

# Medicina y computación

Dos aliados excepcionales

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# Agenda

- Introducción
- Alcance de la computación
- Medicina y computación
- Emprendimiento en Colombia
- Emprendimiento internacional
- El camino a seguir
- Extra perks
- Preguntas

# Introducción



```
#!/usr/bin/env python

import scapy.all as scapy

def scan_ip(IP):

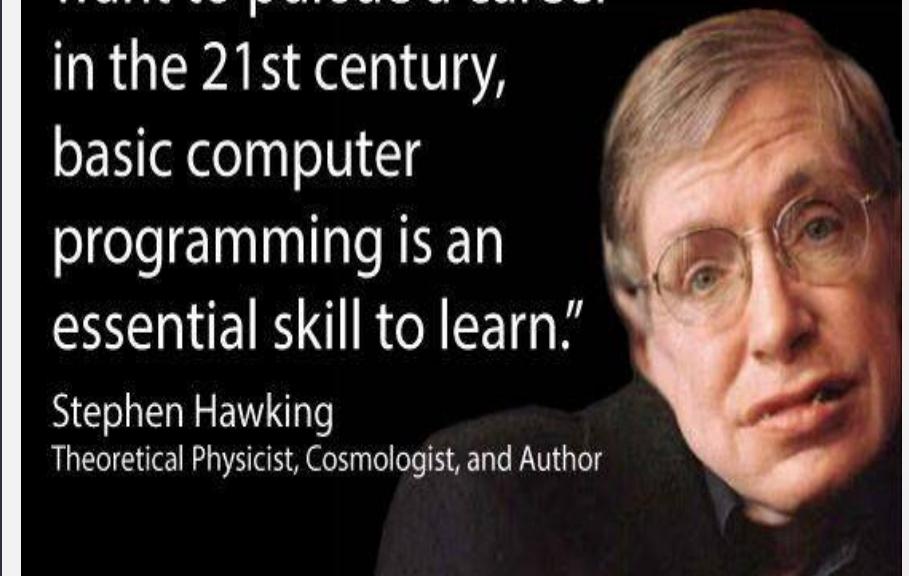
    """
    Scanning IP
    """

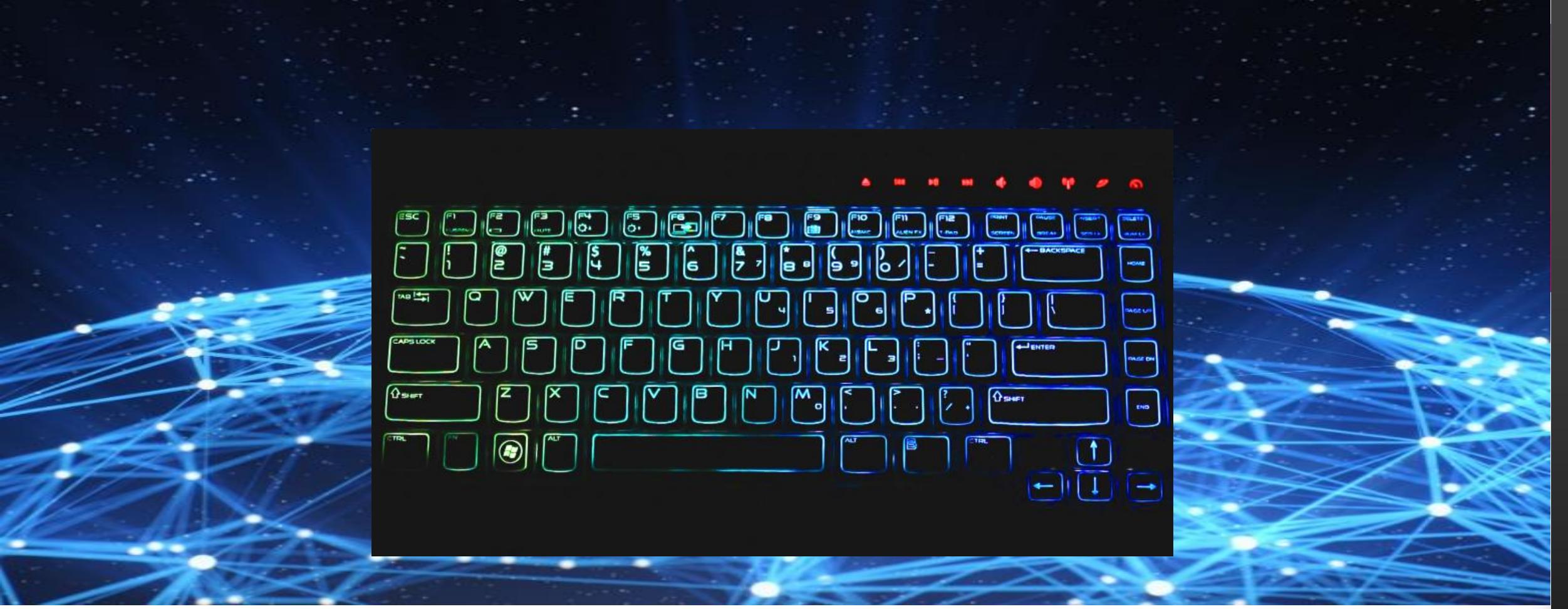
    arp_request = scapy.ARP(pdst = IP)
    arp_request.show()
    broadcast = scapy.Ether(dst ='ff:ff:ff:ff:ff:ff')
    broadcast.show()
    arp_request_broadcast = broadcast/arp_request
    print(arp_request_broadcast.summary())
    arp_request_broadcast.show()

scan_ip('192.168.1.1/24')
```

“Whether you want to uncover the secrets of the universe, or you want to pursue a career in the 21st century, basic computer programming is an essential skill to learn.”

