

El médico ante el mundo de los datos

Ignacio Hernández Medrano
@ihmedrano

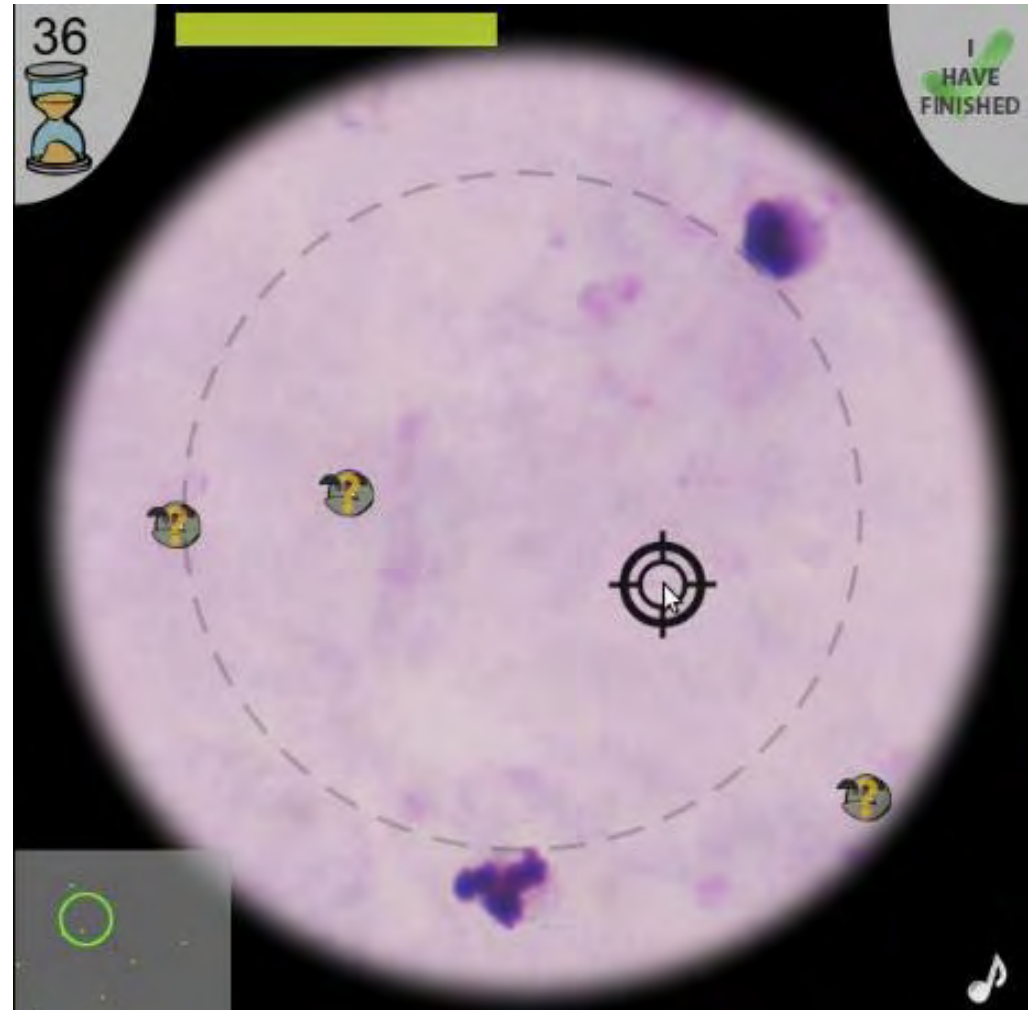
11 de mayo de 2017



Matternet: drones to bring drugs closer

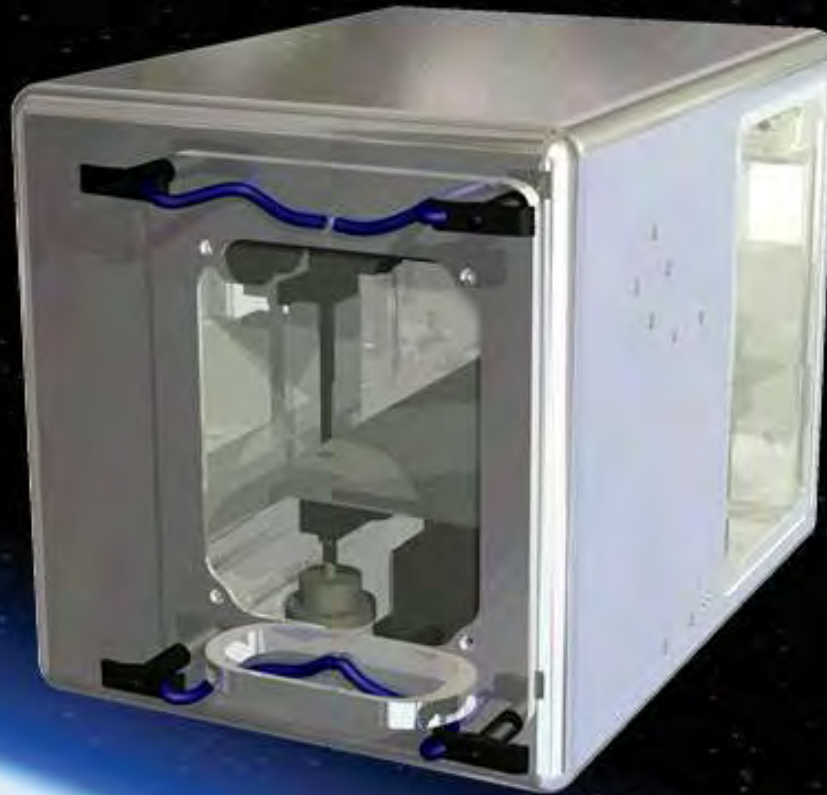


Malariaspot: luchando contra la malaria a través de los videojuegos





MADE IN SPACE



3D Printing in Zero-G International Space Station
(ISS) Technology Demonstration



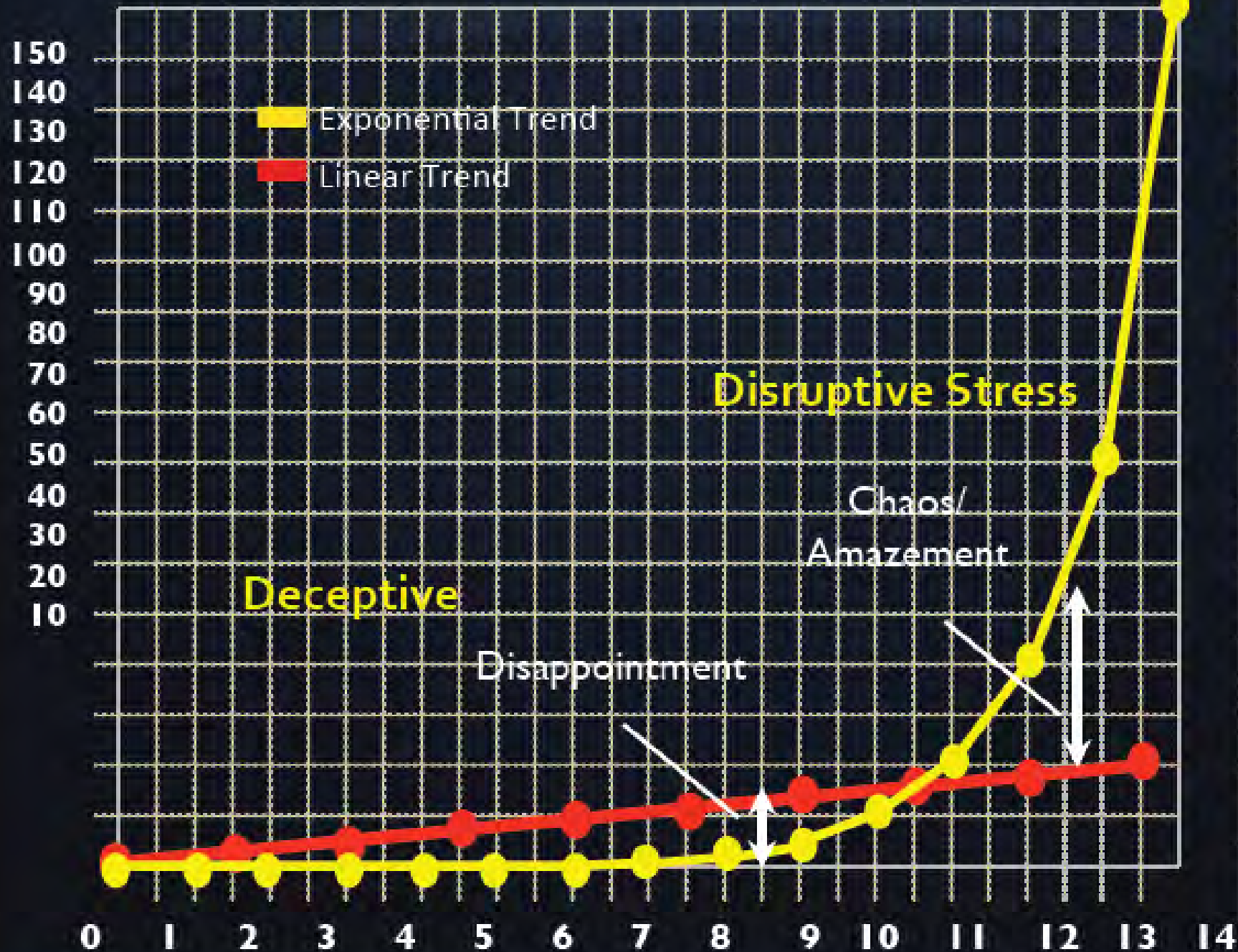
SINGULARITY UNIVERSITY



Quien **sigue** tendencias, entiende el mundo.

Quien **anticipa** tendencias, lo cambia.

