

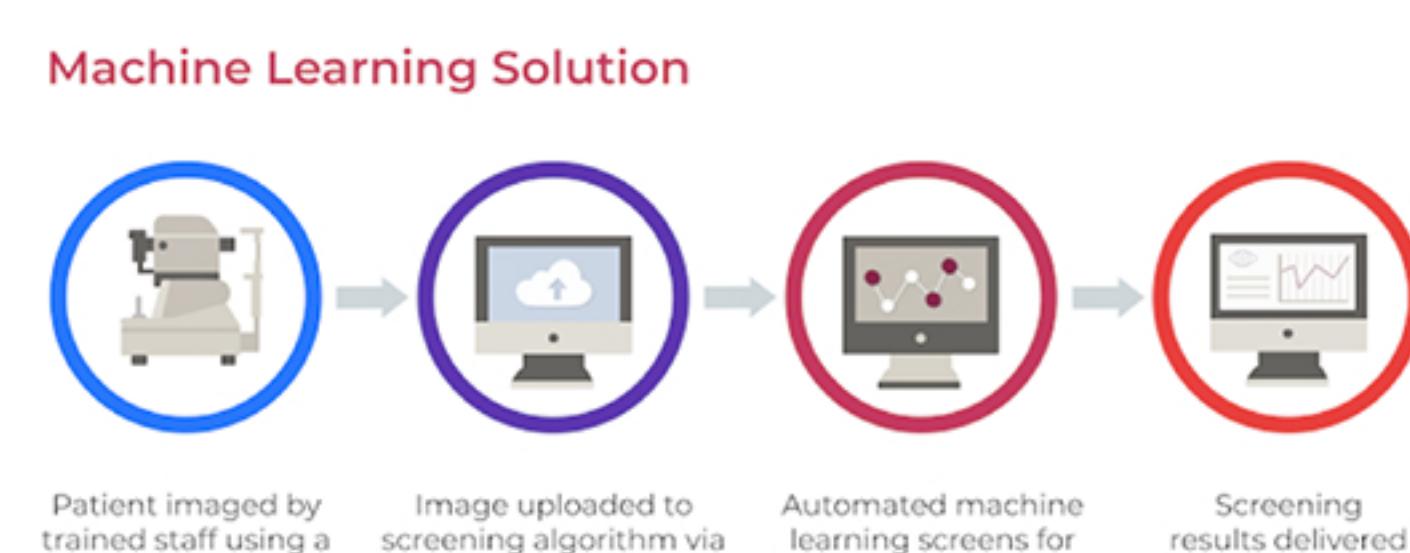
HEALTHCARE: AN EXAMINATION OF THE CURRENT STATE OF DATA SCIENCE APPLICATIONS IN PREVENTATIVE PATIENT TREATMENT

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INTRODUCTION

WITH THE ADVANCEMENT IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING WITHIN THE PAST FEW YEARS, IT IS ONLY REASONABLE THAT COMPANIES FIND OPPORTUNITIES FOR THESE TECHNIQUES TO EMPOWER TREATMENT METHODS IN THE HEALTH CARE INDUSTRY. THESE TOOLS CAN ENABLE EARLIER SCREENING, TREATMENT AND DIAGNOSIS OF DISEASE, AND BRING US CLOSER TOWARDS PREVENTATIVE AND PROACTIVE HEALTHCARE. TODAY, TWO OF THE LEADING CAUSES OF PREVENTABLE BLINDNESS IN ADULTS [20] ARE DIABETIC RETINOPATHY (DR) AND DIABETIC MACULAR EDEMA (DME). MORE THAN 2 IN 5 AMERICANS [19] WITH DIABETES HAVE SOME STAGE OF DIABETIC RETINOPATHY. BOTH OF THESE DISEASES ARE SERIOUS AND CAN LEAD TO BLINDNESS AND FOR THESE DISEASES. RETINAL DETACHMENT. IN RECENT YEARS, GOOGLE AND VERILY (ALPHABET'S HEALTHCARE AND LIFE SCIENCES ARM) HAVE BEEN RESEARCHING THE USE OF MACHINE LEARNING TO SCREEN FOR THESE DISEASES. SIMILARLY, 25% OF THE WORLD'S MEDICAL EXAMINATIONS DEAL WITH SKIN DISEASES.

