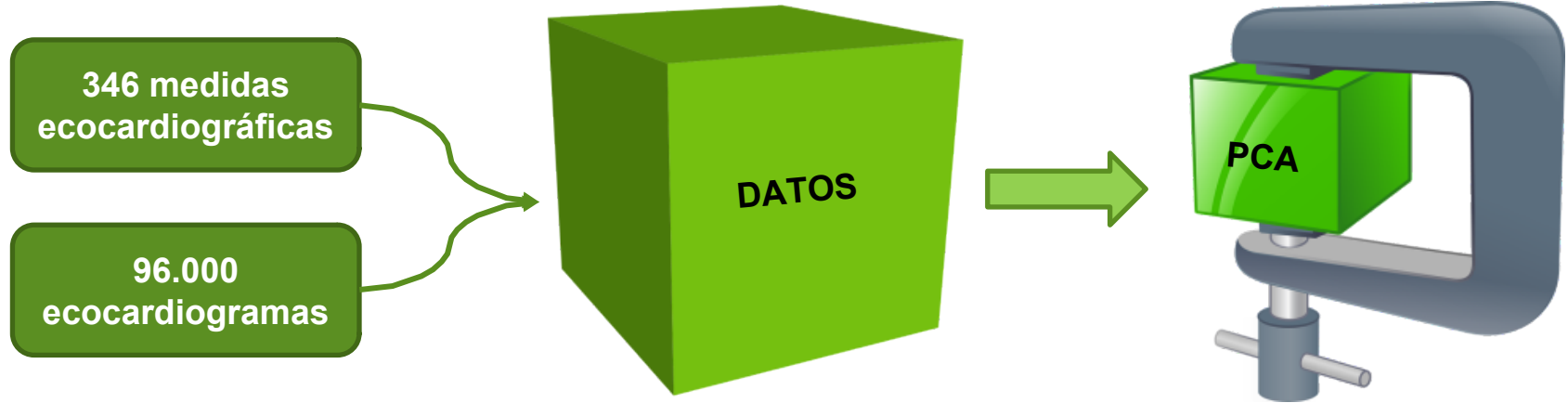
MILD / MODERATE



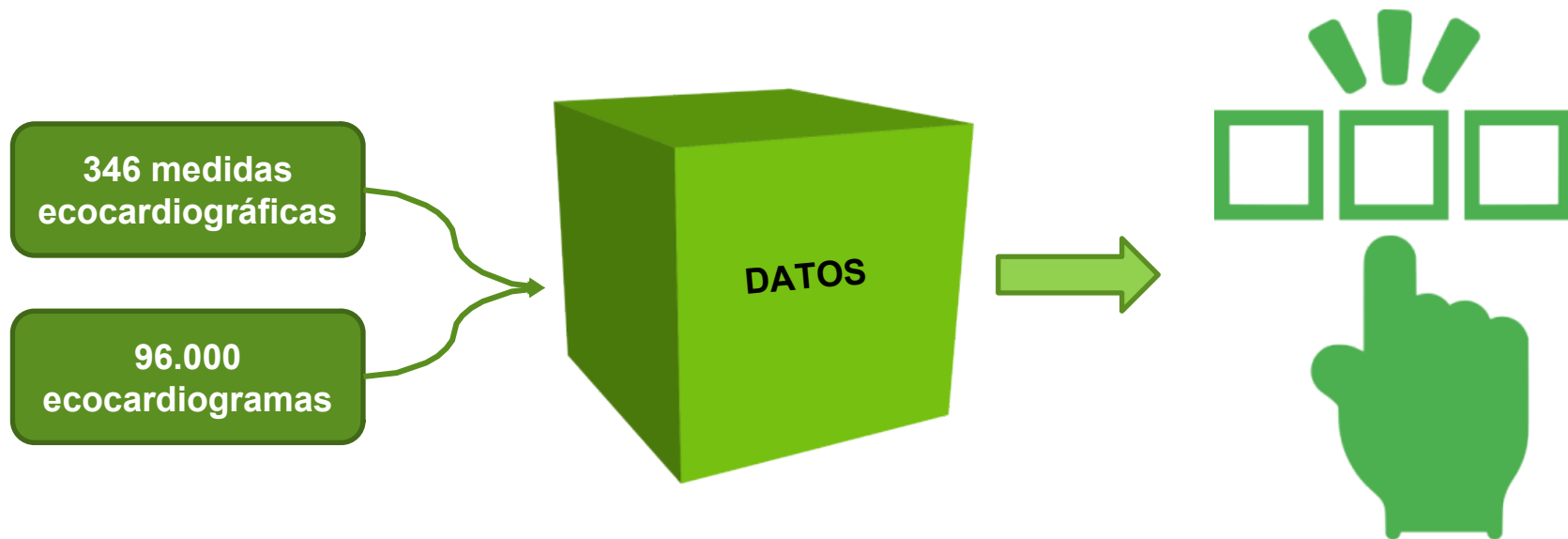
SEVERE



Selección de variables



Selección de variables



