SITE 1101: Principles of Information Systems

Week 01 & 02

System, Engineering, Technology

Authors: Rahida Asadli, Nilufar Ismayilova, Rahman Karimov, Ismayil Shahaliyev

Created / Updated: Oct 10 2025 / Dec 18 2025

Cybernetics is the study of control, communication, and feedback in systems, a field developed by Norbert Wiener. During WWII, Weiner worked on predicting the future position of enemy aircraft: he realized that both the gun and the pilot form a feedback system are constantly correcting actions based on error and delay rather than following a fixed plan. This insight led him to extend control theory beyond machines to living systems, emphasizing self-regulation and adaptation under uncertainty. This way of thinking later influenced artificial intelligence and deep learning, where feedback from errors is used to adjust internal *parameters* and improve performance.

System is a set of interrelated components working together toward a common goal by accepting **inputs**, **processing** them, and producing **outputs**. *Control system* is a system that continuously monitors outputs and uses **feedback** to adjust inputs or processes, maintaining the system's desired performance and stability.

- **Input:** The resources (data, materials, or energy) that enter the system.
- **Process:** The transformation mechanism that converts input into output.
- **Output:** The result produced by the system.
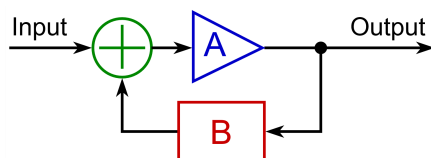- **Feedback:** Information about system performance used to make adjustments.

Figure 1. Ideal feedback model. By Intgr - Own work, Public Domain, Wikipedia Commons.

> *Example.* In a home heating system, the desired room temperature is the input, the furnace heating the air is the process, and the warm air circulating through the house is the output. Feedback comes from a thermostat, which senses the actual temperature and switches the furnace on or off to keep the room at the set temperature.
>
> *Example.* In the mid-19th century, several suspension bridges across Europe failed due to poor system design – weak materials and unpredictable environmental conditions. When John Roebling proposed the Brooklyn Bridge, he applied engineering systems thinking to overcome these failures.
>
> *Input:* Industrial materials (steel cables, stone, and concrete) and human expertise.
> *Process:* Design, testing, construction using pneumatic caissons, and ongoing adjustment based on feedback.
> *Output:* A stable, functional bridge that connected Manhattan and Brooklyn.
> *Feedback:* Design improvements (such as hybrid cable systems) and safety checks during construction.
>
> Roebling's bridge demonstrates how system components and interactions determine reliability and success. When one subsystem (e.g., faulty cables) failed, built-in redundancies

maintained the system's stability – an example of system resilience and feedback control in practice.

* * *

Engineering (from Latin *ingenium*: cleverness) is the creative application of **scientific principles** to design, build, operate, and predict the behavior of structures, machines, processes, or systems in a safe and efficient manner to achieve a specific **objective**.

Technology (from ancient Greek *τέχνη + λογία = techne + logia*: science + art, skill) is the application of techniques, skills, methods, and processes to produce goods and services or achieve specific objectives.

Data (plural, from Latin datum – something given) are raw facts, figures, or symbols without **context** or interpretation. They represent unprocessed observations and have little meaning on their own. *Information* is data that has been processed, organized, or structured in a way that gives it context and meaning. *Knowledge* is the understanding, insight, and experience gained from interpreting and applying information.

> ***Example.*** Data: "30," "32," "31" just raw numbers with no context. Information: "The temperatures recorded over three days were 30°C, 32°C, and 31°C." – now the data has context and meaning. Knowledge: "Since temperatures above 30°C increase water evaporation, watering plants in the early morning is more effective." – applying the information to guide action.

Context is the background, circumstances, or setting that gives meaning to data, information, or events. It allows us to interpret and understand facts correctly by showing how they relate to one another and to the situation in which they occur.

> ***Example.*** Numbers like 1, 4, 9, 16, and 25 by themselves are just data. Without context, our experience may lead us to assume they are the squares of numbers from 1 to 5. But such a quick pattern recognition may mislead us once the context is given that these numbers represent the quantity of ice cream sold in a small grocery store on five different days. Context gives data its true significance and turns it into meaningful information.

* * *

Information system is a set of interrelated components that collect, **process**, store, disseminate **data** and **information**, provides a **feedback** mechanism to monitor and control its operation to make sure it continues to meet its goals and **objectives**.

> ***Example.*** A library information system records books (input), organizes and catalogs them (process), provides search results for users (output), and updates records based on borrowing activity (feedback).

Computer-Based Information System is a single set of

- hardware,
- software,
- databases,
- telecommunications,
- people, and
- procedures

that are configured to collect, manipulate, store, and process data into information.

> ***Example.*** An online banking system takes transaction requests as input, processes them through secure software, and provides account balances or confirmations as output. Feedback such as error alerts or user actions improves future transactions and system reliability.

Additional Material

- [One of the most epic engineering feats in history](#)
- [How do Steam Engines Work?](#)
- [The Meaning of Knowledge](#)