



From Collections & Services to Features & Algorithms:

New roles for libraries in the age of
artificial intelligence

Knowledge

Corey Harper -- @chrpr

IGeLU 2017

11 September 2017

Contributions: Brad Allen, Paul Groth

Artificial Intelligence Is Here

The New York Times Magazine

Share

448

The Great A.I. Awakening

How Google used artificial intelligence to transform Google Translate, one of its more popular services — and how machine learning is poised to reinvent computing itself.

BY GIDEON LEWIS-KRAUS DEC. 14, 2016



<https://www.nytimes.com/2016/12/14/magazine/the-great-ai-awakening.html>

Benchmarks are being *Shattered*

“...*overnight* improvements *roughly equal* to the total gains the old [system] had accrued over its *entire lifetime*.”

- Not just machine translation
- Huge improvements seen in
 - Human Speech Recognition
 - Computer Vision
 - Speech and text generation
 - Question Answering

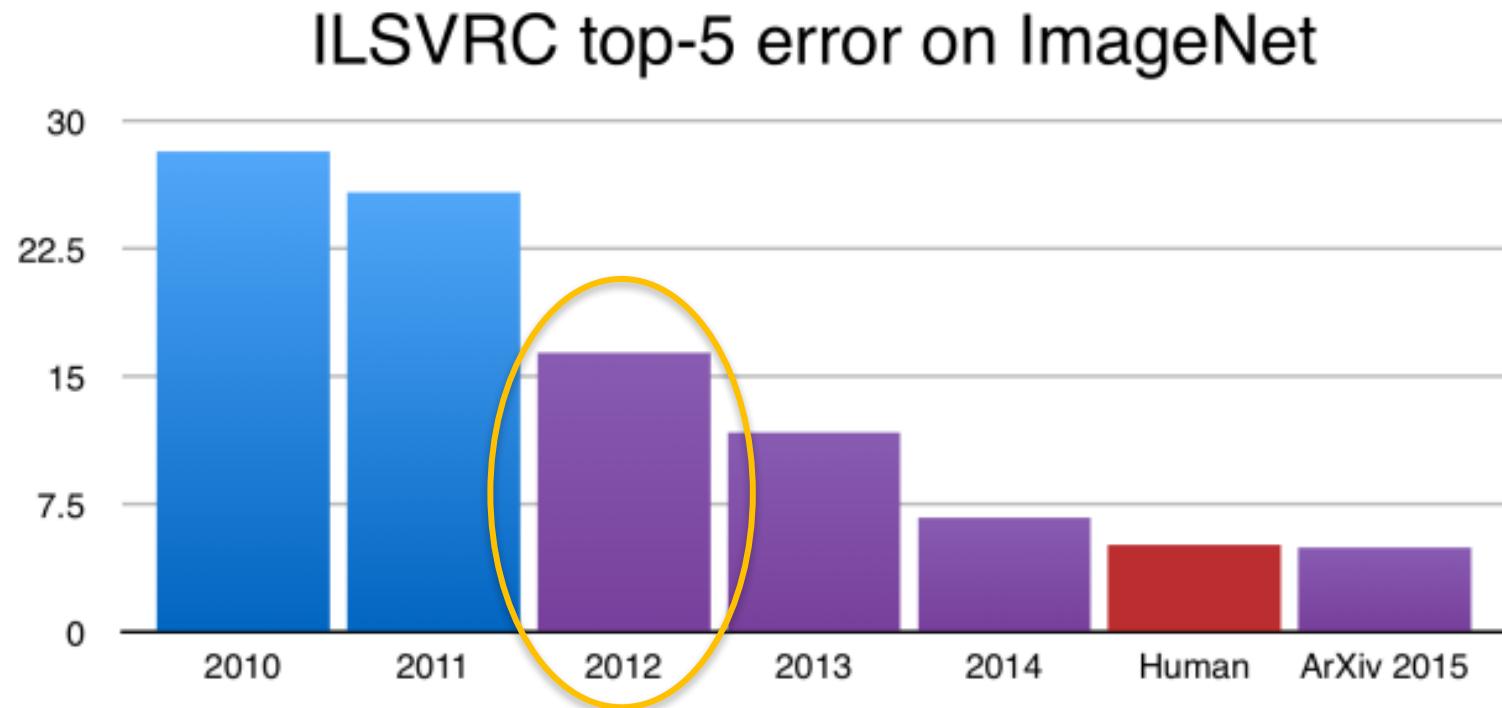
Human Speech Recognition



Was 23% in 2013, and over 35% in 2012.

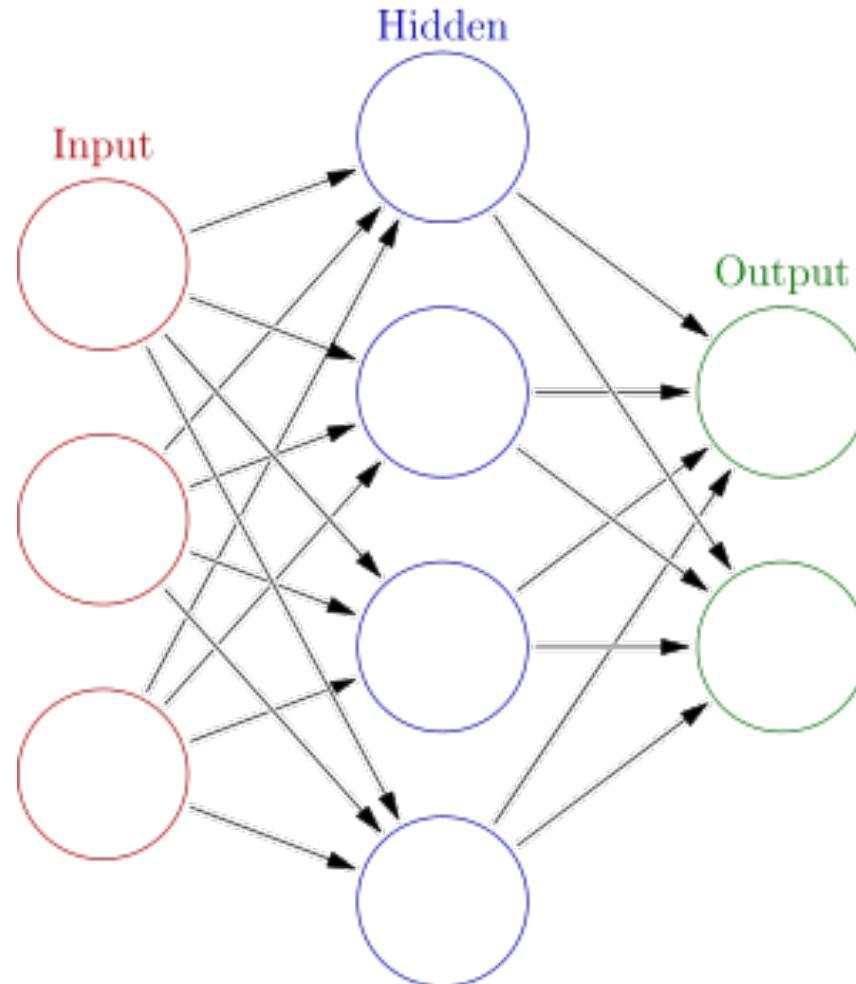
<https://venturebeat.com/2017/05/17/googles-speech-recognition-technology-now-has-a-4-9-word-error-rate/>

