### Al and Machine Learning for Social Impact Primer

Presented by MIT Solve in Partnership with the Patrick J. McGovern Foundation

#### James W. Weis

Research Affiliate and Instructor, *MIT Media Lab* CEO and founder, *Nest.Bio* 

Content Creator: Geeticka Chauhan, PhD Student at MIT CSAIL



### Overview of What AI Can and Cannot Do for Social Good

Definitions Artificial Intelligence

The wide-ranging branch of computer science concerned with building smart machines capable of tasks requiring human intelligence

www.builtin.com/artificial-intelligence



### **Definitions** Machine Learning

The field of study that gives computers the ability to learn without being explicitly programmed

-Arthur Samuel

A Computer Program is said to learn from experience E with respect to some class of tasks T and performance measure P, if its performance at tasks in T, as measured by P, improves with experience E

-Tom Mitchell

### Machine Learning Provides Automated Methods of Data Analysis



### How can AI be Useful in Solving Social Problems?

#### Mental Health: Suicide Prevention and Opioid Use

#### Facebook

#### How Facebook AI Helps Suicide Prevention

September 10, 2018 Catherine Card, Director of Product Management





Post details e.g. post type, time posted, day posted Classifiers' Main text classifier { "so": 0.01, "much": 0.02, "so much": -0.3, "much sadness": 0.99, "so": 0.04, "o": 0.04, "o": 0.04, "m": -0.01, "m": -0.01, "m": -0.09, ... } Comment classifier { ... } Random forest learning algorithm<sup>3</sup>

Post flagged for additional review

Reviewed by Community Operations

#### Take Action

Send tips + resources Escalate to local authorities

in serious situations

#### RESEARCH-ARTICLE

#### Discovering Alternative Treatments for Opioid Use Recovery Using Social Media

¥ in & f ≌

Authors: Stevie Chancellor, George Nitzburg, Andrea Hu, Francisco Zampieri, Munmun De Choudhury Authors Info & Affiliations

#### https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7251955 https://crcs.seas.harvard.edu/ai-social-impact

# How can AI be Useful in Solving Social Problems?

CORD-19: Covid-19 Open Research Dataset

Call to Action to the Tech Community on New Machine Readable COVID-19 Dataset

**STATEMENTS & RELEASES** 

HEALTHCARE | Issued on: March 16, 2020

# Over 24,000 coronavirus research papers are now available in one place

The data set aims to accelerate scientific research that could fight the Covid-19 pandemic.

by Karen Hao

March 16, 2020

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7251955 https://crcs.seas.harvard.edu/ai-social-impact

### **Broad Classes of AI Uses**

#### **Supervised**

Given input and correct expected output (or labels), predict the correct output for new, unseen examples

#### **Classification vs regression**

**Classification**: Classify whether someone will be a defaulter on a loan

**Regression**: Predict housing prices based on attributes such as locality, square footage etc.

#### **Pandora Business Model**



### **Broad Classes of AI Uses**

#### Unsupervised

Deriving structure from data when we do not have access to labels. Involves learning patterns from data.

Facebook news feed is populated based on ► unsupervised learning.



https://youtu.be/5kXYC265yn8

### **Broad Classes of AI Uses**

#### Reinforcement Learning

Teaching a model to make a sequence of decisions to achieve a goal in an uncertain environment.

Google DeepMind's program (Alpha Go) to crack the complex board game Go



https://youtu.be/SUbqykXVx0A

### **Limitations of AI for Social Good**

10

#### May not have enough data available

Most machine learning methods require hundreds or thousands of examples to generalize meaningfully



## Data alone is not enough

Your model may not be sufficient

Generalization beyond data is a major challenge for AI systems: you need to make assumptions, or have labels



#### The problem may be too challenging to model and deploy

Applying expertise to decision making and planning e.g. replacing clinicians in making high-risk patient outcome decisions



Facebook uses AI for suicide prevention using Natural Language Processing



https://about.fb.com/news/2018/09/inside-feed-suicide-prevention-and-ai/

 Identifying valuable data present in medical notes

#### demographics

patient condition, diseases, etc.

procedures, tests

results of measurements

time

Mr. Blind is a 79-year-old white white male with a
history of diabetes mellitus, inferior myocardial
infarction, who underwent open repair of his increased
diverticulum November 13th at Sephsandpot Center.
The patient developed hematemesis November 15th and
was intubated for respiratory distress. He was
transferred to the Valtawnprinceel Community Memorial Hospital
for endoscopy and esophagoscopy on the 16th of November
which showed a 2 cm linear tear of the esophagus at
30 to 32 cm. The patient's hematocrit was stable and he
was given no further intervention.

