Cybernetics is an interdisciplinary field that studies the structure, function, and regulation of systems. It focuses on the communication and control processes in biological, mechanical, and electronic systems. The field explores how systems self-regulate, adapt, and evolve through feedback loops and information processing. Cybernetics has applications in various areas, including robotics, computer science, biology, and social sciences.

In cybernetics, a **system** is a set of interconnected components that interact with each other and the environment to achieve specific goals or functions. These components can be biological, mechanical, electronic, or a combination thereof. A system in cybernetics is characterized by its ability to process information, self-regulate, and adapt through feedback loops. The focus is on understanding how systems maintain stability, adapt to changes, and achieve desired outcomes through communication and control mechanisms.

Informatics is the study and practice of creating, storing, finding, manipulating, and sharing information. It combines aspects of computer science, information technology, and data management to understand how information is processed and utilized. Informatics is applied in various fields, such as healthcare, where it helps manage patient data, and in business, where it supports decision-making processes. The field emphasizes the design and use of information systems to improve efficiency and effectiveness in different domains.

Information as a physical entity refers to the concept that information is not just an abstract idea but can be represented and manipulated in physical forms. This perspective is rooted in the idea that information is embodied in physical states and processes, such as the arrangement of molecules in DNA, the magnetic states on a hard drive, or the electrical states in a computer circuit. In this view, information has a tangible presence and can be quantified, stored, and transmitted using physical media. This concept is fundamental in informatics, where the physical nature of information plays a crucial role in understanding and control computation and communication processes.

Non-semantic information refers to data that does not inherently carry meaning or context on its own. It is often raw and unprocessed, such as binary code, signals, or raw sensor data.
values in a given format
--> **contextualisation** (e.g. "1" --> One kilogram, one meter, one earth mile...)
Semantic information, on the other hand, is understandable and interpretable by humans or machines, often involving symbols, language, or **structured data formats**.

An **algorithm** is a step-by-step procedure or set of rules designed to perform a specific task or solve a particular problem. It consists of a finite sequence of well-defined instructions that, when executed, lead to a desired outcome or result. Algorithms are fundamental to computer science and are used in programming to automate processes, perform calculations, and process data efficiently. They can vary in complexity, from simple arithmetic operations to complex data processing and machine learning tasks.
e.g. n+1, f(x)

A **database** is an organized collection of structured information or data, typically stored electronically in a computer system. Databases are managed by database management systems (DBMS), which allow users to create, read, update, and delete data efficiently. Key features of databases include:

1. Structured Format: Data is organized in tables, rows, and columns, making it easy to access and manage.
2. Data Integrity: Ensures accuracy and consistency of data through constraints and validation rules.
3. Scalability: Can handle large volumes of data and accommodate growth over time.
4. Security: Provides mechanisms to protect data from unauthorized access and ensure privacy.
5. Querying and Reporting: Supports complex queries and reporting to extract meaningful insights from data.

Databases are used in various applications, from business operations and customer relationship management to scientific research and online services.

Applied ontology is the practical use of ontological principles and methods to address real-world problems in various domains. It involves creating structured frameworks to represent knowledge, enabling better data integration, interoperability, and communication across systems. Applied ontology is used in fields like information science, artificial intelligence, healthcare, and business to improve data management, enhance decision-making, and facilitate clearer understanding of complex information.
--> **databases of databases**

Artificial Intelligence (AI) is a branch of computer science focused on creating systems capable of performing tasks that typically require human intelligence. These tasks include learning, reasoning, problem-solving, perception, language understanding, and decision-making. AI systems can be designed to mimic human cognitive functions or to perform specific tasks more efficiently than humans. AI encompasses various subfields, such as machine learning, natural language processing, computer vision, and robotics, and is applied in numerous areas, including healthcare, finance, autonomous vehicles, and more.

