

Edsger Wyde Dijkstra

A short biography by James Tait

Widely known for his Shortest Path algorithm, Dr. Edsger Dijkstra was an exceptionally intelligent and influential computer scientist. He has made contributions to most all areas of the discipline, specifically structured programming and software architecture. Known for his somewhat eccentric character, he has lots of great quotes to his name too:

The art of programming is the art of organizing complexity, of mastering multitude and avoiding its bastard chaos as effectively as possible.

Early Life

Dijkstra was born on the 11th of May, 1930. He was the third child of four had by his parents Douwe Wybe Dijkstra and Brechtje Cornelia Kluijver. In school, he had hopes of studying law and representing the Netherlands in the European Union. However this changed after finishing his final exams, and getting the maximum mark in Maths, Physics, Chemistry, and Biology. Both his teachers and his parents persuaded him to pursue a career in science after this clear demonstration of talent and skill. Hence, his focus shifted to theoretical physics. He studied it at the University of Leiden until 1956, during which time his father told him of a three week programming course in Cambridge. He figured programming was a good skill to have as a theoretical physicist and so in 1951, he enrolled and completed the course. After the fact he said:

It was a frightening experience: it was the first time that I left the Netherlands, the first time I ever had to understand people speaking English and immediately I was all by myself, trying to follow a course on a totally new topic. But I liked it very much.

Academic Endeavours

In 1952, Dijkstra accepted a part-time position as a programmer at the *Mathematisch Centrum* (or Mathematical Center) in Amsterdam. He was officially the Netherlands' first "programmer". After three years of programming in parallel with his studies at the University of Leiden, he decided it was time to make his mind up between the two. He sat and discussed his future in the office of A. van Wijngaarden, who was his boss at the time. This was a "*turning point*" in his life: he chose to complete his studies formally as quick as he could, and become a programmer.

He continued working in the Mathematical Center in Amsterdam until 1962. In 1956, the same year he graduated from the University of Leiden, he gave a public demonstration of the new computer the Mathematical Center had just built. This is when he designed a program to find the shortest route between two cities in the Netherlands. As there was no journal dedicated to automatic computing, it wasn't until 1959 that he published his shortest path algorithm in *A Note on Two Problems in Connexion with Graphs*. The University of Amsterdam awarded him his Ph.D. that same year for his thesis *Communication with an Automatic Computer*.

In 1962, Dijkstra was appointed Professor of Mathematics at the Eindhoven University of Technology. Even though there was no Computer Science department at the University, and some colleagues actually had reservations about it, he set up a group of computer scientists within the Mathematics department. This is when he began writing the manuscripts known as *EWDs* (his initials). Usually no longer than 15 pages, the articles were written over a period of 40 years, each numbered consecutively. They contained letters, speeches and reports of his travels discussing computer science and mathematics. 1318 total EWDs were written, almost all of which with his signature fountain pen.

Later, in 1972, he received the ACM Turing Award (regarded as the most prestigious award in Computer Science). The address he gave when accepting the award, *The Humble Programmer*, is an insightful collection of thoughts about the future of computer science, many of which have since come true.

The following year, Dijkstra joined Burroughs Corporation, serving as its only Research Fellow, in its smallest research facility: his study at home. As part of his duties he was required to travel to the United States and visit the other research centers a number of times a year, and as he was already quite famous at this stage, he received a multitude of invitations to lecture around the world. Subsequently, he would spend only Tuesdays at the University of Eindhoven, and he was made Professor Extraordinarius.

Finally, Dijkstra was offered the Schlumberger Centennial Chair in the Computer Science Department at the University of Texas, Austin, in 1984. He graciously accepted, and stayed there until his retirement in 1999.

Influence and Contribution

The number of contributions Dijkstra has made to the field of Computer Science is remarkable to say the least. A survey conducted in 1994 found that of the top 38 most influential papers in computer science, Dijkstra was the author of **five** (according to over a thousand professors in the field).

His book *Structured Programming*, coauthored with C.A.R. Hoare and Ole-Johan Dahl, lay the foundations for the structured programming movement. Without this, the increasingly gigantic and complex software are projects that have since been undertaken would be practically impossible. His ideas about software design and development effectively birthed the software engineering profession. Structured programming is about separating a program into logical subsections, each with one entry and exit point (i.e. functions). The point is to make programs both easier to understand and easier to modify. It also means reusing the subsections in different programs is easier. During the 70s and 80s, this programming methodology heavily influenced the creation of languages like Pascal, C, and Ada.

Dijkstra was also part of the international team that designed the ALGOL 60 language. The introduction of recursion was due to him, and in doing so the introduction of what he called a *stack*. Now stack is universal computer science jargon and it's implemented in most all languages. By 1960, Dijkstra and his colleague Jaap Zonneveld had completed the first ALGOL 60 compiler, which wasn't a feat repeated for another year.

His iconic Shortest Path algorithm has been applied to a plethora of problems throughout the years, the OSPF routing protocol, airplane paths between airports, and more. It's no wonder the algorithm is responsible for much of his fame. In an interview with Philip L. Frana, 2001, he had this to say:

One morning I was shopping in Amsterdam with my young fiancée, and tired, we sat down on the café terrace to drink a cup of coffee and I was just thinking about whether I could do this, and I then designed the algorithm for the shortest path. As I said, it was a twenty-minute invention.

When working on concurrent programming, Dijkstra identified the deadlock problem, and invented semaphores. Lots of multitasking software systems like operating systems heavily rely on semaphores and the idea of mutual exclusion.

Clearly, many of the software engineering projects that have been completed since, would look very different without these contributions.

Later Life

Dr. Edsger Wyde Dijkstra died on the 6th of August, 2002, after a long battle with cancer. He had three children with his wife Maria Debets. He was awarded the Dijkstra Prize shortly before his death, which had originally been called the *PODC Influential-Paper Award*, but was renamed in his honour in 2003.

I mean, if 10 years from now, when you are doing something quick and dirty, you suddenly visualize that I am looking over your shoulders and say to yourself "Dijkstra would not have liked this", well, that would be enough immortality for me. - Edsger W. Dijkstra