

Biomedicine: Driven by IT – Driving IT



Rudi Balling
Luxembourg Centre for Systems Biomedicine
(LCSB)
rudi.ballung@uni.lu

LCSB: An interdisciplinary research centre

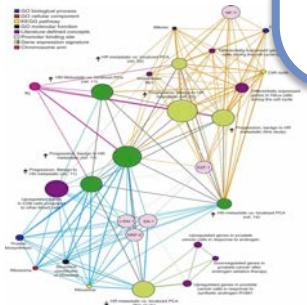
Experimental biology



Technology platforms



Computer modeling & simulations



Clinical research



LCSB: At the interface of IT and medicine

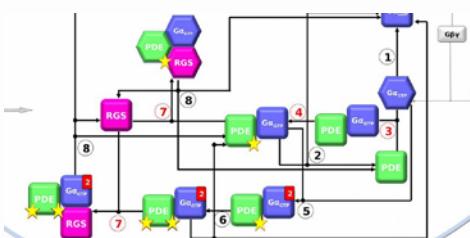
Bioinformatics Core



Integration of Clinical and Non-Clinical Data



Computational Disease Modeling



International Data Hub

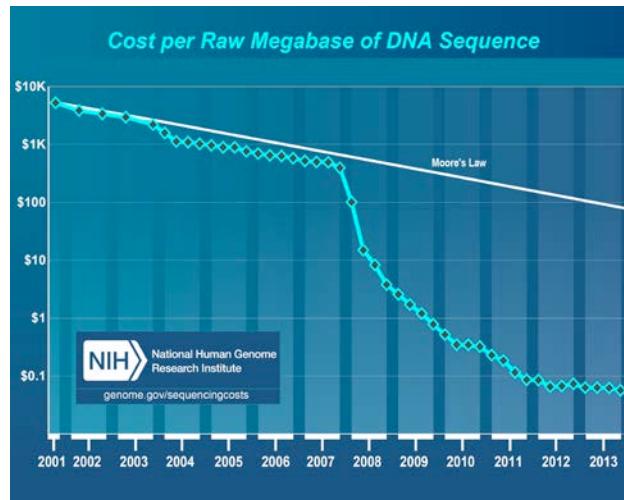
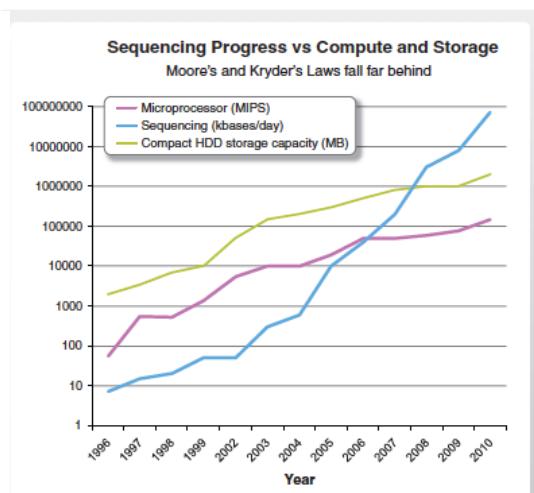


Infrastructure matters !



Bioinformatics Core Facility of the LCSB: >35 FTE's
Cluster with >5000 cores
Several large memory machine 1-4 TB RAM
~4 PetaByte storage

