Tech in Different Pathways

Agenda

1. Augmented Reality (AR)/Virtual Reality (VR)
2. Health Informatics
3. Software Engineering
4. Data Science
5. Data Engineering
6. Inclusive & Participatory Design
7. Case studies: using tech for social good

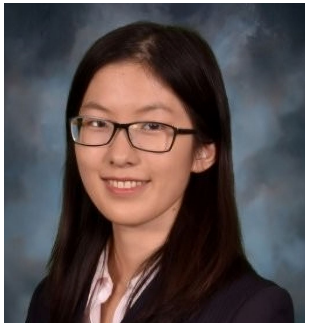
1. What?
2. Why?
3. Career Paths

Who are we?

Rachel Gong
Harvard Graduate School of Arts and Science, Computational Science & Engineering

Yiran Bowman
Harvard Graduate School of Education
Technology, Innovation, and Education

Dawn Chen
PhD Student in Systems Biology
ex-Software Engineer@Google



Selina Wu
Harvard Graduate School of Arts and Science,
Data Science

Augmented Reality (AR), Virtual Reality(VR), and the Future

By Yiran Bowman

yiran_bowman@gse.harvard.edu

Video clip

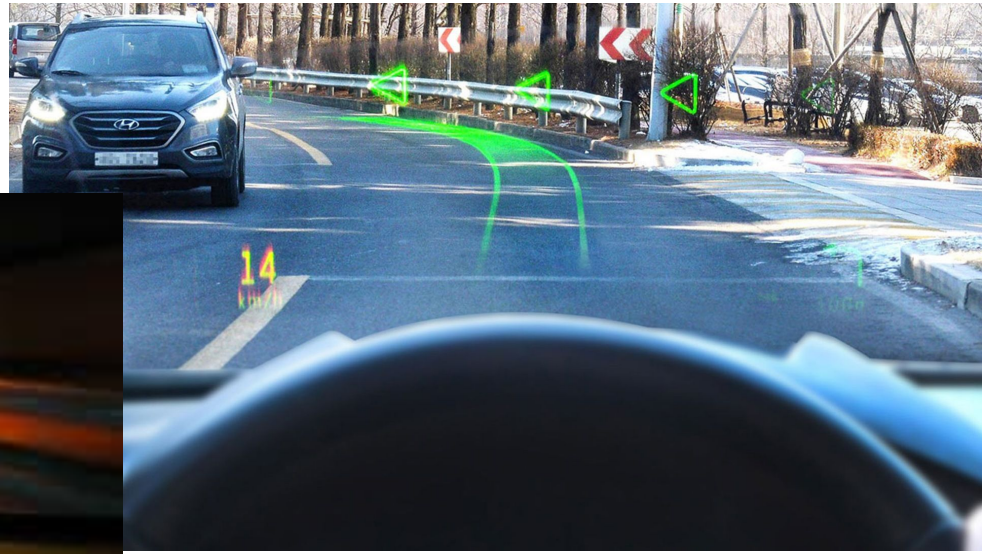
https://www.youtube.com/watch?v=nPcb05I0anY

00:42 - 1:44

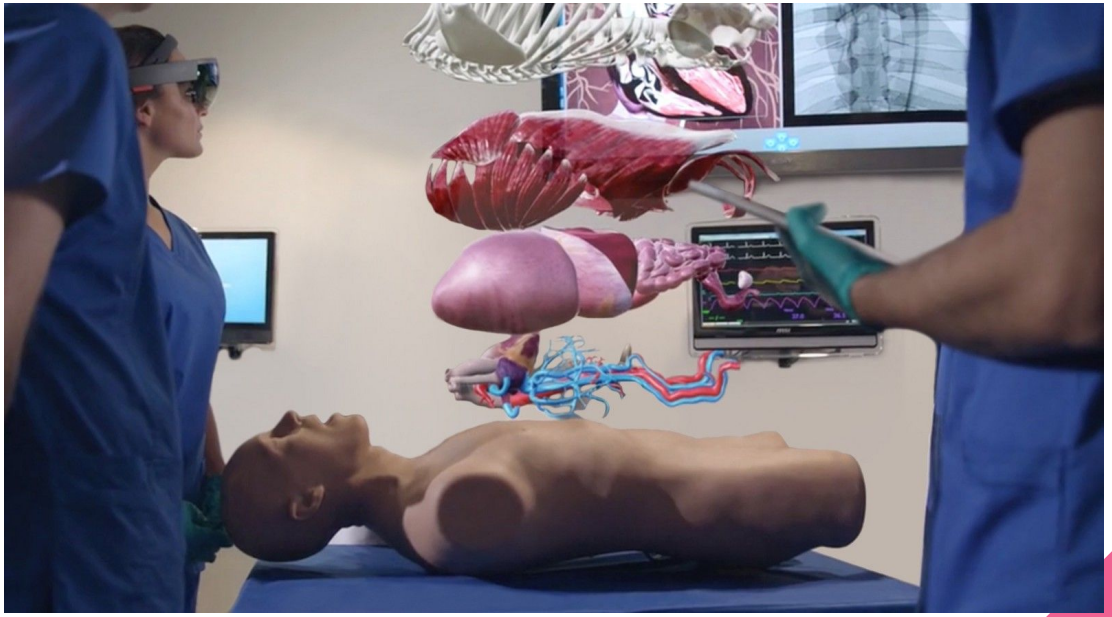
What is...AR/VR?