Linear Vs. Exponential



0	0.01
1	0.02
2	0.04
3	0.08
4	0.16
5	0.32
6	0.64
7	1.28
8	2.56
9	5.12
10	10.2
11	20.5
12	40.9
13	81.9
14	163.8

LINEAR



EXPONENTIAL



1996

MarketCap: **\$28B**

Employees: **140,000**



2012

MarketCap: **<\$100M**

Employees: **17,000**



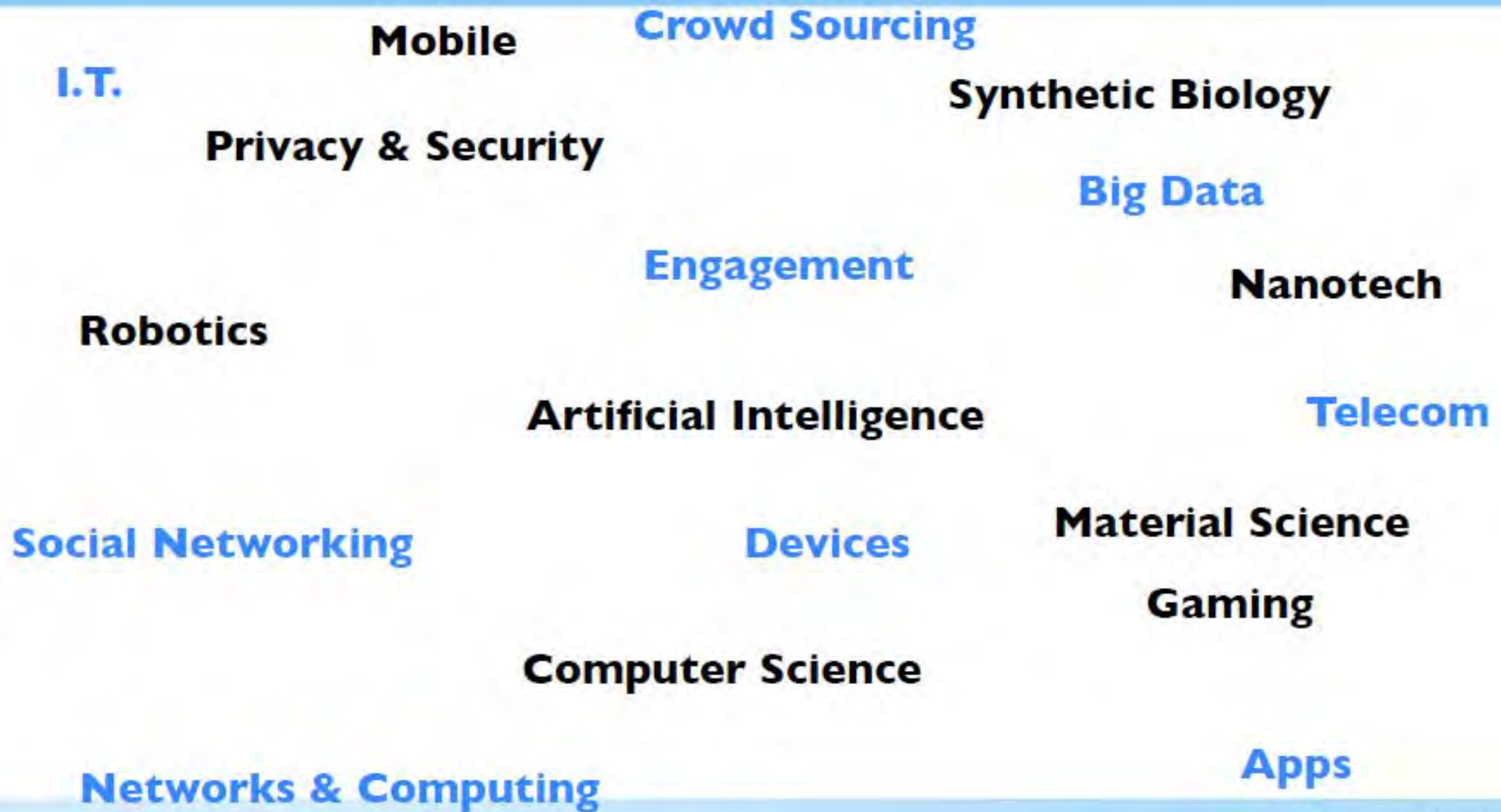
April 2012

MarketCap: **\$1B**

Employees: **13**

VIA 9GAG.COM





Mobile

I.T.

Crowd Sourcing

Synthetic Biology

Privacy & Security

Big Data

Engagement

Robotics

Nanotech

Artificial Intelligence

Social Networking

Telecom

Material Science

Devices

Gaming

Computer Science

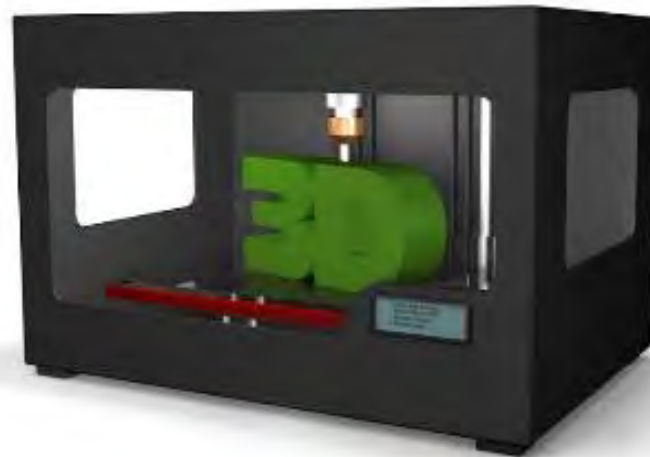
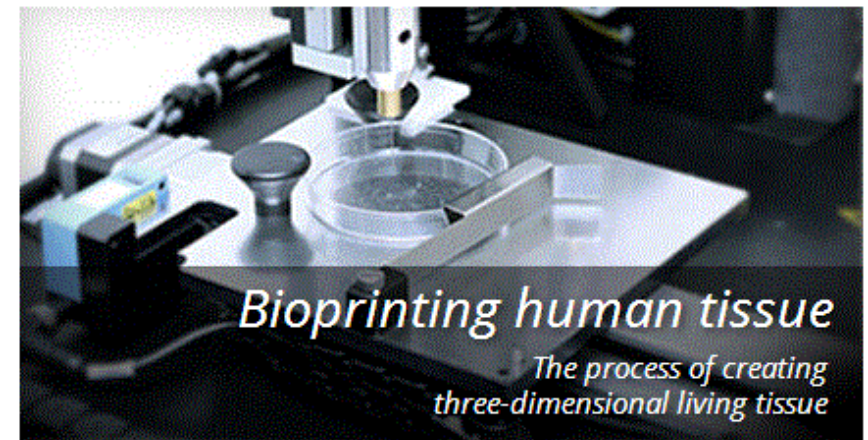
Networks & Computing

