第一部實用的電子計算機

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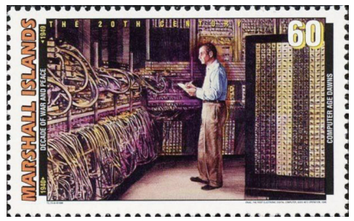

Herman Goldstein 設定 ENIAC 功能表的開關。

我擔任國立陽明交通大學資訊學院院長時，學院有不少老舊的大型電腦設備。根據學校流程，這些舊設備應該報廢，以免佔據空間。我當時覺得這些電腦代表計算機科學的演進，應該予以保存，而有了成立電腦歷史博物館的念頭。

經過十幾年後，這個構想才由彭文志系主任實現，在資訊學院的地下室成立博物館。

當初我擔任院長時，國外友人願意捐出一部 ENIAC（Electronic Numerical Integrator And Computer；ENIA）部分零件，然而物換星移，最後沒成功，相當可惜。

ENIAC 是首部實用的電子計算機。第二次世界大戰時，美國陸軍軍械部（Army Ordnance Department）為了量測槍砲的彈道，出資給賓州大學的摩爾學院（Moore School of Electrical Engineering），研製能進行大量計算的機器，以填寫彈道表格。

當時軍方的聯絡人是 Herman Goldstine 少尉，而賓州大學計畫主持人是 John Brainerd 教授，團隊成員包括 2 位學生 John Mauchly，以及 Presper Eckert。關於 Brainerd 對 ENIAC 的貢獻，鮮少人提及。IEEE 有文章溢美 Brainerd，說：「Under Dr. Brainerd's inspiration, leadership, and supervision the ENIAC was conceived and built.」。但是，其他文件卻顯示 Brainerd 曾阻撓 ENIAC 的發展。

Mauchly 首先於 1942 年提出程式（Program）這個名詞，並寫了一份 7 頁的提案《The Use of High-Speed Vacuum Tube Devices for Calculation》，建議發展電子設備（Electronic Device）取代機械式計算設備（Mechanical Calculation Device），認為可藉此大幅加速計算。然而 Brainerd 懷疑其可行性，將之存檔，束之高閣。幸好 Goldstine 看到這份報告，直接要求 Mauchly 正式提案，由軍方提供經費。

1943 年，發展 ENIAC 的計畫由 Mauchly 主導觀念性的設計，Eckert 負責硬體工程。這個計畫被列為最高機密，代號為「PX」。ENIAC 由 18,000 個真空管及 1,500 個繼電器組成，重量約 30 公噸，佔地 1,500 平方呎，消耗 140 千瓦電力，需要 2 部 12 匹馬力的吹風機散熱。ENIAC 程式設定為外接式，全由手工在接線板上設定完成之。

ENIAC 的高速計算能力遠勝於過去機械方式，可以在一秒鐘內做 5,000 個加法或 357 個十位數的乘法運算。除了用來計算彈道外，ENIAC 也用於發展原子彈的計算。傳說這部機器一運轉，費城（Philadelphia）西區的燈光會變暗。維持此機器正常連轉著實不易，大約每 2 天就有 1 個真空管故障。

ENIAC 服役 10 年後，於 1955 年 10 日月 2 日正式退役。

1945 年，ENIAC 升級改善，增加程式儲存的功能（Stored-Program），命名為 EDVAC。

Eckert 發明一種特殊記憶體「水銀音波延遲線」（Mercury Delay Line Memory），同時儲存數據（Data）及程式（Program）。這是一個創新做法。此時數學奇才 John von Neumann 正於賓州大學擔任顧問，參與 EDVAC 計畫的相關討論。von Neumann 寫了一份 EDVAC 的內部報告《First Draft of a Report on the EDVAC》。因為 von Neumann 是超級大牌人物，Goldstein 將這份報告送到和 von Neumann 往來的軍事單位，以宣傳 EDVAC 計畫的卓越。

問題是，Goldstein 刻意將報告中提到 Mauchly 和 Eckert 的部分刪除（大概嫌他們不夠大牌）。讀到這份 von Neumann 報告的人，對於報告中 EDVAC 這種創新的計算機架構都大感驚豔，稱之為「von Neumann Architecture」。現代計算機的設計幾乎都遵循 von Neumann Architecture。例如劍橋大學的 Maurice Vincent Wilkes，根據這份報告造出第一部儲存程式的計算機 EDSAC（Electronic Delay Storage Automatic Calculator）。Mauchly 和 Eckert 吃了悶虧，未能得到應有的功勞。

von Neumann 非掠奪之人，從未宣稱他是這個架構的發明人。

Mauchly 一直活躍於電腦界，是 ACM（Association for Computing Machinery）共同發起人，後來並成為 ACM 的總裁。我因為資訊技術（Information Technology）貢獻，有幸於 2003 年被選為 ACM 會士（Fellow），為全球第十七位華人獲此殊榮者，深感榮幸。

John Mauchly（1907～1980）。

Presper Eckert（1919～1995）。

The First Practical Electronic Computer

When I served as the Dean of the College of Computer Science at National Yang Ming Chiao Tung University, the college housed numerous outdated and sizable computer systems. According to the university's protocols, these aging devices should have been scrapped to free up space. However, I believed that these computers symbolized the evolution of computer science and, therefore, deserved to be preserved. This conviction inspired the concept of establishing a Computer History Museum.

