

# 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

# Introducción



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

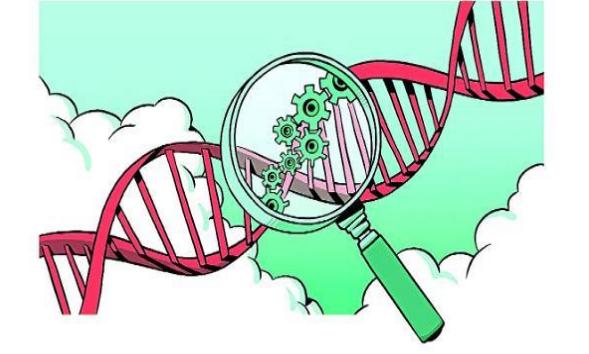
import scapy.all as scapy

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

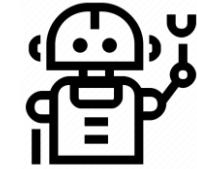


**El man que arregla el  
computador**

**“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



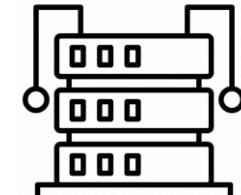
Lenguajes de programación



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  
Linux



Inteligencia artificial



- Redes neuronales
- Aprendizaje supervisado
- Aprendizaje no supervisado
- Aprendizaje por refuerzo
- Visión por computador
- Algoritmos genéticos

