



# ARTIFICIAL INTELLIGENCE: FRIEND OR FOE?

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## ARTIFICIAL INTELLIGENCE: FRIEND OR FOE?

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- **Assistant Professor & Director of Optometric Services at the University of Mississippi Medical Center Dept of Ophthalmology**
- **Disclosures**
  - Advisory board member for Apellis
  - Advisory board member for Visus Pharmaceuticals



# Expected Learning Objectives

At the end of the session, attendees should be able to:

1. Understand the background and historical origins of AI
2. Summarize AI technology and algorithms within the context of 'machine learning'
3. Identify the strengths and limitations of AI utilization in health care
4. Describe utilization of AI in the delivery of care in patient disease detection, diagnosis, treatment and management
5. Compare the utilization of AI in aiding with office-based patient assessment versus remote "telemedicine" care
6. Summarize the advantage of AI in standardization metadata analysis and calculation
7. Explain the inability of AI to relate to the humanistic interactions required for patientcare

# ARTIFICIAL INTELLIGENCE (AI)

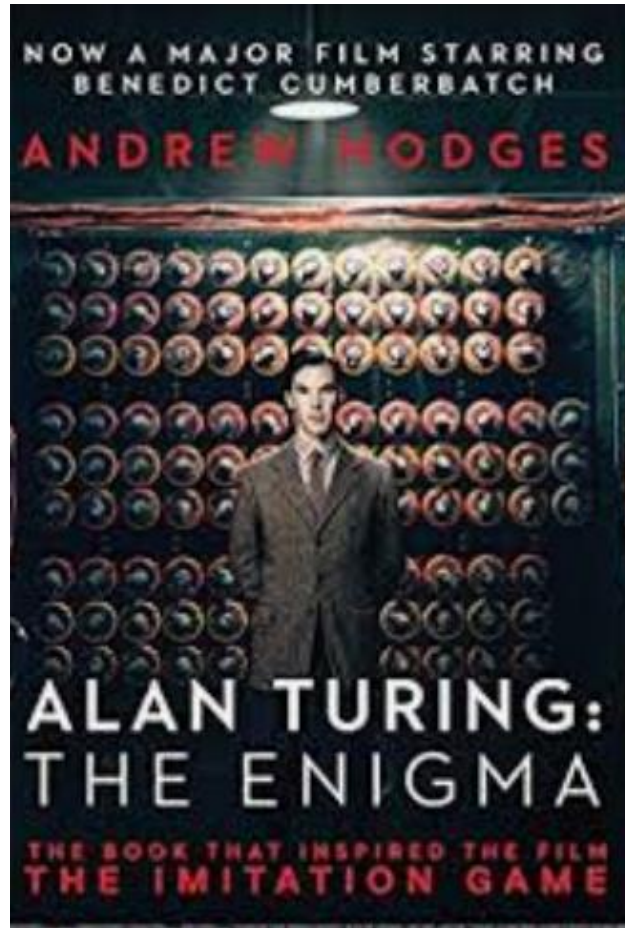
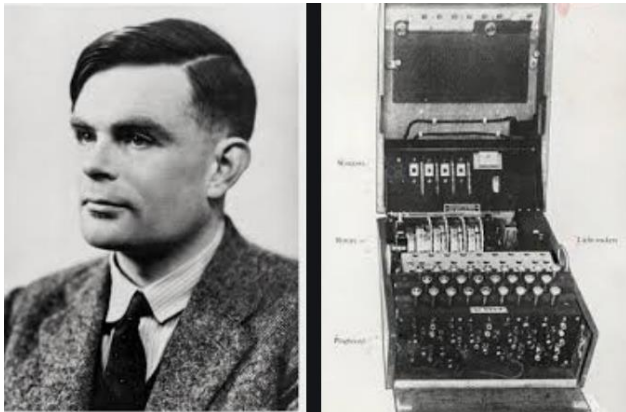
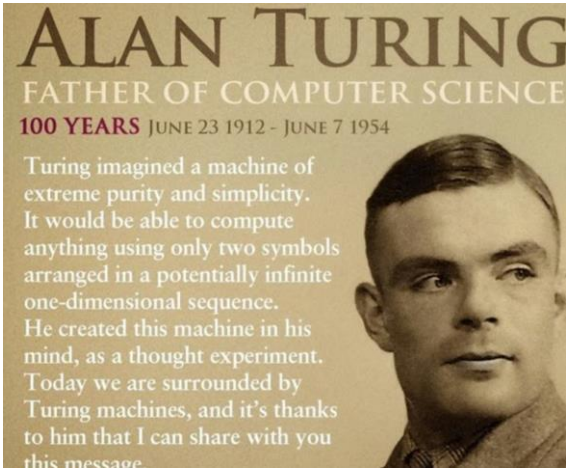


- What is AI?
  - Intelligence exhibited by machines
  - Using computers to solve problems or to make decisions for tasks that are typically done by humans which require intelligence

# HISTORY OF ARTIFICIAL INTELLIGENCE

- **First AI: 1672**
  - The Staffelwalze: the first known calculator to perform all operations: addition, subtraction, multiplication, and division





# HISTORY OF ARTIFICIAL INTELLIGENCE

- 19<sup>th</sup> Century: AI started getting developed by philosophers and mathematicians
  - Alan Turing: best known founding father of modern AI

# HISTORY OF ARTIFICIAL INTELLIGENCE

- **1956-1974: Founding of AI & Practice**
  - AI research was founded in Dartmouth College in 1956
  - The founders and students wrote programs that were winning at checkers, solving word problems in algebra, proving logical theorems, and speaking English
  - Expectation was to have pure AI within 20 years, but underestimated difficulties, and in 1974, all funding was discontinued