Selección de variables

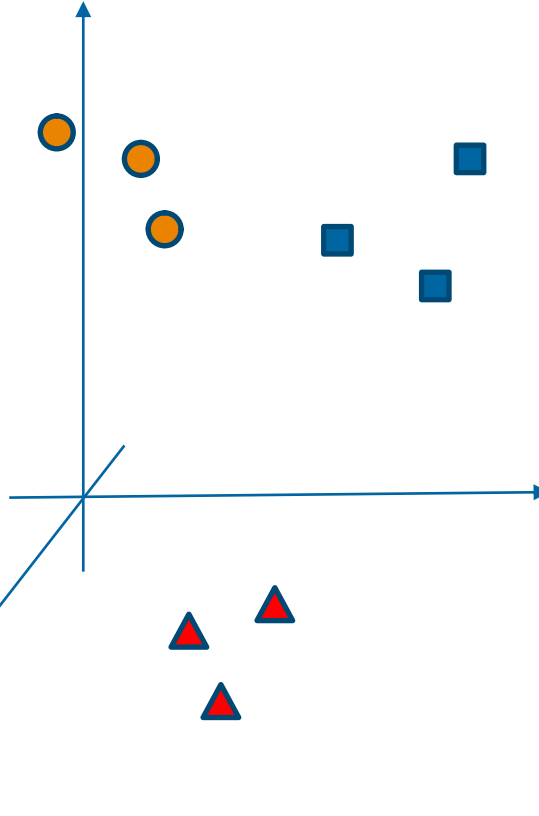
X_{nm}

n elements

m features

d dimensions

j groups



Selección de variables

