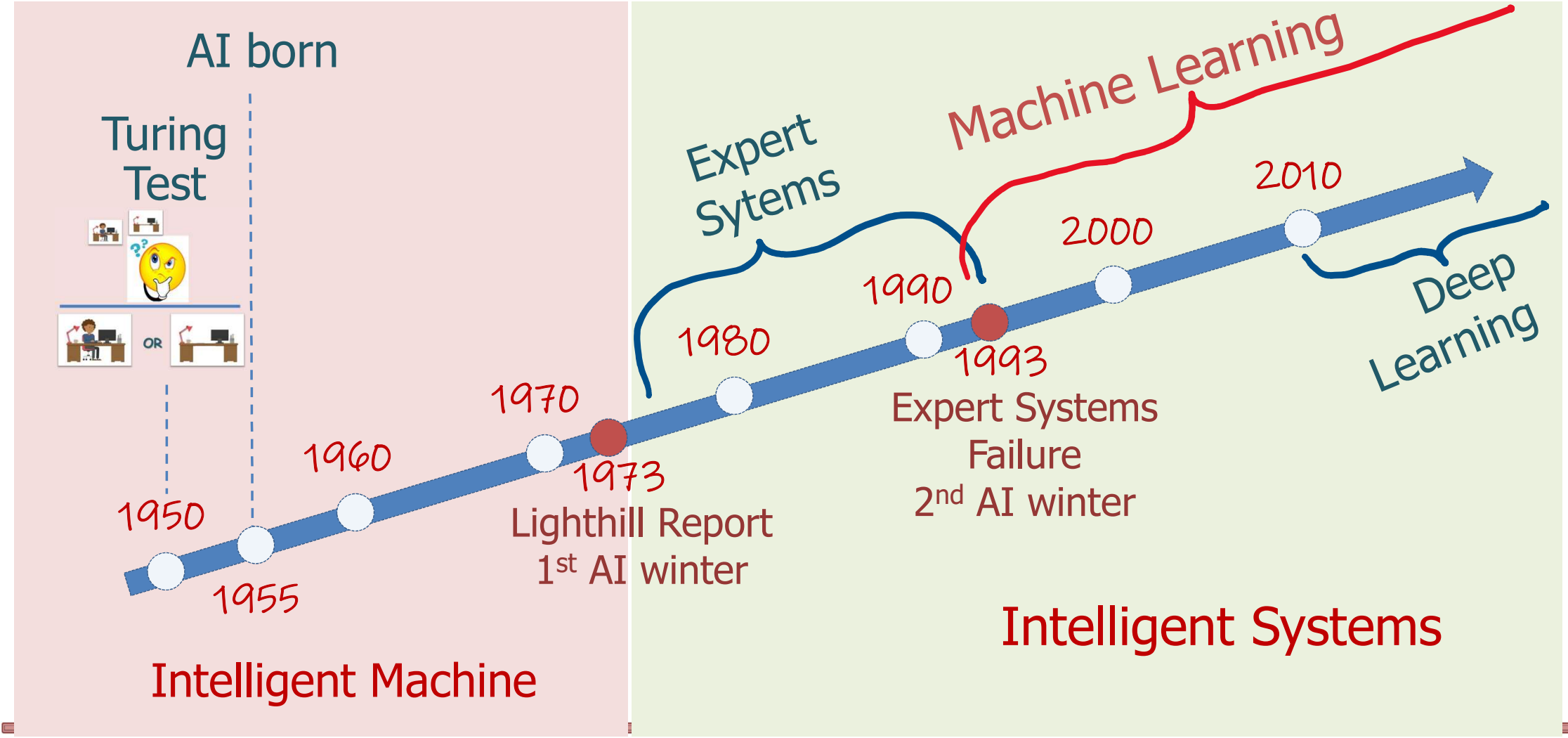
Lezione 6

2 Maggio 2023

Prossime lezioni Balestra

MAGGIO	mart 2	16.00-17.30
	ven 5	11:30-13
	ven 12	11:30-13
	mart 16	16.00-17.30
	ven 19	13:00-14:30
	ven 26	13:00-14:30
	mart 30	16.00-19.00
GIUGNO	ven 9	11:30-14:30

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 ...

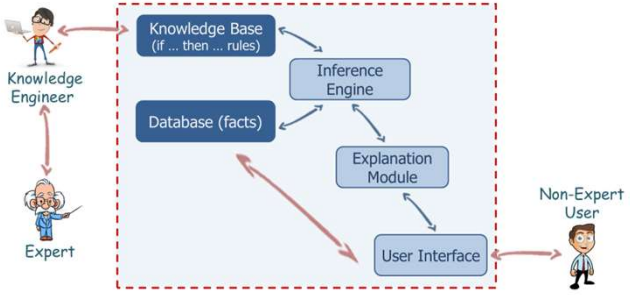
Intelligent Systems

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

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).

Rules elicitation

Consider a simple example:

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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?

R1: Se c'è un semaforo andare ad attraversare al semaforo

R1.1: Arrivati al semaforo se è verde attraversare

R1.2: Arrivati al semaforo se è rosso non attraversare

R1.3: Arrivati al semaforo se è giallo non attraversare attraversare

R1.4: Arrivati al semaforo se diventa giallo mentre stai attraversando cerca di affrettarti

R1.5: Arrivati al semaforo se è rosso, ma non ci sono auto in arrivo puoi attraversare