What can AR/VR do

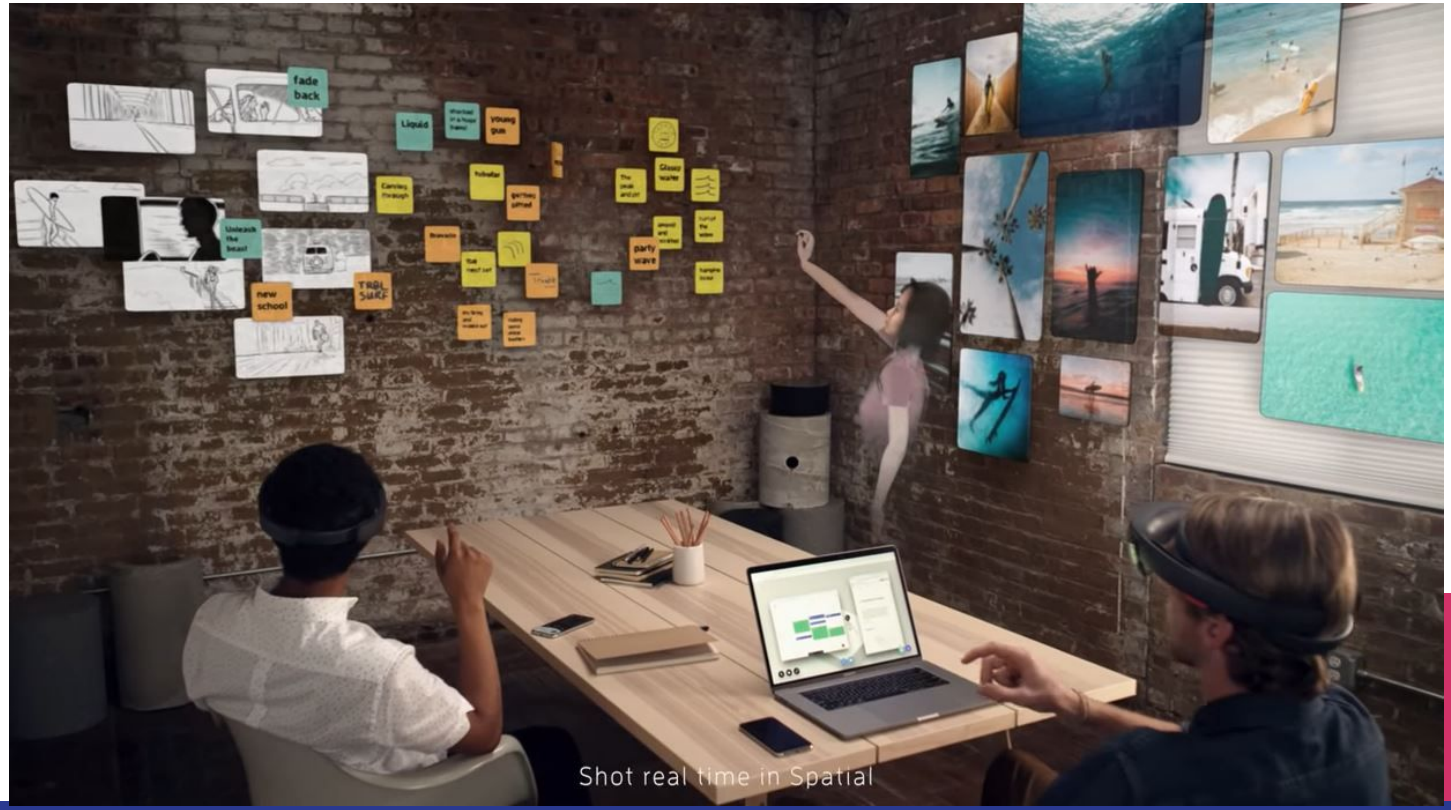
AR - GPS on windshield



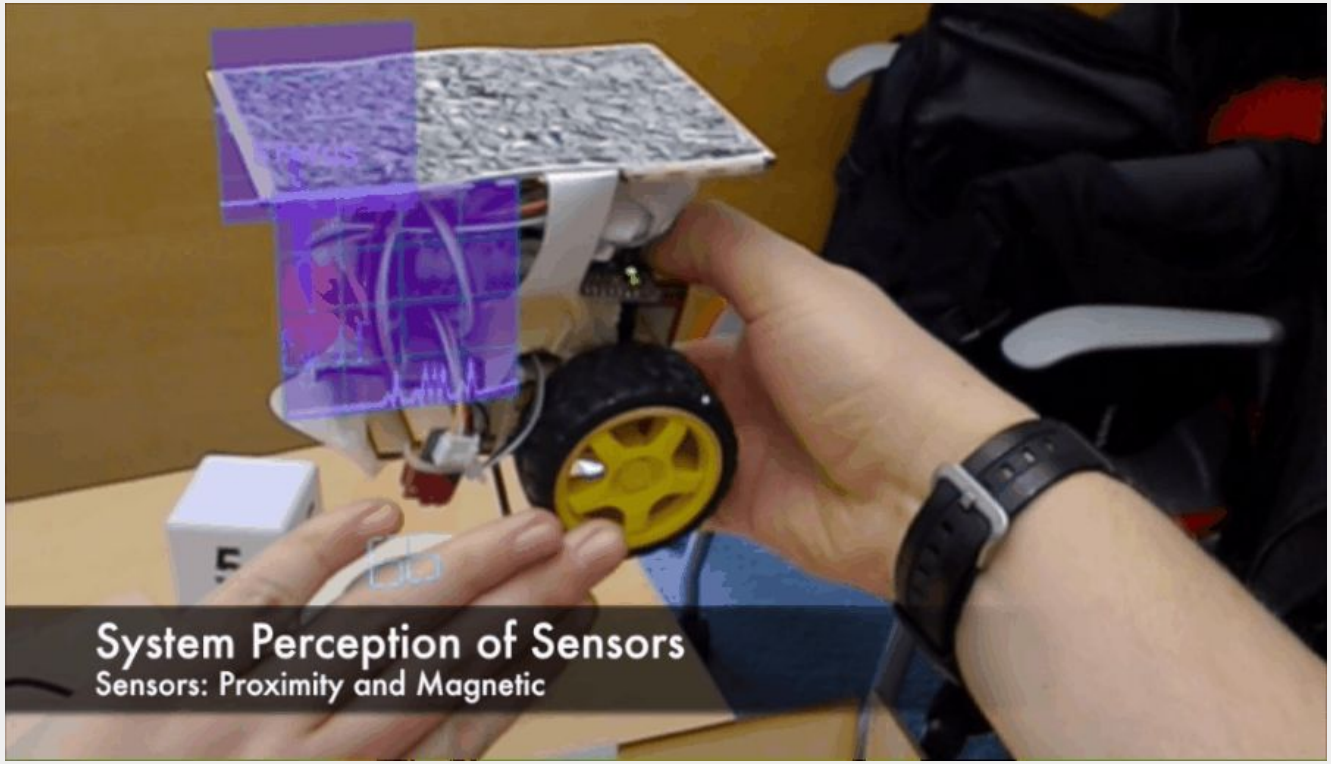
AR - Medical training



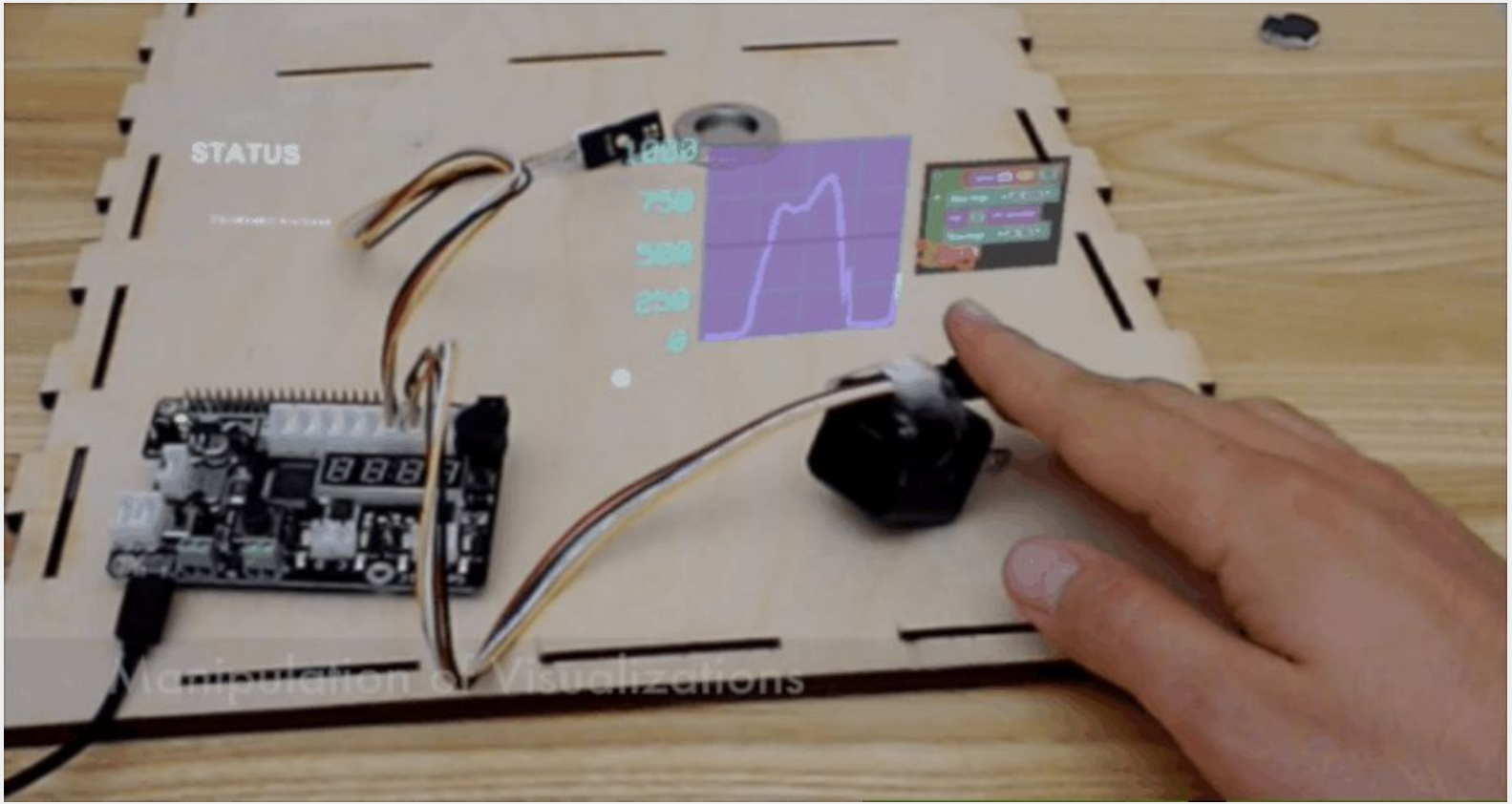
AR/VR - Meeting/Collaboration



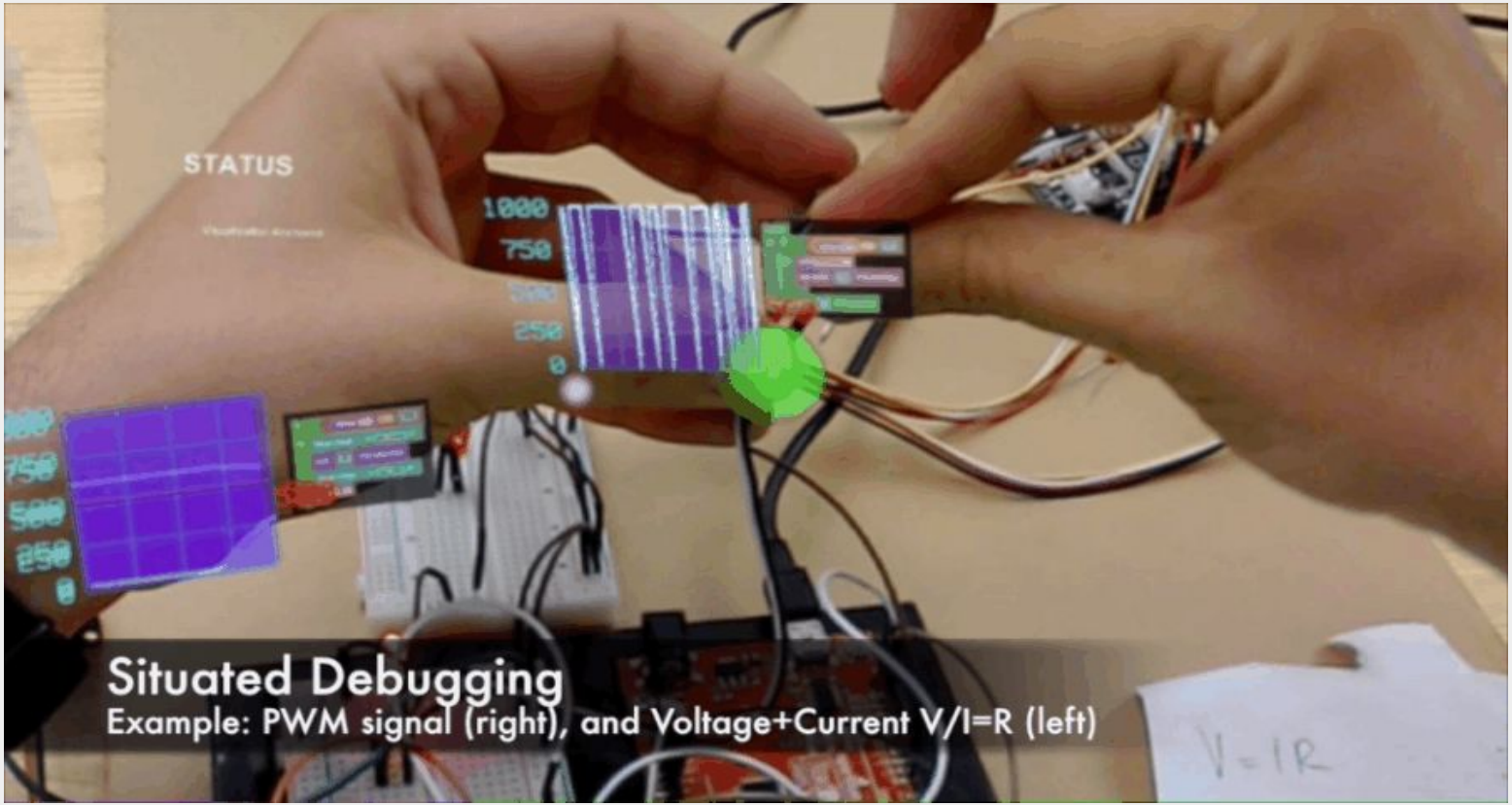
AR - Learning/Project/Debugging

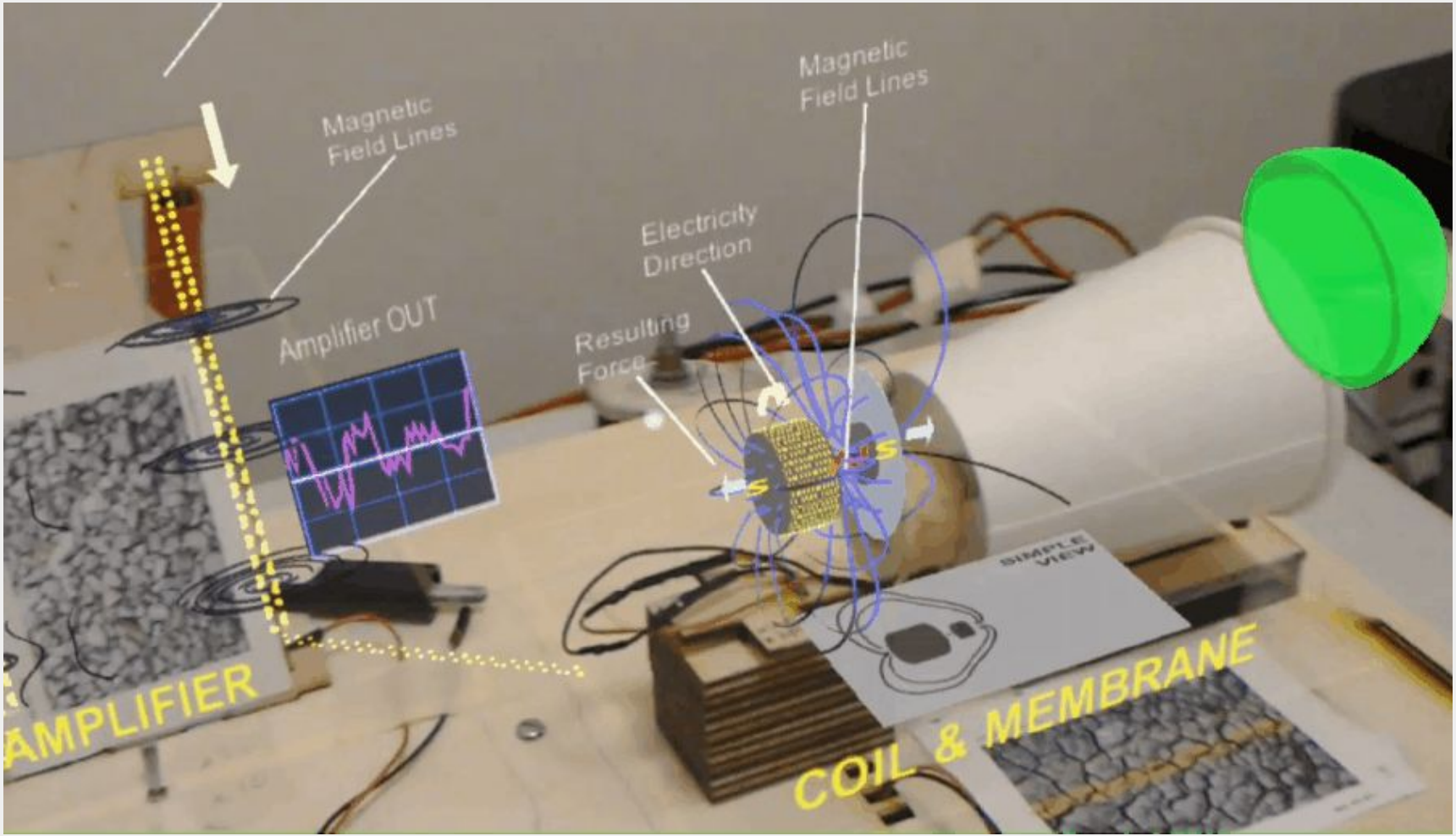


AR - Learning/Project/Debugging



AR - Learning/Project/Debugging




Magnetic
Field Lines
Magnetic
Field Lines
Electricity
Direction
Amplifier OUT
Resulting
Force
SIMPLE
VIEW
AMPLIFIER
COIL & MEMBRANE

Why AR/VR can do these?

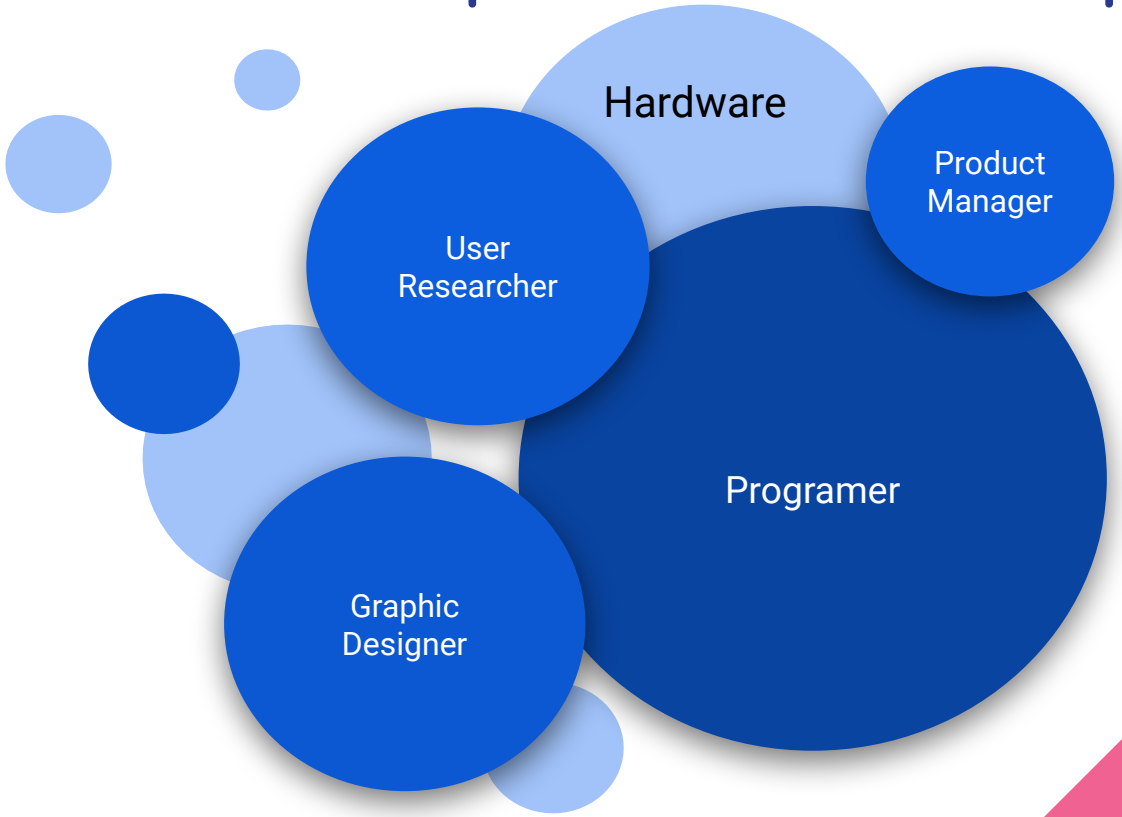
Transfer/Present Information

- Benefits: Acquiring information more effectively
- Text - Drawing - Painting - Picture - Video - AR/VR

Virtual Presence

- People want to be here and be there.
- Realtime Audio (phone call) - Realtime Video + Audio (Video call) - VR/AR
- Benefits: Collaborating and communicating more effectively

What it takes to produce AR/VR applications?