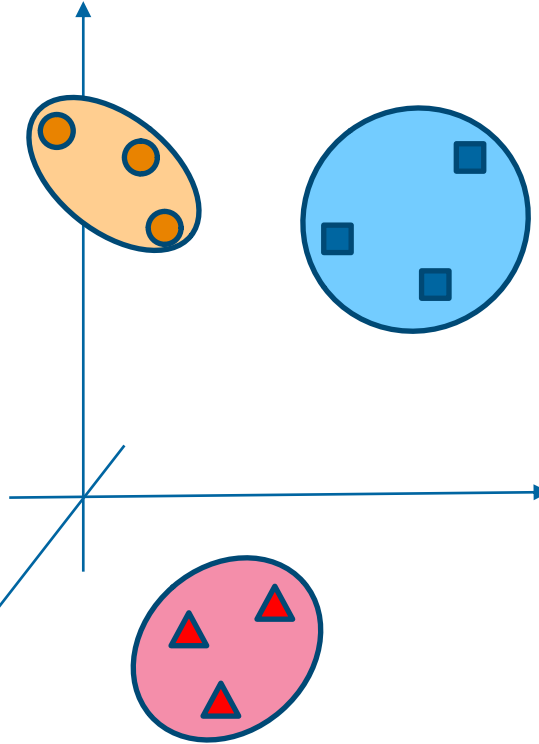
X_{nm}

n elements

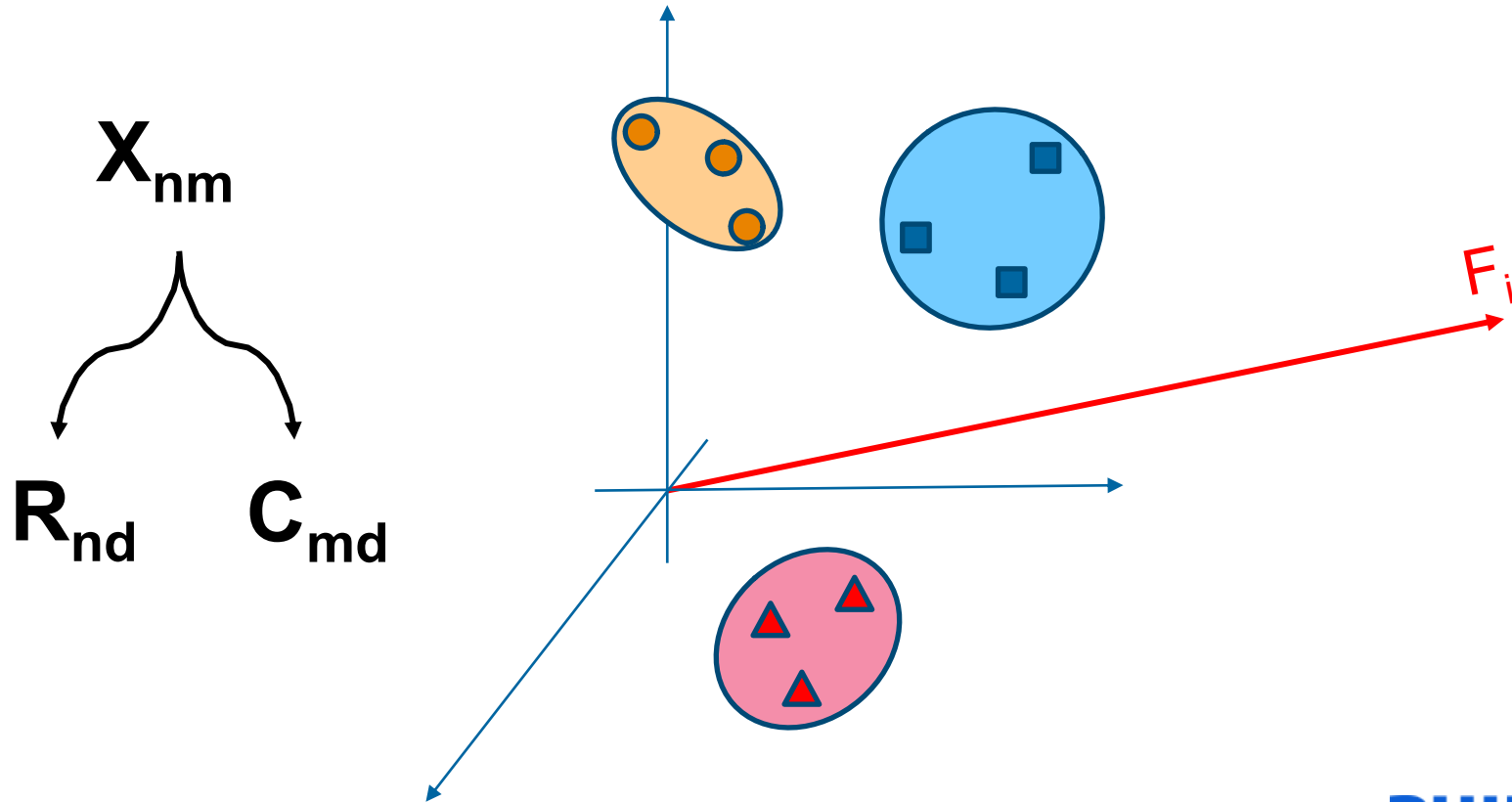
m features

d dimensions

j groups