IN THIS BUILDING DURING THE SUMMER OF 1956

JOHN McCARTHY (DARTMOUTH COLLEGE), MARVIN L. MINSKY (MIT)  
NATHANIEL ROCHESTER (IBM), AND CLAUDE SHANNON (BELL LABORATORIES)  
CONDUCTED

THE DARTMOUTH SUMMER RESEARCH PROJECT  
ON ARTIFICIAL INTELLIGENCE

FIRST USE OF THE TERM "ARTIFICIAL INTELLIGENCE"

FOUNDING OF ARTIFICIAL INTELLIGENCE AS A RESEARCH DISCIPLINE

"To proceed on the basis of the conjecture  
that every aspect of learning or any other feature of intelligence  
can in principle be so precisely described that a machine can be made to simulate it."

IN COMMEMORATION OF THE PROJECT'S 50th ANNIVERSARY  
JULY 13, 2006



# HISTORY OF ARTIFICIAL INTELLIGENCE



- **1990s**

- After a few more attempts at revival, AI began to be used more in the 1990s in all kinds of areas
- In 1997, IBM's Deep Blue beat Garry Kasparov, the reigning world champion at chess

# HISTORY OF ARTIFICIAL INTELLIGENCE

- 2000's

- In 2011, IBM's Watson beat Ken Jennings and Brad Rutter in the TV Quiz Jeopardy, the first sign of AI beating people at non-math



# HISTORY OF ARTIFICIAL INTELLIGENCE

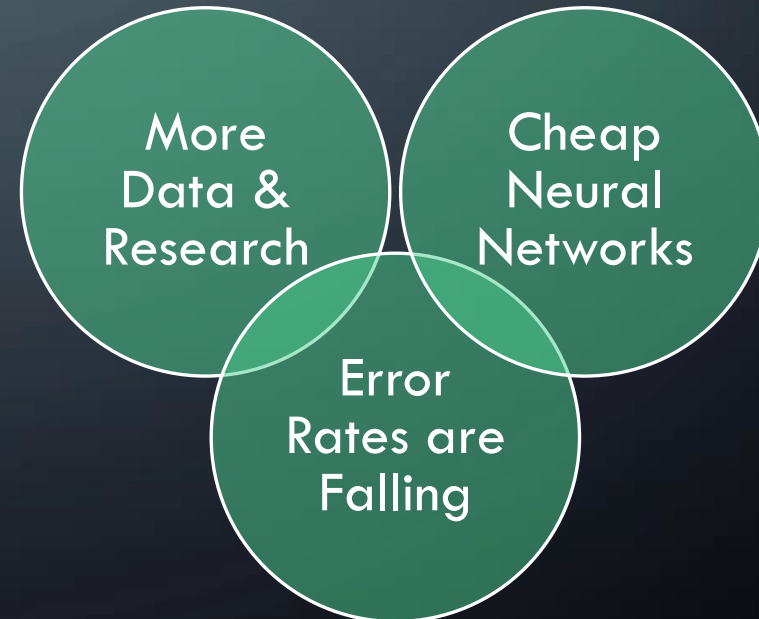
- **2016**

- Google's Deepmind beat Lee Sedol 4-1 at Go, putting AI 10 years ahead of expectations

