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Building ethical AI and tech for the health sector

February 2019

Academy of Medical Royal Colleges

January / 2019

Artificial Intelligence in Healthcare

Recommendations:

1. Politicians and policymakers should avoid thinking that AI is going to solve all the problems the health and care systems across the UK are facing. Artificial intelligence in everyday life is still in its infancy. In health and care it has hardly started – despite the claims of some high-profile players

2. As with traditional clinical activity, patient safety must remain paramount and AI must be developed in a regulated way in partnership between clinicians and computer scientists. However, regulation cannot be allowed to stifle innovation

3. Clinicians can and must be part of the change that will accompany the development and use of AI. This will require changes in behaviour and attitude including rethinking many aspects of doctors' education and careers. More doctors will be needed who are as well versed in data science as they are in medicine

4. For those who meet information handling and governance standards, data should be made more easily available across the private and public sectors. It should be certified for accuracy and quality. It is for Government to decide how widely that data is shared with non-domestic users

5. Joined up regulation is key to make sure that AI is introduced safely, as currently there is too much uncertainty about accountability, responsibility and the wider legal implications of the use of this technology

6. External critical appraisal and transparency of tech companies is necessary for clinicians to be confident that the tools they are providing are safe to use. In many respects, AI developers in healthcare are no different from pharmaceutical companies who have a similar arms-length relationship with care providers. This is a useful parallel and could serve as a template. As with the pharmaceutical industry, licensing and post-market surveillance are critical and methods should be developed to remove unsafe systems

7. Artificial intelligence should be used to reduce, not increase, health inequality – geographically, economically and socially.

ALPHA: EUROPE'S 1st MOONSHOT FACTORY

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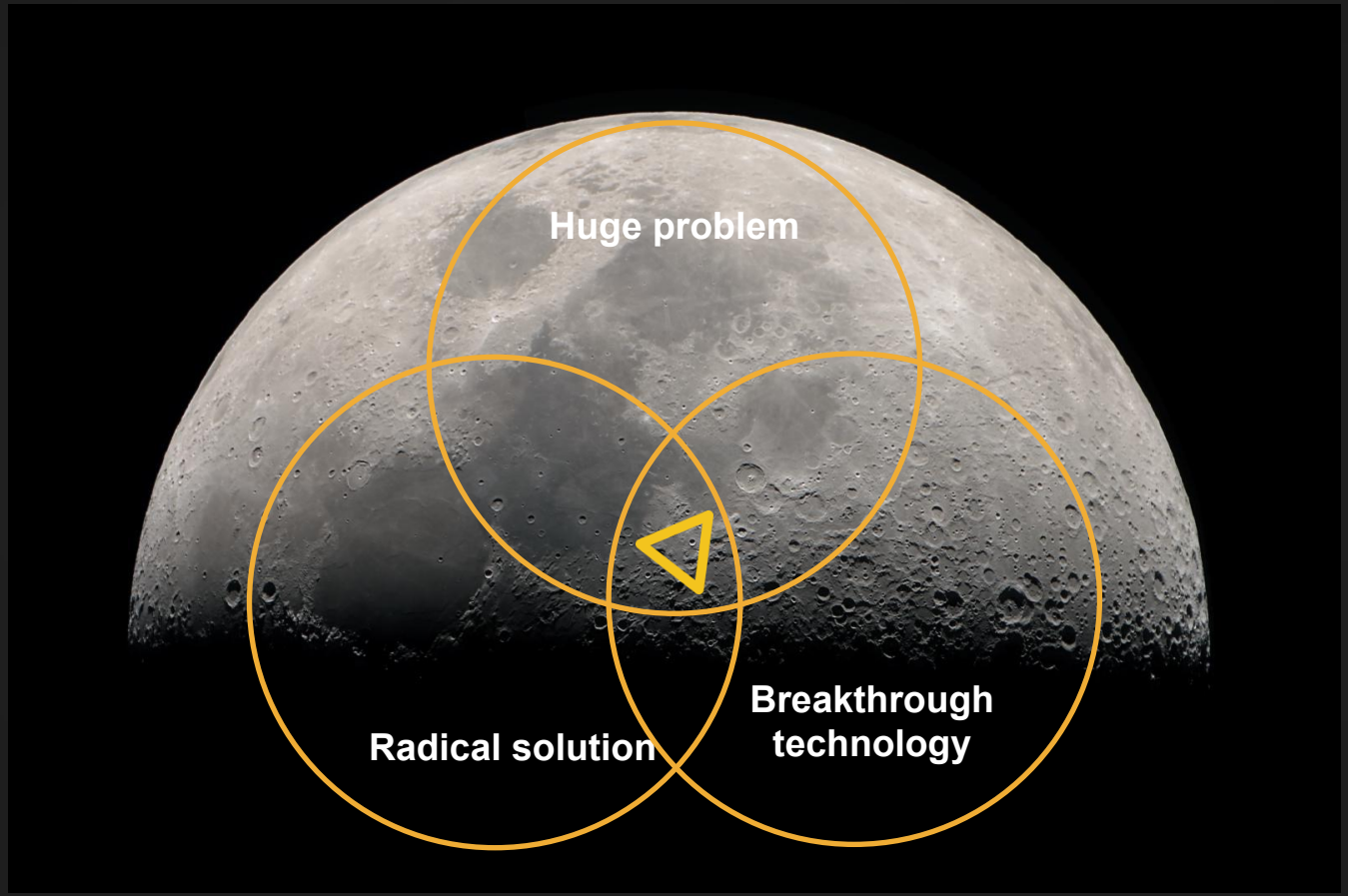