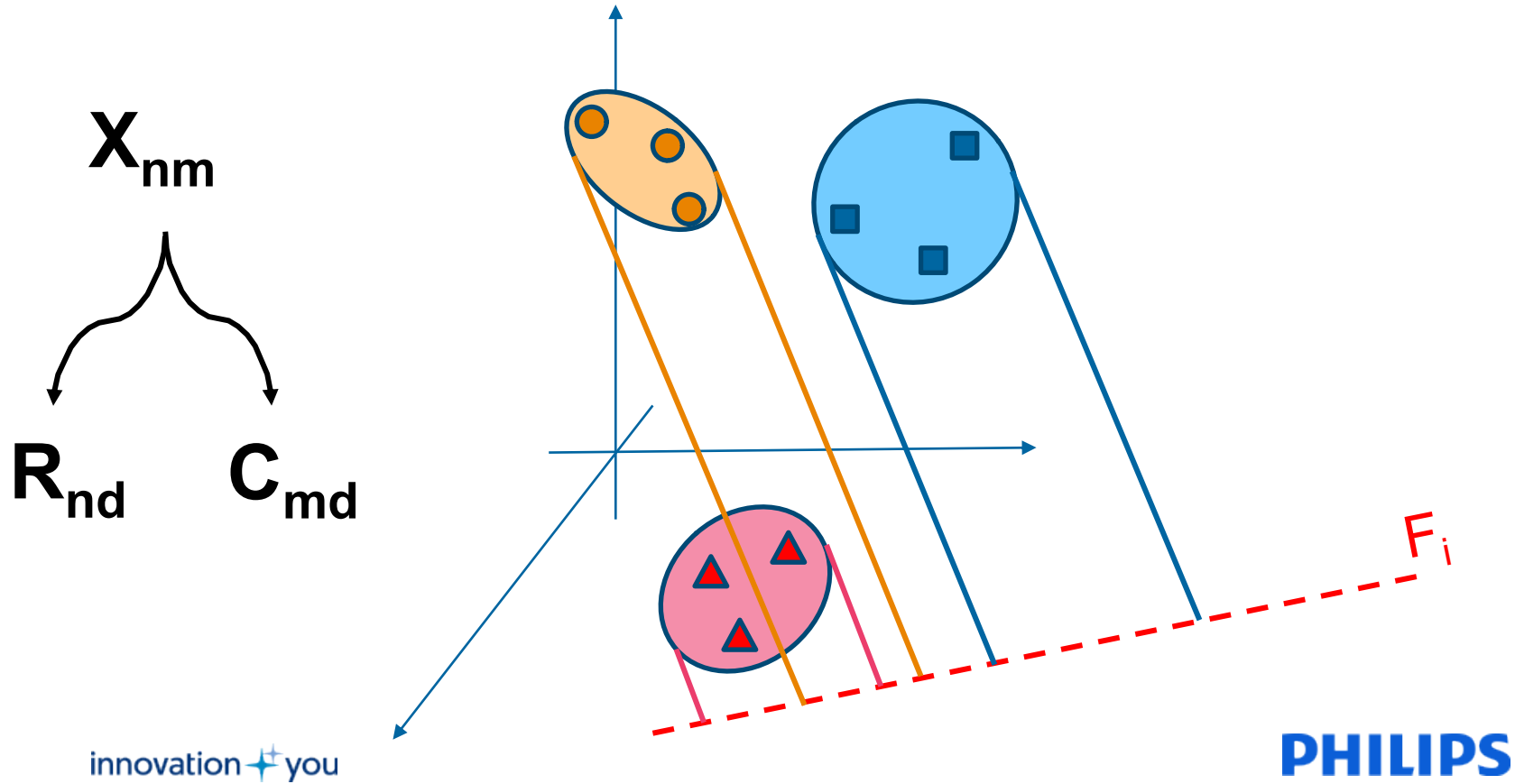
Selección de variables



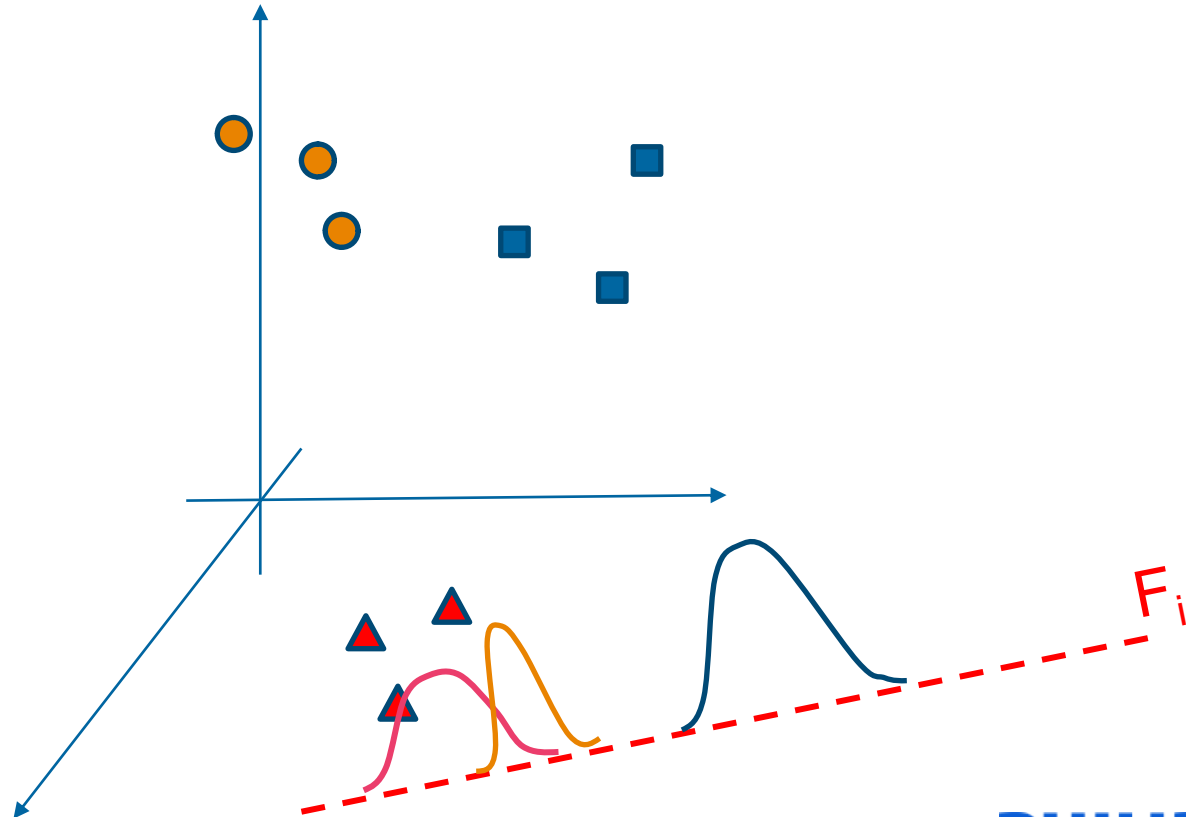
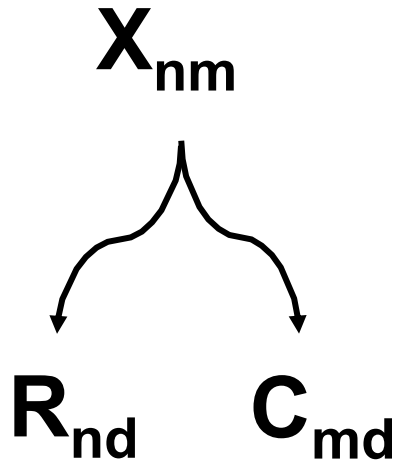
X_{nm}