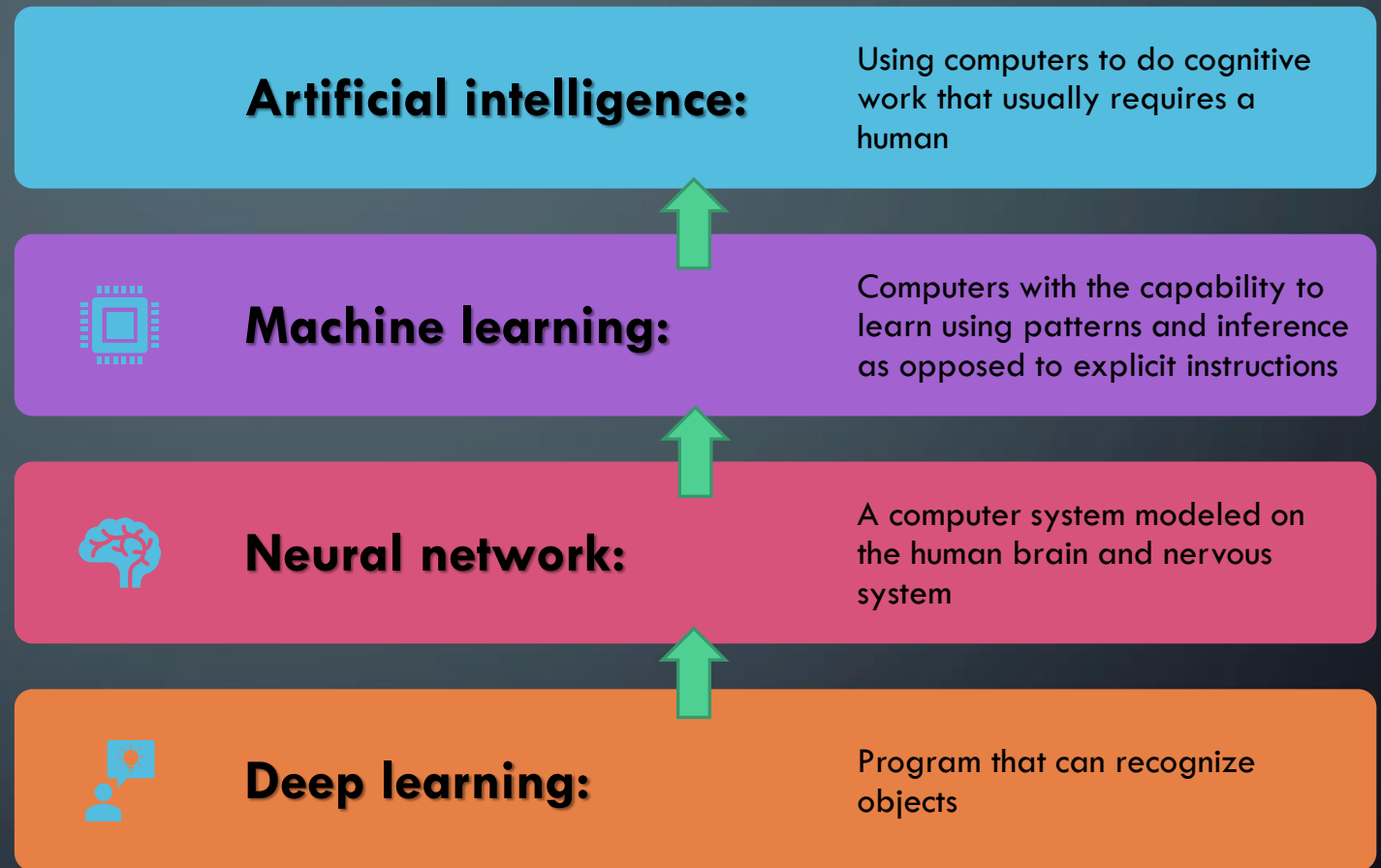


# ARTIFICIAL INTELLIGENCE TODAY

- Today AI is BOOMING
  - Across ALL sectors
  - The AI sector was valued at about \$600 million in 2014 and is projected to reach a \$150 billion by 2026
- Why Now?



# AI: PUTTING THE HUMAN MIND IN THE COMPUTER





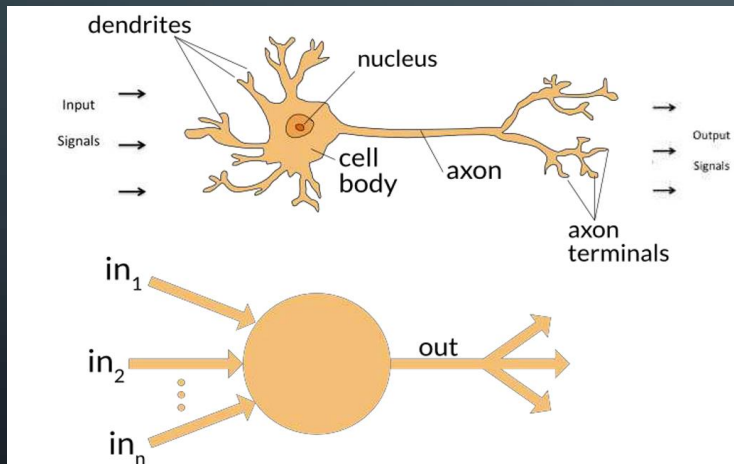
# WHAT IS DEEP LEARNING?

- Deep learning is a subset of machine learning where artificial neural networks, algorithms inspired by the human brain, learn from large amounts of data

# WHAT IS A NEURAL NET?



- **Intuition:** create an Artificial Neural Network to solve problems in the same way as the human brain