R2: Se non c'è semaforo, ma ci sono i passaggi pedonali utilizzarli

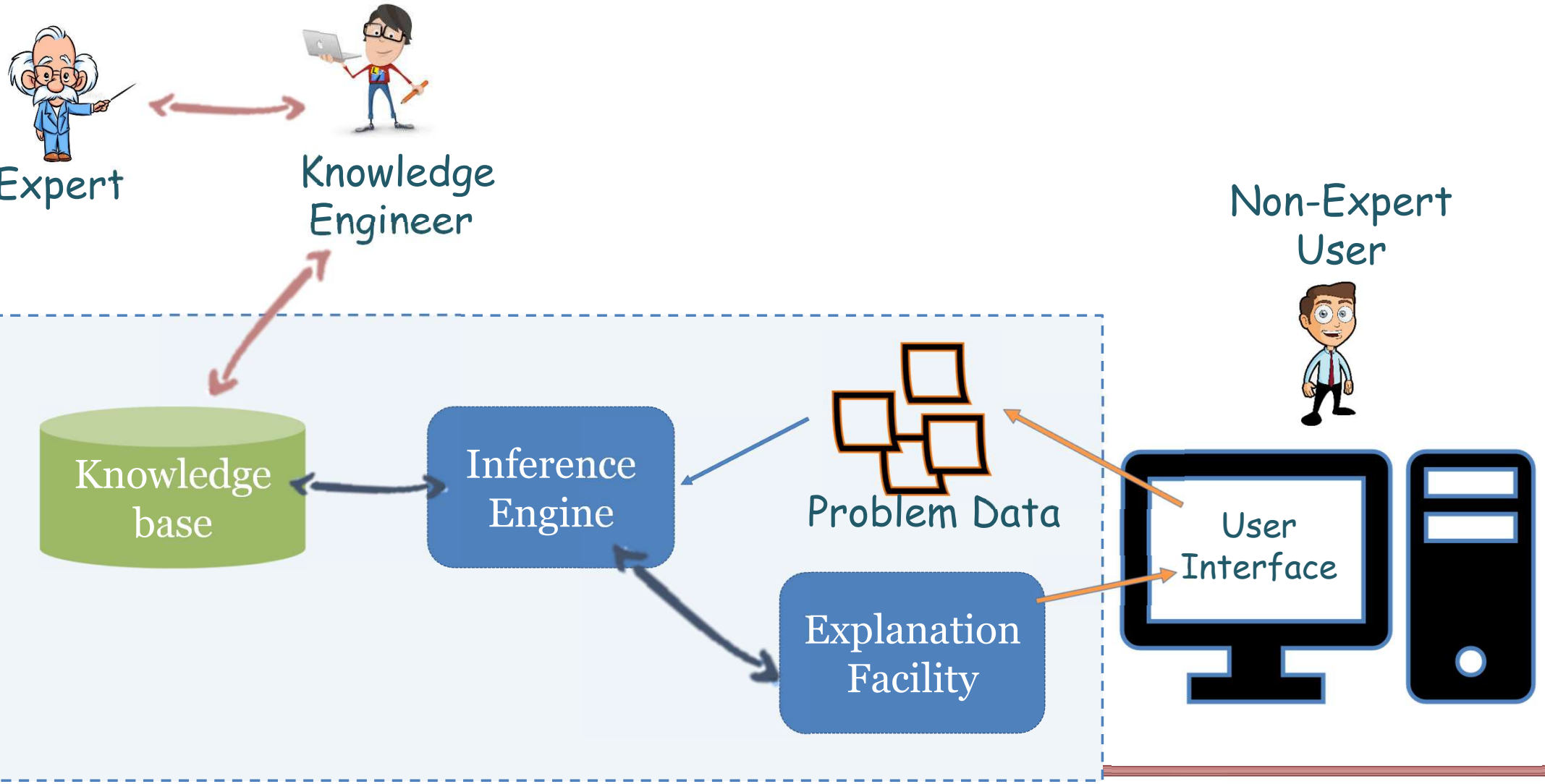
R2.1: Se ci sono delle auto in arrivo valutare se si fermeranno …

Padlet

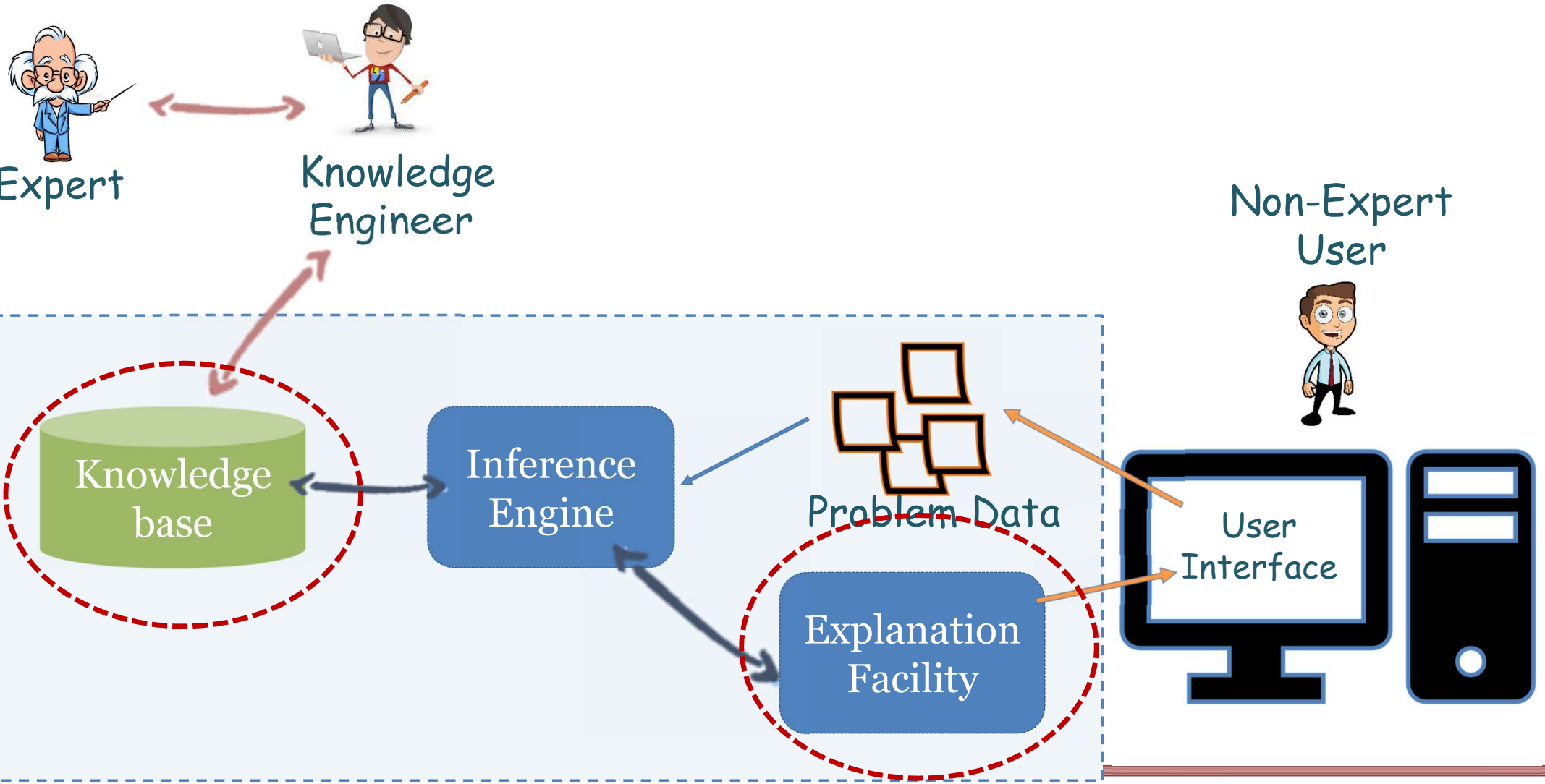
assistenza-sanitaria-e-intelligenza-artificiale-vwhqhqb5flmhnpkr

Costruire le regole da utilizzare per il seguente problema: "organizzare un viaggio"