An Avalanche is coming



Biomedicine: The art is in the integration

Cellular
Models

Animal/iPSC
Models

Patient
Cohorts

Clinical
Trials

EHR

Sequencing
Data

Omics
Data

Imaging
Data

Clinical
Data

Social
Data

Bioinformatics

Computational
Biology

Constraint based
Modeling

Dynamic
Modeling

Biomarkers

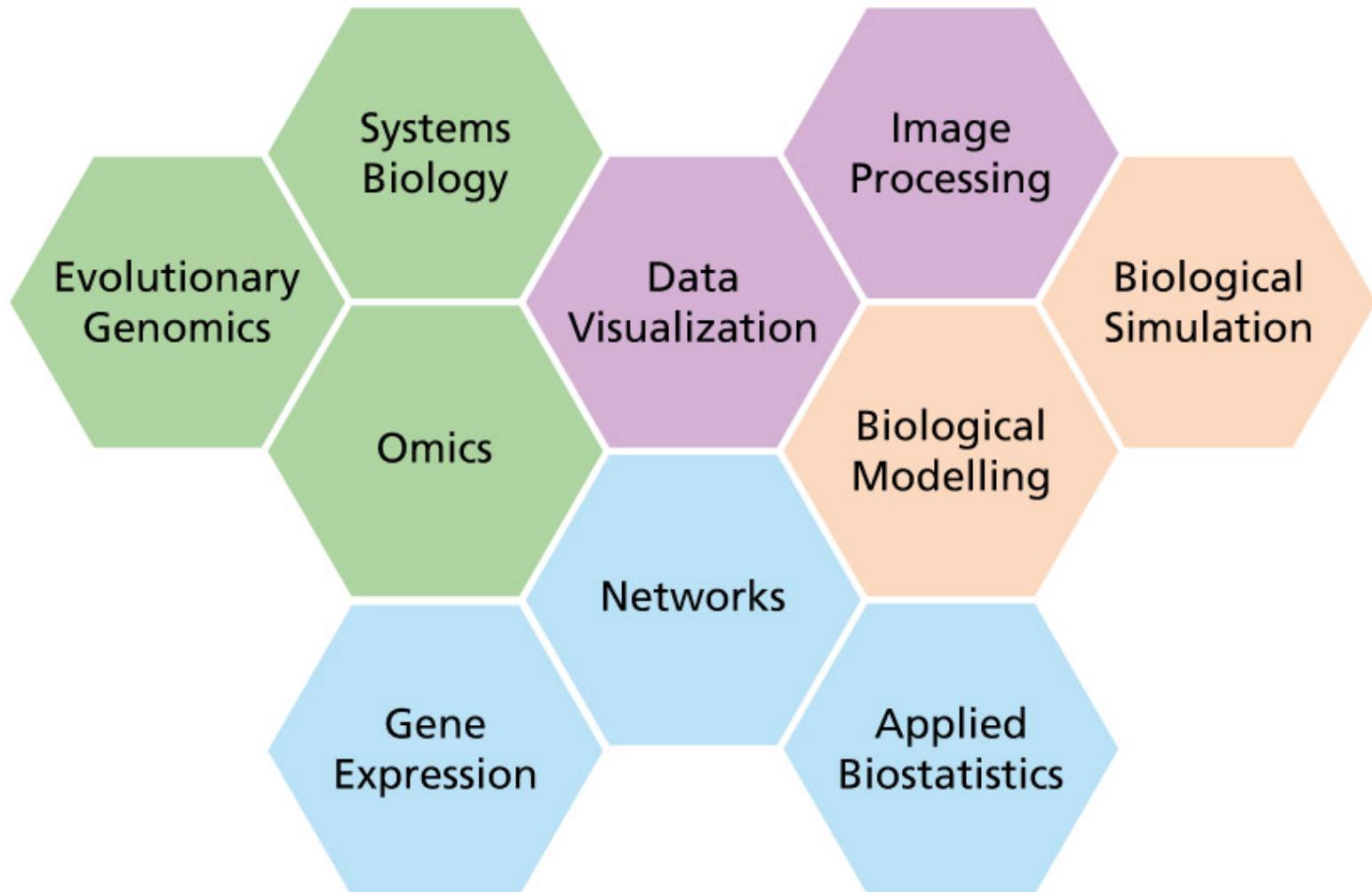
Drug Targets

Clinical Decision
Support

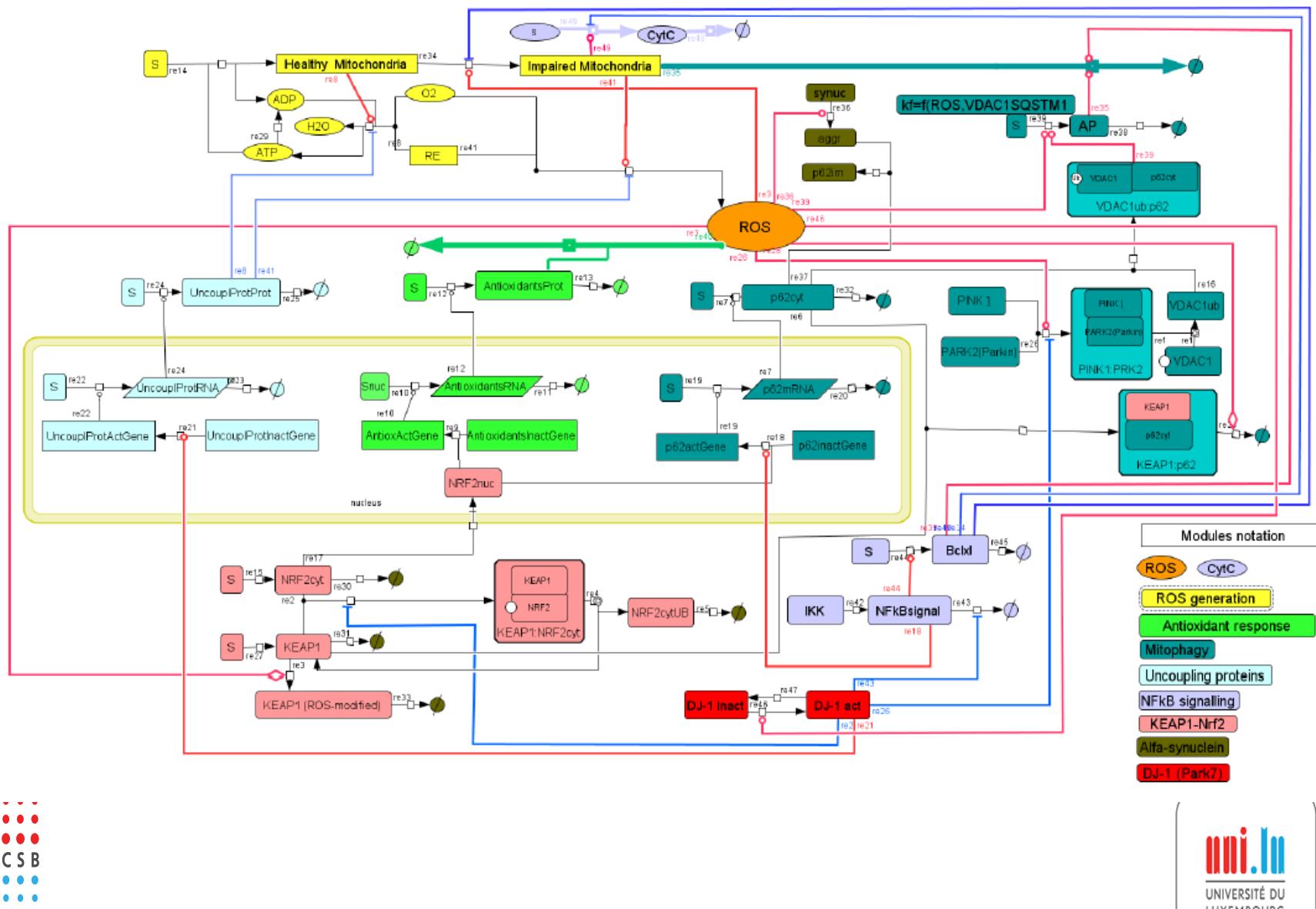
Public Health
Guidance



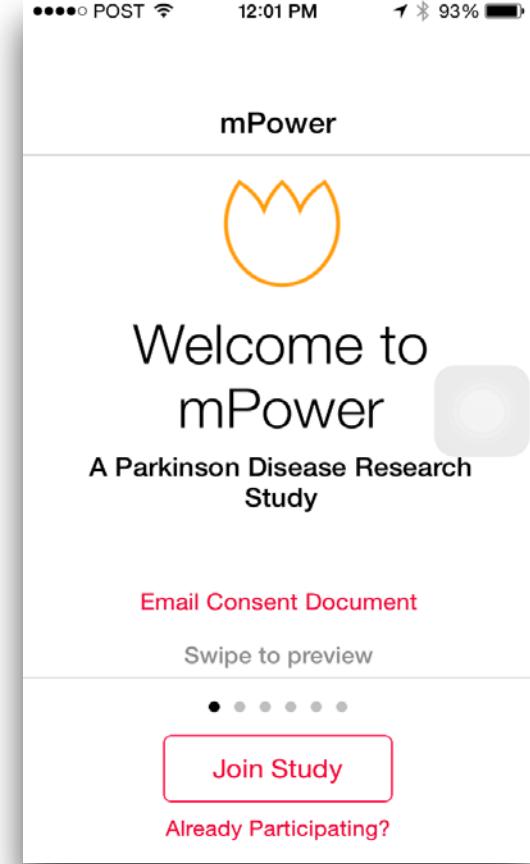
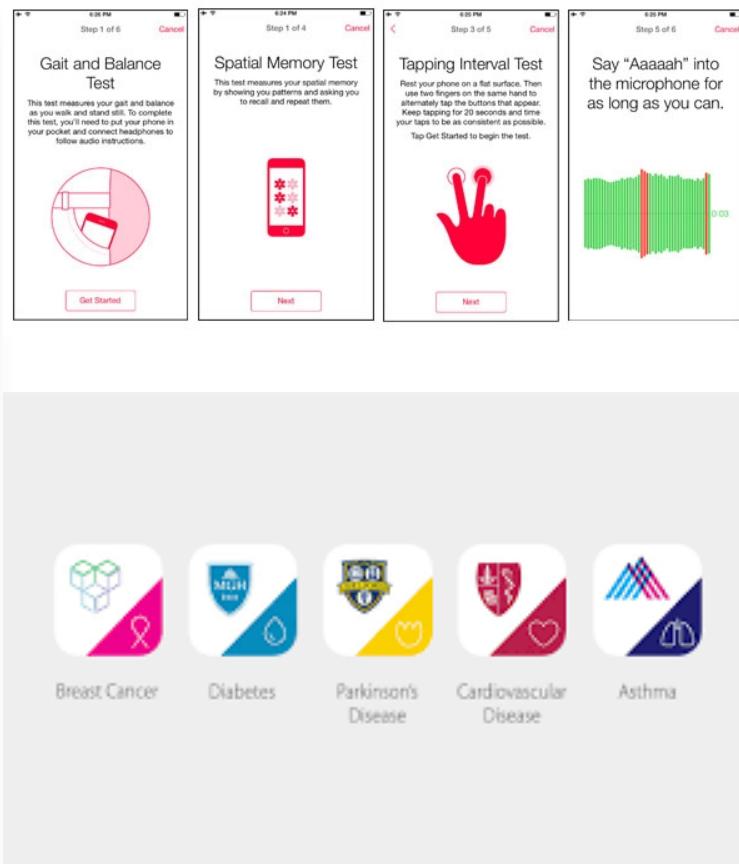
From data to modeling and simulations