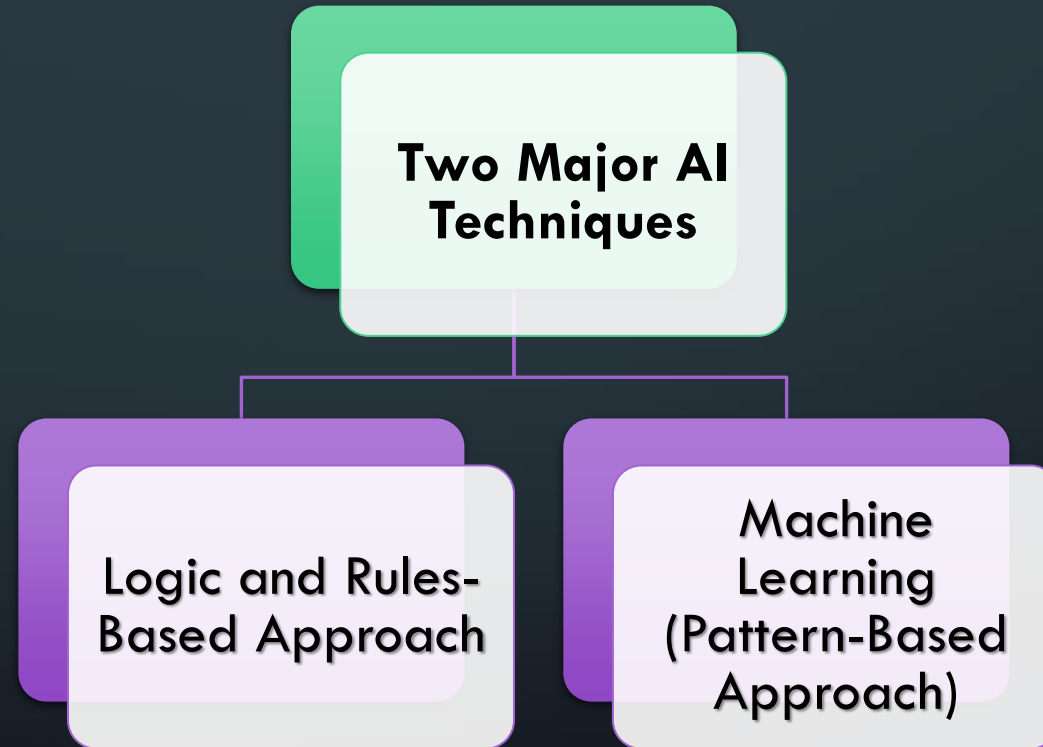


# WHAT IS MACHINE LEARNING?

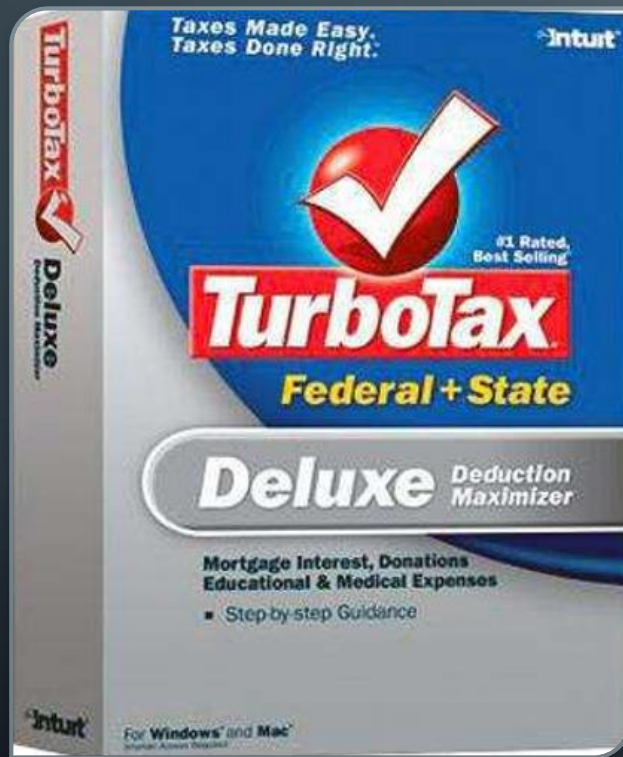
- Machine learning is a method of data analysis that automates analytical model building
- It is a branch of artificial intelligence based on the idea that systems can
  - Learn from data
  - Identify patterns
  - Make decisions with minimal human intervention



# MAJOR AI APPROACHES




# LOGIC AND RULES-BASED APPROACH



- **Logic and Rules-Based Approach**
  - Representing processes or systems using logical rules
  - Top-down rules are created for computer
  - Computers reason about those rules
  - Can be used to automate processes
- Example within law – Expert Systems
  - TurboTax
    - Personal income tax laws
    - Represented as logical computer rules
    - Software computes tax liability



# MACHINE LEARNING (PATTERN BASED)

- Machine Learning (ML)
    - Algorithms find patterns in data and infer rules on their own
      - "Learn" from data and improve over time
    - These patterns can be used for automation or prediction
    - ML is the dominant mode of AI today
- 

# MACHINE LEARNING USES



**Self-driving  
vehicles**

**NETFLIX**

**Automated  
Recommendations**



**Computer  
Translation**

# AI VS. HUMAN



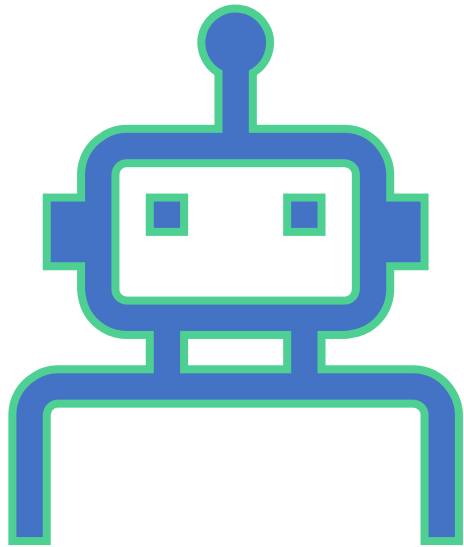
## ARTIFICIAL INTELLIGENCE

- Speed of execution; data processing
- Less Biased
- Operational Ability
- Accuracy

## HUMAN INTELLIGENCE

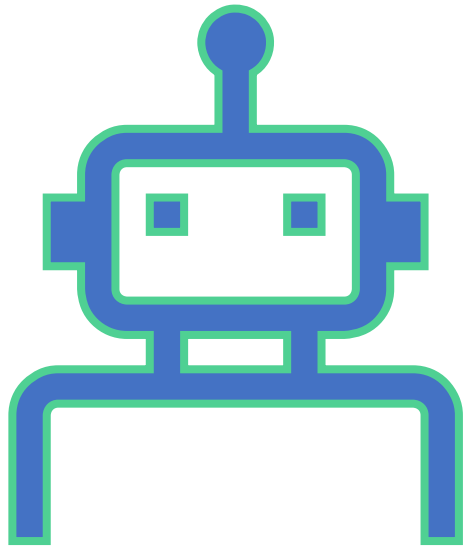
- Abstract thinking
- Common sense
- Transferring knowledge from one area to another

# LIMITS OF ARTIFICIAL INTELLIGENCE



- “Weak” Pattern-Based Artificial Intelligence
  - Computers solve problems by detecting useful patterns
  - Pattern-based AI is an **Extremely** powerful tool
  - Has been used to automate many processes today
    - Driving, language translation
  - This is the dominant mode of AI today

