

Milestones in Computer Science and Information Technology

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Laser printer

a cube a third of a millimeter on a side. **Semiconductor** lasers based on Hall's original design are used in all CDs and CD-ROMs, all laser printers, some TV remote controls, and most **fiber optic** communications systems. In 1964, Townes was awarded a Nobel Prize in Physics shared with Russian physicists Aleksandr Prokhorov and Nikolai Basov. In 1981, Schawlow and Nicolaas Bloembergen of Harvard University received the Nobel Prize, also in physics, for their contributions to the development of laser spectroscopy. In 1991, Gordon Gould was inducted into the National Inventors Hall of Fame, as was Robert Hall in 1994.

Additional reading: *Computing Encyclopedia*, vol. 1, pp. 200–201.

Laser printer

I/O DEVICES AND MEDIA

The *laser printer* was invented in 1969 at a Xerox research facility in Webster, New York, by Gary Starkweather, who did so by combining a **laser**, **xerography**, and something called a Research Character Generator (RCG) developed by Butler Lampson and Ron Rider. The laser "draws" the printable image on a special light-sensitive drum, which then collects powdered ink ("toner") using an electrostatic charge and rolls it onto the page. A hot roller melts the toner to the paper to fix the image. By 1971, the first perfected version of Starkweather's invention could print two pages per second at a resolution of 300 dpi (dots per inch). In 1976, **IBM** introduced its IBM 3800 laser printer, capable of printing 20,000 lines per minute. Xerox's first commercial laser printer, the 9700, did not come until 1977. In 1984, **Hewlett-Packard** introduced its LaserJet printer featuring 300 dpi resolution for \$3,600, and a year later **Apple** released its Apple LaserWriter. Laser printer technology continued to advance over the years until 1,200 dpi black and white printers with a speed of ten pages per second for less than \$1,000 became typical.

Additional reading: Hiltzik, *Dealers of Lightning*, pp. 127–144.

Least squares method

ALGORITHMS

In 1809, Carl Friedrich Gauss claimed to have used the statistical method of *least squares* as early as 1795, but he credited Adrien Marie Legendre with its first publication. Legendre did

so in 1805 in the form of an appendix entitled "Sur la méthode des moindres carrés" in his "Nouvelles méthodes pour la détermination des orbites des comètes." Given data that appear to follow a linear trend, the **least squares algorithm** computes the slope m and the intercept b of the straight line $y = mx + b$ that best approximates the data in the sense that the sum of the deviations of measured values from the corresponding points on the approximating line is minimized. The method is an important milestone in **data reduction** and can be generalized to apply to **data** that is nonlinear with respect to an independent **variable**.

Additional reading: *Encyclopedia of Computer Science*, pp. 963–964.

Leibniz calculator

CALCULATORS

The *Leibniz calculator*, the first major improvement over the **Pascal calculator**, was invented in 1671 by the German mathematician Gottfried Wilhelm Leibniz, the codiscoverer of **calculus** and the first person to describe the **binary number system**. By adding a "stepped drum" and wheels based on an active/inactive principle and a delayed carry mechanism, Leibniz modified Pascal's machine so that it could multiply and divide as well as add and subtract (Figure 24). The stepped drum became the basis for virtually all **calculators** until late in the nineteenth century. Knowledge of the precise workings of the Leibniz calculator was almost lost. Leibniz gave his machine to the University of Göttingen in the late 1670s, and it lay dormant in an attic until discovered in 1870 by workers trying to fix a leaky roof.

Additional reading: Aspray, *Computing before Computers*, pp. 42–49.

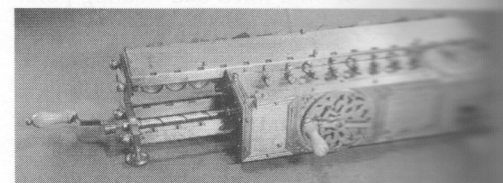


Figure 24. In 1671, Gottfried Wilhelm Leibniz, discoverer of the calculus, invented the "stepped wheel" calculator, which, since it could perform four basic arithmetic functions, was a significant advance over the Pascal calculator. (Deutsches Museum, Munich)