Stephen Hawking  
Theoretical Physicist, Cosmologist, and Author





# Alcance de la computación

# Alcance de la computación

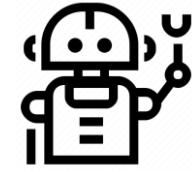


**El man que arregla el  
computador**

**“Un ingeniero de sistemas no lo necesitas  
todo el día, sino dos horas”: Alicia Arango  
sobre una posible reforma laboral**

**Sin embargo**

# Alcance de la computación



Robótica



Ethical hacking



Lenguajes de programación



IoT

- 1.Computer Hardware
- 2.Computer Networking
- 3.Computer Software
- 4.Cloud computing
- 5.Cyber Security and Ethical Hacking
- 6.Data Science and Data Analysis
- 7.Programming Language
- 8.Micro Architecture
- 9.Operating system
- 10.Web Development

11. Web Designing
12. Graphics design
13. Network Analytics and testing
14. Robotics
15. R&D
16. Artificial intelligence
17. Computer Aided Design drafter
18. Computer Operator
19. Data Entry Operator
20. Computer Administrator



Supercomputación



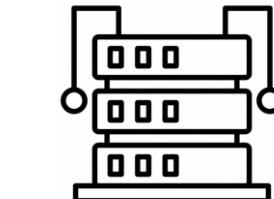
Inteligencia artificial



Realidad virtual y  
Realidad aumentada

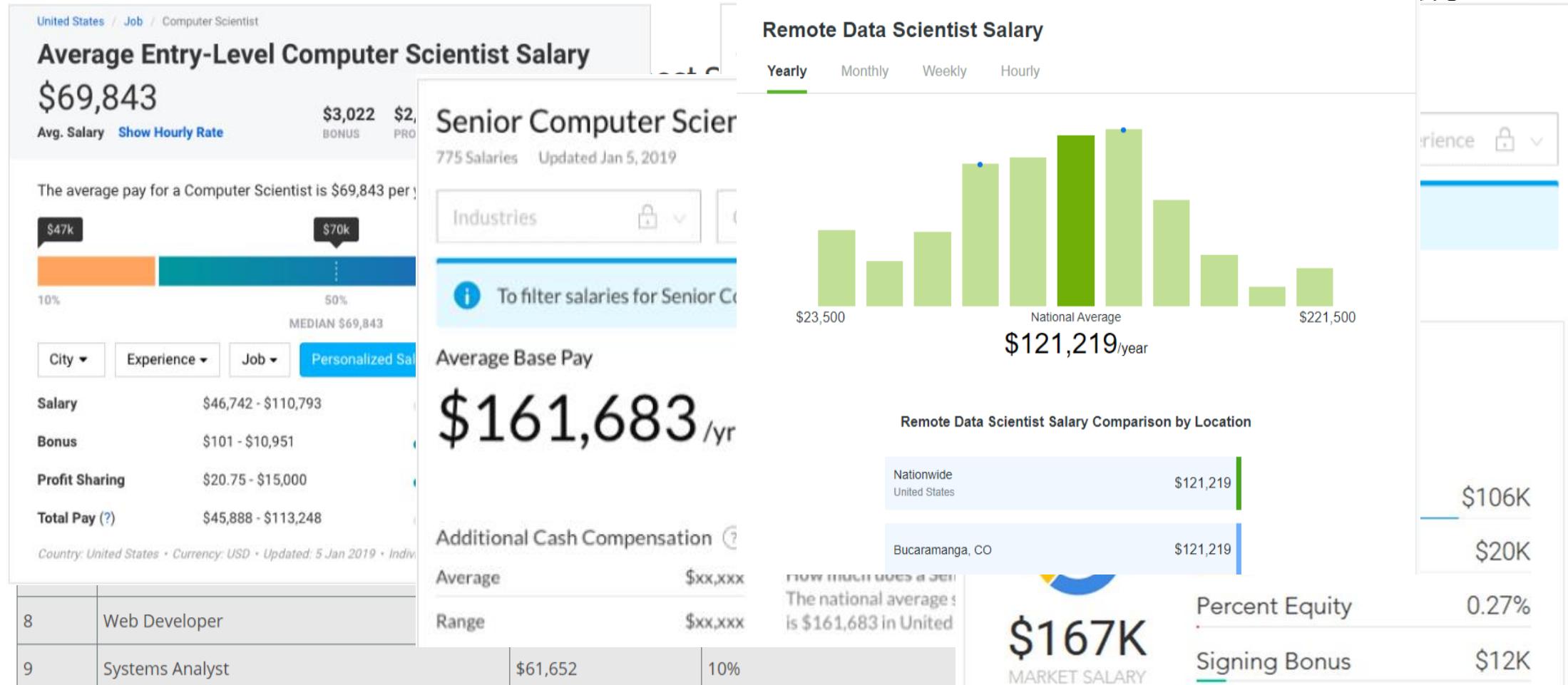
- Redes neuronales artificiales
- Aprendizaje supervisado
- Aprendizaje no supervisado
- Aprendizaje por refuerzo
- Visión por computador

Automatización



21. DBMS (DataBase management system)
22. IT Help Desk Technician
23. Video Game Designer
24. Computer Architecture and Engineering
25. UI designer
26. Computer Animation and 3D design
27. Computer vfx
28. Motion graphics and Visual Effects
29. Computer Biosystem
30. Numeric analysis
31. Cryptography
32. Education field
33. Research and development
34. Traffic control system
35. Mobile Application Development
36. Computer Accounting
37. User Experience design
38. Content Writer
39. SEO
40. Digital Marketing
41. Business Management
42. Stenographer and typist
43. Health diagnosis
44. Clinical image processing
45. Hospital administrator
46. Medical Record Technology
47. Video editing and compositing
48. Online marketing
49. Computer service and maintenance
50. Computer Assembling

# Alcance de la computación



Es un buen momento para saber de computación, o aprender

Es muy bacano todo lo que se puede hacer



# Medicina y computación

# Por qué combinar medicina y computación?

# Medicina y computación



Table 1

Increase of Data Volume and Complexity relative to Computational Power.

