

HOW AI WILL IMPROVE MEDICAL CARE

AI applications in Development & Trial

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Enhanced Diagnosis:

AI algorithms analyse medical data (X-rays, MRIs ..) to identify patterns & anomalies leading to earlier more accurate diagnoses

Personalized Treatment:

Analyse a patient's medical history, genetic data, and lifestyle factors to develop personalised treatments

More effective than one-size-fits-all treatments

Neurological Health:

Chatbots provide 24/7 support & guidance

Drug Discovery:

AI to accelerate the process of drug discovery and development

Prediction of protein structures

AI Implants

Health monitoring – personal & remote

Brain communication with external devices (paraplegics/spinal injury)

Challenges

Ensuring accuracy, privacy & fairness

Complement not replace, human doctors



WHAT IS ARTIFICIAL INTELLIGENCE?

AI refers to systems/machines which display intelligent behaviour
Can act autonomously & learn

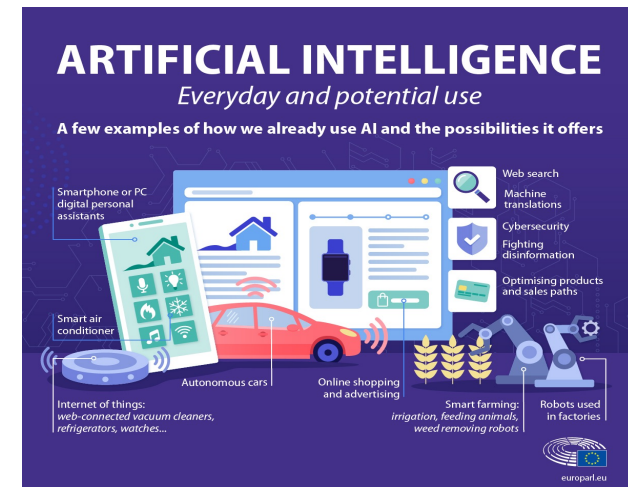
Global investment in AI ~\$100 billion per year across the sectors
It is everywhere

Generative AI Generates new content
Large Language Models
Chatbots
Entertainment Industry

None Generative AI Interprets existing data
Self Drive Cars
Medical Diagnosis
Image Recognition

Hybrid
Education
Discover New Drugs/Treatments

...



ARTIFICIAL INTELLIGENCE TECHNOLOGY

AI is an umbrella term including Machine Learning & Deep Learning

Machine learning uses algorithms
Adapt & improve

Deep learning uses neural networks
Logic gate interconnections as in the
human brain

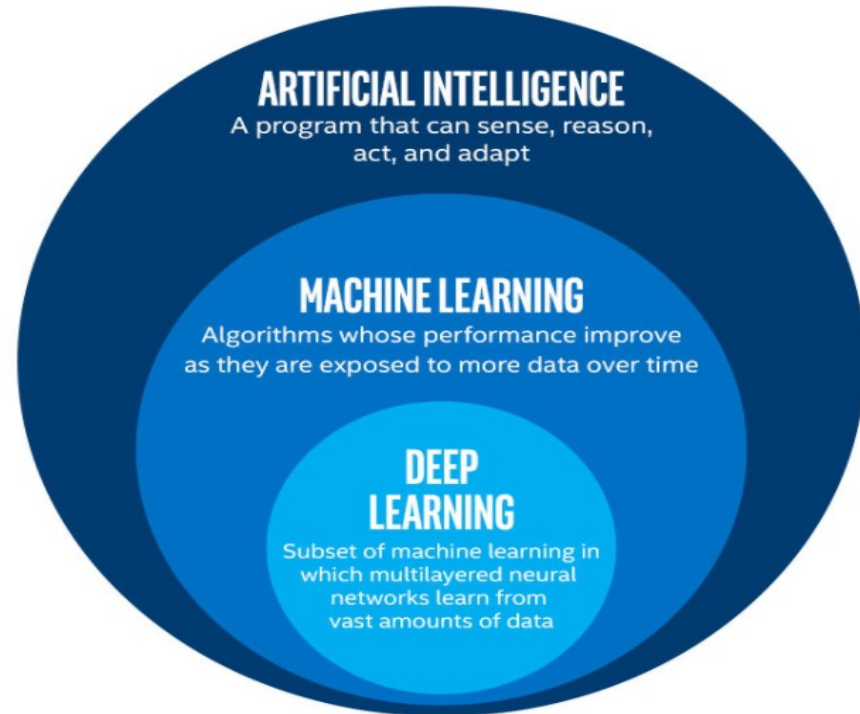
AI systems learn by example
Supervised learning