DESPITE HUGE GLOBAL INVESTMENT HEALTHCARE HAS MADE LITTLE PROGRESS BEYOND INFECTIOUS DISEASE

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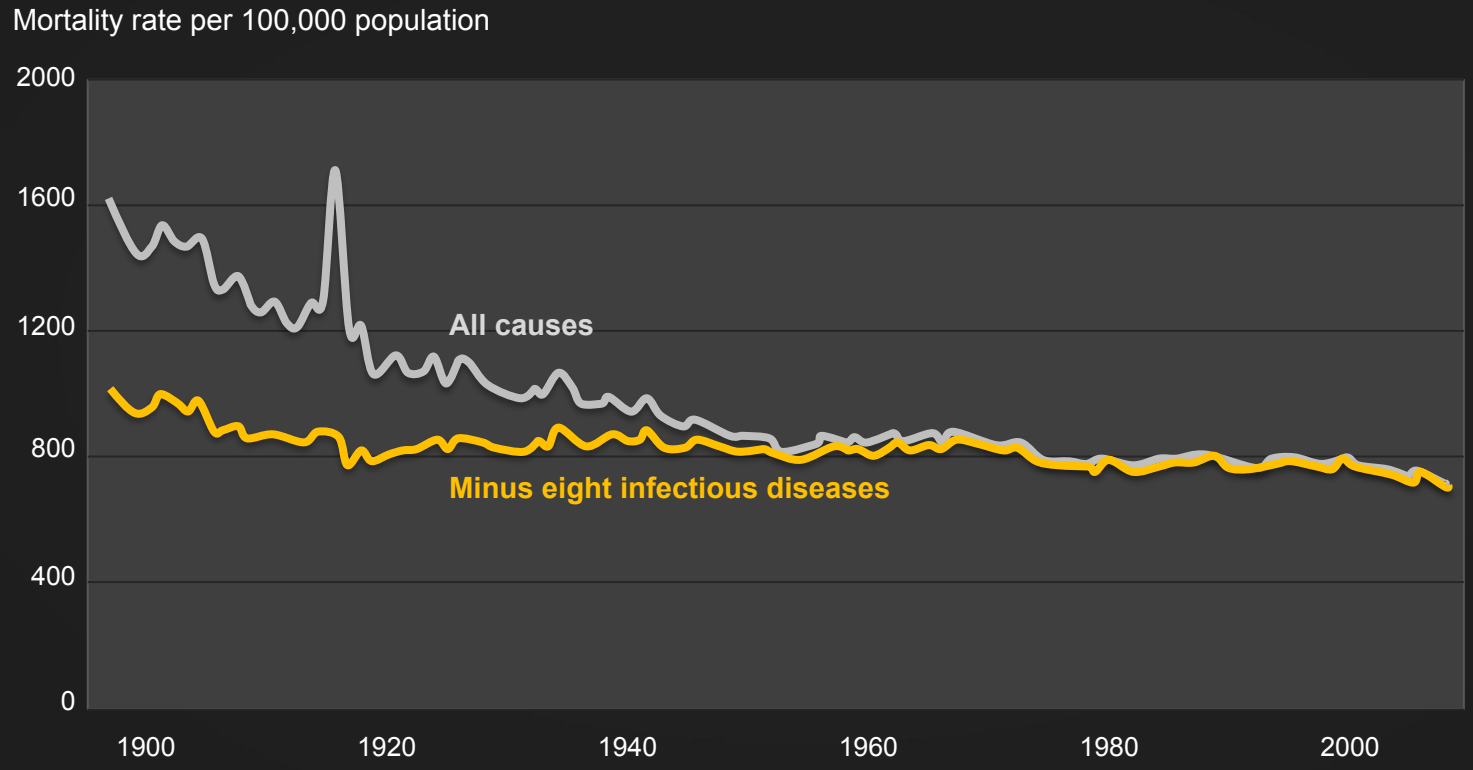

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Source Historical Statistics of the United States

THE KEY REASON IS A SHIFT FROM ACUTE DISEASE TO CHRONIC DISEASE...