R_{nd} C_{md}

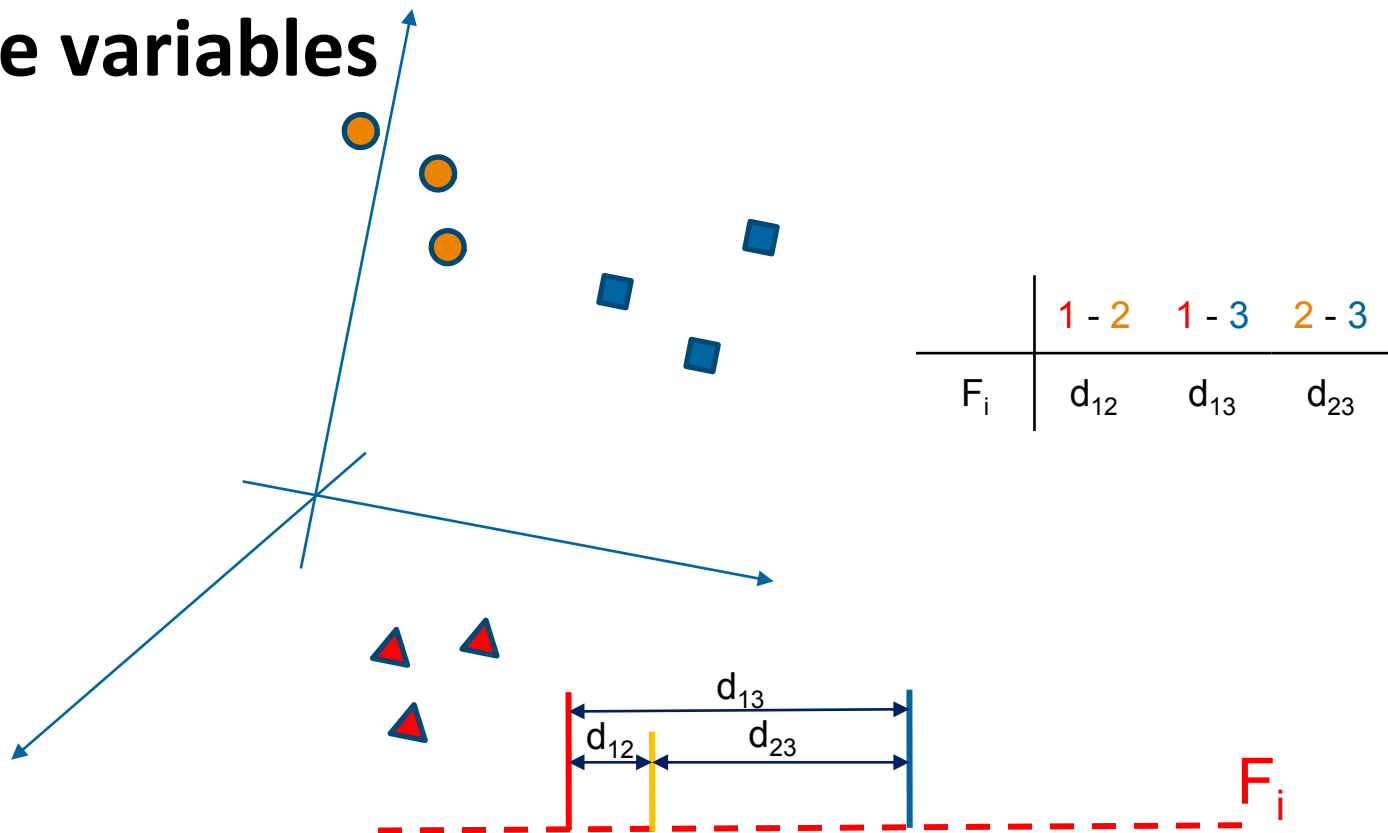
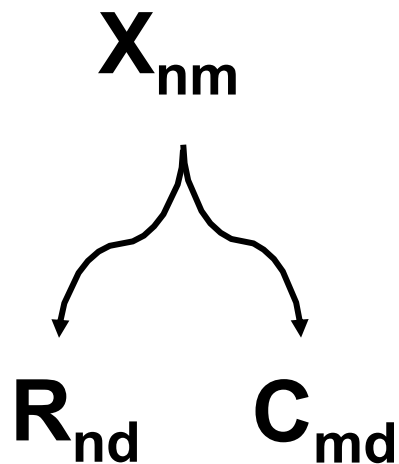
Selección de variables