Over a decade later, Chairman Wen-Hsiao Peng of the Department of Computer Science realized this idea, and the museum was established in the basement of the College of Computer Science.

During my tenure as the dean, there was a period when foreign friends expressed their willingness to donate some parts of the ENIAC (Electronic Numerical Integrator And Computer). Unfortunately, as time passed, the endeavor did not materialize, which is regrettable.

ENIAC was the first practical electronic computer. During World War II, the United States Army Ordnance Department funded the Moore School of Electrical Engineering at the University of Pennsylvania to create a machine capable of conducting intricate calculations, specifically for gauging the ballistics of artillery to complete ballistic tables.

Lieutenant Herman Goldstine served as the military liaison during that timeframe, with Professor John Brainerd overseeing the project at the University of Pennsylvania. The team consisted of two students, John Mauchly and Presper Eckert. Despite little mention of Brainerd's contributions to ENIAC, an IEEE article commends him, stating, 'Under Dr. Brainerd's inspiration, leadership, and supervision, the ENIAC was conceived and built.' Nonetheless, contrasting documents suggest that Brainerd impeded the progress of ENIAC.

In 1942, Mauchly introduced the term 'program' and authored a 7-page proposal titled 'The Use of High-Speed Vacuum Tube Devices for Calculation.' Within this proposal, he advocated for the development of electronic devices to replace mechanical calculation devices, foreseeing a significant acceleration of computations. Although Brainerd initially expressed skepticism about its feasibility and archived the proposal, Goldstine later discovered the report. He directly urged Mauchly to formally propose the idea, ultimately securing military funding support.

In 1943, Mauchly spearheaded the conceptual design for the development of ENIAC, with Eckert overseeing hardware engineering. This top-secret initiative was classified under the codename 'PX.' ENIAC, equipped with 18,000 vacuum tubes and 1,500 relays, weighed approximately 30 tons and occupied 1,500 square feet. Consuming 140 kW of electricity, it required two 12-horsepower blowers for cooling. The programming of ENIAC was exclusively configured through manual processes on wiring boards.

ENIAC's high-speed computing capacity significantly surpassed earlier mechanical methods, allowing it to perform 5,000 additions or 357 multiplications of ten-digit numbers within one second. Beyond its application in ballistic calculations, ENIAC played a crucial role in computations related to the development of atomic bombs. Legend has it that the lights in the western part of Philadelphia would dim when the machine was in operation. Maintaining optimal operation for this machine proved challenging, with approximately one vacuum tube failure occurring every two days.

After ten years of service, ENIAC was officially retired on October 2, 1955.

In 1945, ENIAC underwent an upgrade and enhancement, acquiring the capability to store programs, which became known as Stored-Program, and was subsequently named EDVAC (Electronic Discrete Variable Automatic Computer).

Eckert devised a unique memory system known as the 'Mercury Delay Line Memory,' capable of concurrently storing data and programs—an innovative solution. During this period, the renowned mathematician John von Neumann served as a consultant at the University of Pennsylvania, actively participating in discussions on the EDVAC project. Von Neumann authored an internal report on EDVAC titled 'First Draft of a Report on the EDVAC.' Given von Neumann's significant stature, Goldstein distributed this report to military entities associated with him, aiming to promote the excellence of the EDVAC project.

The problem stems from Goldstein's deliberate omission of references to Mauchly and Eckert in the report, possibly due to considering them insufficiently prestigious. Readers of von Neumann's report were highly impressed by the innovative computer architecture described in it, later known as the 'von Neumann Architecture.' Almost all modern computers adhere to the von Neumann Architecture in their design. For example, inspired by this report, Maurice Vincent Wilkes at the University of Cambridge constructed the first stored-program computer named EDSAC (Electronic Delay Storage Automatic Calculator). Unfortunately, Mauchly and Eckert faced setbacks and did not receive the credit they deserved for their contributions.

Von Neumann did not appropriate the accomplishments of others. He never claimed to be the inventor of this architectural framework.

Mauchly played an active role in the computer field and co-founded the Association for Computing Machinery (ACM). Subsequently, he assumed the role of ACM's president. Due to my contributions to information technology, I was named an ACM Fellow in 2003. I feel a profound sense of honor as the seventeenth Chinese individual globally to receive this prestigious recognition.