# LIMITS OF ARTIFICIAL INTELLIGENCE



- “Strong” Artificial Intelligence
  - Computers thinking at a level that meets or surpasses people
  - Computers engaging in abstract reasoning & thinking
  - This is not what we have today
    - There is no evidence that we are close to Strong AI

# LIMITS OF ARTIFICIAL INTELLIGENCE

## Artificial Intelligence Accomplishments

- Automate many things that couldn't do before

## Limits

- Many things still beyond the realm of AI
- No thinking computers
- No abstract reasoning
- Often AI systems have accuracy limits
- Many things difficult to capture in data
- Sometimes hard to interpret systems



# WHY DOES AI MATTER?

## OUR LIVES

*How will AI impact our purpose?*

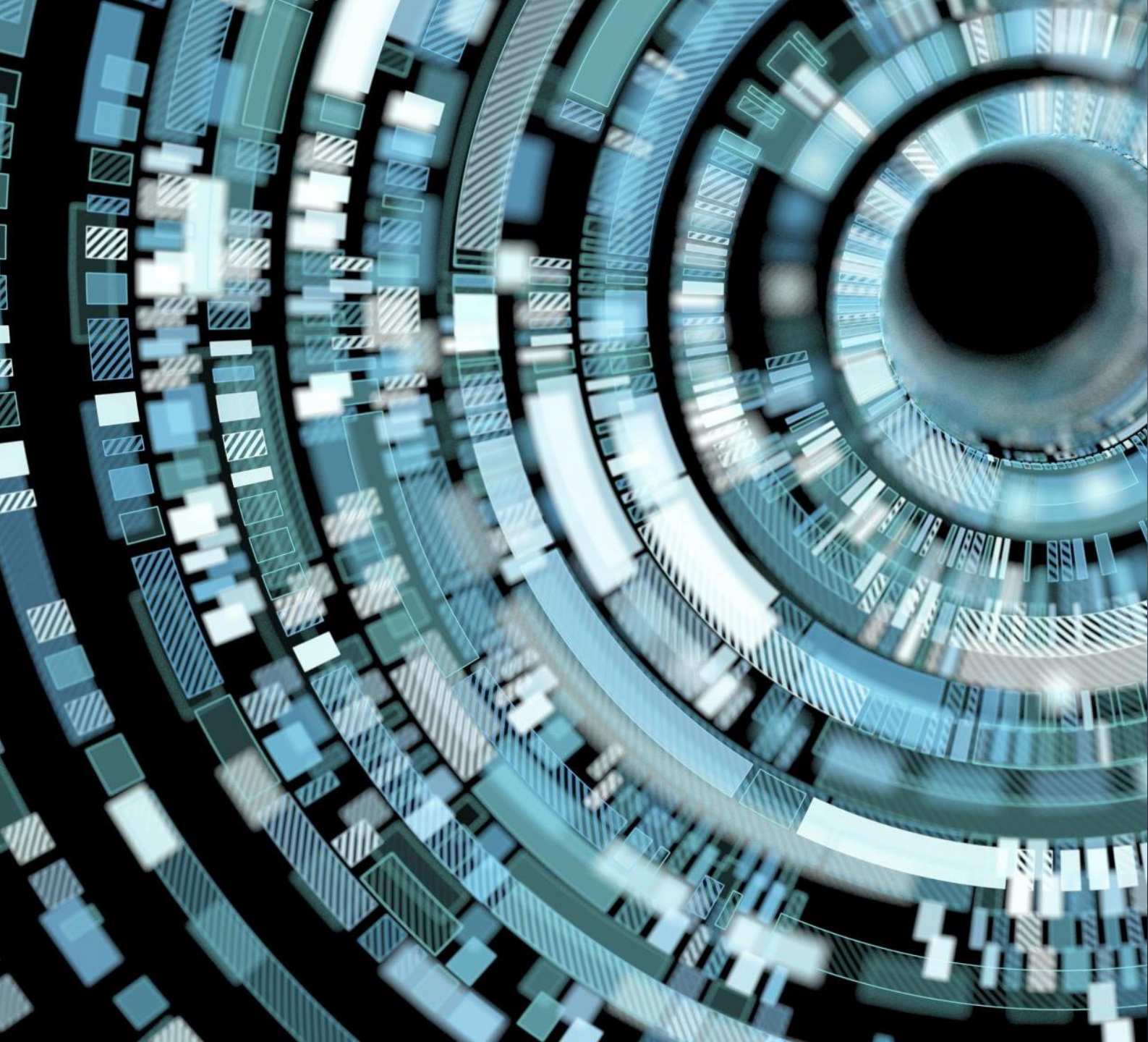


## OUR BUSINESSES

*How will AI change our businesses?*

## OUR SOCIETY

*How will AI impact our workforce?*



**AI IS ALL  
AROUND US**

**5 Business  
Applications**



Uber

# AI BUSINESS APPLICATION

UBER IS USING AI FOR ROUTE OPTIMIZATION

COMPOSE

[Delete all spam messages now](#) (messages that have been in Spam more than 30 days will be automatically deleted)

