Artificial Intelligence in Healthcare

ROGERS
Behavioral Health

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History of AI 1950—1980s

- **1950s: Foundations and Concepts**
  - **1950:** Alan Turing proposes the Turing Test to evaluate a machine's ability to exhibit intelligent behavior.
  - **1956:** The term "Artificial Intelligence" is coined by John McCarthy at the Dartmouth Conference.
- **1960s: Early Enthusiasm and Research**
  - Development of early AI programming languages, like LISP by John McCarthy.
  - Governments and universities invest heavily, expecting quick progress.
- **1970s: AI Winter Begins**
  - **Early 1970s:** AI research faces setbacks due to limited computational power and overly ambitious expectations.
  - **Late 1970s:** The field shifts towards domain-specific problem solving and expert systems.
- **1980s: Rise of Expert Systems**
  - Expert systems like XCON become widely used in industries for specific tasks.
  - **1987–1993:** Another AI Winter occurs, due to the limitations of expert systems and cutbacks in funding

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1980’s present

- **1990s: AI Integration and Expansion**
  - **1997:** IBM’s Deep Blue defeats world chess champion Garry Kasparov.
  - AI techniques begin to be integrated into mainstream technologies and applications.
- **2000s: Advances in Algorithms and Hardware**
  - Improvements in machine learning algorithms, driven by increases in computational power and data availability.
  - **2006:** The term “Deep Learning” is popularized, marking a renewed interest in neural networks.
- **2010s: AI Boom**
  - **2011:** IBM’s Watson wins on the game show Jeopardy!.
  - **2014:** Google acquires DeepMind; shortly after, its AlphaGo program defeats a human professional Go player.
  - AI becomes central in technology, impacting sectors from healthcare to automotive with technologies like self-driving cars and personalized medicine.
- **2020s: Ethical Considerations and Expansion**
  - Growing awareness and debate over AI ethics, privacy, and potential biases.
  - Development of AI governance and regulatory frameworks.
  - Continued advancements in AI capabilities, including natural language processing and generative AI technologies.

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Healthcare is ripe for application of AI

1. **Electronic Health Records (EHRs):**
   1. The widespread adoption of EHRs has been a fundamental change in the storage and accessibility of patient data.
2. **Wearable Technology:**
   1. The proliferation of wearable devices that monitor health metrics like heart rate, sleep patterns, and physical activity has led to an explosion of data. These devices contribute to personalized medicine by providing continuous, real-time health monitoring data to both patients and physicians.
3. **Genomic Data:**
   1. Advances in genomic sequencing technology have led to a dramatic increase in the availability of genetic data. This genomic data is crucial for personalized medicine, allowing for treatments tailored to the genetic profiles of individual patients.
4. **Imaging Data:**
   1. Improvements in medical imaging technology, such as MRI and CT scans, have resulted in higher-resolution images, which generate more data. This has enhanced diagnostic capabilities but also increased the volume of data that healthcare systems need to manage.
5. **Telemedicine:**
   1. The growth of telemedicine, especially accelerated by the COVID-19 pandemic, has led to new forms of data collection from virtual consultations and remote patient monitoring, integrating more sources of health data into medical records.
6. **Interoperability and Data Sharing:**
   1. There has been a significant push towards improving interoperability between different health systems and data platforms, which facilitates the broader sharing and analysis of health data. This helps in creating more comprehensive patient profiles and supports public health monitoring and research.
7. **Big Data and AI:**
   1. The use of big data analytics and artificial intelligence in healthcare has grown, enabling the analysis of vast amounts of data for insights into patient care, operational improvements, and predictive analytics.

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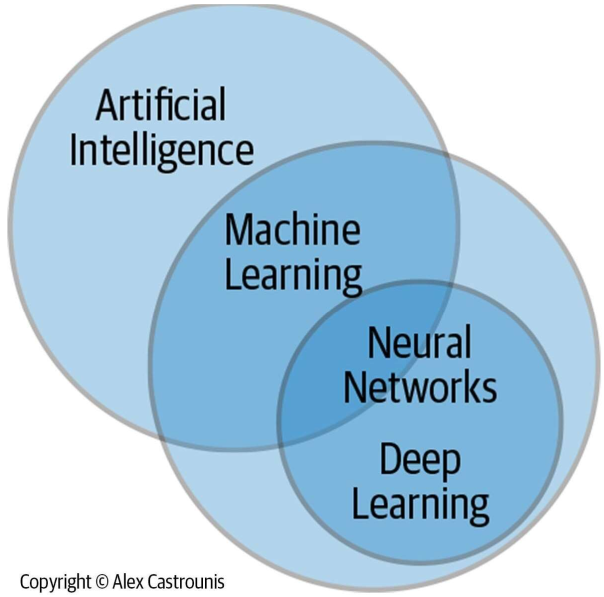
What is AI?