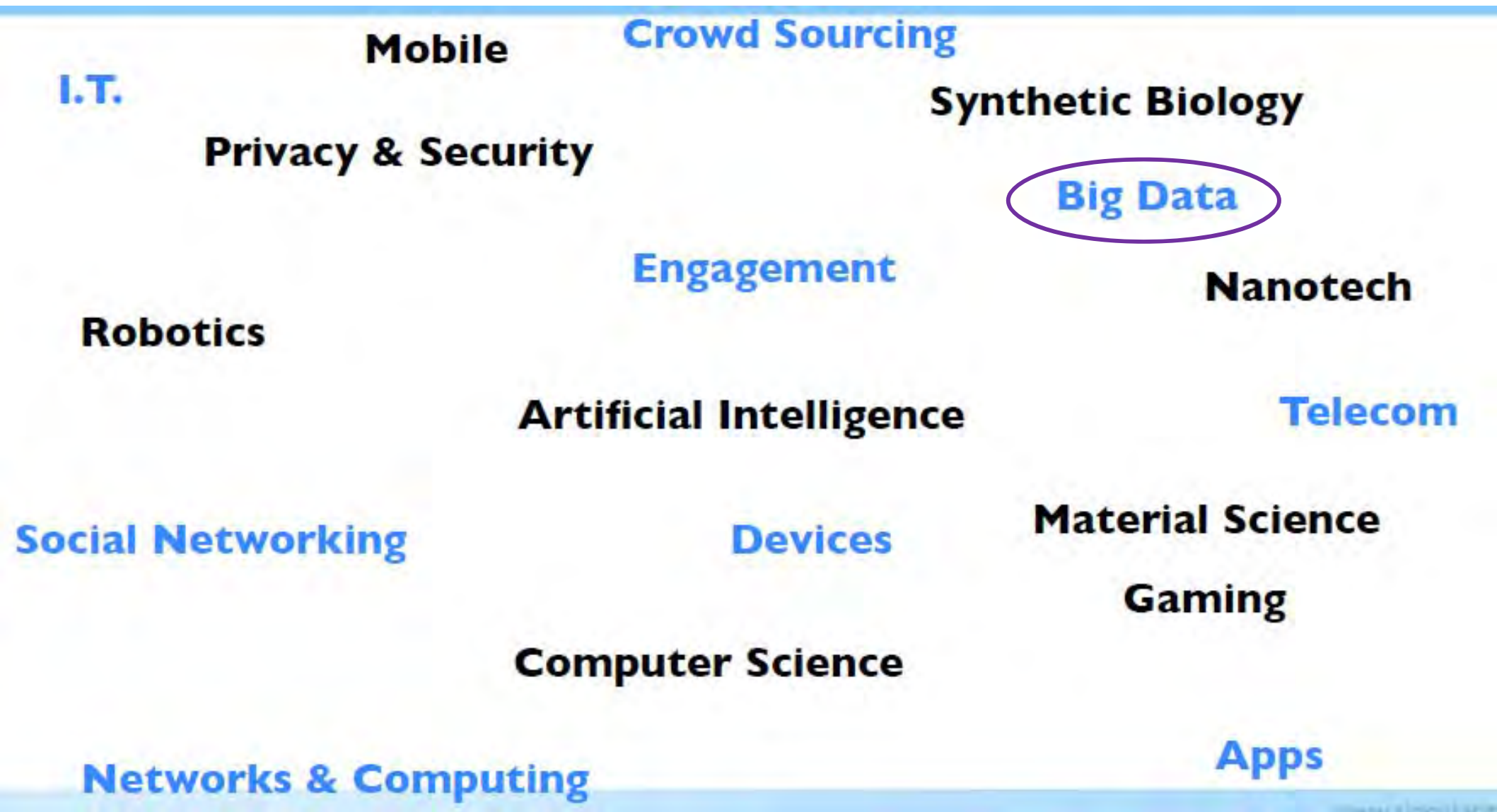
Apps

Sensors









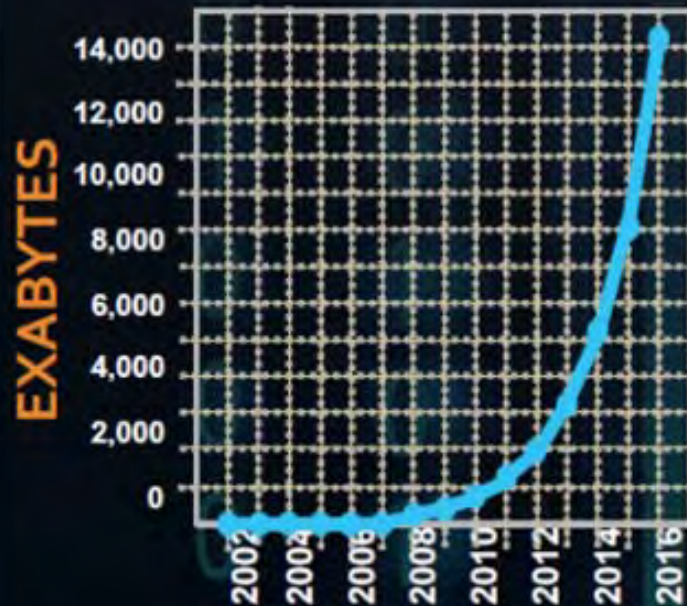


**explosión
big data**



The Exponential Growth of Data...

5 EXABYTES = 5 BILLION-GIGABYTES



From the start of time

~ 2003

In 2010...

~2 days

In 2013...

~10 minutes

>72 Hours of video content is added to YouTube every minute

A commercial airliner generates 1 Terabyte of data per day.

2015 = ~8,000 EXABYTES/yr



Machine Learning: Google Translate Example





shaadi.com

**Celebrate
the joy of
Marriage**

Register Now

Find your Life Partner

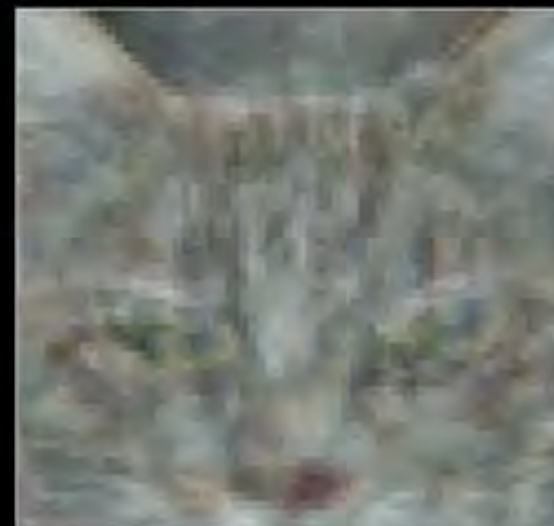
A woman is shown in traditional Indian wedding attire, including a yellow sari, a large gold necklace, and a white garland. She is smiling and looking towards the camera. The background is a solid red color.

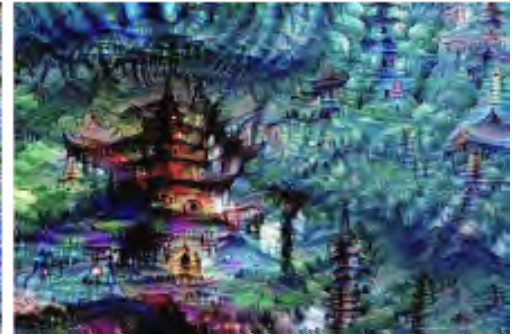
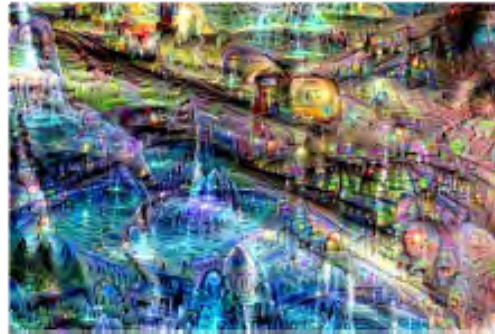
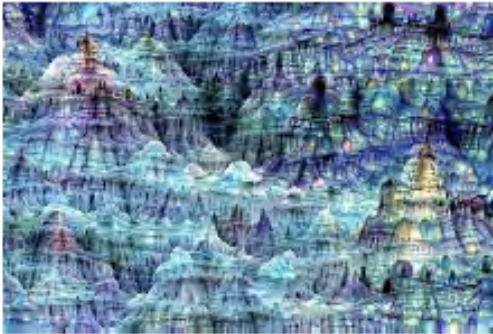
Building High-level Features Using Large Scale Unsupervised Learning

Q. Le, M. Ranzato, R. Monga, M. Devin, K. Chen,
G. Corrado, J. Dean, A. Ng

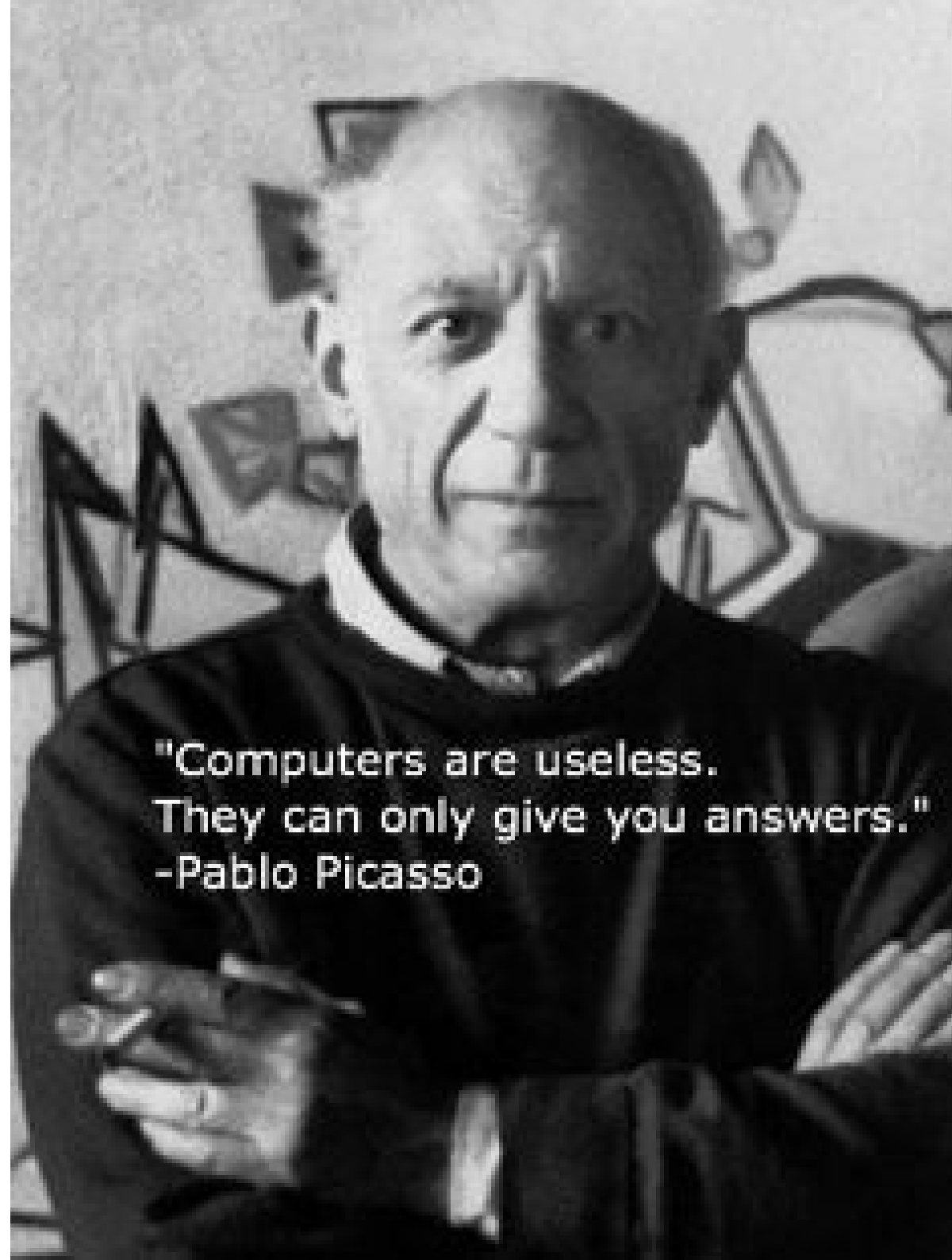
Stanford / Google

1 billion connections
10 million 200x200 pixel images
1,000 machines (16,000 cores)
3 days