Image Recognition

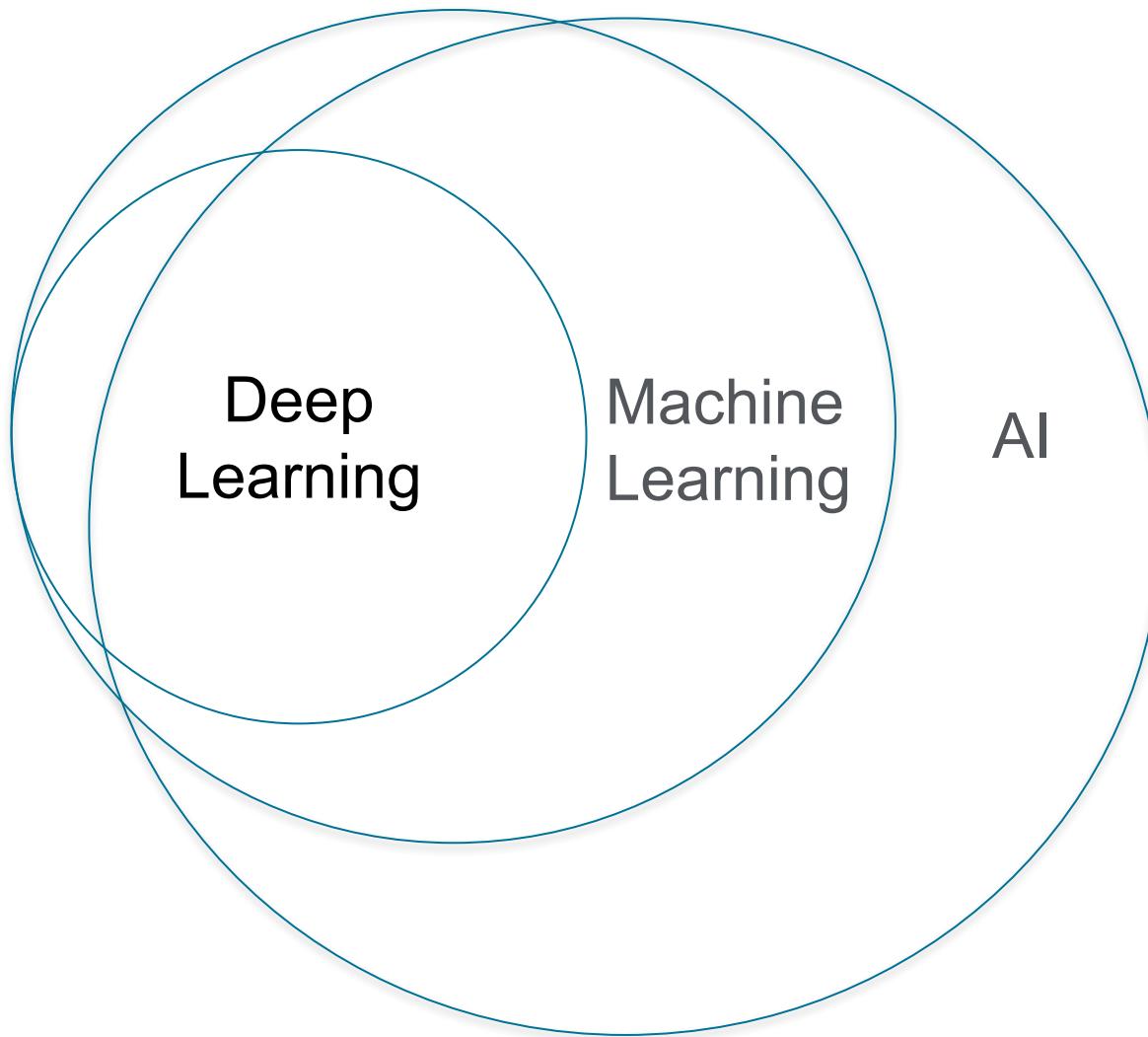


<https://devblogs.nvidia.com/parallelforall/author/czhang/>

Deep Learning – Neural Networks



AI, Machine Learning, Deep Learning



Supervised Learning vs Unsupervised

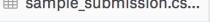
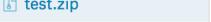
[kaggle](#) Search kaggle  Competitions Datasets Kernels Discussion Jobs ...

Dogs vs. Cats Redux: Kernels Edition

Distinguish images of dogs from cats
1,314 teams · 6 months ago

Overview **Data** Kernels Discussion Leaderboard Rules

Additional Files

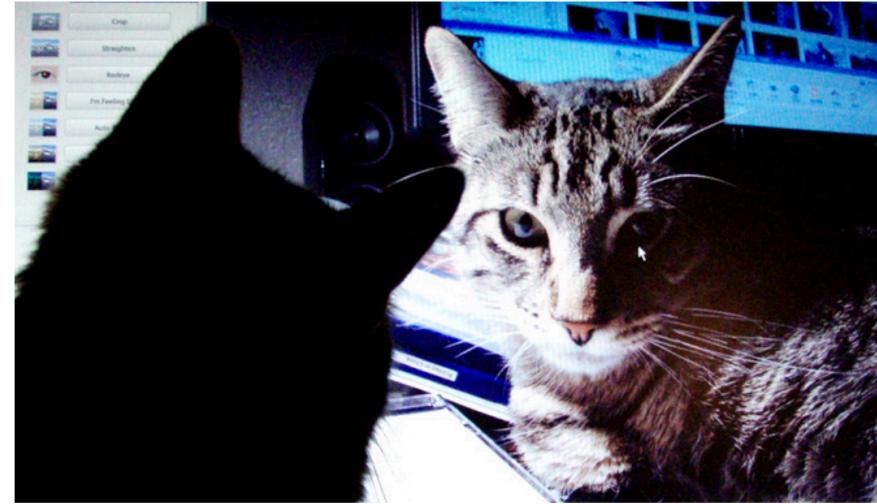
	test.zip 271.3 MB	 Download
		
		

Data Introduction

The train folder contains 25,000 images of dogs and cats. Each image in this folder has the label as part of the file. The test folder contains 12,500 images, named according to a numeric id. For each image in the test set, you should predict a probability that the image is a dog (1 = dog, 0 = cat).

WIRED STAFF SCIENCE 06.26.12 11:15 AM

GOOGLE'S ARTIFICIAL BRAIN LEARNS TO FIND CAT VIDEOS



By Liat Clark, Wired UK

<https://www.kaggle.com/c/dogs-vs-cats-redux-kernels-edition/data>

<https://www.wired.com/2012/06/google-x-neural-network/>

<https://arxiv.org/abs/1112.6209>

Supervised Learning vs Unsupervised

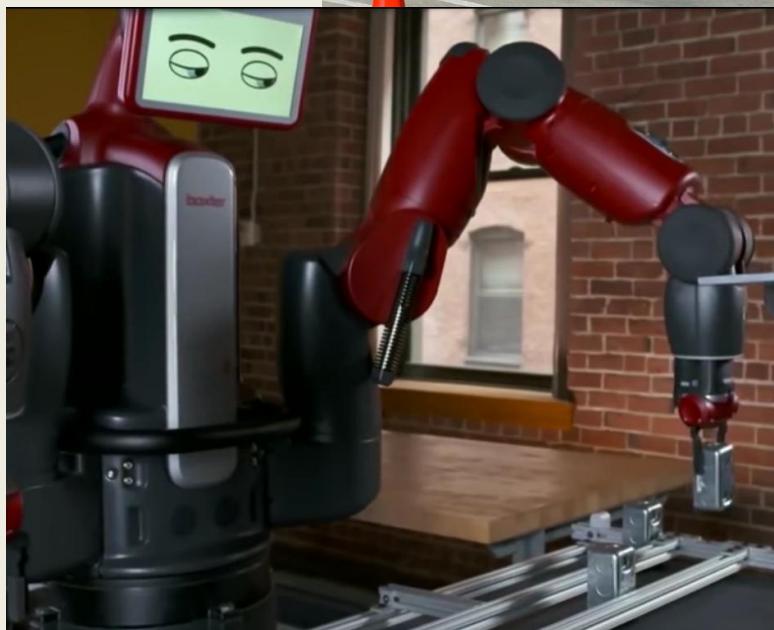
- Labeled Training & Labeled Test Data
 - Classifiers
 - Regression
 - Decision Trees
 - Support Vector Machines
 - Many Neural Networks
- Implicit Labels
 - Latent Semantic Analysis
 - K-Means Clustering
 - Some Neural Nets (GANs, word2vec)
 - Distant or Weak Supervision

Why is English <-> French the most performant translation task?

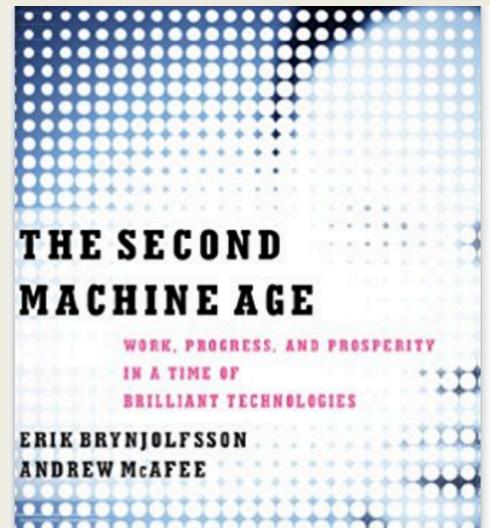


By Saffron Blaze - Own work, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=28678264>

The Second Machine Age



By Flckr user jurvetson (Steve Jurvetson). Trimmed and retouched with PS9 by Mariordo = http://commons.wikimedia.org/wiki/File:Jurvetson_Google_driverless_car.jpg, CC BY-SA 2.0
By Source, Fair use, <https://en.wikipedia.org/w/index.php?curid=31142331>
By Salammbo31 - Own work, CC BY-SA 4.0, <https://commons.wikimedia.org/w/index.php?curid=36902398>
<https://www.amazon.com/Second-Machine-Age-Prosperity-Technologies-ebook/dp/B00D97HPQI>



Machine Learning in Health & Medicine

Chan Zuckerberg Initiative acquires and will free up science search engine Meta

Posted Jan 23, 2017 by Josh Constine (@joshconstine)



ELSEVIER



NVIDIA.