<input type="checkbox"/>	<input type="star"/>	<input type="trash"/>	Nicole Gonzalez	Sam Wouters, Urgent Reminder! - Dear Sam Wouters, The 29Designx in association with	27 Feb
<input type="checkbox"/>	<input type="star"/>	<input type="trash"/>	Piotr Pawlak	Kinetise 2.0 - Source Code Generator - Hi! Thank you for signing up at www.kinetise.com	27 Feb
<input type="checkbox"/>	<input type="star"/>	<input type="trash"/>	Video Animation Agency	Sam Wouters, Urgent Reminder! - Hey Sam Wouters , Animated Video Department in as:	24 Feb
<input type="checkbox"/>	<input type="star"/>	<input type="trash"/>	Sohail	RE:Website Design & Development Proposal - Hi, Hope you are doing well. I recently se	24 Feb
<input type="checkbox"/>	<input type="star"/>	<input type="trash"/>	Elizabeth Gonzalez	Sam Wouters, Here's Logo for GBP19 Only - Hey Sam Wouters, Your domain needs a Lr	23 Feb
<input type="checkbox"/>	<input type="star"/>	<input type="trash"/>	suman kumari	RE:Website Design & Development Proposal - Hi, Hope you are doing well. I recently se	23 Feb
<input type="checkbox"/>	<input type="star"/>	<input type="trash"/>	Best Content Help	Complete Your Website! Win Your Customer With Great Content - Add Brandon@bestc	22 Feb
<input type="checkbox"/>	<input type="star"/>	<input type="trash"/>	Elizabeth	Sam Wouters, Weekend Special! 🎉 50% Off - Branding Bundle Deal 🎉 Extended Due	22 Feb
<input type="checkbox"/>	<input type="star"/>	<input type="trash"/>	priya singh	Google Help - Best Wishes! We are offering web services for our beloved customers only!'	22 Feb
<input type="checkbox"/>	<input type="star"/>	<input type="trash"/>	Nicole Gonzalez	Sam Wouters, Reminder! 📧 Get 80% Off Your Website Design & Development! - Dear	22 Feb
<input type="checkbox"/>	<input type="star"/>	<input type="trash"/>	Web Services	Revamp Your Website At Low Price !! - Hi, Hope you are doing well!! We are an Indian co	22 Feb
<input type="checkbox"/>	<input type="star"/>	<input type="trash"/>	Sierra Alex	Custom Branding with Unique Sense - Do not Wish to receive these Newsletters.Reply u	22 Feb
<input type="checkbox"/>	<input type="star"/>	<input type="trash"/>	vineet	Website   e-Commerce   SEO   Apps at affordable price - Hi, I am Vineet Now get 10 Pa	21 Feb

Inbox  
Starred  
Important  
Sent Mail  
Drafts  
Circles  
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# AI BUSINESS APPLICATION

GOOGLE SAYS ITS AI  
CATCHES 99.9% OF  
GMAIL SPAM

# AI BUSINESS APPLICATION



- Netflix uses AI to go from recommendations based on what you've seen, to what you like

# AI BUSINESS APPLICATION



- Need a lawyer?
  - A 19-year-old made a free chatbot lawyer that is now available in all 50 states



# AI BUSINESS APPLICATION

- Identifying diseases by comparing huge amounts of data

# ARTIFICIAL INTELLIGENCE IN HEALTHCARE



The implementation of AI in healthcare has changed the way in which patients are treated



AI can complement human intelligence, allowing us to achieve **MORE** with the information we have



The **most common** implementations of AI in healthcare are medical imaging diagnostics and virtual health assistants



# ARTIFICIAL INTELLIGENCE IN HEALTHCARE

- **AI can reduce non-adherence to medication issues**
  - The program analyzes several variables, such as age, gender, payer type, geography, and out-of-pocket costs, so it can predict the possibility for non-adherence
  - With this information, they can identify patients who need additional support to follow the recommendations for treatment
  - They will focus more on communication and they will explain exactly why it's important for the patient to follow recommendations



# ARTIFICIAL INTELLIGENCE IN HEALTHCARE

- **DEVELOPING NEW MEDICINES WITH AI**



- AI in biopharmaceutical development
- Treating rare disease with ai
- AI, cloud-based digital drug discovery
- Neural network for clinical trials
- Finding better candidates for developmental drugs
- Deep learning for targeted treatment

# ARTIFICIAL INTELLIGENCE IN HEALTHCARE



- **STREAMLINING PATIENT EXPERIENCE WITH AI**
  - Automating healthcare's most repetitive processes
  - Real-time patient flow optimization
  - Increasing access to healthcare
  - Using machine learning for a better patient journey
  - Personalized healthcare plans with AI
  - Faster hospital visits, courtesy of AI

# ARTIFICIAL INTELLIGENCE IN HEALTHCARE



- **USING AI TO EFFICIENTLY DIAGNOSE AND REDUCE ERROR**

- More accurate cancer diagnosis with AI
- An intelligent symptom checker
- AI deep learning for actionable insights
- Earlier cancer detection with AI
- AI-powered radiology assistant

# ARTIFICIAL INTELLIGENCE IN HEALTHCARE

- **MINING AND MANAGING MEDICAL DATA WITH AI**



- A massive data library for personalized health
- AI for hospital risk prediction
- Looking at the data behind the medical image
- AI for data throughout the health system
- Alerting doctors when patients are in trouble

# ARTIFICIAL INTELLIGENCE IN HEALTHCARE

- **AI ROBOT-ASSISTED SURGERY**



- Pioneering robotic surgery
- Virtual reality-enabled robotics for surgery
- AI robots revolutionizing endoscopy
- Precision robotic treatment for treating cancer
- Robot-facilitated heart therapy
- Improving surgical precision
- Spinal surgery with robotics & AI

