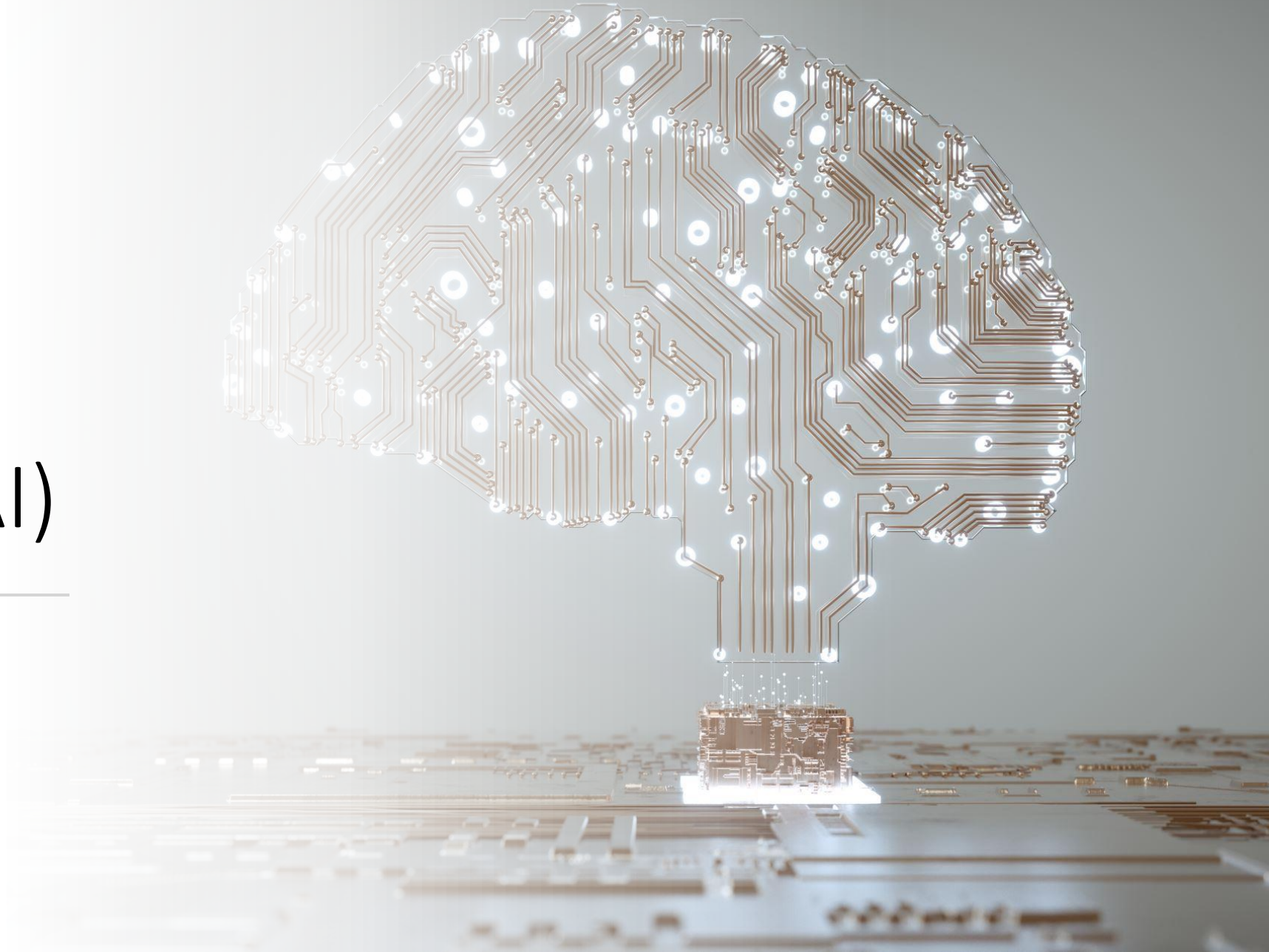




Artificial Intelligence (AI)

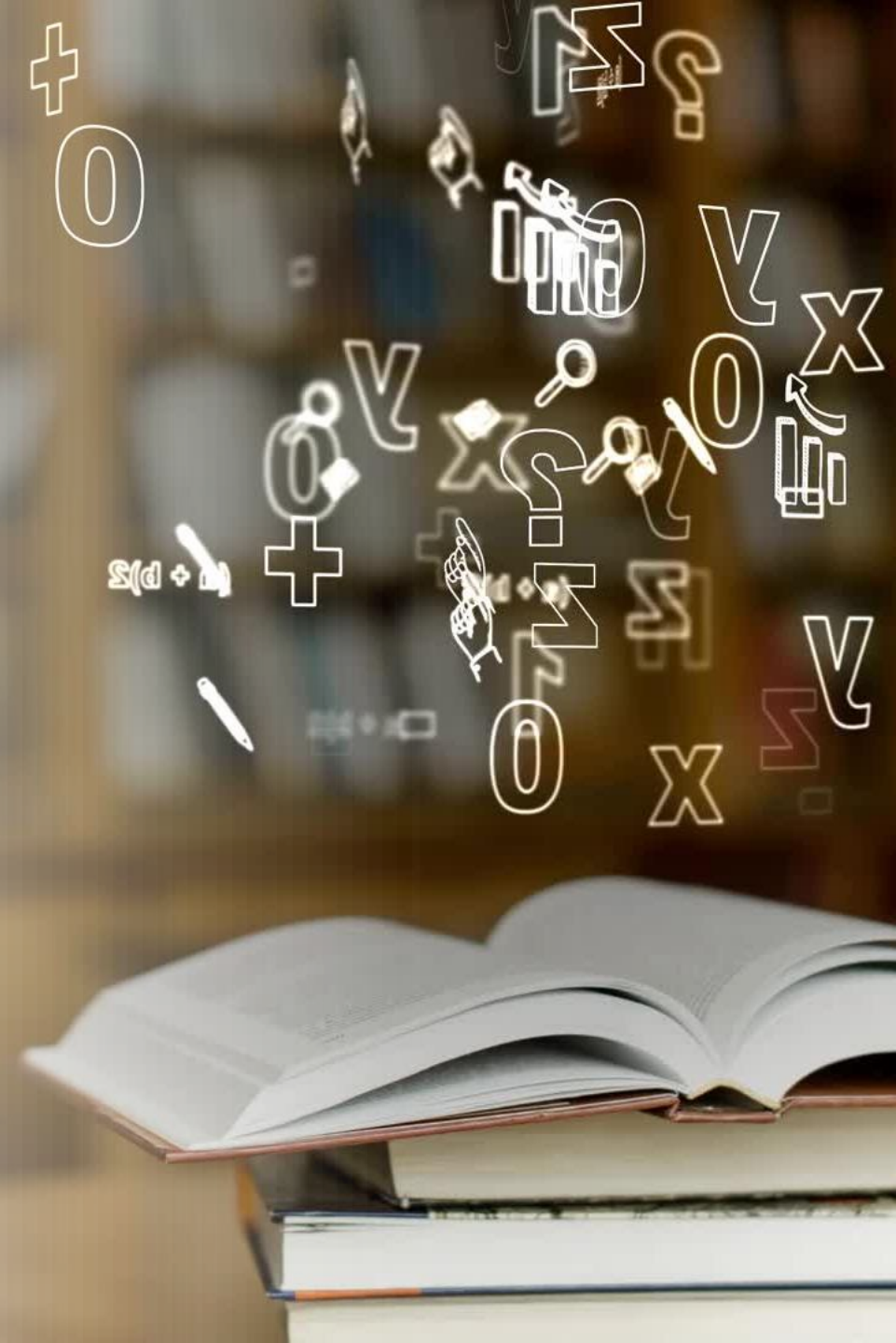
Introduction





Short description:

Extending the knowledge of the course Introduction to artificial intelligence to: theory of representation of the knowledge (approximation of sets), fuzzy logic, artificial neural networks. Skills in theoretical and practical using theory and methods are particularly requirement., as well building of new algorithms is demand.