Chest Defense: Deep Learning Spots Disease Early Using Chest X-Rays

Input Image	generated annotation	true annotation
	aorta_thoracic / tortuous / mild aorta_thoracic / tortuous	opacity / lung / middle_lobe / right / aorta_thoracic / tortuous opacity / lung / base / left
	calcified_granuloma / lung / middle_lobe / right / multiple calcified_granuloma / lung / hilum / right	opacity / lung / middle_lobe / right / blood_vessels calcified_granuloma / lung / middle_lobe / right
	airspace_disease / lung / hilum / right / lung / hilum nodule / lung / hilum / right	thoracic_vertebrae_degenerative / mild aorta_borтуous / thoracic_vertebrae_degenerative / mild
	normal	normal
	normal	normal

ELSEVIER

- <https://techcrunch.com/2017/01/23/chan-zuckerberg-initiative-meta/>
- <https://blogs.nvidia.com/blog/2016/05/10/deep-learning-chest-x-rays/>
- <https://www.crunchbase.com/organization/ibm-watson-health>

Applications to Social Good

- Precision Medicine, Genomics, Oncology
- Agriculture and Nutrition
- Smart Cities and Urban Development
- Economics and Social Justice
- Social Work
- Environmental Health and Environmental Justice

Precision Sciences

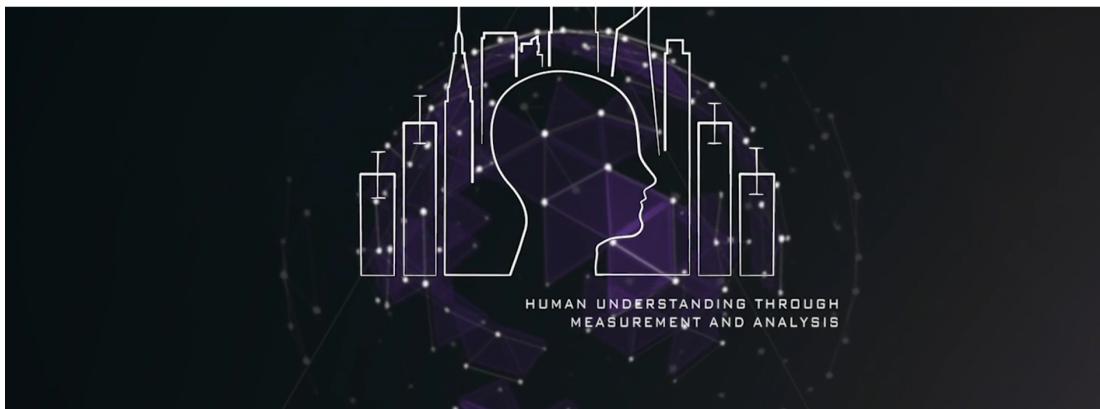


10,000
New Yorkers

4,000
Households

20
Years

1
Research Platform



<http://aims.fao.org/activity/blog/global-data-ecosystem-agriculture-and-food-godan-discussion-paper>

<https://www.nytimes.com/2017/06/04/nyregion/human-project-new-york-city-study.html>

<https://www.thehumanproject.org/>

The need for training data

- Machine Learning is pattern recognition
- Machine Learning needs *millions* of examples
- There is huge value in training data
- Google, Amazon, Baidu, Facebook, IBM...
- Common theme? **Data**

Google “...drew upon both the company’s *peerless reserves of data* and its massive computing infrastructure.” – NYTimes

New Roles For Libraries

Roles for Libraries in AI

- Applying Machine Learning ourselves
- Ranganathan Revisited
 - Every Algorithm its Dataset
 - Every Dataset its Algorithm
 - Save the time of the Machine
- Combating the Dark Side of AI
 - Algorithmic Literacy
 - Bias Identification

Applications of ML in Libraries

- Recommender Systems & Personalization
- Machine Assisted Classification
 - Topic Modeling for Subject Analysis
 - ML for Format Identification
- Knowledge Graph Development
 - Named Entity Recognition
 - Open Information Extraction
 - Relationship Extraction
 - Universal Schema

Recommender Systems



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Information Sciences Institute
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Browse to search, visualize to explore: Who needs an alternative information retrieving model?

Pajić D.
Computers in Human Behavior (2014)
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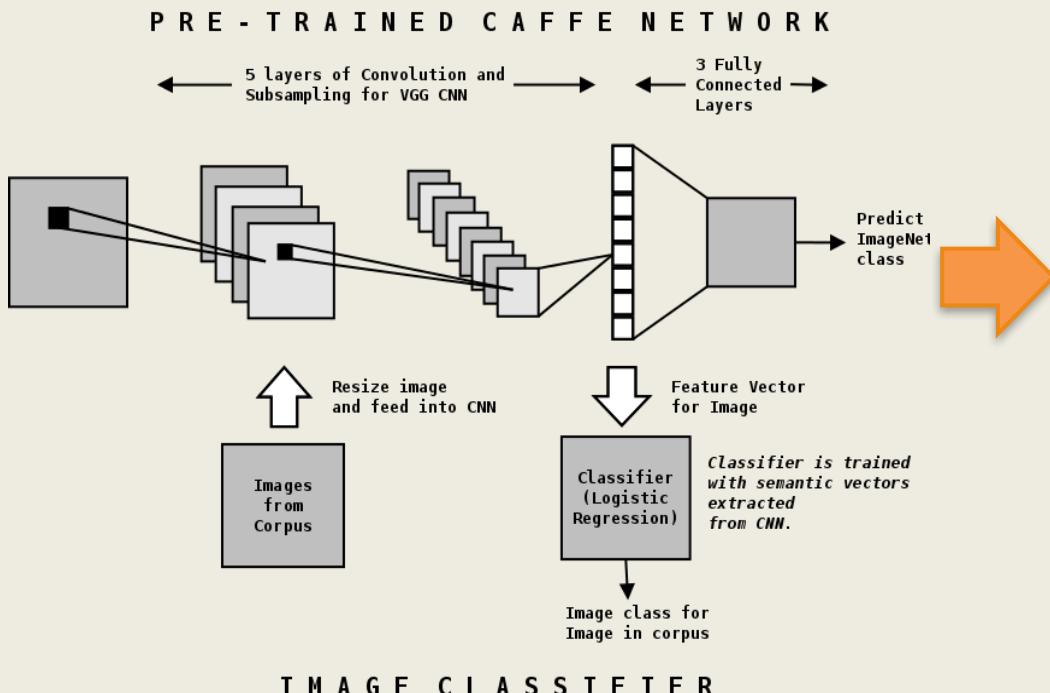
Pundit: Augmenting web contents with semantics
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Literary and Linguistic Computing (2013)
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Proceedings - International Conference on Data Engineering (2009)
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Distributed Indexing for Semantic Search
Mika P.

Image Classification based Recommendations



ClinicalKey®

All Types Books Journals More

Filter By: Source Type Specialties Rate Results

34991 results

Relevance

CLINICAL OVERVIEW

Hypertension

- Synopsis
- Terminology
- Diagnosis
- Screening and Prevention
- Treatment

FIRST CONSULT

Hypertension

Yonghong Huan, MD, Assistant Professor of Medicine, Renal, Electrolyte and Hypertension Division, University of Pennsylvania Health System, Philadelphia, Pennsylvania; Ruben J. Nazario, MD, MA, Contributing Editor, First Consult. Published January 4, 2014. Last updated September 18, 2013.

FIRST CONSULT

Hypertension in children

Charles Kwon, MD, Director, Center for Pediatric Nephrology, Cleveland Clinic, Cleveland, Ohio; Ruben Nazario, MD, MA. Published February 19, 2013. Last updated September 17, 2013.

Searches related to hypertension

pulmonary hypertension	pulmonary hypertensive arterial disease
pre-eclampsia	intracranial hypertension
essential hypertension	portal hypertension

BOOK CHAPTER

Hypertension

Rosett's Emergency Medicine, Levy, Philip D., Published January 1, 2014. Pages 1113-1125 ed. © 2014.

FULL TEXT ARTICLE

Selected Content (6)

Comparison of Hypertension Guidelines Mayo CME Proceedings • February 2015

Standardised effects of a 10 mm Hg reduction in systolic blood pressure stratified by blood pressure *J Am Heart Assoc* • March 2016

Evidence-based dosing of antihypertensive medications *American Journal of Health Advocacy* • July 2015

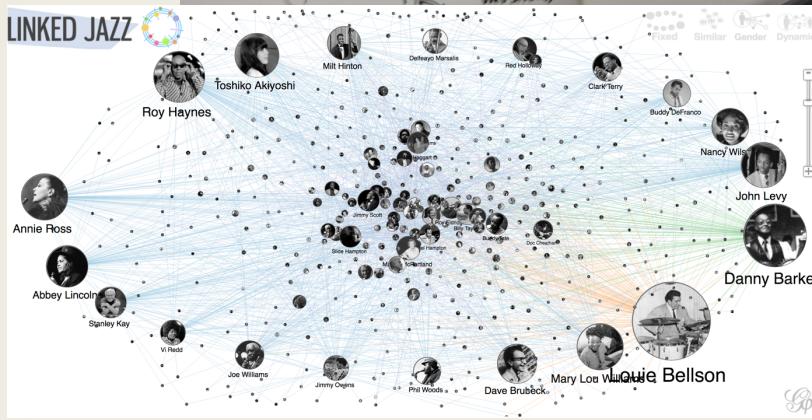
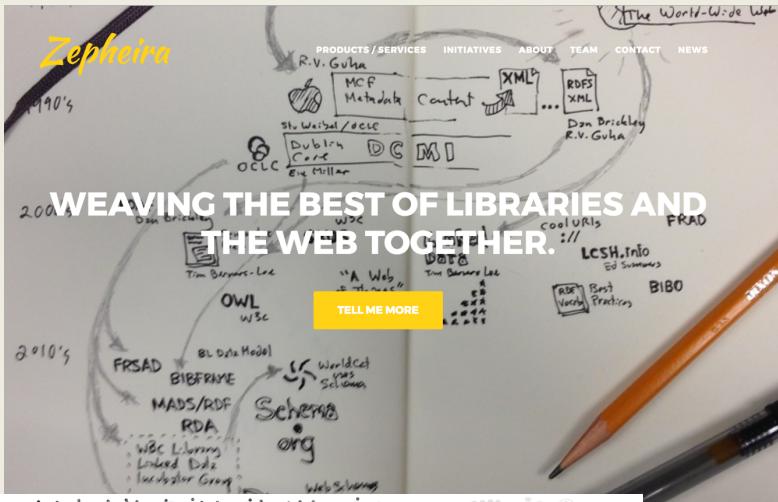
Was this helpful? Yes or No

Answers are about things, not just Works



- Why shouldn't a search on an author return information about the author, including the author's works? Where was the author born, when did she live, what is she known for? ... All of this is possible, but only if we can make some fundamental changes in our approach to bibliographic description. ... The challenge for us lies in transforming what we can of our data into interrelated “things” without overindulging that metaphor.
- Coyle, K. (2016). FRBR, before and after: a look at our bibliographical models. Chicago: ALA Editions.