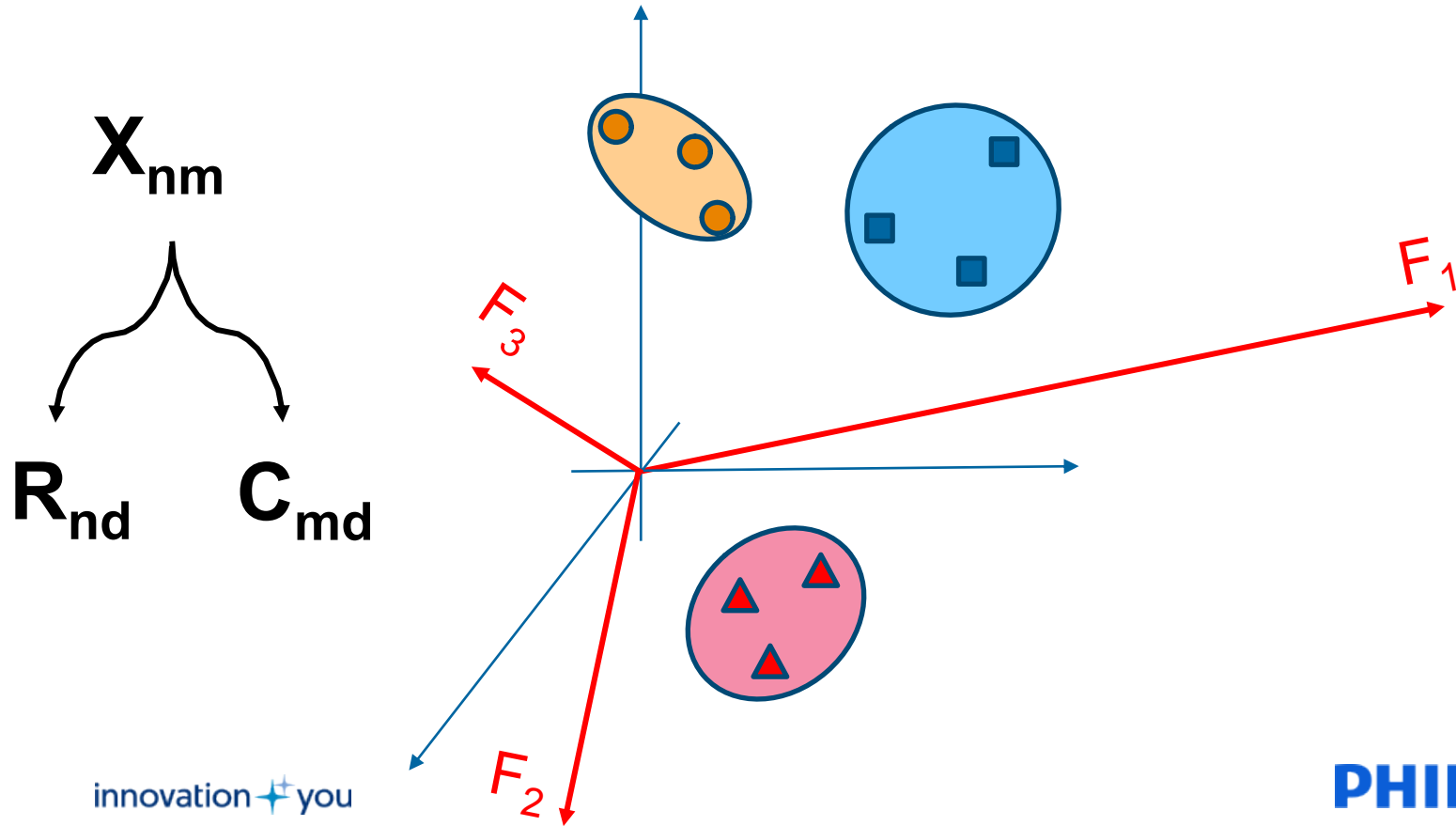
Selección de variables



Selección de variables



Selección de variables



Selección de variables

victorvicpal/biofes



GitHub repository page for **victorvicpal / biofes**. The repository is titled "Biomedical Feature Selection for Machine Learning Models". It shows 4 commits, 1 branch, 0 releases, and 1 contributor.

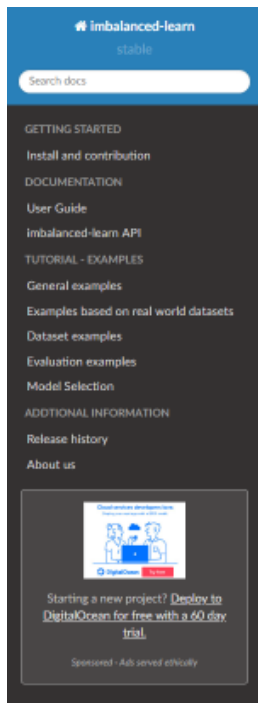
Files listed:

- README.md (Create README.md, 3 months ago)
- biplot.py (Correspondence, 2 months ago)
- bipplot.py (First commit, 3 months ago)
- feature.py (First commit, 3 months ago)

A large red triangular warning sign with a black silhouette of a person digging is overlaid on the repository content.

Datos Desbalanceados

imbalanced-learn



[Docs](#) » Welcome to imbalanced-learn documentation!

[Edit on GitHub](#)

Welcome to imbalanced-learn documentation!

Getting started

Information to install, test, and contribute to the package.

User Guide

The main documentation. This contains an in-depth description of all algorithms and how to apply them.

API Documentation

The exact API of all functions and classes, as given in the docstring. The API documents expected types and allowed features for all functions, and all parameters available for the algorithms.

Examples

A set of examples illustrating the use of the different algorithms. It complements the [User Guide](#).

What's new

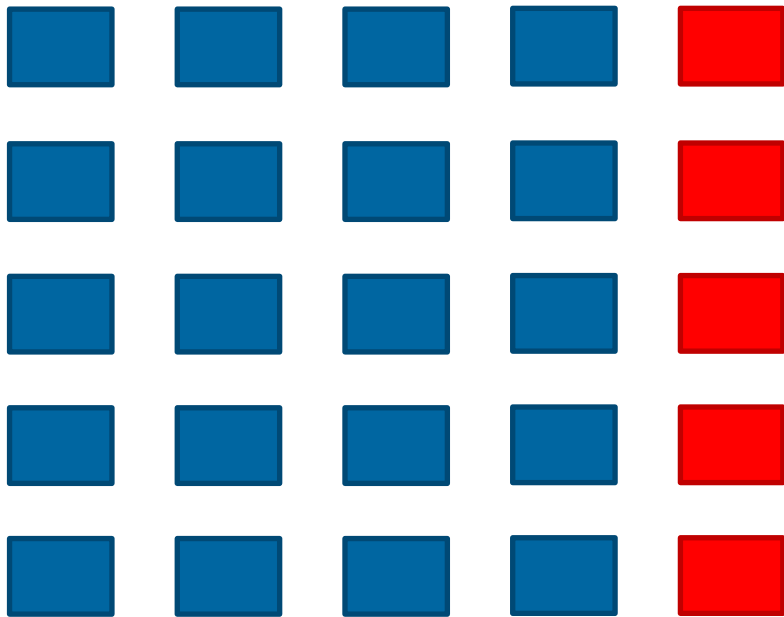
Log of the imbalanced-learn history.