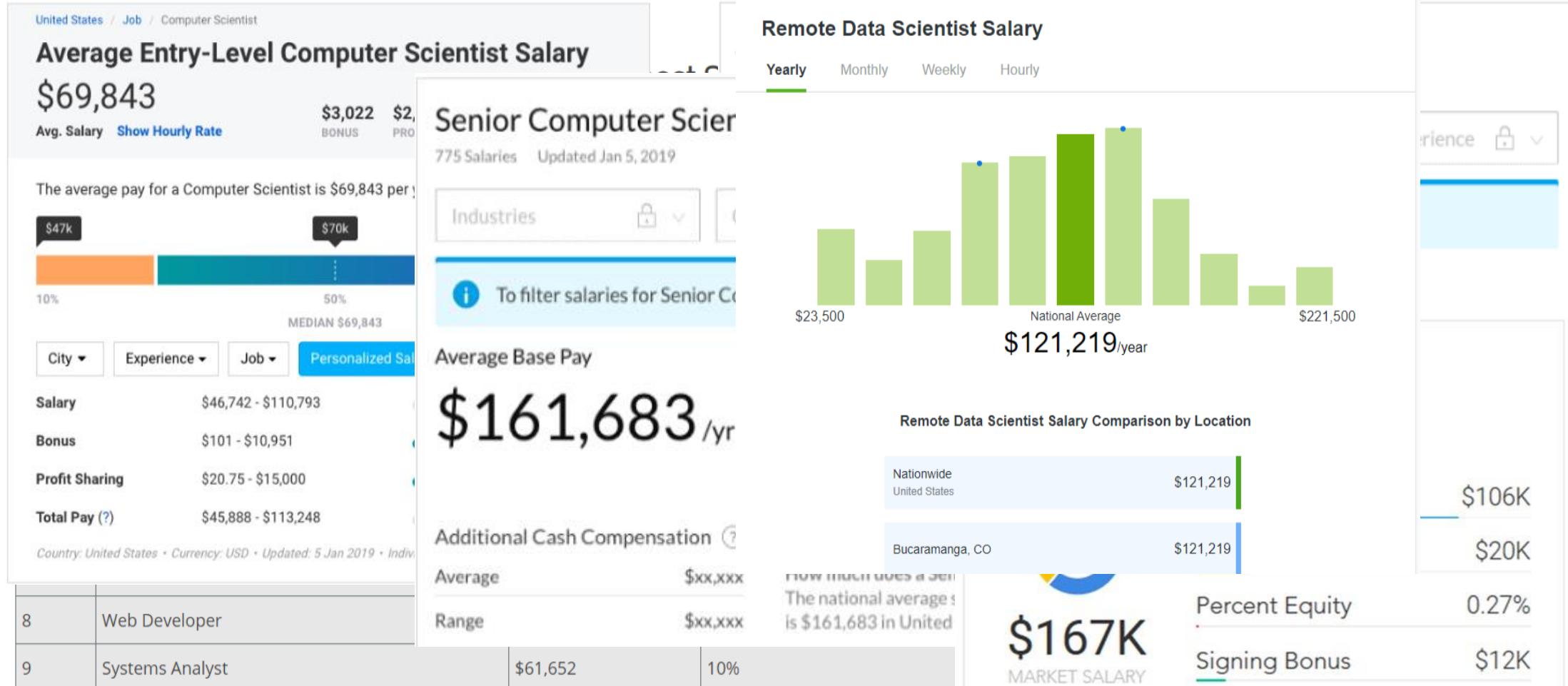
Automatización



Realidad virtual y  
Realidad aumentada

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



If somebody is working in computer science he does things. We have a whole Seattle called the Internet. Modelling that is a mix of people who are science and math-type people we're making in polio or whatever we're really driven by the need to do something.

— Bill Gates

AZ QUOTE

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	$1 \times 10^5$	$10^5$	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/>

## Datos masivos

- Útiles?
- Mantenimiento? Actualización?
- Organizados?

# Medicina y computación



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

AGCCCCTCAGGAGTCCGGCACATGGAAACTCCTCATTCCGGAGGTAGTC  
AGATTACCCCTGGCTCACCTGGCGTGCCTCGCGGGCAAACATAAGAAC  
CGTCGTCTAAATGACTCTTAAAGTAGAATAGCGTGTCTCCTTCCAGCC  
TCCGAAAAACTCGGACCAAGATCAGGCTTGTCCGTTCTCGCTAGTGATG  
AGACTGCGCCTCTGTCGTACAACCAATTAGGTGAGTTCAAACCTCAGGG  
TCCAGAGGCTGATAATCTACTTACCCAAACATAG