Large Language Models
Recognises data patterns
Unsupervised learning

AI systems are trained using Big Data

AI systems have no understanding
Yet

AI is getting faster
Speed is increasing x2 every 2 years (Moors law)
In 20 years AI speed x1000



MEDICAL EXAMPLES

ENHANCED MEDICAL DIAGNOSIS

Human diagnosis
using scans & lab
methods is
SLOW & EXPENSIVE



CHEAP & FAST
>90% accurate!



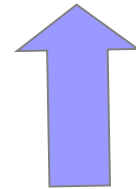
(1) Train the AI machine
using human diagnosis
of 1000s patients



(2) Machine builds an
internal model relating
observation & diagnosis



Humans focus on
none routine cases



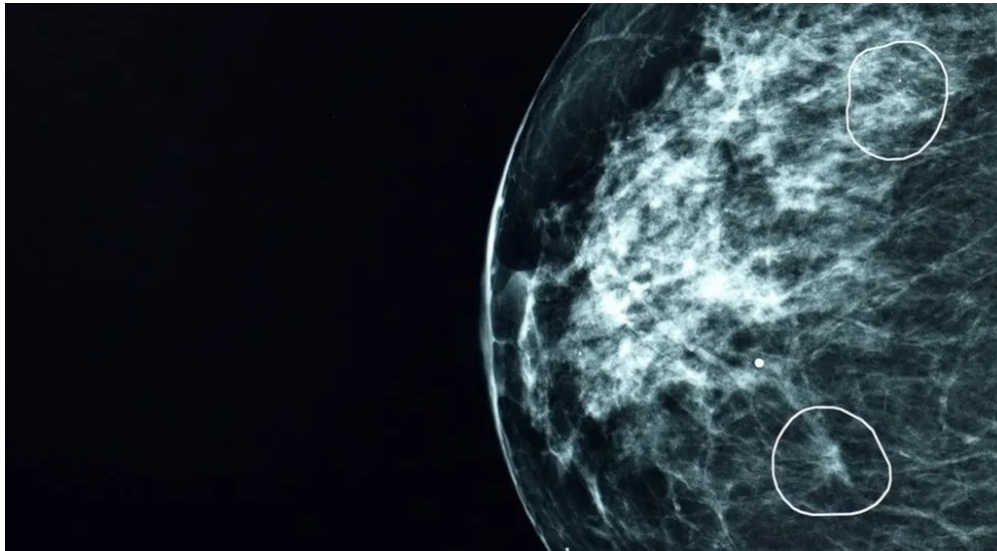
(3) Routine diagnosis
using AI machines

CANCER DIAGNOSIS

AI Can Spot Cancers

An AI tool tested by an NHS hospital trust identified tiny signs of breast cancer missed by human doctors.

Tool was piloted alongside NHS clinicians and analysed the mammograms of over 10,000 women.



11 additional cases were diagnosed in the original data

At their earliest stages, cancers can be extremely small and hard to spot.