MIT 6.S897: Machine Learning for Healthcare; Peter Szolovits

Using Computer Vision to detect diseases like Covid-19



Prevention of tuberculosis using Prediction and Multi-Agent Planning

Proceedings > KDD '19 > Learning to Prescribe Interventions for Tuberculosis Patients Using	Digital Adherence Data		
RESEARCH-ARTICLE Learning to Prescribe Interventions for	Tuberculosis		
Patients Using Digital Adherence Data	Ƴ in de	f	Y

34th Conference on Neural Information Processing Systems (NeurIPS 2020), Vancouver, Canada.

#### Collapsing Bandits and Their Application to Public Health Interventions

Technical Feasibility as a Necessary Precondition

Technical feasibility,

% of time spent on activities that can be automated by adapting currently demonstrated technology



78

#### Time spent in all US occupations, %

7	14	16	12	17	16	18
	Applying expertise <sup>1</sup>	l	Jnpredictabl physical	e	Data processing	
Managi other	ng s	Stakeholder interactions	work <sup>2</sup>	Data collection		Predictable physical work <sup>2</sup>

► Other Factors



Predictable physical work

Unpredictable physical work



For example, welding and soldering on an assembly line, food preparation, or packaging objects For example, construction, forestry, or raising outdoor animals

### Work activity summary: All



#### Some activities can be more affected by AI than others



Time spent in US occupations, %



Technical feasibility, % of time spent on activities that can be automated by adapting currently demonstrated technology



#### Learning patterns from complex data



Emerging professors in areas of interest



Recruits and hires with specific expertise





Name	Impact Score		
Anastasia Khvorova	312.66	Alice M. Chiang	279.93
Katherine L. hall	307.66	Irena Y. Bronstein	276.49
Mona Singh	304.70	Elizabeth A. Wang	473.09
Angela Reynolds	296.19	Hayley Binch	418.55
Helen S. Raizen	293.02		

# Implementing Al in Your Solution

//

### **Choosing the Right AI Method or Capability**



**Others**: Rule-based methods like Decision Trees, Advanced techniques like meta-learning

### **Identifying the Datasets You Need**

## Your problem may require a **data collection phase**

- If so, identify the stakeholders and experts who can help obtain clean data and/ or labels if needed.
- Some difficulties may arise, like:



### **Identifying the Datasets You Need**

#### Build baseline models using relevant open source data, if available

Why? Data collection may take time! And you might want to maximize your efforts by parallelizing your data collection and model building efforts

Finding open source datasets:

https://towardsdatascience.com/top-sources-for-machine-learning-datasets-bb6d0d c3378b or

https://medium.com/towards-artificial-intelligence/best-datasets-for-machine-learnin g-data-science-computer-vision-nlp-ai-c9541058cf4f

### Steps to Building Out an AI Strategy

#### **Technical Steps**



- **Data Acquisition**
- Data Cleaning
- Data Analysis
- Model Selection
- Model Training
- Model Validation

Deployment

#### **Business Steps**

Ensure your goals guide your corporate strategy Assemble a multi-skilled team Pick the right battles to fight 3 Hit your KPIs Repeat to build best practices

https://www.computerweekly.com/opinion/Five-steps-to-build-an-artificial-intelligence-strategy | https://bernardmarr.com/default.asp?contentID=1843 | https://www.forbes.com/sites/bernardmarr/2019/03/19/how-to-develop-an-artificial-intelligence-strategy-9-things-every-business-must-include/?sh=f1888ae 83609

### **Responsible Implementation: Ethical Issues**

#### REPORT

### OPENAI'S LATEST BREAKTHROUGH IS ASTONISHINGLY POWERFUL, BUT STILL FIGHTING ITS FLAWS

#### The ultimate autocomplete

By James Vincent | Jul 30, 2020, 10:01am EDT

NEWS · 24 OCTOBER 2019 · UPDATE 26 OCTOBER 2019

# Millions of black people affected by racial bias in health-care algorithms

Study reveals rampant racism in decision-making software used by US hospitals – and highlights ways to correct it.

Heidi Ledford

May 3, 2019, 05:33pm EDT | 15,197 views

#### China Is Using Facial Recognition To Track Ethnic Minorities, Even In Beijing



Zak Doffman Contributor Cybersecurity I write about security and surveillance.

#### Tech policy / Tech and health

#### Machines can spot mental health issues — if you hand over your personal data

Digital diagnosis could transform psychiatry by mining your most intimate data for clues. But is the privacy cost worth it?

#### by David Adam

### **Responsible Implementation: Different Ethical Challenges**



https://www.accenture.com/gb-en/company-responsible-ai-robotics

### **A Guide for Responsible Implementation**

## 01

Organizational transparency and diffuse accountability

### 02

Coordinate the drivers for change inside and outside the organization

### 03

Expand notion of measurable value to evolve from short to long-term mindset

https://sloanreview.mit.edu/article/putting-responsible-ai-into-practice/



Overview of What AI Can and Cannot Do for Social Good

#### Spotting Opportunities to Apply AI in Your Solution

Implementing AI in Your Solution