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

## Genoma limpio

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

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

## Genoma al salir del secuenciador (recién cocinado)

- Almacenarlo
- Pre-procesarlo
- Almacenarlo

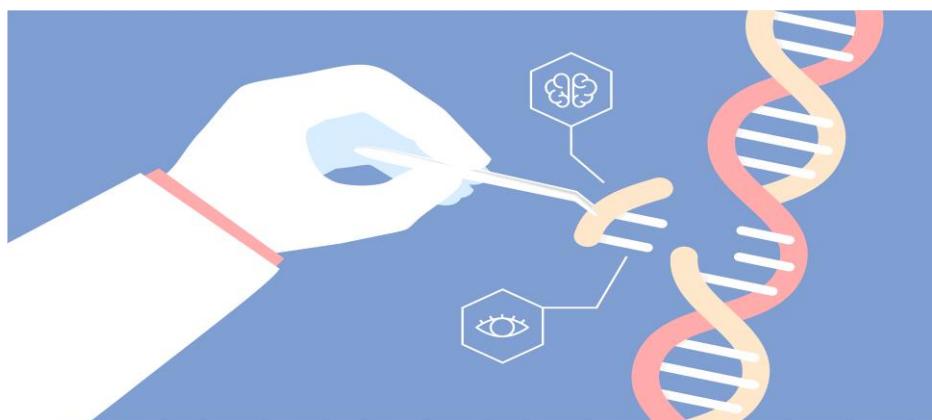
# Medicina y computación



## 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

Programación  
Paralelización  
IA



# Medicina y computación



- Prevención
- Preparación
- Promoción
- Políticas públicas



Salud pública

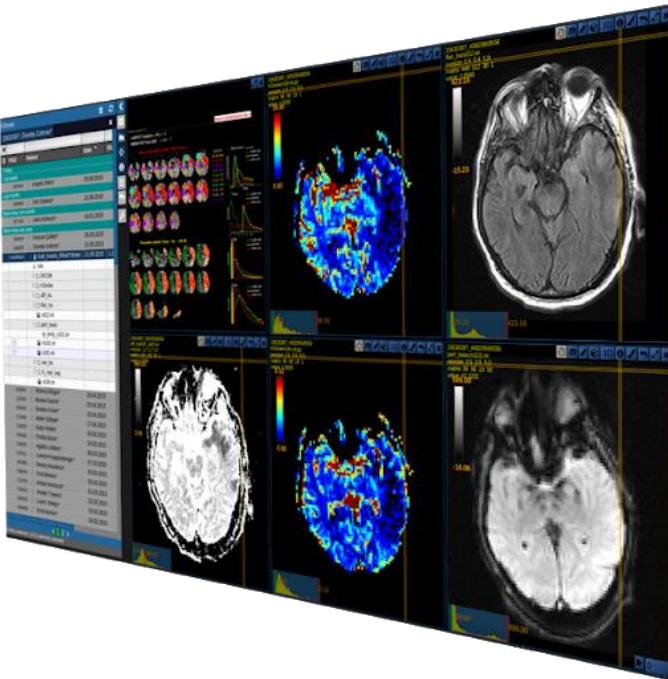


Datos de los pacientes

- Accesibilidad del personal médico
- Accesibilidad del personal médico
- Aplicaciones móviles
- Eficiencia
- Medio ambiente



Imágenes médicas



# Medicina y computación



 babylon

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£44.97 billed every 3 months	£149 billed annually	£49 per consultation

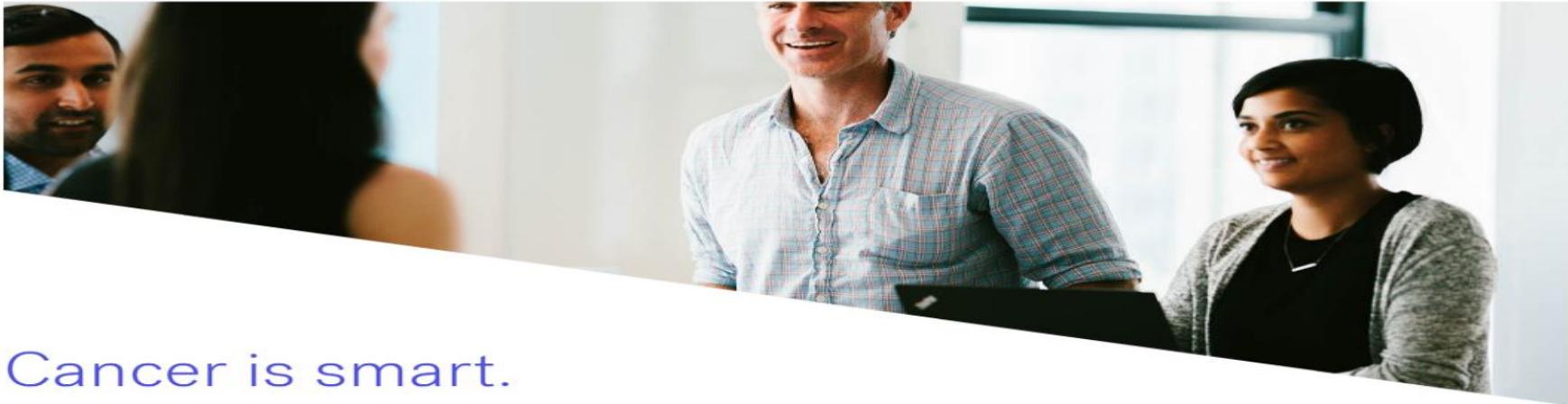
<https://www.babylonhealth.com/>

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 Cancer – Cloud computing, IA