DIAGNOSE DEMENTIA EARLY

Manage The Disease

AI trained on brain scans from 1000s dementia patients

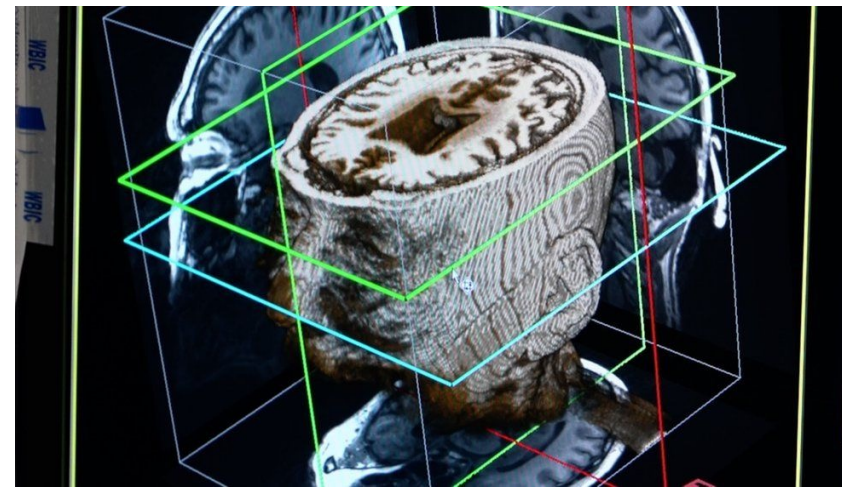
Identify 'invisible' patterns in the scans

Enabling early diagnosis of dementia in patients
10 years before symptoms appear

Dementia treatments is ongoing research

AI may also diagnose dementia from measurements of memory, speech, movement

Researchers are using AI methods for Parkinson's, MS and other neural conditions



PERSONALISED TREATMENT

More Effective Individual Treatment

Precision Medicine

Precision medicine identified using AI tailors treatments to individuals unique biology & health profile

Genetics:

Gene sequencing & analysis can help predict risk of certain diseases and response to medications.

Medical history:

Past health experiences analysed using AI informs treatment decisions.

Lifestyle factors:

Diet, exercise, and environment influence how a disease progresses
AI past & real time analysis informs lifestyle choices and treatments if needed

Cancer Treatment:

Analyse tumour's genetic makeup to identify specific mutations and select targeted therapies



AI DRUG DISCOVERY

At the Molecular Level

AI algorithms can help design new drugs

Faster targeted approach to developing new medications

AI analyses massive datasets of medical research, clinical trials, patient records & genetic information.

Fast data analysis reduces drug development times

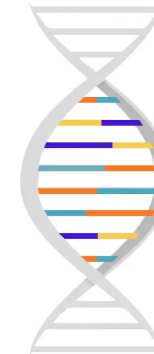
Simulate molecular interactions and predict new drug candidates

Development of drugs with fewer side effects

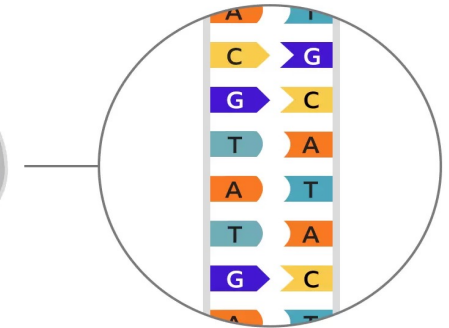
New treatments for Alzheimer's, Cancers, Parkinson's...

How AI is helping scientists spot disease genes

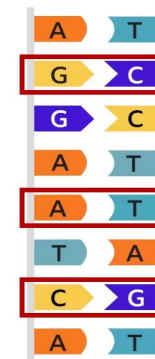
All living organisms
are built from
DNA



DNA is made up of
blocks of repeating
chemicals, **A, C, G, T**



AI can spot if the
letters are in the
wrong order



This can lead to disease
because the body's cells
and tissues aren't
made properly

AI & 3D PROTEIN STRUCTURES

Identify new treatments

Predict protein structures using trained AI systems

Phase 1:

Train Alpha Fold to associate
amino acid sequences with
180,000 known protein structures
x-ray crystallography (slow)

Protein Amino Acid Sequence



Known Protein
Structures



Deep Mind
Alpha Fold Neural Network

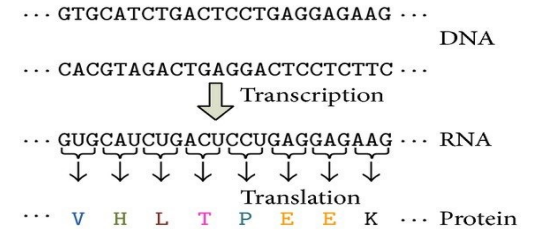


**Predict Protein
Structure**

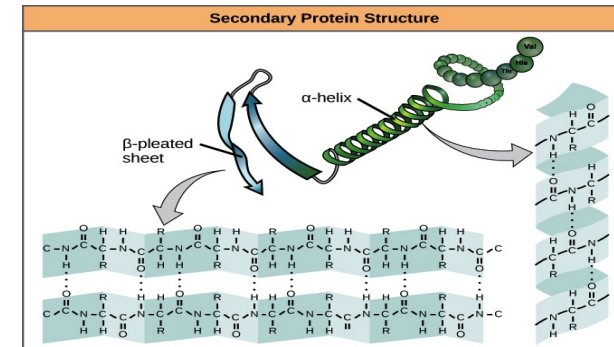
Phase 2:

Predict protein structures
from sequence data
2 million by 2023

Automated Sequencer



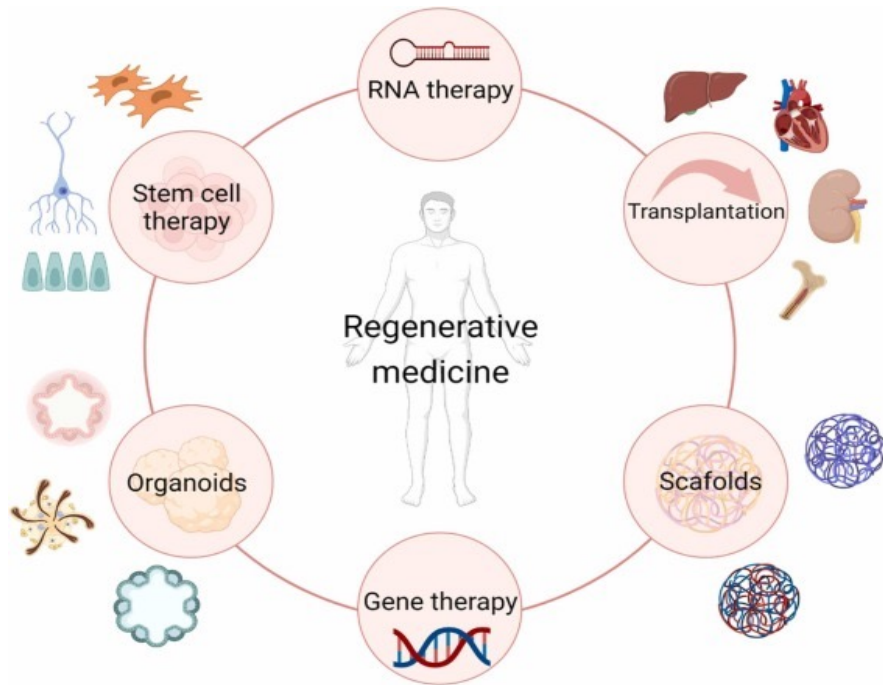
Protein Structure



AI & REGENERATIVE MEDICINE

Regenerative medicine focuses on repairing damaged/diseased tissues & organs

Re-engineer extracted stem cells to replace damaged cells
Inject into the body which will then generate healthy cells



Benefits of AI:

Automated screening
Use AI to identify usable cells taken from the patient

Improve manufacturing efficiency
Automation, quality control, faster production

Tissue Engineering and Simulation
AI used to simulate how tissues grow and repair themselves

PREDICTIVE ANALYTICS

Making best use of medical resources

Sophisticated algorithms analyse medical data to identify patterns & predict future health trends in individuals & communities

Identify Patients At Risk:

Predicting patient's risk of heart disease from health data prompts lifestyle changes or preventive medications

Hospital Resources:

Hospital is a major challenge for patient treatment (beds...)

AI can analyse data to predict patient needs and help allocate resources

AI can be used to predict which patients are most likely to need an intensive care unit bed

Predict disease outbreaks:

Analysing healthcare data can help identify potential epidemics and allow public health officials to take preventive measures



AI IMPROVES OPERATIONAL EFFICIENCY

AI can automate & optimise tasks such as scheduling appointments & managing patient flow

AI adapts to the local hospital environment

By improving efficiency and resource allocation AI can help hospitals offer more medical services



Search ID: aban1214

"Another advantage of switching to electronic health records is that it will make your indecipherable handwriting obsolete."