How can I be part of this cool tech?

- Programmer - Computer Science
- Graphic Designer - Graphic Design
- User Researcher - Psychology
- Product Manager - Information System/Computer Science/Business etc
- Hardware - Mechanical Engineering etc

Or

Any Major!

Create your own AR/VR

No coding AR

https://sparkar.facebook.com/ar-studio/

https://www.adobe.com/products/aero.html

Development Platform
https://unity3d.com/

Spark AR

unity

Health Informatics

By Ning Hua

About me

>> Yining Hua

Harvard Medical School

Massachusetts General Hospital

Topics

a. Biostatistics

b. Bioinformatics

c. Biomedical informatics

d. Computational pathology

e. Computational Medicine

...

Health informatics

What is health informatics ?

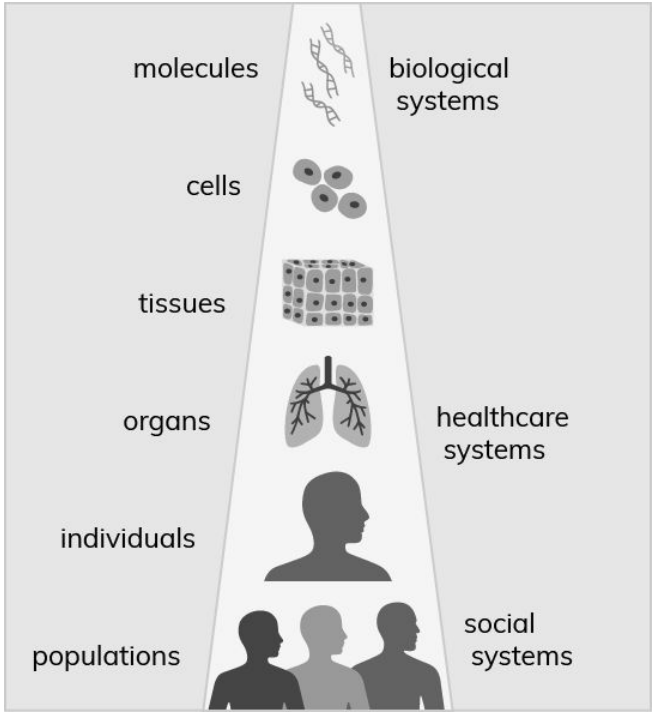
Health informatics

"... the integration of healthcare sciences, computer science, information science, and cognitive science to assist in the management of healthcare information".