# Medicina y computación



CLIENTS TECHNOLOGY PUBLICATIONS NEWS CONTACT

\$ 77.3M

GNS Healthcare: discover the true drivers  
of patient therapeutic response

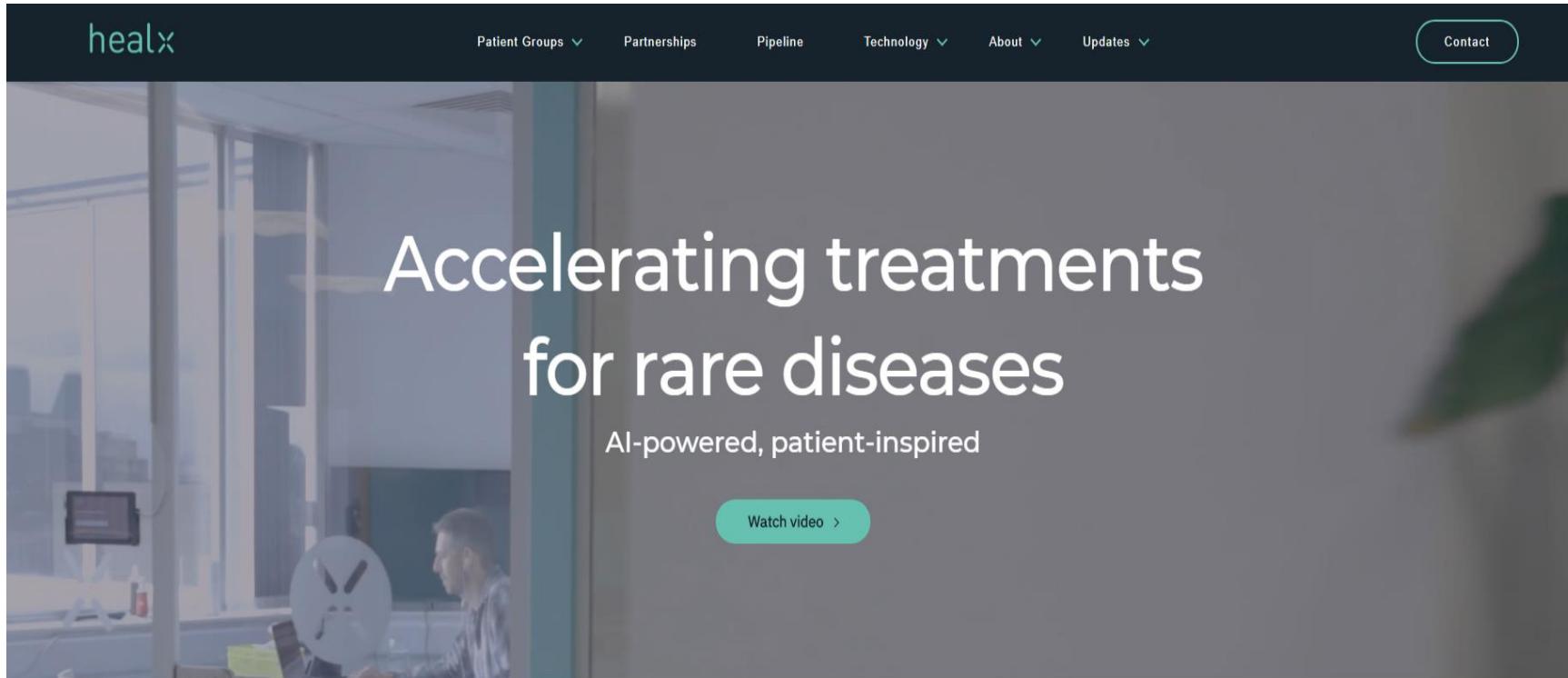
LEARN MORE

GNS Healthcare is the leading causal AI company enabling the discovery of *which* patients respond to drugs and *why*. The world's largest biopharma companies trust us to help them better understand disease progression, quickly pinpoint patient subpopulations, and generate stronger evidence of clinical value. Access to next generation patient data, combined with our causal AI and simulation technology, enables rapid knowledge generation driving clinical trial design and market access positioning.

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

Cuáles pacientes responden a las medicinas y porqué?

