Lezione 5

21 Aprile 2023

Padlet

assistenza-sanitaria-e-intelligenza-artificiale-vwhqhqb5flmhnpkr

Telemedicina in generale

Telemedicina

Il complesso delle applicazioni della telematica alla medicina, per diagnosi e terapie a distanza.

L'home care è un forma di assistenza alla persona, in favore di malati, disabili o anziani, che viene prestata a domicilio, senza che debbano recarsi in ospedale o ambulatorio

Telemedicina per le zone rurali

How Technology Is Improving Access to Medical Services for Rural and Remote Areas

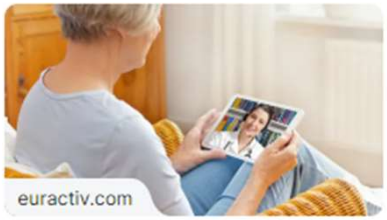
La telemedicina diventa un servizio essenziale per le persone che abitano in zone rurali o difficili da raggiungere, oltre che un servizio aggiuntivo per le persone in zone più accessibili.

https://www.nbst.it/1517-sanita-digitale-in-italia-tra-pnrr-e-telemedicina.html

1517-sanita-digitale-in-italia-tra-pnrr-e-telemedicina

https://www.medicair.it/aree-terapeutiche/telemedicina-e-monitoraggio-clinico-a-distanza/

EU cross-border Telemedicine



EU ministers to scrap cross-border telemedicine from health data space

https://www.euractiv.com/section/health-consumers/news/eu-ministers-to-scrap-cross-border-telemedicine-from-health-data-space/

Telemedicina, parte dal Cedim di Montoro la prima sperimentazione in Campania - Orticalab.it

https://www.orticalab.it/Telemedicina-parte-dal-Cedim-di-Montoro

Applicazioni per la salute mobile mHealth: le applicazioni mHealth consentono ai pazienti di monitorare la propria salute e comunicare con gli operatori sanitari utilizzando i propri smartphone o tablet. Queste applicazioni possono fornire promemoria per i farmaci, monitorare i sintomi e consentire ai pazienti di accedere alle informazioni sulle loro condizioni

Manca il riferimento

Teleconsulto: Il medico o il professionista sanitario fornisce una consultazione virtuale tramite videoconferenza. Questo consente ai pazienti di ricevere una diagnosi e una prescrizione di farmaci senza dover uscire di casa.

Monitoraggio remoto: I dispositivi di monitoraggio a distanza, come i sensori di pressione sanguigna, le bilance e le cuffie per la pressione arteriosa, possono essere utilizzati per monitorare la salute del paziente da remoto. Questi dati vengono inviati a un professionista sanitario che può effettuare il follow-up con il paziente e apportare eventuali modifiche al piano di cura.

Telemedicina diagnostica: La telemedicina diagnostica permette

Manca il riferimento

Panoramica situazione telemedicina in Europa

Sanità, ecco le tante velocità dell'Europa digitale

Sanità, ecco le tante velocità dell'Europa digitale - AboutPharma

Telemedicina per pazienti oncologici, progetto pilota in Puglia

https://notizie.tiscali.it/salute/articoli/telemedicina-pazienti-oncologici-progetto-pilota-in-puglia-00003/

Tele-ICU

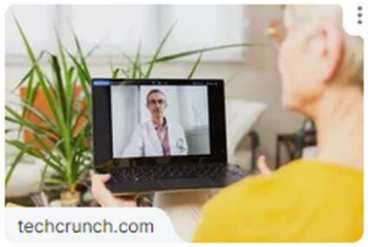
i programmi di tele-ICU utilizzano la tecnologia di monitoraggio remoto e le videoconferenze per collegare gli specialisti di terapia intensiva con i pazienti delle unità di terapia intensiva (ICU) in aree remote o poco servite. Ciò consente di monitorare in tempo reale i segni vitali, i farmaci e altri dati importanti dei pazienti e di intervenire rapidamente in caso di eventi critici.

Progetto THALEA: Telemonitoraggio delle terapie intensive nell'UE

cordis.europa.eu

Il telemonitoraggio: una svolta per la terapia intensiva

Il progetto THALEA ha sviluppato un sistema di telemonitoraggio che consente ai principali ospedali di integrare e analizzare i dati dei pazienti dell'unità di terapia intensiva (ICU) ovunque si trovino, consentendo loro di monitorare le loro condizioni e rilevare



techcrunch.com

Russian insurtech and telemedicine startup BestDoctor raises $26M B from Winter Capital Partners

chinamoneynetwork.com

Chinese Healthcare Platform Miaoshou Doctor Closes $84M Series D Round

La telemedicina si è resa sempre più indispensabile per gestire l'aumento delle malattie croniche che hanno imposto l'esigenza di intensificare l'assistenza domiciliare integrata con quella a distanza, soprattutto nei confronti dei pazienti più fragili. È a questo scopo che è nato il **Progetto Fragilità di VIDAS**, un servizio rivolto a pazienti anziani con una o più patologie croniche e un quadro clinico tendenzialmente stabilizzato, ma che necessitano di un monitoraggio clinico e di un'assistenza multidisciplinare continuativa, sia sanitaria sia sociale, psicologica e assistenziale. Il servizio è organizzato per offrire una rete di assistenza capillare con **medici e infermieri attivi 24 ore su 24** e integrati in équipe multidisciplinari.

Esempi in italia

https://www.digital4.biz/executive/digital-transformation/telemedicina-che-cosa-e-definizione-tecnologie-adozione-in-italia/

lastampa.it

Arrivano le cabine della salute a Macugnaga e Formazza, mini ambulatori con dispositivi per consulti medici a distanza

https://www.lastampa.it/verbano-cusio-ossola/2023/03/07/news/arrivano_le_cabine_della_salute_a_macugnaga_e_formazza_mini_ambulatori_con_dispositivi_per_consulti_medici_a_distanza-12679643/

regione.piemonte.it

Telemedicina, al via il progetto sperimentale

https://www.regione.piemonte.it/web/temi/sanita/telemedicina-al-via-progetto-sperimentale

SESAMO

https://sesamo.sanita.fvg.it/sesamo/

Piattaforma nazionale telemedicina

pnrr.salute.gov.it

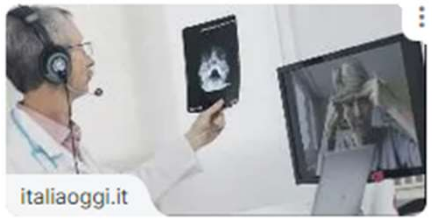
Telemedicina

Creazione di una **Piattaforma Nazionale per i servizi di Telemedicina** e finanziamento di progetti che consentano interazioni medico-paziente a distanza e le iniziative di ricerca ad hoc sulle tecnologie digitali in materia di sanità e assistenza.

agendadigitale.eu

Dalla telemedicina alla medicina digitale: il passo da fare in Italia - Agenda Digitale

https://www.agendadigitale.eu/sanita/dalla-telemedicina-alla-medicina-digitale-il-passo-da-fare-in-italia/



italiaoggi.it

Telemedicina, realtà in Svezia - ItaliaOggi.it

https://www.italiaoggi.it/news/telemedicina-realta-in-svezia-2276492

Digital Health in some European Countries

healthcareitnews.com

The European digital health revolution in the wake of COVID-19

https://www.healthcareitnews.com/news/emea/european-digital-health-revolution-wake-covid-19

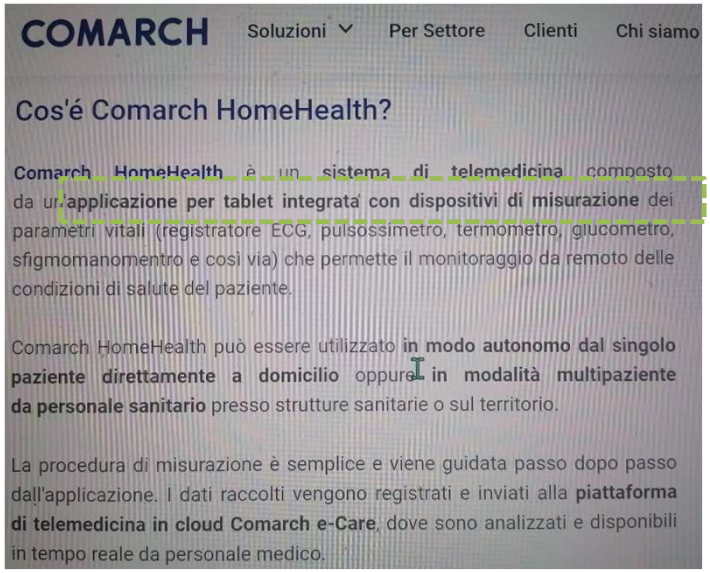
Telemonitoraggio

Monitorare i pazienti con biosensori indossabili

Per quanto riguarda il monitoraggio remoto dei pazienti, cosa succederà? I biosensori indossabili sono in gran parte la risposta. Indossati discretamente sul torace, questi sensori possono misurare e trasmettere segni vitali come i dati respiratori e la frequenza cardiaca, nonché altri dati del paziente come la postura e il livello di attività.