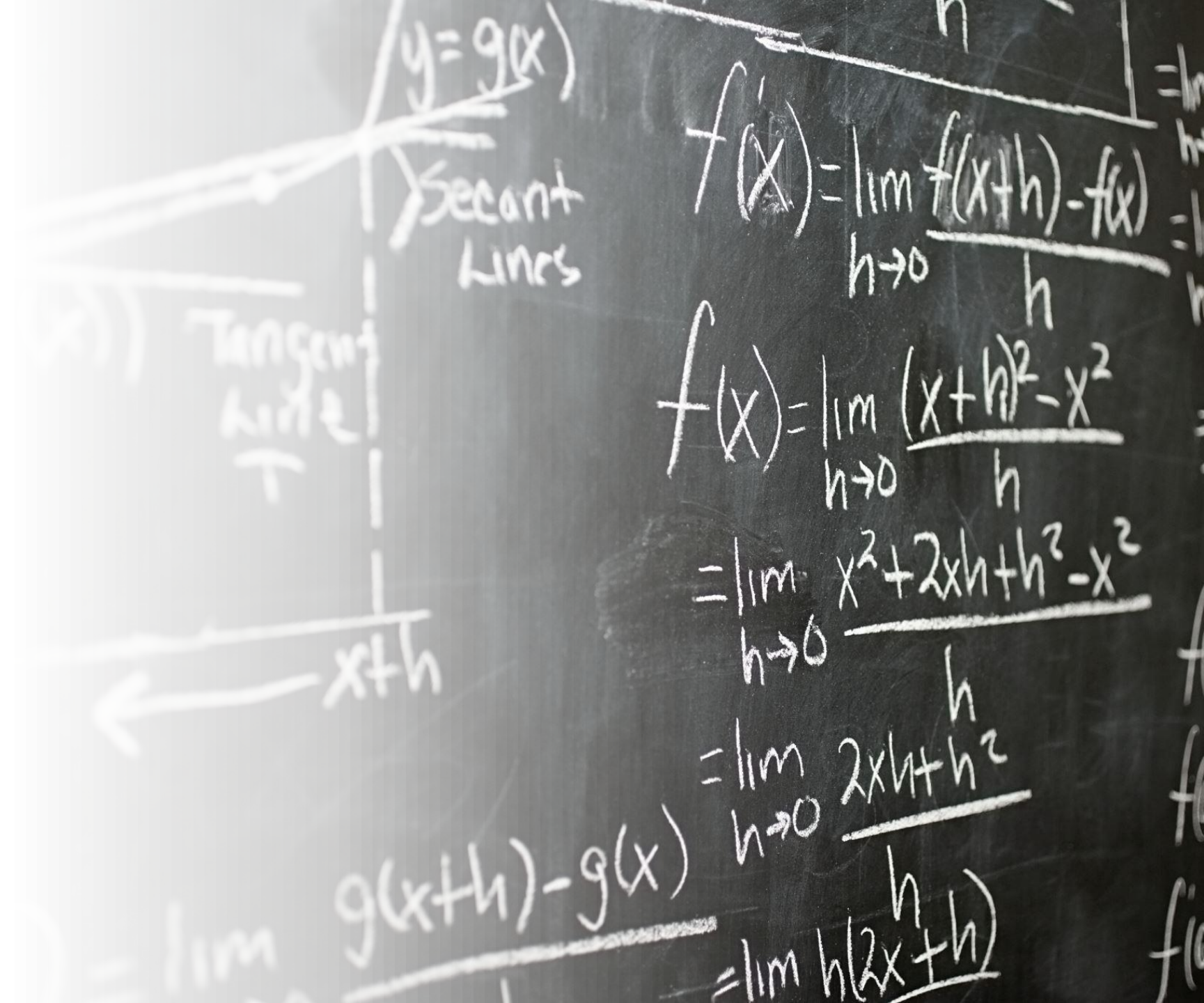


Learning outcomes:

1. One has understanding mining of computer sciences and applications,
2. Is able to use algorithms of artificial intelligence to solve problems,
3. Recognize practical problems which can be solved by algorithm,
4. On one's own is able to solve practical problems building new algorithms of artificial intelligence,
5. One can analyze advanced algorithms and make their implementation,
6. One has ability to self-education and is open for new direction of computer sciences,
7. Is able to work in team.

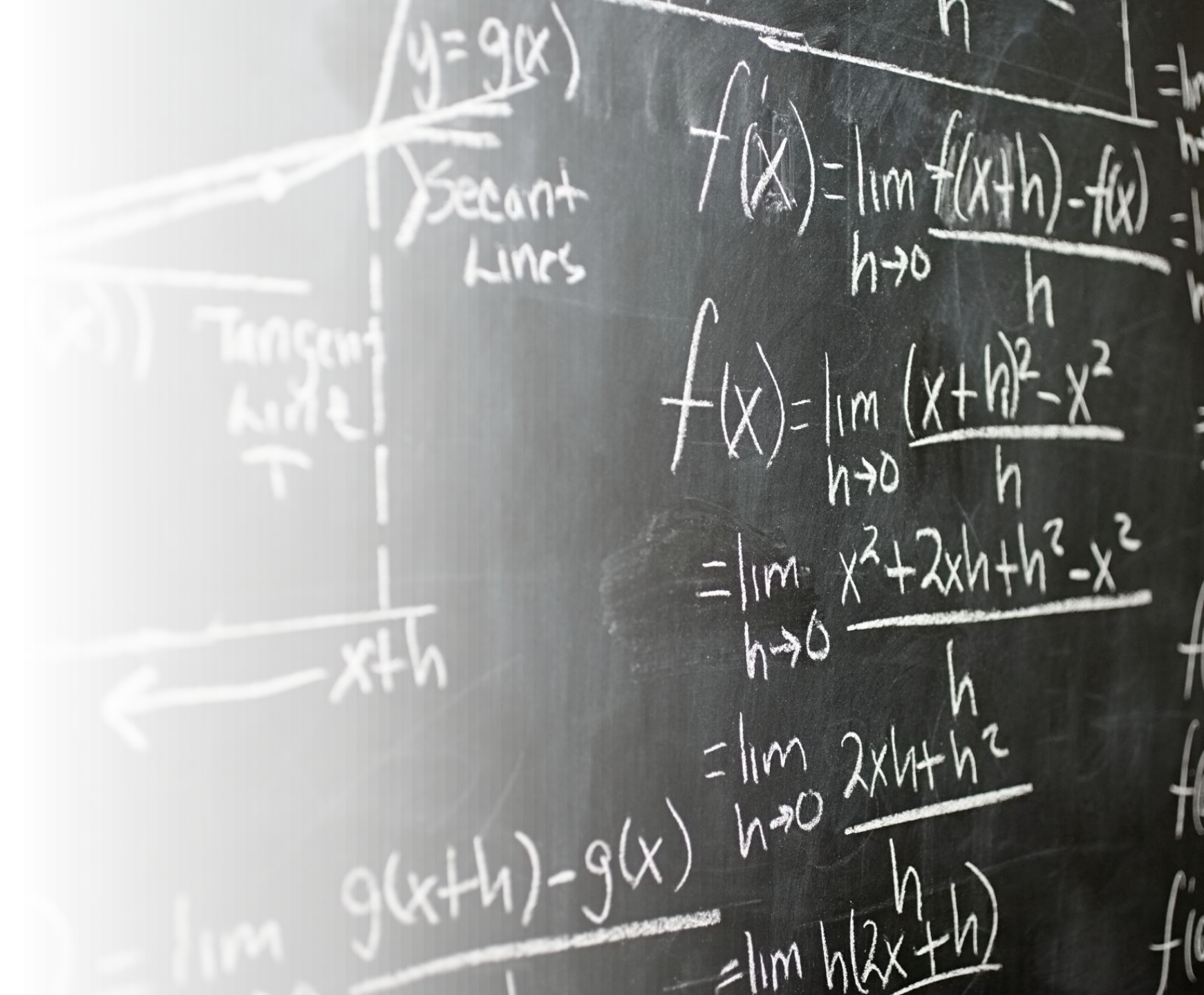
Type of class:

- Laboratory, 28hours
- Lecture, 28 hours



Method and Criteria of Assessment:

- Mark for subject is an average of mark for
 - lab (50%) and
 - lectures (written test) (50%).