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*

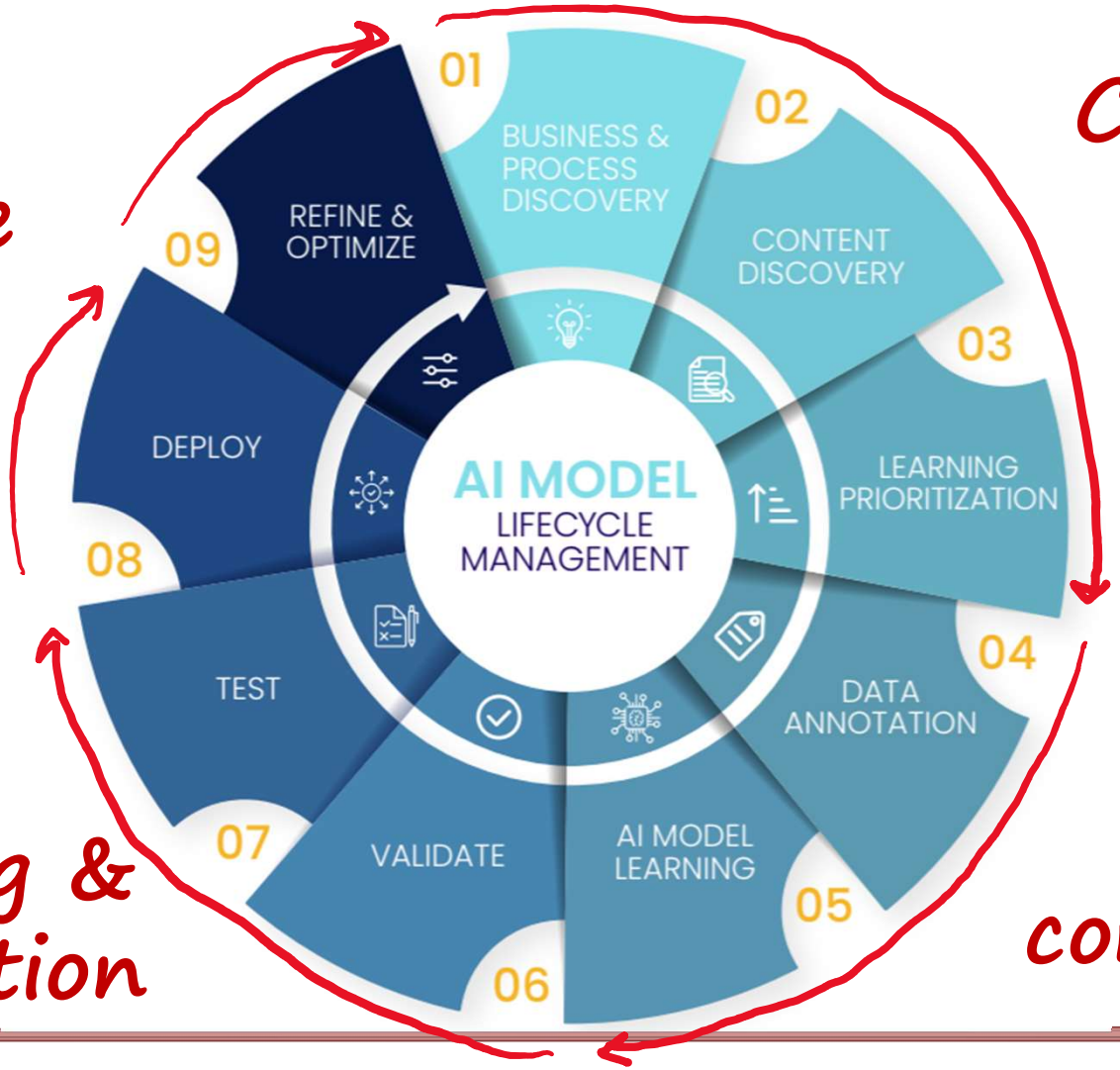
THE DREAM WILL COME TRUE?

Computer are faster than humans to perform computation

But

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

AI tools life cicle



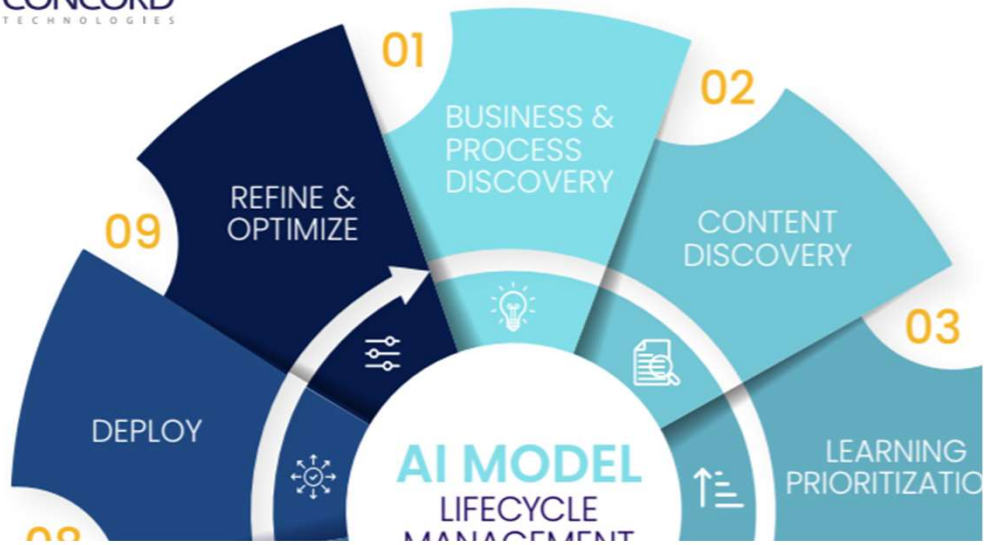
Conceptualization

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.

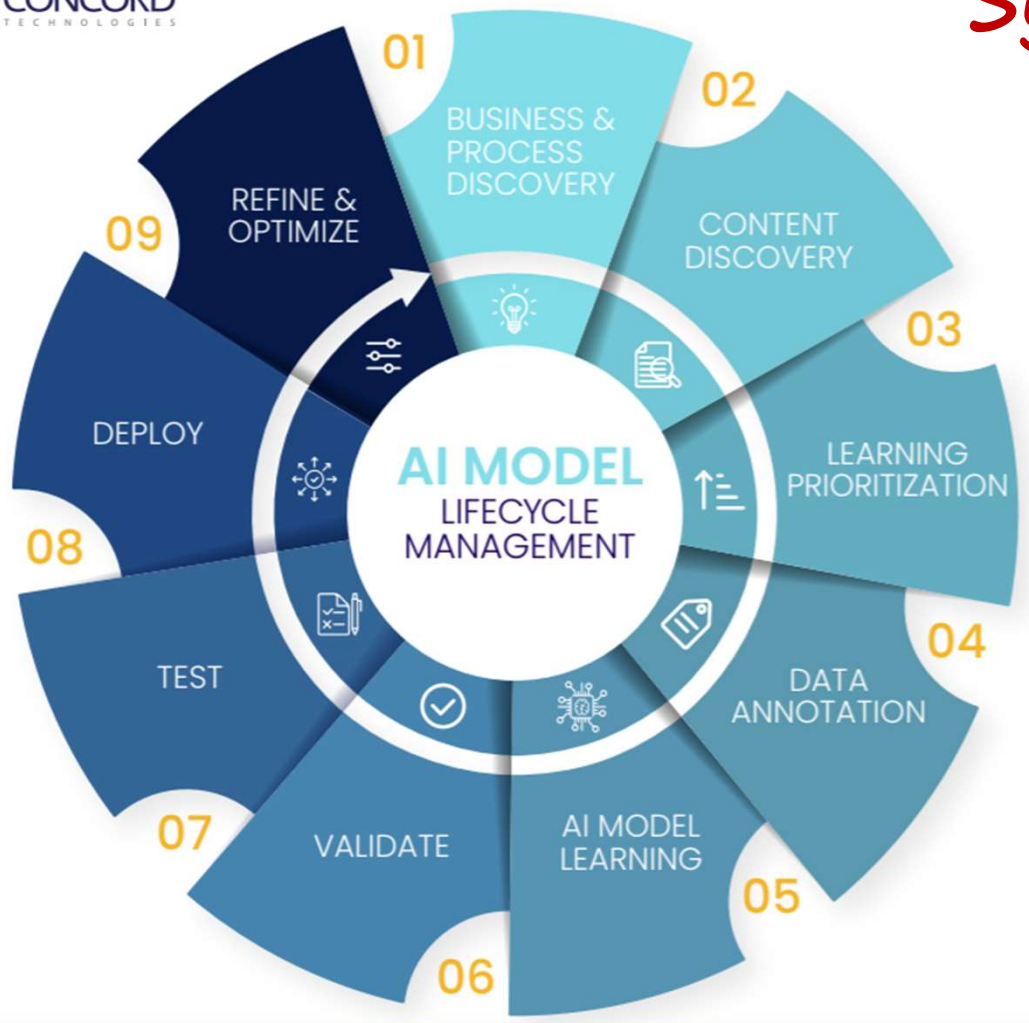
3

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.