Dopo l'epidemia di COVID-19 e le carenze di DPI che l'hanno inizialmente caratterizzata, gli ospedali hanno tratto grande beneficio dall'uso di biosensori indossabili per monitorare da vicino i pazienti nei reparti dedicati al COVID-19 senza esporre il personale a rischi inutili. Tuttavia, la loro applicazione potenziale si estende ben oltre, da scenari di assistenza minima in ospedale fino alle case delle persone.

Manca il riferimento



Telemonitoraggio domiciliare e patient engagement

https://digitalhealthitalia.com/telemonitoraggio-domiciliare-patient-engagement/

Immuni

Immuni - Sito Ufficiale

Immuni è un esempio di app di healthcare.
https://www.immuni.italia.it/

Screening e coinvolgimento dei pazienti a distanza prima del loro accesso a strutture sanitarie

Tra i molti esempi di telemedicina spinti dalle necessità emerse durante la pandemia, uno che probabilmente resisterà è lo screening e il coinvolgimento dei pazienti tramite supporti digitali, anche prima di accedere alle strutture sanitarie.

Con la crisi di COVID-19, ospedali e organizzazioni di assistenza domiciliare hanno utilizzato questionari online per effettuare il triage e il monitoraggio dei pazienti con sospetta COVID-19, mediante call center incaricati di contattare i pazienti ad alto rischio per fornire ulteriori informazioni prima di indirizzarli alle cure appropriate. Questo ha aiutato a evitare che sia il personale che i pazienti fossero esposti a rischi inutili e ha

Riferimenti scientifici

App-based telemedicine program for COVID-19 primary care

https://pubmed.ncbi.nlm.nih.gov/33733868/

Regulatory, Legal, and Ethical Considerations of Telemedicine

Regulatory, Legal, and Ethical Considerations of Telemedicine - PubMed

https://pubmed.ncbi.nlm.nih.gov/32762973/

Telemedicine for healthcare: Capabilities, features, barriers, and applications

La telemedicina in Medicina Generale: dove siamo e prospettive future

scholar

https://scholar.google.com/scholar?hl=it&as_sdt=0,5&q=telemedicina+e+assistenza+sanitaria+&btnG=#d=gs_qabs&t=1681829679770&u=#p=Ig8ZJHIINhAJ

Normativa

Telemedicina e assistenza domiciliare. In Gazzetta le linee guida del ministero. Dalle visite on line col medico al controllo dei pazienti da remoto - Quotidiano Sanità

https://www.quotidianosanita.it/m/governo-e-parlamento/articolo.php?articolo_id=105038

Strumenti di aiuto/wellness

Startup di telemedicina in italia

Telemedicine-report-2020

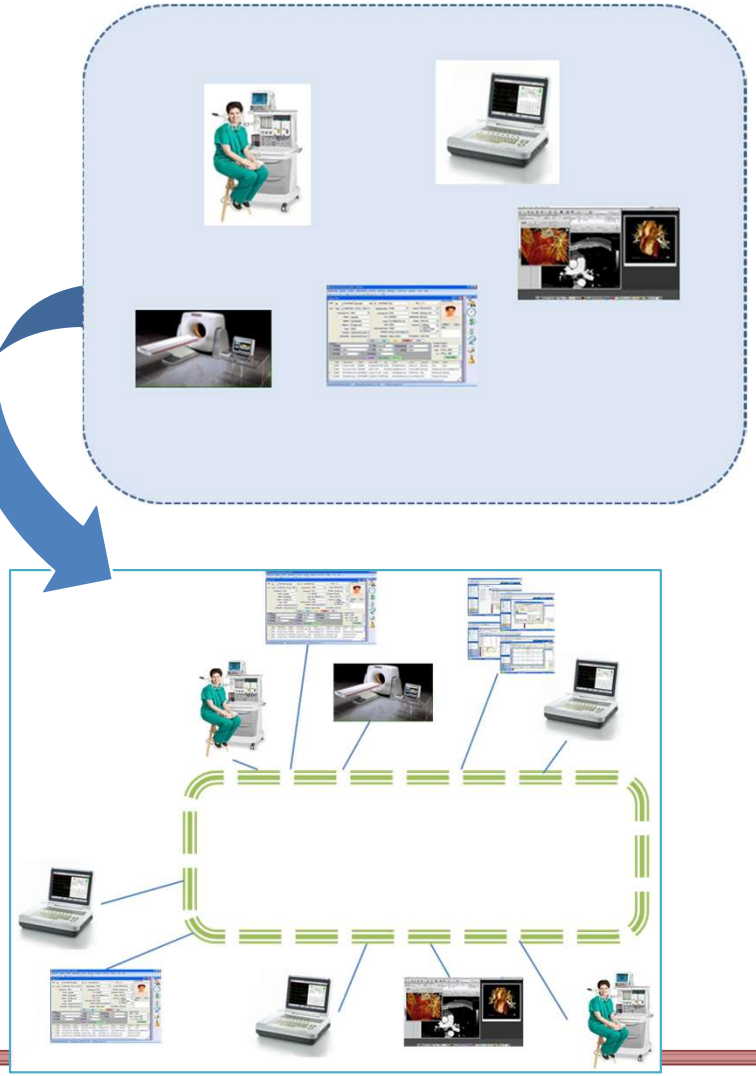
La startup DoctorsinItaly fornisce aiuto ai turisti stranieri per trovare medici che parlino inglese in Italia per consulti online e di persona.

non so se possono essere incluse tra le app di telemedicina anche quelle riguardanti il benessere psicologico delle persone. in caso la possibilità di fare psicoterapia online attraverso per esempio unobravo o serenis credo ne sia un esempio

La **misurazione domiciliare della pressione arteriosa** è un mezzo di screening estremamente efficace per tenere sotto controllo le **patologie del sistema cardiovascolare**, grazie alla semplicità di utilizzo e all'immediatezza dell'intera procedura che consente al medico di avere sempre sotto controllo in tempo reale il quadro pressorio del paziente.

