AI SPRINT
AI IN SECURE PRIVACY-PRESERVING COMPUTING CONTINUUM

Barcelona Supercomputing Center
Centro Nacional de Supercomputación

EXCELENCIA SEVERO OCHOA

Unleashing the potential of AI with the AI-SPRINT Personalised Healthcare Use Case

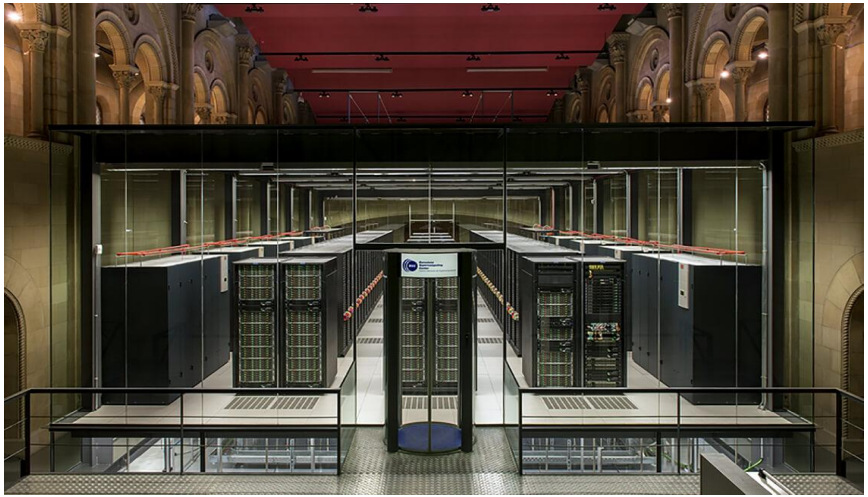
Davide Cirillo

Machine Learning for Biomedical Research

Life Sciences Department

November 2, 2022

Barcelona Supercomputing Center (BSC)



GOBIERNO DE ESPAÑA
MINISTERIO DE ECONOMÍA Y COMPETITIVIDAD

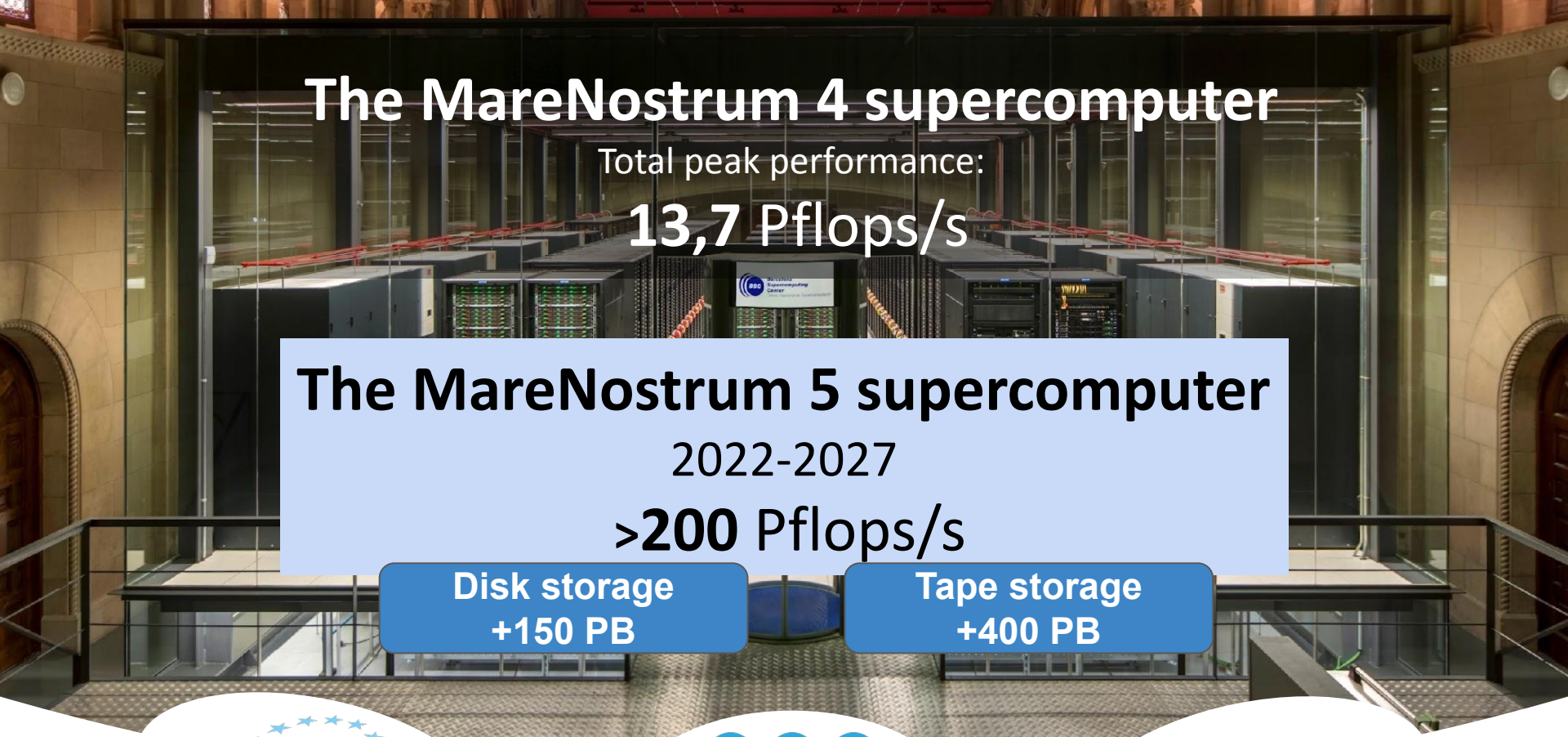
Generalitat de Catalunya
Departament d'Economia i Coneixement