Kinetic models of mitochondrial dysfunction



Systems Medicine & Social Media



LCSB: Data integration and interpretation

Bioinformatics platform

Development of dedicated problem oriented research tools

Data
integration
and
management

Network (re-)
construction

Large scale
visualisation
tools for
heterogenous
data

Automatic
pipelines for
large scale
data analysis

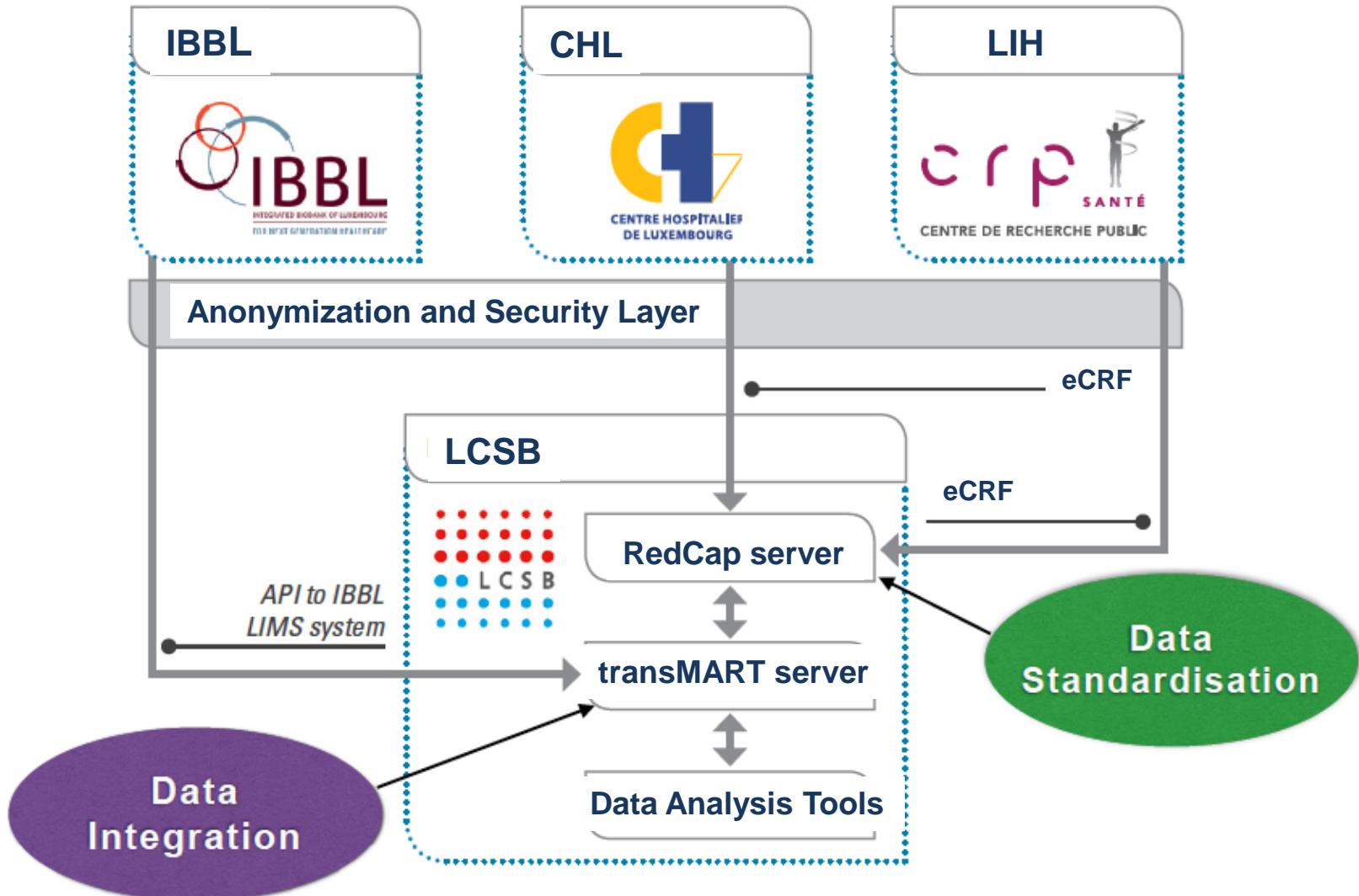
Large scale
automatic
text mining

Research Efficiency, Performance Reproducibility



The biggest challenge of all

Data Integration & Data Standardization



Driver, partner, competition?



Deep learning

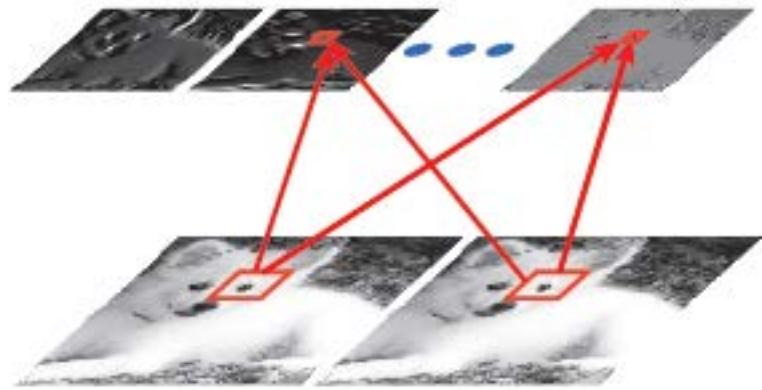
Yann LeCun^{1,2}, Yoshua Bengio³ & Geoffrey Hinton^{4,5}

Probabilistic machine learning and artificial intelligence

Zoubin Ghahramani¹

Reinforcement learning improves behaviour from evaluative feedback

Michael L. Littman¹





1. Ensure the legacy of project data/results
2. Facilitate dataset integration
3. Increase operational efficiency
4. Establish a common set of standards

www.eTRIKS.org

Linked In Discussion Group: eTRIKS Twitter @etriks1

Welcome to ELIXIR

Building a sustainable European infrastructure for biological information, supporting life science research and its translation to medicine, agriculture, bioindustries and society.

ELIXIR unites Europe's leading life science organisations in managing and safeguarding the massive amounts of data being generated every day by publicly funded research. It is a pan-European research infrastructure for biological information.