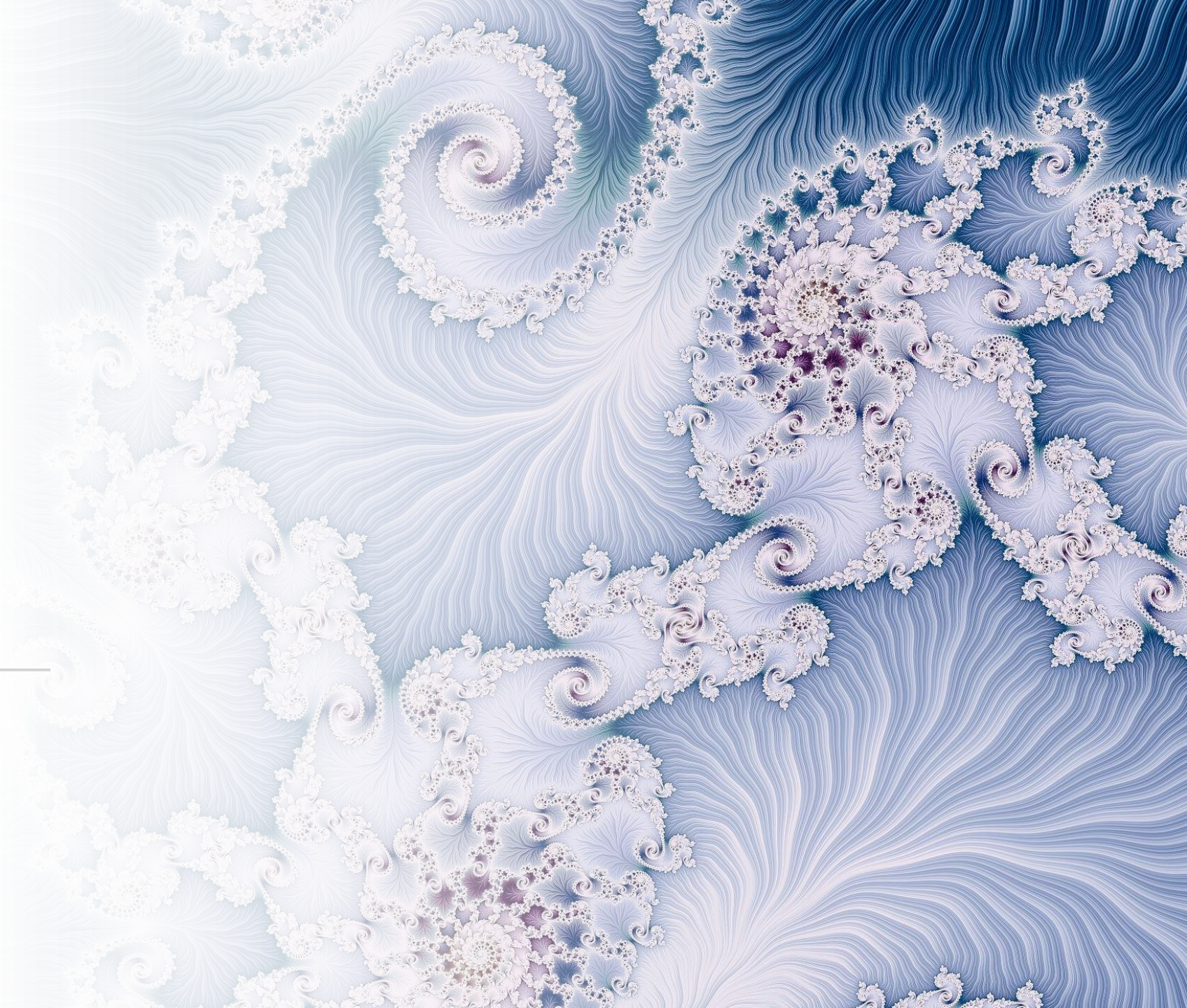
Lectures

1. Artificial intelligence - introduction
2. Fuzzy logic - introduction
3. Fuzzy logic - fuzzy driver
4. Classical genetic algorithm
5. Search algorithms
6. Min_max
7. Neural networks - construction of a neuron, construction of a network
8. Neural networks - gradient learning method
9. Neural networks - LM learning method
10. Examples of neural networks
11. Neural networks in Matlab
12. Neural networks in Statistica
13. Neural networks in games
14. Test





Introduction

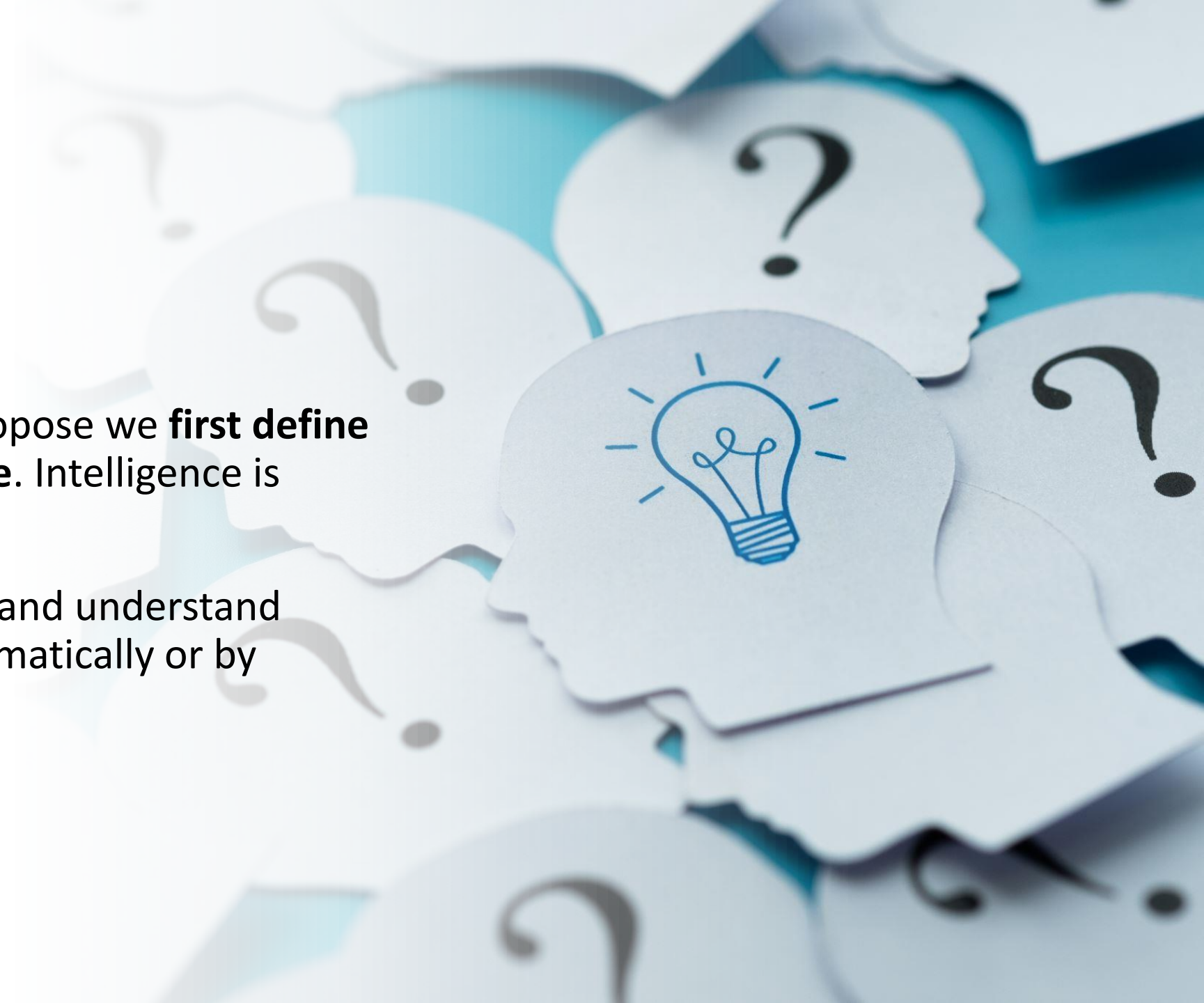




What is intelligence ?

To answer this question I propose we **first define what is (human) intelligence**. Intelligence is

‘the ability to think, reason, and understand instead of doing things automatically or by instinct’



What is intelligence ?