Knowledge Graphs for Research





Cornell University

Search Cornell

VIVO | Research & Expertise Across Cornell

Index Log in

Home People Organizations Research Events

Welcome to VIVO

VIVO is a research-focused discovery tool that enables collaboration among researchers across all disciplines.

Browse or search information on people, departments, courses, grants, and publications.

Log in

Log in using Cornell NetID

Search VIVO

limit search →

Research

- 61,040 Academic Articles
- 12,652 Conference Papers
- 56 Edited Books
- 80 Library Collections
- 39 Media Contributions

[View all ...](#)

Faculty

-  **Aburua, Héctor D.**, Professor, Chemistry and Chemical Biology (CHEM)
-  **Wilson, Justin J.**, Assistant Professor, Chemistry and Chemical Biology (CHEM)
-  **Ealick, Steven E.**, Professor, Chemistry and Chemical Biology (CHEM)
-  **Park, Jiwoong**, Associate Professor, Chemistry and Chemical Biology (CHEM)

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Research Facilities

- Confocal and Multiphoton Microscopy
- Low Temperature and Helium Distribution Facility
- Iodination Core Facility
- Cornell NMR Facility
- NanoBiotechnology Center BioFacility
- Cancer Protein Expression Laboratory (CPXL)

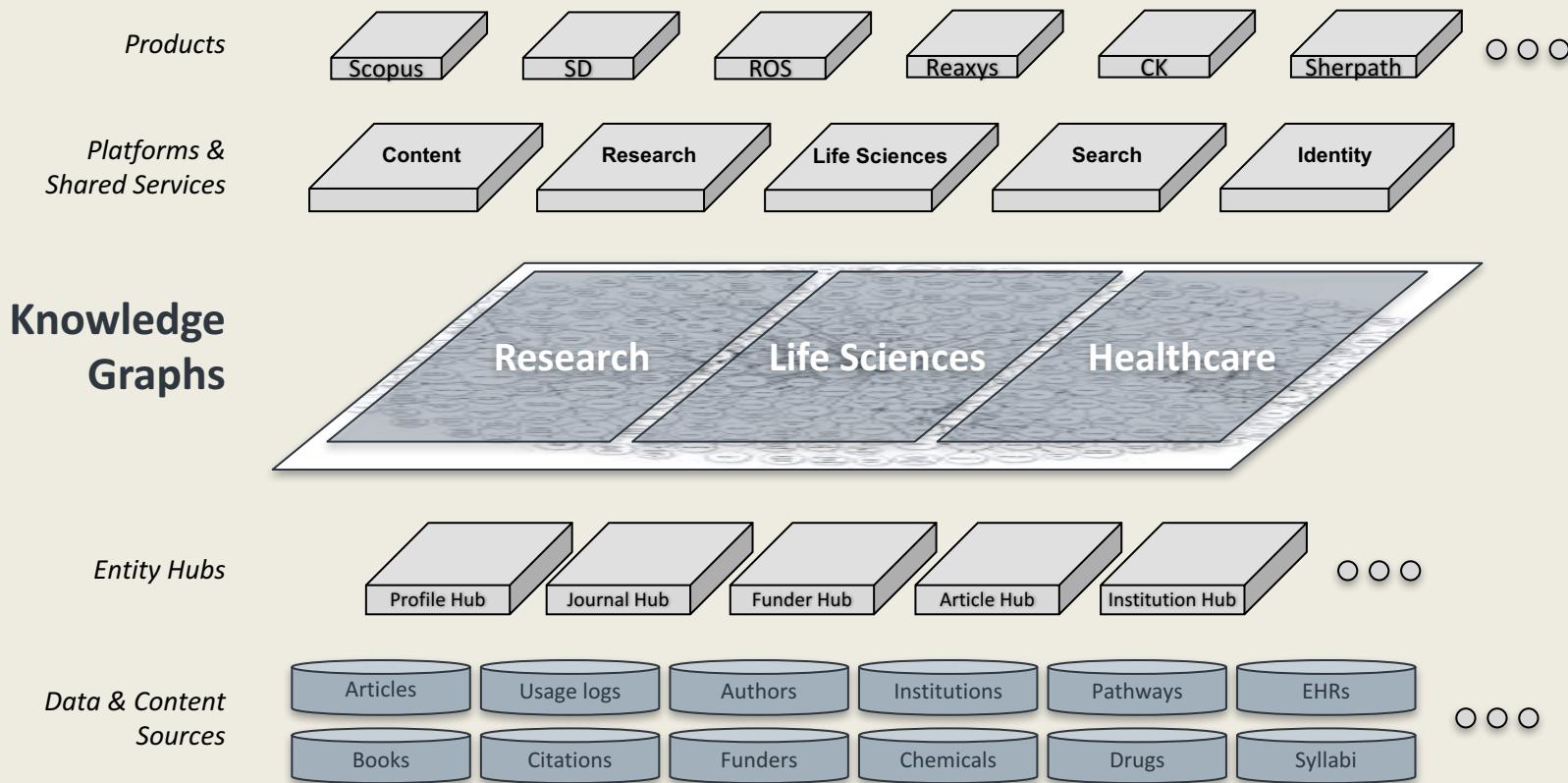
[View all ...](#)

Plus LAWDI, LOD-LAM, LD4L-Labs, & Many More

<https://zepheira.com/> – <https://linkedjazz.org/network/> – <http://vivo.cornell.edu/>

ELSEVIER

Elsevier's Knowledge platform



Elsevier: Knowledge Graphs for Research



Elsevier: Knowledge Graphs for Life Sciences

Biological Pathways extracted via semantic text mining

Bioactivities through text analysis

Chemical Structures And Properties



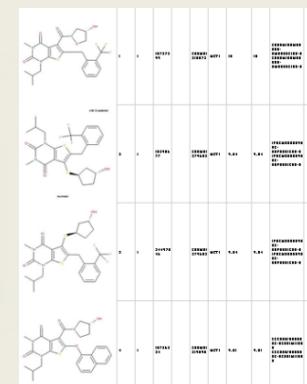
A upregulates B

B upregulates C

C increases disease D

$A \Rightarrow B \Rightarrow C \Rightarrow D$

IC_{50} 6.3nM, kinase binding assay
10mM concentration



EMTREE

NCBI,
Uniprot

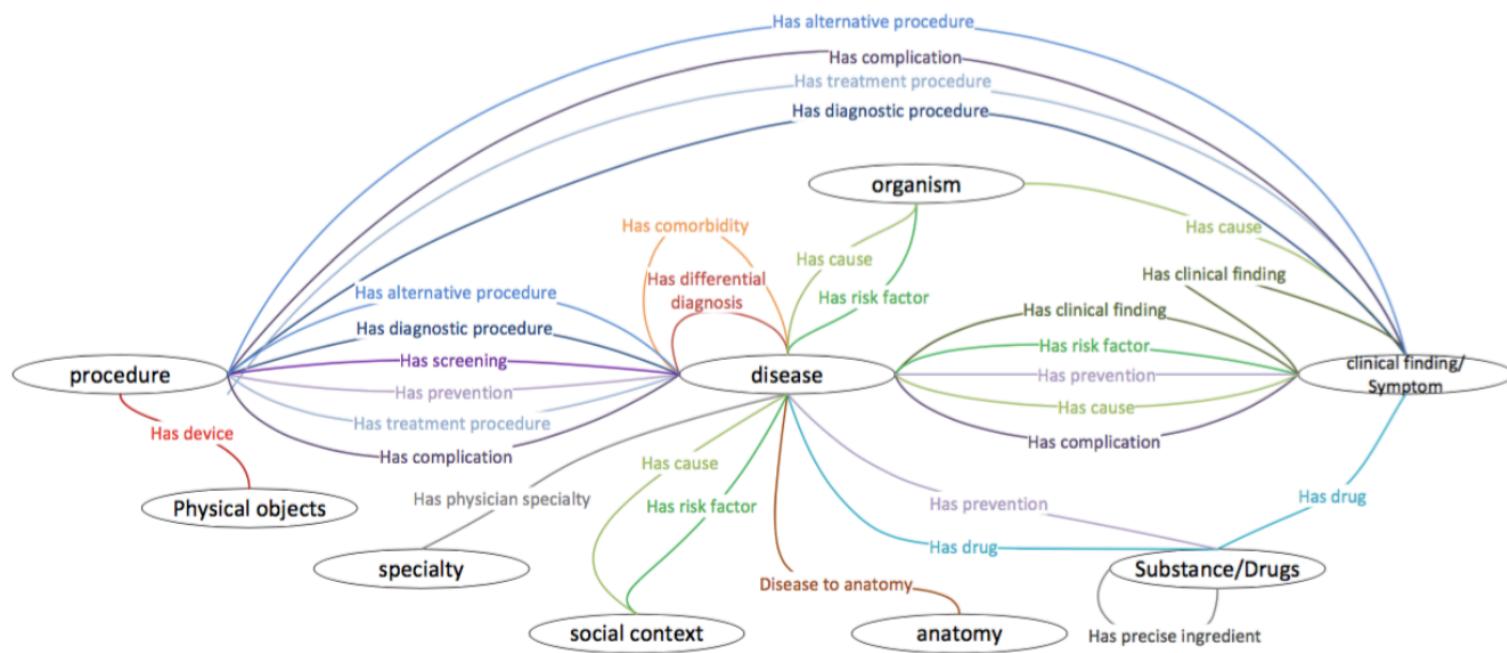
InChi,
Name

ReaxysTree,
Structures

Normalizing vocabularies required: proteins, diseases, drugs, chemicals

Elsevier: Knowledge Graphs for Healthcare

EMMeT Knowledge Graph



A Ranganathan Redux

Or...