ELIXIR will provide the facilities necessary for life science researchers - from bench biologists to cheminformatics - to make the most of our rapidly growing store of information about living systems, which is the foundation on which our understanding of life is built.

SERVICES



TRAINING



EU PROJECTS



EVENTS

[RD-Connect workshop data linkage and ontologies](#)

24 Sep 2015 (All day) to 25 Sep 2015 (All day)

[ELIXIR UK Workshop: Data Analysis Using IPython](#)

28 Sep 2015 - 09:30

[See more events](#)

NEWS

[ELIXIR - GOBLET workshop: defining an e-learning lingua franca](#)

18 Sep 2015

[Barend Mons appointed Chair of European Commission's high level expert group on 'European Open Science Cloud'](#)

17 Sep 2015

[ELIXIR appoints Martin Cook as Web Developer](#)

11 Sep 2015

[See more news...](#)

Tweets

[Follow](#)

AlfonsoValencia
@Alfons_Valencia

15h

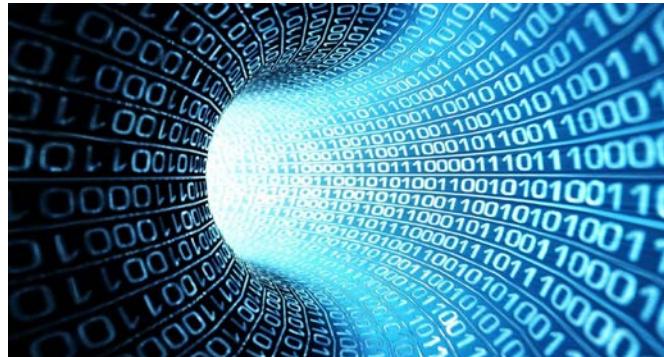
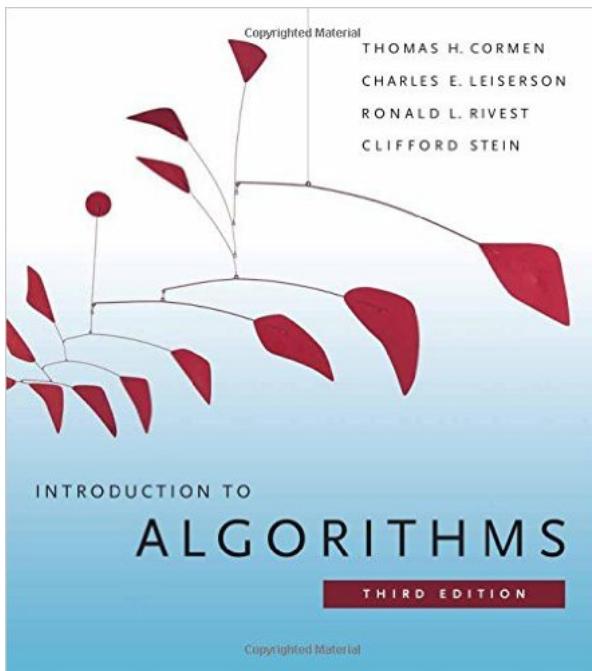
Visit: @TorstenSchwede @jurgenhaas @isbsib. "Online Evaluation Systems of Bioinformatics services" for @ELIXIREurope
pic.twitter.com/JaWlrfx7pS

Retweeted by ELIXIR Europe

Biomedicine: Quo vadis?

data **science**

Scientists support research activity in sciences. Data is used to support science. The word "data" is composed of various terms related to science and research.



ITTM - IT for Translational Medicine

HOME SOLUTIONS & SERVICES PROJECT EXPERIENCES CONTACT ABOUT US

ITTM S.A. - Information Technology for Translational Medicine



Data Curation and Integration
tranSMART Hosting
Software Development
Data Archiving & Backup

ITM SOLUTIONS

OUR SOLUTIONS

Contact us:

ITTM S.A.
9, avenue des Hauts-Fourneaux
L-4362 Esch-sur-Alzette
Luxembourg

 **transSMART** FOUNDATION ITTM is a member of the transSMART Foundation

[Druckversion](#) | [Sitemap](#)

[Login](#)

ITNATION.LU
TECHNOLOGY - BUSINESS - NETWORKING

DON'T MISS SES choisit System Solutions pour son plus grand projet IT Posted 3 days ago

Home > News > Actualité > POST Luxembourg prend une participation dans une spin-off de Biomedicine

POST Luxembourg prend une participation dans une spin-off de Biomedicine

By [Jessica Cencetti](#) on October 23, 2015

Posts by Jessica Cencetti

POST Luxembourg a pris une participation dans une société récemment créée par des chercheurs du Luxembourg Centre for Systems Biomedicine (LCSB) de l'Université du Luxembourg.

