

Medicina y computación

Dos aliados excepcionales

Leonardo Camargo Forero, Ph.D

CEO **UbiHPC**
www.ubihpc.com





Agenda

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

Introducción



A photograph of an IBM server rack with several blue server units. In the foreground, a terminal window displays Python code for performing an ARP scan on a local network.

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

import scapy.all as scapy

def scan_ip(IP):

    """
    Scanning IP
    """

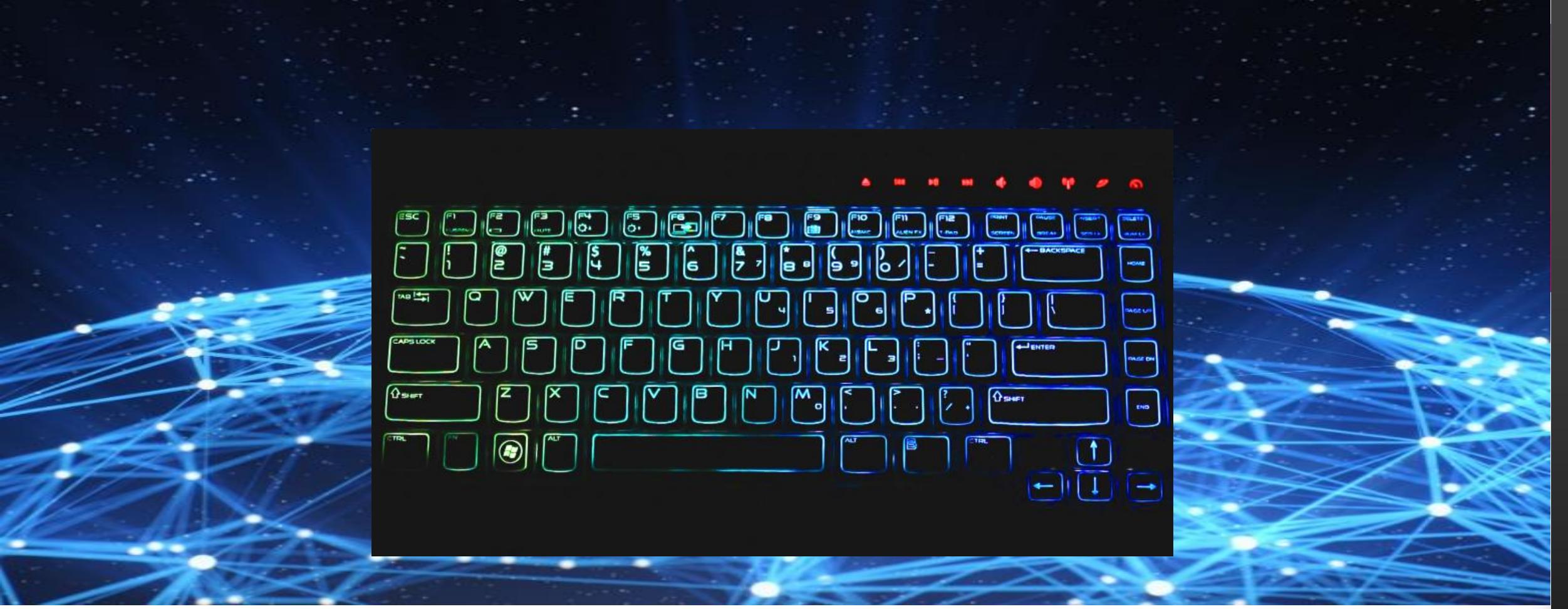
    arp_request = scapy.ARP(pdst = IP)
    arp_request.show()
    broadcast = scapy.Ether(dst ='ff:ff:ff:ff:ff:ff')
    broadcast.show()
    arp_request_broadcast = broadcast/arp_request
    print(arp_request_broadcast.summary())
    arp_request_broadcast.show()