UPC UNIVERSITAT POLITÈCNICA DE CATALUNYA BARCELONATECH

BSC Barcelona Supercomputing Center
Centro Nacional de Supercomputación

RES RED ESPAÑOLA DE SUPERCOMPUTACIÓN

PRACE



The MareNostrum 4 supercomputer

Total peak performance:

13,7 Pflops/s

The MareNostrum 5 supercomputer

2022-2027

>200 Pflops/s

Disk storage
+150 PB

Tape storage
+400 PB

PRACE

Access: prace-ri.eu/hpc-access

R E S

RED ESPAÑOLA DE SUPERCOMPUTACIÓN

Access: bsc.es/res-intranet

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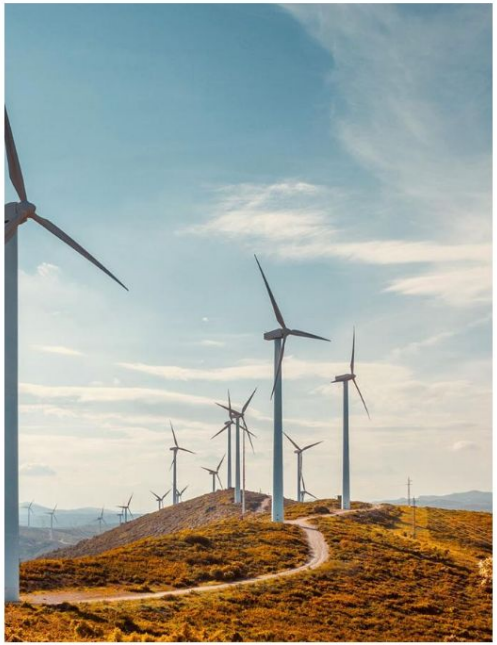
AirFusion

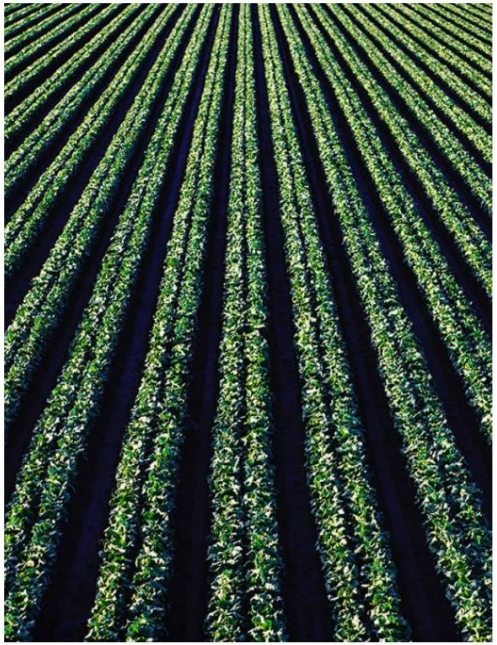
GREGOIRE

Beck et al. work. together.