Neuroimaging (annually)		Genomics (BP/Yr)		Moore's Law (transistor counts)	Bandwidth (Edholm's Law)	Years
Size	Complexity	Size	Complexity			
200 GB	1	10 MB		$1 \times 10^5$	$10^5$	1985-1989
1 TB	2	100 MB	2	$1 \times 10^6$	$10^6$	1990-1994
50 TB	5	10 GB	3	$5 \times 10^6$	$10^8$	1995-1999
250 TB	6	1TB	4	$1 \times 10^7$	$10^9$	2000-2004
1 PB	7	30TB	5	$8 \times 10^6$	$10^{10}$	2005-2009
5 PB	8	1 PB	7	$1 \times 10^9$	$10^{11}$	2010-2014
10+ PB	9	20+ PB	8	$1 \times 10^{11}$	$10^{13}$	2015-2019 (estimated)

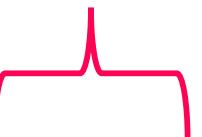
MB (megabyte) =  $10^6$ , GB (gigabyte) =  $10^9$ , TB (terabyte) =  $10^{12}$ , PB (petabyte) =  $10^{15}$ , BP=base pairs

Complexity = measure of data heterogeneity (e.g., new imaging data acquisition modalities or sequence coverage depth; complexity of 5 indicates a 5-fold increase of the data diversity over 1985)

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4795481/>

## Por qué combinar medicina y computación?

## Datos masivos



- Útiles?
- Mantenimiento?
- Actualización?
- Organizados?

# Medicina y computación



Genoma humano  $\approx$  3 billones de bases  $\rightarrow$  700 MB  $\rightarrow$   $\approx$  200 GB

AGCCCCTCAGGAGTCCGGCCACATGGAAACTCCTCATTCCGGAGGTCAAGTC  
AGATTACCTGGCTCACCTTGGCGTCCGGCGGCAAACATAAGAACCA  
CGTCGTCTAAATGACTTCTTAAAGTAGAATAGCGTGTTCTCCTTCCAGCC  
TCCGAAAAACTCGGACCAAAGATCAGGCTTGTCCGTTCTCGCTAGTGATG  
AGACTGCGCCTCTGTTCGTACAACCAATTAGGTGAGTTCAAACCTCAGGG  
TCCAGAGGCTGATAATCTACTTACCCAAACATAG

@SEQ\_ID  
GATTGGGGTTCAAAGCAGTATCGATCAAATAGTAAATCCATTGTTCAACT  
CACAGTTT  
+  
!'''\*(((\*\*\*+))%%%++)  
(%%%%).1\*\*\*-+\*")\*\*55CCF>>>>CCCCCCC65

## Genoma limpio

Procesarlo  $\rightarrow$  supercomputación  
Aprender  $\rightarrow$  Inteligencia Artificial

## Genoma al salir del secuenciador (recién cocinado)

Almacenarlo  $\longrightarrow$  PC?  $\longrightarrow$  Nube  
Pre-procesarlo

Por qué combinar medicina y computación?

HERV-K – Leucemia Mieloide Aguda  
25 casos y 25 controles  
 $\approx$  10 TB



# Medicina y computación



## Enfermedades

Como crear nuevos fármacos efectivos para el tratamiento o prevención de enfermedades y con mínimos efectos secundarios?

## Quimioterapia



## CRISPR/Cas9

## Edición génica

Como realizar modificaciones en un solo gen que no afecten a largo plazo el genoma completo?

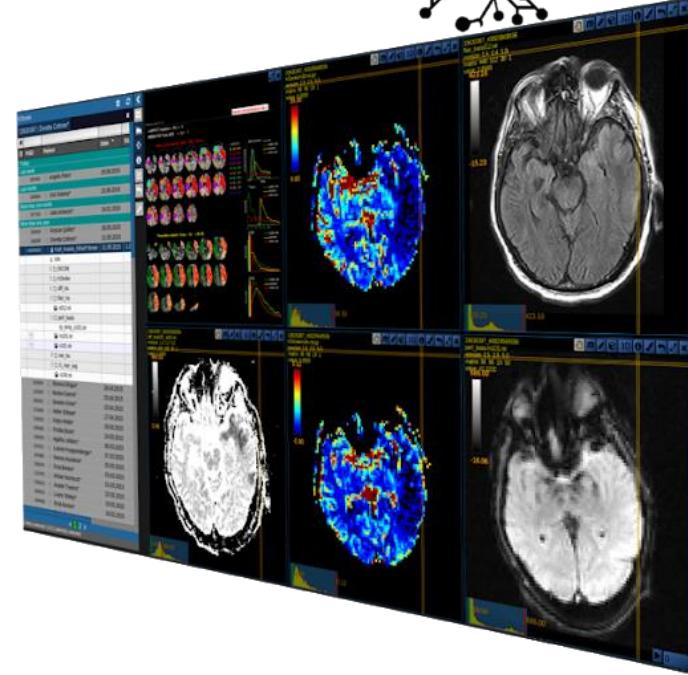
## Simulación

Por qué combinar medicina y computación?

# Medicina y computación



Imágenes médicas



- Prevención
- Preparación
- Promoción
- Políticas públicas



Salud pública

Por qué combinar medicina y computación?



Datos de los pacientes

- Accesibilidad por parte de los pacientes
- Accesibilidad del personal médico
- Aplicaciones móviles
- Eficiencia
- Medio ambiente

# Qué se está haciendo?

# Medicina y computación



## Ciencia de datos e Inteligencia Artificial

<b>ROBOTIC SURGERY</b>  Currently used only for routine steps in simple procedures like laser eye surgery and hair transplants.	<b>IMAGE ANALYSIS</b>  Experts are just beginning to use automated systems to help them examine X-rays, retina scans, and other images.	<b>GENETIC ANALYSIS</b>  With genome scans becoming a routine part of medicine, AI tools that quickly draw insights from the data are becoming necessary.	<b>PATHOLOGY</b>  Experimental systems have proved adept at analyzing biopsy samples, but aren't yet approved for clinical use.
<b>CLINICAL-DECISION SUPPORT</b>  Hospitals are introducing tools for applications like predicting septic shock, but they haven't yet proved their value.	<b>VIRTUAL NURSING</b>  Rudimentary systems can check on patients between office visits and provide automatic alerts to physicians.	<b>MEDICAL ADMINISTRATION</b>  Companies are rushing to offer AI-enabled tools that can increase efficiency in tasks like billing and insurance claims.	<b>MENTAL HEALTH</b>  Researchers are exploring such applications as monitoring depression by mining mobile phone and social media data.