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

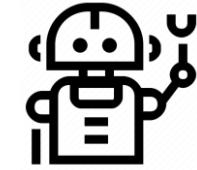


**El man que arregla el
computador**

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

Sin embargo

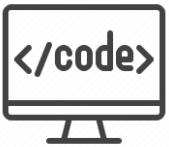
Alcance de la computación



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



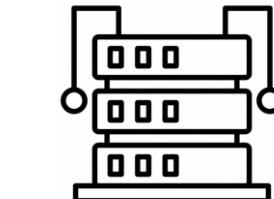
Inteligencia
artificial



Realidad virtual y
Realidad aumentada

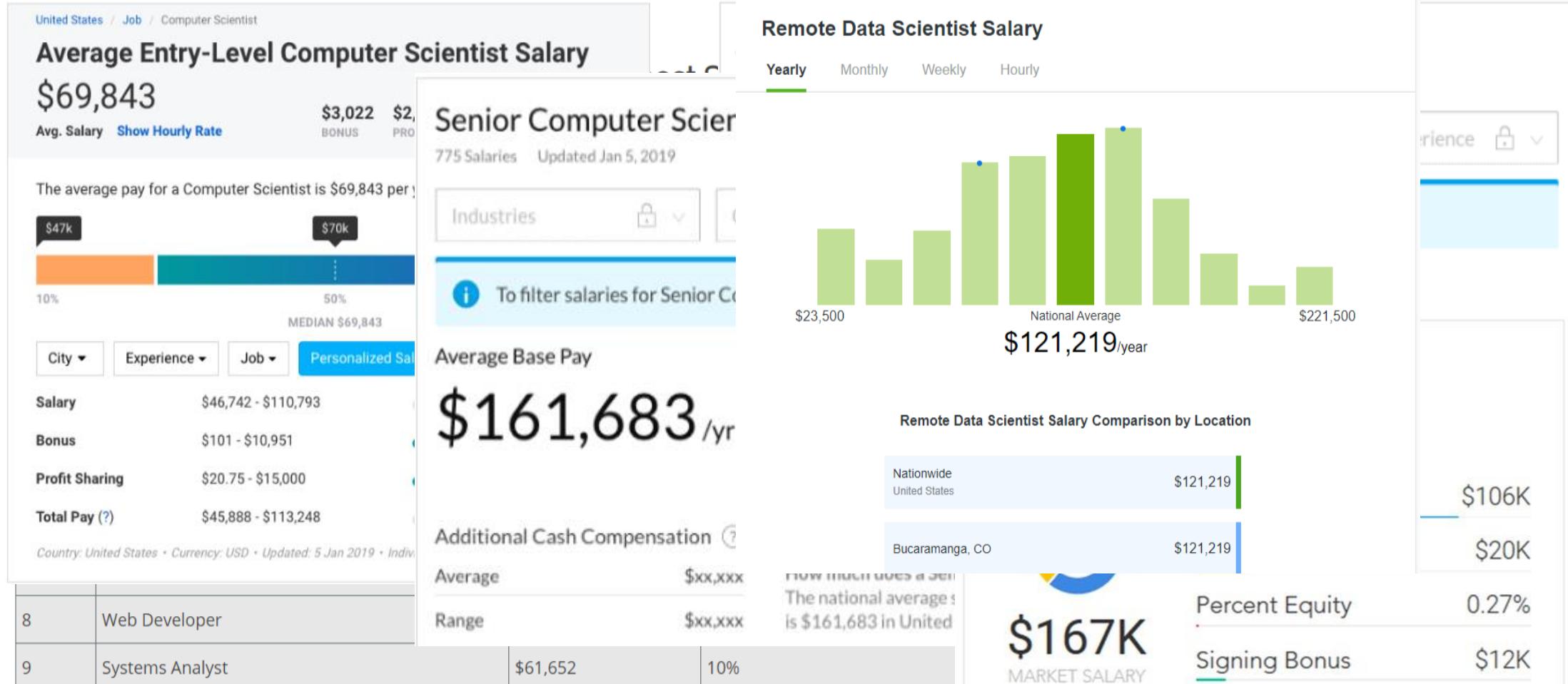
- Redes neuronales artificiales
- Aprendizaje supervisado
- Aprendizaje no supervisado
- Aprendizaje por refuerzo
- Visión por computador
- Algoritmos genéticos

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		1×10^5	10^5	1985-1989
1 TB	2	100 MB	2	1×10^6	10^6	1990-1994
50 TB	5	10 GB	3	5×10^6	10^8	1995-1999
250 TB	6	1TB	4	1×10^7	10^9	2000-2004
1 PB	7	30TB	5	8×10^6	10^{10}	2005-2009
5 PB	8	1 PB	7	1×10^9	10^{11}	2010-2014
10+ PB	9	20+ PB	8	1×10^{11}	10^{13}	2015-2019 (estimated)

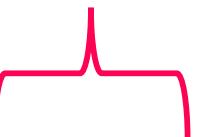
MB (megabyte) = 10^6 , GB (gigabyte) = 10^9 , TB (terabyte) = 10^{12} , PB (petabyte) = 10^{15} , BP=base pairs

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



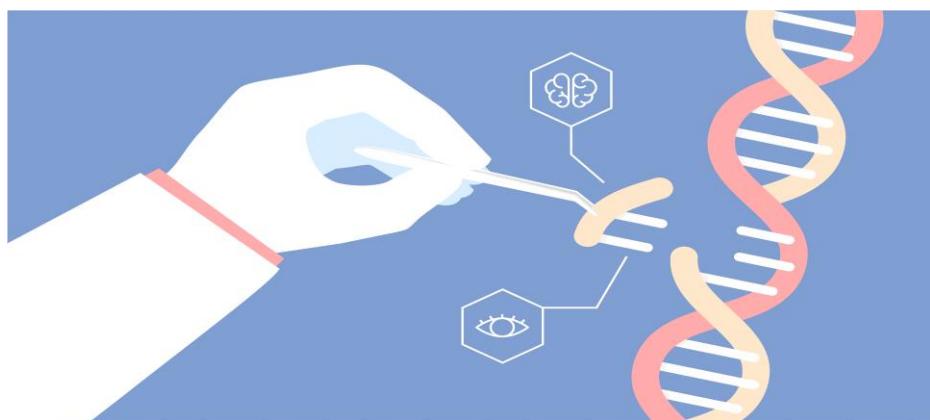
Medicina y computación



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

Programación
Paralelización
IA

Por qué combinar medicina y computación?