AI tools life cicle

CONCORD TECHNOLOGIES

Testing & Validation

6

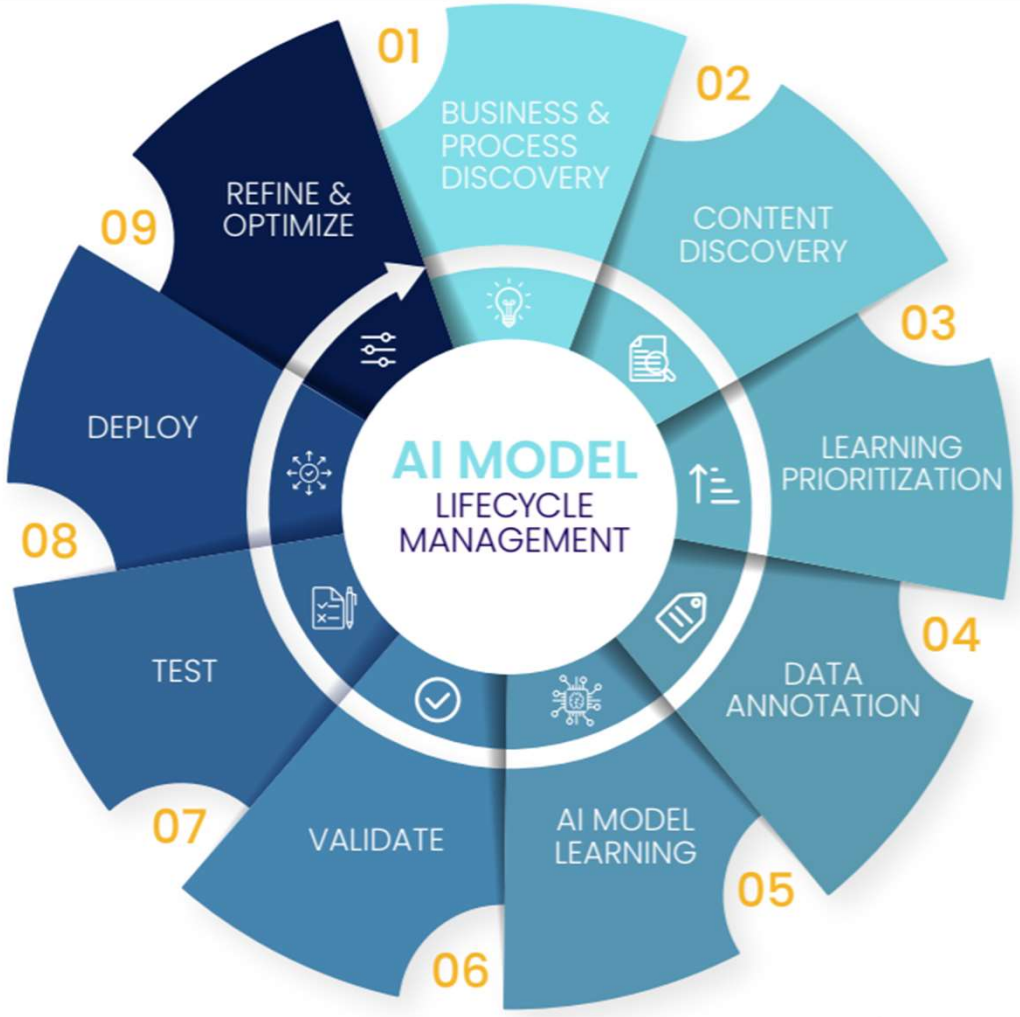
VALIDATE

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.



