Sheet # 5

Module 02: Cybernetics

Cybernetics

- The science of control and communication, in the animal and the machine.
- Art of steering
- Concerns with errors in systems of control and communication.
- It has the aim of achieving a condition of equilibrium which is the maintenance of order.
- Concerned with the restoring of stability within all kinds of systems.

Measure of Performance

Effectiveness: - This is a measure of the extent to which a system achieves its intended transformation

Efficiency: - The measure of the extent to which the system achieves its intended transformation with the minimum use of resources.

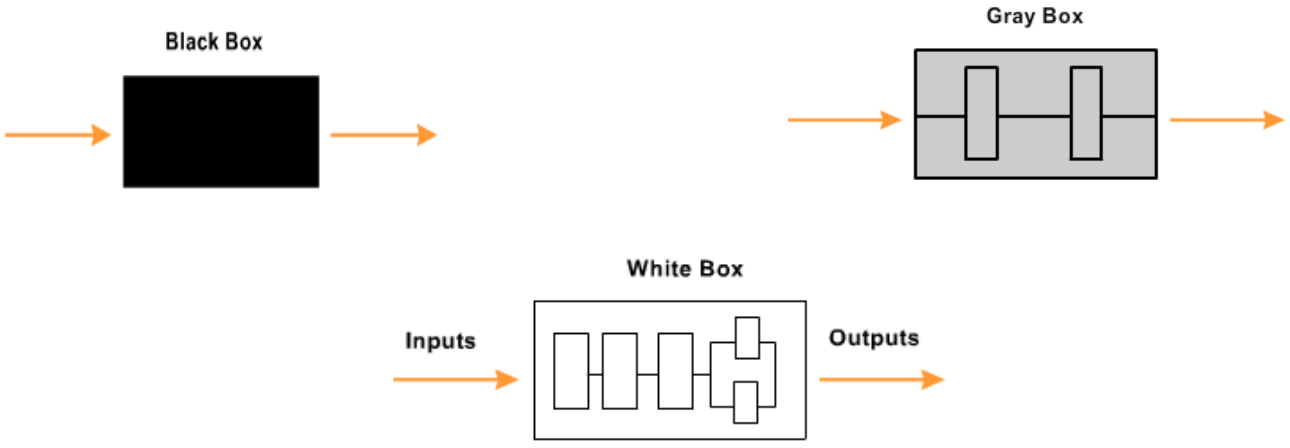
Efficacy: - A measure of the extent to which the system contributes to the purposes of a higher-level system of which it may be a subsystem.

System as a Box

Black Box: behaves in a certain way without giving any clue to the observer how exactly the result is obtained.

Gray Box: offers partial knowledge of selected internal processes.

White Box: giving full information about internal processes.



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Five Key Elements

When good understanding of the whole transformation process is necessary, the following five elements have to be calculated.

1- **Set of inputs**

The variable parameters observed to affect the system behavior

2- **Set of Outputs**

The observed parameters affecting the relationship between the system and its environment

3- **Set of States**
The internal parameters which determine the relationship between input and output

4- **State-transition function**
Decide how the state changes when various inputs are fed into the system

5- **Output function**
Decide the resulting system output with a given input in a given state

Feedback concepts

- System processes may or may not be self-regulated.
- **A self-regulated system** is called a **closed-loop system** and has its output coupled to its input.
- **In the open-loop system**, the output is not connected to its input for measurement.

Open-loop System

- In a sprinkler (طفاية حريق) system, a smoke sensor activates the opening of water valves in order to extinguish a fire. Once activated, the system continues to deliver water until the reservoir is empty or somebody shuts it off.

Closed-loop system (feed-forward)

- It provides information about expected behavior and simulates actual processes.
- To make a budget and to state goals for an organization.

Feedback is a basic strategy which allows a system to compensate for unexpected disturbances. This is done through feedback loops that maintain certain variables.

- It is often defined as the “transmission of a signal from a later to an earlier stage.”
- When the -ve feedback of a system disappears, the stable state vanishes

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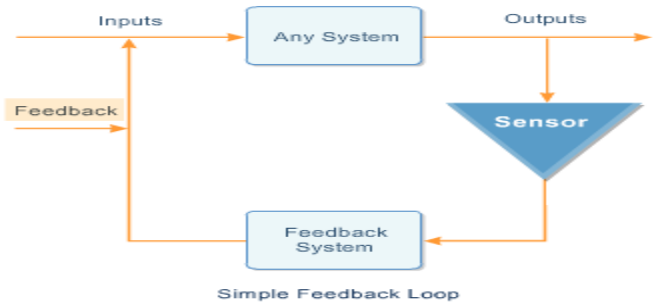
Simple feedback loop



Simple Feedback Loop

Negative feedback: is a fraction of the output delivered back to the input, regulating the new output to a multiplier smaller than one.

Measured output compared with desired values or reference standards, continuously or at intervals. To bring the output to the desired level is referred to as **error nulling** (إلغاء).

Example of Negative feedback

The simple thermostat which can only perform two actions: turn the heat on or turn it off.

A state of positive feedback exists, if the multiplier is greater than one.

Questions:-

1- In the basic terms of cybernetics, a system may be represented by three boxes. Box color denotes different degrees of user interest in the understanding of the internal working process of a system. 'Cold shower' can be represented as
a.) A black box
b) A grey box
c) A white box

2- _____is a process that uses information from the output.

a.) Feedback
b) feed-forward
c) quasi-static

3- Internal parameters of the system which determine the relationship between input and output are known as

a) The set of states
b) state-transition function
c) input-output trajectories

4- A measure of the extent to which a system achieves its goal is known as

a) Effectiveness
b) Efficiency
c) Efficacy

5- To provide a simple kind of regulation, buffering is used in _____ systems

a) self-regulated
b) open-loop
c) closed-loop

6- In the basic terms of cybernetics, a system may be represented by three boxes

a) The black, the grey, and the yellow
b) The red, the yellow, and the green
c) The black, the grey, and the white

7- an automatic sprinkler system is an example of __ system

a) self-regulated
b) open-loop
c) closed-loop

8- In the basic terms of cybernetics, a system may be represented by three boxes. Box color denotes different degrees of user interest in the understanding of the internal working process of a system. 'visit nurse for treatment' can be represented as

a) A black box
b) A grey box
c) A white box

9- _____ describes how the state changes when various inputs are fed into the system

a) The set of states
b) state-transition function
c) input-output trajectories

10- Closed-loop systems are

a) self-regulated
b) servo-regulate
c) not-regulated

11- A measure of the extent to which the system contributes to the purposes of a higher-level system of which it may be a subsystem is known as

a) Effectiveness
b) Efficiency
c) Efficacy

12- In the basic terms of cybernetics, a system may be represented by three boxes. Box color denotes different degrees of user interest in the understanding of the internal working process of a system. 'hospitalize for intensive treatment' can be represented as

a) A black box
b) A grey box
c) A white box

13- A system in which an output is not connected to its input is known as _____ system

a) self-regulated
b) closed-loop
c.) open-loop

14- The process uses information from the input in a _____ system
a) feed-back
b) feed-forward
c) self-regulated

15- The measure of the extent to which the system achieves its intended transformation with the minimum use of resources is known as
a) Effectiveness
b) Efficiency
c) Efficacy