Medicina y computación



- Prevención
- Preparación
- Promoción
- Políticas públicas



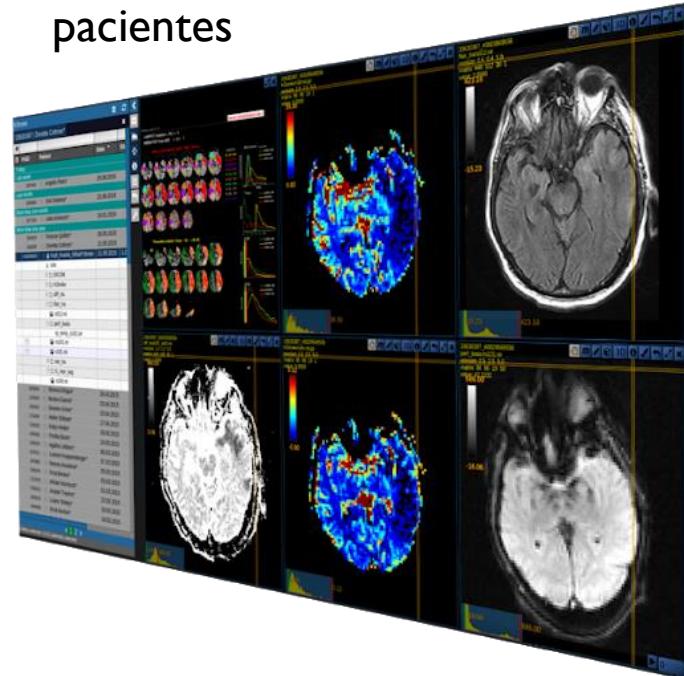
Salud pública



Datos de los pacientes



Imágenes médicas



Por qué combinar medicina y computación?

- 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

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

Medicina y computación



 babylon

About Services What we treat Blog NHS Pricing

Sign up Log in Download app



We're for health, for all

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

[Register for Babylon](#)

[Check symptoms](#)

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

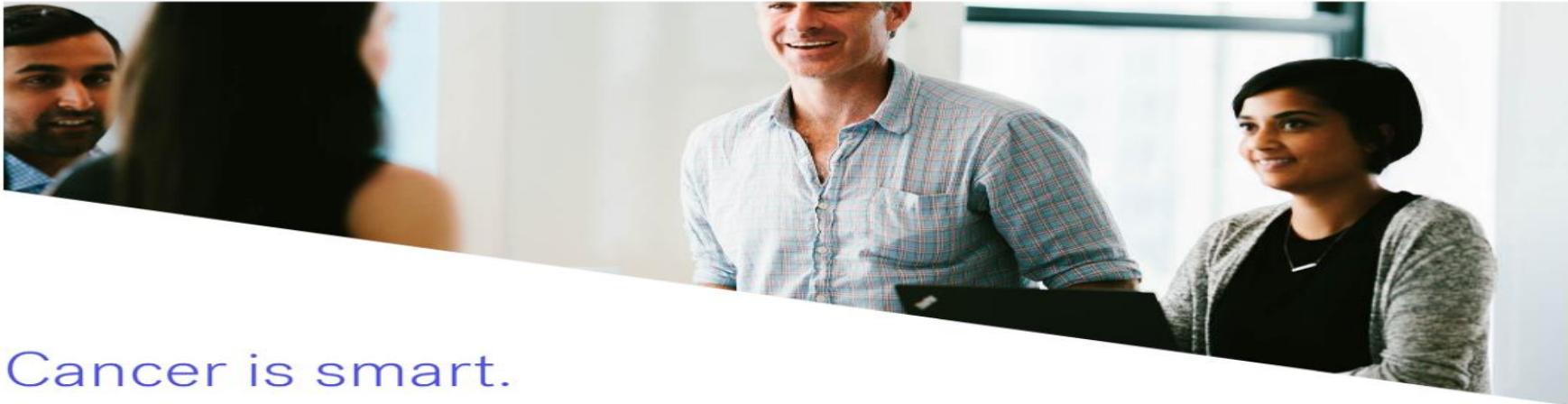
Herramienta diagnóstica (IA)

Comunicación 24/7 con personal médico

\$ 635.3M



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.