La nouvelle entreprise, Information Technology for Translational Medicine (ITTM S.A.), est spécialisée dans la préparation et l'analyse de données provenant d'essais cliniques. Par l'intermédiaire de sa filiale POST Capital, POST Luxembourg a acquis environ 35 % des actions d'ITTM. Le directeur général d'ITTM, le Dr Andreas Kremer, et le directeur général adjoint de POST Luxembourg, Joseph Glod, viennent de signer les contrats en

ITTM

Information Technology
for Translational Medicine

Le Luxembourg
est un pays de l'Europe

 innovation.
public.lu

News > October

21-10-2015

"Biomedical research is an important driver for IT"

ITTM POST Luxembourg takes a share in an LCSB spin-off

[f](#) [t](#) [e](#) [m](#) [s](#)

ITTM
Information Technology
for Translational Medicine

POST Luxembourg has taken a share in a company recently founded by scientists of the Luxembourg Centre for Systems Biomedicine (LCSB) of the University of Luxembourg. The new enterprise, Information Technology for Translational Medicine (ITTM S.A.), specialises in the preparation and analysis of data from clinical trials. Through its subsidiary POST Capital, POST Luxembourg has acquired about 35 percent of the shares in ITTM. ITTM Managing Director Dr Andreas Kremer and POST Luxembourg Deputy Managing Director Joseph Glod have recently signed the contracts to this effect.

Automatization & Miniaturization

Genome sequencing



Applied Biosciences, 1987



Oxford Nanopore, 2016

HPC/Big Data Uni LU



- 4 Admins, 4 clusters, ~322 users
- 446 nodes, 4788 cores (70 TFlops)
- 29 GPU boards
- LCSB has additional several large RAM server (1 - 4 TB)
- Cumulative shared raw storage: 5 PB
- > 7,31 M€ HW investment so far
- in 2016 new server rooms (Maison du Savoir)
- FPGA Dragen bioinformatics processor (Edico genome)



Reconstruction of Human metabolism

computational
BIOLOGY

RESOURCE

NATURE BIOTECHNOLOGY VOLUME 31 NUMBER 5 MAY 2013



Ines Thiele

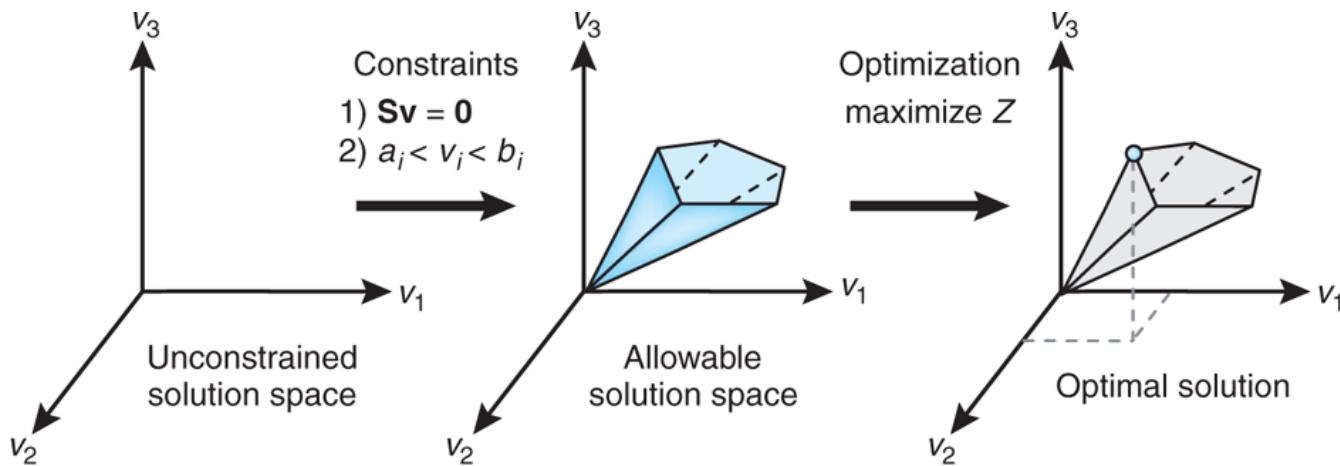
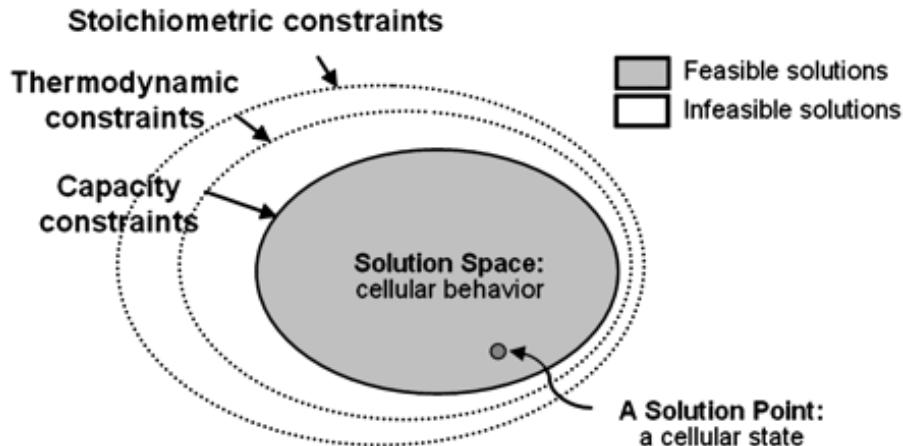
A community-driven global reconstruction of human metabolism