- Saba & McCormick, 2015, p. 232

Health informatics

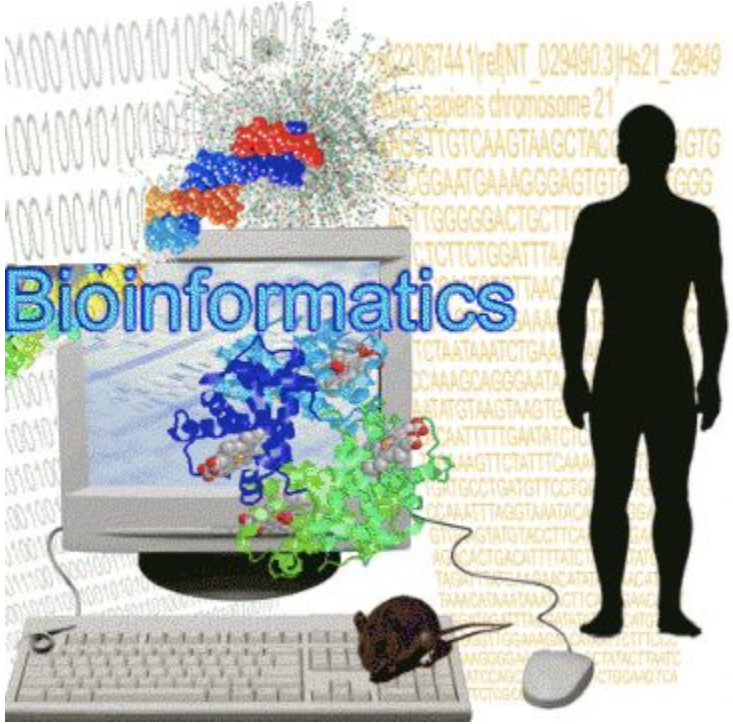
-

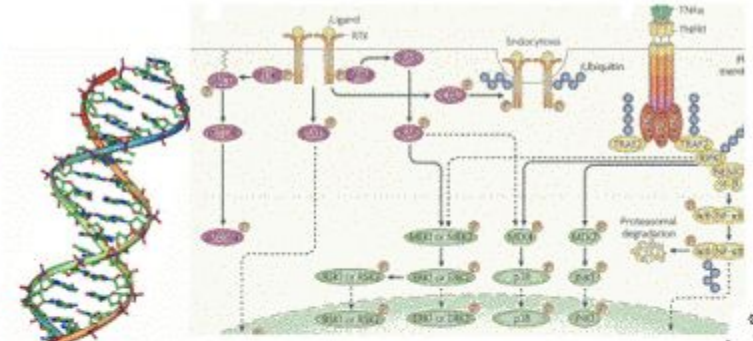


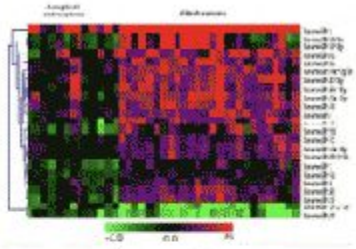
Biostatistics

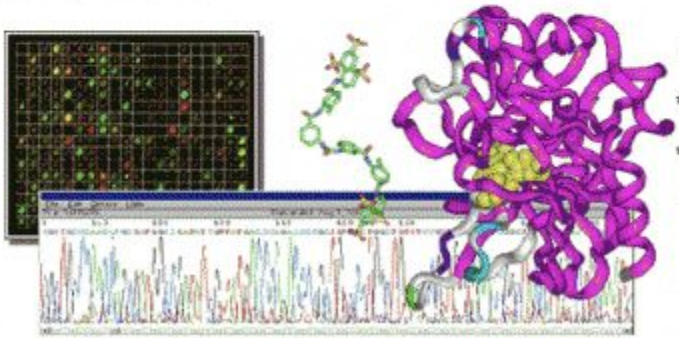
"Data don't make any sense,
we will have to resort to statistics."