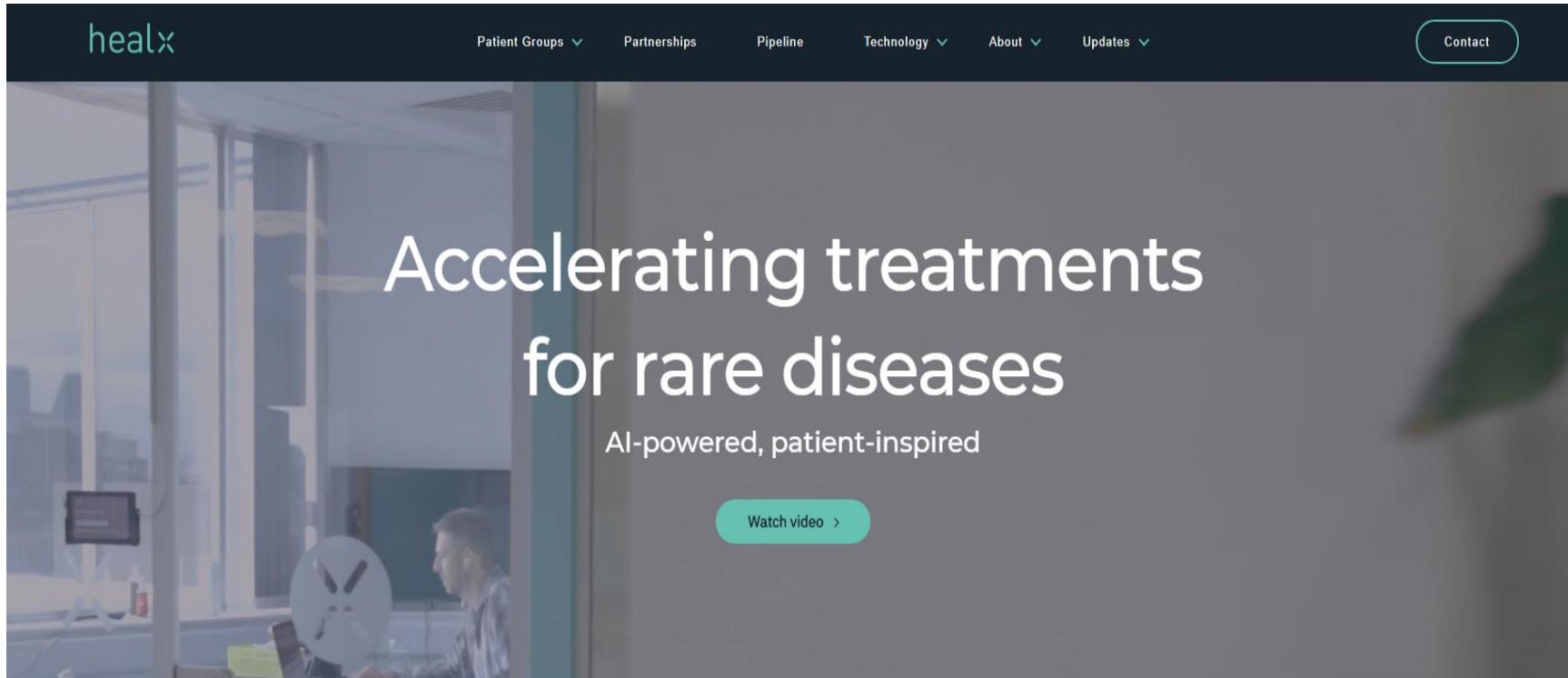
Together, we can learn from the experience of every patient.