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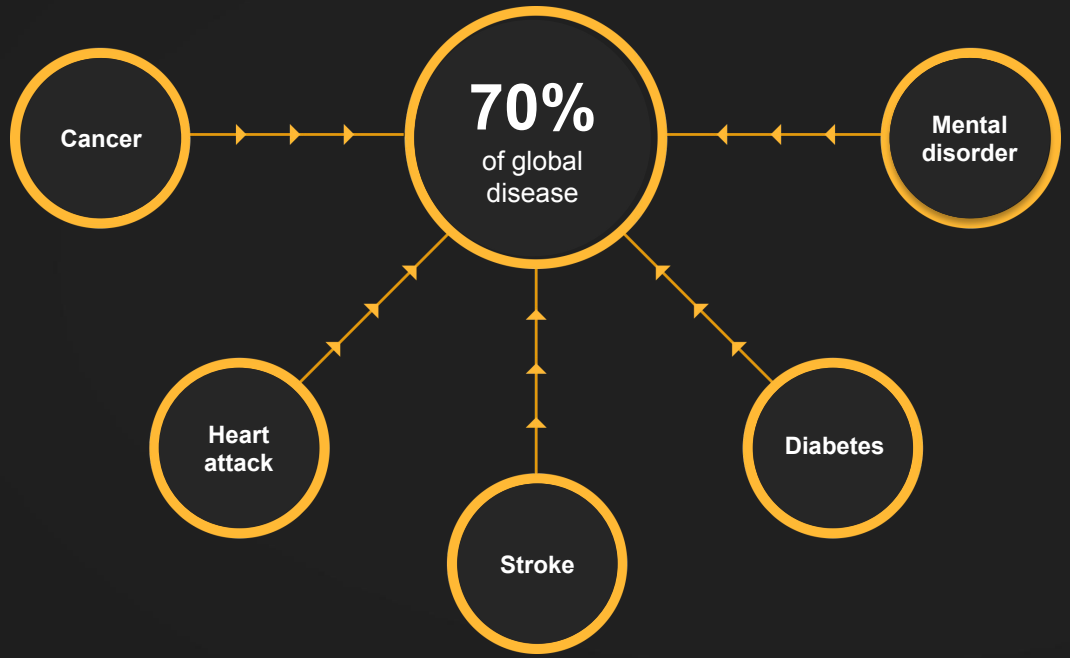

Since 2000, for every life saved from infectious disease, two lives have been lost from chronic disease

…AND THE KEY DRIVER OF CHRONIC DISEASE IS EVERYDAY BEHAVIOUR

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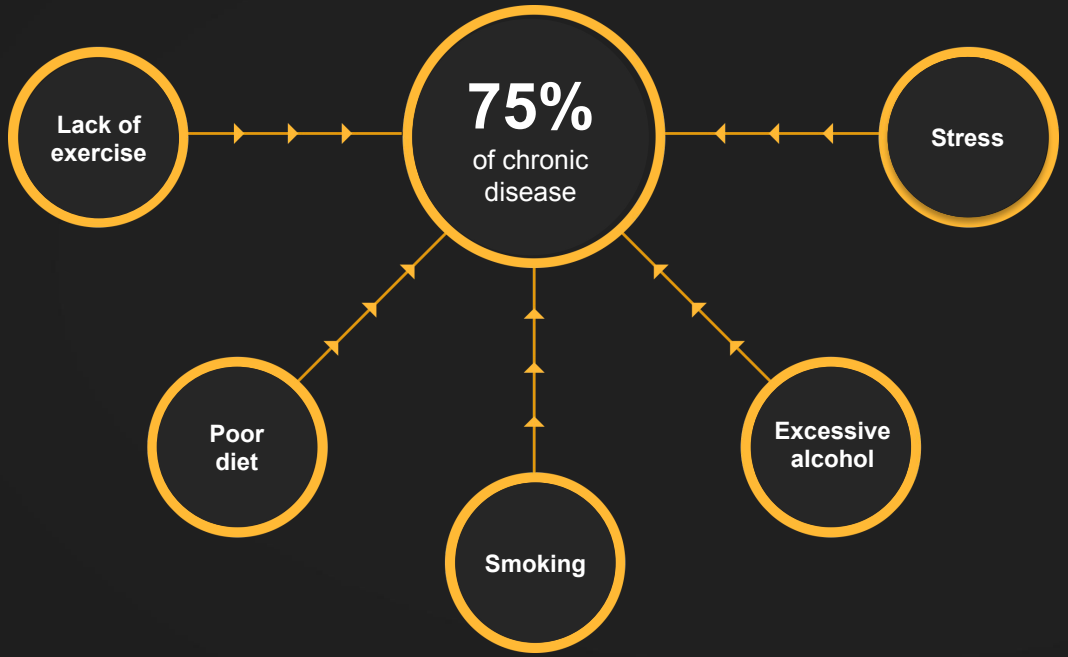

These five everyday behaviours cost the world $5tn

ALPHA HEALTH: OUR MOON & OUR SHOT

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A personal health assistant that guides you along an **effective path** to improve **health-related behaviours** and live a **happier** and **healthier life**

ENCOURAGE **BEHAVIOUR CHANGES** THAT WILL RADICALLY **REDUCE THE BURDEN OF CHRONIC DISEASE** GLOBALLY.

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TRUST IS FUNDAMENTAL TO OUR WORK...

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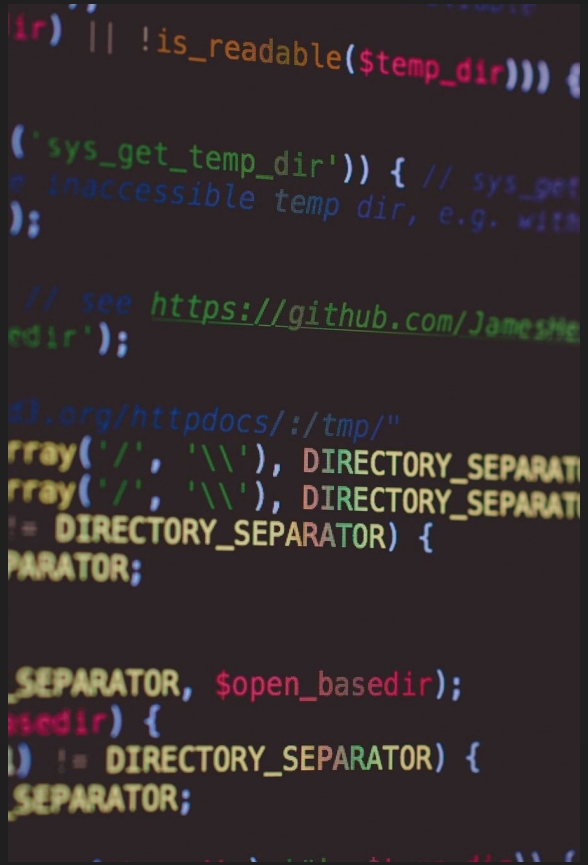

...IN THE WHAT AND HOW OF THE SOLUTIONS WE PROVIDE...