Personalized healthcare



Maintenance and inspection



Farming 4.0

AI-SPRINT for personalized healthcare

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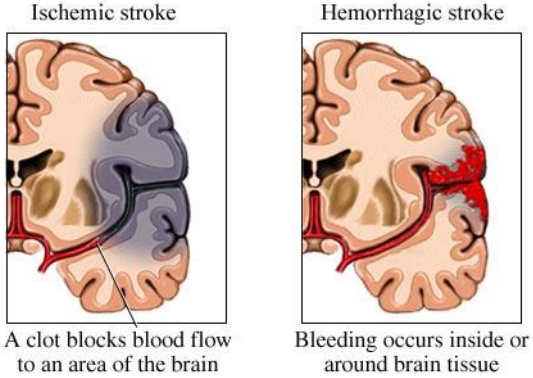
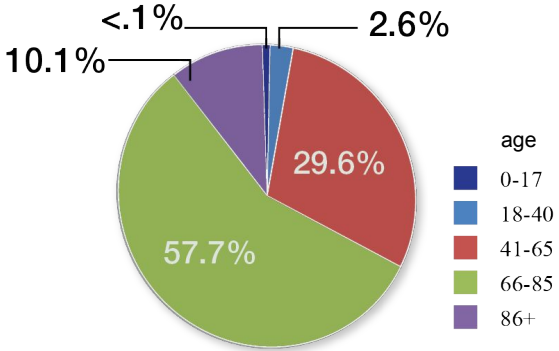
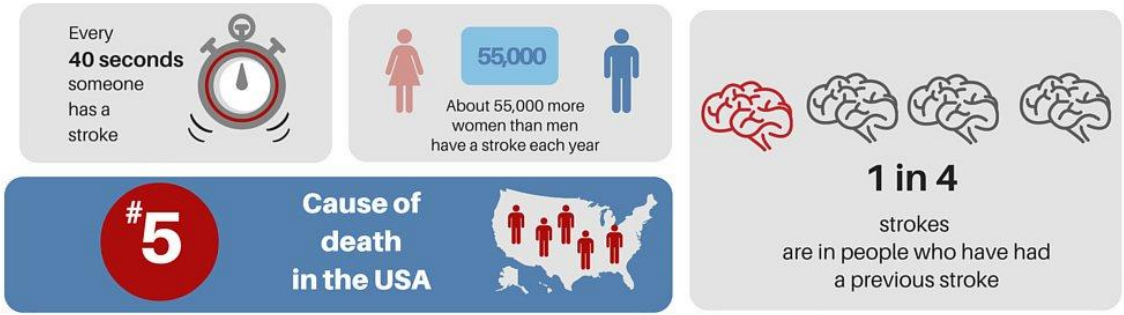






sources: *American Stroke Association*
St. Luke's Rehabilitation Institute
BrainsGate.com

STROKE SIGNS:
WOMEN VS. MEN

Men and women share a common set of stroke symptoms. But women also can experience more subtle warning signs.

WOMEN

- Face drooping
- Arm weakness
- Speech difficulty
- Vision problems
- Trouble walking or lack of coordination
- Severe headache without a known cause
- General weakness
- Disorientation & confusion or memory problems
- Fatigue
- Nausea or vomiting