# Medicina y computación



 babylon

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We're for health, for all

We want to put an accessible and affordable health service in the hands of every person on earth

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[Check symptoms](#)

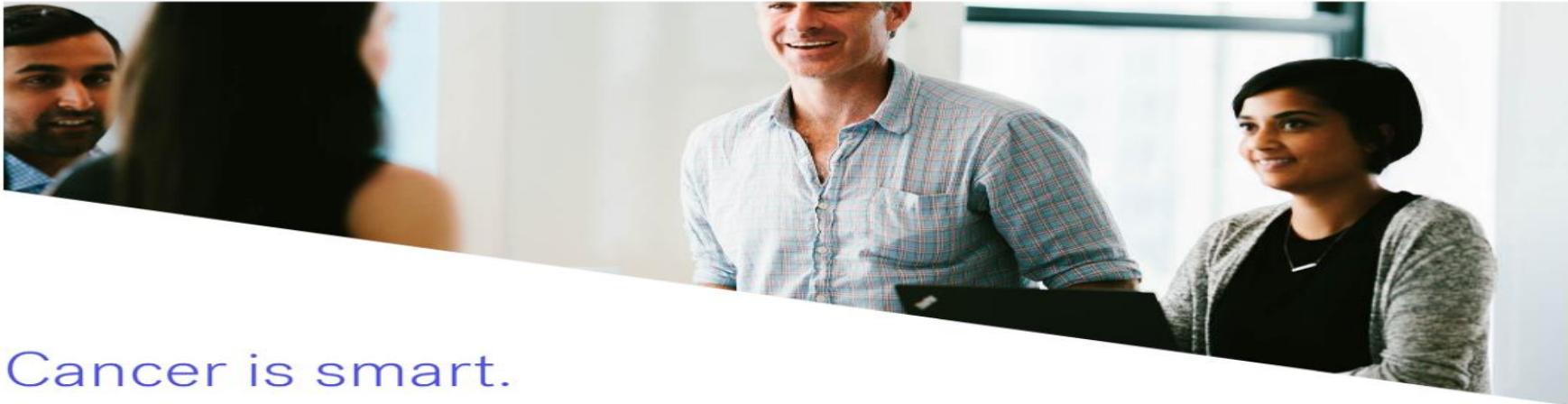
\$ 635.3M

Herramienta diagnóstica (IA)

Comunicación 24/7 con personal médico



# Medicina y computación

[Technology ▾](#)[Company ▾](#)[Publications](#)[Careers](#)[Blog](#)

\$ 313M

Cancer is smart.  
Together, we can  
be smarter.

Accelerating cancer research and improving the quality of care requires the entire industry to work together. Our products connect community oncologists, academics, hospitals, life science researchers and regulators on a shared technology platform.

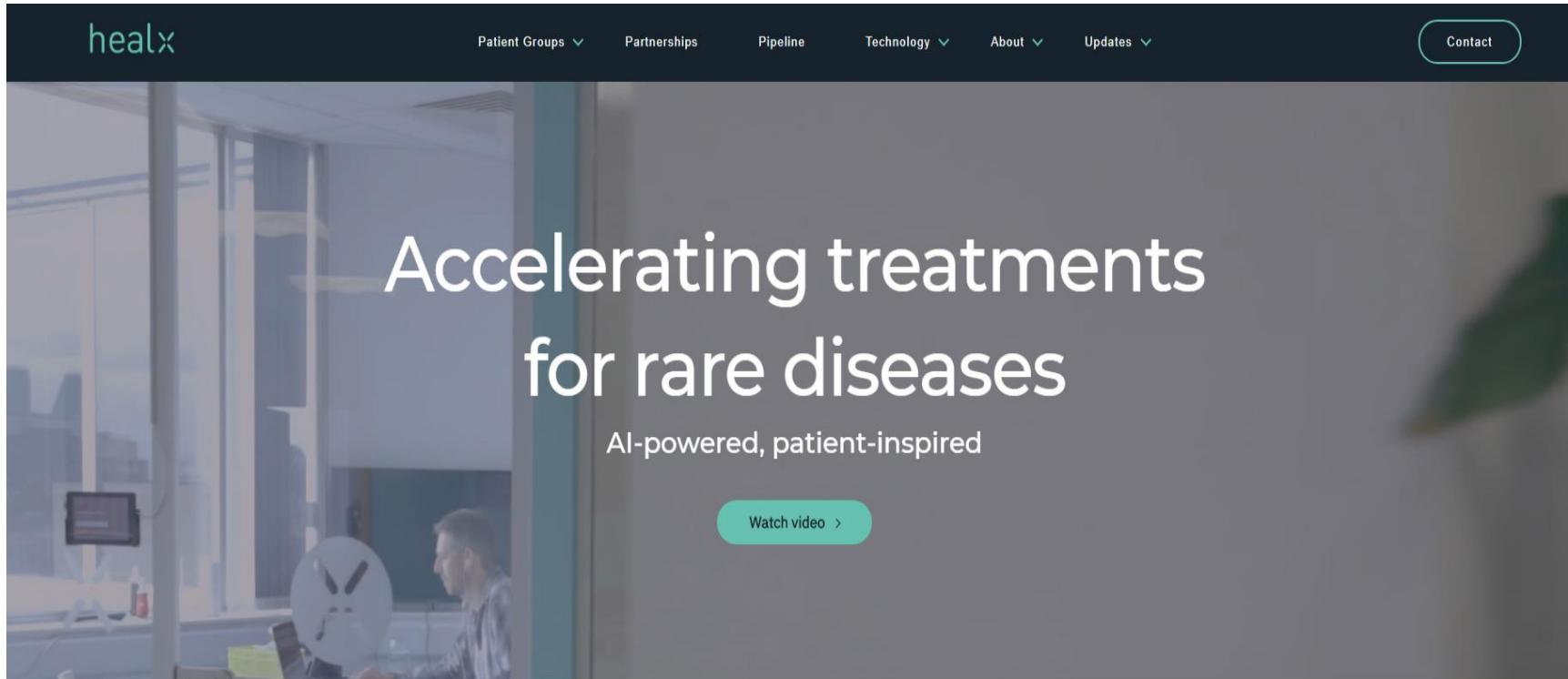
Together, we can learn from the experience of every patient.