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...AND IN WHO IS SETTING THE AGENDA.

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BEING ETHICAL MEANS BEING TRUSTWORTHY.

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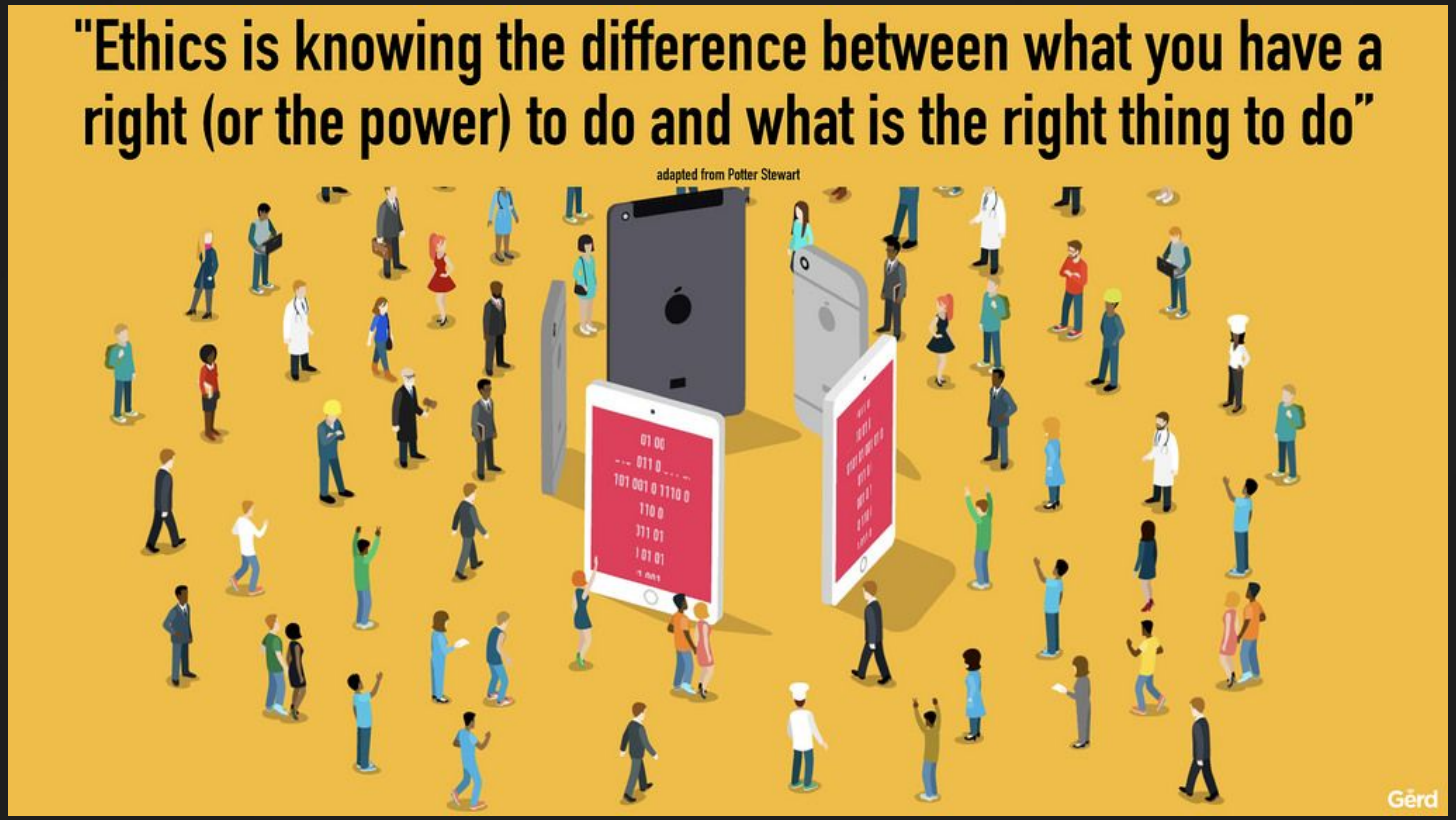

CUTTING EDGE AI RESEARCH FROM BCN FOR THE WORLD: THE ALPHA HEALTH AI LAB

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Trustworthy AI

Design and implementation of AI and ML algorithms and systems which are “explainable”, helping to build trust in AI/ML for sensitive use-cases.

Empathic AI

Understanding and reacting to human emotion in multi-modal, interactive settings.

Privacy-Preserving AI/ML

Development and implementation of AI/ML frameworks making “touching” or “seeing” the users’ data obsolete.