SAFER BRAIN SURGERY USING AI

AI imaging technology presents the surgeon with an augmented reality

Highlights small tumours & blood vessels allowing removal of more of the tumour



The AI system learns from 1000s brain videos in <1 year

AI powered simulations used for surgery training

ROBOTICS SYSTEM FOR BRAIN SURGERY

Centre for AI & Robotics (CAIR) has developed a robotics system for brain surgery

Combines flexible endoscopy, precision control & AI for minimally invasive neurosurgery



Breaks the limit of human hand-eye coordination

Robotic system reduces brain tissue damage during surgery by >50%

AI BRAIN IMPLANTS

Allow direct communication between brain and external devices.

Applications include controlling prosthetic limbs & augmenting cognitive abilities
Making us smarter

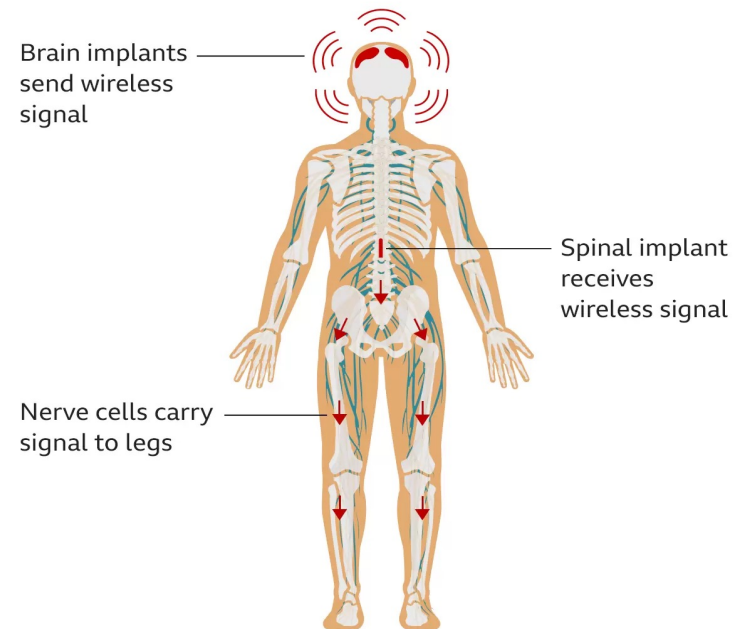
Spinal Injuries: Electronic implants wirelessly transmit thoughts to the legs and feet via a second implant on the spine

The implants amplify and transmit the brain commands to the muscles by passing the injured spine

Walking, pain relief...