<https://flatiron.com/>

Investigación de Cáncer en comunidad – Cloud computing, IA

OncoEMR  
OncoTrials

# Medicina y computación



The screenshot shows the homepage of the healx website. At the top, there is a dark navigation bar with the 'healx' logo on the left and links for 'Patient Groups', 'Partnerships', 'Pipeline', 'Technology', 'About', 'Updates', and 'Contact'. Below the navigation bar is a large, semi-transparent image of a medical office. Overlaid on this image is the text 'Accelerating treatments for rare diseases' in large white font, followed by 'AI-powered, patient-inspired' in smaller white font. At the bottom of this overlay is a teal button labeled 'Watch video >'. The background image shows a person working at a desk in a modern office environment.

\$ 67.9M

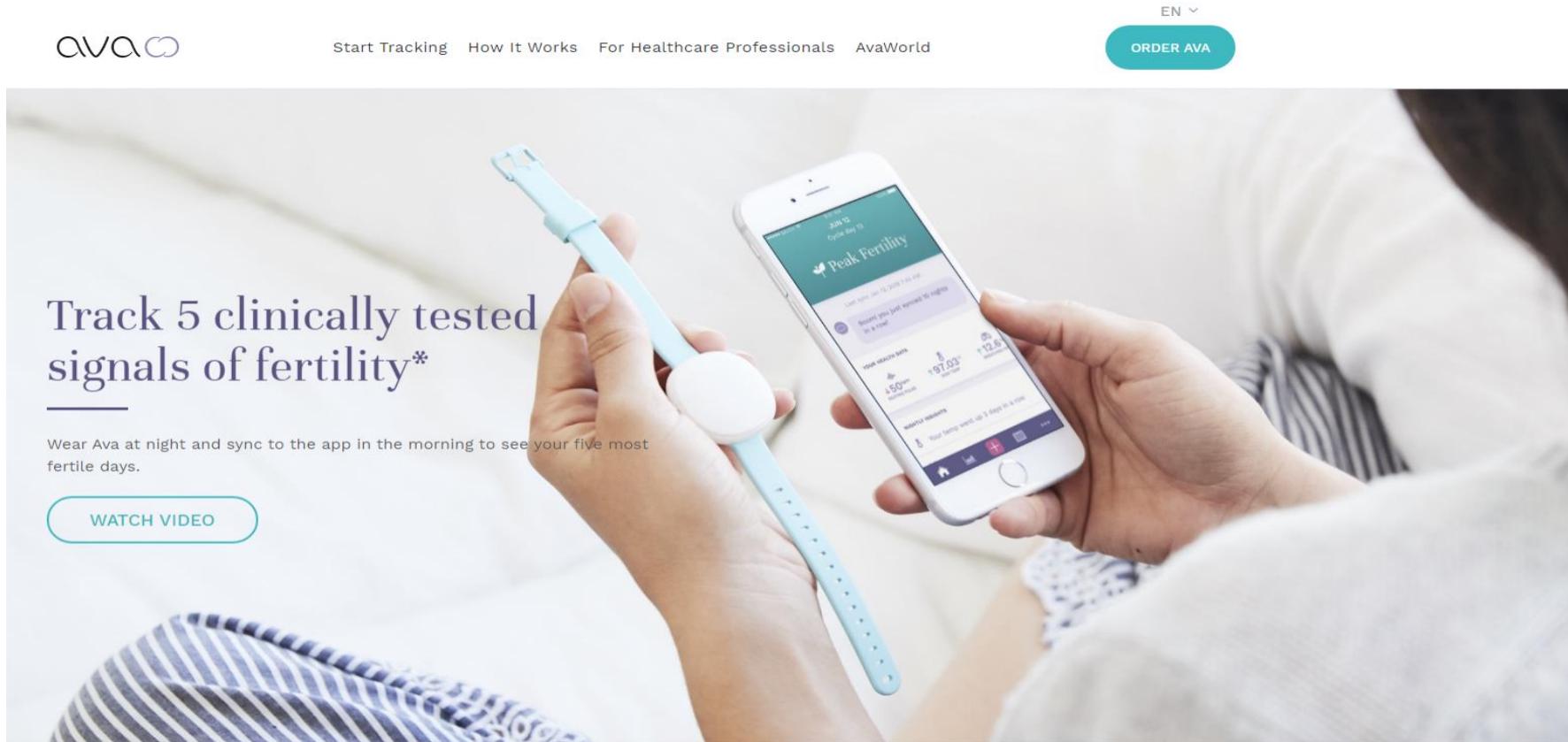
We've created the world's most efficient AI platform for rare diseases. It makes drug discovery faster, smarter and safer, and supports our team and partners in discovering and translating new treatments towards the clinic.

<https://healx.io/>

David Brown – co-inventor del Viagra

7000 enfermedades raras → 5% con tratamiento aprobado

# Medicina y computación



The image shows a person wearing a white Ava smartwatch with a light blue strap. They are holding a white smartphone displaying the Ava app's 'Peak Fertility' screen. The app interface includes a date ('June 13'), a cycle day ('Cycle Day 13'), and various health metrics like heart rate and blood pressure. A text overlay on the left reads: 'Track 5 clinically tested signals of fertility\*'. Below it, smaller text says: 'Wear Ava at night and sync to the app in the morning to see your five most fertile days.' A 'WATCH VIDEO' button is visible at the bottom left.