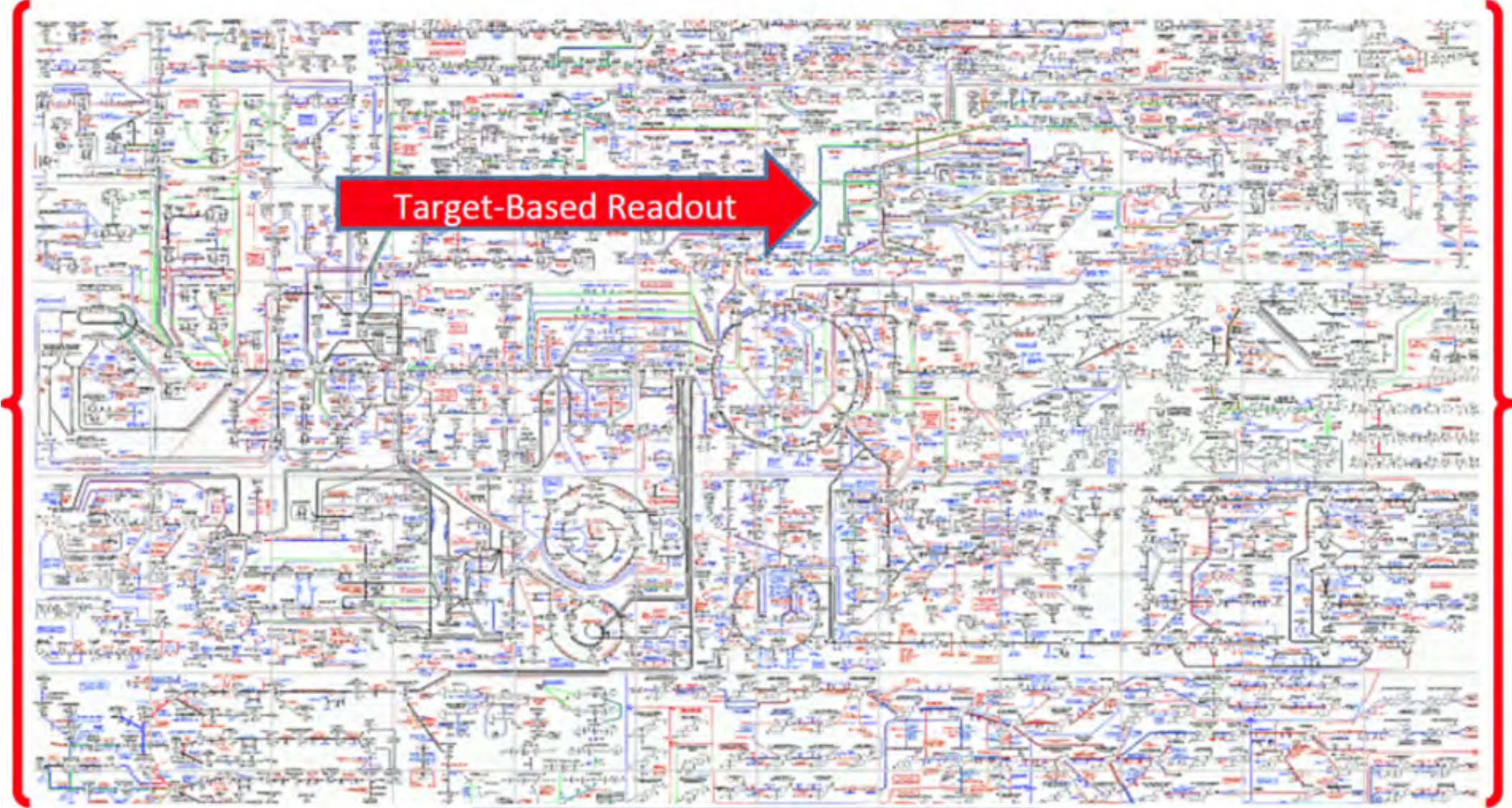
<https://github.com/graphific/DeepDreamVideo>



"Computers are useless.
They can only give you answers."
-Pablo Picasso



High-Content Analysis Provides Systemic Readout

A detailed photograph of a printed circuit board (PCB) populated with numerous electronic components, including integrated circuits, resistors, and capacitors. The board is densely packed with components and intricate wiring. A large red arrow is superimposed on the image, pointing from the left towards the center-right. The arrow contains the text 'Target-Based Readout' in white. The entire image is framed by a red border.

Target-Based Readout

Systemic Readout

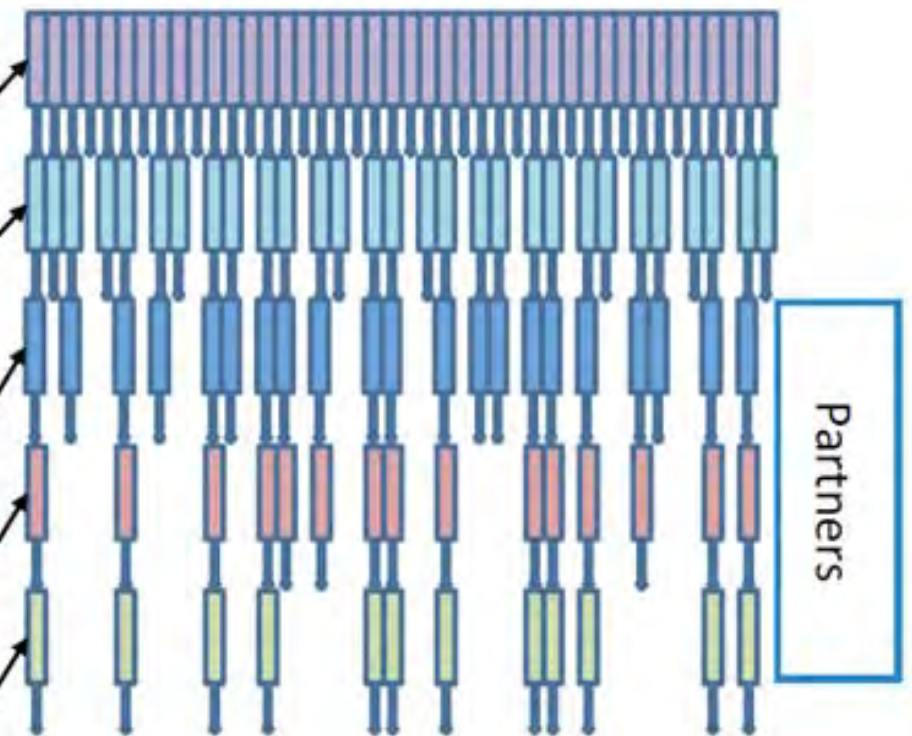
Traditional Drug Discovery

1 new drug = >\$1B and 1 decade



Recursion Drug Discovery

Dozens of new drugs = \$Many Millions and 3-6 years

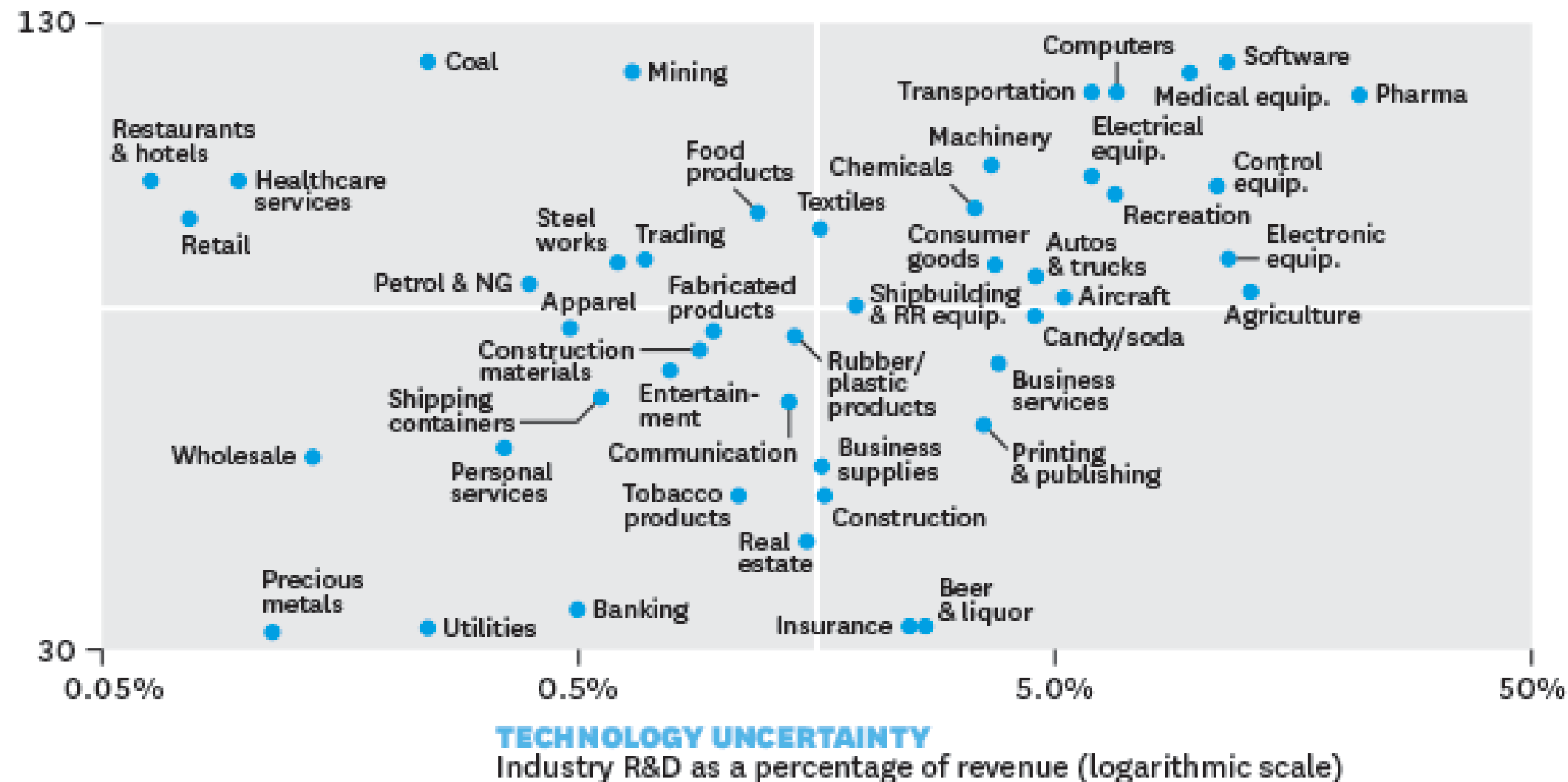


RECURSION
pharmaceuticals

DEMAND AND TECHNOLOGICAL UNCERTAINTY BY INDUSTRY, 2002-2011

DEMAND UNCERTAINTY

Index of industry revenue volatility and firm turnover (logarithmic scale)



Savana: Un Entorno Integral de Extracción de Información y Expansión de Terminologías en el Dominio de la Medicina

Savana: A Global Information Extraction and Terminology Expansion Framework in the Medical Domain

Luis Espinosa-Anke^{*†}, Jorge Tello[†], Alberto Pardo^{**}, Ignacio Medrano[†]
Alberto Ureña[†], Ignacio Salcedo[†], Horacio Saggion^{*}

^{*}TALN-DTIC, Universitat Pompeu Fabra, Carrer Tànger, 122 08018 -Barcelona

[†]Medsavana S.L., C/ Jiloca 4 - 5 Derecha, 28016 - Madrid

^{**}Fundación Jiménez Díaz

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alberto.pardo@quironsalud.es