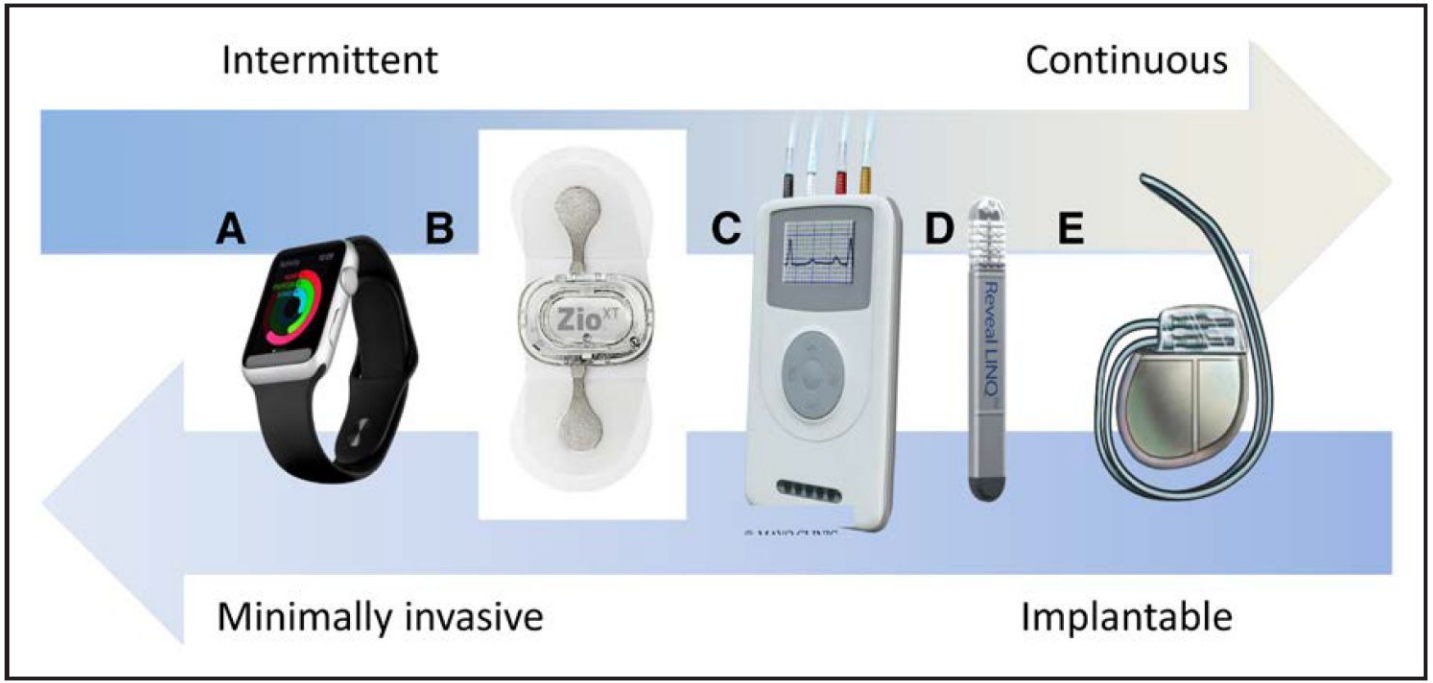
Sources: American Stroke Association; Gender Medicine; Journal of Neuroscience Nursing

80% OF ALL STROKES CAN BE PREVENTED

CEREBROVASCULAR RISK FACTORS

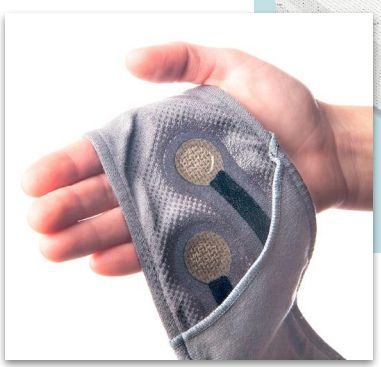
NON-INVASIVE CONTINUOUS MONITORING

sources: *American Stroke Association*
St. Luke's Rehabilitation Institute
BrainsGate.com



Noseworthy et al. *Circulation* (2019)
doi:10.1161/CIR.0000000000000740

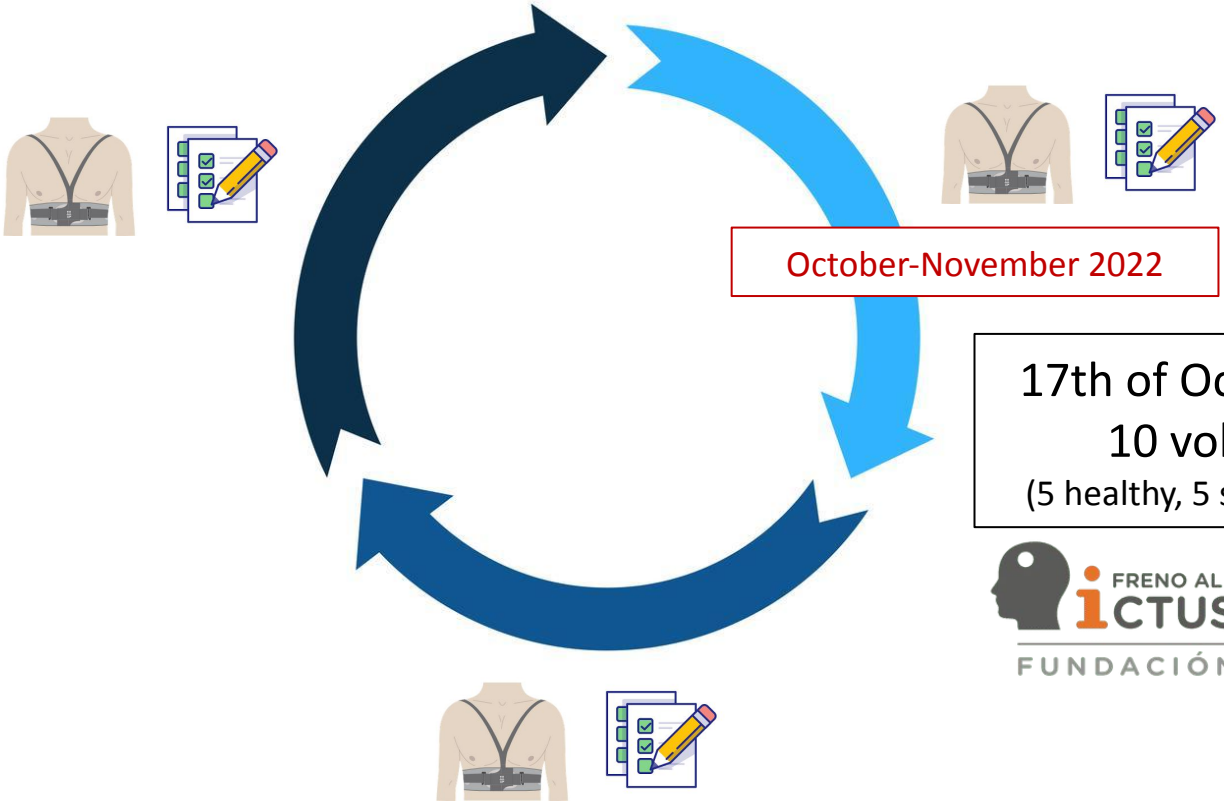
A, Apple Watch.
B, ZIO XT Patch.
C, Holter or event monitor.
D, Reveal LINQ.
E, Implanted pacemaker or defibrillator.