Costruire una presentazione power point che riassuma questi temi

How internet is changing healthcare



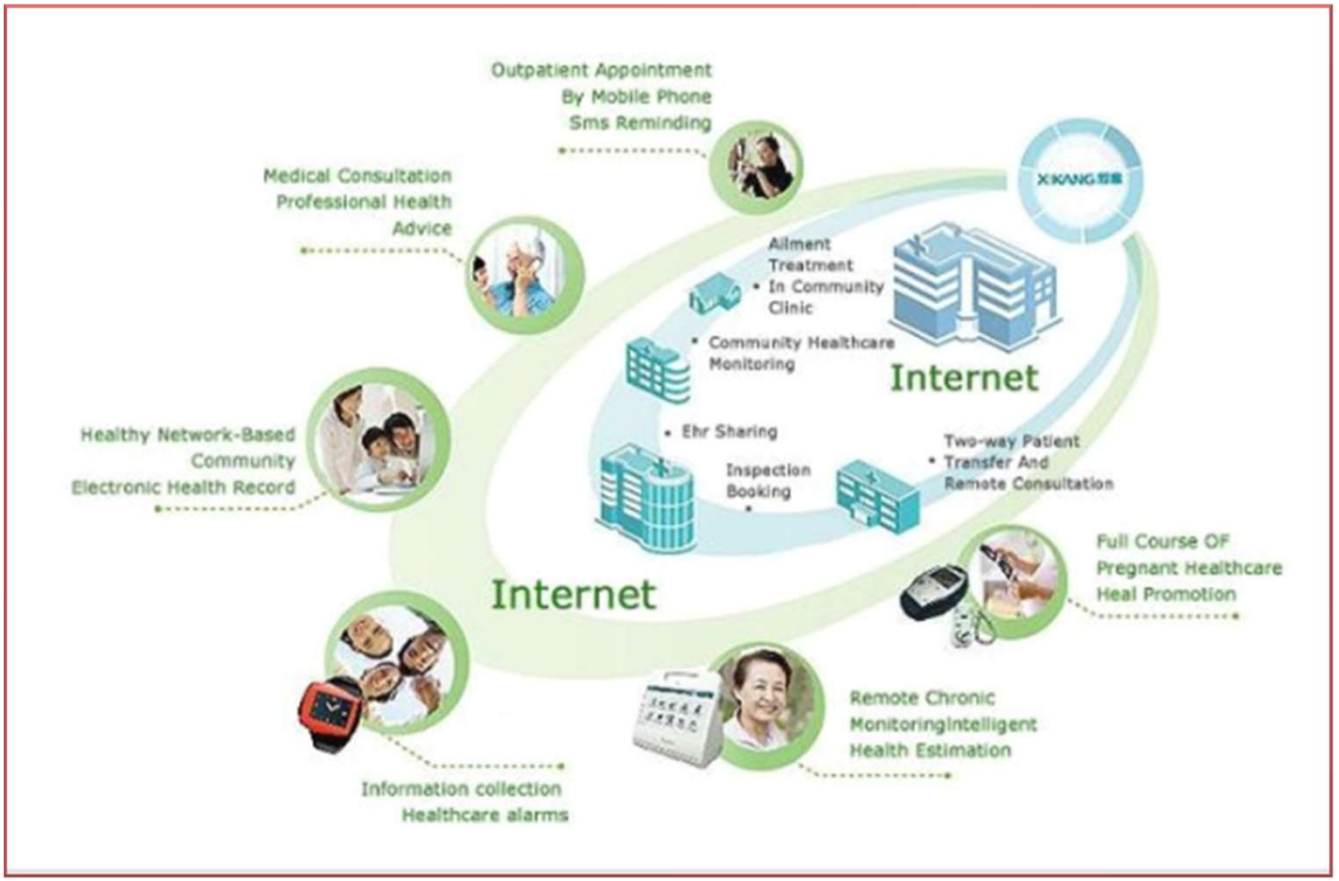
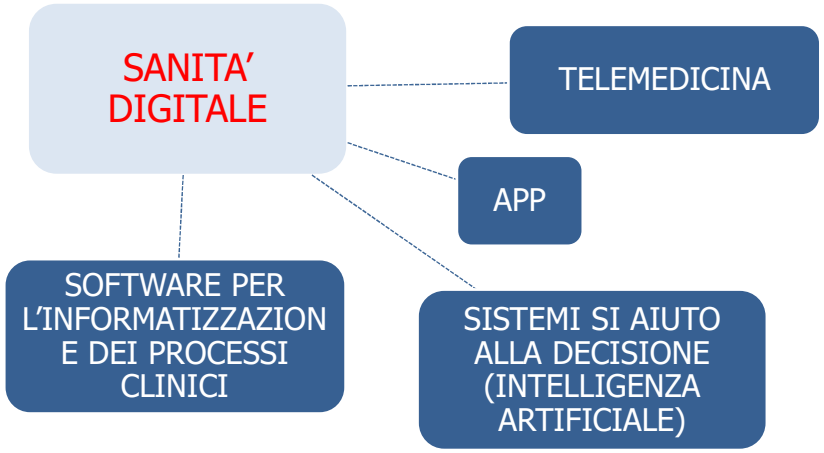


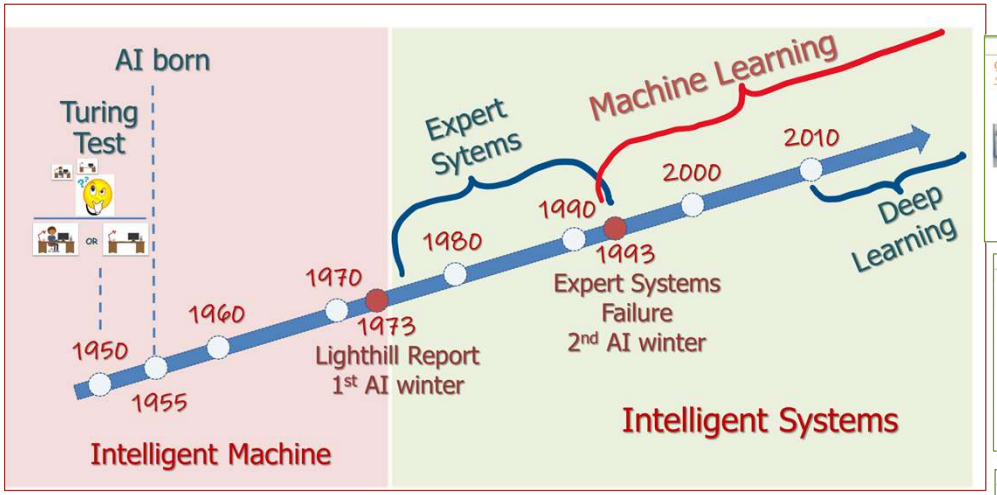
Fig1 (from *A Survey Paper on Internet of Things based Healthcare System*)

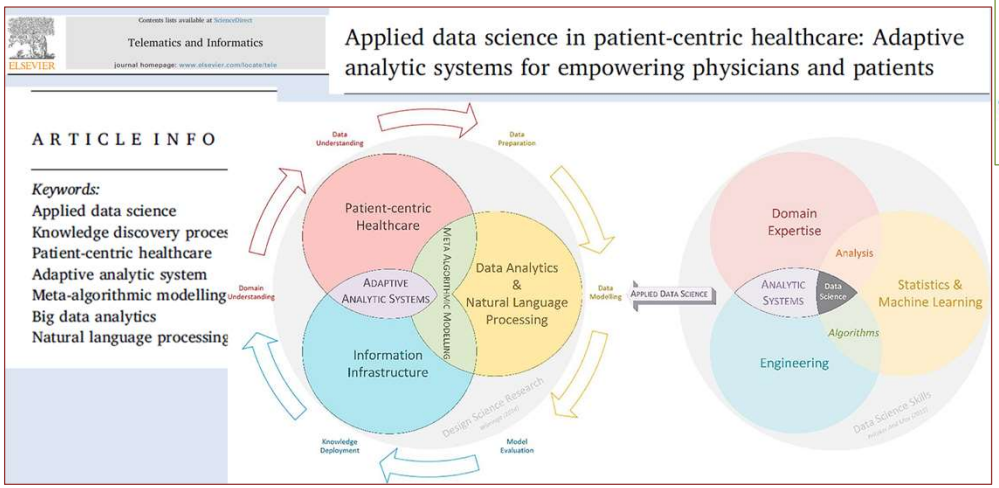
La tecnologia al servizio della cura: Intelligenza Aritificiale

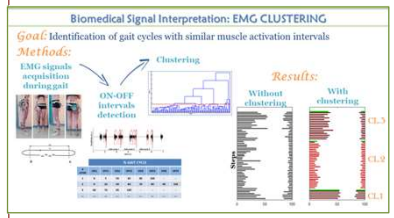


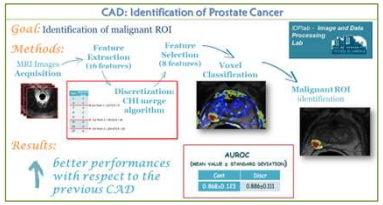
Automated machine learning (AutoML) and automated data science (AutoDS) aim at automating standard and modular analytical and learning tasks and processes.

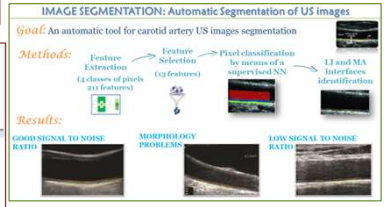
Autonomous AI (AutoAI)



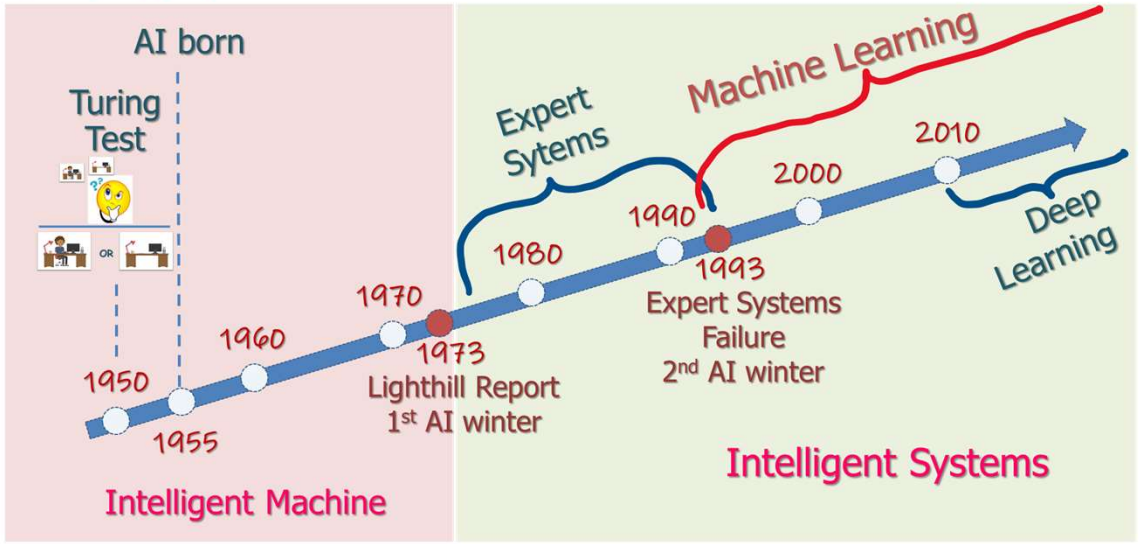








AI: Timeline



Today AI applications are based on

machine learning

and

deep learning

Knowledge is data driven

- Supervised Learning: learning from labelled training data (the correct classes of the training data are known)
- Unsupervised Learning: discovering patterns from unlabelled data (the correct classes of the training data are unknown)

AI applications may support diagnosis, treatment and patient monitoring

Four main distinct ways in which AI is being employed:

- in the assessment of risk of disease onset and in estimating treatment success prior to initiation;
- in an attempt to manage or alleviate complications/adverse events;
- to assist with patient care during the treatment or diagnosis;
- in research aimed at elucidating the pathology or mechanism of and/or the ideal treatment for a disease.