# ARTIFICIAL INTELLIGENCE IN HEALTHCARE

- **Effective Image Analysis**

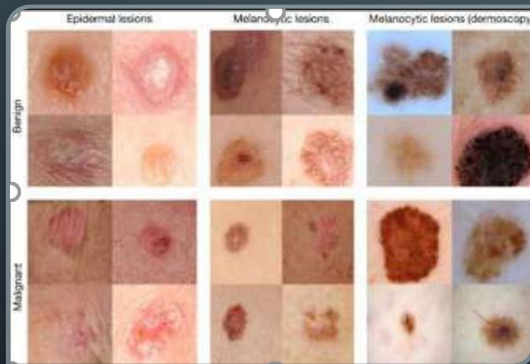
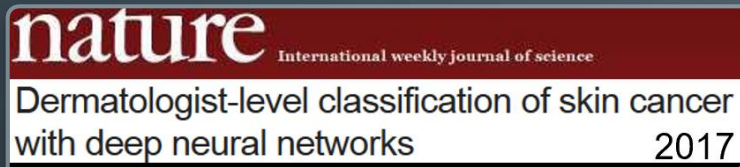
- In June 2018, a team of MIT researchers came out with the news that they developed a machine learning algorithm, which analyzes 3D scans up to 1,000 faster than doctors
- Been shown to be highly effective in the fields of
  - Radiology
  - Dermatology
  - Ophthalmology

# RADIOLOGY: TUMOR IMAGE RECOGNITION

- Computer-Aided Diagnosis with Deep Learning
  - Breast tissue lesions in images
  - Pulmonary nodules in CT Scans



# MELANOMA IMAGE RECOGNITION



- AI has made melanoma detection easier
- Algorithm trained to detect skin cancer using 130,000 images of skin lesions representing over 2,000 different diseases

# AI AND EYE CARE

- Artificial intelligence is becoming more common for screening, diagnosing and helping treat eye conditions
- Several studies show the potential for AI to help doctors detect eye disease
- Recent advances in the field of machine learning and computer vision are enabling artificial intelligence (AI) based software to be trained on millions of retinal photographs allowing them to screen for diseases with high accuracy, often **meeting and even exceeding human performance**

# AI AND EYE CARE

- Clinical studies are demonstrating **safety and effectiveness of AI** in detecting the presence or absence of vision threatening conditions like
  - DR
  - AMD
  - Glaucoma

# AI AND EYE CARE



- Clinical studies are demonstrating **safety and effectiveness of AI** in assessing risk for systemic conditions like
  - Hypertension
  - Stroke
  - Cardiovascular diseases
- And looking for signs of neurological disorders like MCI and Alzheimer's disease in retinal photographs

# AI AND EYE CARE

- Artificial intelligence excels at image recognition
- The IDx-DR is the first FDA-approved AI-based device for detecting diabetic retinopathy
  - A software program that uses an artificial intelligence algorithm to analyze images of the eye taken with a retinal camera, the Topcon NW400



# ARTIFICIAL INTELLIGENCE IN EYE CARE

- IDx-DR
  - If the images are of sufficient quality, the software provides the doctor with one of two results:
    1. “more than mild diabetic retinopathy detected: refer to an eye care professional”  
or
    2. “negative for more than mild diabetic retinopathy; rescreen in 12 months.”
  - If a positive result is detected, patients should see an eye care provider for further diagnostic evaluation and possible treatment as soon as possible


# ARTIFICIAL INTELLIGENCE IN EYE CARE

- IDx-DR is an AI diagnostic system that autonomously analyzes images of the retina for signs of diabetic retinopathy
  - Designed and tested for use in primary care
  - Immediate diagnosis at the point of care
  - No need for specialist overread or telemedicine callbacks
  - Image analysis with integrated quality assessment

Source: <https://www.eyediagnosis.net/idx-dr>

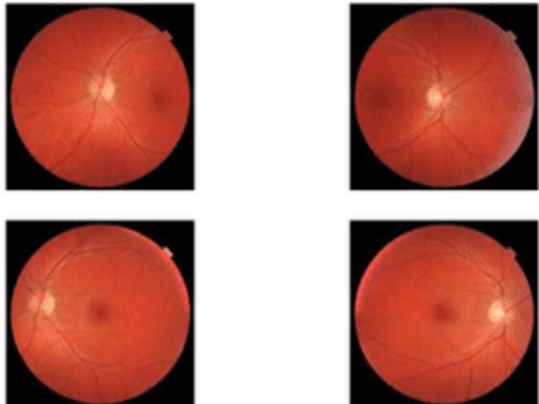
# ARTIFICIAL INTELLIGENCE IN EYE CARE

- Within one minute, the operator will receive a results report with one of the following outputs:
  - **Exam quality is insufficient**  
Low-quality images can be retaken while the patient is still at the camera
  - **Negative for more than mild diabetic retinopathy**  
Retest in 12 months
  - **More than mild diabetic retinopathy detected**  
Refer to an eye care professional



## IDx-DR Analysis Report

Patient ID:	DEMO-ICJS0420
IDx Submission ID:	2-148
Exam Analysis Date:	2018-08-01
Exam Analysis Time:	1:56:08 PM
Exam Result: <small>mtmDR Configuration*</small>	Negative for more than mild diabetic retinopathy; Retest in 12 Months