Our Aim

*Developing and scaling the **breakthrough methods** necessary for **answering our moonshot question** while becoming a **globally acknowledged player for translational AI/ML** research.*

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ML/AI TOOLS ARE INCREASINGLY ENTERING THE HEALTH SPACE...

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Baidu Research's breast cancer detection algorithm outperforms human pathologists

KHARI JOHNSON @KHARIJOHNSON JUNE 18, 2018 9:00 AM

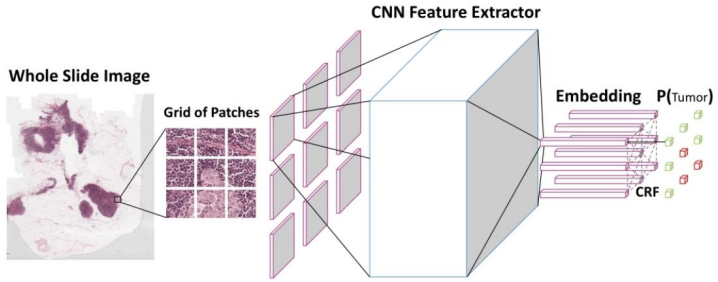

Image Credit: Baidu

AI-Pathway Companion from Siemens Healthineers supports decisions along the clinical pathway, with artificial intelligence

Erlangen, Germany | Nov 25, 2018

...BUT DO WE UNDERSTAND WHY AND/OR HOW THEY ACTUALLY WORK?

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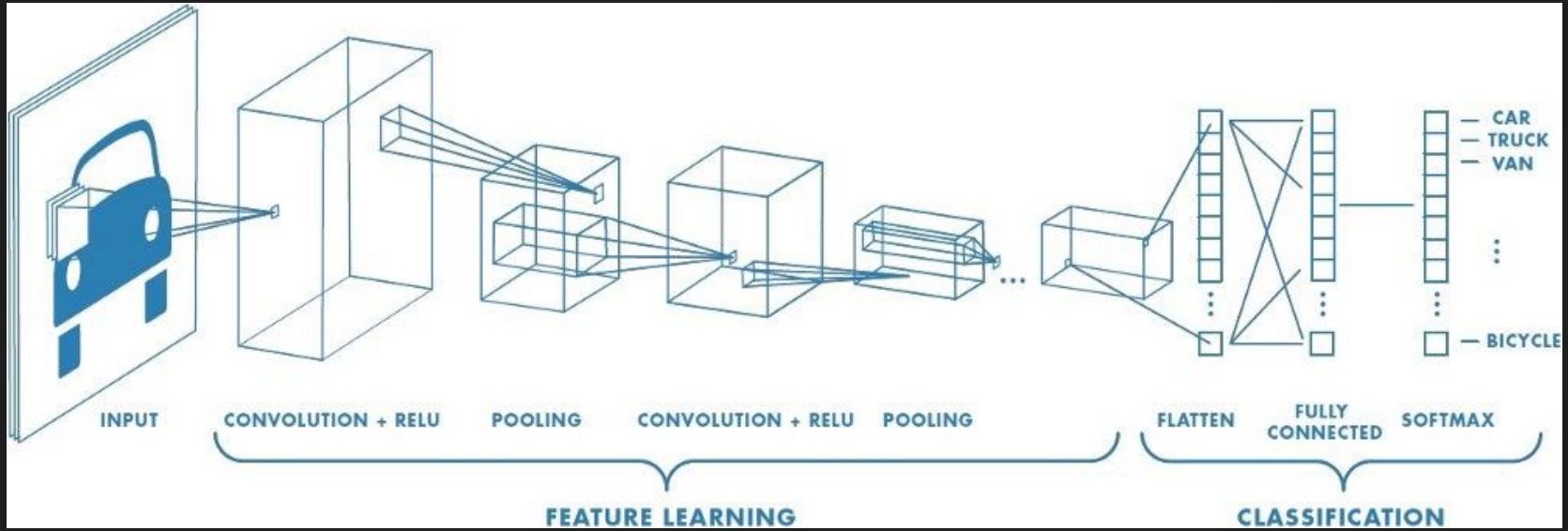

(MathWorks: Introducing Deep Learning with MATLAB, 2018)