AI tools life cicle

CONCORD TECHNOLOGIES

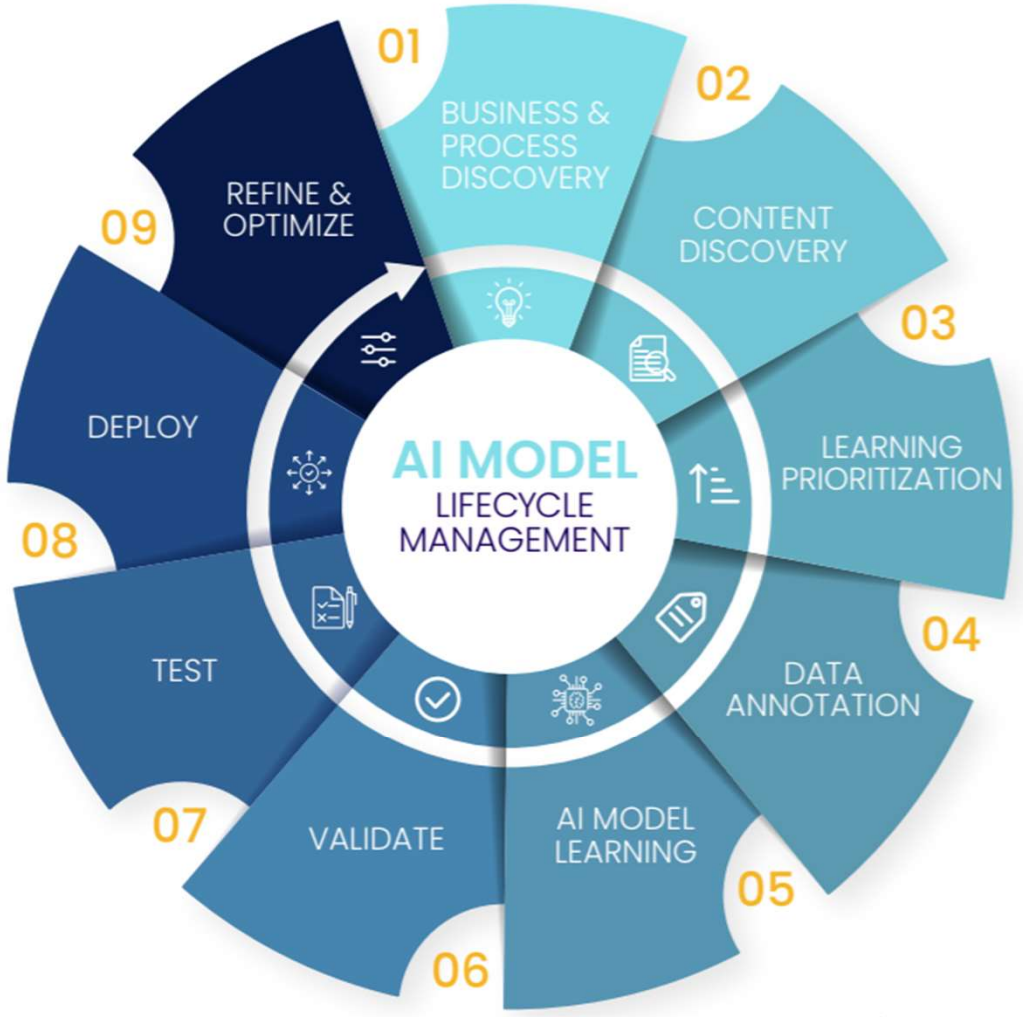
08 DEPLOY

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

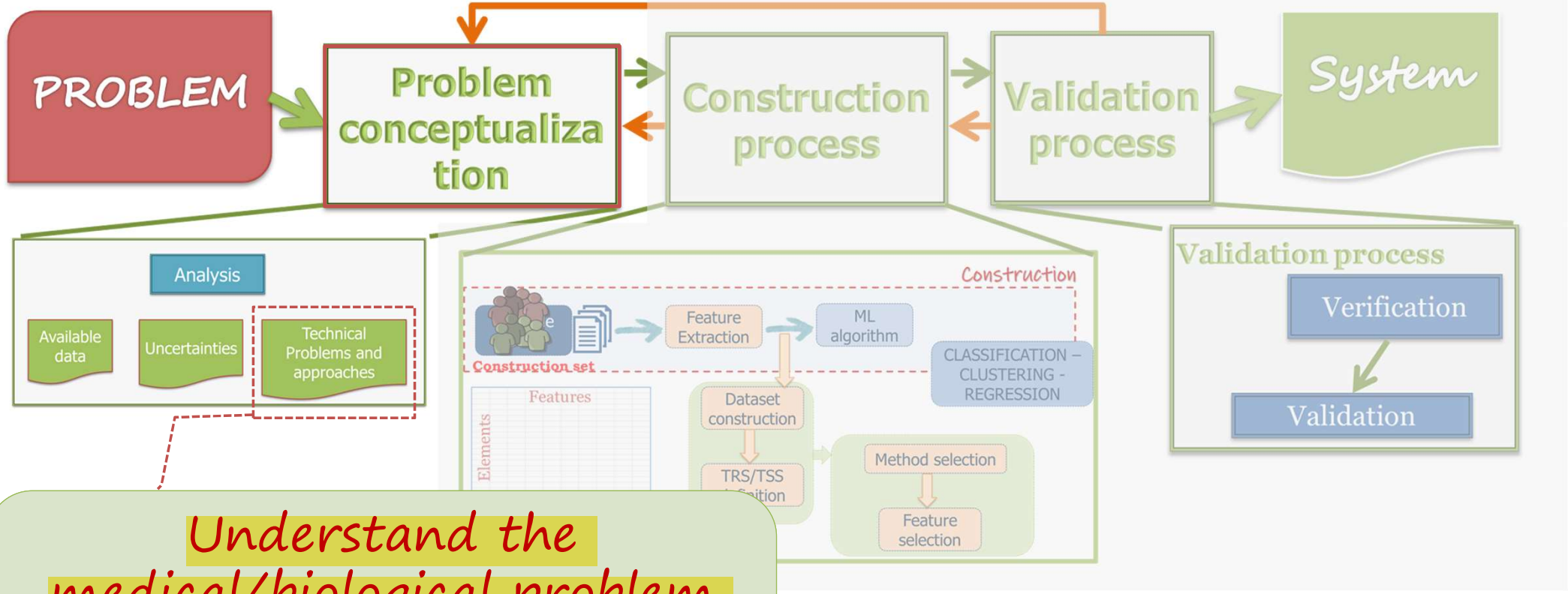
Once the AI is deployed into production, refinements to the model can be made. Refining and optimizing is an iterative process. Over time, AI's accuracy will continue to improve as it learns more about the data it is processing.

Use



The steps to construct an intelligent systems

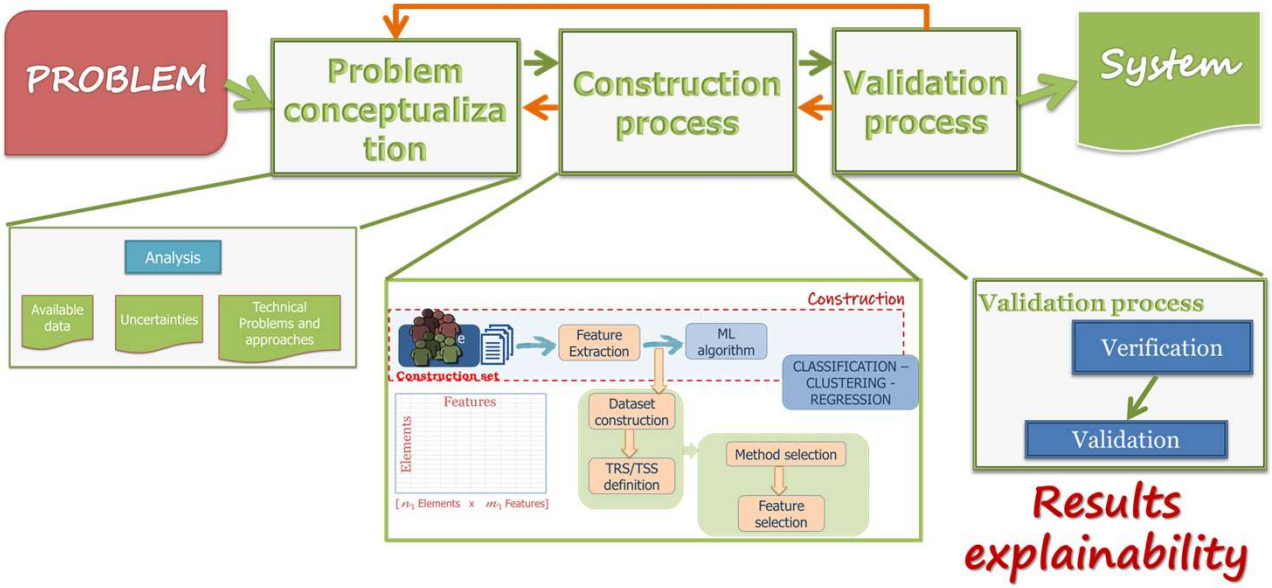
The steps to construct an intelligent systems

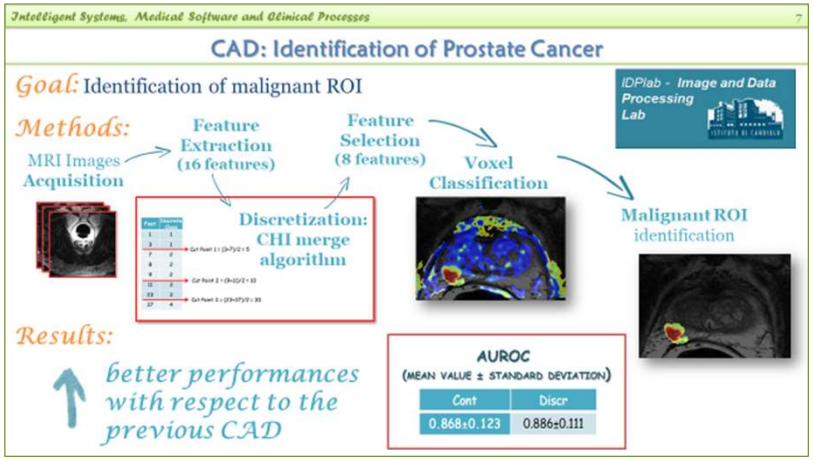


Understand the medical/biological problem and associate the technical(s) problem(s) to it