Artificial intelligence, or AI, is technology that enables computers and machines to simulate human intelligence and problem-solving capabilities.



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What is Machine Learning?

- Machine Learning
  - Study of algorithms that improve their performance at some task with experience
- Optimize a performance criterion using example data or past experience.
- Role of Statistics: Inference from a sample
- Role of Computer science: Efficient algorithms to solve the optimization problem representing and evaluating the model for inference

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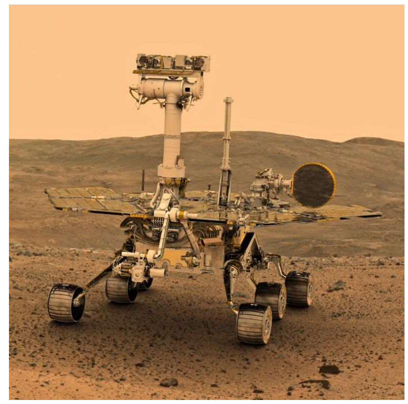
Why "Learn"?

- Machine learning is programming computers to optimize a performance criterion using example data or past experience.
- Learning is used when:
  - Human expertise does not exist (navigating on Mars),
  - Humans are unable to explain their expertise (speech recognition)
  - Solution changes in time (hospital census)
  - Solutions are highly complex and made of many variables (Bioinformatics)



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When Would We Use Machine Learning?

- When patterns exists in our data
  - Even if we don't know what they are
    - Or perhaps especially when we don't know what they are
- We can not pin down the functional relationships mathematically
  - Else we would just code up the algorithm
- When we have lots of (unlabeled) data:
  - Labeled training sets harder to come by
  - Data is of high-dimension
    - High dimension "features"
    - For example, sensor data
  - Want to "discover" lower-dimension representations
    - Dimension reduction

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Examples in Healthcare

- Acute care applications:
  - Cerner/Epic- Sepsis Prediction
- Predicting Against Medical Advice Discharges
- Behavioral Health Specific
  - Suicide Risk Prediction
- Behavioral Health Treatment Response
- Quantifying sleep from accelerameter in observe smart bands

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How do we prevent bias in algorithms

1. **Diverse Data Collection:**
   1. Ensure that the data used to train AI models is representative of all relevant aspects of the population. This includes addressing issues of underrepresentation or overrepresentation of certain groups.
2. **Bias Detection and Mitigation Techniques:**
   1. Employ statistical and computational techniques to detect and mitigate bias in AI models. This includes analyzing model predictions for fairness across different groups and adjusting the model or its training data accordingly.
3. **Transparent and Explainable AI:**
   1. Develop AI systems that are transparent and explainable, allowing users and developers to understand how and why decisions are made. This transparency helps in identifying potential biases in decision-making processes.
4. **Inclusive Development Team:**
   1. Assemble diverse teams to design and develop AI systems. Diversity in terms of race, gender, cultural background, and professional expertise can help in recognizing and eliminating unconscious biases.
5. **Ethical Guidelines and Standards:**
   1. Establish and adhere to ethical guidelines and standards for AI development. This includes guidelines for fairness, accountability, and transparency.
6. **User Feedback:**
   1. Incorporate continuous feedback from users to understand how AI applications perform in the real world and how they impact different groups of people.
7. **Cross-Disciplinary Approaches:**
   1. Involve experts from various fields, such as sociology, psychology, and ethics, in the AI development process to ensure a broad perspective on potential impacts.