I particularly like this other definition of intelligence by Jeff Schweitzer:



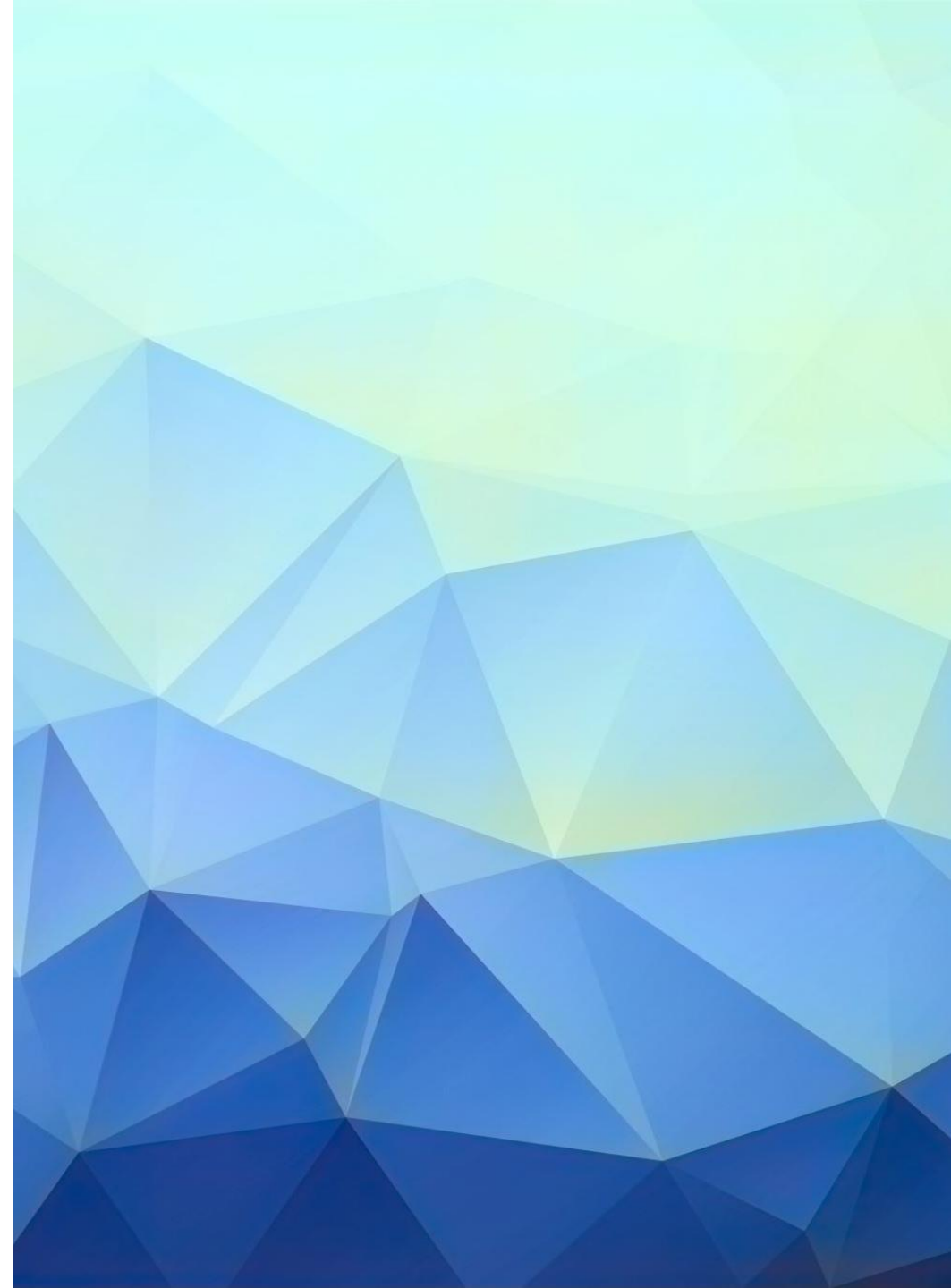
“Intelligence can be thought of as the ability to learn from experience (acquire and retain new knowledge), and to subsequently apply that new knowledge with flexibility to manipulate or adapt to a changing environment. Or intelligence can be seen as the ability to create abstract thought, beyond instinct or responses to sensory input.”



What is intelligence ?

Neel Burton proposes to define intelligence by its opposite, dementia. He writes :

“In Alzheimer’s disease, the most common form of dementia, there is disturbance of multiple higher cortical functions including memory, thinking, orientation, comprehension, calculation, learning capacity, language, and judgement”. Intelligence would therefore be the opposite of all that.





What is intelligence ?

Summing up the various definitions, **intelligence could be briefly (and very incompletely) defined as :**

- the ability to memorize and learn from experience
- the capacity to think and to be creative
- the ability to speak
- the capacity to judge and make decisions

What is intelligence ?

Intelligence can also be more than just those factual abilities, the absence of which defines dementia. Feeling emotions is certainly also what makes us intelligent beings (don't we speak of "emotional intelligence" and emotional IQ?) . But I think we'll leave it aside for the moment and will just focus on the most obvious aspects.



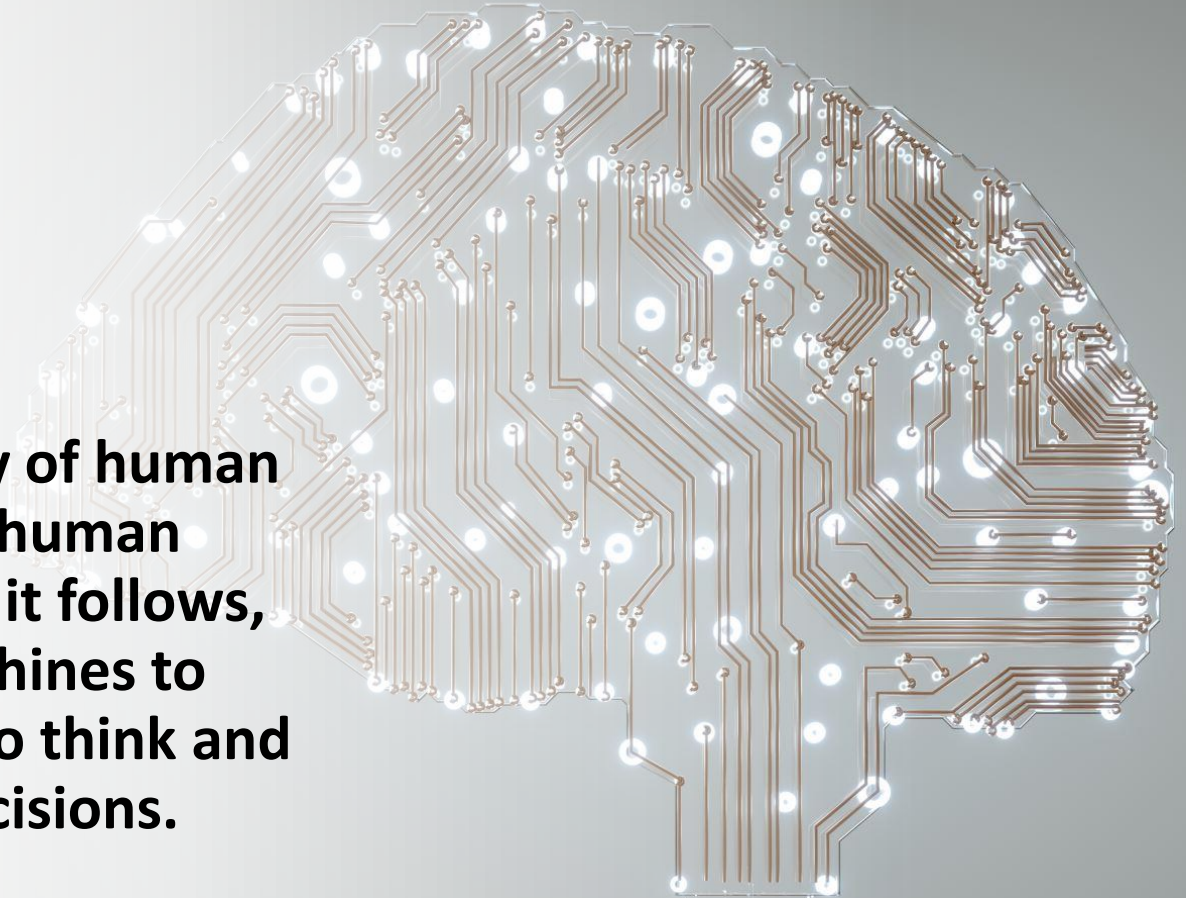
What is artificial intelligence ?

The Oxford dictionary defines the adjective “artificial” as follows : “Made or produced by human beings rather than occurring naturally, especially as a copy of something natural.”



What is artificial intelligence ?