Skin cancer is the leading cause of death from these skin diseases. Within the last 5 years, researchers at Google and Stanford have created image processing algorithms to detect skin cancer early through nothing more than images.



In our research, we will take a look at the development of a machine learning algorithm to power automated screening with the intention of detecting disease earlier and expanding access to screening for DR, DME, and skin cancer. We will also look at the history of AI, its historical origins, how it works, and how it will can and will change the way eye care is provided.

A BIRD'S EYE VIEW, WHAT DATA SCIENTISTS DO

As a broad term, data science means pulling information out of data or converting raw data into actionable insights. Data scientists are knowledgeable in their subject matter (e.g., healthcare clinical data) and statistics, and use computer programming skills to tell the computer how to leverage data to derive insights. Data scientists augment traditional data analysis by automating the process of insight delivery through code. This automation can bring efficiency gains and new depths of insight to analytics and enables real-time predictive analytics [3] by reducing the time it takes to go from data to prediction.

Success in today's data-driven [4] healthcare industry will be increasingly defined by leaders who understand data science. This knowledge will be critical as executives build and guide teams toward a harmonious, well-planned vision for healthcare improvement that fully harnesses data's capabilities.

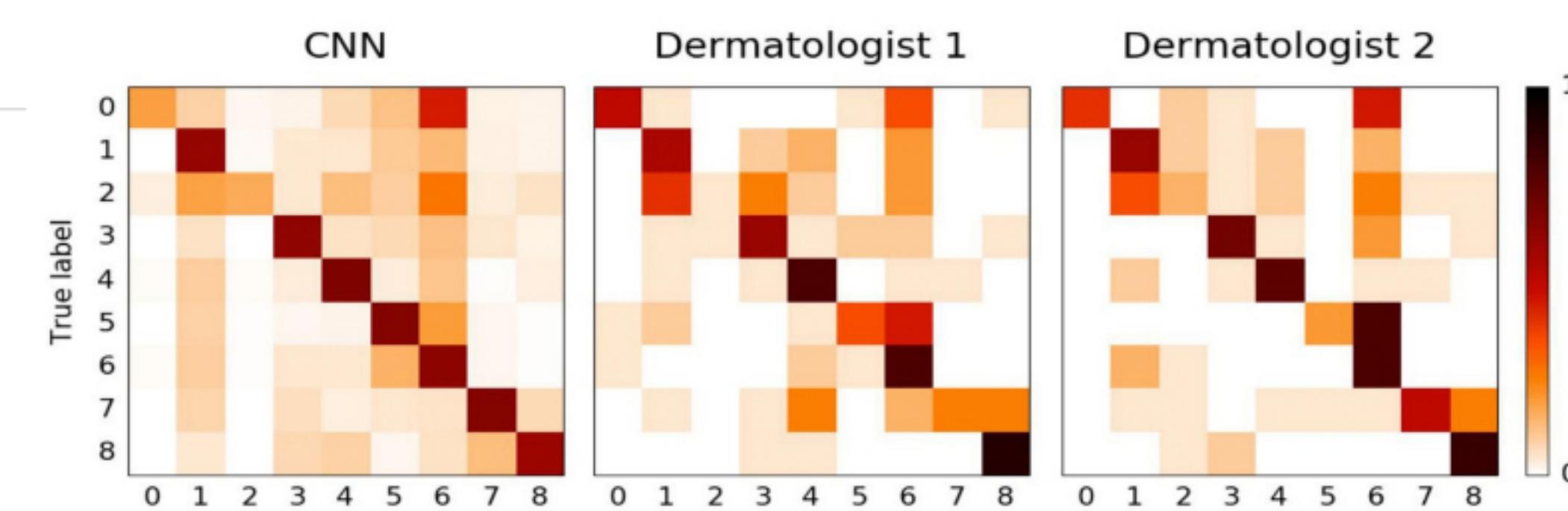
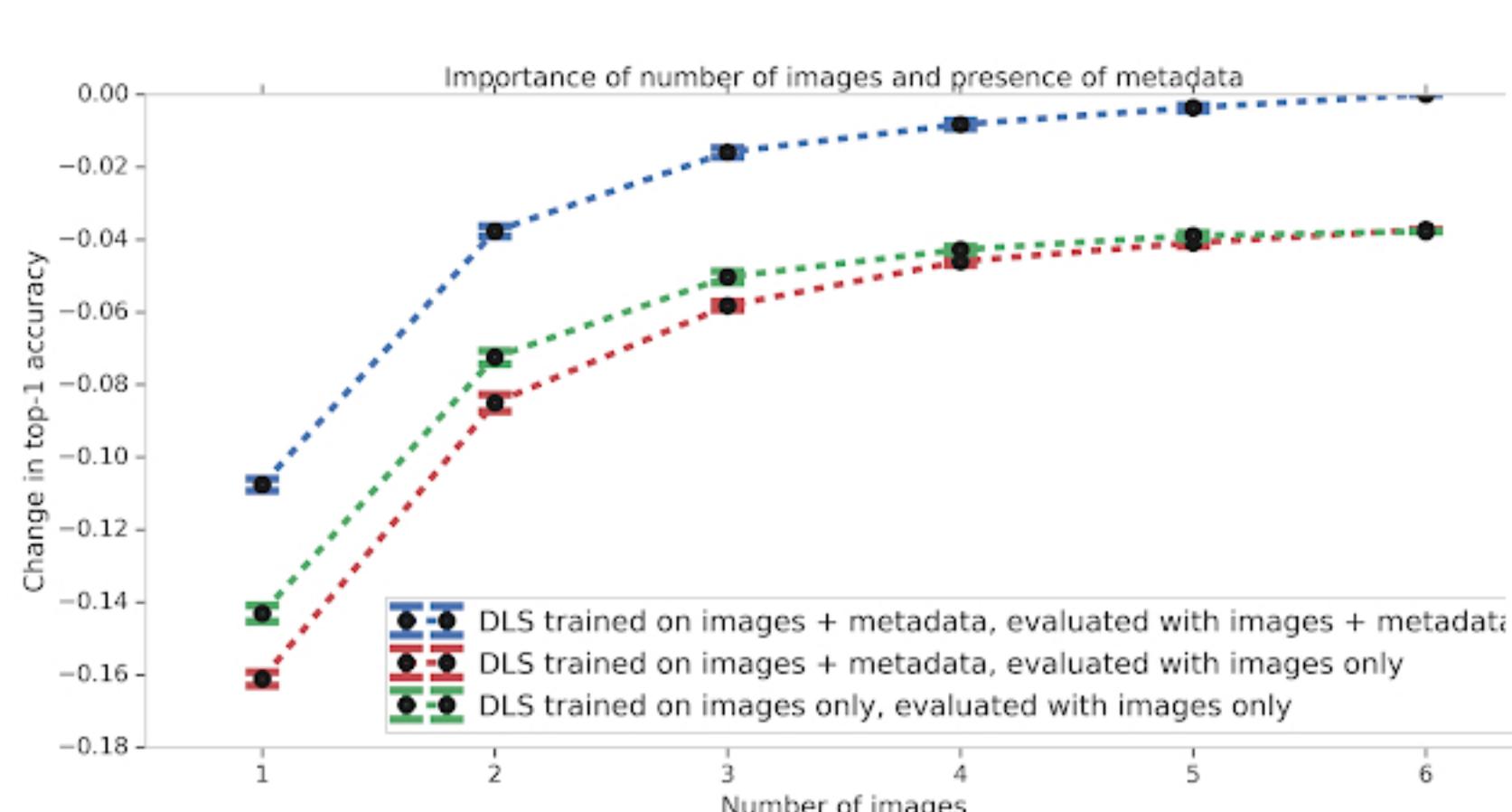
WHAT'S THE POINT?

Technology has laid out the opportunities, but, to realize gains in the digital era, healthcare leaders must understand data science and the urgency of investing in data science resources (technology and people). We are trying to draw more attention to how data science can be applied to preventative patient care because while there have been significant advances, we think the field can go further.