www.nuubo.com

continuous ECG recording (up to 30 days)

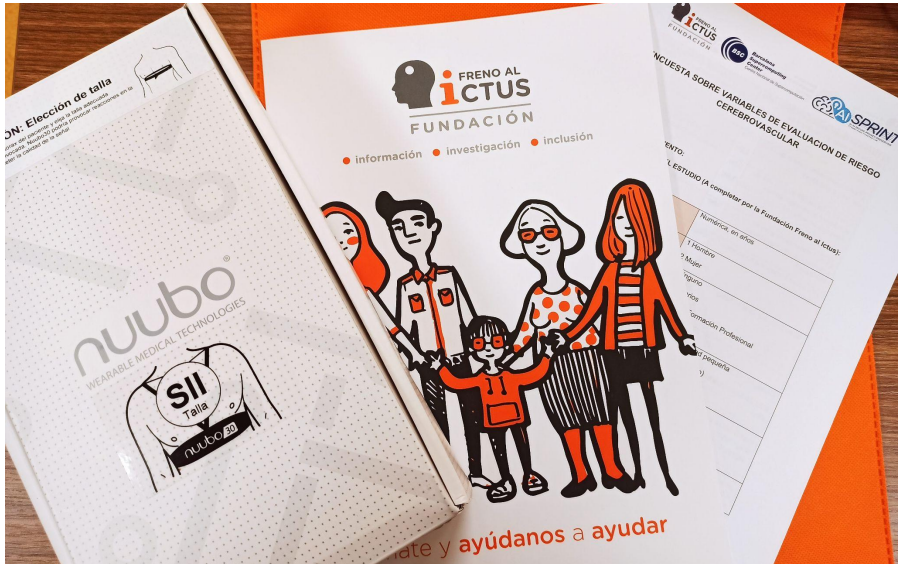
The AI-SPRINT pilot study



October-November 2022

17th of October 2022:
10 volunteers
(5 healthy, 5 stroke survivors)

The AI-SPRINT pilot study



Madrid, 17.10.2022

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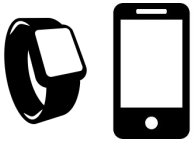
Different data for a common goal



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FRENO AL ICTUS FUNDACIÓN

nuubo
WEARABLE MEDICAL TECHNOLOGIES

Data: Long-term ECG from pilot study (60 volunteers, balanced by sex) + predictions of AF
Objective: Collect real-world data for the AI-SPRINT use case

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fitbit

Data: multi-parameter data from 2 devices
Objective: include the real-time dimension in the use case of AI-SPRINT

Additional collaborations:

Vall d'Hebron
Institut de Recerca
VHIR

bioinfo 4women

https://bioinfo4women.bsc.es/

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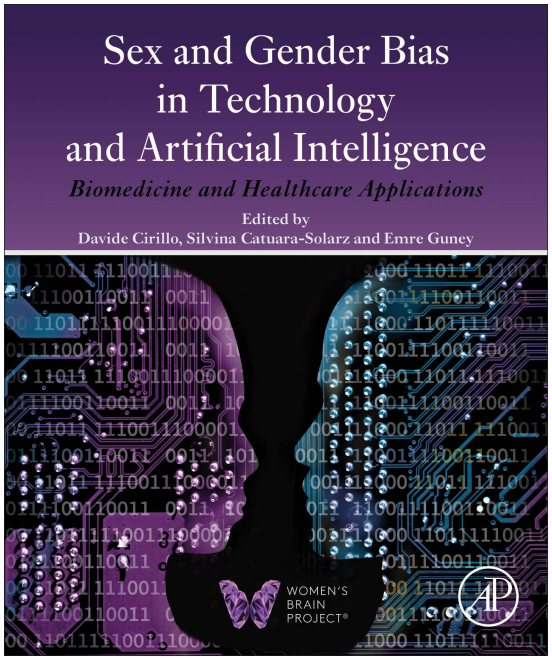
bioinfo 4women



"It's a must read for anyone working in this area; the materials presented here should be integrated into medical school curricula."

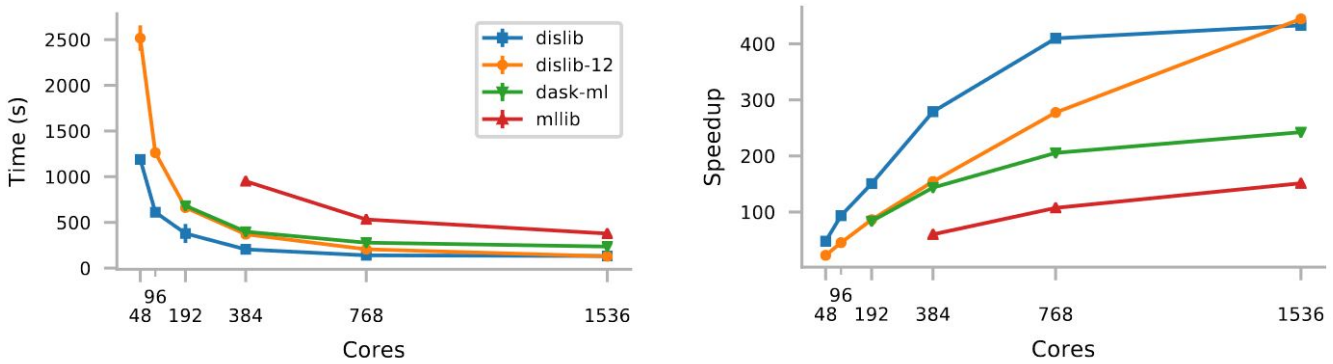
Londa Schiebinger
John L. Hinds Professor of History of Science, Stanford University
Founding director, Gendered Innovations in Science, Health & Medicine, Engineering, and Environment

WOMEN'S BRAIN PROJECT®
BSC
bioinfo 4women
upf.
Universitat Oberta de Catalunya
Roche
Microsoft
GRIB RESEARCH PROGRAMME ON BIOMEDICAL INFORMATICS
UPC
Bar-Ilan University
BAYER
Biogen
eurecat Centre Tecnològic de Catalunya
Telefónica
IRML Interactive Robots and Media Laboratory

ELSEVIER
ISBN: 9780128213926

dislib | distributed computing library

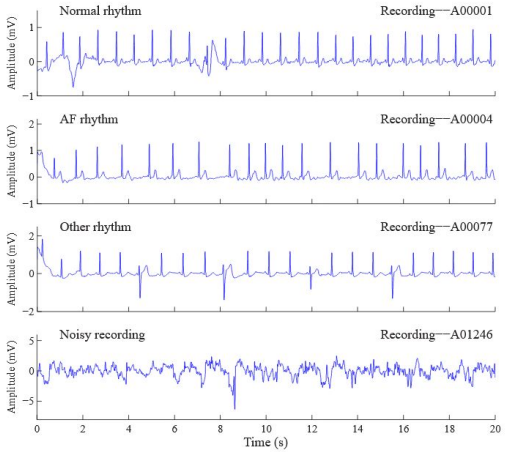
https://dislib.readthedocs.io/

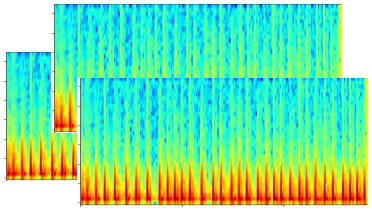


500 million samples with high granularity (100 features and 500 clusters).