Artificial intelligence in medicine: What is it doing for us today? (2019) Aliza Becker

THE DREAM

TO HAVE MACHINES
THAT DO THINGS
LIKE HUMANS DO

As soon as computers were born
people started trying to put
intelligence in them

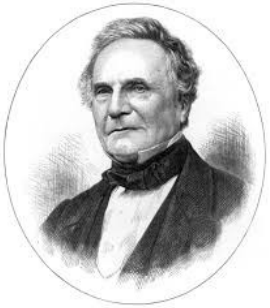
The origins of AI

COGITO ERGO SUM
'I think, therefore I am'
René Descartes,
1596–1650

David Hume (1711–1776)
brought computations to the discussion, deeply embedding a widely believed premise in Cognitive Science that

cognition is computation

George Boole (1815–1864)
challenged human presumptions of complexity using three binary operators: 'and,' 'or' and 'not.'
Boole demonstrated that these are sufficient for universal computations.



Charles Babbage
(1791–1871)
invented the first mechanical computational device, the computer.

Alan Turing
(1912–1954)
designed the Turing machine as a general-purpose computer

Turing Test

In 1950, Alan Turing defined the
intelligent behaviour of a computer
as the ability to achieve the human-level performance in cognitive tasks.

A computer passes the test if the interrogator cannot distinguish the machine from a human on the basis of the answers to their questions

"AI means..." An historical perspective

The story of AI started in the 50s

Five of the attendees of the 1956 Dartmouth Summer Research Project on Artificial Intelligence reunited at the July 2006 AI@50 conference. From left: Trenchard More, John McCarthy, Marvin Minsky, Oliver Selfridge, and Ray Solomonoff. (Photo by Joseph Mehling)

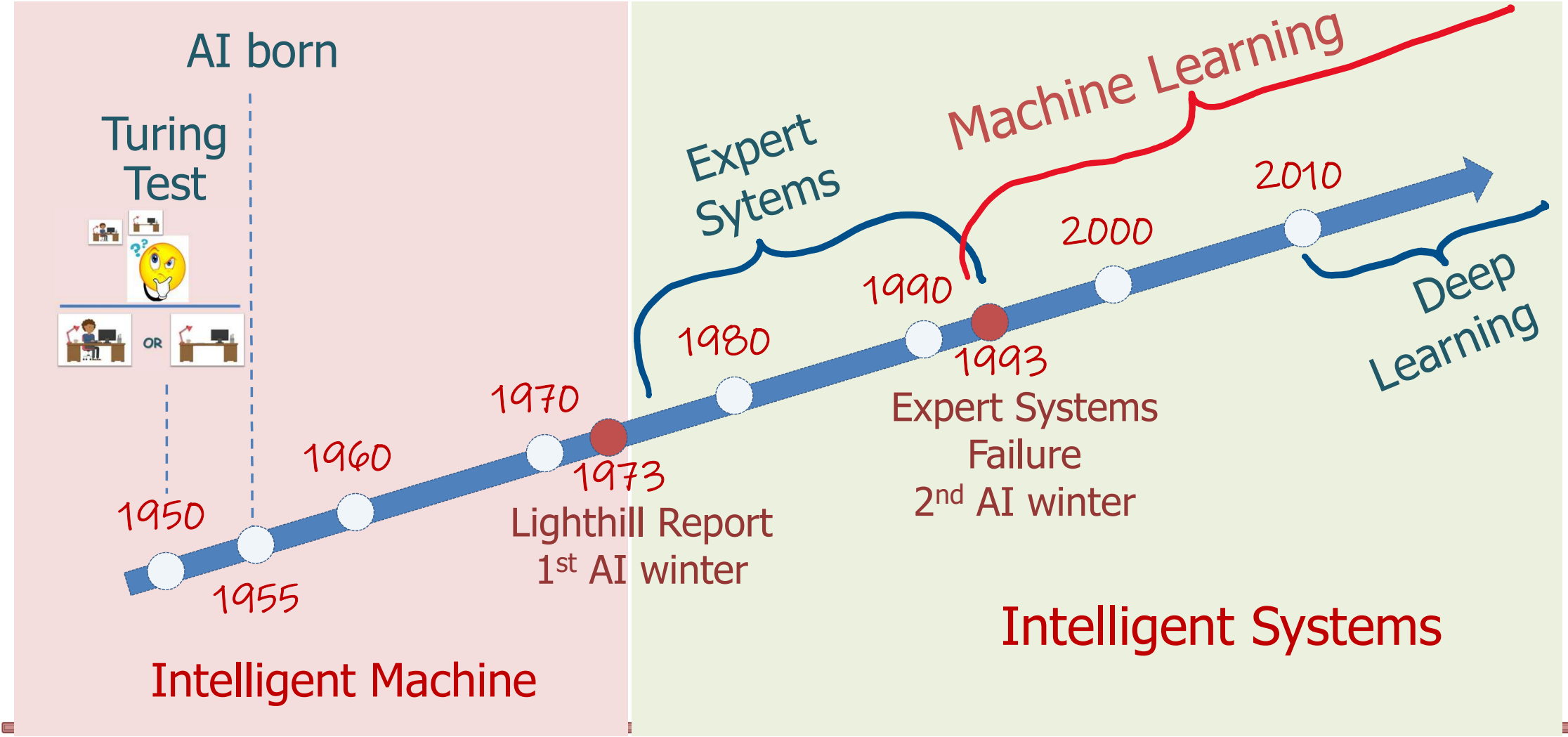
https://www.forbes.com

August 31, 1955

The term "artificial intelligence" is coined in a proposal for a "2 month, 10 man study of artificial intelligence" submitted by John McCarthy (Dartmouth College), Marvin Minsky (Harvard University), Nathaniel Rochester (IBM), and Claude Shannon (Bell Telephone Laboratories).

The workshop, which took place a year later, in July and August 1956, is generally recognized as the official birthdate of the new field.

AI: Timeline


AI born
Turing Test
OR
1950
1955
1960
1970
1973
Lighthill Report
1st AI winter
1980
1990
1993
Expert Systems Failure
2nd AI winter
2000
2010
Expert Sytems
Machine Learning
Deep Learning
Intelligent Machine
Intelligent Systems

Different AI approaches

Automated machine learning (AutoML) and *automated data science (AutoDS)* aim at automating standard and modular analytical and learning tasks and processes.

AutoML and AutoDS focus on automating standard and decomposed tasks, such as data cleaning, feature selection, hyperparameter optimization, algorithm selection, and pipeline selection.

They rely on predefined and design-time techniques such as search, selection, and optimization. The resultant systems offer standard workflows, and neutral techniques for search and selection, independent of data characteristics, problem domain, analytical and learning objectives and tasks, algorithm and model design methodologies, and business expectations.

These enable the standardization, production, manufacturing, and commercialization of machine learning and data science for applications.

Autonomous AI (AutoAI) aims at constructing autonomous systems …

Intelligent Systems

Intelligent Systems are systems allowing to represent the knowledge in a form that can be processed by a computer

- Knowledge from experts → Expert Systems
- Knowledge from data → Machine Learning, Deep Learning

Expert Systems (ESs)

Building an ES means to develop a computer program capable of performing at the level of a human expert in a narrow problem area or in a specific domain of expertise.