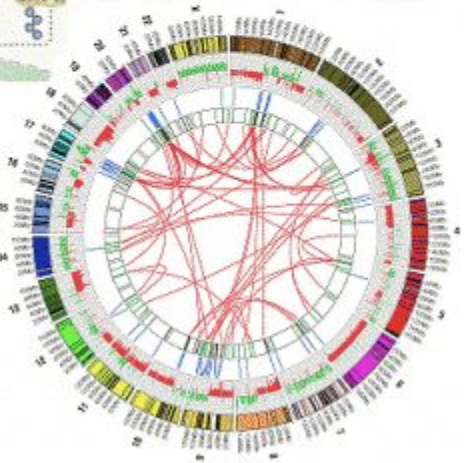
Bioinformatics



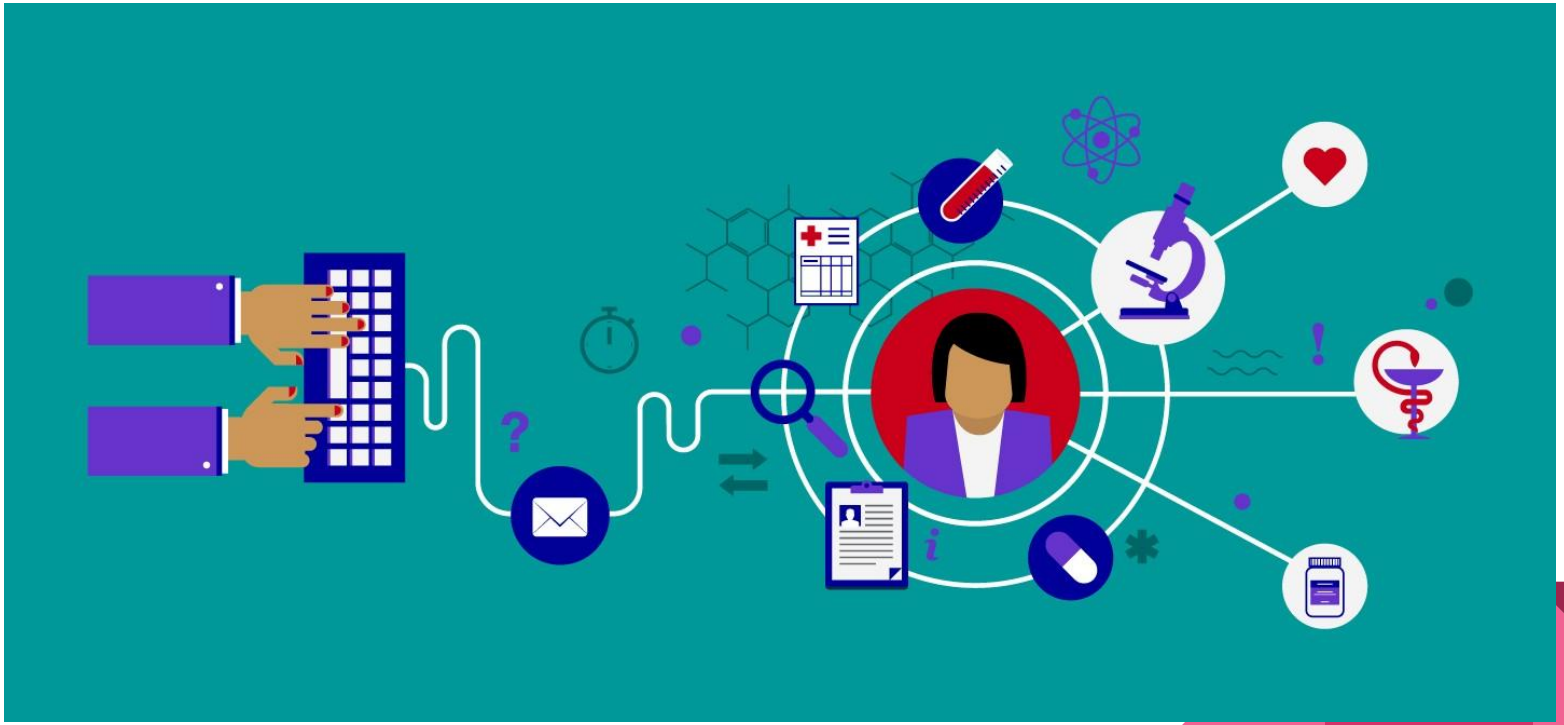




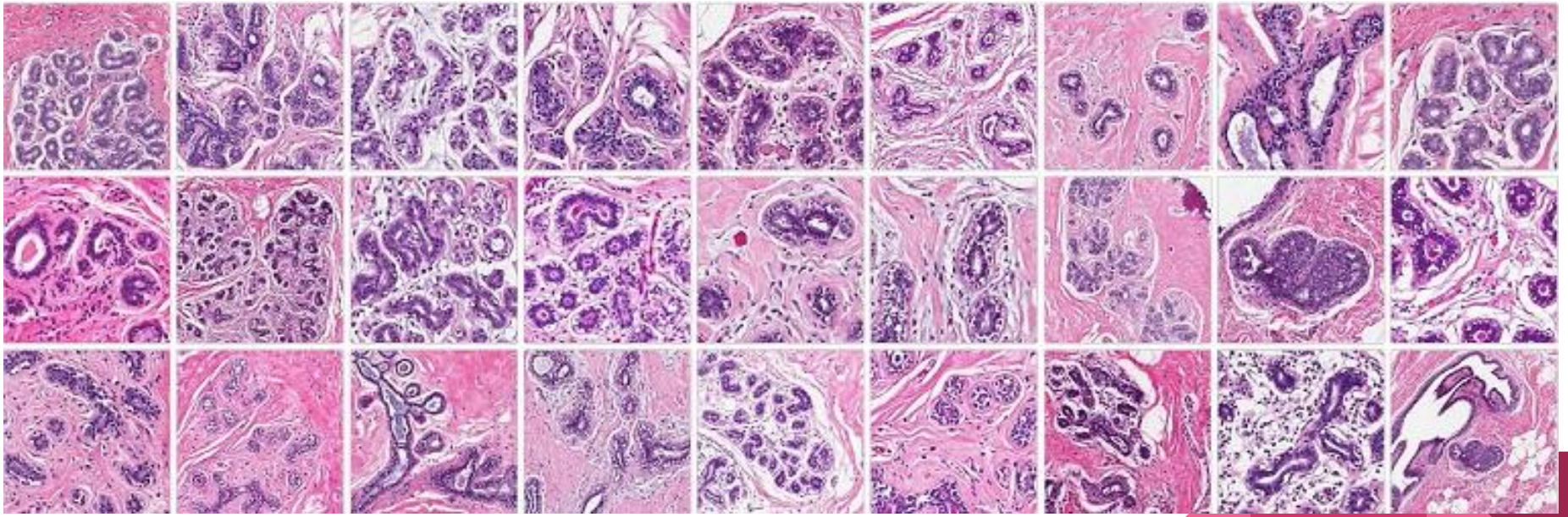




Biomedical informatics



Computational pathology

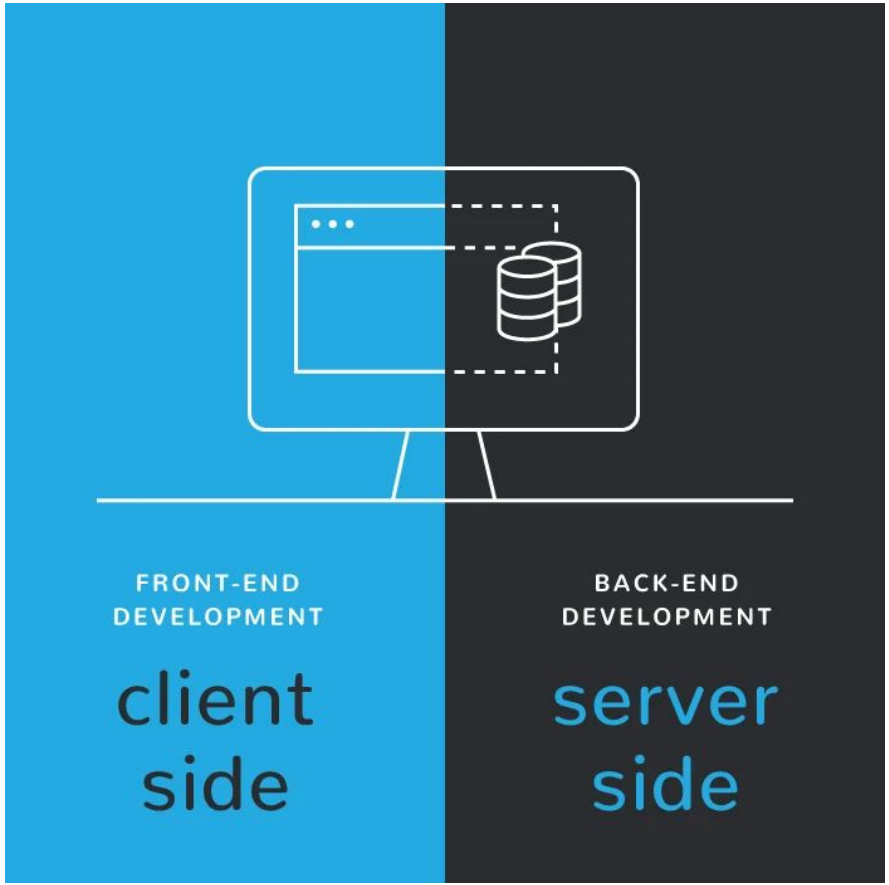


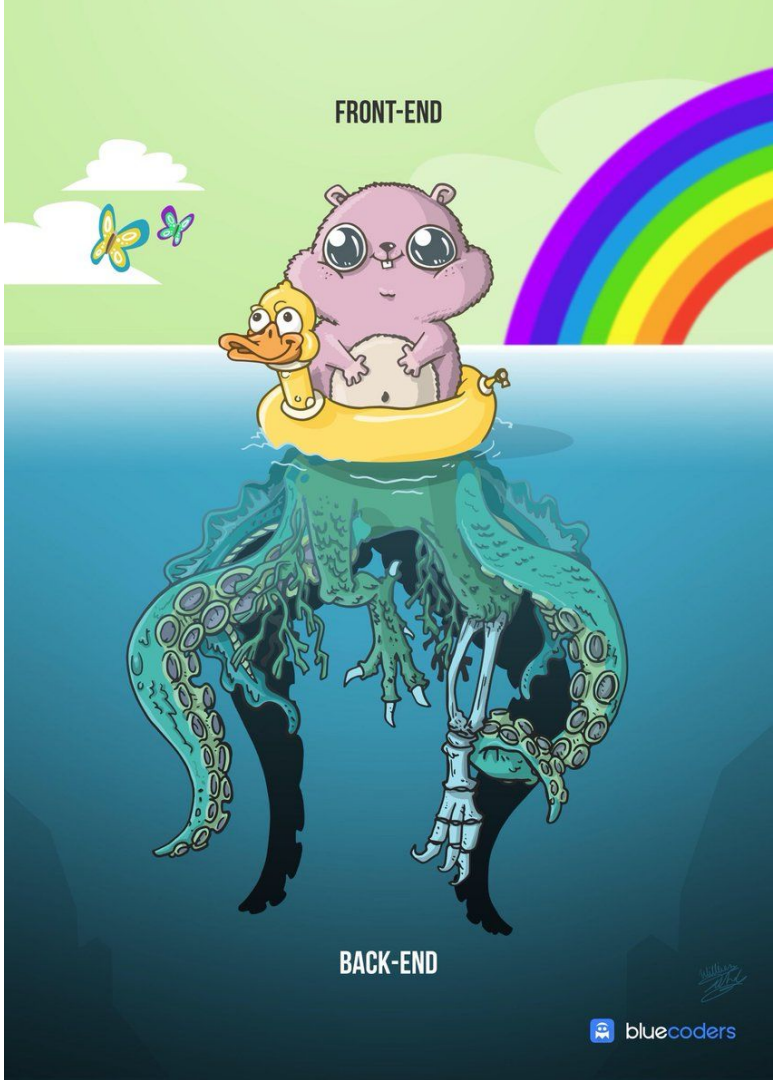
Software Engineering

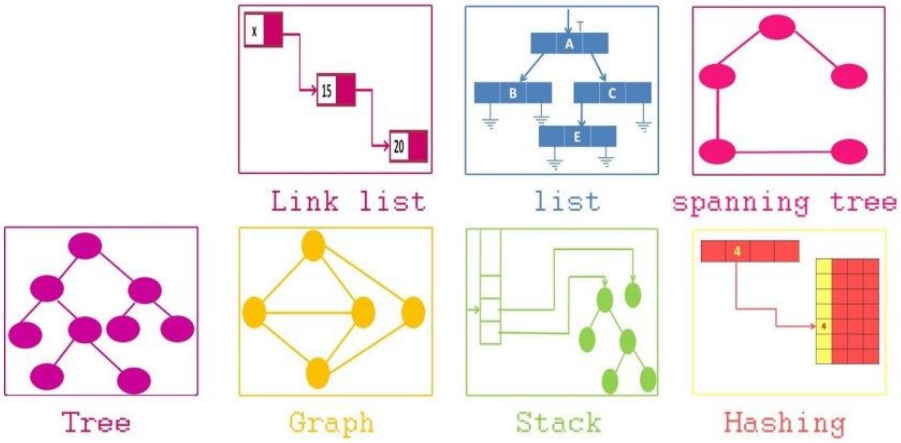
By Rachel


DELL

Front-End vs. Back-End Development:
Which Side of the Screen Are You?