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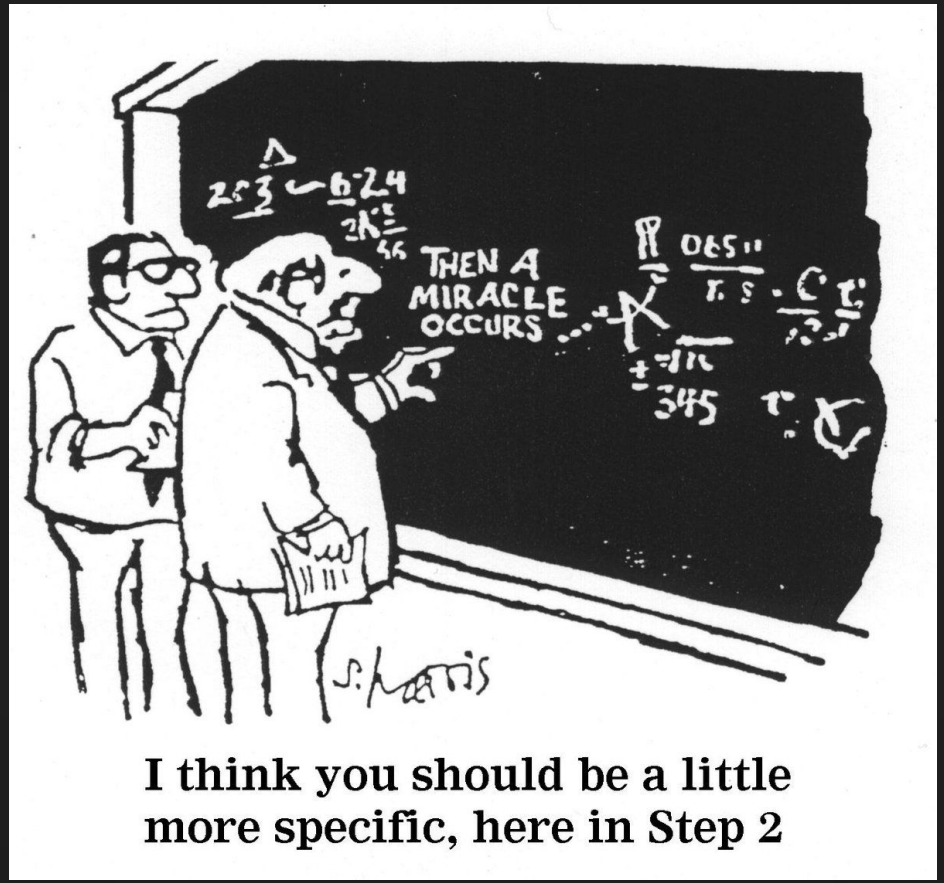

HOW CAN WE BRING EXPLAINABILITY INTO AI/ML?

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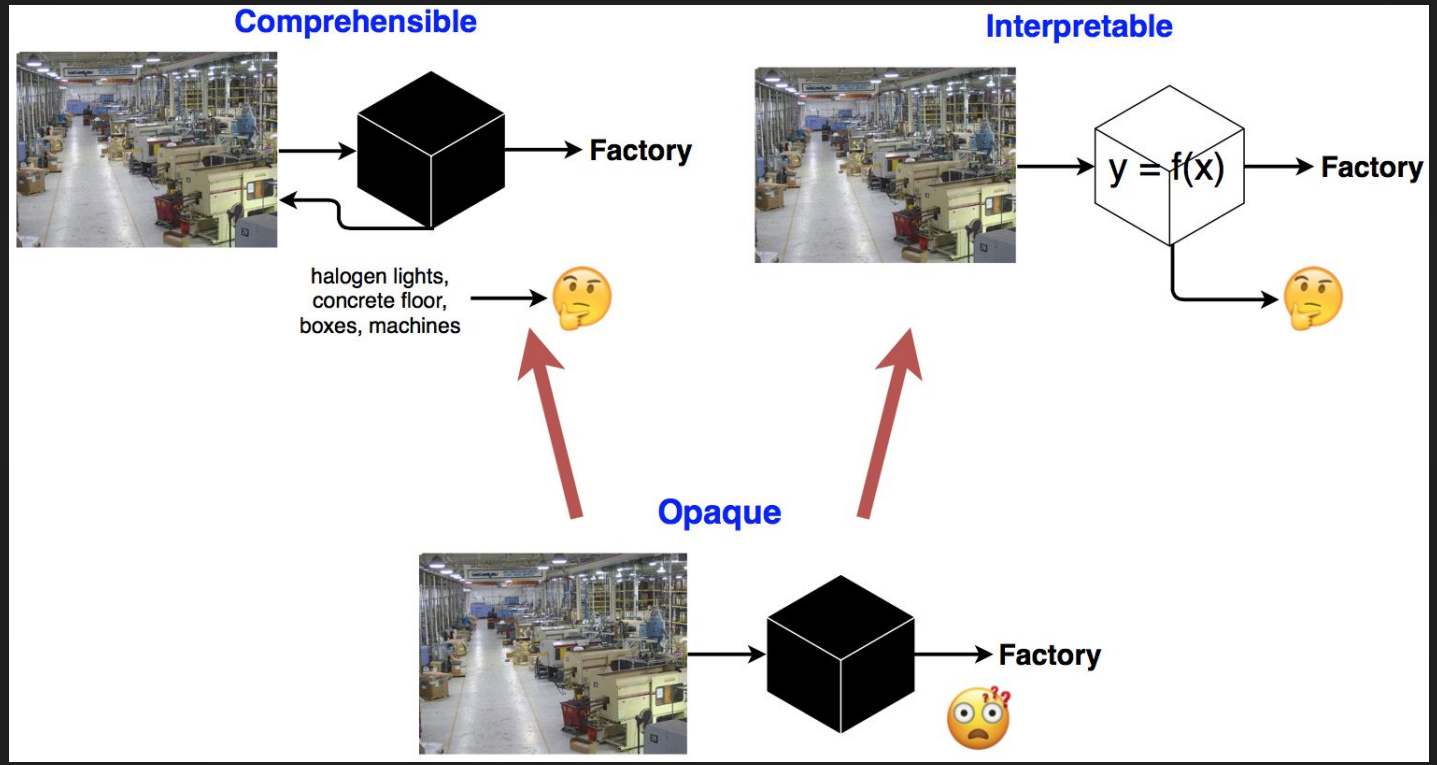
The five key questions:

- How does the algorithm create the model?
- How does the trained model make predictions?
- How do parts of the model influence predictions?
- Why did the model make a specific decision for an instance?
- Why did the model make specific decisions for a group of instances?

