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Introduction: Symposium on Computer Uses

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The two main types of computers are the digital and the analog ones. This symposium will deal mainly with digital computers, but first the main features and uses of both types will be described briefly.

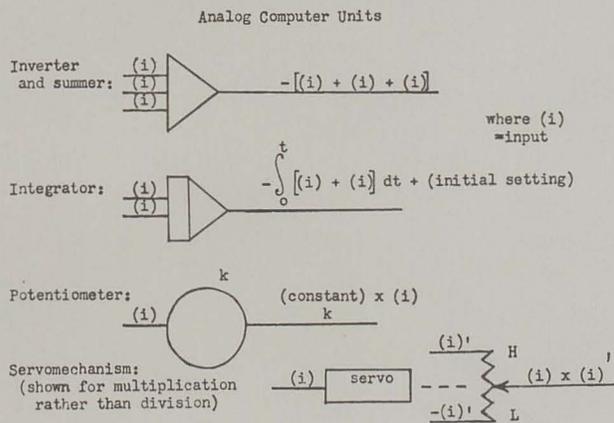
The motivations for using the different types of computers are different, partly because the types of operations that they can perform are inherently different. This is partially illustrated on Table 1:

	Computer type	
	Analog	Digital
Type of data	<i>Continuous functions (or curves)</i>	Discrete numbers
Number of Variables	Capacity-limited	Capacity-limited
Dependent	<i>Only one</i>	Capacity-limited
Independent	<i>(machine time)</i>	Capacity-limited
Mathematical Operations	1. Add-subtract 2. Multiply-divide 3. <i>Integration of differential equations</i>	1. Add-subtract 2. Multiply-divide 3. <i>Algebraic logic sequences</i>

On this Table I have italicized the points of distinction between the two types of computers.

The analog computer deals with continuously varying functions and can, therefore, provide an electrical analog, or model, for natural phenomena such as mechanical or chemical systems. I shall give two simple examples of its use and leave digital computer uses for the main talks.

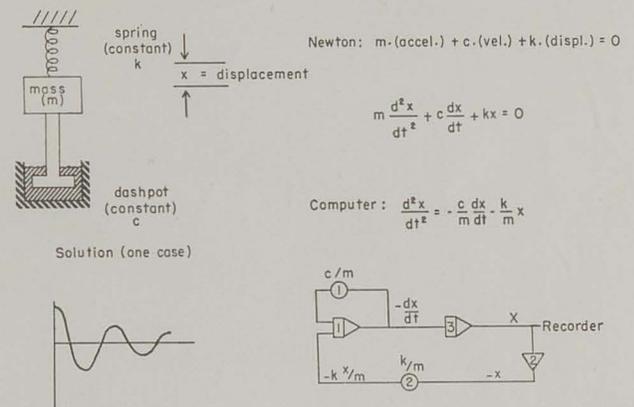
Some of the symbols used with the analog computer, and the mathematical operations they represent are shown on Figure 1:



The potentiometer settings and the initial conditions on the integrators are usually adjustable parameters.

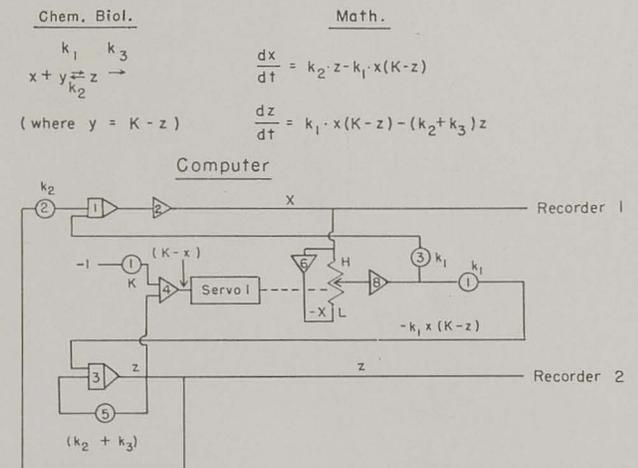
In putting a problem on the computer these elements are combined by wires having jacks at both ends, which are inserted into the appropriate holes on a "patch board". When the computer becomes available, the "patch board" is then attached to the machine, the "pots" (potentiometers) are set, and the solution can be traced by a recorder that is "run off" the computer.

A simple example of this is the analog of the damped oscillation of a mass on a spring, which is shown in Figure 2:



In this example the pots happen to be wired from right to left, which is different than I showed before but not uncommon.

This example is used as a model of certain systems that are used to measure pressure in a blood vessel, and it is simple enough to be calculated rather easily without a computer.



However, the solution of some *simple-appearing non-linear* differential equations would scarcely be possible for most of us unless we had the aid of an analog computer. As a simple example we can turn to a chemical model of a certain liver function test, as shown in Figure 3:

I shall not show you the computer solution of this problem. Instead, I merely point out that it is no more realistic than a linear model that can be solved without

the computer,* which was learned only by using the computer.

In completing this introduction, I mention that analog and digital computers can be used together in solving partial differential equations.

Another example of a combined use may come when a friend of mine in Utah gets his digital computer programmed to run his analog computer and to optimize the parameters that are represented on its "pot" settings.

* Robert L. Evans, *Science*, 117, pp. 718-719 (1953).