FRONT-END
DEVELOPMENT
client
side
BACK-END
DEVELOPMENT
server
side

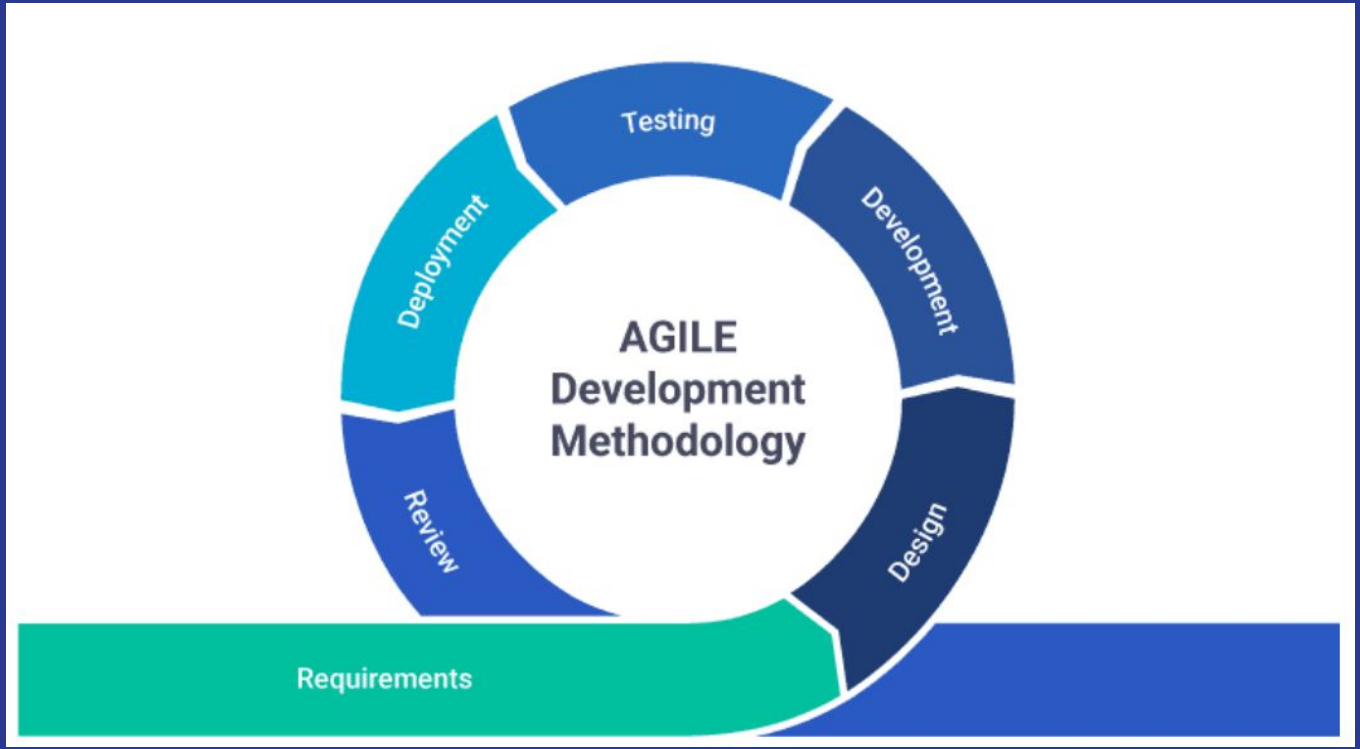

FRONT-END
BACK-END
bluecoders



Data Structures

Algorithms

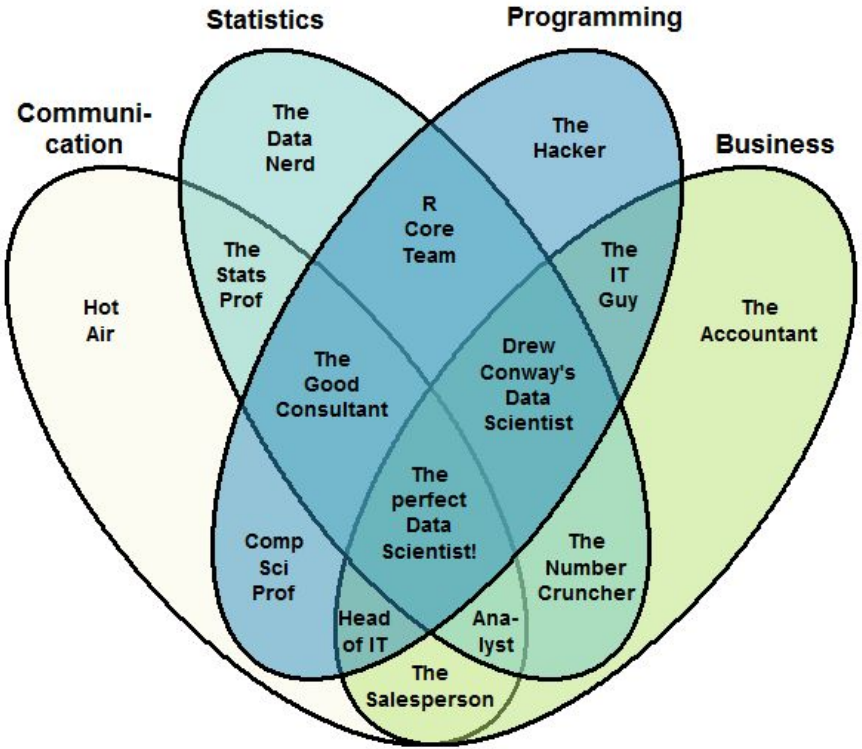
Software Development Lifecycle



Data Science

By Selina Wu

What is data science?



Why data science?

Influence: help companies make quicker and better decisions

Demand & Job: grown over 650% since 2012 (LinkedIn's Emerging Jobs report)
creating 11.5M jobs by 2026 (U.S. Bureau of Labor Statistics)

Fun: The only limitation is your imagination!

The data science process

Ask an interesting question

What do you want to predict?

E.g. How many people take blue bike in a given weekday?

What's in data - plot it

Are there any anomalies? Are there any patterns?

E.g. In average people use blue bike for 8 h/day. Is that reasonable?

Communicate the Insights

Does the result make sense?

What we learn?

Which decision/action we take?

Set Goal — **Acquire** — **Explore** — **Build** — **Deliver**

Get the Data

How were data sampled?

Are there privacy issues?

Model the Data

Select, build, fit, validate the model

Career Path

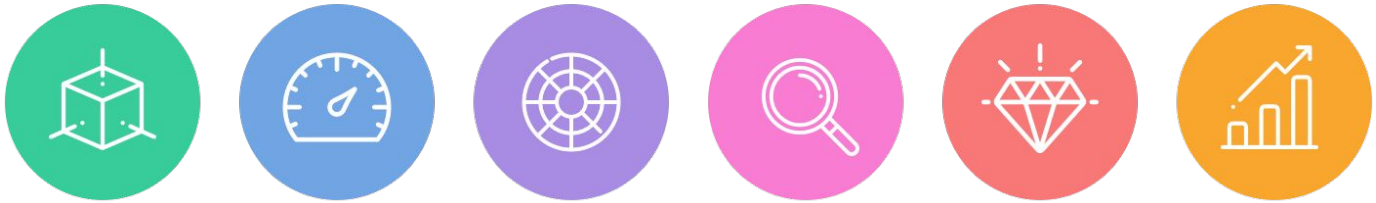
Data Analyst	☆	☆ ☆ (SQL)	☆ ☆ ☆	☆	☆ ☆ ☆
Data Scientist	☆ ☆ ☆	☆	☆	☆ ☆ ☆ (Python, R)	☆ ☆
Consulting	☆ ☆	☆ ☆ ☆	☆	☆	☆ ☆ ☆
Quant Trading	☆	☆ ☆	☆ ☆ ☆	☆ ☆ ☆	☆

Note: the above list is my own opinion. They are not views of any organization.

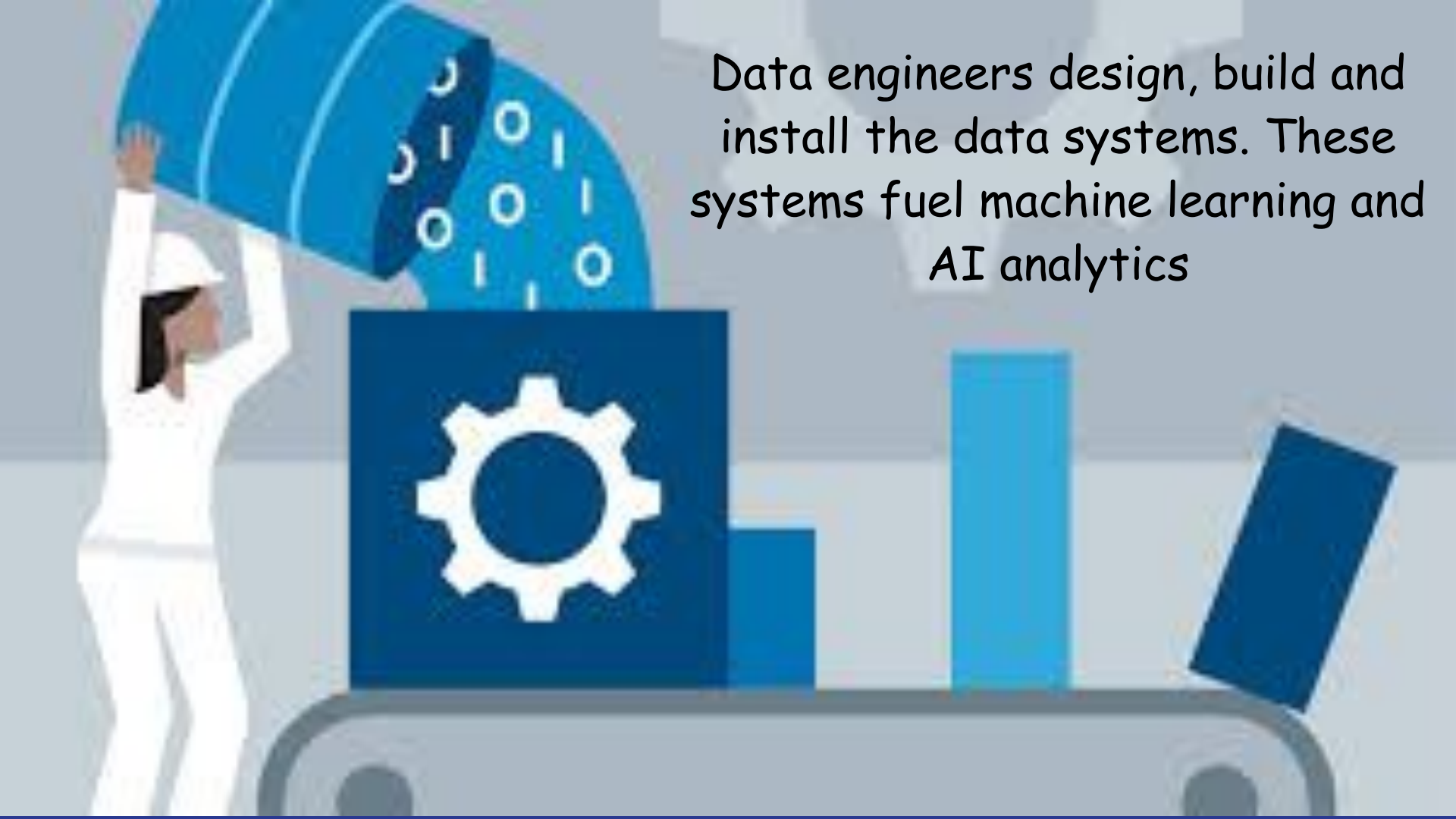
Data Engineering

By Rachel

The six Vs of big data



How this can be achieved?