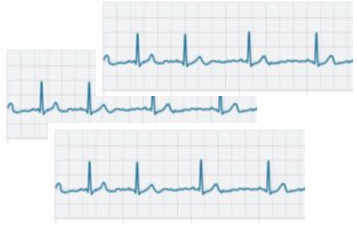
J. Álvarez Cid-Fuentes, S. Solà, P. Álvarez, A. Castro-Ginard, and R. M. Badia, **dislib: Large Scale High Performance Machine Learning in Python** in *Proceedings of the 15th International Conference on eScience*, 2019, pp. 96-105

Initial developments using the PhysioNet database





spectrograms



time series

Pareto-Optimal Progressive Neural Architecture Search (POPNAS)

POLITECNICO MILANO 1863

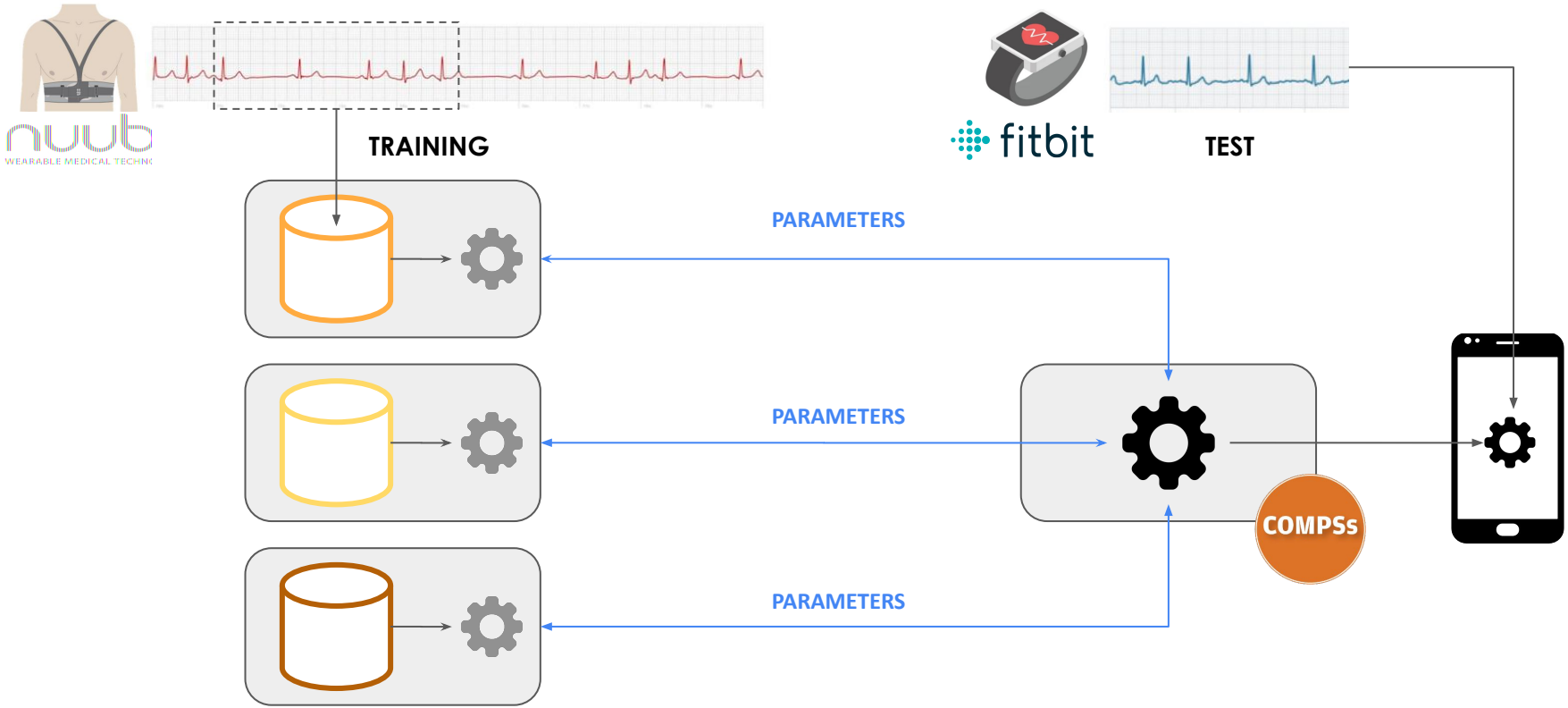
Cascade Support Vector Machine (CSVM)

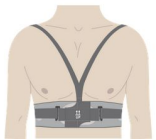
k-nearest neighbors (KNN)

Random Forest (RF)

PhysioNet Clifford et al. 2017 Computing in Cardiology (CinC). IEEE, 1-4. DOI: 10.22489/CinC.2017.065-469
POPNAS Lomurno et al. 2021. Proceedings of GECCO '21. ACM, 1726–1734. DOI: 10.1145/3449726.3463146
dislib Cid-Fuentes et al. 2019. Proceedings of eScience, pp. 96-105, DOI: 10.1109/eScience.2019.00018.