\$ 45.3M

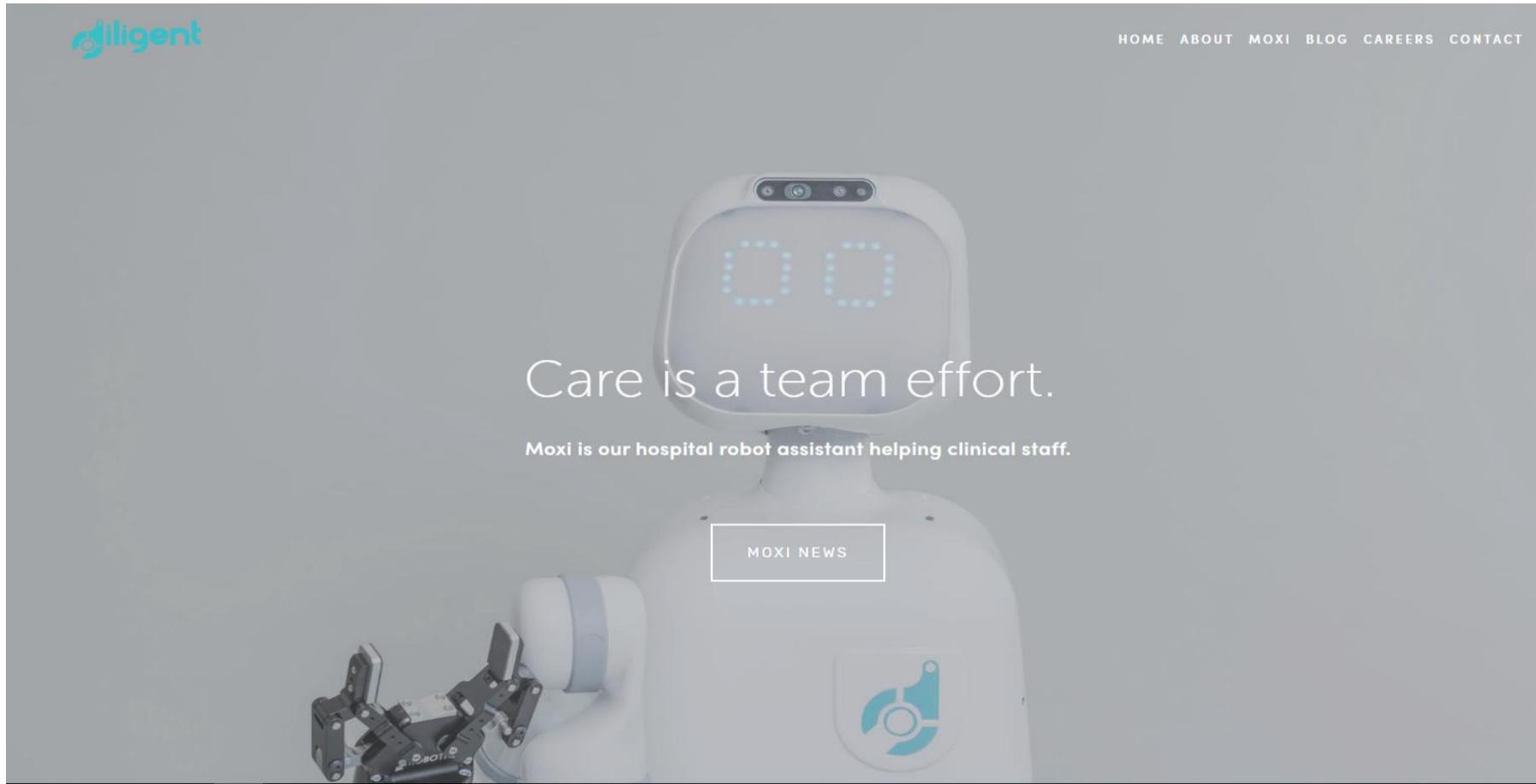
<https://www.avawomen.com/>

Brazalete → predicción de días fértiles (IA)

1. Temperatura de la piel
2. Frecuencia de pulso en reposo
3. Índice de variabilidad de la frecuencia cardíaca
4. Perfusion
5. Frecuencia respiratoria