About imbalanced-learn

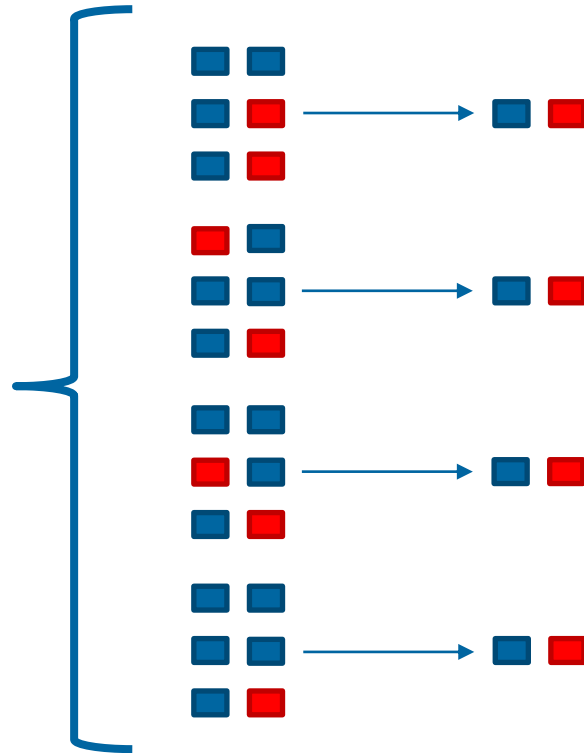
Just to know about history of imbalanced-learn.

See the [README](#) for more information.

Datos Desbalanceados



Balanced Bagging Classifier



Datos Desbalanceados

```
>>> from imblearn.ensemble import BalancedBaggingClassifier
>>> bbc = BalancedBaggingClassifier(base_estimator=DecisionTreeClassifier(),
...                                ratio='auto',
...                                replacement=False,
...                                random_state=0)
>>> bbc.fit(X_train, y_train)
BalancedBaggingClassifier(...)
>>> y_pred = bbc.predict(X_test)
>>> confusion_matrix(y_test, y_pred)
array([[ 9,  1,  2],
       [ 0, 55,  4],
       [42, 46,1091]])
```

¿Falsos Positivos o Falsos Negativos?

| | NO | SÍ |
|----|-------------------|------------------|
| NO | VN 9760 | FP 140 |
| SÍ | FN 3 | VP 97 |



9900 casos



100 casos

$$\text{ACCURACY} = (9760 + 97) / 10000 = 0.99$$

$$\text{PRECISION} = 97 / (97 + 140) = 0.55$$

$$\text{RECALL} = 97 / (97 + 3) = 0.97$$

¿Falsos Positivos o Falsos Negativos?

| | NO | SÍ |
|----|-------------------|------------------|
| NO | VN 9760 | FP 140 |
| SÍ | FN 3 | VP 97 |



9900 casos



100 casos

PRUEBA NO INVASIVA

$$\text{ACCURACY} = (9760 + 97) / 10000 = 0.99$$

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¿Falsos Positivos o Falsos Negativos?