They are based on the **expert** **knowledge**

Who possesses knowledge and strong practical experience in a particular domain (the domain area is be limited)

Knowledge is a theoretical or practical understanding of a given domain

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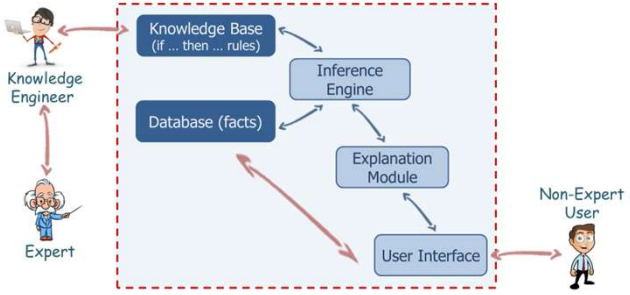

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Knowledge is a theoretical or practical understanding of a given domain

How to represent expert knowledge?

- ✓ The human mental process is internal, and it is too complex to be represented as an algorithm.

Consider a simple example:

Imagine, you meet an alien! He wants to cross a road.

Can you help him? You are an expert in crossing roads – you've been on this job for several years. Thus you are able to teach the alien.

How would you do this?

- ✓ However, most experts are capable of expressing their knowledge in the form of rules for problem solving.

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Rules as a knowledge representation technique

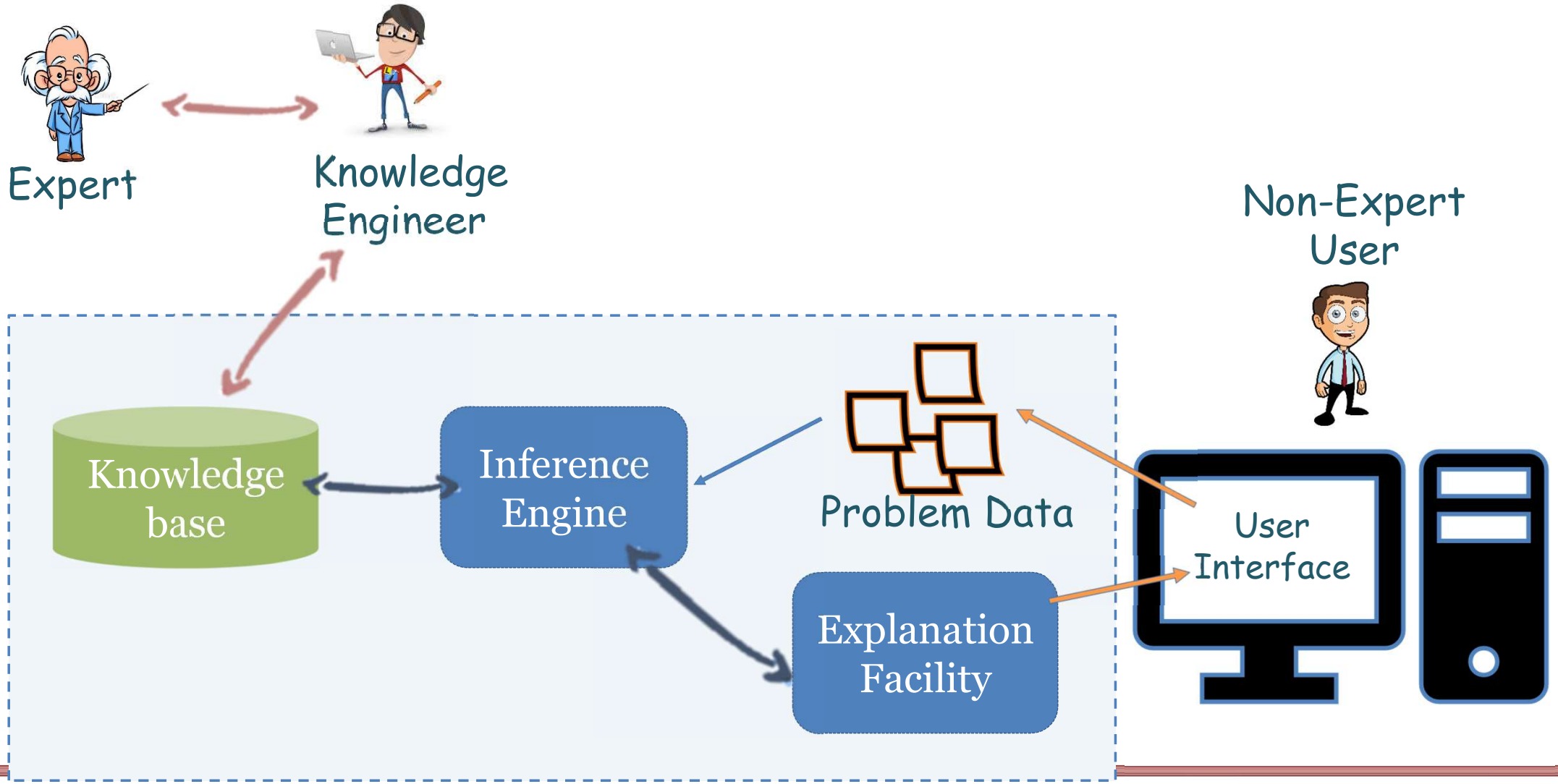
The basic syntax of a rule is:

IF ... THEN ...

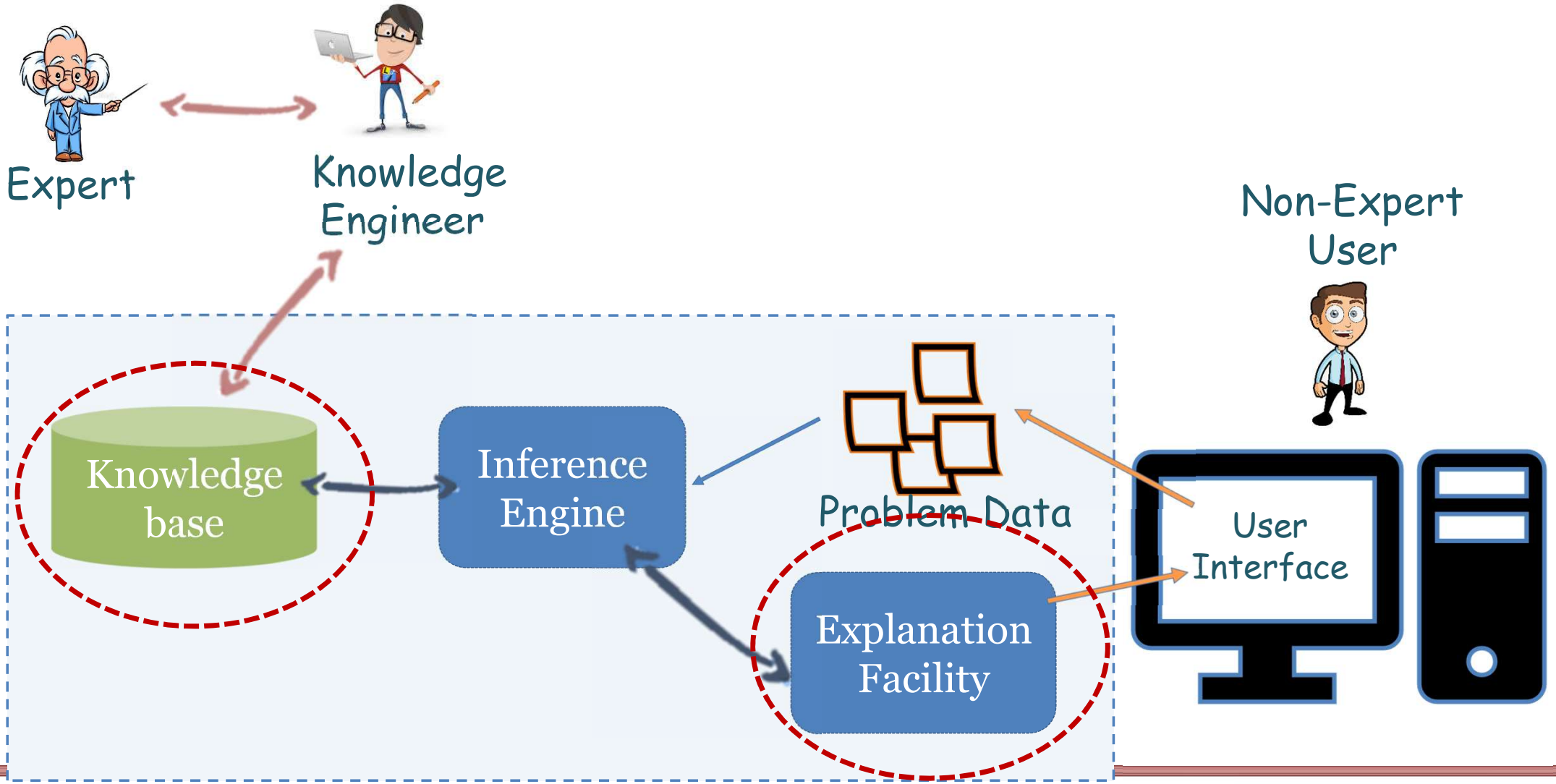
the IF part, called the **antecedent** (premise or condition) and

the THEN part called the **consequent** (conclusion or action).