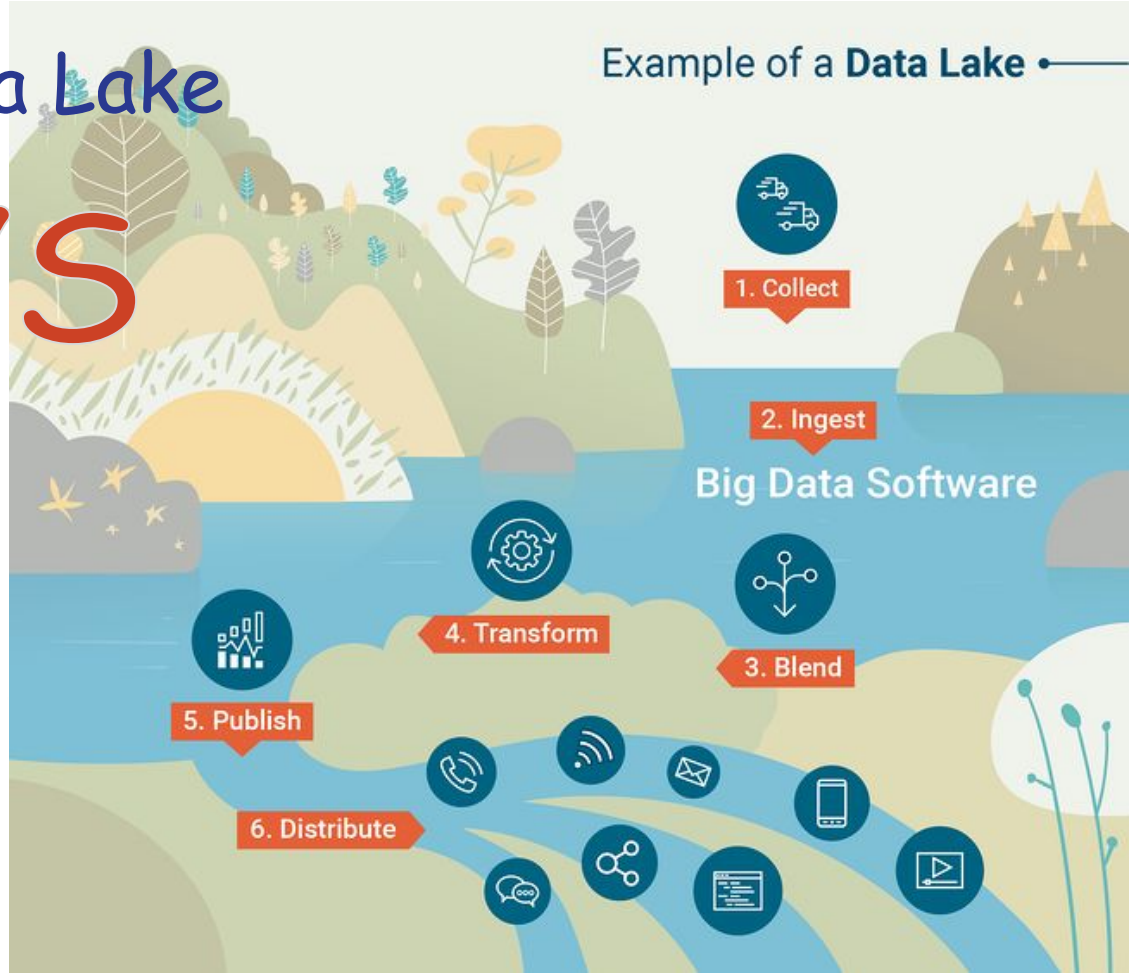


Data engineers design, build and install the data systems. These systems fuel machine learning and AI analytics

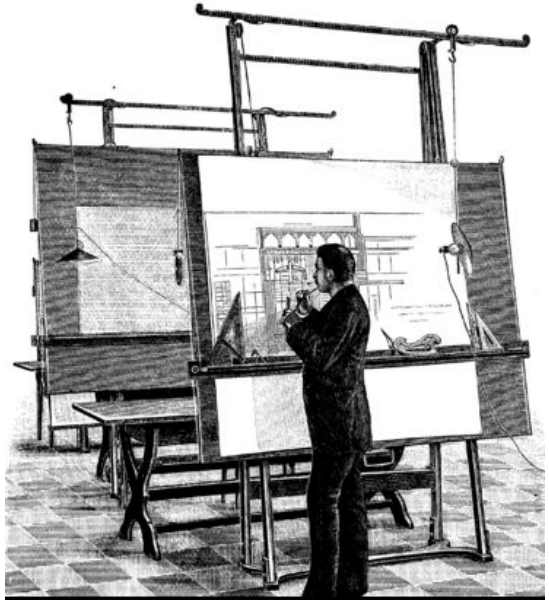
Data Lake

VS

Data Warehouse



Career Paths



Architect

Data Engineer

Database Administrator

Inclusive & Participatory Design in Machine Learning (ML)

By Rachel

EXAMPLES OF DATA SCIENCE FAILS:

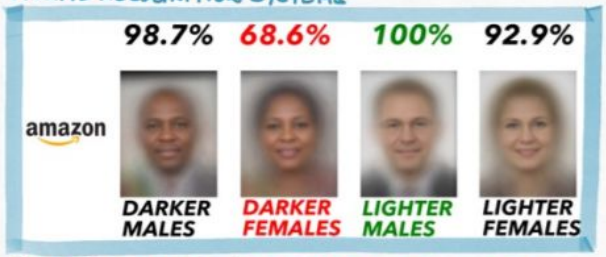
PREDICTIVE POLICING

PREDICTIVE POLICING ALGORITHMS ARE RACIST. THEY NEED TO BE DISMANTLED, MIT TECHNOLOGY REVIEW 2020

PRE-TRIAL, PAROLE RISK ASSESMENT

INJUSTICE EX-MACHINA: PREDICTIVE ALGORITHM IN CRIMINAL JUSTICE, UCLA LAW REVIEW, 2019

FACIAL RECOGNITION SYSTEMS



FACIAL RECOGNITION IS ACCURATE, IF YOU'RE A WHITE GUY, NEW YORK TIMES, 2018

PRECISION HEALTH CARE

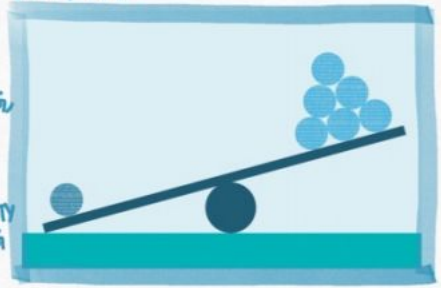
SEX AND GENDER DIFFERENCES AND BIASES IN ARTIFICIAL INTELLIGENCE FOR BIOMEDICINE AND HEALTH CARE, NATURE, 2020

WHY IS THIS HAPPENING?

BIAS IN TECH IS NOT AN ALGORITHMIC, MATH PROBLEM; IT IS A PEOPLE PROBLEM, IT IS ABOUT NEGLECTING THE HUMAN DIMENSION AND INEXTRICABLY LINKED WITH DIVERSITY & REPRESENTATION.

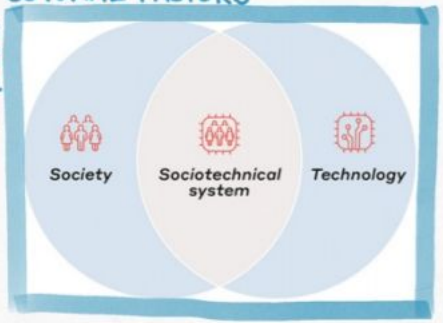
DATA GAP

- LACK OF SEX AGGREGATED DATA IN ECON, URBAN PLANNING, MEDICINE, AGRICULTURE, ETC.
- LACK OF DIVERSITY IN ML TRAINING DATA

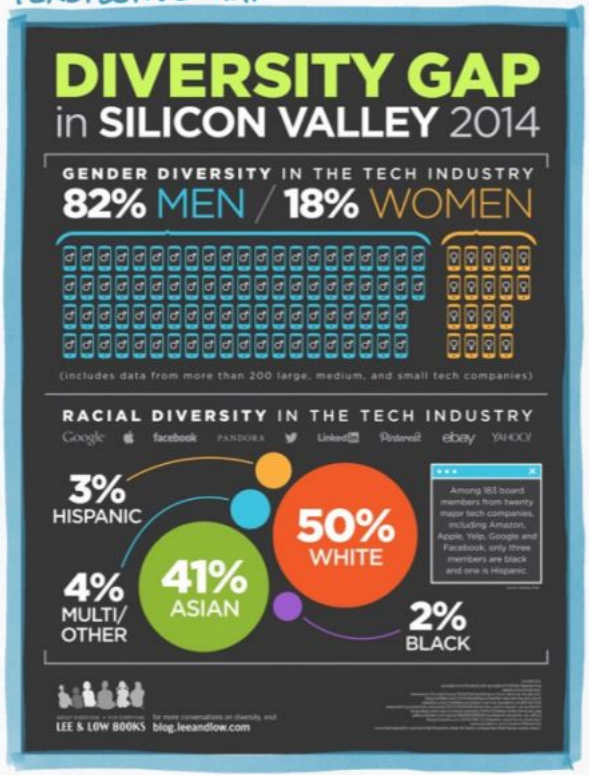


NEGLECTING SOCIAL, POLITICAL CUTURAL FACTORS

- NO TECH STANDS ALONE WITHOUT SOCIAL, CULTURAL POLITICAL, ECON HISTORICAL CONTEXT
- NO PROBLEM IS SOLUABLE BY TECH ALONE