Ranganathan
for Robots

Save the time
of the
Machine

Shiyali Ramamrita Ranganathan



five laws of library science

1. Books are for use.
2. Every reader his or her book.
3. Every book its reader.
4. Save the time of the reader.
5. The Library is a growing organism.

What does it look like to have *machines* as library patrons?

- Curate Training Data
 - Catalog Data
 - Help Create Labels
 - Facilitate Discovery
- Curate Models
- Access to Tools



Public Training Data

Health Data

- Cancer Genome Data: <https://dcc.icgc.org/>
- Clinical Trial Data: <https://clinicaltrials.gov/>
- De-identified Electronic Medical Records
<https://mimic.physionet.org/about/mimic/>

Web Content

- Common Crawl <http://commoncrawl.org/>

Language Data

- Translation Data: <http://opus.lingfil.uu.se/>
- Linguistics Data: <http://www.anc.org/data/oanc/>
- Inference Data: <https://nlp.stanford.edu/projects/snli/>

Word Vectors

- Pre-trained word vectors from Word2Vec:
<https://code.google.com/archive/p/word2vec/>
- Pre-trained word vectors from GLoVE:
<https://nlp.stanford.edu/projects/glove/>
- Pre-trained FastText word vectors in 294 language from Facebook AI Research:
<https://github.com/facebookresearch/fastText/blob/master/pretrained-vectors.md>

Contests and Crowdsourcing

The Home of Data Science & Machine Learning
Kaggle helps you learn, work, and play

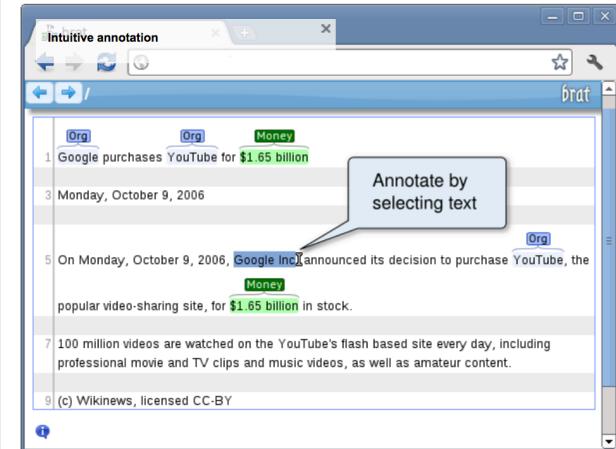
Create an account or Host a competition

Competitions ›
Climb the world's most elite machine learning leaderboards

Datasets ›
Explore and analyze a collection of high quality public datasets

brat rapid annotation tool

online environment for collaborative text annotation



Discover, preview and complete HITs on the new Worker website. Try it out Today!

Already have an account? Sign in as a Worker | Requester

Mechanical Turk is a marketplace for work.
We give businesses and developers access to an on-demand, scalable workforce. Workers select from thousands of tasks and work whenever it's convenient.
192,042 HITs available. [View them now.](#)

Make Money
by working on HITs

HITS - Human Intelligence Tasks - are individual tasks that you work on. [Find HITs now.](#)

As a Mechanical Turk Worker you:

- Can work from home
- Choose your own work hours
- Get paid for doing good work

Find an interesting task → **Work** → **Earn money**

[Find HITs Now](#) or [learn more about being a Worker](#)

Get Results
from Mechanical Turk Workers

Ask workers to complete HITS - Human Intelligence Tasks - and get results using Mechanical Turk. [Get Started.](#)

As a Mechanical Turk Requester you:

- Have access to a global, on-demand, 24 x 7 workforce
- Get thousands of HITs completed in minutes
- Pay only when you're satisfied with the results

Find your account → **Load your tasks** → **Get results**

[Get Started](#)

CrowdFlower AI
Human-in-the-loop for Machine Learning

WHY AI USE CASES SUCCESS STORIES PRICING BLOG CONTACT US

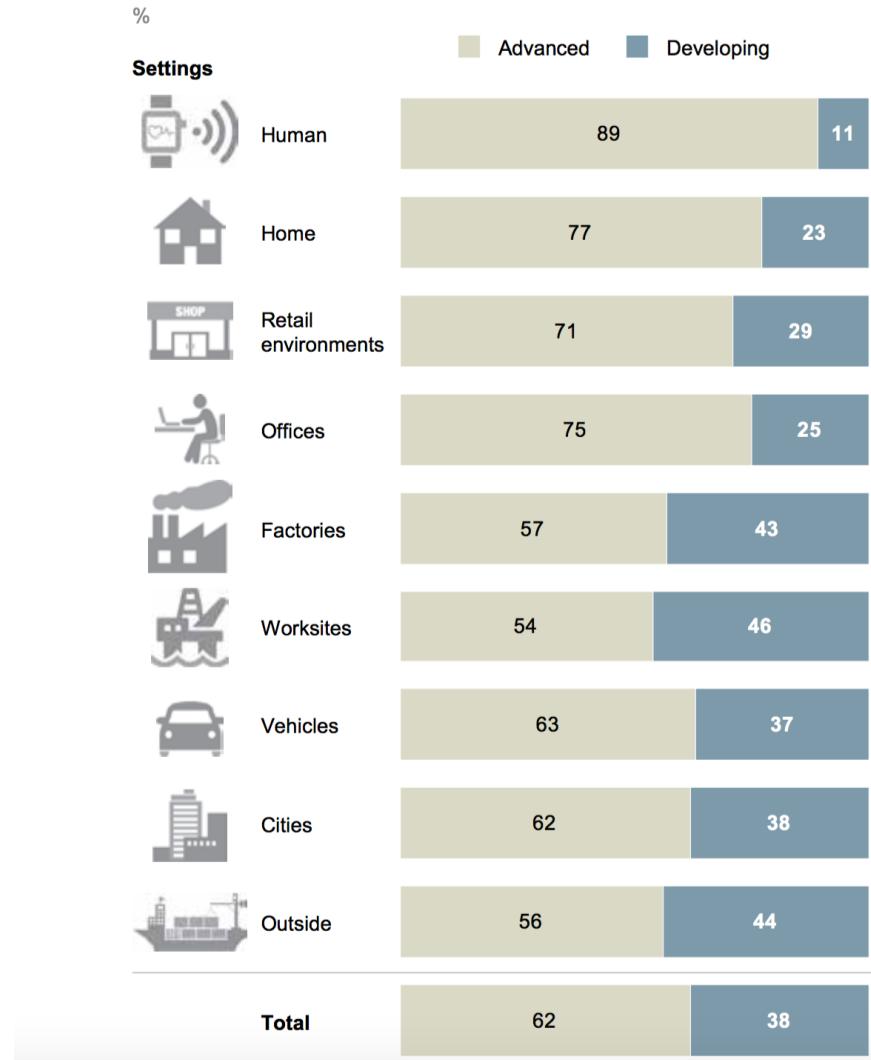
<http://brat.nlplab.org/> – <https://www.mturk.com/mturk/welcome> – <https://kaggle.com/>
ELSEVIER <https://www.crowdflower.com/machine-learning-with-crowdflower/>

Are any libraries collecting and providing access to this stuff?

Do libraries have Machine Learning expertise on staff to help faculty and students find appropriate training data?

Internet of Things "Edge" Data

- McKinsey: \$11.1T / year by 2025
- Gartner projects 20B Internet connected devices in 2020





Medtronic launches smartphone connectivity for CGMs, insulin pumps

By **Jonah Comstock** | September 29, 2015

SHARE 1

Internet Connected Bottle Caps Help Remember to Take Your Pills

AUGUST 14TH, 2009 EDITORS OTC

Facebook Twitter Google+ LinkedIn

GlowCap, a product of Vitality out of Cambridge, MA, is a bottle cap that reminds patients to take their meds on a regular schedule. We covered the devices in the past (see flashbacks below), but now the firm has released a version of the GlowCaps that use a wireless microchip to communicate with a computer connected device to program the drug regimen.