FROM PROBLEM …… TO «SOLUTION»

SOLUTION means a SYSTEM TO SUPPORT MEDICAL DECISIONS on DIAGNOSIS or THERAPY PRESCRIPTION

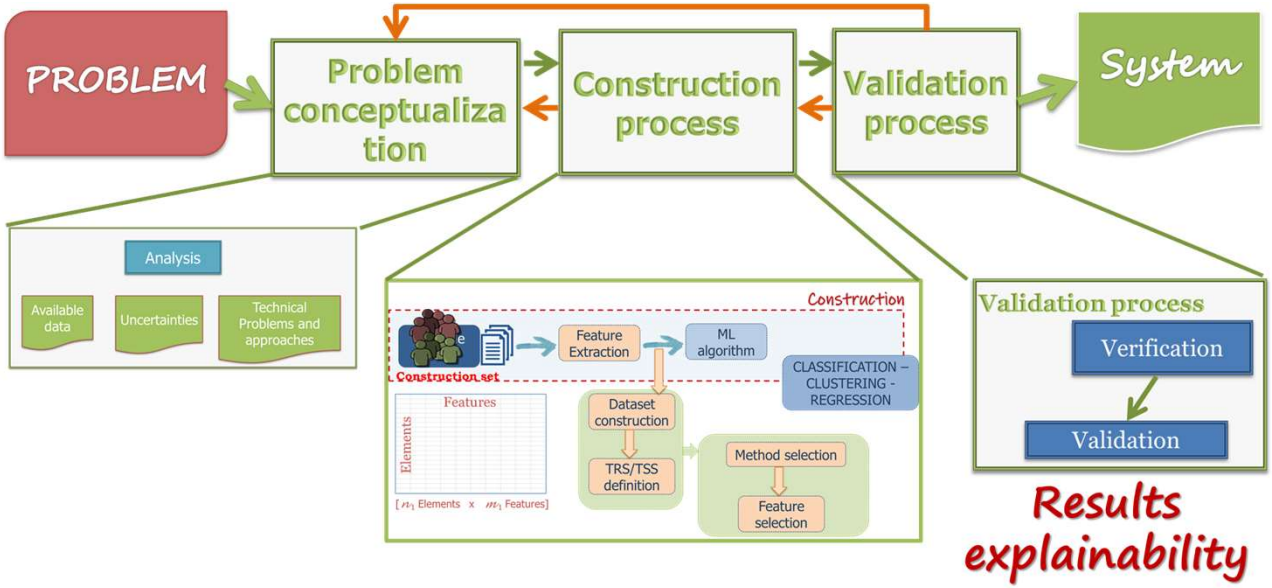


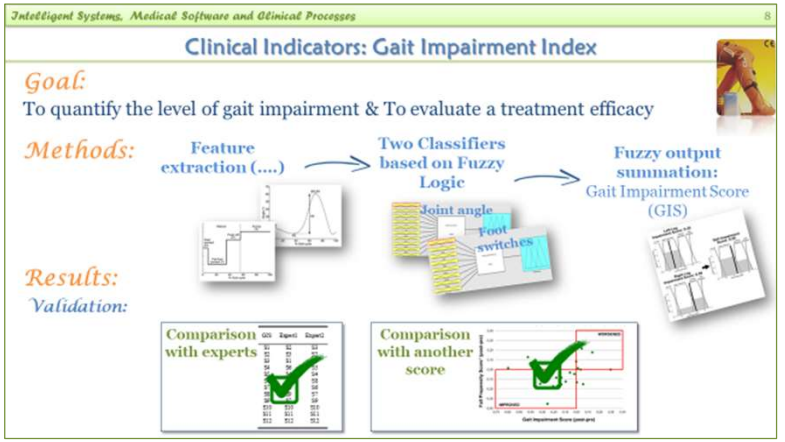


This kind of system provides a possible solution or a set of solutions that must be evaluated by the *user*.

FROM PROBLEM …… TO «SOLUTION»