Artificial intelligence is therefore a copy of human intelligence. It aims at reproducing the human brain's functions. Artificial intelligence, it follows, is the capacity given by humans to machines to memorize and learn from experience, to think and create, to speak, to judge and make decisions.



What is artificial intelligence ?

Mimicking the functioning of the brain may seem as a unsurmountable challenge. The human brain, shaped by millions of years of evolution, is an incredibly efficient machine. It's able to process up to 10^{17} - 10^{18} operations per second at a cost of 25W while the best GPU cards can process 10^9 – 10^{10} at a cost of 250W. It's 100m less and 10 times more energy.

What is artificial intelligence ?

The very process of creating an artificial intelligence is anchored in the observation of how the human brain works. For instance convolutional networks were inspired by the observation of how visual cortex works. Convolutional neural network have been around since the 90's but found real life applications only when processing and storage became cheaper, in the last decade or so.


There is no
such thing as
artificial
intelligence
... yet

The big hurdle to make artificial intelligence happen is to bridge the gap between recognition and cognition.

So-called artificial intelligence is today capable of recognition; not cognition. Machines operate within the limits set by their designers or within the limits of the datasets they are fed with.


Consider these few examples :

- 100m images are needed to reach 98% reliability for image recognition ; yet it takes only 2 images for a baby to learn that difference
- vocal assistants' answers are based on scripts defined by humans

A large orange circle is positioned on the left side of the slide, partially cut off by the edge. It contains the text 'There is no such thing as artificial intelligence ... yet' in white.

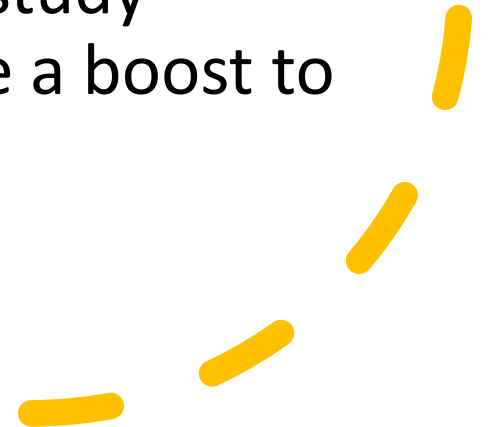
There is no
such thing as
artificial
intelligence
... yet

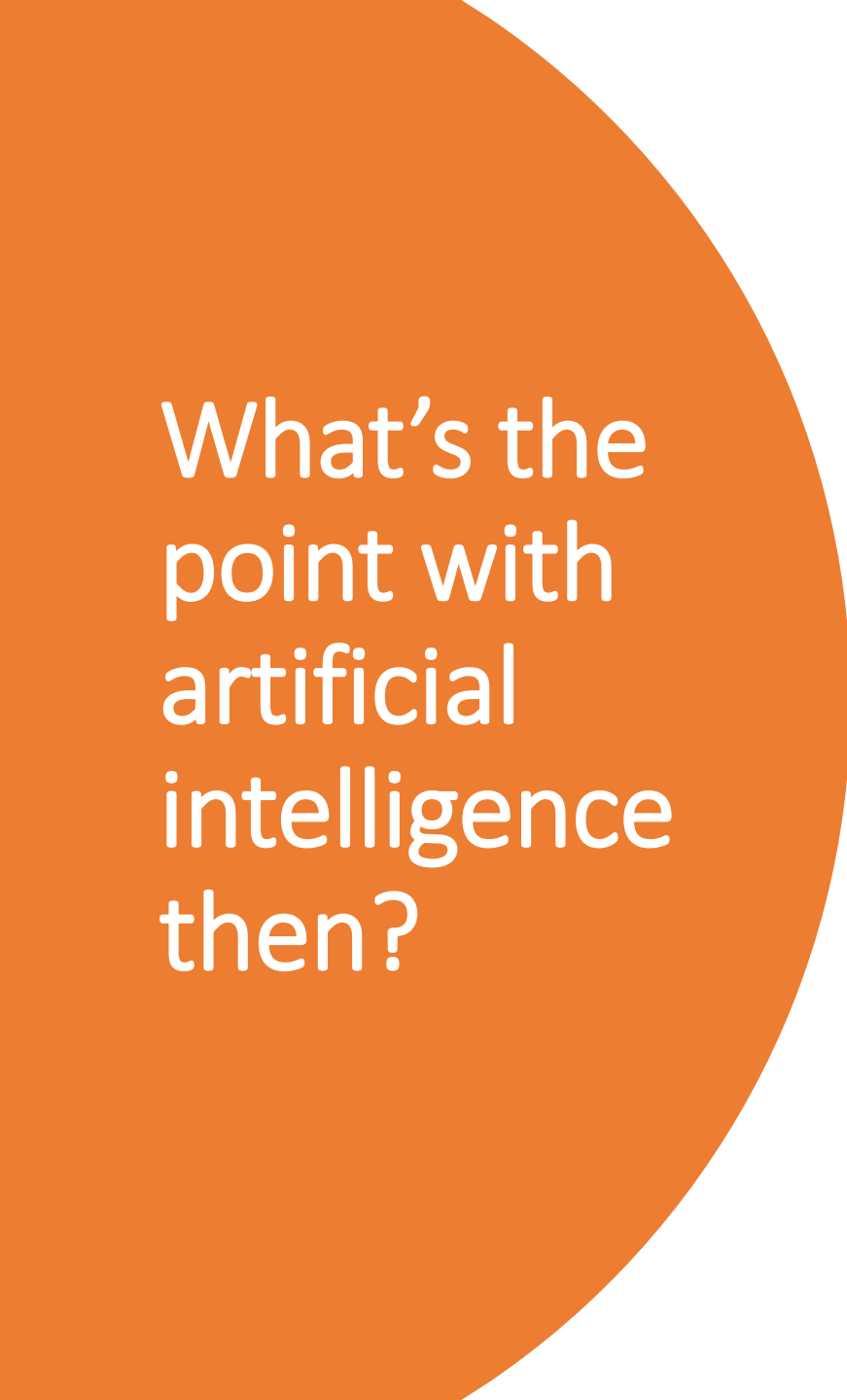
In short, deep-learning makes it possible to train machines on the task to “recognize”. But there are still no technical possibilities to develop an artificial common sense, something that is an integrate part of your human nature. While toddlers can learn rapidly from a few examples, it takes machines massive databases to achieve non-perfect results.

A series of four yellow dashed line segments are arranged in a curved, upward-pointing arc in the bottom right corner of the slide.

What's the point with artificial intelligence then?

While artificial intelligence may seem purely imitational by nature, technology can also be a springboard for fundamental research. In a 2017 interview, Yann Le Cun (the Director of the Facebook Labs) explained that technological innovation sometimes drives fundamental research in one particular area. For example the telescope, invented in the 16th century, made it possible to study astronomy and optics; planes gave a boost to the study of aerodynamics.





What's the
point with
artificial
intelligence
then?

In the end we can say there's many more
advances to make through the combination of
human intelligence and artificial intelligence.



What's the point with artificial intelligence then?

A machine, a computer program, can explore all existing possibilities without without getting tired or being bored, allowing us sometimes to discover something new. Let's call this computer serendipity, in other words an ability to explore systematically what humans may have ignored or forgotten. Maybe movement 37 had been played by someone 2000 years ago but no record has been kept of it. The observation period is just too long to remember and this is where algorithms can be useful, by quickly exploring, over a reasonable period of time, all the solutions to a given problem.

What Is Artificial Intelligence (AI)?

- There are various technical definitions available to describe Artificial Intelligence but all of them are very complex and confusing. We will elaborate on the definition in simple words for your better understanding.
- The humans are considered as the most intelligent species on this earth as they can solve any problem and analyze big data with their skills like analytical thinking, logical reasoning, statistical knowledge, and mathematical or computational intelligence.

What Is Artificial Intelligence (AI)?

- Keeping all these combinations of skills in mind, artificial intelligence is developed for machines and robots which impose the ability to solve complex problems in the machines as similar to those that can be done by humans.
- The artificial intelligence is applicable in all fields inclusive medicine field, automobiles, daily lifestyle applications, electronics, communications as well as computer networking systems.
- So technically the **AI in context to computer networks can be defined as the computer devices and networking system which can understand the raw data accurately, gather useful information from that data and then use those findings to achieve the final solution** and assignment of the problem with a flexible approach and easily adaptable solutions.