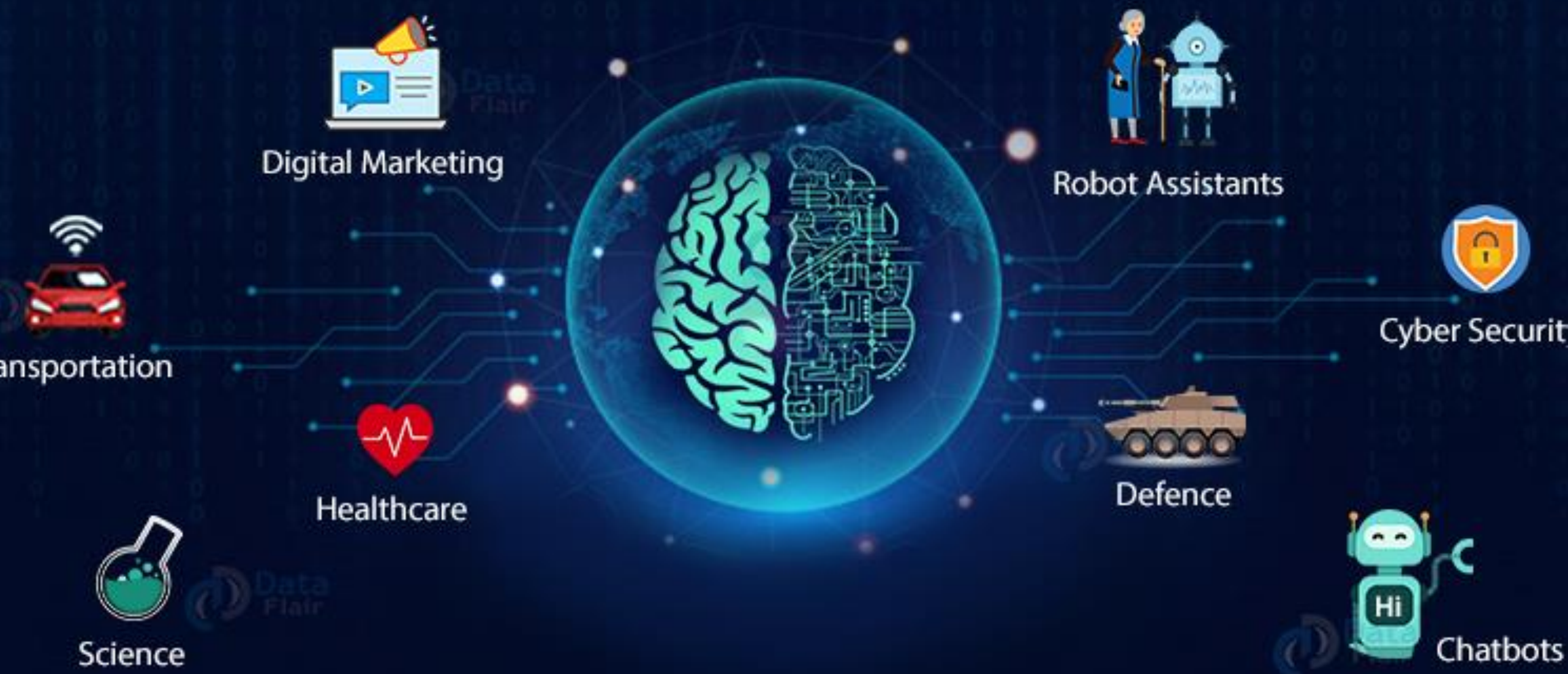
WARNING: The above images are reduced resolution, compressed versions of the original images used by IDx-DR Client. Do NOT use these images for diagnostic purposes.

\* IDx-DR is configured to screen for more-than-mild diabetic retinopathy (mtmDR). A positive result indicates a high risk of moderate non-proliferative retinopathy, severe non-proliferative retinopathy, proliferative retinopathy, and/or macular edema.

DR-US\_2.1



# FUTURE OF ARTIFICIAL INTELLIGENCE





# FUTURE OF ARTIFICIAL INTELLIGENCE IN EYE CARE

- AI will serve to augment human intelligence and optimize the efficacy of the eyecare team in treating patients
- Emerging AI systems will also enhance and be enhanced by telemedicine
- AI-augmented systems in conjunction with telemedicine will undoubtedly reshape the eyecare landscape in the coming years

# FUTURE OF ARTIFICIAL INTELLIGENCE IN EYE CARE

- Technologies based on AI also show promise in serving as “physician assist” tools to aid diagnosis and improve treatment decisions



# FUTURE OF ARTIFICIAL INTELLIGENCE

- With all the implementations described above, under careful human oversight AI can reduce human errors in healthcare, and make the providers more effective
- The good news is that currently, AI is being used under careful human oversight
- The day for robots that operate autonomously will probably come
- But by then, we'll be absolutely confident in their capacity
- Despite the concerns, the growing implementation of AI in the medical industry is part of the inevitable progress





## AI CHALLENGES AHEAD

- Medicolegal concerns
- Physician and patient acceptance of AI
- Coding and reimbursement
- Quality-measure guidelines that weren't needed prior to the advent of AI must also be addressed

# AI CHALLENGES AHEAD



- Does it actually improve patient outcomes?
- Is it safe?
- Is it validated against the right standard?
- Is the patient-derived training data stewarded?
- Where is the liability?
- It is crucial that we discuss the risks and benefits openly, with accountability and transparency about all these aspects

# AI AND THE FUTURE

- AI systems are only as good as the data used to train them, and the reasoning behind their results
- Google AI research group shows that physicians and algorithms working together are more effective than either alone
  - Ex. assist physicians in more accurately diagnosing diabetic retinopathy
- AI eye screening will make screening more accessible, enable population screening at large-scales, and reduce screening cost



*"AI is likely to be either the best or worst thing ever to happen to humanity." ~**Stephen Hawking***