SOLUTION means an INDICATOR TO SUPPORT PATIENT MONITORING or THERAPY RESULTS EVALUATION or …

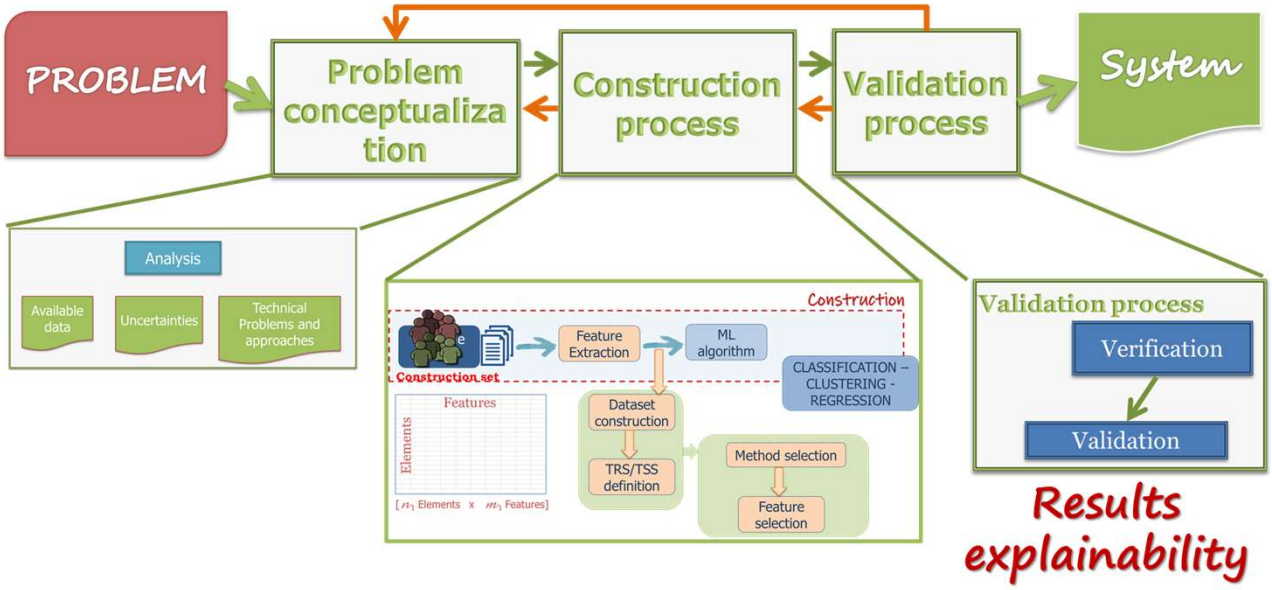


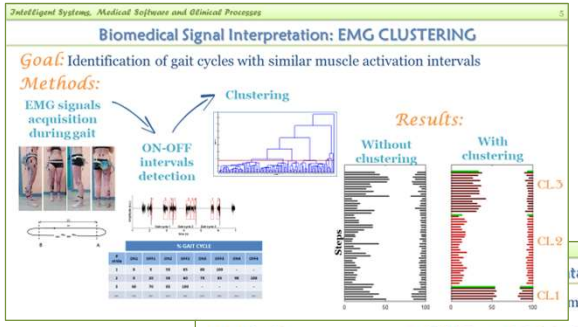


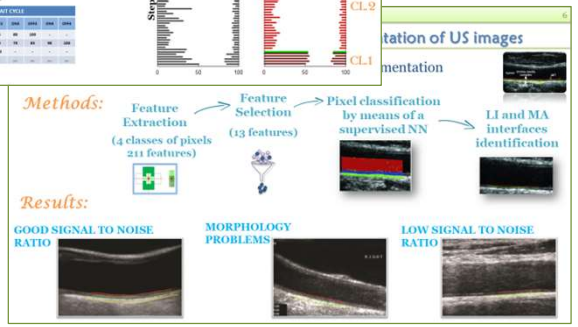
An indicator is the result of the aggregation of different parameters.

FROM PROBLEM …… TO «SOLUTION»

SOLUTION means an ALGORITHM or a SYSTEM TO SUPPORT SIGNALS or IMAGES INTERPRETATION



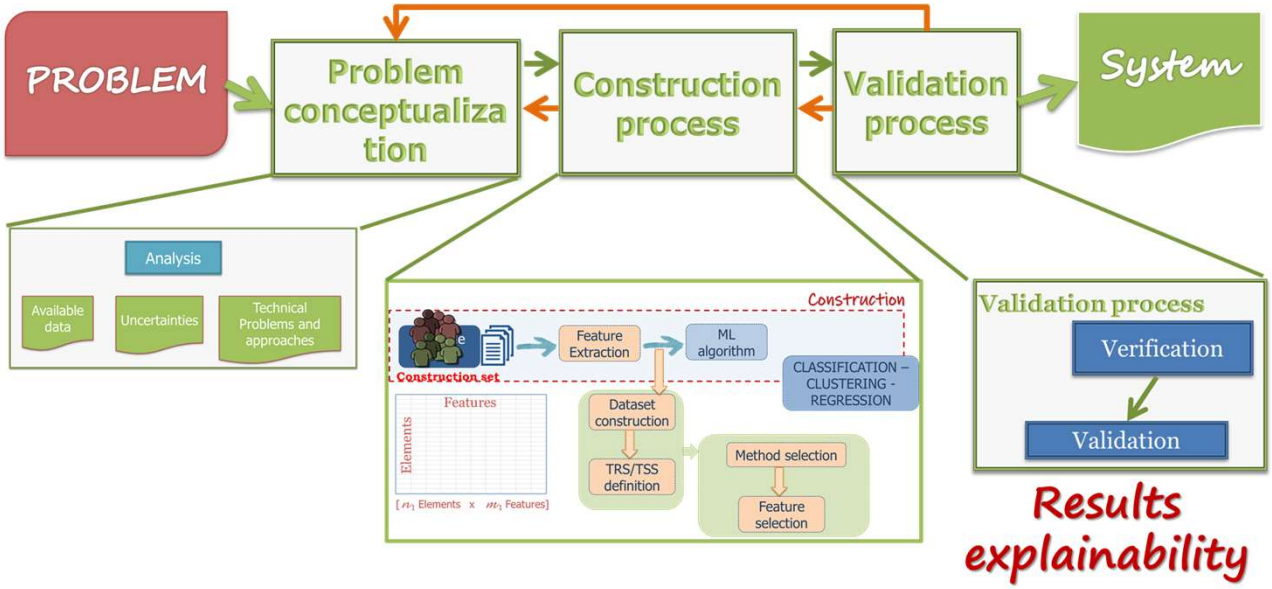


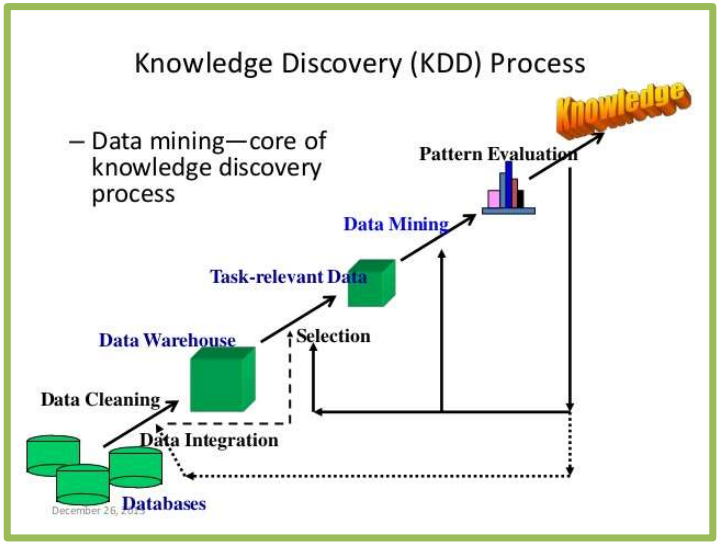


Also expert may have difficulty in extracting information from signals or images. Examples of this kind of algorithms are image segmentation algorithms or detecting patterns in biosignals.

FROM PROBLEM …… TO «SOLUTION»