# Medicina y computación

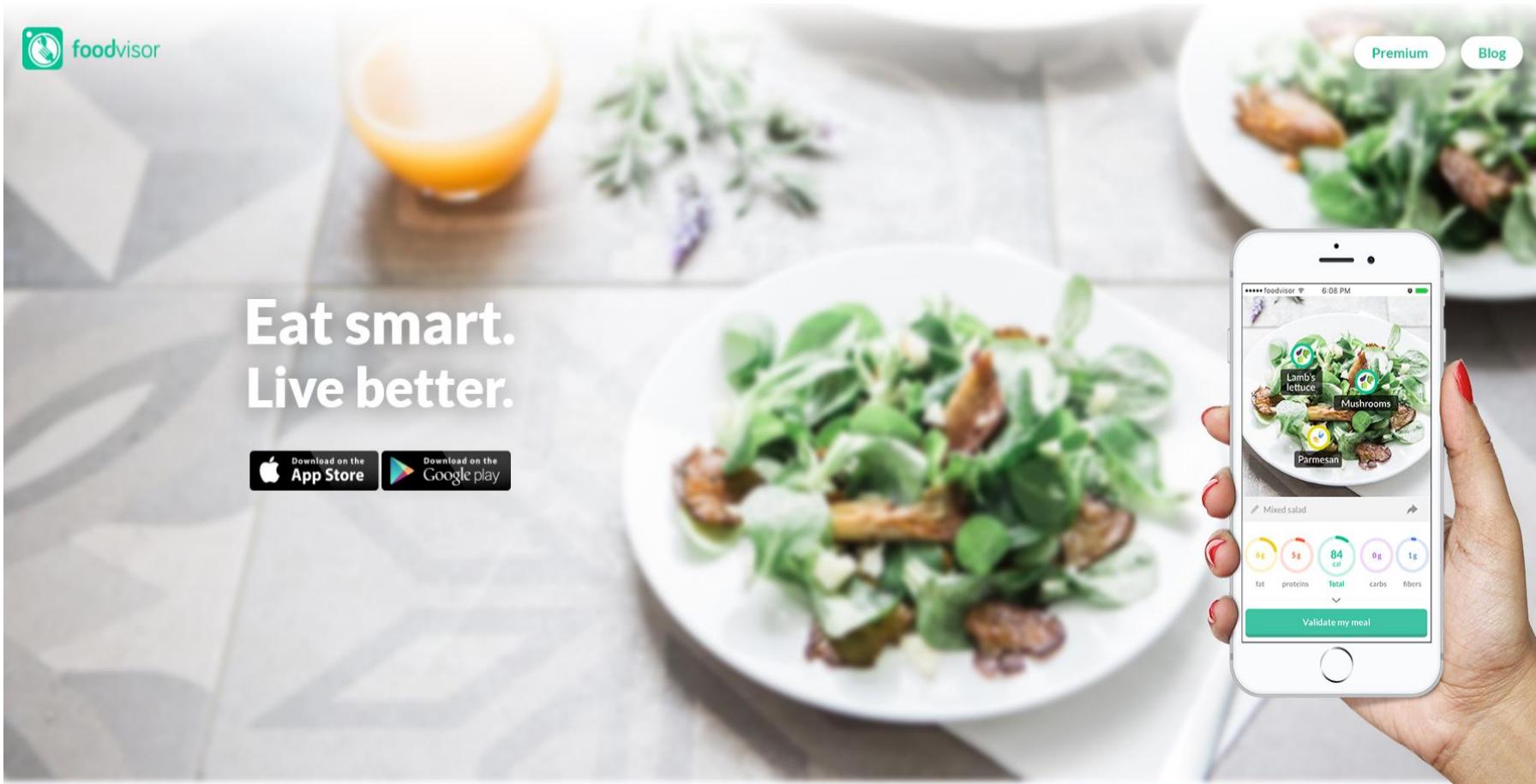


\$ 5.8M

<https://diligentrobots.com/moxi>

Enfermera robot

# Medicina y computación

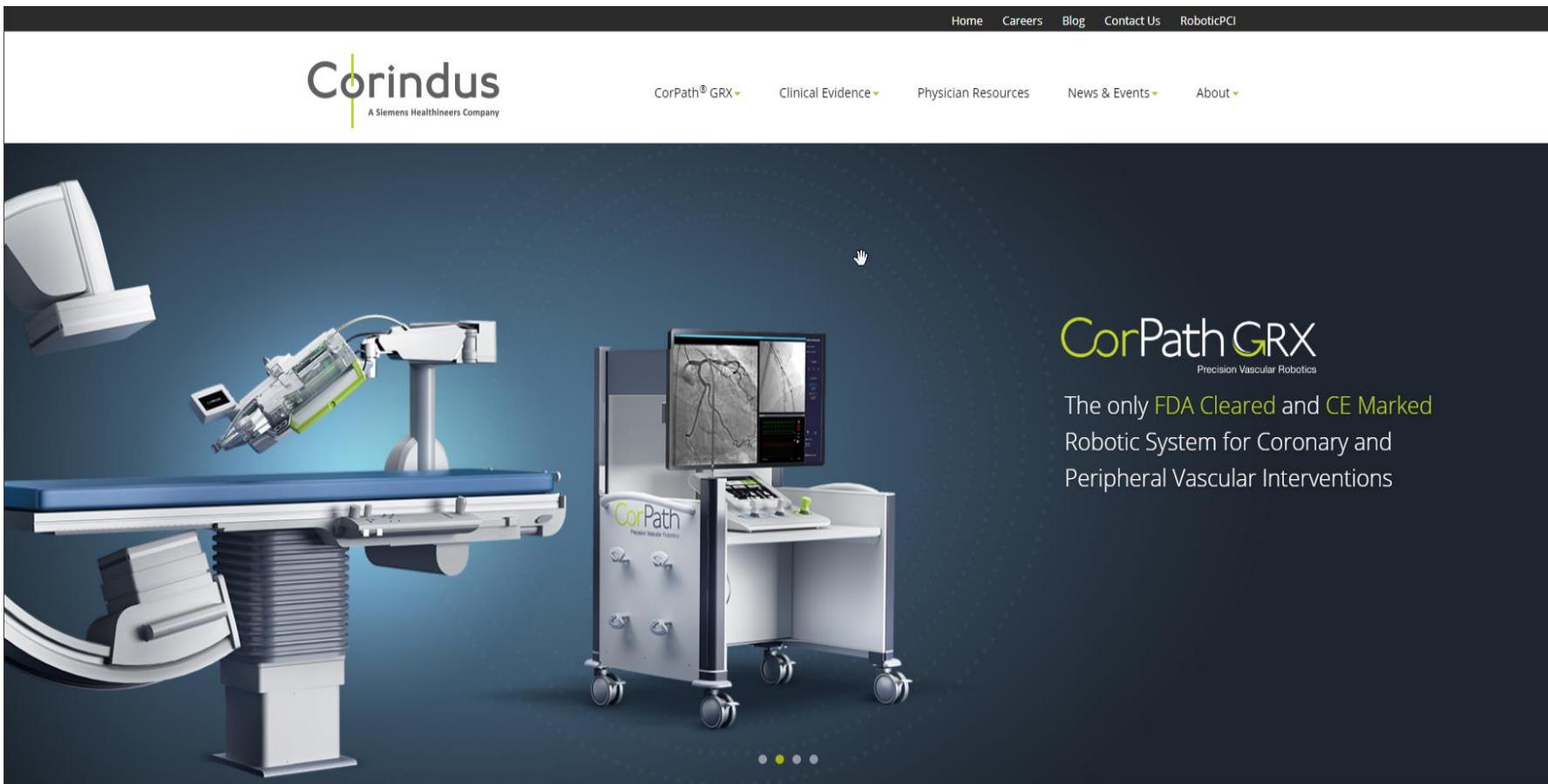


\$ 5.1 M

<https://www.foodvisor.io/>

Visión por computador para detectar cantidades y tipos de comida  
y estimar valor nutricional

# Medicina y computación



\$ 133.6M

<https://www.corindus.com/>

Telerobótica

# Medicina y computación



ScienceDirect

Journals & Books

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medicine

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196,811 results

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Years

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- 2020 (3,687)
- 2019 (10,816)

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Article type

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- Research articles (132,275)
- Encyclopedia (1,909)
- Book chapters (11,777)

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Publication title

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- Brain Research (2,474)
- Social Science & Medicine (2,007)