CURRENT NOTIONS OF “EXPLAINABILITY”



The Doctor Analogy:

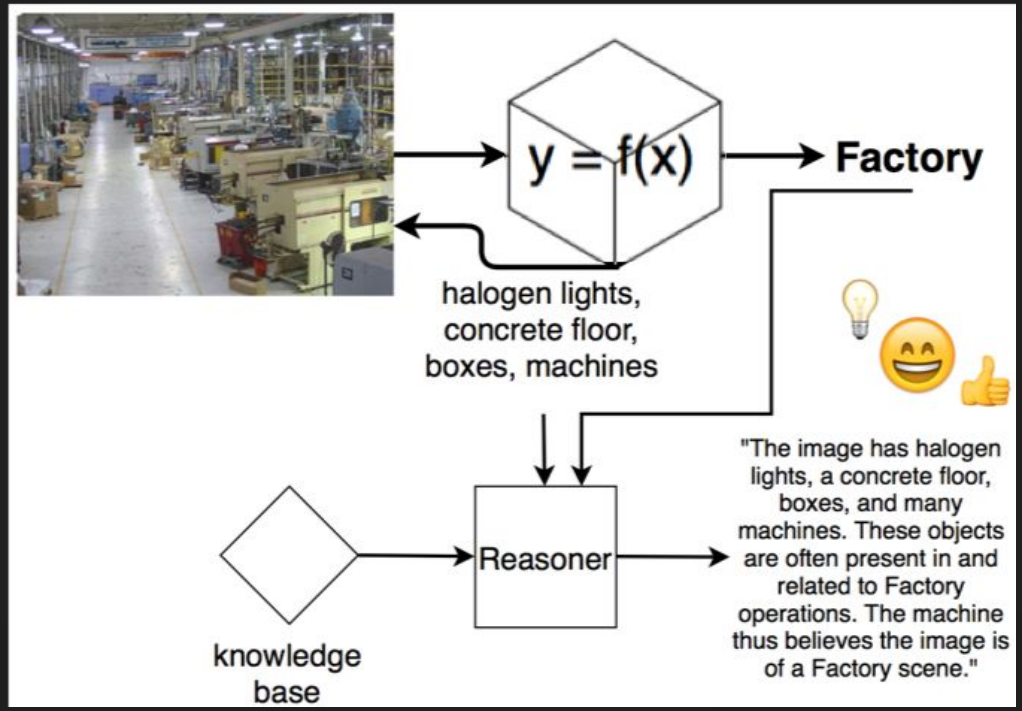
- **Towards patients, physicians should be like comprehensible models:**

- Deliver diagnosis by providing well-known, high-level indicators revealed in tests (i.e. system symbols).
- Not giving information about how medical tests and evaluations work.

- **Towards other doctors/medical staff, physicians may be like interpretable models:**

- Sketch technical line of connecting patient symptoms and test results to particular diagnosis.
- Other doctors and staff can interpret diagnosis, ensuring that conclusions are supported by reasonable evaluation functions and weight values for presented evidence.

BUT WHAT ABOUT “ACTUAL EXPLANATIONS”?



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NON-PRIVACY PRESERVING AI/ML

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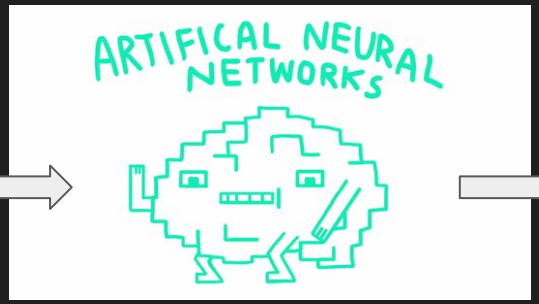
"Traditional" machine learning approach

Name	Age	Sex	Salary
User A	18	M	12.000 €
User B	30	F	24.000 €
User C	25	M	22.000 €
User D	50	F	50.000 €



Updates model parameters

Model that can predict salary from age and sex

Problems:

- Users may not want to share their data.
- With the trained model we might still be able to reveal individual user information.

PRIVACY-PRESERVING AI/ML

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PPAI offers techniques that allow us to learn from a population without owning/revealing individual information:

- Federated Learning
- Fully Homomorphic Encryption
- Secure Multiparty Computation
- Secure Enclaves
- Differential Privacy

