History of Computing (work in progress)

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abacus – Many people consider the abacus (which is thousands of years old) to be the first computing device, since a skilled user is able to do simple arithmetic on an abacus. It is, however, purely mechanical and requires specialized knowledge to use.

Pascal's mechanical calculator – Around the middle of the seventeenth century, in France, **Blaise Pascal** constructed a mechanical calculator (why did it have to be mechanical at that point in time?) to help his father, who was a tax collector. By modern standards, the device was rudimentary at best, but it is considered a precursor of a modern calculating device.

Leibniz's extension – Around 1670, which 30 or so years after Pascal, the German mathematician **Gottfried Leibniz** created a more powerful machine (still mechanical) that could do simple multiplications and divisions. Leibniz is also credited with having invented the binary number system and is considered a co-inventor, with Isaac Newton, of calculus.

Jacquard's loom – Around 1800, Joseph-Marie Jacquard, a master weaver in France, used punch cards to automate which threads in a loom (a fabric-weaving machine) moved so that another color could be inserted to form a pattern. These ideas were later used by Babbage and Hollerith (see below).

Babbage's machines – In the early nineteenth century, the English navy had ships sailing to colonies all across the globe. Navigators on the ships needed a precise way of locating their position, and the British Admiralty offered a prize to anyone who could simplify the laborious process of calculating everything by hand. Around 1825, an inventor named **Charles Babbage** came up with a machine, called a **Difference Engine**, which did automate part of the process. He also proposed a much more ambitious machine, called an **Analytical Engine**. Babbage extended Jacquard's idea of punch cards for several different purposes in this machine. Even though it was mechanical and not electronic, the Analytical Engine contained many of the aspects of a modern computer: a way to enter information (an input device), a way to store information (a memory device), a way to enter a series of instructions to be performed (a program), and a way to display results (an output device). Unfortunately, for a number of reasons, Babbage was unable to build an Analytical Engine. (In the twentieth century, people were able to follow his plans and actually build a working model.) Despite this failure, because of his contributions, Babbage is sometimes called the "**father of modern computing."**

Lady Lovelace - In addition to support from the British Navy, Babbage tried to raise money on his own to support his inventions. One of his patrons was an English noblewoman named Lady Ada Augusta, Countess of Lovelace. (She was the daughter of the poet, Lord Byron.) Besides contributing money, she also wrote programs for

Babbage's Analytical Engine; of course, these programs were not able to be run. She is called the “first programmer.”

Boole's logic - **George Boole** was an English mathematician, working in the middle of the nineteenth century. Boole invented a system of logic (in his honor, the system is called **boolean algebra**) which forms part of the theoretical basis for the operations of a computer.

Herman Hollerith – Every 10 years, the United States conducts a population census. In the late part of the nineteenth century, the population of the US was growing rapidly, and it took eight years just to tabulate the results of the 1880 census. In fact, it was predicted that the 1890 census would take 12 years to tabulate; this would mean that the 1900 census would be conducted before the census results from 1890 were known. Herman Hollerith, an engineer who had worked for the Census Bureau, proposed a new way of storing census data, using holes punched on cards, or punch cards, to store information. For example, a hole in a certain row and column would signify a male, while a punch in another row of that column would signify female. (Jacquard had used punch cards to control things, not to store data.) Similarly, punches in other columns could be used for age, address, and other information. In addition, Hollerith created a machine that would allow relatively fast tabulation of results from these cards. (In another major advance, Hollerith used electricity to power his machines.) Hollerith's ideas resulted in much more timely availability of census data; the Census Bureau got preliminary results for the 1890 census in 6 weeks and final results in two years, far less than the census for 1880 despite a large increase in population.

Hollerith formed a company to market machines which could be used to tabulate data of this type. After a series of acquisitions and name changes, the company became known as International Business Machines—or just IBM.

machine language – For the first generation of computers, the only way to communicate with the machine was using that particular computer's machine language. In machine language, each instruction consists of a long series (typically 16 bits long) of zeroes and ones. It is possible for a human to use machine language, but almost all work nowadays is done either in assembly language or in a high-level language.

FORTRAN and COBOL – In the mid 1950's, as computer usage grew, it became clear that the demand for computer programs would outpace the number of people who could learn to program in machine language. A number of groups worked on projects which would simplify the process. The basic idea was to introduce an intermediate step between a natural language (e.g., English or Spanish or Chinese) that a human would understand, and machine language that a computer would understand. This intermediate step would be a compiler (or translator) and a high-level language that would be precise enough for a computer to work with but still easy enough for a human to work with. Another program, called a compiler, would translate a program written in a high-level language into machine language, and the machine-language program could then be run on the computer. The first high-level language was called FORTRAN (for

FORmula TRANslator), designed for scientific applications, and the second one was called COBOL (Common Business-Oriented Language, for commercial applications). Although by modern standards they are primitive, these first two languages were incredibly successful, as literally thousands if not millions of people learned how to write computer programs. FORTRAN and COBOL were widely used for many years, and there are some legacy systems still using these languages today.