Product features:



The GlowCap™ is an Internet-connected medication adherence product that helps remind you to take your once-a-day medication or vitamin. It pulses orange

ed Connect system, s who use both a monitor (CGM) and a ta from both device on their caregiver.

holistic diabetes Brüls, President of the business at Medtronic, e how we are moving nsors to providing future -- providing of also transforming



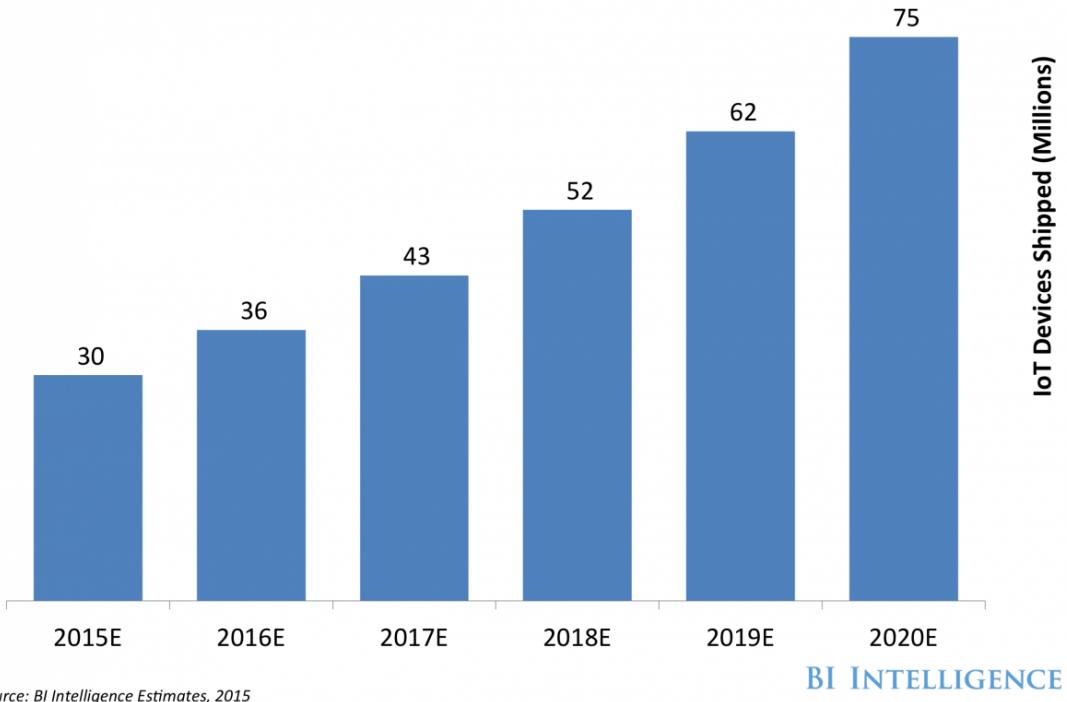
https://en.wikipedia.org/wiki/Fitbit#/media/File:Fitbit_Flex.jpg

https://www.medgadget.com/2009/08/internet_connected_bottle_caps_help_remember_to_take_your_pills.html

<http://www.mobihealthnews.com/47112/medtronic-launches-smartphone-connectivity-for-cgms-insulin-pumps>

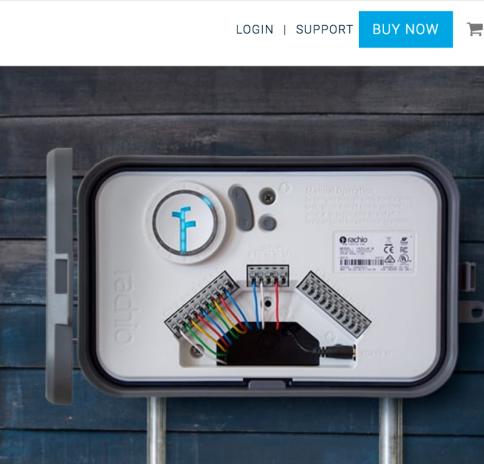
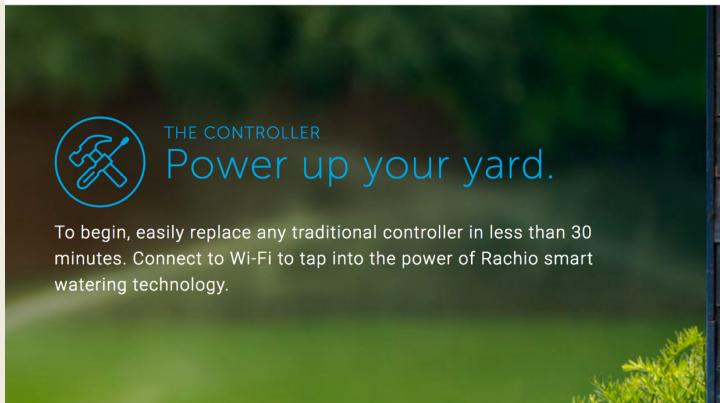
Estimated Agricultural IoT Device Shipments

Global



HOW IT WORKS FEATURES INSTALL

LOGIN SUPPORT BUY NOW

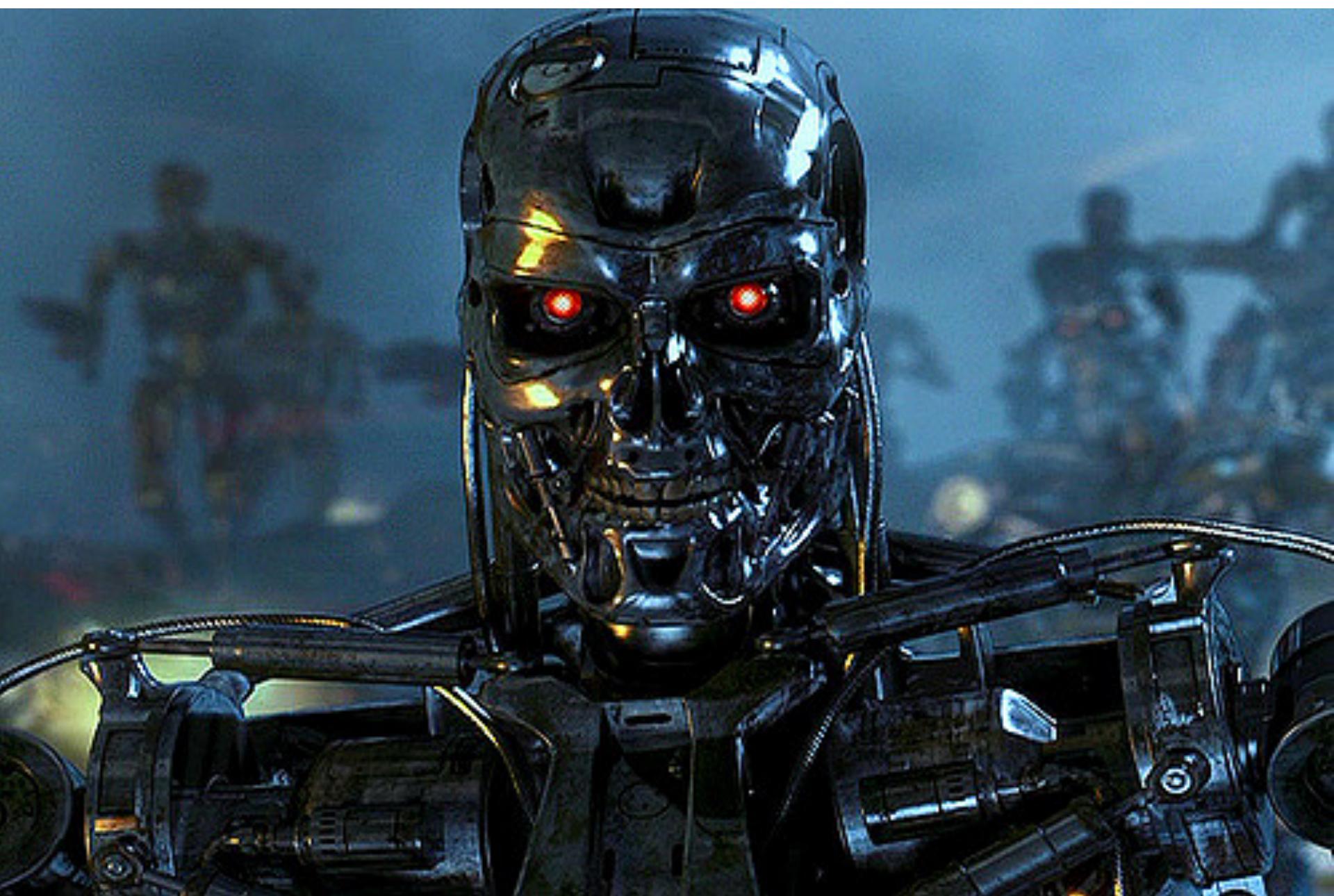


<http://www.businessinsider.com/internet-of-things-smart-agriculture-2016-10>
<http://www.iotjournal.com/articles/view?13777>
<http://rachio.com/how-it-works>