Ines Thiele^{1,4,37}, Neil Swainston^{3,4,37}, Ronan M T Fleming^{1,5}, Andreas Hoppe⁶, Swagatika Sahoo¹,
Maike K Aurich¹, Hulda Haraldsdottir¹, Monica L Mo⁷, Ottar Rolfsson¹, Miranda D Stobbe^{8,9},
Stefan G Thorleifsson¹, Rasmus Agren¹⁰, Christian Bölling⁶, Sergio Bordel¹⁰, Arvind K Chavali¹¹,
Paul Dobson¹², Warwick B Dunn^{3,13}, Lukas Endler¹⁴, David Hala¹⁵, Michael Hucka¹⁶, Duncan Hull⁴,
Daniel Jameson^{3,4}, Neema Jamshidi⁷, Jon J Jonsson⁵, Nick Juty¹⁷, Sarah Keating¹⁷, Intawat Nookaew¹⁰,
Nicolas Le Novère^{17,18}, Naglis Malys^{3,19,20}, Alexander Mazein²¹, Jason A Papin¹¹, Nathan D Price²²,
Evgeni Selkov, Sr²³, Martin I Sigurdsson¹, Evangelos Simeonidis^{22,24}, Nikolaus Sonnenschein²⁵, Kieran Smallbone^{3,26},
Anatoly Sorokin^{21,27}, Johannes H G M van Beek²⁸⁻³⁰, Dieter Weichert^{3,31}, Igor Goryanin^{21,32}, Jens Nielsen¹⁰,
Hans V Westerhoff^{3,28,33,34}, Douglas B Kell^{3,35}, Pedro Mendes^{3,4,36} & Bernhard Ø Palsson^{1,7}

its re

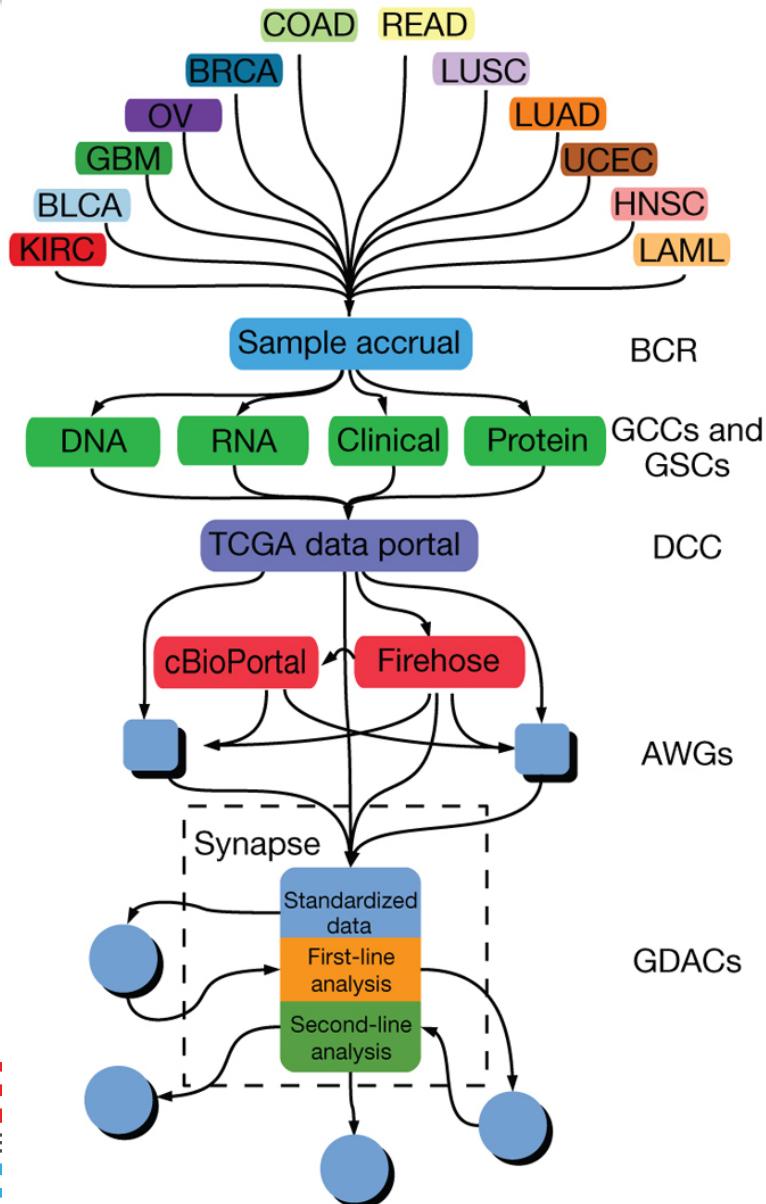


Constraint based modeling





Bioinformatics Core Facility of the LCSB: >35 FTE's
Cluster with >5000 cores
Several large memory machine 1-4 TB RAM
~4 PetaByte storage