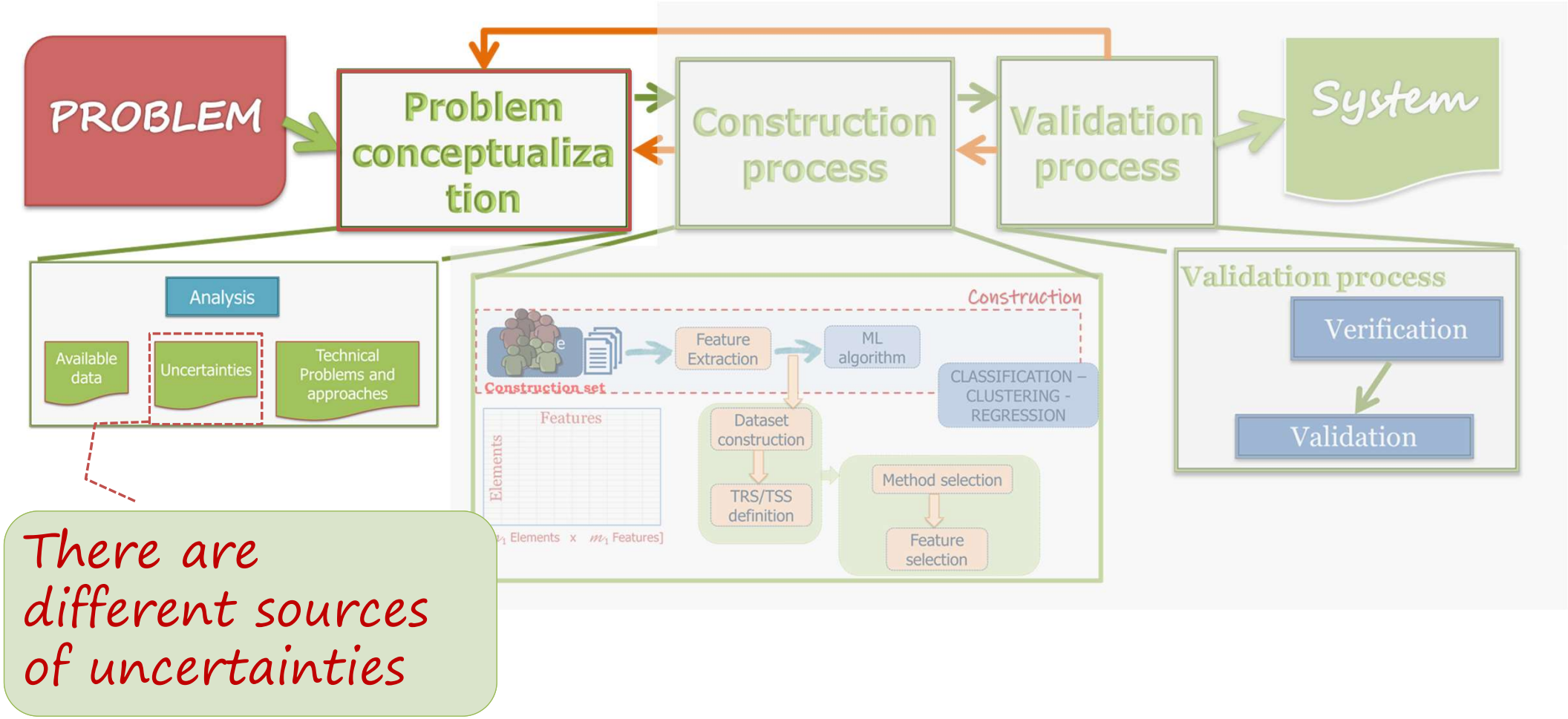
SOLUTION means NEW KNOWLEDGE



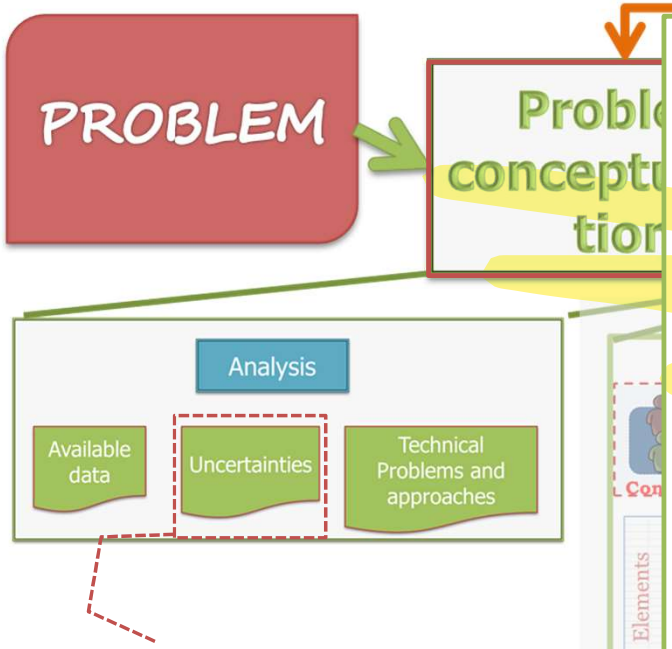


Extracting knowledge for large datasets is a challenging process.

The steps to construct an intelligent systems



The steps to construct an intelligent systems



There are different sources of uncertainties

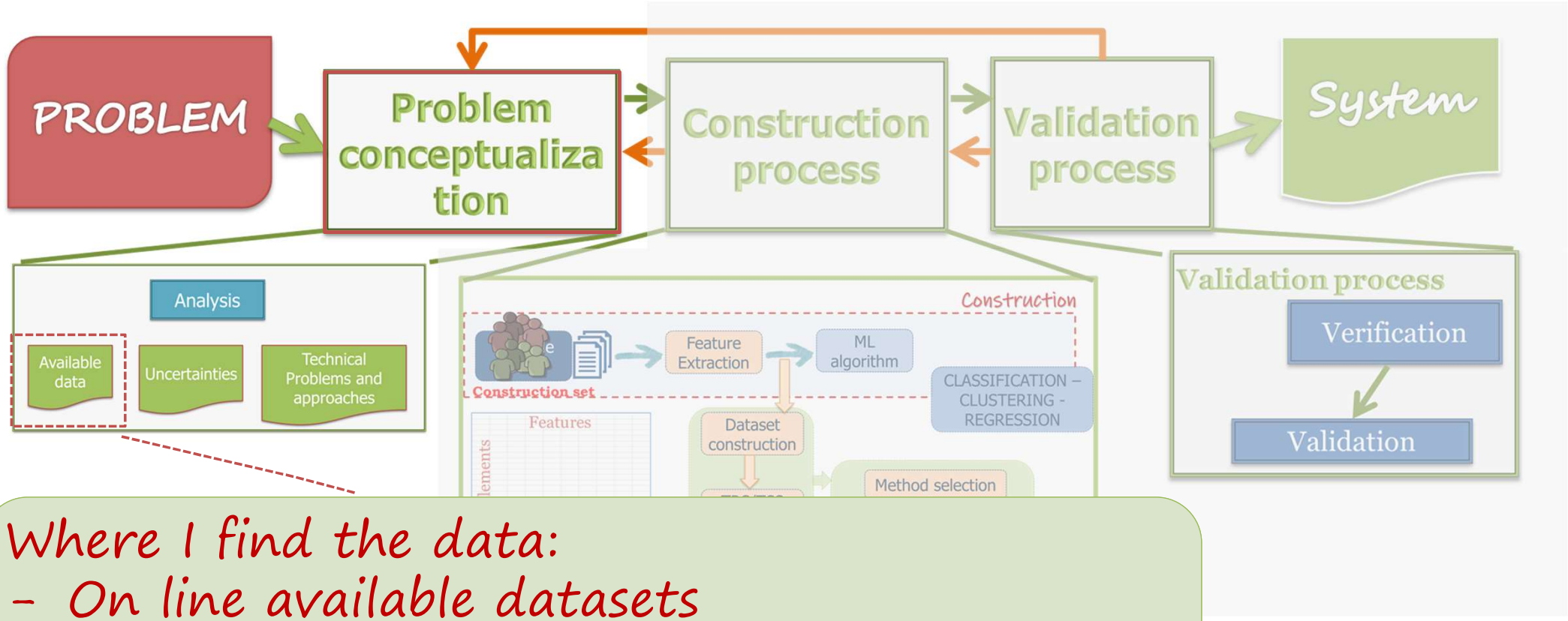
UNCERTAINTY may have different origins.

The most common type of UNCERTAINTY is that linked to **DATA**: measurements errors, judgments related to "border line" situations, thresholds …

A second type of UNCERTAINTY is associated with **KNOWLEDGE**: there is incoherency among different rules, there are conflicting objectives, there is uncomplete knowledge …

Finally, UNCERTAINTY may be caused by **DECISION THAT CANNOT BE CONTROLLED**.

The steps to construct an intelligent systems



Where I find the data:

- On line available datasets
- Clinical trials
- Clinical centers, healthcare facilities