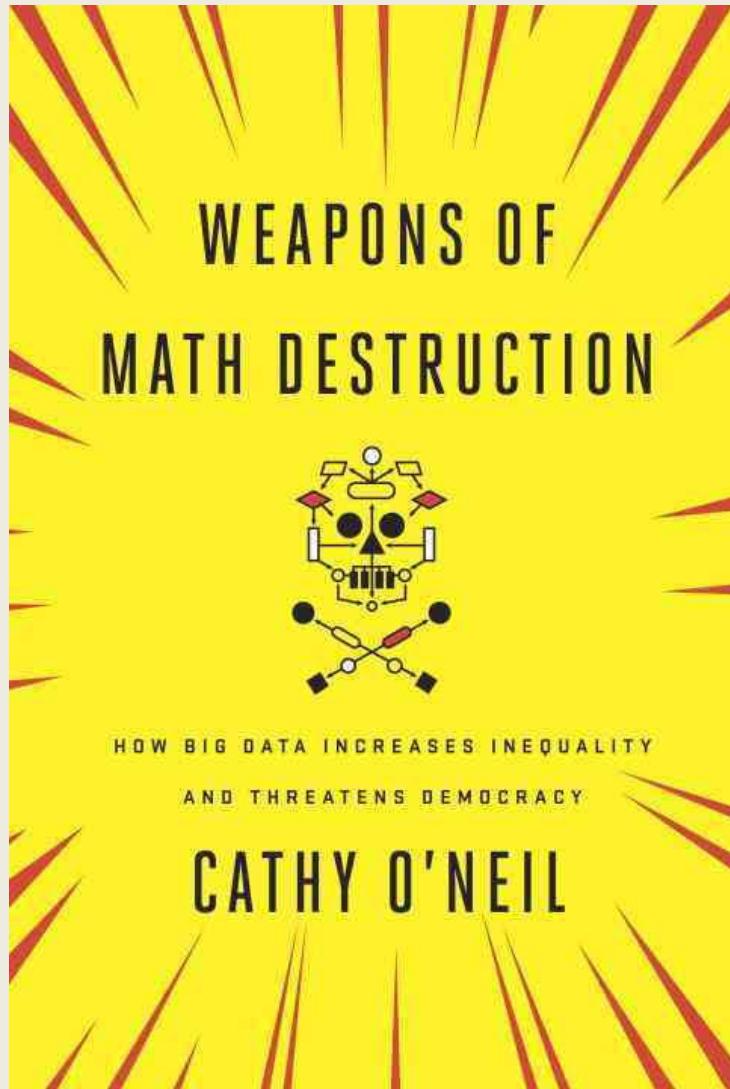
Roles for Information Professionals

- Data Aggregation
- Collection, curation, and search
- Normalization and alignment
- Identifier management
- Format standardization
- Contextualization Services
 - Enrich with information from literature and knowledge graphs.
- Identifying and Documenting Biases

The Dark Side Of Artificial Intelligence



Weapons of Math Destruction



“Ill-conceived mathematical models now micromanage the economy, from advertising to prisons.”



<https://weaponsofmathdestructionbook.com/>

https://www.ted.com/talks/cathy_o_neil_the_era_of_blind_faith_in_big_data_must_end

Algorithms Sorting People

Making decisions about:

- Loan eligibility
- Teacher effectiveness
- Insurance premiums
- Job applications
- Where to send our cops
- Recidivism & parole

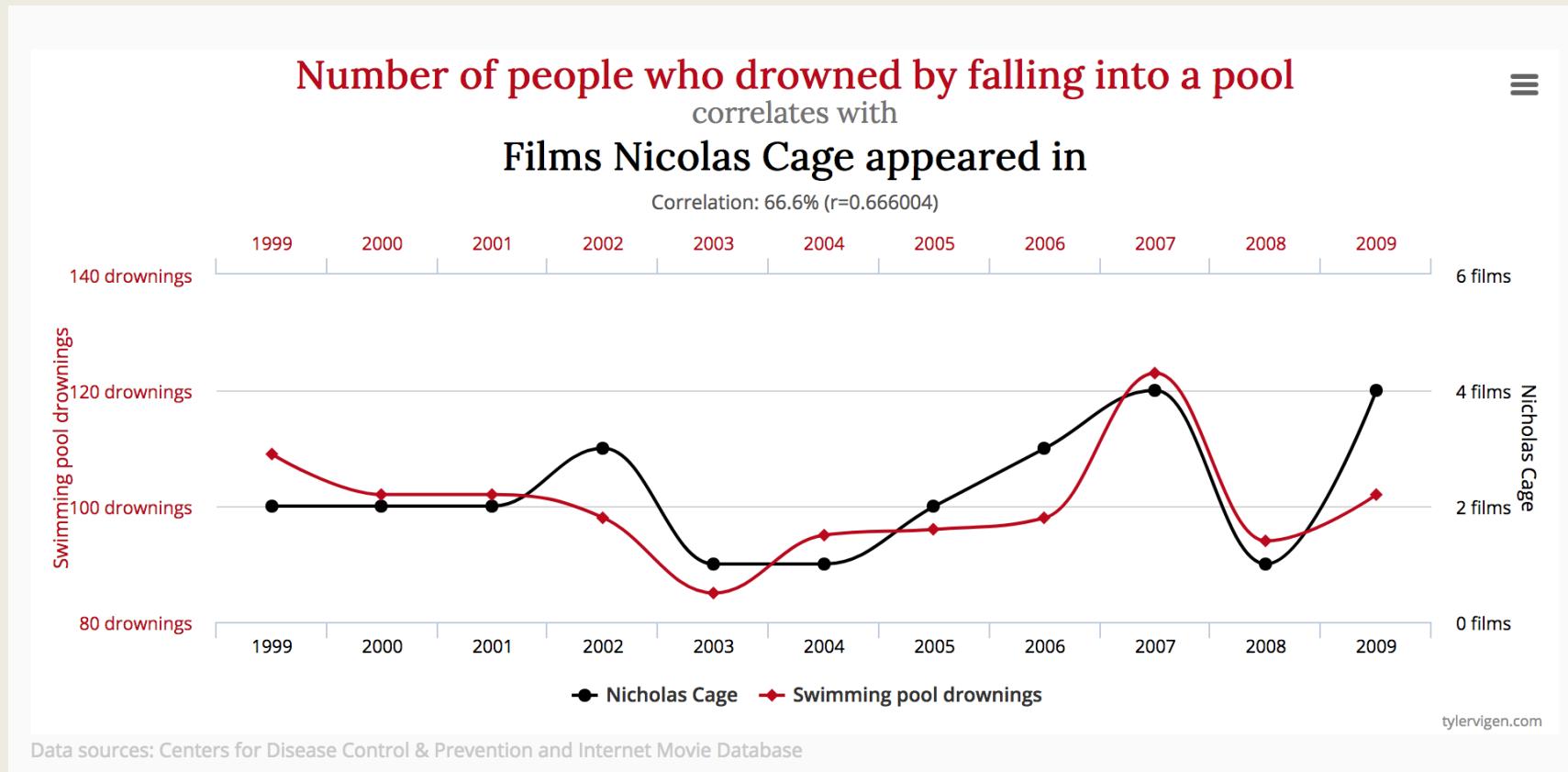
Feedback Loops

“Employers, for example, are increasingly using credit scores to evaluate potential hires. Those who pay their bills promptly, the thinking goes, are more likely to show up to work on time and follow the rules...

“But the belief that bad credit correlates with bad job performance leaves those with low scores less likely to find work... worsens their credit scores...

“It's a downward spiral.”

Spurious Correlations ≈ Causality



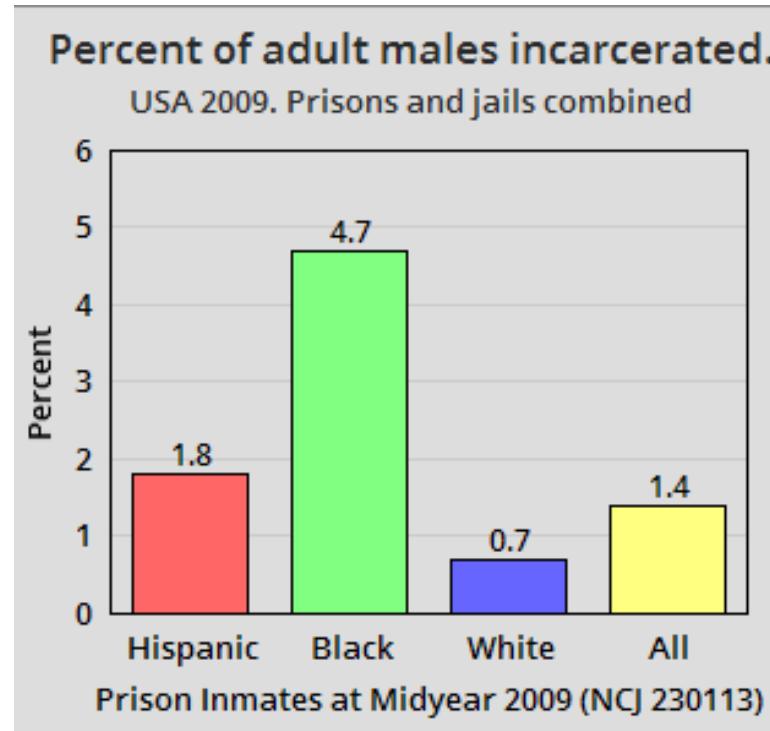
<http://www.tylervigen.com/spurious-correlations>

Machine Bias

- Proxy Data Points
- Small Data Samples
- Overfitting
- Discriminatory Leakage
 - We wouldn't use race in a formula
 - But zip code + age of first encounter with police + brother's criminal record?

Data Bias

- Training data is Labeled Data
- If recidivism data is from the legal system?