SAVANA
CONSULTA



ℹ Rellena el siguiente formulario y lanza la búsqueda

Options



Antecedentes y tratamientos previos

mensaje atenuado

Situación clínica actual

mensaje atenuado

Especialidad

Todas



Edad entre

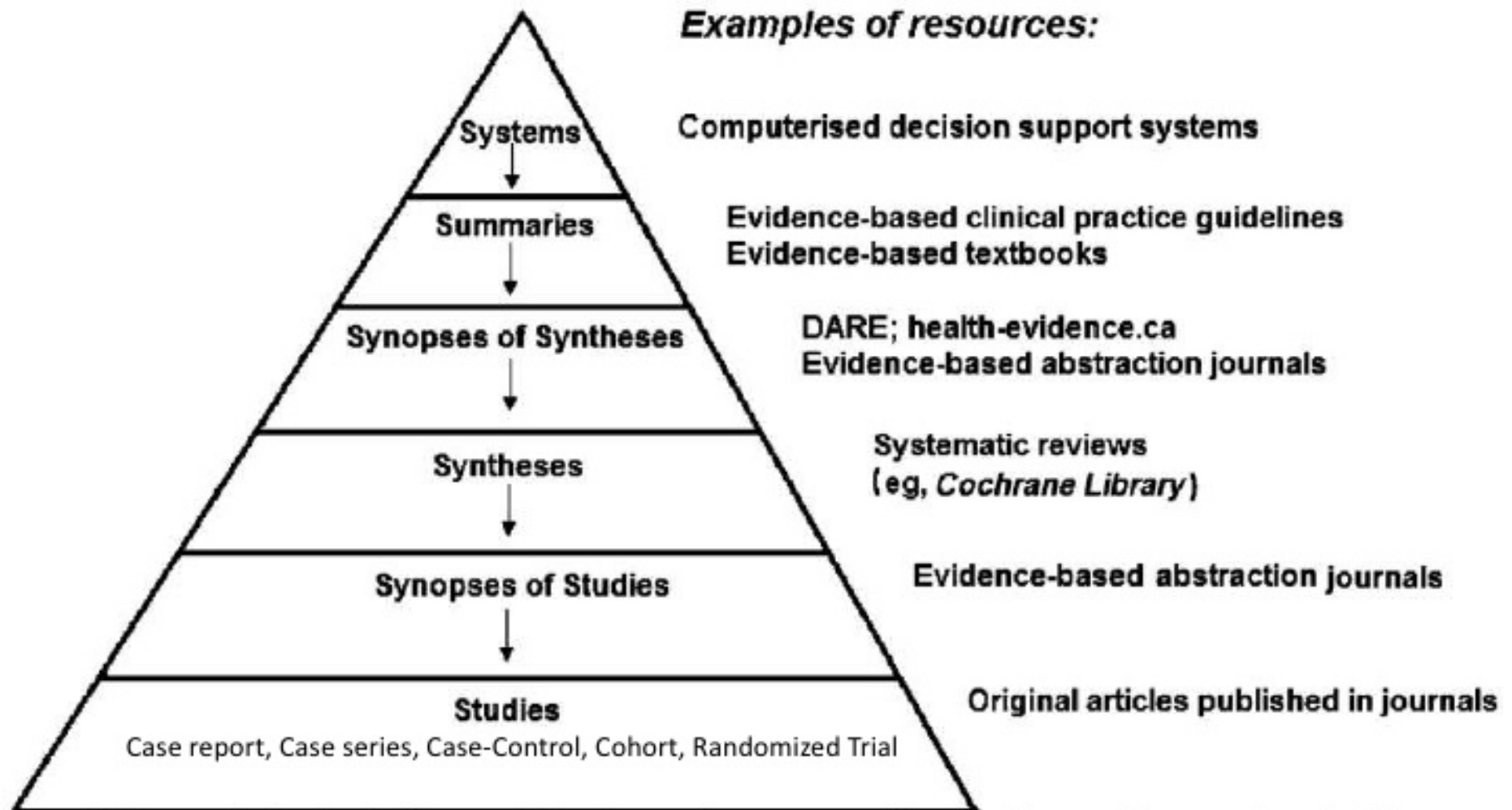
0

-

100

🔍 Buscar

Searching for evidence



DiCenso A, Bayley L, Haynes RB. Accessing preappraised evidence: fine-tuning the 5S model into a 6S model. ACP Journal Club, 2009

\$10M QUALCOMM TRICORDER X PRIZE

HEALTHCARE IN THE PALM OF YOUR HAND...

FUNDED BY THE QUALCOMM FOUNDATION



Qualcomm Tricorder X PRIZE Team Distribution



>330 TOTAL TEAMS
33 NATIONS AS OF 2013

The exponential growth of computing on a *Logarithmic Plot*

Calc./second for a \$1000 laptop vs. Time

Calculations per Second per \$1000

10^{60}
 10^{55}
 10^{50}
 10^{45}
 10^{40}
 10^{35}
 10^{30}
 10^{25}
 10^{20}
 10^{15}
 10^{10}
 10^5
 10^0
 10^{-5}
 10^{-10}