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Medical Joyworks LLC	MyTherapy LLC	Przemyslaw Słota	Medical Joyworks LLC	Netmeds Marketplace L	OpenEM Foundation	Medisafe	Bhaee Technologies	Hall Date
★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★
AccessMedicine Ap	HARRISON'S	MedSchool	Arabic Medicine Di	American Journal o	Full Code - Emerge	Heart's Medicine H	MedPlus Mart - Onl	Online Pharmacy N
Unbound Medicine, Inc	MANUAL OF MEDICINE	The Medical Company	Muhammad Riaz	Elsevier Inc	Minerva Medical Simula	GameHouse	MedPlus Health Service	Online Pharmacy & He
★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★	★★★★★
jCU	t	life care	Medicine Dictionary	life care	QMDT	Medicine Dictionary	Quick Medical Dx & Rx	Medicine Dictionary
		HEALTH	HEALTH	HEALTH	McGraw-Hill Education	McGraw-Hill Education	McGraw-Hill Education	McGraw-Hill Education

# Qué vamos a hacer?

# Emprendimiento en Colombia



<https://minciencias.gov.co/convocatorias/todas>



<https://innpulsacolombia.com/es/ofertas>



<http://www.fondoemprender.com/>

# Apps.co

<https://apps.co/>



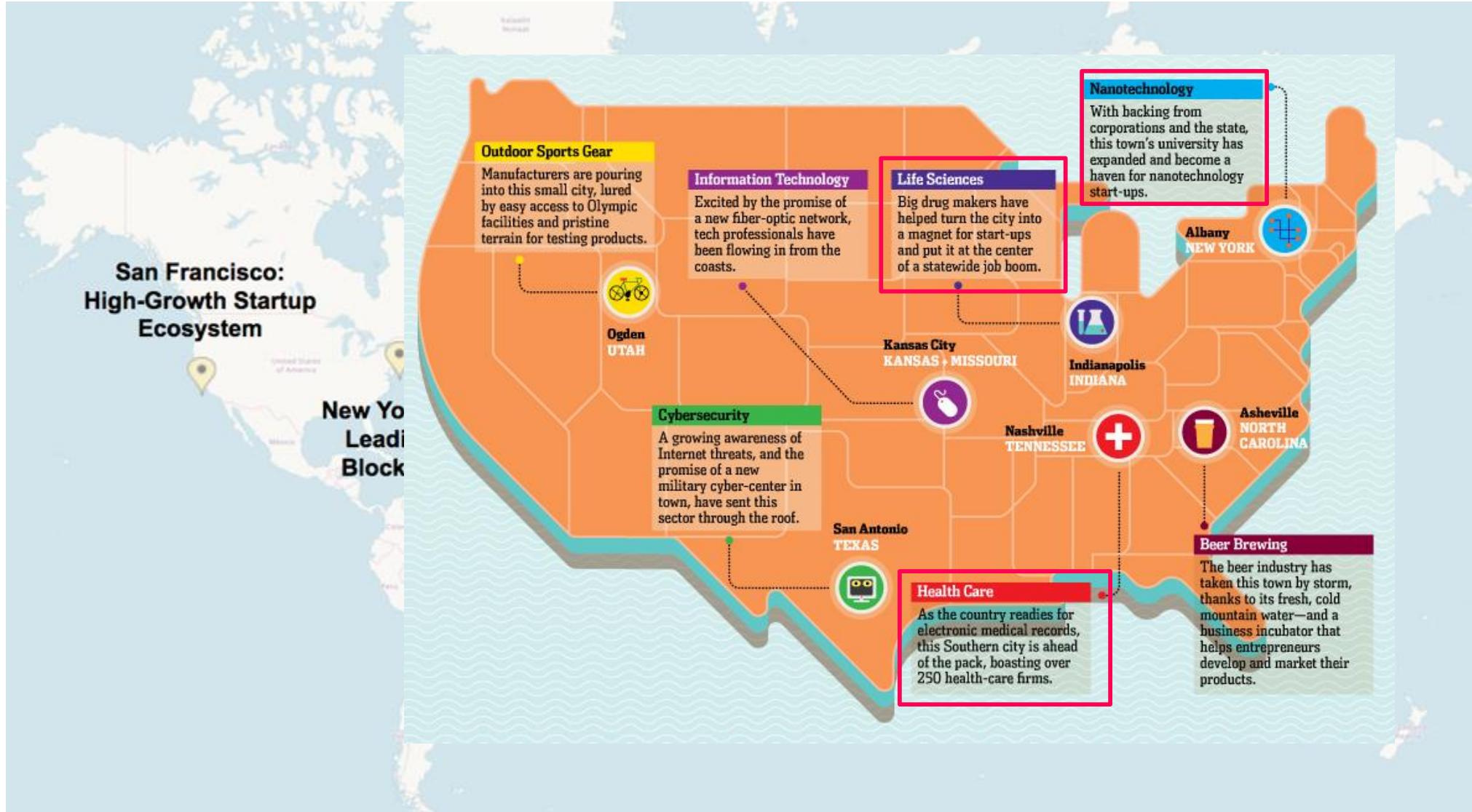
Cursos gratis      Convocatorias

marketing  
Diseño  
social media  
conceptos legales

Reto lab



# Emprendimiento internacional



# Emprendimiento internacional



Combinator



# Emprendimiento nacional e internacional



## Tracción



- Ventas
- Usuarios
- Pilotos
- Artículos científicos?

# Los convencí?

# El camino a seguir



Bases de datos



Cloud computing



Apps



# El camino a seguir



Supercomputación



Ciencia de datos e IA

# El camino a seguir

coursera

edX®

Udemy

Recursos online



- Nuevos cursos
- Semilleros
- Grupos de investigación

Universidades



UbiHPC

- Programación
- Ciencia de datos
- Inteligencia Artificial
- Visión por computador
- Aplicaciones móviles
- Robótica

Club 4.0

club40ubihpc@gmail.com



# El camino a seguir



# GitHub

<https://github.com/leonardocfor>

Repo: teaching  
Folder: conferences

# Extra perks



Lecturas interesantes:

<https://spectrum.ieee.org/biomedical/diagnostics/how-ibm-watson-overpromised-and-underdelivered-on-ai-health-care>

<https://elmistrana.github.io/jekyll/update/2017/10/21/From-medical-to-computer-sceince-career.html>

<https://www.quora.com/What-is-the-relationship-between-computer-science-and-medicine>

<https://medium.com/precision-medicine/how-big-is-the-human-genome-e90caa3409b0>

Datos:

<https://github.com/beamandrew/medical-data>

# Gracias

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