PERSPECTIVE GAP

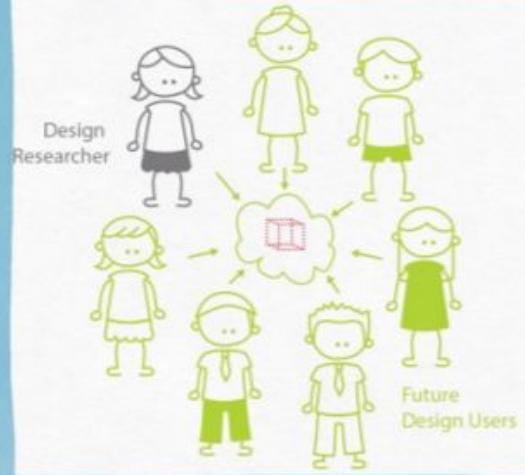


- DESIGN CHOICES ARE NOT NEUTRAL NOR OBJECTIVE BUT ENCODE VALUES AND PERSPECTIVES
- PRIORITIZE TECHNICAL PARAMETERS OVER USER NEEDS
- COMMUNITIES THAT ARE IMPACTED BY TECH ARE NOT REPRESENTED AS DESIGNERS, POLICY MAKERS, ENGINEERS

RACE AFTER TECHNOLOGY, RUHA BENJAMINE

INVISIBLE WOMEN, CAROLINE CRIADO PEREZ

PARTICIPATORY FRAMEWORKS FOR MACHINE LEARNING



- PARTICIPATORY DESIGN IS DESIGN THAT ACTIVELY INCORPORATE FEED BACK FROM STAKE-HOLDERS
- CO-DESIGN IS A COLLABORATIVE DESIGN PROCESS BTW DESIGNERS & STAKE-HOLDERS
- PARTICIPATORY ACTION RESEARCH IS COMMUNITY EMBEDDED RESEARCH THAT PARTNER WITH AFFECTED COMMUNITIES TO ACHIEVE SOCIAL CHANGE

ASCE CODE OF ETHICS

1. SOCIETY

Engineers:

a. first and foremost, protect the health, safety, and welfare of the public;

b. enhance the quality of life for humanity;

c. express professional opinions truthfully and only when founded on adequate knowledge and honest conviction;

d. have zero tolerance for bribery, fraud, and corruption in all forms, and report violations to the proper authorities;

e. endeavor to be of service in civic affairs;

f. treat all persons with respect, dignity, and fairness, and reject all forms of discrimination and harassment;

g. recognize the diverse historical, social, and cultural needs of the community, and incorporate these considerations in their work;

h. consider the capabilities, limitations, and implications of current and emerging technologies when part of their work; and

"Don't let the perfect be the enemy of the good."

- Chelsea Barabas, "Beyond Bias: Re-imagining the Terms of "Ethical AI" in Criminal Law"

Case studies: using tech for social good

Dawn Chen

Resources to find emerging ideas

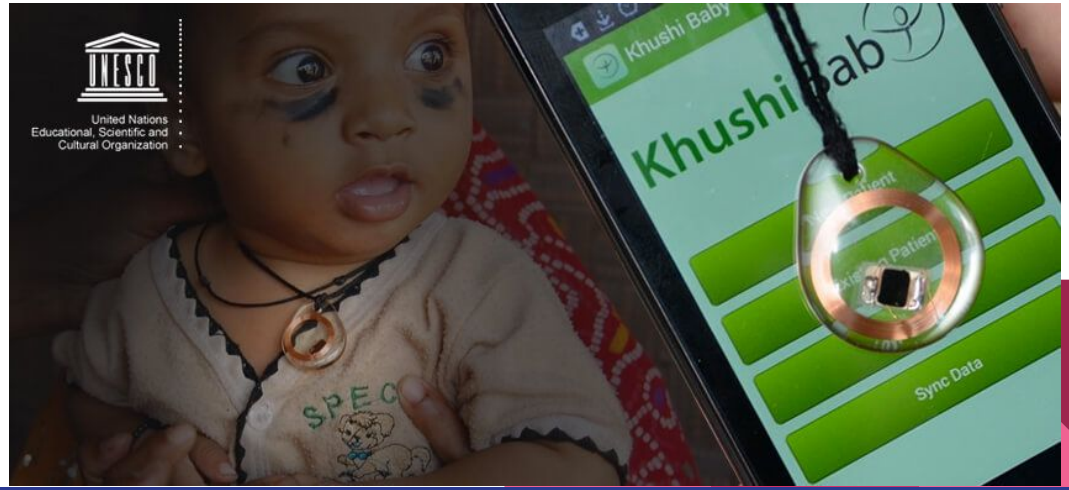
- ProductHunt: "Kickstarter" for new apps and products
- EdSurge: Reports on new startups in education
- EndpointsNews: News in BioPharma
- Google AI for Social Good: List of social impact ideas. Here is their report.

Google Live Transcribe

- Use AI to convert speech to text in real-time

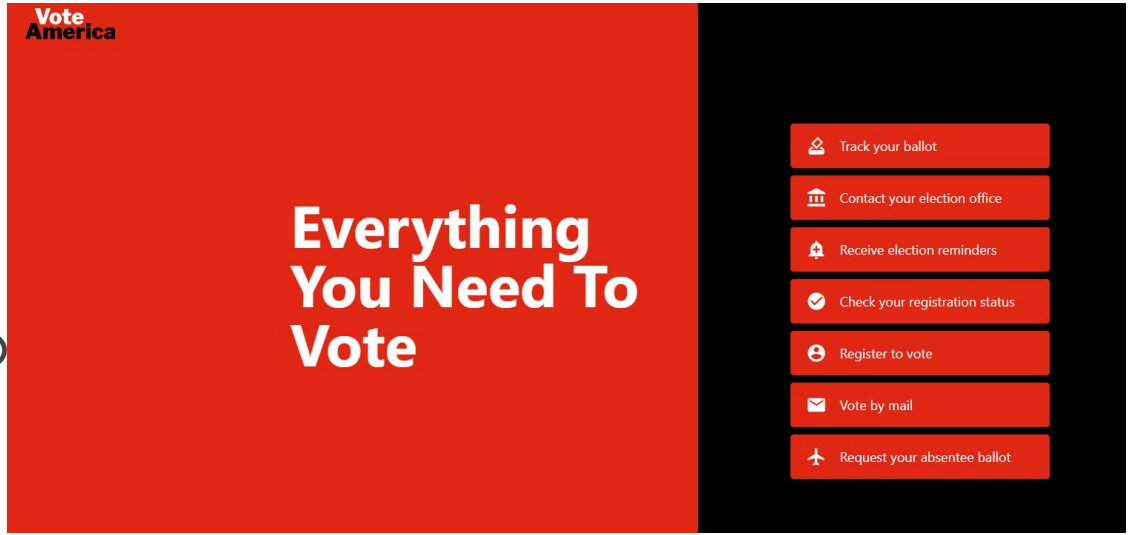
Khushi Baby

- The problem: How to store digital health records for babies in rural India?
  - Parents can’t remember what vaccines their children have already received
- Solution: Store the records in a necklace/bracelet that the babies will wear.
- Health workers can read the records using NFC technology, don’t need internet



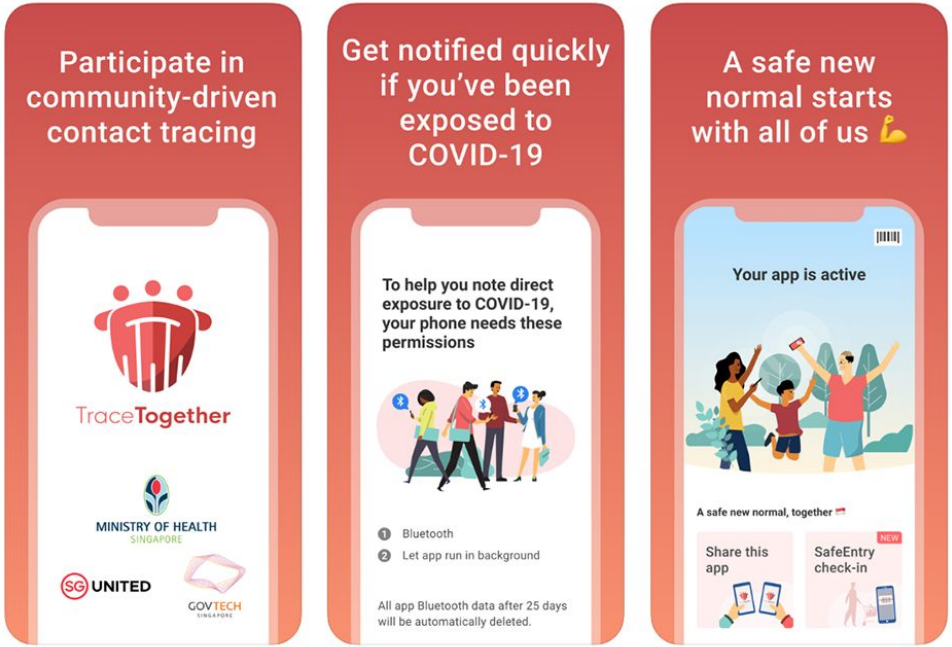
Vote America

- Makes voting easier by helping people register or request for absentee ballots
- Collecting and aggregating data for all states is HARD



TraceTogether

- Contact tracing for COVID19 in Singapore
- Tracks the people you've been in close contact with using phone bluetooth
    - Changed to a physical token due to low app download rate



Thank you. Q&A

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7. Case studies: using tech for social good

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