1900

'20

'40

'60

'80

2000

Year

'20

'40

'60

'80

2100

10^8

10^{11}

10^{16}

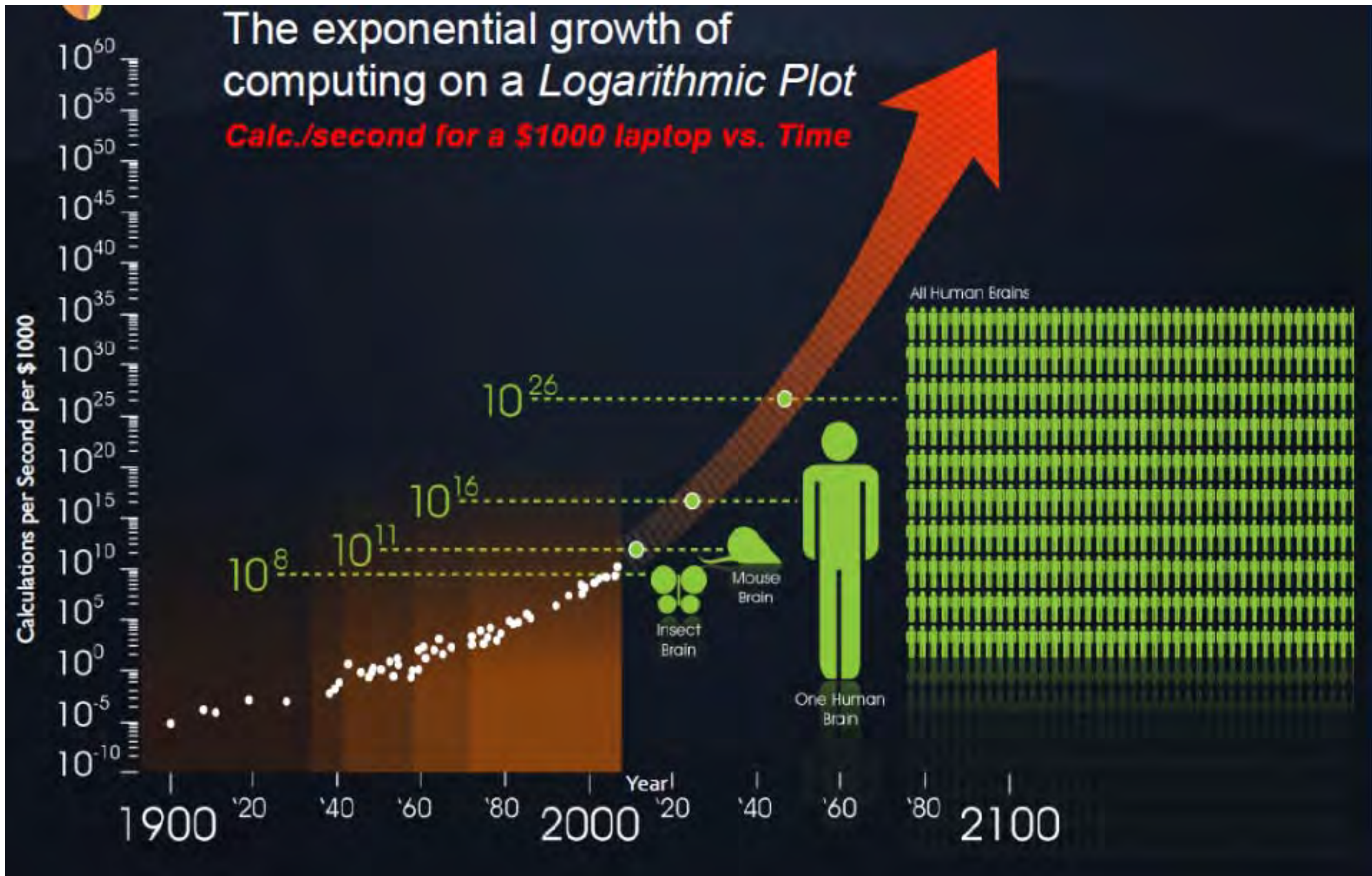
10^{26}

Insect
Brain

Mouse
Brain

One Human
Brain

All Human Brains



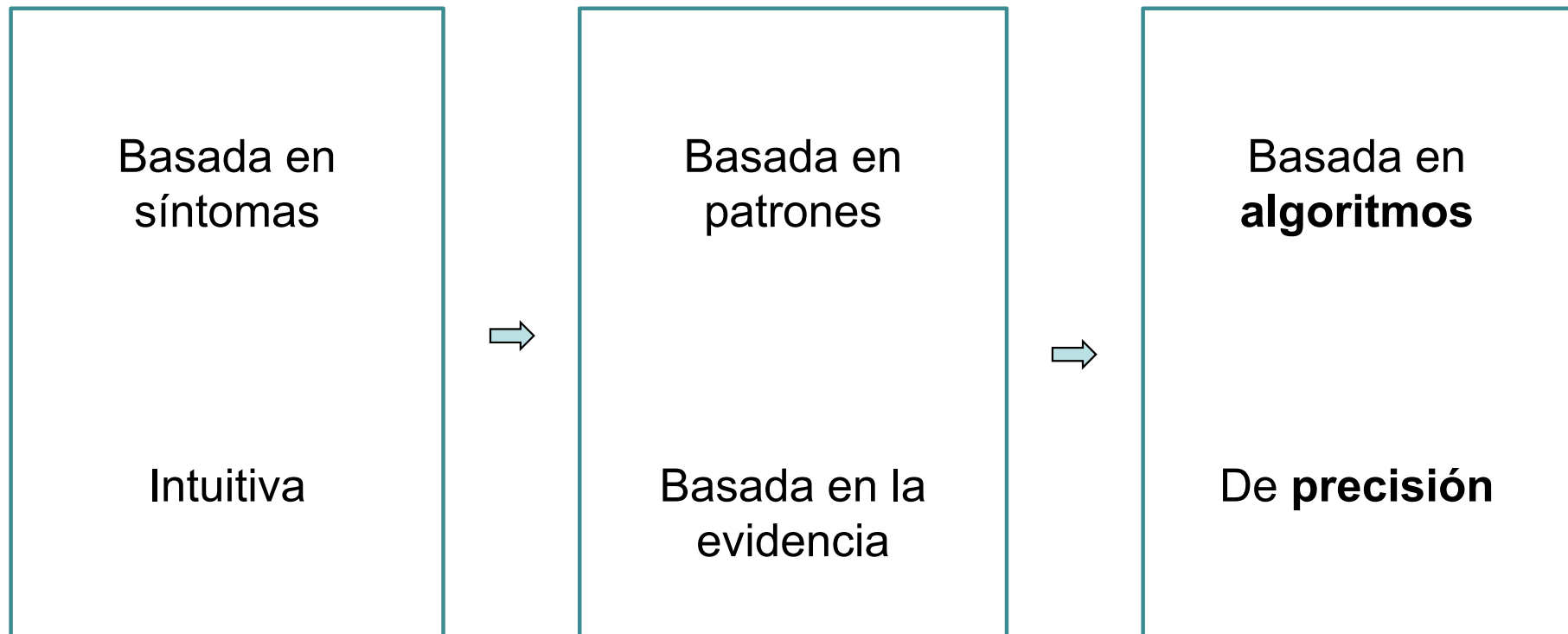
\$10M QUALCOMM TRICORDER X PRIZE

HEALTHCARE IN THE PALM OF YOUR HAND...

FUNDED BY THE QUALCOMM FOUNDATION

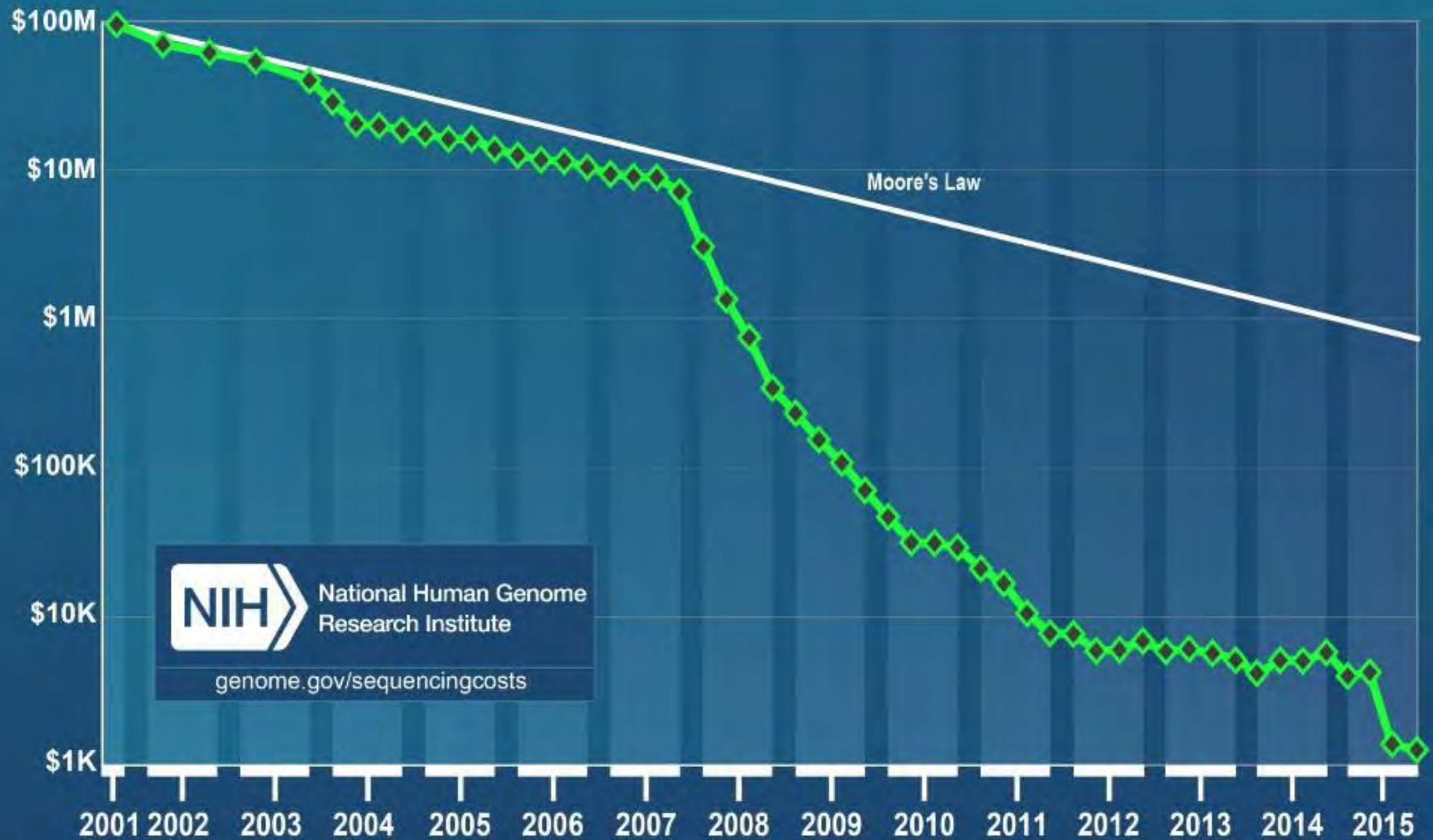


Medicina





Cost per Genome



In The Future - DNA information will just exist. For everyone.



In 2025, Everyone Will Get DNA Mapped At Birth

Alice Park | @aliceparky | June 30, 2014



Scientists have scoured trends in research grants, patents and more to come up with these 10 innovations that will be reality in 10 years (or so they think)

Everybody likes to blue-sky it when it comes to technology. Driverless cars! Fat-burning pills! Telepathic butlers! But the folks at Thomson Reuters



How Useful is Your Genome?

Medical Utility



Diagnosis



Predict Risk



Select Therapy



Carrier screening



Pre-Implantation Genetic Diagnosis



Pre-natal screening

Personal Utility



Genetically Curious?



Ancestry



Traits



Lifestyle



Optimize Wellness



Personalization of products

mendelian

The best way to predict the future is to
create it.

Alan Kay

Clinical Features

Trunk ataxia



Abnormality of the corpus callosum



Related Clinical Features

Vitreoretinopathy



Somnolence



Nonprogressive cerebellar ataxia



Chorioretinal coloboma



Abnormal lower motor neuron morphology



Other family members with similar clinical features (experimental):



Results

[Show details](#)Genes: [download as a file](#)

NAT8L, SLC1A3, COG5, CWF19L1, HARS, ATP8A2, SYT14, STUB1, ARID1A, KCTD7

Diseases: [download as a file](#)

N-ACETYLSPARTATE DEFICIENCY; NACED

Genes: NAT8L

Ref: OMIM 614063 Score: 0.16666666666666666

EPISODIC ATAXIA, TYPE 6; EA6

Genes: SLC1A3

Ref: OMIM 612656 Score: 0.125

CONGENITAL DISORDER OF GLYCOSYLATION, TYPE II; CDG2I

Genes: COG5

Ref: OMIM 613612 Score: 0.125

SPINOCEREBELLAR ATAXIA, AUTOSOMAL RECESSIVE 17; SCAR17

Genes: CWF19L1

Ref: OMIM 616127 Score: 0.125

USHER SYNDROME, TYPE IIIIB; USH3B

Genes: HARS

Ref: OMIM 614504 Score: 0.11111111111111111

CEREBELLAR ATAXIA, MENTAL RETARDATION, AND DYSEQUILIBRIUM SYNDROME 4; CAMBQ4

Genes: ATP8A2

Ref: OMIM 615268 Score: 0.1

SPINOCEREBELLAR ATAXIA, AUTOSOMAL RECESSIVE 11; SCAR11

Genes: SYT14

Ref: OMIM 614229 Score: 0.1

SPINOCEREBELLAR ATAXIA, AUTOSOMAL RECESSIVE 16; SCAR16

Genes: STUB1

mendelian-genes.csv

160531_pmtic...pdf

160531_diarlod...pdf

160530_pampl...pdf

[Mostrar todas las descargas...](#)

Buscar en la web y en Windows

17:30
02/06/2016

The Future: Combining Genetic Risk with Chronic Disease Monitoring

Patel et al. *Genome Medicine* 2013, 5:58
http://genomemedicine.com/content/5/1/58



RESEARCH

Open Access

Whole genome sequencing in support of wellness and health maintenance

Chirag J Patel^{1,2†}, Ambily Sivasubramanian^{1†}, Rubina Tabassum², Thanawadee Pileeporn³, Jing Zhao⁴, Dalia Anafie¹, Rong Chen^{1,2,4}, Alexander A Morgan^{1,2}, Gregory S Martin², Kenneth L Brigham⁵, Atul J Butte^{1,2,7} and Greg Gibson^{1,2,6*}