Privacy preservation by Federated Learning





TRAINING
(in a federated setting)

INFERENCE

SPACE 4AI-D

COMPSs

SPACE 4AI-R

Krake

Infrastructure Manager

MODEL

dislib

MINIO

OSCAR

SCONE

COMPSs

PREDICTION

PERFORMANCE MODELS

influxdb

Conclusions

- AI needs resources in the **computing continuum** and this poses great challenges from an infrastructural perspective.

- **AI-SPRINT** is one of the first platforms for AI application development in the computing continuum.

- The application of AI-SPRINT technology to the use case of personalized medicine will allow the development of **stroke risk models** in real time.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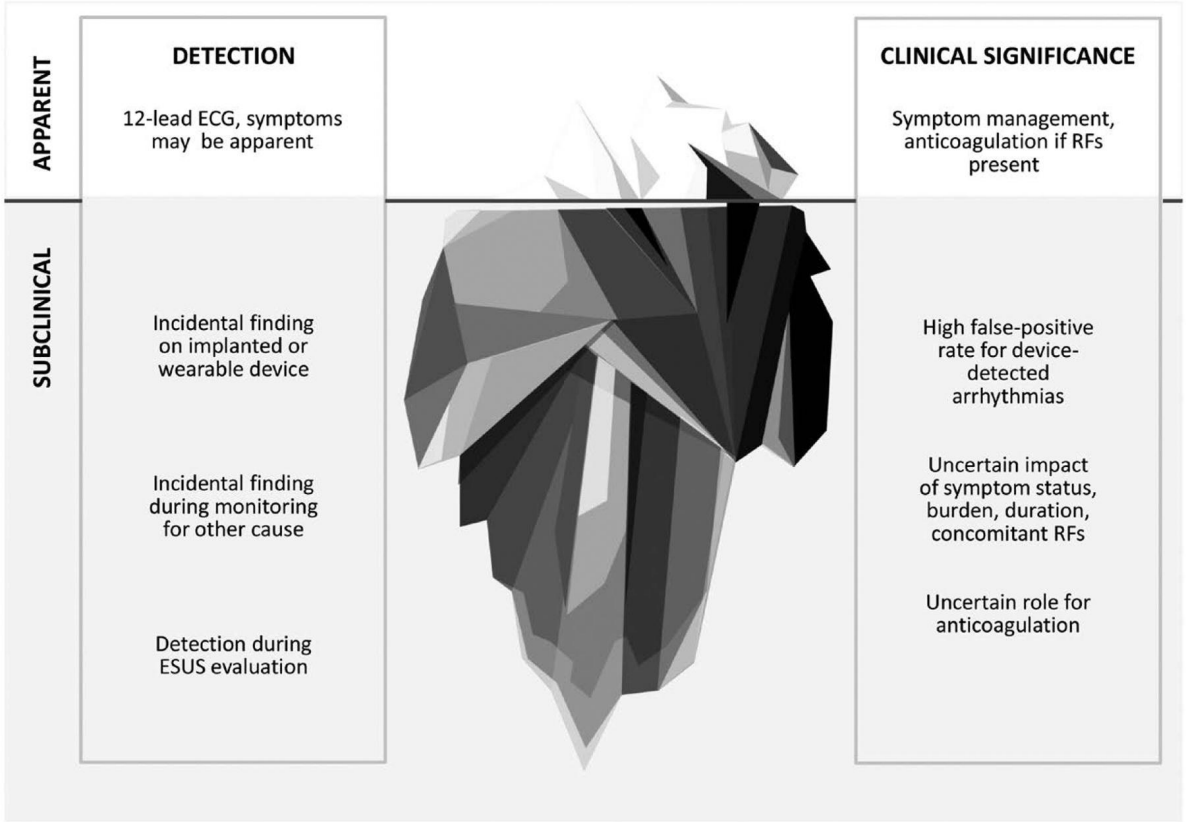
EXCELENCIA
SEVERO
OCHOA
Thank you!
davide.cirillo@bsc.es

A tip of the iceberg



ESUS: embolic stroke of undetermined source
RF: radiofrequency

Noseworthy et al. *Circulation* (2019)
doi:10.1161/CIR.0000000000000740