- Applied data science for healthcare can empower physicians and patients.
- Applied data science can focus on adaptive analytic systems to improve daily care.
- Adaptive analytic systems for patient-centredness enable personalised medicine.
- Empowerment of physicians and patients accelerates healthcare innovation and saves lives [12]

WHY IS THIS DATA SCIENCE?

UP TO 30 PERCENT [1] OF THE WORLD'S WAREHOUSED DATA COMES FROM THE HEALTHCARE INDUSTRY. THERE'S A SIGNIFICANT OPPORTUNITY FOR HEALTHCARE IMPROVEMENT IN THIS INFORMATION CACHE. BUT THE INDUSTRY CAN ONLY WELCOME THESE PROSPECTS IF HEALTH SYSTEMS FULLY LEVERAGE DATA TO IDENTIFY AREAS FOR IMPROVEMENT AND PROMOTE EVIDENCE-BASED CARE. EVEN WITH THIS MASSIVE DATA POTENTIAL, HEALTHCARE TOO OFTEN RELIES ON OUTDATED TECHNOLOGY. FOR EXAMPLE, UP TO 75 PERCENT [2] OF MEDICAL COMMUNICATION STILL OCCURS VIA FAX MACHINE (IN AN ERA WHERE AUTOMOTIVE COMPANIES USE DATA SCIENCE TO ADD NAVIGATION CAPABILITIES TO CARS). THE ENORMOUS AMOUNTS OF DATA THAT ARE GENERATED IN THE HEALTHCARE PROCESS AND STORED IN ELECTRONIC HEALTH RECORD (EHR) SYSTEMS ARE AN UNDERUTILIZED RESOURCE THAT, WITH THE USE OF DATA SCIENCE APPLICATIONS, CAN BE EXPLOITED TO IMPROVE HEALTHCARE [13].



CONFUSION MATRIX COMPARISON BETWEEN CNN AND DERMATOLOGISTS. CONFUSION MATRICES FOR THE CNN AND BOTH DERMATOLOGISTS FOR THE NINE-WAY CLASSIFICATION TASK OF THE SECOND VALIDATION STRATEGY REVEAL SIMILARITIES IN MISCLASSIFICATION BETWEEN HUMAN EXPERTS AND THE CNN. ELEMENT (i, j) OF EACH CONFUSION MATRIX REPRESENTS THE EMPIRICAL PROBABILITY OF PREDICTING CLASS j GIVEN THAT THE GROUND TRUTH WAS CLASS i , WITH i AND j REFERENCING CLASSES FROM EXTENDED DATA TABLE 2d. [13]

THE GOOD WITH THE BAD

If Albert Einstein was good for nothing else, he was good for a quote. Case-and-point, when he said, "RELATIVITY APPLIES TO PHYSICS, NOT ETHICS." There are legitimate ethical questions when it comes to utilizing data science in preventative care. Even if the care saves lives, if not approached ethically is it justified? We identified just a few ethical considerations in favor and against data science in healthcare.

THE GOOD

- Cost effective, democratized of research, unintended bias
- More accurate diagnosis of diseases and ailments than board-certified dermatologist. [8]
- Additional available research resources and greater access available due to machine learning. [11]

THE BAD

- Vulnerable to cyberattacks [6]
- Algorithms may mirror human biases in decision making [6]
- Capability to threaten patient preference, safety, and privacy [8]

CONCLUSION

In years to come, artificial intelligence will continue to play a significant role in the way healthcare providers care for their patients. There is a clear and imminent potential for earlier, more accurate, and more uniform diagnosis, as we have seen in the detection of diabetic retinopathy, diabetic macular edema, and skin cancer. AI can improve the classification of disease and will open doors to unseen avenues for developing therapeutic interventions. It will also allow us to discover latent features in ophthalmic images, clinical profiles, and genetics, [25] which will improve our understanding of eye disease. We can venture to guess that in the near future, eyecare providers will have devices that, take an image of a patient's retina, and tell of the exact diagnosis at the touch of a button. Likewise, we can expect dermatologists to use image classifying AI to help patients detect skin cancer at early stages. Artificial intelligence and machine learning systems will undoubtedly reshape the eyecare and skincare industry in the coming years, and open doors for other applications in healthcare.

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