| | NO | SÍ |
|----|-------------------|------------------|
| NO | VN 9760 | FP 140 |
| SÍ | FN 3 | VP 97 |



9900 casos



100 casos

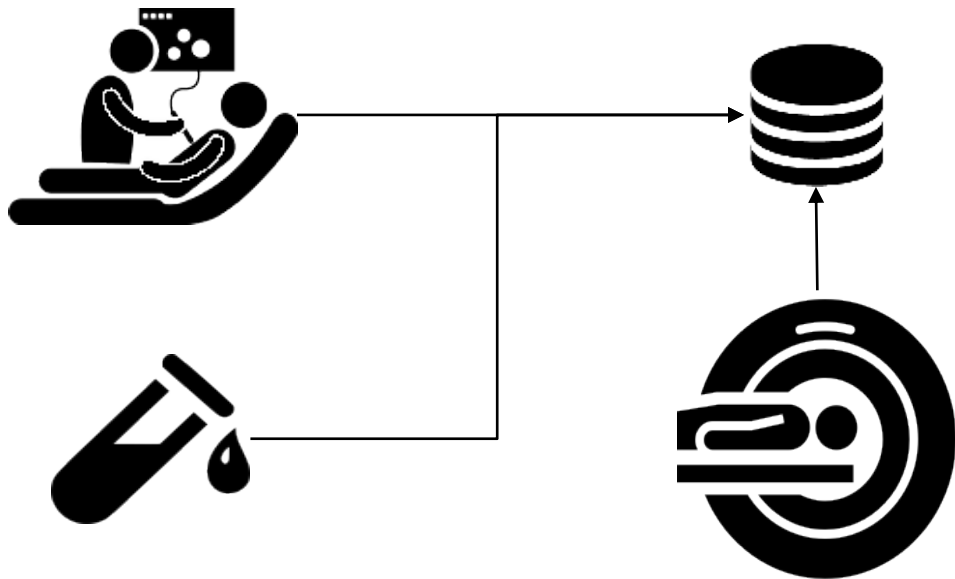
PRUEBA INVASIVA

$$\text{ACCURACY} = (9760 + 97) / 10000 = 0.99$$

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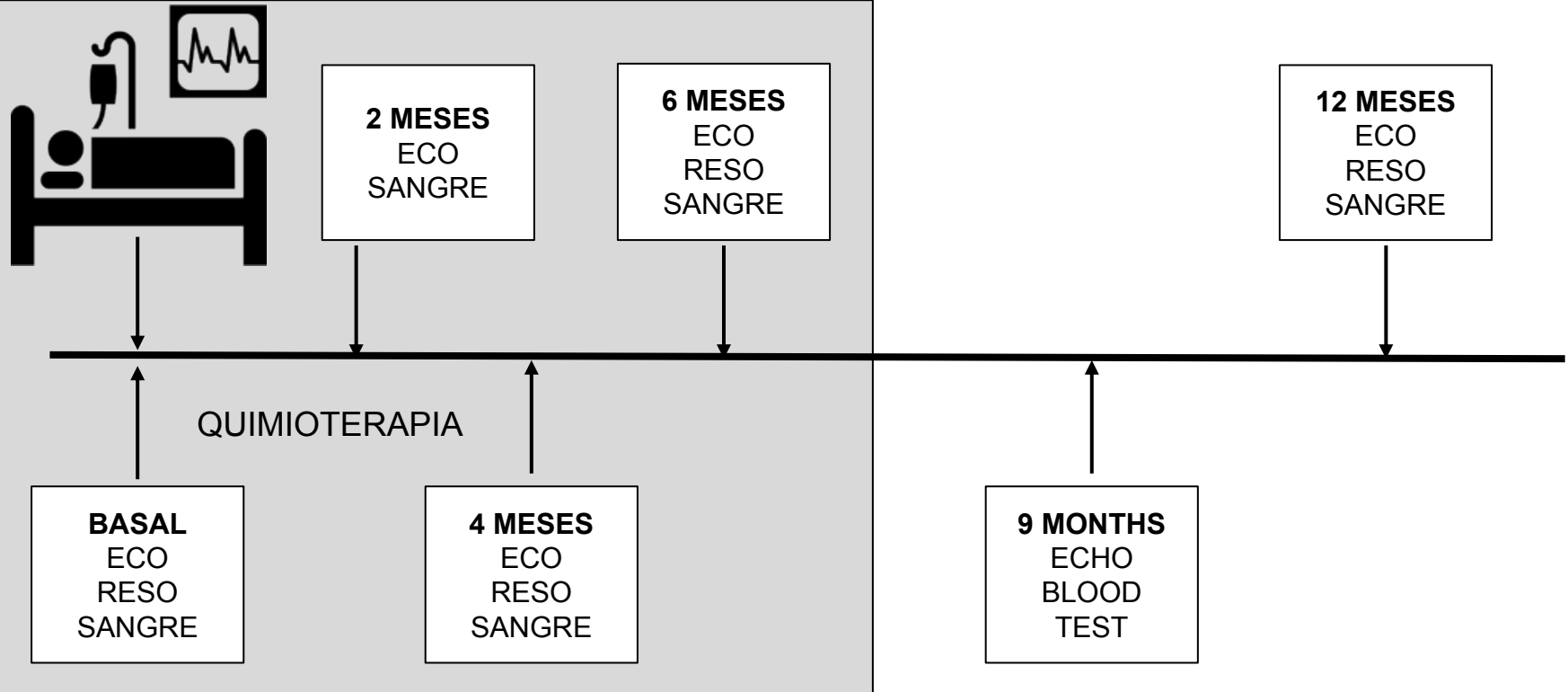
$$\text{RECALL} = 97 / (97 + 3) = 0.97$$

Cardiotoxicidad

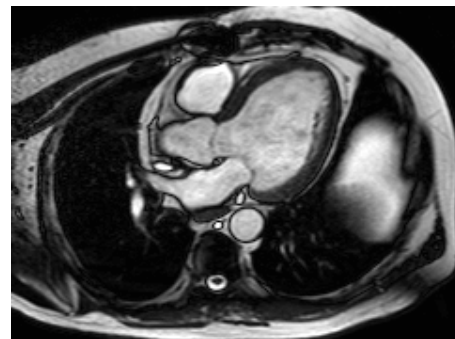
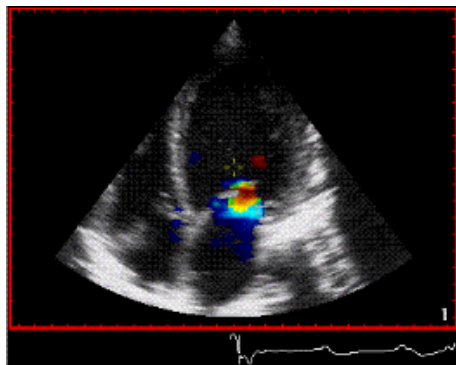


CARTIER

Cardiotoxicidad



¿Riesgo de cardiotoxicidad?



PROXIMAMENTE...

Muchas gracias por su atención



Víctor Vicente Palacios
victor.vicente.palacios@Philips.com