A **Turing machine** is a mathematical model of computation describing an abstract machine that manipulates symbols on a strip of tape according to a table of rules. Despite the model's simplicity, it is capable of implementing any computer algorithm.
The machine operates on an infinite memory tape divided into discrete cells, each of which can hold a single symbol drawn from a finite set of symbols called the alphabet of the machine. It has a "head" that, at any point in the machine's operation, is positioned over one of these cells, and a "state" selected from a finite set of states. At each step of its operation, the head reads the symbol in its cell. Then, based on the symbol and the machine's own present state, the machine writes a symbol into the same cell, and moves the head one step to the left or the right, or halts the computation. The choice of which replacement symbol to write, which direction to move the head, and whether to halt is based on a finite table that specifies what to do for each combination of the current state and the symbol that is read.
A Turing machine is an idealised model of a central processing unit (CPU) that controls all data manipulation done by a computer. It is capable of enumerating some arbitrary subset of valid strings of an alphabet. A set of strings which can be enumerated in this manner is called a recursively enumerable language, so it can equivalently be defined as a model that recognises valid input strings.

The Turing machine is capable of processing an unrestricted grammar, which further implies that it is capable of robustly evaluating first-order logic in an infinite number of ways.
A Turing machine that is able to simulate any other Turing machine is called a universal Turing machine. The Church-Turing thesis states that Turing machines, lambda calculus, and other similar formalisms of computation do indeed capture the informal notion of effective methods in logic and mathematics and thus provide a model through which one can reason about an algorithm or "mechanical procedure" in a mathematically precise way without being tied to any particular formalism.

Turing considers the question "Can machines think?", and says that since the words "think" and "machine" cannot be clearly defined, we should "replace the question by another, which is closely related to it and is expressed in relatively unambiguous words". To do this, he must first the word "think", second he must explain which "machines" he is considering, and finally he formulates a new question, related to the first.
Turing suggests we should ask if the machine can win a game, called the "Imitation Game". The original Imitation game, that Turing described, is a simple party game involving three players. Player A is a man, player B is a woman and player C (who plays the role of the interrogator) can be of either sex. In the Imitation Game, player C is unable to see either player A or player B (and knows them only as X and Y), and can communicate with them only through written notes or any other form that does not give away any details about their gender. By asking questions of player A and player B, player C tries to determine which of the two is the man and which is the woman. Player A's role is to trick the interrogator into making the wrong decision, while player B attempts to assist the interrogator in making the right one.
Turing then proposes a variation of this game that involves the computer.
We now ask the question, "What will happen when a machine takes the part of A in this game?" Will the interrogator decide wrongly as often when the game is played like this as he does when the game is played between a man and a woman?
So the modified game becomes one that involves three participants in isolated rooms: a computer (which is being tested), a human, and a (human) judge. The human judge can converse with both the human and the computer by typing into a terminal. Both the computer and human try to convince the judge that they are the human. If the judge cannot consistently tell which is which, then the computer wins the game.
In further researches the question has become "Can machines do what we (as thinking entities) can do?" We are no longer asking whether a machine can "think"; we are asking whether a machine can act indistinguishably from the way a thinker acts.

In the context of computer science and artificial intelligence, an **agent** is an entity that perceives its environment through sensors and acts upon that environment through actuators. Agents can be software-based, like chatbots or virtual assistants, or physical, like robots. They are designed to autonomously perform tasks, make decisions, and adapt to changes in their environment to achieve specific goals. Agents can be simple, following predefined rules, or complex, using advanced algorithms and learning techniques to improve their performance over time.

Agentic AI refers to artificial intelligence systems designed to operate autonomously, making decisions and taking actions to achieve specific goals. These systems perceive their

environment, process information, and execute tasks without constant human intervention.
Key characteristics of agentic AI include:

1. Autonomy: The ability to perform tasks independently, adapting to new situations and environments.
2. Goal-Oriented Behavior: Designed to achieve specific objectives, often optimizing for efficiency or effectiveness.
3. Perception and Action: Equipped with sensors or data inputs to perceive the environment and actuators or outputs to interact with it.
4. Adaptability: Capable of learning from experiences and adjusting strategies to improve performance over time.

Agentic AI is used in various applications, from autonomous vehicles and drones to virtual assistants and robotic process automation.