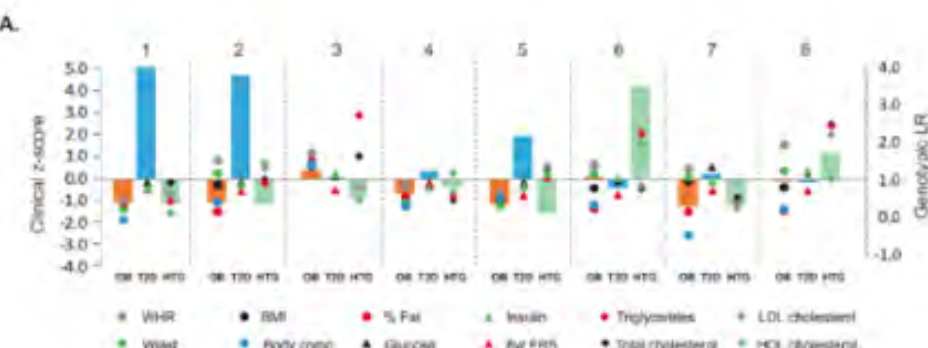
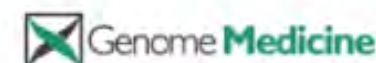


Table 2 Genetic predictions and clinical phenotypes related to metabolic and cardiovascular disorders

Sample ID	Common variant prediction	Clinical phenotype	Clinical risk factors
Q1D-1	T2D (1.3)	—	FMD, CVD, CVD, CVD
Q1D-2	T2D (3.8), MI (1.2)	—	BP, LDL, HDL, SEPR, HDL-C
Q1D-3	Stroke (2.18), CAD (1.2), obesity (1.2)	Obesity	Total cholesterol, TG, LDL, HDL, HDL-C, FMD, PWV, FMD
Q1D-4	T2D (1.2), CAD (1.3)	—	SEPR, LDL, HDL, SEPR, HDL-C, CVD
Q1D-5	CAD (2.0), T2D (2.2), MI (1.3), MI (1.3)	—	Total cholesterol, LDL-C, HDL-C, SEPR, HDL-C, FMD, PWV
Q1D-6	Hypertension (1.4), arterial fibrillation (1.2)	Hypertension	HDL-C, SEPR, HDL-C, CVD
Q1D-7	Stroke (2.18), MI (1.2), arterial fibrillation (1.3), CAD (1.4)	Stroke	FMD, CVD, CVD
Q1D-8	Hypertension (1.2), CAD (1.3)	Hypertension	WHR, glucose, PRS (T2D), total cholesterol, LDL-C, BP, FMD, PWV, FMD

Abbreviations: AIC: Augmentation Index; BP: Blood pressure; CAD: coronary artery disease; CVD: cardiovascular disease; FMD: flow-mediated dilation; PRS: Polygenic Risk Score; HDL: high-density lipoprotein cholesterol; LDL-C: low-density lipoprotein cholesterol; MI: myocardial infarction; SEPR: serum endothelial viability ratio; T2D: Type 2 diabetes; TG: triglycerides; PWV: pulse wave velocity. Numbers in brackets indicate LR due to genetic variants. *Correspondence with clinical risk factors. †Correspondence with clinical phenotype.

Schork *Genome Medicine* 2013, 5:54
http://genomemedicine.com/content/5/1/54



RESEARCH HIGHLIGHT

Genetic parts to a preventive medicine whole

Nicholas J Schork*

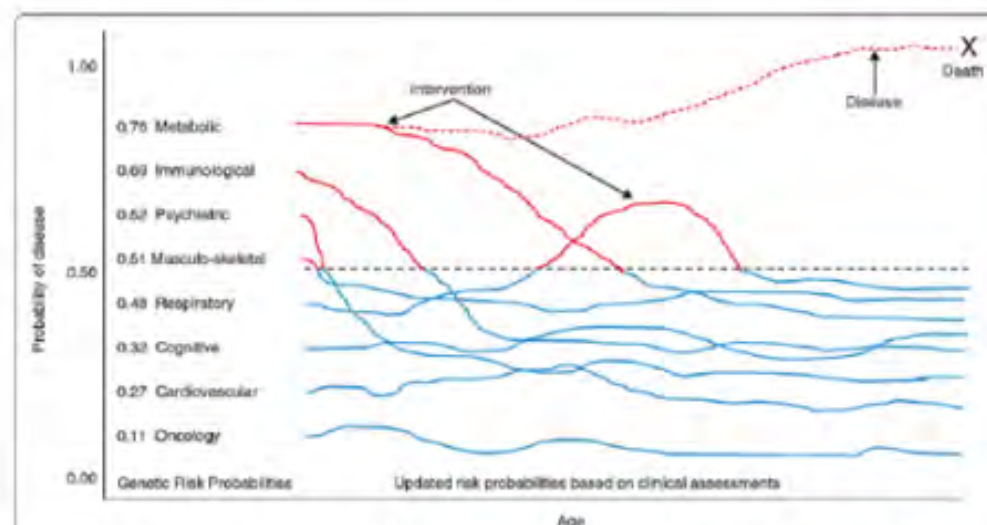


Figure 1. Schematic of the links between genetic risk and longitudinal clinical assessments for disease surveillance and health maintenance. In this scenario, the probabilities of disease based on genetic variants are calculated at a point in time for as many different conditions as possible, preferably at birth to facilitate lifetime health maintenance. Disease risks deemed high (such as with a probability over 0.5, denoted by the black dotted line) are noted and immediately focused on. Clinical measures are then obtained periodically to monitor disease and inform the calculation of a posterior probability of a disease manifesting itself given an individual's genetic predisposition (depicted as lines emanating from each disease category). Risks above the threshold for intervention are noted (red parts of lines). The graph also depicts a hypothetical setting (dashed line) in which risk for metabolic disease is high, clinical measures indicate increased risk and an intervention is not undertaken, leading to disease and ultimately death from that disease.

Slide courtesy Nicholas J Schork, PhD, at JCVI and HLI

**Posture**

Lumo
Zephyr
Jins Memo

**Muscle Activity**

Athos

**Blood Pressure**

Health
Withings

**Skin Conductance**

Basis
Body Media
Empatica
Neumitra

**Movement**

Fitbit
Nike FuelBand
Jawbone Up Band
Garmin
Samsung
MC10
Zephyr
Withings
Spire
iHealth
Jins Memo
Proteus
Neumitra
Body Media
Empatica
Oxlet

**Oxygen Level**

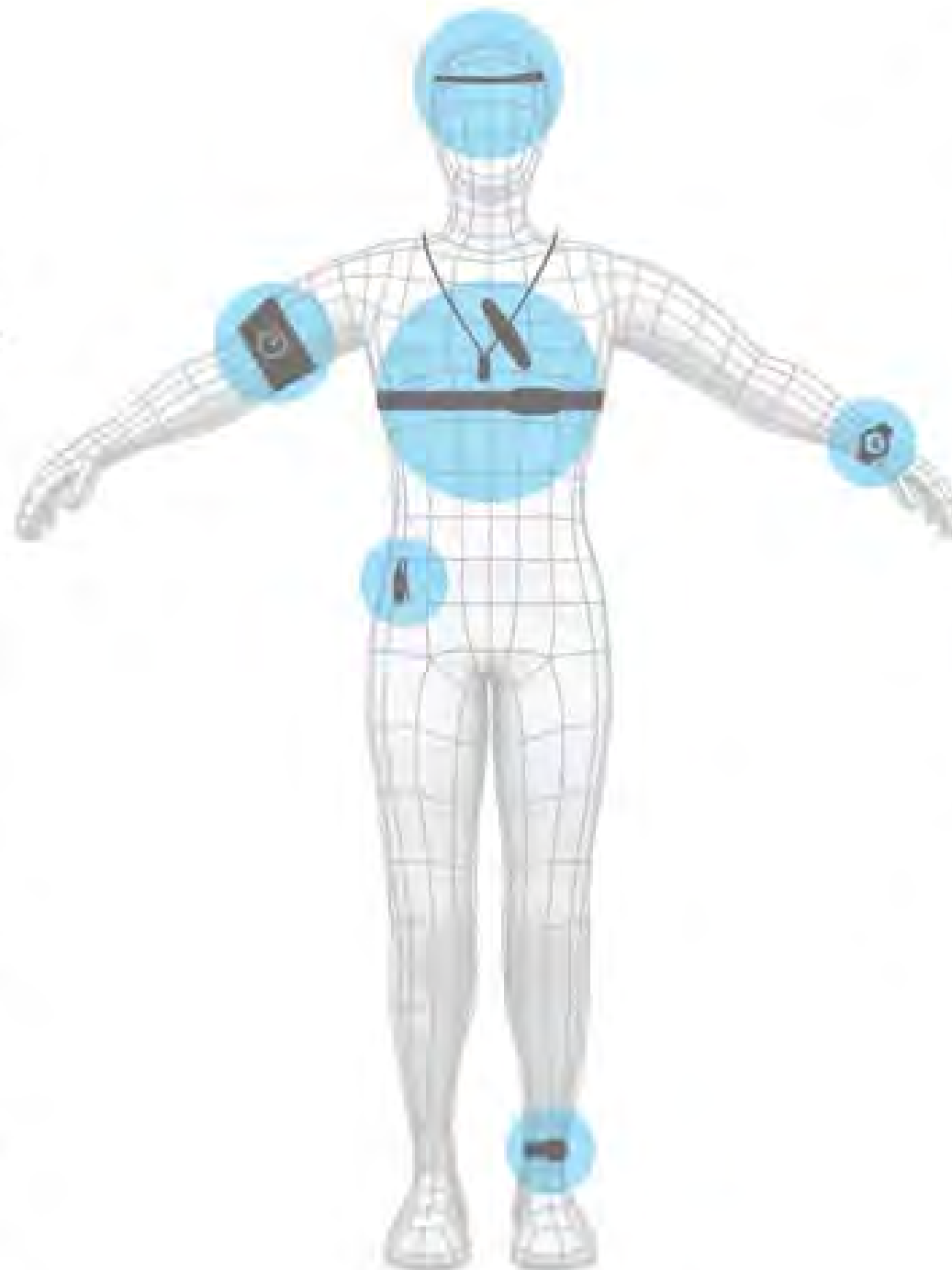
Health
Withings
Oxlet

**Hydration**

Conventis
MC10

**Temperature**

Tempdrop
MC10
Empatica
BodyMedia
Basis
Oxlet

**Brain Activity**

NeuroSky
Melon (acquired by DAQMI)
Emotiv

**Glucose**

Google
Dexcom
Glycens Incorporated

**Eye Tracking**

Jins Memo

**Sleep**

Fitbit
Rest Devices
Garmin
Nike
Amigo
BodyMedia
Withings
Samsung
Might
Jawbone
iHealth
Basis
Oxlet