# Medicina y computación



\$ 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

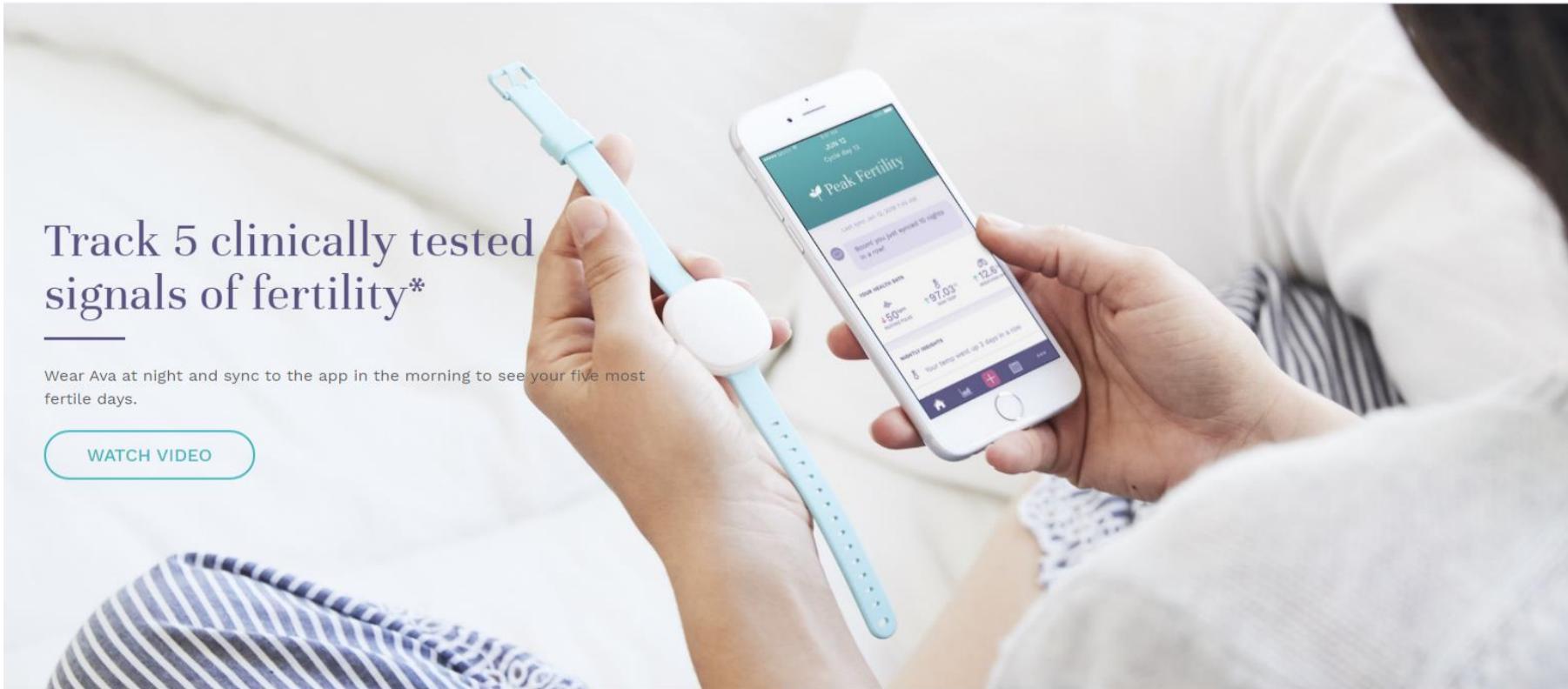
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Start Tracking How It Works For Healthcare Professionals AvaWorld

EN

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Track 5 clinically tested signals of fertility\*