<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

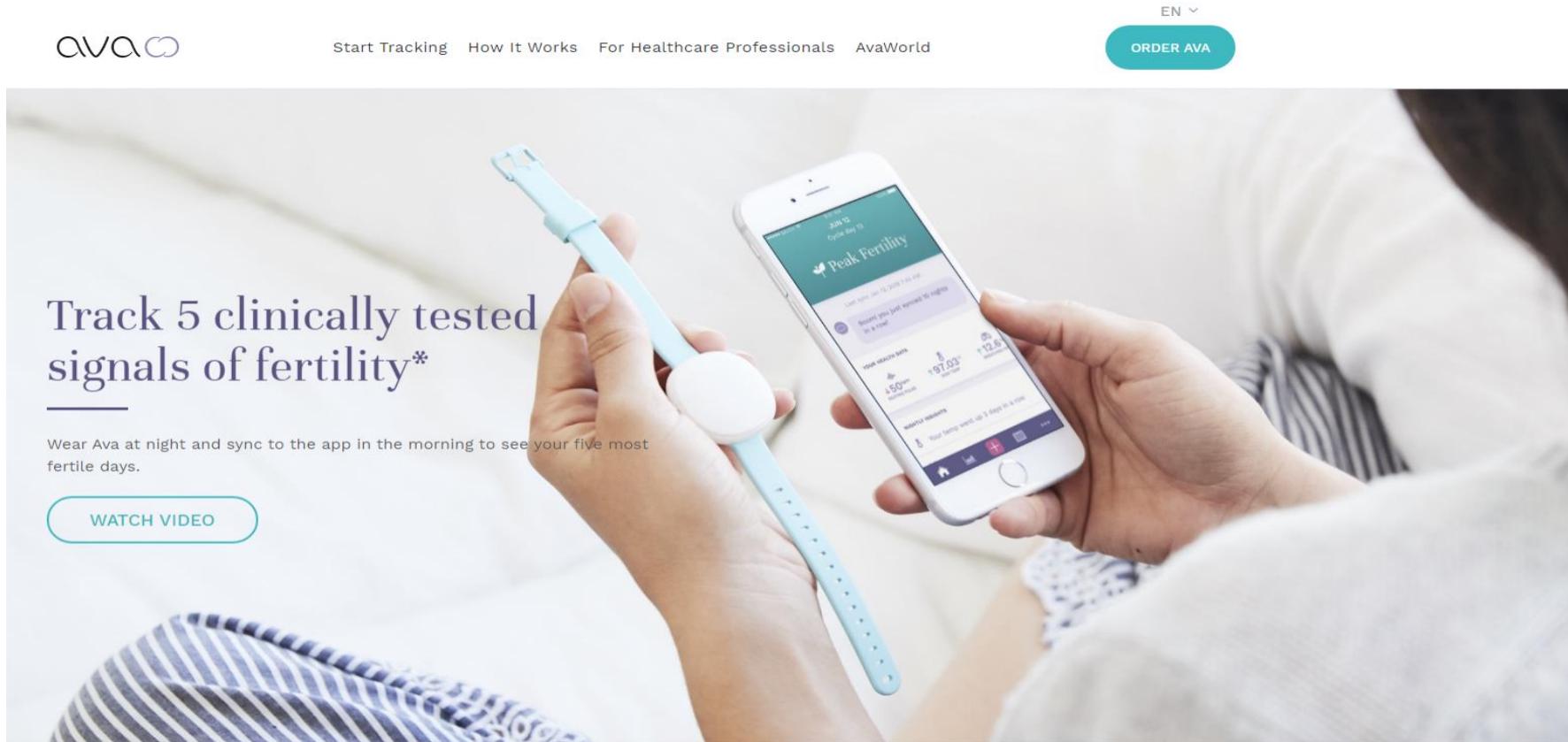
We've created the world's most efficient AI platform for rare diseases. It makes drug discovery faster, smarter and safer, and supports our team and partners in discovering and translating new treatments towards the clinic.

<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 (19), and various health metrics like heart rate and blood oxygen levels. The background is a blurred indoor setting.

EN ▾ ORDER AVA

Start Tracking How It Works For Healthcare Professionals AvaWorld

Track 5 clinically tested signals of fertility*

Wear Ava at night and sync to the app in the morning to see your five most fertile days.

[WATCH VIDEO](#)