Implants boost brain signals to legs



AI MIND READING

Research activity

Show the human subject many images/sounds

Functional MRI generates data specific for each image/sound

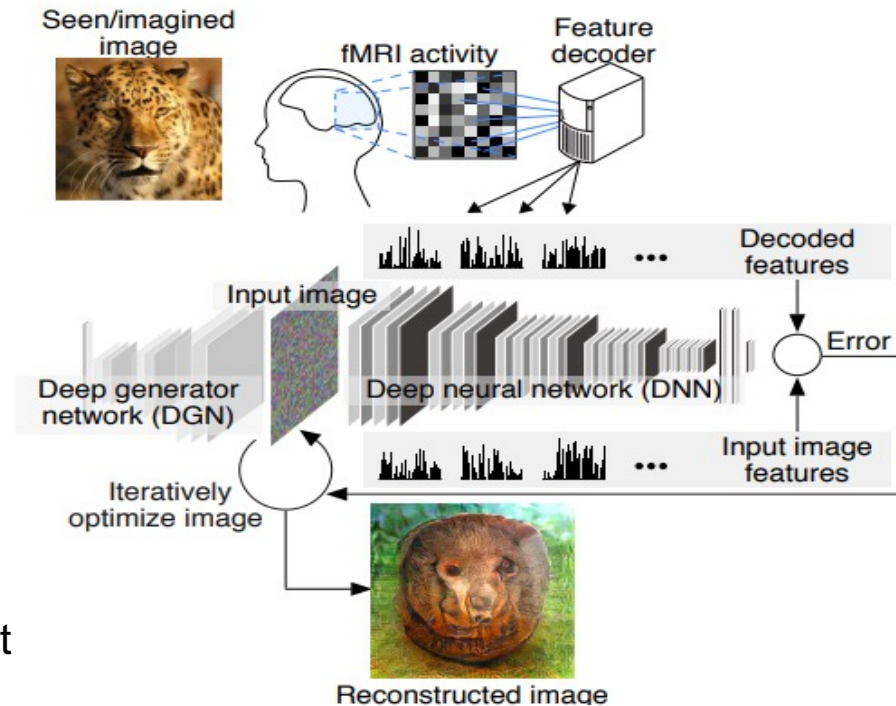
Data is used to train the AI system

AI associates fMRI data with specific images/sounds

In principle the AI can read what the subject is thinking

Also works on other patients to lesser extent

Communicate with people who have lost the ability to speak



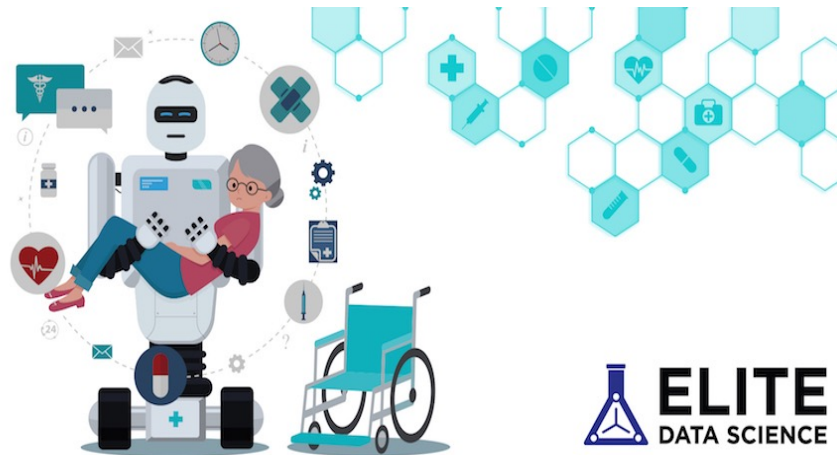
AI IN SOCIAL CARE

Improved Elder Care

Elderly relatives assisted by in-house robots

Help seniors with every day tasks and keep them independent

Monitor alcohol/food consumption, fevers, restlessness, urinary frequency, chair & bed comfort, sleeping, declining mobility



Robot Developments

Development needed to make suitable home robots

AI HEARING ENHANCEMENT

Smarter Noise Reduction

Traditional hearing aids can struggle to distinguish between speech and background noise.

AI can analyse sound environments in real-time

Dynamically adjust noise cancellation features

Personalized Listening Experiences

AI can learn user preferences and adjust settings accordingly.

AI hearing aid amplify voices while suppressing background noise

Machine Learning and Adaptation

Some hearing aids continuously learn and adapt to the user's listening environment.

This allows for a more natural and personalized listening experience over time



AI & MENTAL HEALTH

AI chatbots hold promise as a supplementary tool in mental healthcare

Accessibility:

Chatbots can provide 24/7 support, acting as a first point of contact or offering ongoing guidance helpful in areas with limited access to mental health professionals

Reduced Stigma:

The anonymity and convenience of chatbots can encourage people to be more open about their mental health struggles

Support and Encouragement:

Chatbots can offer basic mental health information, answer questions, and provide coping mechanisms for everyday stress or anxiety

Self-Assessment Tools:

Some chatbots incorporate self-assessment tools to screen for symptoms of depression, anxiety, or other conditions



DIGITAL FRIENDS & MENTAL HEALTH

Generative AI

A Digital Friend is an AI-powered human-like virtual avatar that interacts intelligently with people

Huge demand for digital friends 24/7

Help with loneliness, grief...

Learn about the human owner

Offer advice

Cheap

Personalise AI Avatars

Look like humans

Risks:

Dependency on the fictional world

Reduction in social skills?

Control of vulnerable people by AI

Protection of intimate data?



SUMMARY

Development & Trial of many AI enhanced medical applications

Improved accuracy and efficiency of diagnosis & treatment

Early disease detection

Personalized medicine

Reduced costs

Improved accessibility

Areas of concern:

Ethical implications such as gender & ethnic bias

Regulatory landscape in catch up

Not a replacement for human medical experts