Expert Systems Architecture



Expert Systems Architecture



The new era of AI

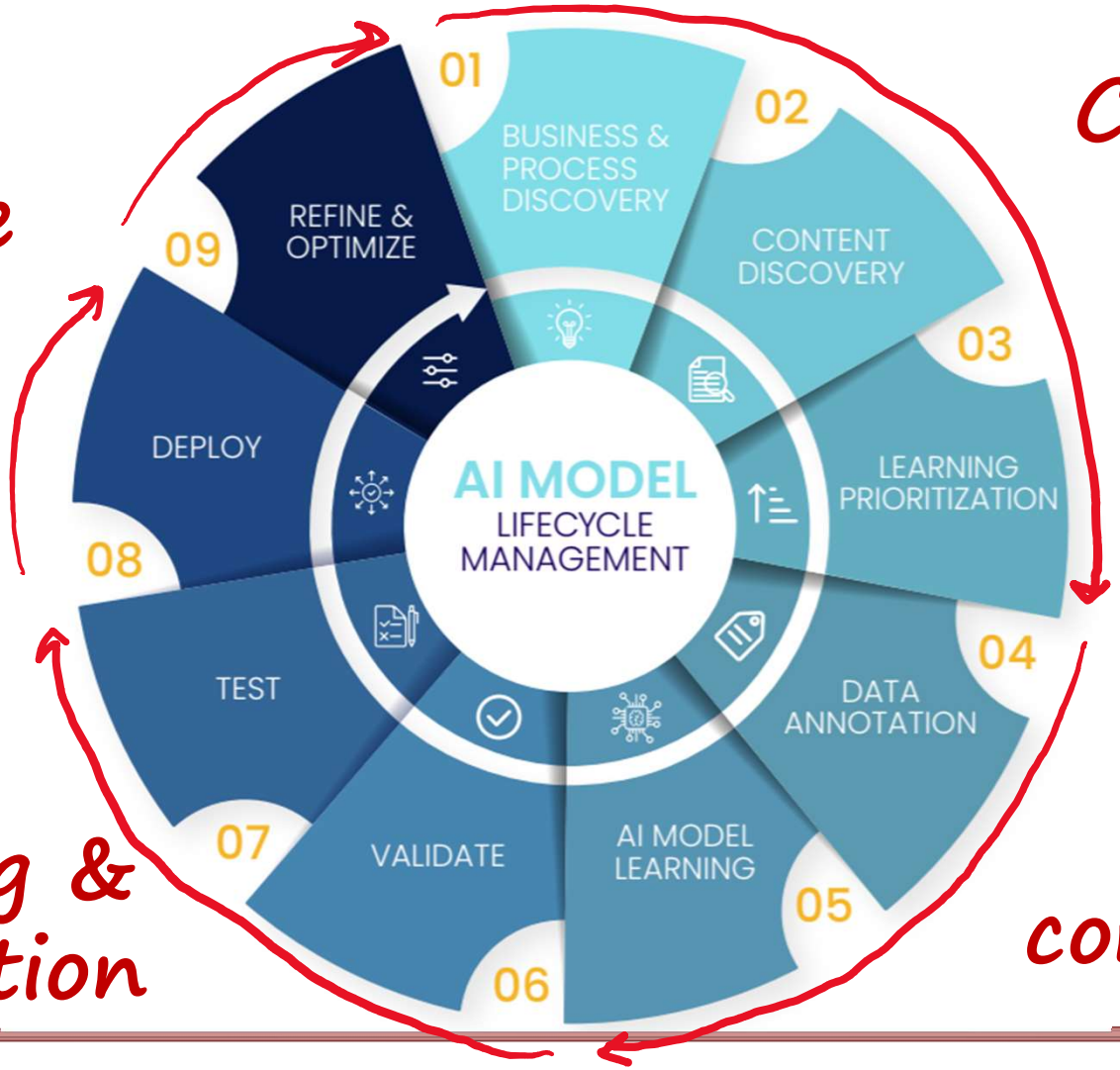
It turns out to be difficult to extract knowledge from human experts -> failure of ESs in the 1980's.

Today AI applications are based on machine learning and deep learning

- Supervised Learning: learning from labelled training data (the correct classes of the training data are known)
- Unsupervised Learning: discovering patterns from unlabelled data (the correct classes of the training data are unknown)

Knowledge is data driven

AI tools life cicle



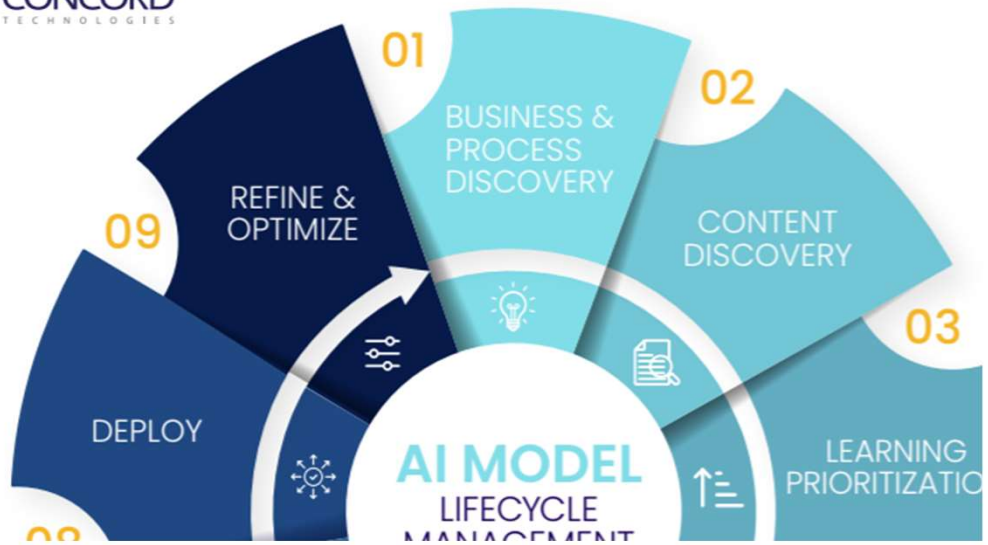
Conceptualization

System construction

Testing & Validation

Use

AI tools life cicle



Conceptualization

1

BUSINESS AND PROCESS DISCOVERY

What do we expect AI to learn? Think of Business and Process Discovery as a teacher developing a syllabus for a class. A narrow syllabus may limit the AI's ability to execute. A broad syllabus will increase the time needed to train the AI.

2

CONTENT DISCOVERY

What *kind* of information will the AI learn from? How *much* information will be available for the AI to learn from? Think of Content Discovery as a teacher defining a curriculum for a class. The quantity and quality of data will directly impact the AI's accuracy and performance.