Elements Of Intelligence

Reasoning: It is the procedure that facilitates us to provide the basic criteria and guidelines for making a judgment, prediction, and decision making in any problem.

Reasoning can be of two types, one is generalized reasoning which is based on the general observed incidences and statements. The conclusion can be false sometimes in this case. The other one is logical reasoning, which is based on facts, figures, and specific statements and specific, mentioned, and observed incidences. Thus the conclusion is correct and logical in this case.

Elements Of Intelligence

Learning: It is the action of acquiring knowledge and skill development from various sources like books, true incidents of life, experiences, being taught by some experts, etc. The learning enhances the person's knowledge in fields that he is unaware of.

The ability of learning is displayed not only by humans but also by some of the animals and artificial intelligent systems possess this skill.


The learning is of different types as enlisted below:

- Audio speech learning is based on the process when some teacher is delivering lecture then the audible students hear it, memorize it, and then use it for gaining knowledge from it.
- The linear learning is based on memorizing the array of events that the person has encountered and learned from it.
- Observational learning means learning by observing behavior and facial expressions of other persons or creatures like animals. **For Example**, the small child learns to speak by mimicking their parents.
- Perceptual learning is based on learning by identifying and classifying the visuals and objects and memorize them.
- Relational learning is based on learning from past incidences and mistakes and make efforts to improvise them.
- Spatial learning means to learn from visuals like images, videos, colors, maps, movies, etc. which will help people in creating an image of those in mind whenever it will be needed for future reference.






Elements Of Intelligence

Problem Solving: It is the process of identifying the cause of the problem and to find out a possible way to solve the problem. This is done by analyzing the problem, decision making, and then finding out more than one solution to reach the final and best-suited solution to the problem.



The final motto here is to find the best solution out of available ones for achieving the best results of problem-solving in minimal time.




Elements Of Intelligence

- **Perception:** It is the phenomenon of obtaining, drawing an inference, choosing, and systematizing the useful data from the raw input.
- In humans, the perception is derived from the experiences, sense organs, and situational conditions of the environment. But concerning artificial intelligence perception, it is acquired by the artificial sensor mechanism in association with the data in a logical manner.



Elements Of Intelligence

Linguistic Intelligence: It is the phenomenon of one's capacity to deploy, figure out, read, and write the verbal things in different languages. It is the basic component of the mode of communication between the two or more individuals and the necessary one also for analytical and logical understanding.



Elements Of Intelligence



Difference Between Human And Machine Intelligence

- We have explained above the components of human intelligence on the grounds of which the human perform different types of complex tasks and solve the various kind of distinctive problems in diverse situations.
- The human develops machines with intelligence just like humans and they also give results to the complex problem to the very near extent just like humans.
- The humans distinguish the data by visual and audio patterns, past situations, and circumstances events whereas the artificially intelligent machines recognize the problem and handle the issue based on predefined rules and backlog data.

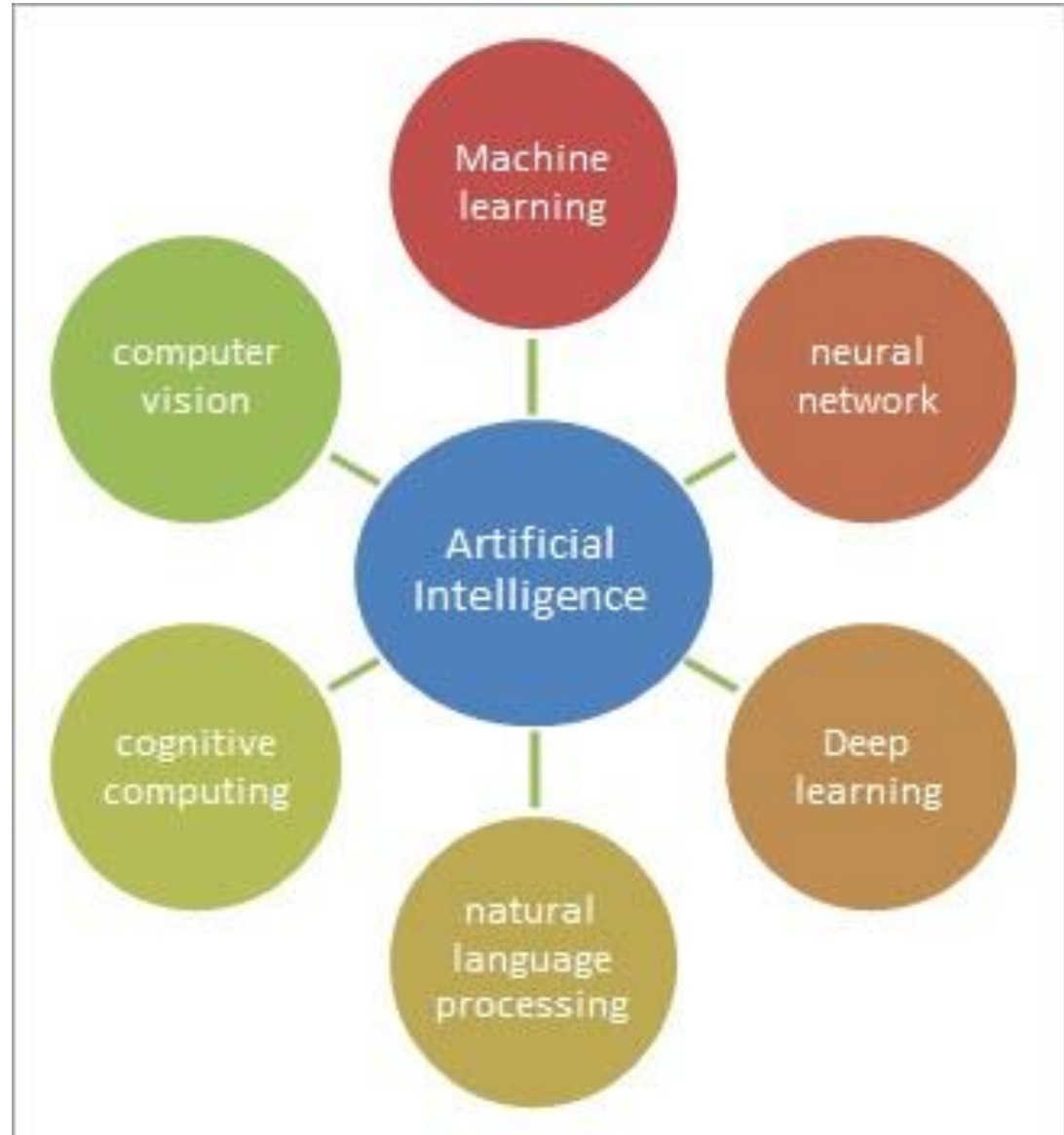
Difference Between Human And Machine Intelligence

- Humans memorize the data of the past and recall it as they learned it and kept in the brain but the machines will find the data of the past by searching algorithms.
- With linguistic intelligence, humans can even recognize the distorted image and shapes and missing patterns of voice, data, and images. But machines don't have this intelligence and they use computer learning methodology and deep learning process which again involves various algorithms to obtain the desired results.

Difference Between Human And Machine Intelligence

- Humans always follow their instinct, vision, experience, circumstances situations, surrounding information, visual and raw data available, and also the things they have been taught by some teachers or elders to analyze, solve any problem and come out with some effective and meaningful results of any issue. On the other hand, artificially intelligent machines at every level deploy the various algorithms, predefined steps, backlog data, and machine learning to arrive at some useful results.
- Though the process followed by the machines is complex and involves a lot of procedure still they give the best results in case of analyzing the big source of complex data and where it needs to perform distinctive tasks of different fields at the same instance of time precisely and accurately and within the given time frame

Sub-fields Of Artificial Intelligence



Sub-fields Of Artificial Intelligence

- **Machine Learning**
- Machine learning is a feature of artificial intelligence that provides the computer with the capability to automatically gather data and learn from the experience of the problems or cases they have encountered rather than specially programmed to perform the given task or work.
- The machine learning emphasizes the growth of the algorithms which can scrutinize the data and make predictions of it. The main use of this is in the healthcare industry where it is used for diagnosis of the disease, medical scan interpretation, etc.