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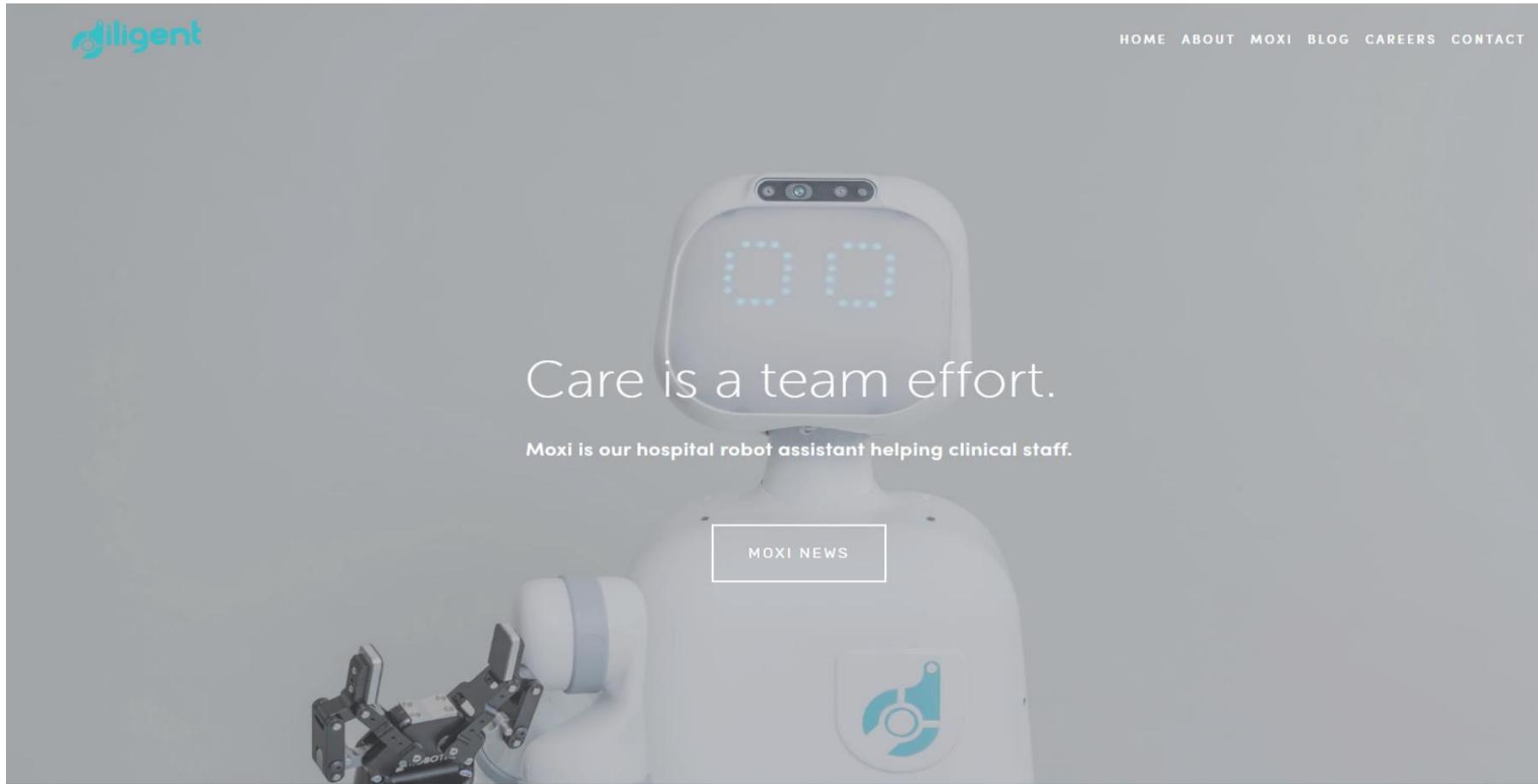
WATCH VIDEO

\$ 45.3M

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

Brazalete → predicción de días fértiles (IA)