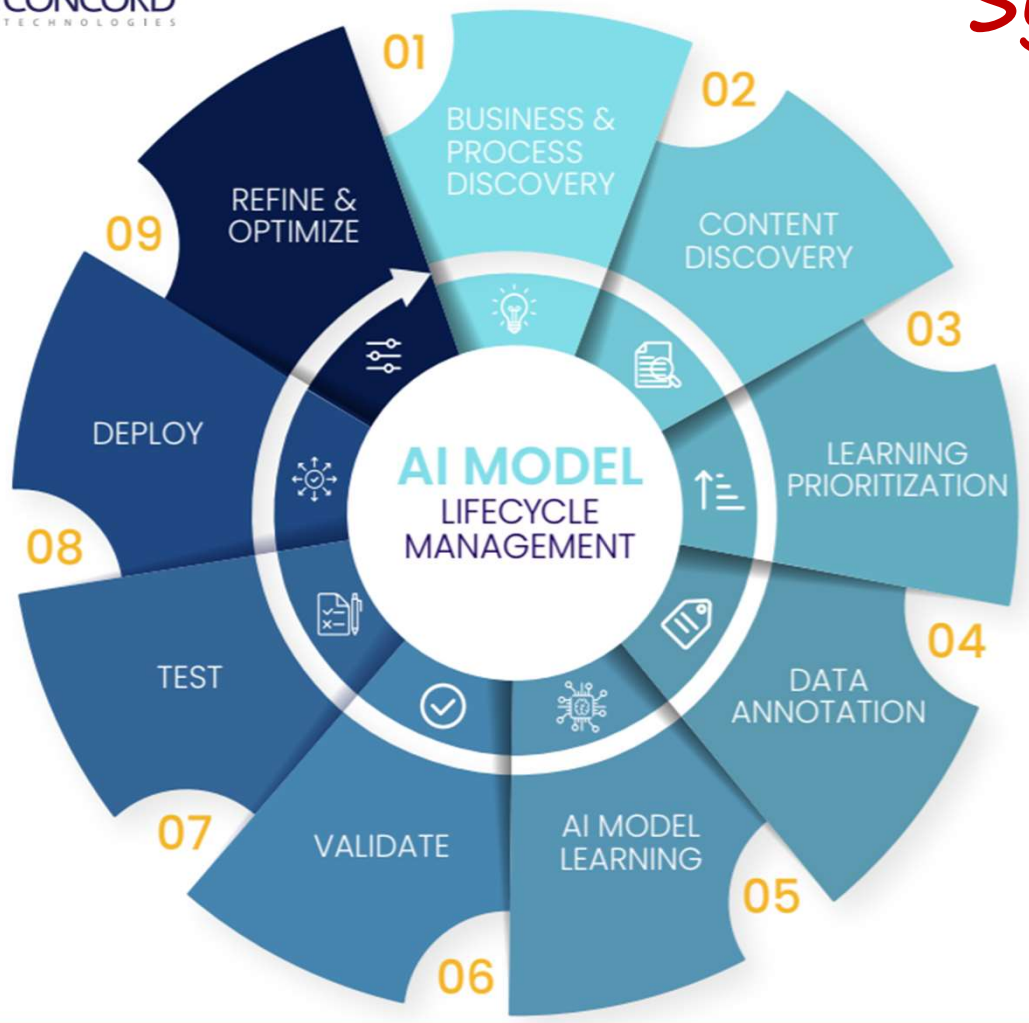
3

LEARNING PRIORITIZATION

Which subjects should AI learn first? How well should the AI know each subject? In healthcare, this could mean the AI first learns how to identify a patient names, social security numbers and charts numbers.

AI tools life cicle

System construction



4

DATA ANNOTATION

The annotation process tells the AI what information it needs to find, where to find it and most importantly, what to do with it. For example, how will the AI differentiate the patient's name from the physician's name or the surgeon's name?

5

AI MODEL LEARNS

This is the first phase of the AI working independently. AI models take into account the annotated data from Step 4 to make decisions or produce outputs. This will be the first indicator of how well the AI is performing.

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Testing & Validation

6

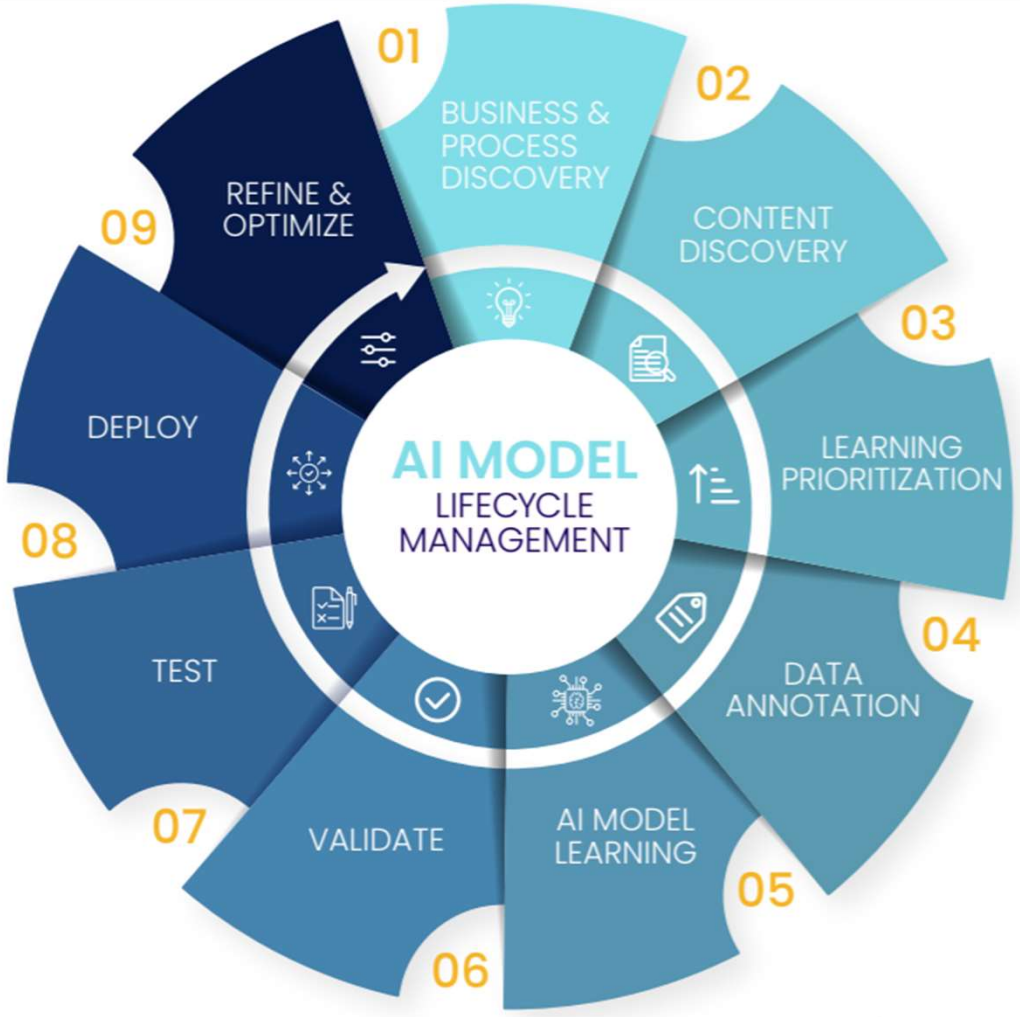
VALIDATE

Is the AI executing as intended? Do significant gaps exist in how the AI is learning? Is additional annotation required? These gaps need to be filled before the AI is ready for prime time.

7

TEST

The AI is now working with test data without any human assistance. The test step can be considered the AI's first full performance review. How the AI performs in this step will dictate what additional learning may be needed.



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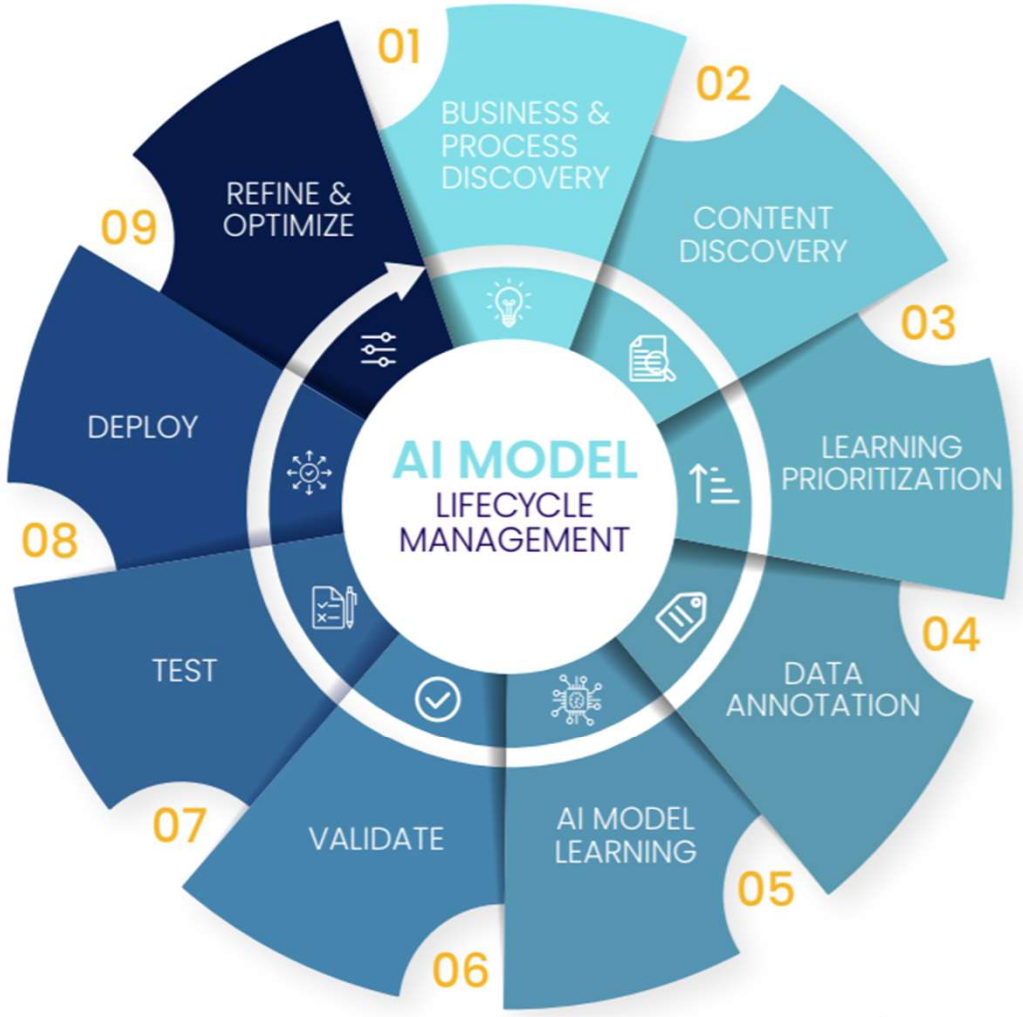
08 DEPLOY

The lessons are over. The exams have been taken. The AI is now ready to graduate and go out into the real world. The AI will begin working with live, production data. This is where the AI's performance benchmarks are established.