AI Nutrition Facts

Generative Journeys in Twilio Engage

Description Accelerate campaign execution by using language prompts to describe a campaign journey. Marketers can apply additional filters but then let CustomerAI create the journey and target the appropriate audience.	
Privacy Ladder Level	1
Feature is Optional	Yes
Model Type	Generative
Base Model	OpenAI - GPT-4
Trust Ingredients	
Base Model Trained with Customer Data Enter comment here...	No
Customer Data is Shared with Model Vendor Journey prompts are NOT used for training OpenAI models	No
Training Data Anonymized	N/A
Data Deletion Journey inferences deleted after 30 days	Yes
Human in the Loop User sees output immediately in UI User must choose to publish journey	Yes
Data Retention	30 days
Compliance	
Logging & Auditing	Yes
Guardrails	Yes
Input/Output Consistency	Yes
Other Resources Learn more at: https://www.twilio.com/en-us/customer-ai	

Learn more about this label at nutrition-facts.ai

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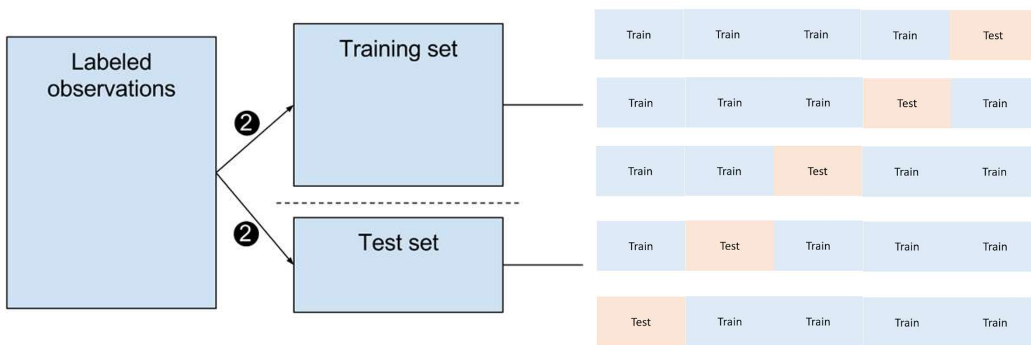
Bias Detection and Mitigation- Cross fold validation



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Evaluation Statistics

Predicted/ Actual	Positive	Negative
Positive	TP	FP
Negative	FN	TN

- **Sensitivity:** *Total number of true positives*
- **Precision***: Number of correctly positive predictions*
- **Accuracy:** *Total number of correctly predicted datapoints*
- **Matthews:** *Balanced taking into true positives, true negatives, false positives and false negatives*

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Demo

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Large Language Models

- Large language models (LLMs) are a category of foundation models trained on immense amounts of data making them capable of understanding and generating natural language and other types of content to perform a wide range of tasks.

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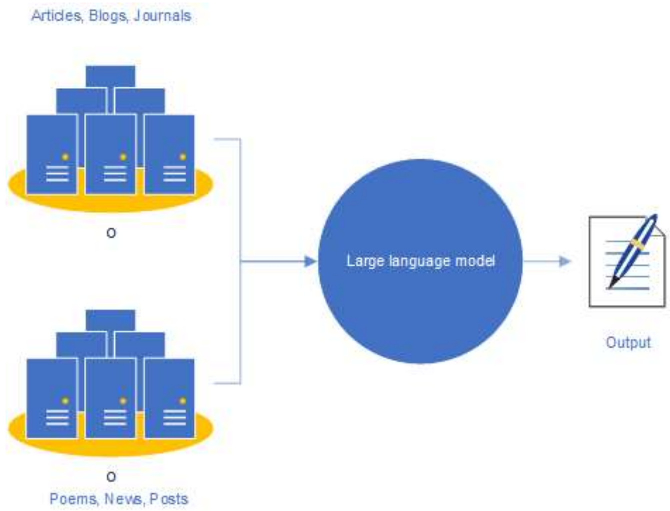
Large Language Models

These (Corpus) vary by application



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Prompt engineering

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Applications in Healthcare

- Administrative:
  - Generating job descriptions
  - Summarizing documents
  - Building powerpoints
- Clinical
  - Ambient listening for clinical documentation
  - Kaiser- Inbox messages for triaging
  - Chatbots for admission screening

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Key Take Aways

- AI will not replace clinicians and providers, but will be a powerful tool to augment decision making
- Understanding the training data is vital to understanding the algorithm
- Algorithms in both machine learning and LLM's will out but based off what it is trained on
- Data security and privacy is paramount
- It should be applied to real business use cases rather than being built because its there
- AI is starting to take off with more sophistication every day
- Ethical considerations need to be taken into account from training to implementation

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