Sub-fields Of Artificial Intelligence

- **Pattern recognition** is a sub-category of machine learning. It can be described as the automatic recognition of the blueprint from the raw data using computer algorithms.
- A pattern can be a persistent series of data over time which is used to predict a sequence of event and trends, particular characteristics of the features of images to identify the objects, recurring combination of words and sentences for language assistance, and can be a specific collection of actions of people in any network which can indicate some social activity and many more things.

Sub-fields Of Artificial Intelligence

The pattern recognition process includes several steps. These are explained as follows:

- **(i) Data acquisition and sensing:** This includes the collection of raw data like physical variables etc and measurement of frequency, bandwidth, resolution, etc. The data is of two types: training data, and learning data.
The training data is one in which there is no labeling of the dataset is provided and the system applies clusters to categorize them. While the learning data have a well-labeled dataset so that it can directly be used with the classifier.
- **(ii) Pre-processing of input data:** This includes filtering out the unwanted data like noise from the input source and it is done through signal processing. At this stage, the filtration of pre-existing patterns in the input data is also done for further references.

Sub-fields Of Artificial Intelligence

- **(iii) Feature extraction:** Various algorithms are carried out like a pattern matching algorithm to find the matching pattern as required in terms of features.
- **(iv) Classification:** Based on the output of algorithms carried out and various models learned to get the matching pattern, the class is assigned to the pattern.
- **(v) Post-processing:** Here the final output is presented and it will be assured that the result achieved is almost as likely to be needed.

Sub-fields Of Artificial Intelligence

- **Deep learning**
- It is the process of learning by processing and analyzing the input data by several methods until the machine discovers the single desirable output. It is also known as the self-learning of the machines.
- The machine runs various random programs and algorithms to map the input raw sequence of input data to output. By deploying the various algorithms like neuroevolution and other approaches like gradient descend on a neural topology the output y is raised finally from the unknown input function $f(x)$, assuming that x and y are correlated.
- Here interestingly, the job of neural networks is to find out the correct f function.

Sub-fields Of Artificial Intelligence

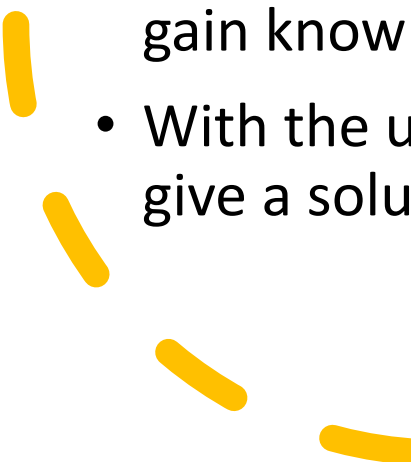
Deep learning will witness all possible human characteristics and behavioral databases and will perform supervised learning. This process includes:

- Detection of different kinds of human emotions and signs.
- Identify the human and animals by the images like by particular signs, marks, or features.
- Voice recognition of different speakers and memorize them.
- Conversion of video and voice into text data.
- Identification of right or wrong gestures, classify spam things, and fraud cases (like fraud claims).



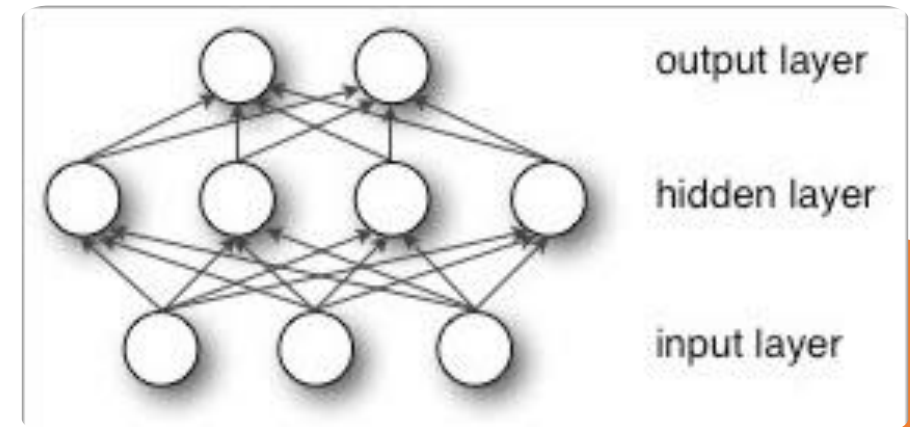
Sub-fields Of Artificial Intelligence

- **Neural Networks**

- The neural networks are the brain of artificial intelligence. They are the computer systems which are the replica of the neural connections in the human brain. **The artificial corresponding neurons of the brain are known as the perceptron.**
 - The stack of various perceptron joining together makes the artificial neural networks in the machines. Before giving a desirable output, the neural networks gain knowledge by processing various training examples.
 - With the use of different learning models, this process of analyzing data will also give a solution for many associated queries that were unanswered previously.
- 

Sub-fields Of Artificial Intelligence

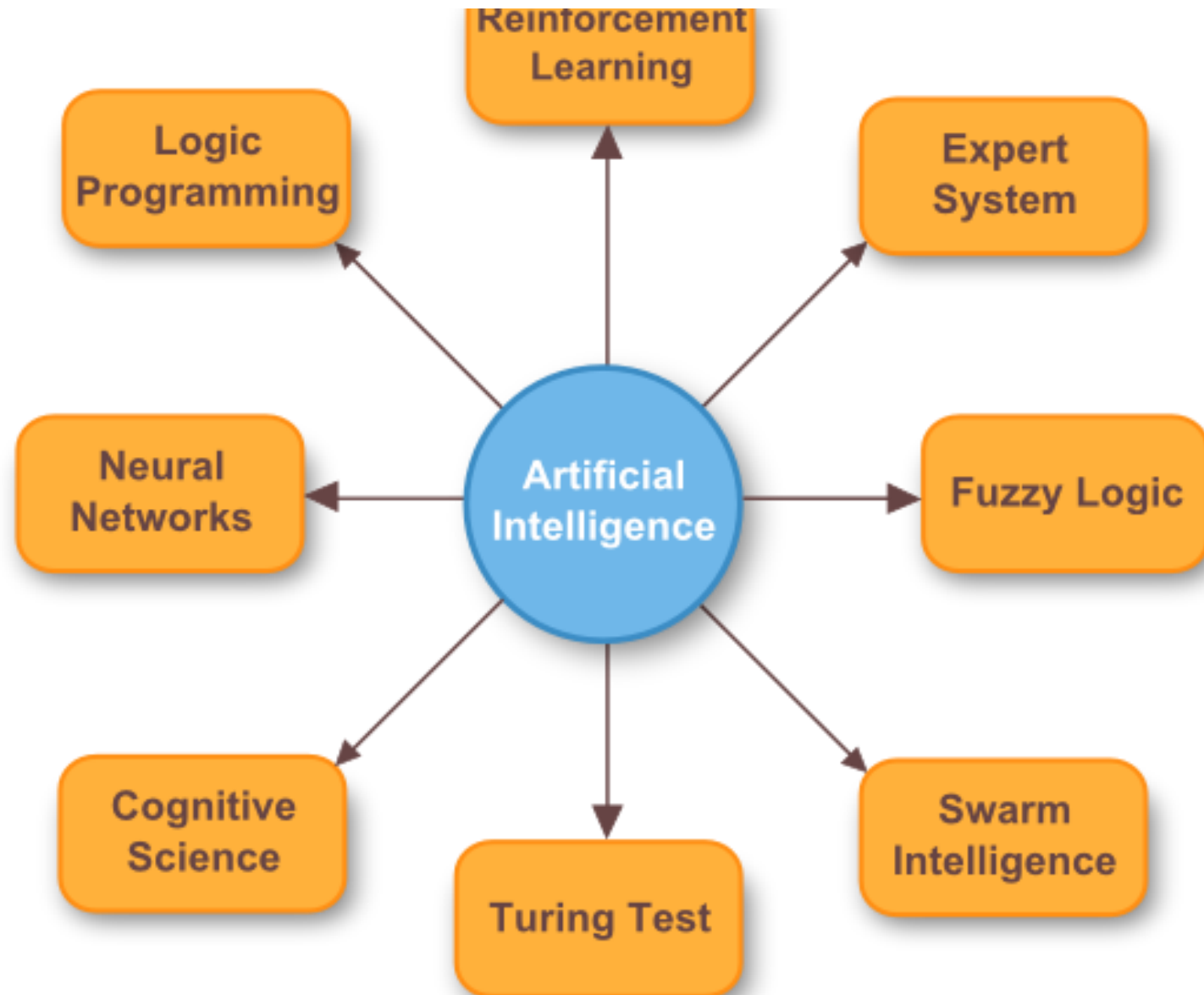
- Deep learning in association with the neural networks can unfold the multiple layers of hidden data including the output layer of complex problems and is an aide for the subfields like speech recognition, natural language processing, and computer vision, etc.