By Timeshifter. Chart was made at chartgo.com - see chart here. - Own work, CC0,
<https://commons.wikimedia.org/w/index.php?curid=37339697>

Algorithmic Bias

Here Are the Microsoft Twitter Bot's Craziest Racist Rants

Sophie Kleeman

3/24/16 11:43am • Filed to: GARBAGE FIRES ▾

274.6K 68 8



Machine Bias
There's software used across the country to predict future criminals. And it's biased against blacks.

by Julia Angwin, Jeff Larson, Surya Mattu and Lauren Kirchner, ProPublica
May 23, 2016

<http://gizmodo.com/here-are-the-microsoft-twitter-bot-s-craziest-racist-ra-1766820160>

<https://medium.com/@blaisea/physiognomys-new-clothes-f2d4b59fdd6a>

<https://www.propublica.org/article/machine-bias-risk-assessments-in-criminal-sentencing>

<https://nyupress.org/books/9781479837243/>



Blaise Aguera y Arcas

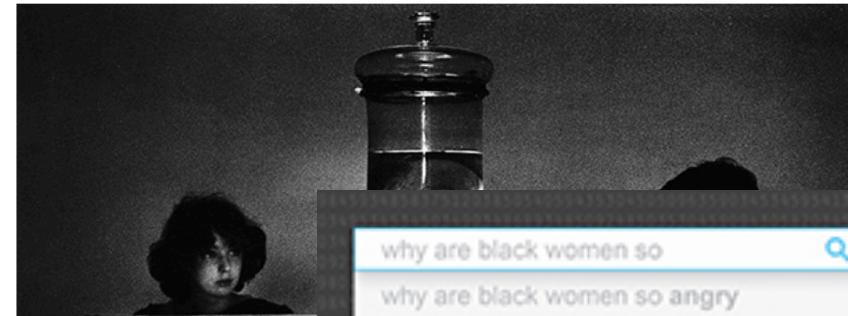
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Blaise Aguera y Arcas leads Google's Machine Intelligence group in Seattle. He founded Seadragon, ...

May 6 · 38 min read

Physiognomy's New Clothes

by Blaise Agüera y Arcas, [Margaret Mitchell](#) and [Alexander Todorov](#)



why are black women so
why are black women so angry
why are black women so loud
why are black women so mean
why are black women so attractive
why are black women so lazy
why are black women so annoying
why are black women so confident
why are black women so sassy
why are black women so insecure

**ALGORITHMS
OF
OPPRESSION**

HOW SEARCH ENGINES
REINFORCE RACISM

SAFIYA UMOJA NOBLE

A Call To Action For the Library Community

Codes of Ethics

Data Science For Social Good

Home People Projects Conference Blog Resources In the News Get Involved Donate

We'd Love to Hear From You, Get In Touch With Us!

There are various ways to get involved in the work we do during the summer as a fellow, mentor, project manager, or project partner for our summer fellowship program, or through the rest of the year as we continue this work at the [Center for Data Science and Public Policy](#) at the University of Chicago.

[✉ JOIN OUR EMAIL LIST](#)

Ways to Get Involved



As a Fellow



As a Data Science Mentor



As Project Partners

Data Science For Social Good

Home People Projects Conference Blog Resources In the News Get Involved

Share This Post!



An Ethical Checklist for Data Science

By Alan Fritzler

DATA FOR
DEMOCRACY

HOME ABOUT PROJECTS PARTNERS IN THE NEWS CONTACT BLOG

USING DATA AND TECHNOLOGY FOR
SOCIAL IMPACT

WHO WE ARE

...

OUR MISSION

To be an inclusive community for data scientists and technologists to volunteer and collaborate on projects that make a positive impact on society.

<http://datafordemocracy.org/>

<https://dssg.uchicago.edu/contact-page/>

<https://dssg.uchicago.edu/2015/09/18/an-ethical-checklist-for-data-science/>

Algorithmic Literacy

“Algorithms all *have their own ideologies*. As computational methods and data science become more and more a part of every aspect of our lives, it is essential that we begin to ensure there is a *broader literacy about these techniques* and that there is an expansive and deep engagement in the *ethical issues surrounding them*.”

Trevor Owens
Library of Congress / Former IMLS

EU General Data Protection Regulation

- Requires *securing* personal data
- Provides an *opt out* on any data collection
- Puts *limitations* around *profiling*



The Right to an Explanation

“The data subject shall have the right to obtain ... the existence of automated decision-making, including profiling ...

meaningful information about the logic involved, as well as the ***significance and the envisaged consequences*** of such processing for the data subject.”

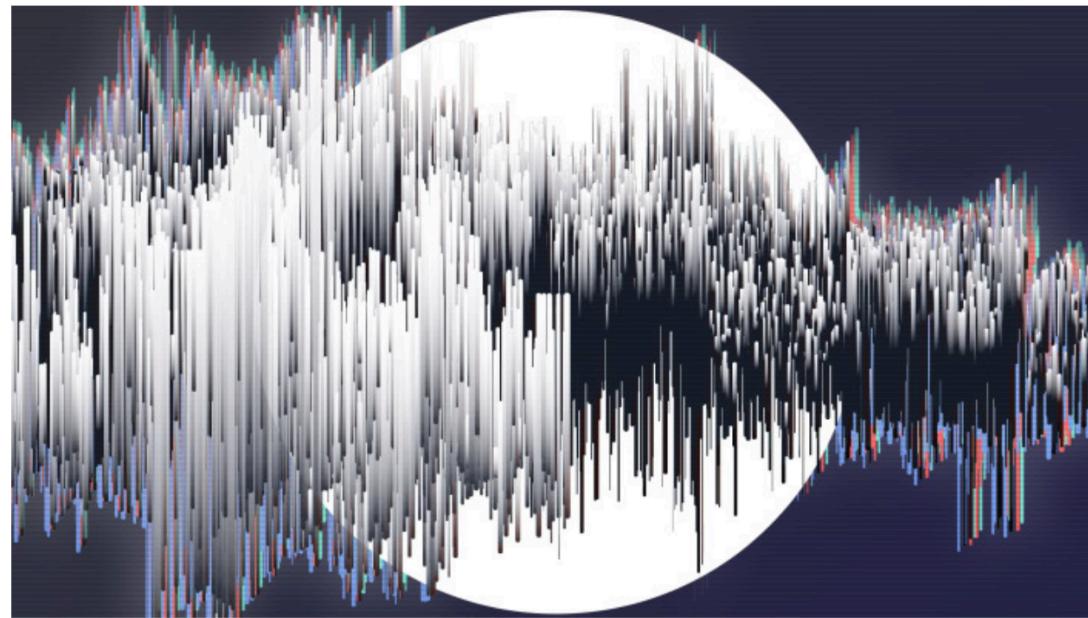
GDPR Chapter 3, Article 15

Data Ethnography

07.24.17

The Most Crucial Design Job Of The Future

What is a data ethnographer, and why is it poised to become so important?



[Source Image: liuzishan/iStock]

BY CAROLINE SINDERS 3 MINUTE READ

Data Ethnography

“I advocate we need data ethnography, a term I define as the ***study of the data*** that feeds technology, looking at it from a ***cultural perspective*** as well as a data science perspective.”

Is this not metadata?

- “social media data, Twitter, 2021, U.S., 75% male users ages 35-40, 50% white.”

year assembled: 2001-2003

original size: 45,000 jpegs

year updated: 2011

current size: 50,000jpegs

people: 60% “white women”+ “blonde hair”; 30% : “white women” + “brown hair”; 10% “black women” + “black hair”

Librarians as Data Ethnographers

Librarians have experience:

- Evaluating Information Quality
- Documenting and cataloging resources
- Documenting provenance

Libraries are invested in:

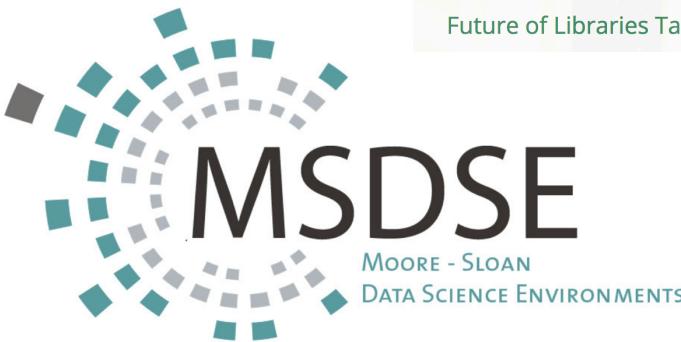
- Social Justice
- Critical Theory

Many roles for libraries

- Curate and **assess** datasets
 - Identify **bias** in datasets
 - Help ML students understand these biases
 - Teach **algorithmic literacy**
 - Become (and training) **Data Ethnographers**
 - Contribute to **standardization** around data management and interoperability
-
- ***But we must first develop machine learning expertise!***

Hints of investment

The screenshot shows the MIT Libraries website. At the top is a dark header with the MIT Libraries logo. Below it is a blue navigation bar with the title 'The Future of Libraries'. Underneath are menu items: Home, About, Task Force members, Working Groups, and Idea bank. A quote from Provost Martin A. Schmidt is displayed: "The time is right for MIT to articulate a bold new vision for a modern research library. I'm asking the Future of Libraries Task Force to think broadly and creatively about the unique role MIT Libraries should play as a leader in defining the future of libraries." Below the quote is a link to the 'Future of Libraries Task Force Preliminary Report'. To the right is a photograph of a person's hands working on a book or manuscript.



<https://future-of-libraries.mit.edu/>
<http://msdse.org/>
<https://youtu.be/L0G9JsPMEXY>



Organizational Implications of Data Science Environments in Education, Research, and Research Management in Libraries

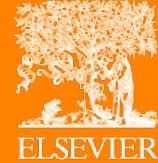
Erik Mitchell, University of California, Berkeley
Vicky Steeves, New York University
Jenny Muilenburg,, University of Washington

Coalition for Networked Information (CNI)
Fall 2015 Membership Meeting
December 14 – 15, 2015
Washington, DC

For more information, visit <http://www.cni.org>

Summary

- AI has ***advanced*** significantly
- This has great potential for ***social good***
- There is a downside and a risk of
algorithmic injustice
- Libraries can help to ***mitigating*** this injustice
- That starts by making AI and ML areas of
investment



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Knowledge