**Respiration**

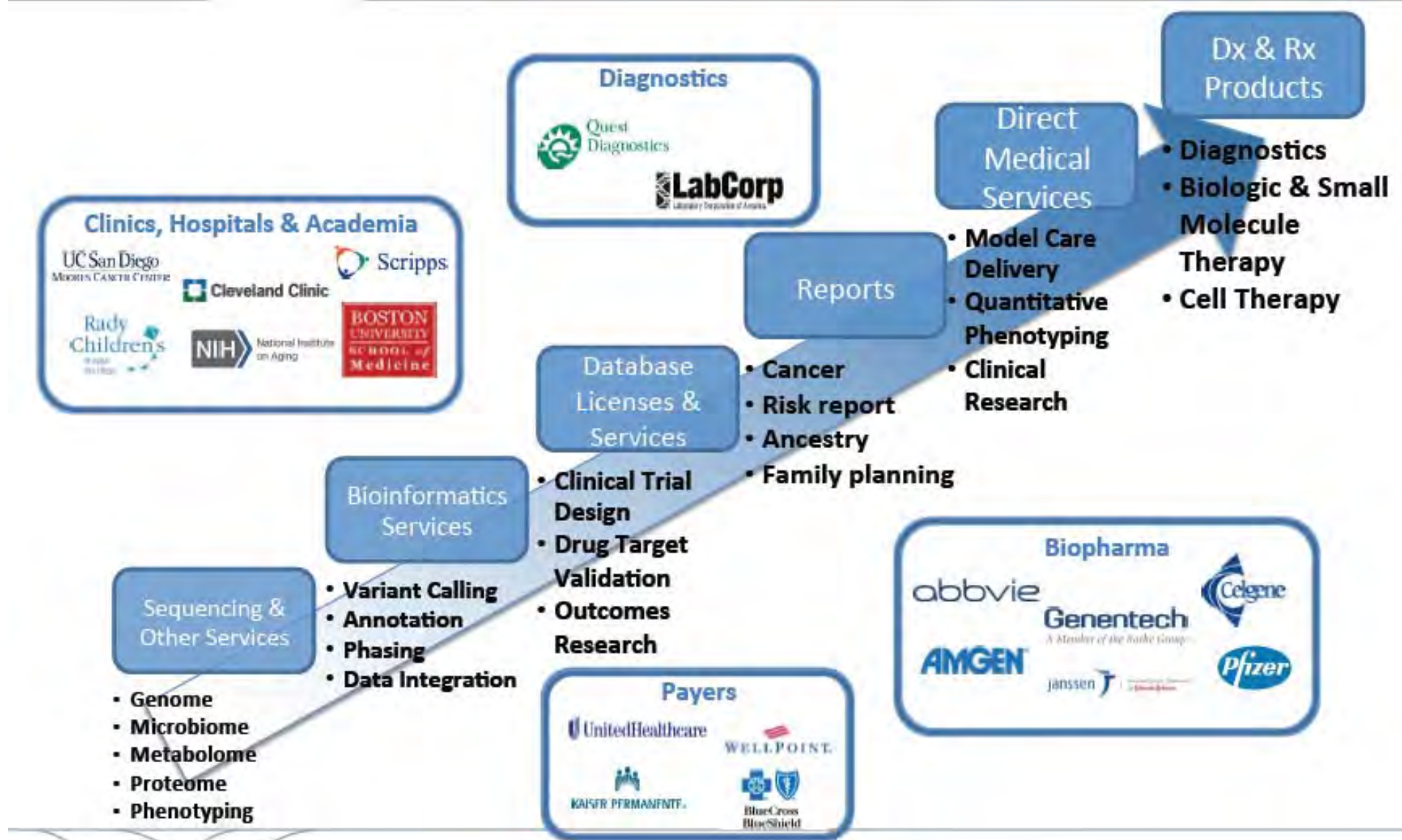
Spira
Zephyr
Rest Devices

**Ingestion**

Proteus

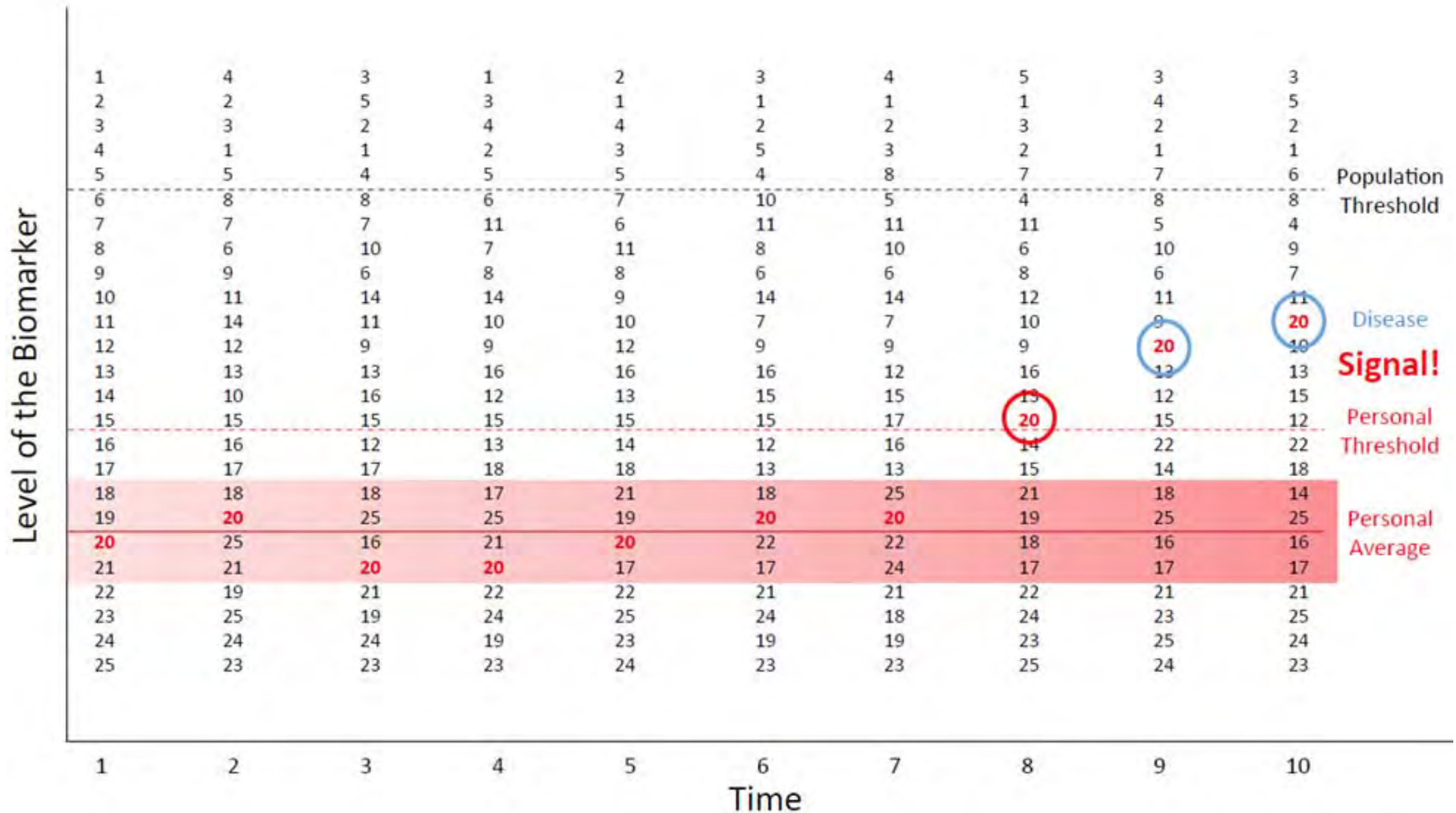
**Heart Tracking**

Zephyr
Withings
Sproutling
Proteus
iHealth
Basis
Conventis
AliveCor
Samsung
Garmin
Empatica
Oxlet

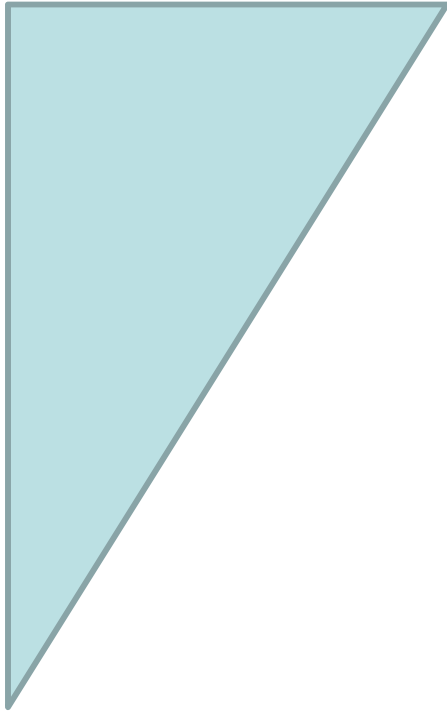




Population vs. Personal Thresholds for Monitoring and Diagnosis



ENSAYO CLÍNICO “POBLACIONAL”



ENSAYO CLÍNICO “INDIVIDUAL”

Aleatorización epidemiológica: sexo, edad,...



Aleatorización ómica: genoma, microbioma,...



Grupos cada vez más específicos

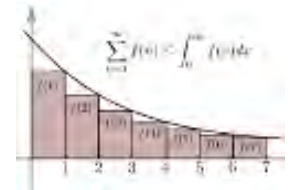


Individualoma



CGAT

AAGC



GAAGCGATAAG

- La compañía de taxis más grande del mundo no posee taxis ([Uber](#))
- El proveedor de hostelería más grande no posee inmuebles ([Airbnb](#))
- La compañía telefónica más grande no tiene infraestructura de telecomunicaciones ([Skype](#))
- Los grandes almacenes más grandes no tienen inventario ([Amazon](#))
- El poseedor más popular de media no produce contenido ([Facebook](#))
- Los bancos que más rápido crecen no tienen dinero de verdad ([Paypal](#))
- El proveedor de cine más grande del mundo no tiene cines ([Netflix](#))
- Los mayores vendedores de software no programan sus aplicaciones ([Google y Apple](#))





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