EXAMPLE: HOMOMORPHIC ENCRYPTION

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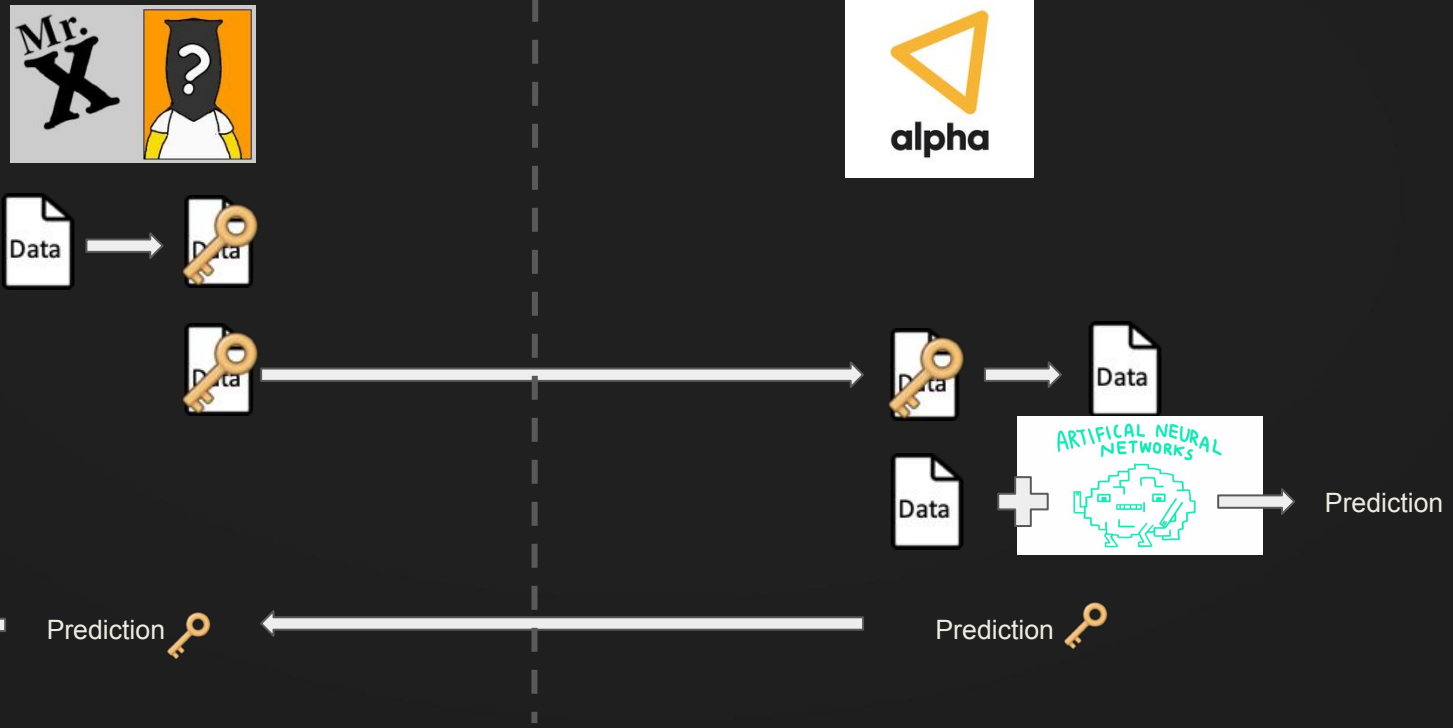
Classic Encryption



EXAMPLE: HOMOMORPHIC ENCRYPTION

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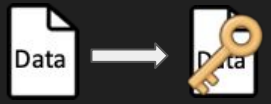
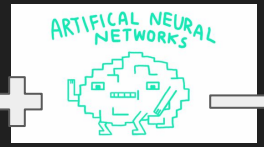
Fully Homomorphic Encryption





Prediction

Prediction

Prediction

Prediction

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A GENERAL REMARK: “ETHICALITY” AS MOT DU JOUR

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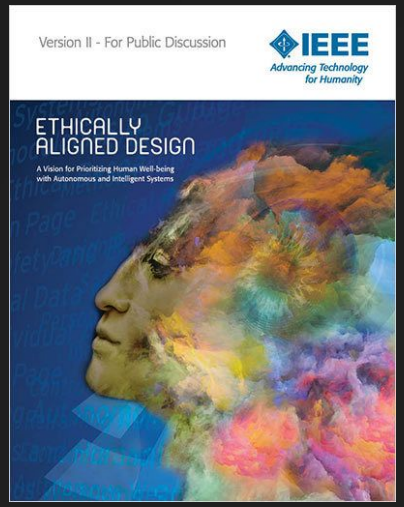

When the rubber hits the road:

- What are your ethical priorities/moral pillars?
- Does the problem you want to solve align within these constraints?
- What are the basic assumptions underlying your (envisioned) solution?
    - Do you need data?
    - Do you need privacy-sensitive information?
    - Will you likely be able to serve all customer groups equally?
    - What is your business model?
    - With whom do you want to partner?
- Are there sufficiently many other players asking for similar services as to create a market driving service/resource availability and prices?
- Are you willing to subject your idea/product/business model/team to public scrutiny?

THE ALPHA HEALTH AI LAB

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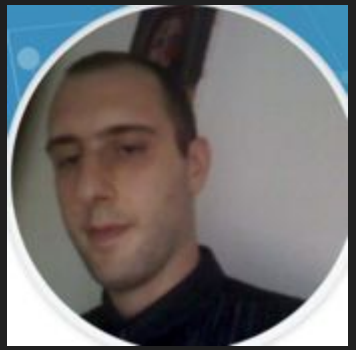
Daniel Malagarriga



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JOIN US IN BUILDING TOMORROW'S ETHICAL AI AND TECH APPLICATIONS

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We've got a real opportunity with AI based tech to gain time and efficiencies, but it has to be implemented in a safe and trusted way. We need to bring everyone with us on this journey of transformation.

Dr Indra Joshi, Digital Health and AI Clinical Lead, NHS England

Want to talk? Get in touch at Tarek.Besold@telefonica.com.

Follow @TeamAtAlpha on Twitter.