\$ 45.3M

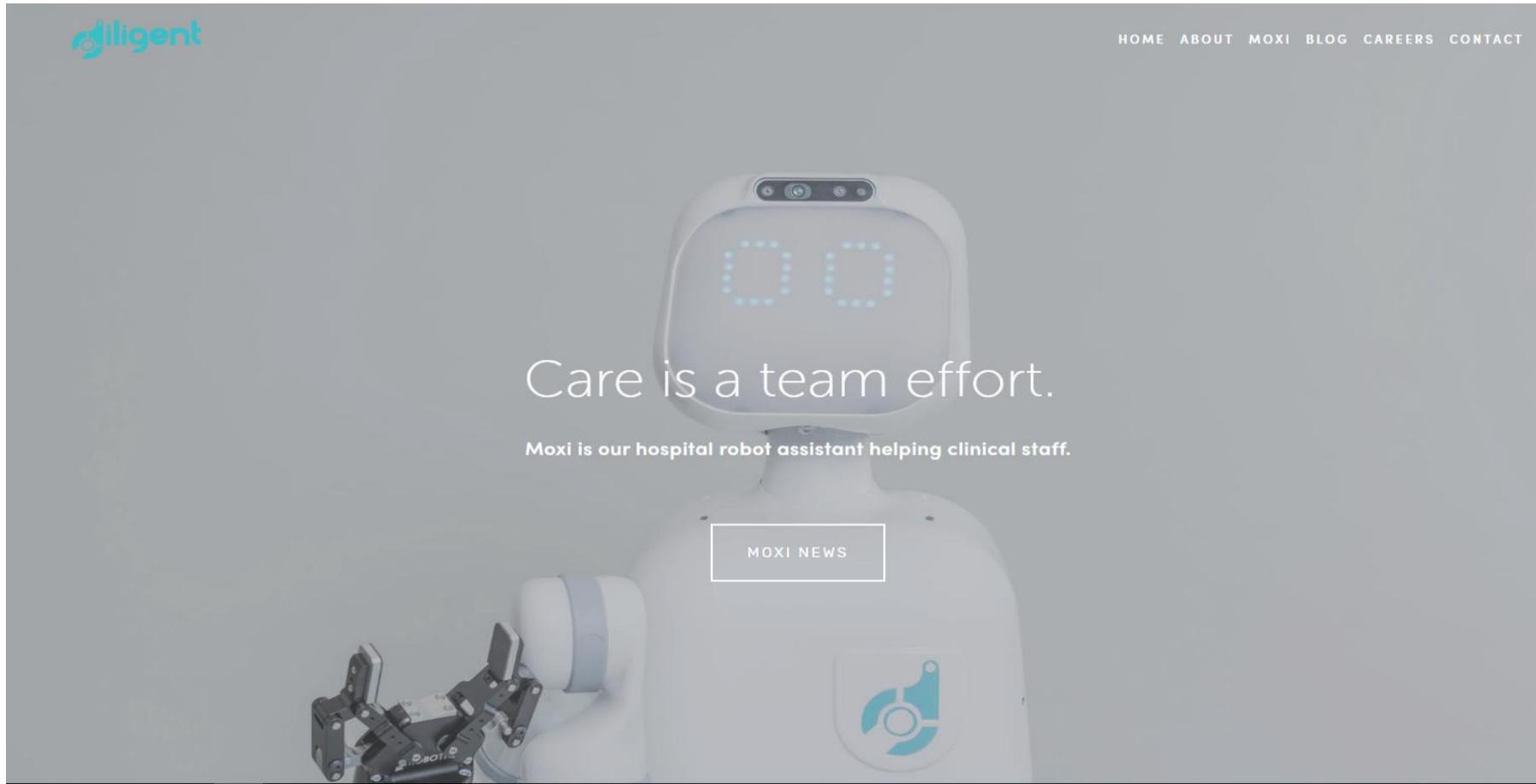
<https://www.avawomen.com/>

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

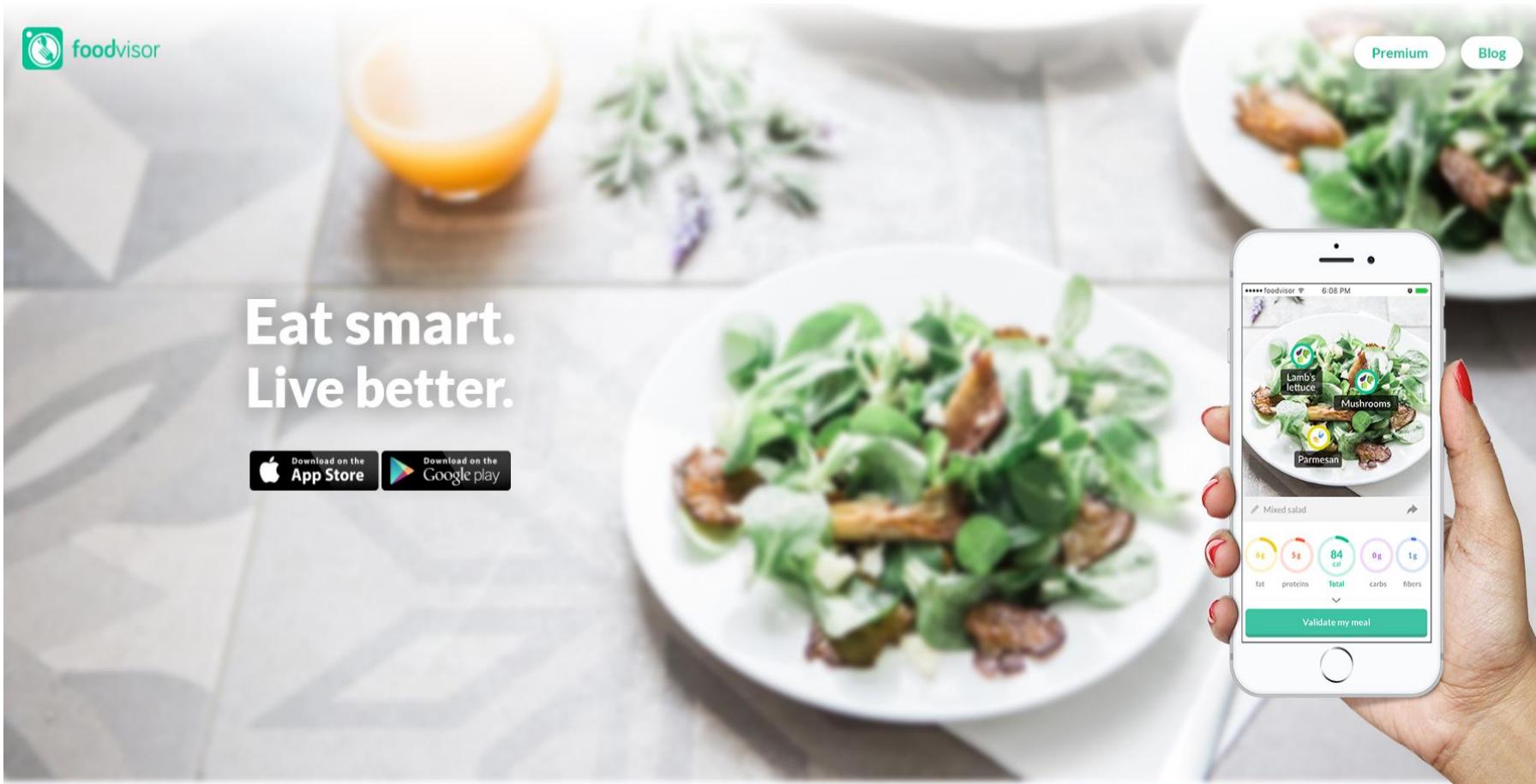


\$ 5.8M

<https://diligentrobots.com/moxi>

Enfermera robot

Medicina y computación

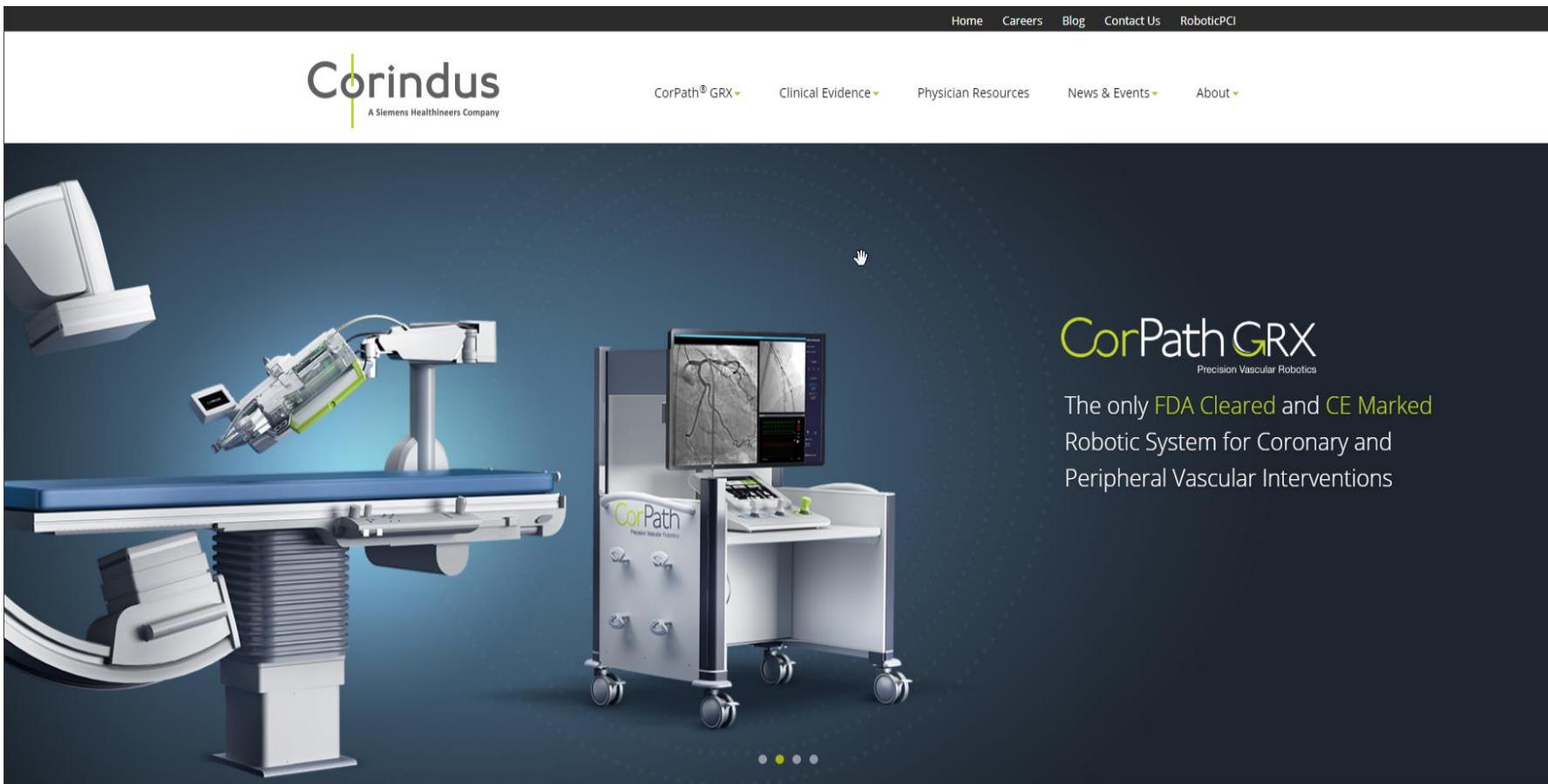


\$ 5.1 M

<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

Register

Sign in

Find articles with these terms

medicine

Google Play

Apps

Search

Android apps

All prices

196,811 results

Set search alert

Refine by:

Years

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

Show more

Article type

- Review articles (11,389)
- Research articles (132,275)
- Encyclopedia (1,909)
- Book chapters (11,777)