Disease Consortia and Cohorts

Biospecimen Collection Resource

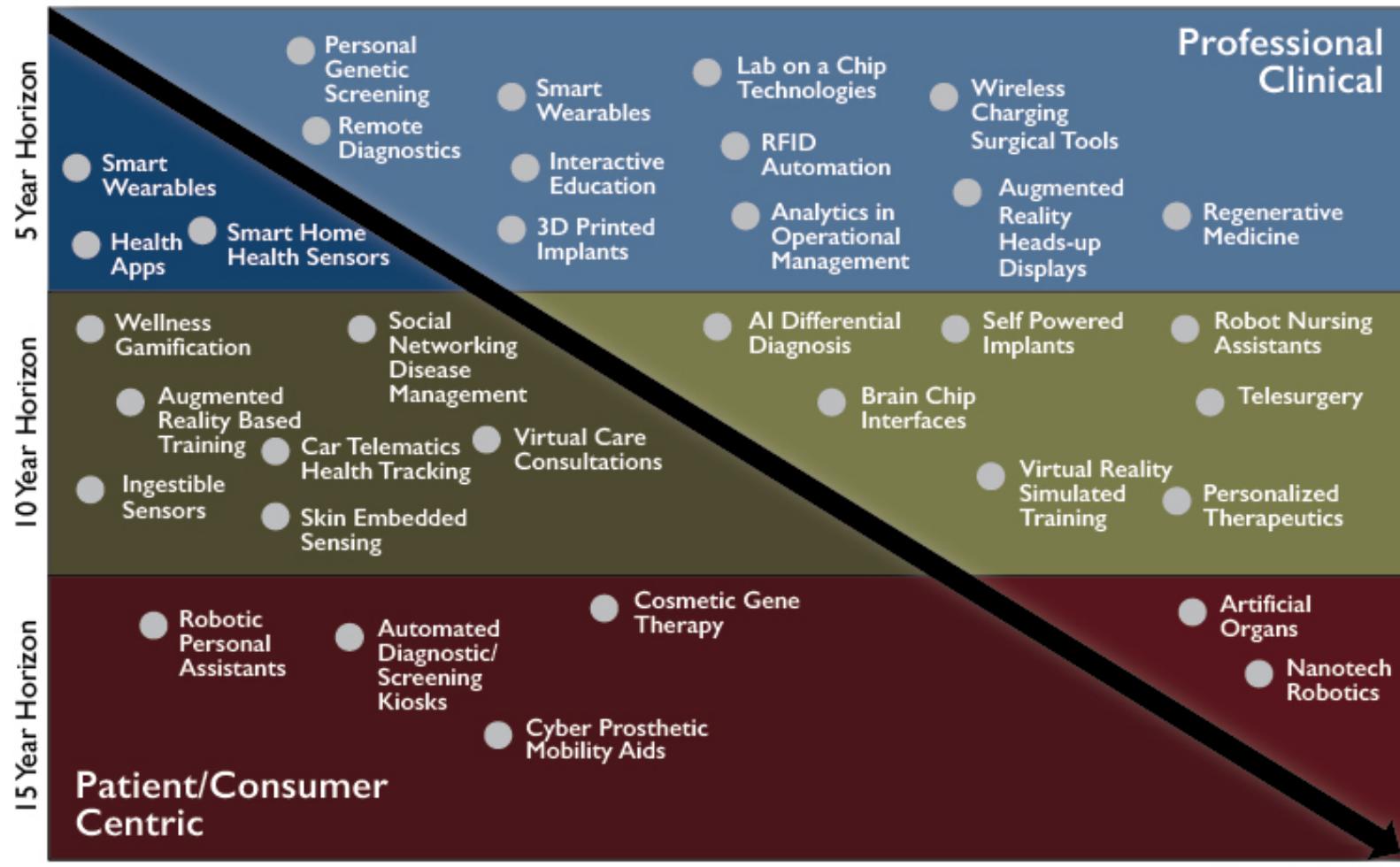
**Genome Characterization Centre
Genome Sequencing Centre**

Data Coordination Centre

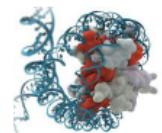
Analysis Working Group

Genome Data Analysis Centre

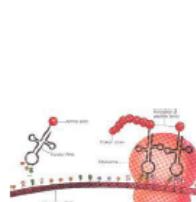
New Technologies in Biomedicine & Healthcare



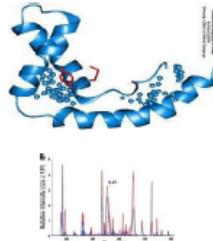
Experimental data



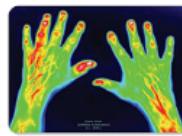
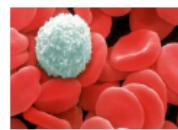
Epi/Genetics
DNA variants & modification



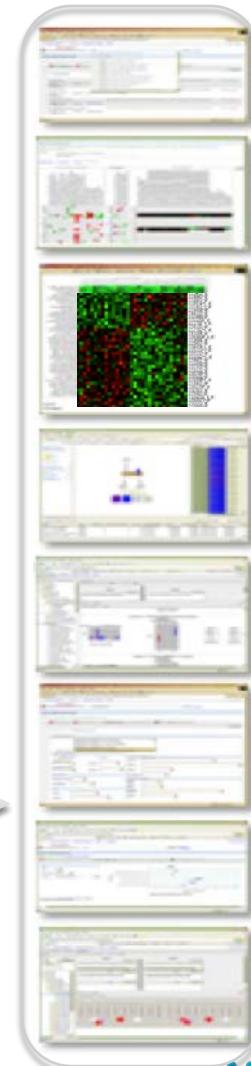
Transcriptome
mRNA, ncRNA
miRNA



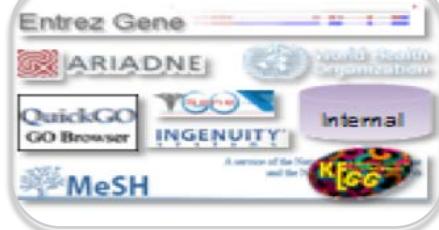
Peripheral markers
Proteins, metabolites,
cells, microbes



Clinical Observations



External data



**Extract,
Transform &
Load (ETLs)**



Analytics