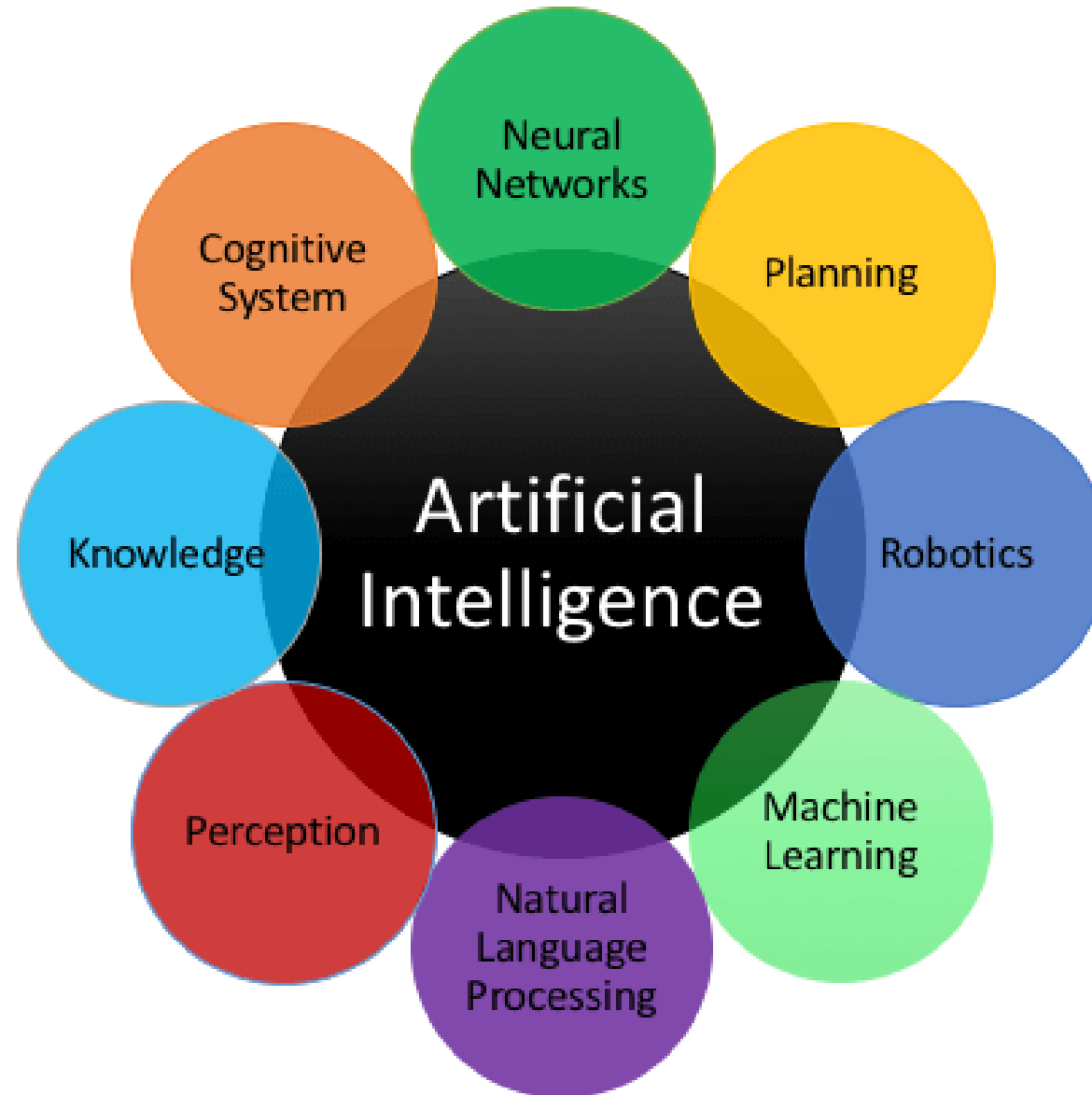


The image features a large, stylized brain shape in the upper half, constructed from a complex network of brown circuit lines and glowing white circular nodes. Below the brain, a small, detailed microchip is shown with a bright white light emanating from its base. The background is a blurred, close-up view of a circuit board. The title text is centered over the middle of the image.

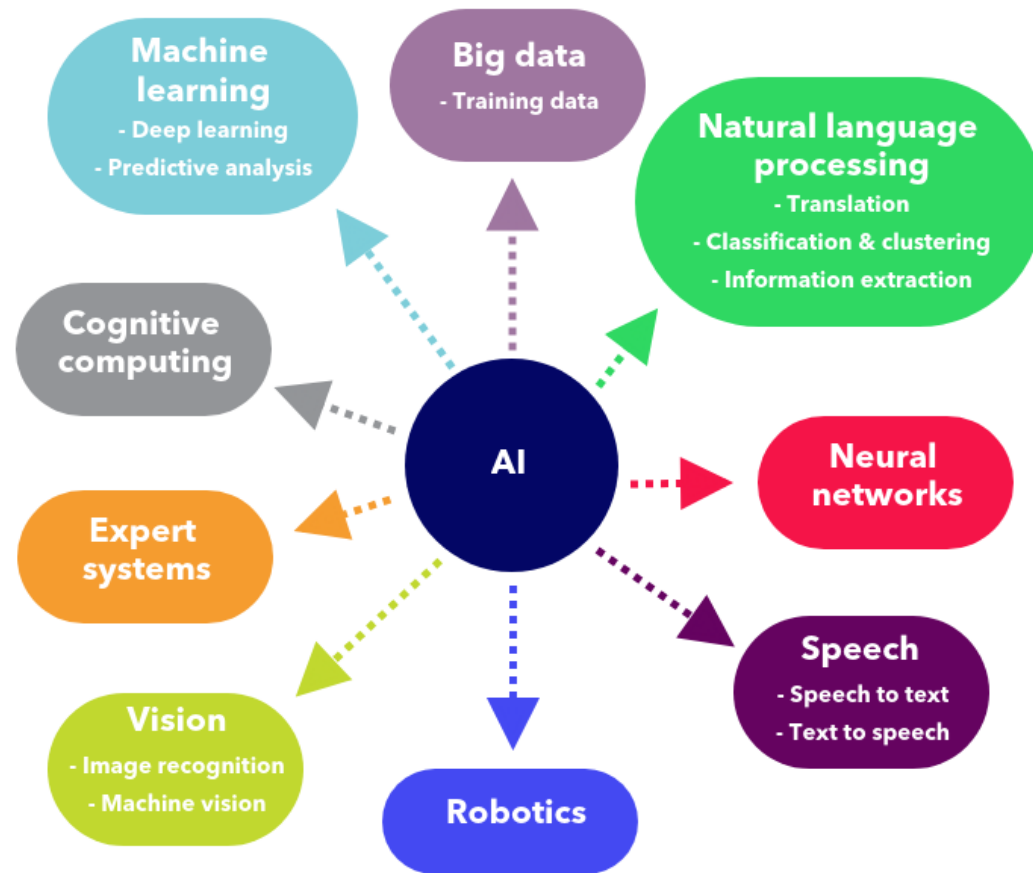
Sub-fields Of Artificial Intelligence

...





THE BRANCHES OF ARTIFICIAL INTELLIGENCE



Sub-fields Of Artificial Intelligence



Fuzzy logic



Classical genetic
algorithm




Search
algorithms



AI in comuter
games



Neural networks



Artificial Intelligence (AI) is the simulation of human intelligence in computers, and they are trained to think and act in the same way as humans do. It can also refer to any computer that demonstrates human-like characteristics such as problem-solving and learning.



History

Artificial Intelligence (AI) was first coined in 1956, but because of increased data volumes, improved algorithms, and computer power and storage advances, AI is becoming more common today.

In the 1950s, early AI research focused on problem-solving and symbolic approaches. The US Department of Defense became interested in this type of work in the 1960s and began teaching computers to emulate fundamental human reasoning.

This pioneering work opened the path for today's computers to automate and formalise thinking, such as decision support systems and smart search engines, which can be built to complement and augment human talents.