Show more

Publication title

- Computers in Biology and Medicine (2,881)
- Brain Research (2,474)
- Social Science & Medicine (2,007)

Ref

As

Exp

Juri

Rev

Th

Inte

Juri

Rev

Th

Account

Payment methods

My subscriptions

Redeem

My wishlist

My Play activity

Parent Guide

Res

Ele

Tel

Irv

Cor

Int

Apps

Search

Android apps

All prices

Apps

EM Explain Medicine	Pill Reminder & Me MyTherapy	Pill Reminder & Me Przemyslaw Słota	Prognosis : Your Di	Netmeds – India's	WikEM - Emergency	Pill Reminder & Me Medisafe	Medicine & Drugs D	Drugbook - All Medi
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/>



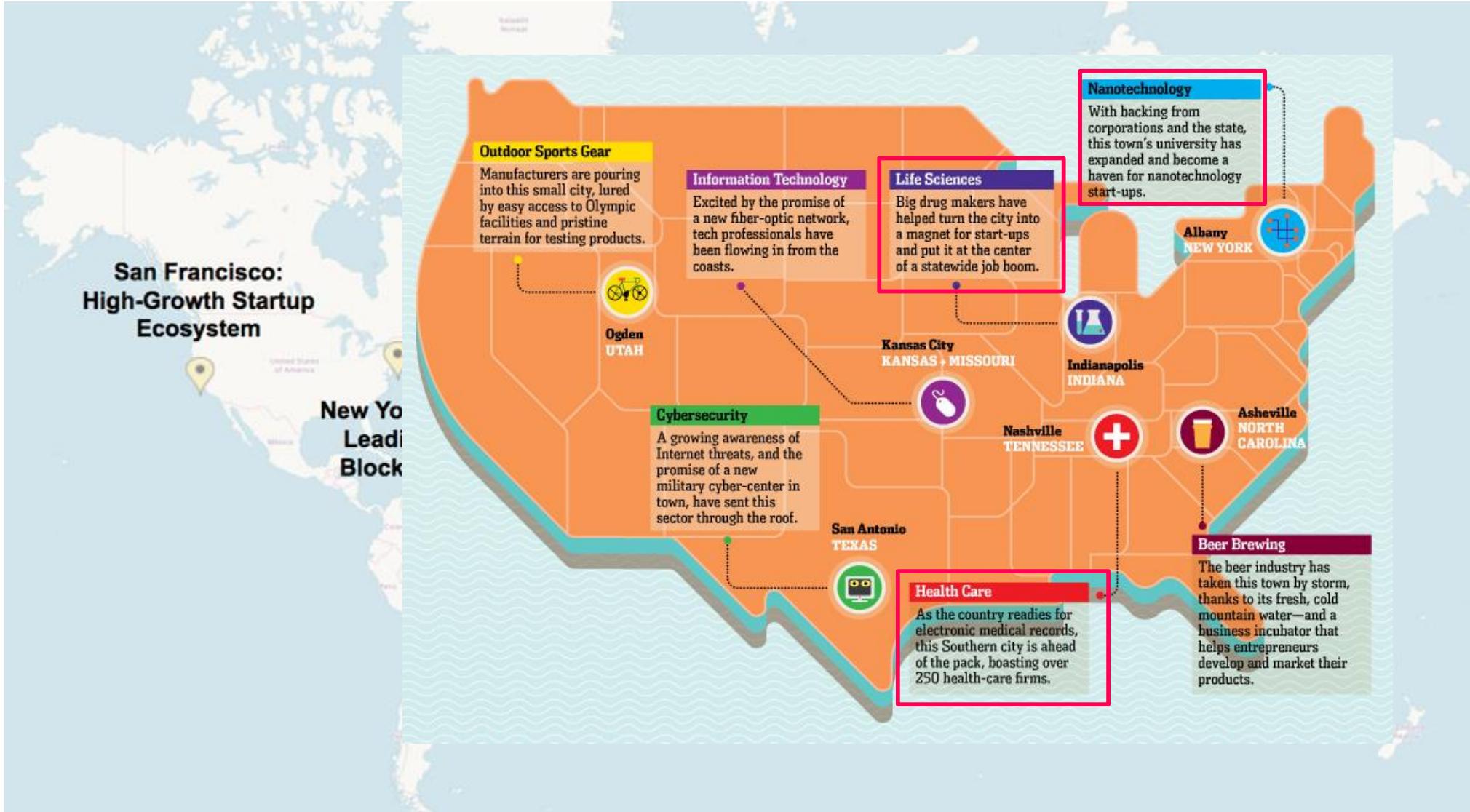
Cursos gratis Convocatorias

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>

Esta presentación:

https://github.com/leonardocfor/teaching/blob/master/conferences/medicina_computacion_unab_catedra_lope_carvajal_v.I.I.pdf

Gracias

Leonardo Camargo Forero, Ph.D

✉ leonardo@ubihpc.com

🌐 www.ubihpc.com

🌐 www.leonardocamargoforero.com