# Medicina y computación

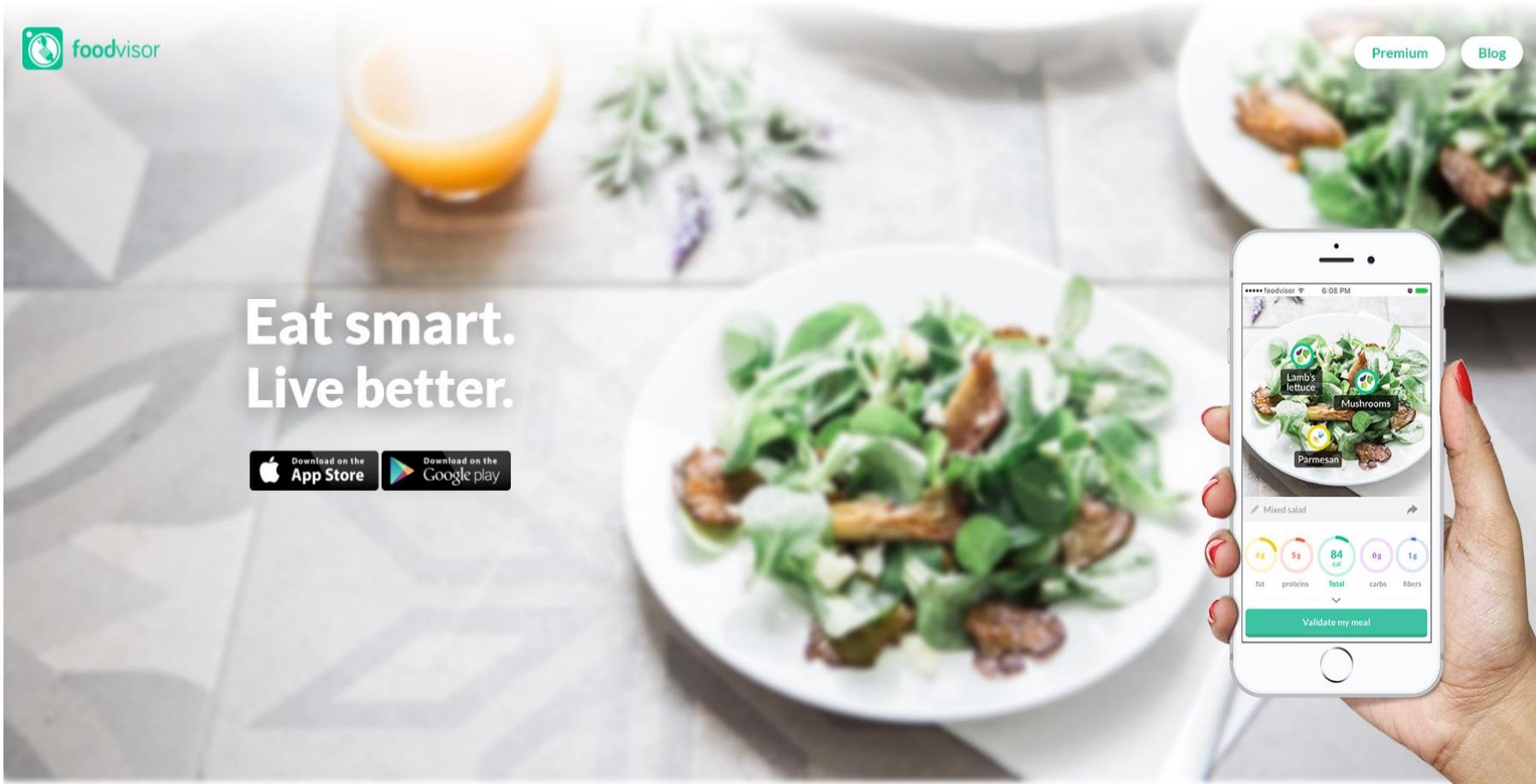


\$ 5.8M

<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



The image shows the CorPath GRX robotic vascular intervention system. It consists of a robotic arm mounted on a mobile cart. The cart features a control console with a monitor displaying a live video feed from the catheter tip, which is shown in a separate inset. The robotic arm is positioned over a simulated patient bed, ready for procedure. The Corindus logo is visible at the top left, and the CorPath GRX brand name with its subtitle 'Precision Vascular Robotics' is prominently displayed on the right side of the cart.

Corindus  
A Siemens Healthineers Company

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CorPath GRX  
Precision Vascular Robotics

The only FDA Cleared and CE Marked Robotic System for Coronary and Peripheral Vascular Interventions

\$  
**133.6M**

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

Telerobótica

# Medicina y computación



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- 2021 (1)
- 2020 (3,687)
- 2019 (10,816)

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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

# 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

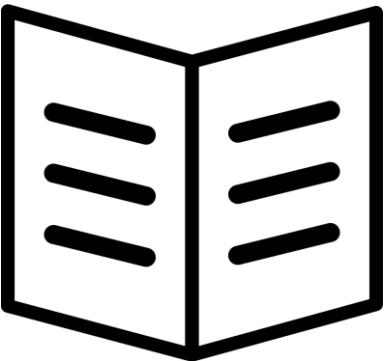
# El camino a seguir

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



# Extra perks



Lecturas interesantes:

<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>

Esta presentación:

[https://github.com/leonardocfor/teaching/blob/master/conferences/medicina\\_computacion\\_unab\\_catedra\\_lope\\_carvajal\\_v.I.I.pdf](https://github.com/leonardocfor/teaching/blob/master/conferences/medicina_computacion_unab_catedra_lope_carvajal_v.I.I.pdf)

# Gracias

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