09 REFINE AND OPTIMIZE

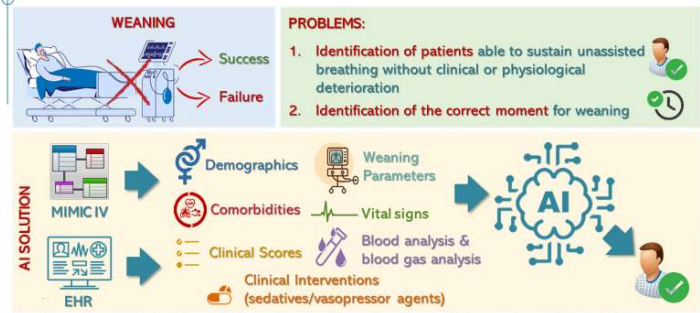
Once the AI is deployed into production, refinements to the model can be made. Refining and optimizing is an iterative process. Over time, AI's accuracy will continue to improve as it learns more about the data it is processing.

Use



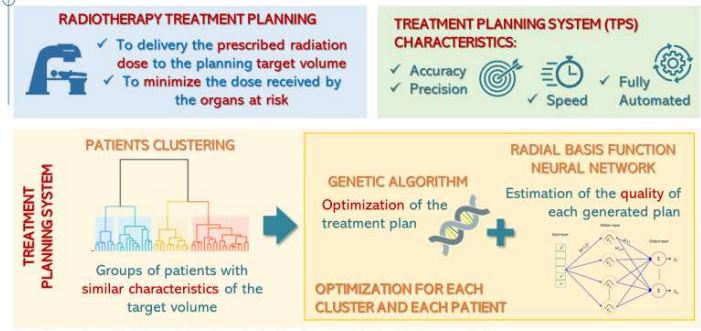
EXAMPLES OF APPLICATIONS

Weaning from Mechanical Ventilation: Outcome Prediction



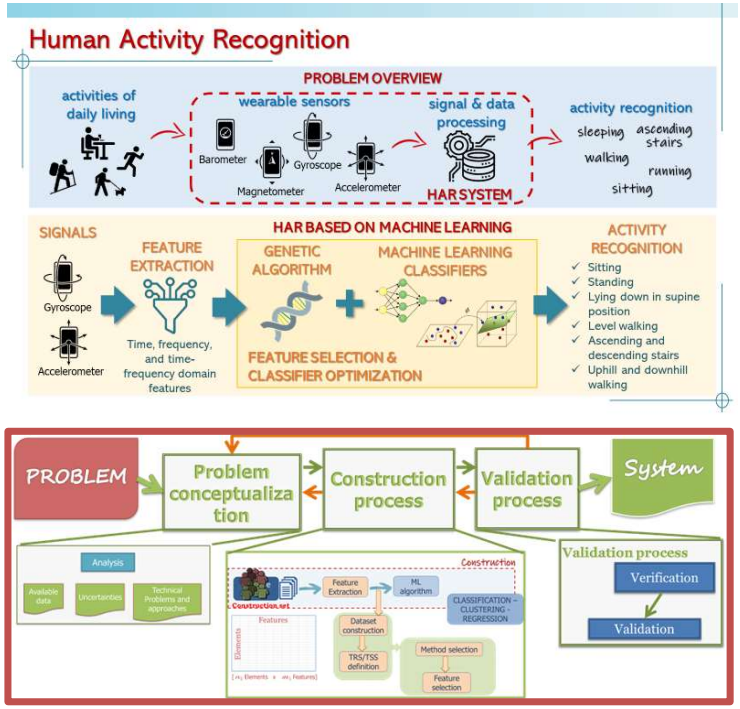
In collaboration with: Dept. of Surgical Science, Section of Anaesthesiology and Intensive Care, Città della Salute e della Scienza di Torino - San Giovanni Battista Molinette Hospital, Turin

Optimization of Radiotherapy Treatment Plans

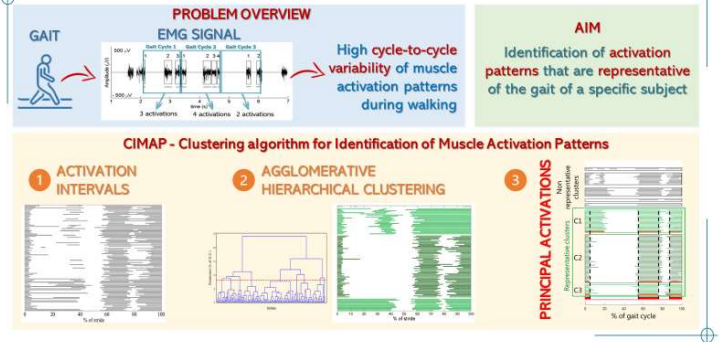


In collaboration with: Dept. of Oncology, Radiation Oncology, Università di Torino, Torino

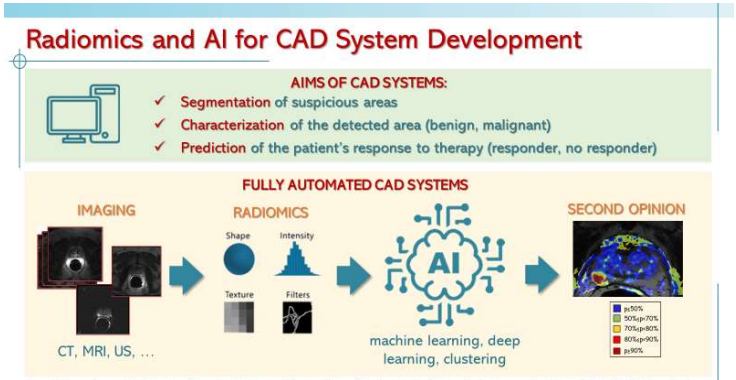
Human Activity Recognition



Identification of Muscle Activation Patterns from sEMG

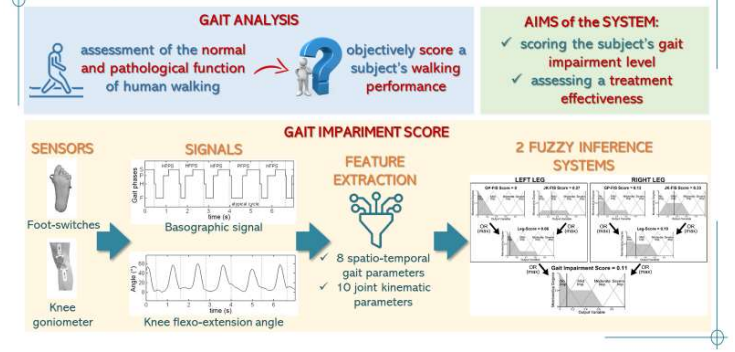


Radiomics and AI for CAD System Development



In collaboration with: Dept of Surgical Science, University of Turin, Turin & Candiolo Cancer Institute FPO-IRCCS, Candiolo

Gait Impairment Score



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Two healthcare apps available for prescription in Germany for first time

Eleven months after the German federal government passed the Digital Healthcare Act (DVG), two health apps are now officially available for prescription.

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FDA action plan puts focus on AI-enabled software as medical device

The agency plans to take a "multi-pronged approach" to advancing oversight of machine learning-enabled devices – with an eye toward ensuring patient safety, algorithm transparency and real-world results.

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The Diverse Roles of AI & ML Global Edition

FDA issues landmark clearance to AI-driven ICU predictive tool

CLEW Medical's ICU tool uses machine learning models to identify patients whose conditions are likely to deteriorate.

By Kat Jercich | February 04, 2021 | 11:42 AM

The U.S. Food and Drug Administration has authorized the use of CLEW Medical's artificial intelligence tool to predict hemodynamic instability in adult patients in intensive care units, the company announced on Wednesday.

The tool, CLEWICU, uses AI-based algorithms and machine learning models to identify the likelihood of occurrence of significant clinical events for ICU patients.

THE DREAM WILL COME TRUE?

Computer are faster than humans to perform computation

But

Humans in most cases are still better in the generalization of their knowledge