A Brief History of Computing

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To my wonderful nieces and nephews Jamie, Tiernan, Cian, Aoife, Lorna and Daniel

Preface

Overview

The objective of this book is to provide an introduction into some of the key topics in the history of computing. The computing field is a vast area and a truly comprehensive account of its history would require several volumes. The aims of this book are more modest, and its goals are to give the reader a flavour of some of the key topics and events in the history of computing. It is hoped that this will stimulate the interested reader to study the more advanced books and articles available.

The history of computing has its origins in the dawn of civilization. Early hunter gatherer societies needed to be able to perform elementary calculations such as counting and arithmetic. As societies evolved into towns and communities there was a need for more sophisticated calculations. This included primitive accounting to determine the appropriate taxation to be levied as well as the development of geometry to enable buildings, templates and bridges to be constructed. Our account commences with the contributions of the Egyptians, and Babylonians. It moves on to the foundational work done by Boole and Babbage in the nineteenth century, and to the important work on Boolean Logic and circuit design done by Claude Shannon in the 1930s. The theoretical work done by Turing on computability is considered as well as work done by von Neumann and others on the fundamental architecture for computers.

The various generations of programming languages that have been developed over the last 50 years are then considered. This includes machine code used in the early days of programming; low-level assembly languages; high-level programming languages such as C and Pascal, and so on. The important field of software engineering is then considered, and this chapter considers various software engineering methodologies to design and develop high-quality software to meet customers' requirements. This includes a discussion on theoretical mathematical approaches as well as practical industrial approaches using the CMMI.

The field of Artificial Intelligence is then considered starting with Greek mythology on creating life and intelligence. The Turing test developed by Alan Turing to judge whether a machine may be considered intelligent is considered as well as Searle's rebuttal argument on Artificial Intelligence.

Next, the development of the internet and world-wide web is considered. This includes the work done by DARPA on the internet as well as the work done by Tim Berners-Lee at CERN that led to the birth of the world-wide web. Applications of the world-wide web are considered as well as the dot com bubble and eventual collapse.

Finally, the contributions of various well-known technology companies are considered. These include companies such as International Business Machines (IBM), Microsoft, and Motorola.

Organization and Features

The first chapter discusses the contributions made by early civilizations to computation. This includes work done by the Babylonians, Egyptians and Greeks. The Babylonians recorded their mathematics on soft clay which they then baked in ovens. The Egyptians applied their mathematics to solving practical problems including the construction of pyramids as well as various accounting problems. The Rhind Papyrus is one of the most famous Egyptian papyri on mathematics, and it is essentially a mathematical text book. The Greeks made a major contribution to mathematics and geometry, and most students are familiar with the work of Euclid on geometry.

Chapter two considers influential figures in the history of computing who did important foundational work. It includes a discussion on Boole, Babbage, Turing, Shannon, and von Neumann. Boolean logic is fundamental to the working of all modern computers, and Boole is considered to be one of the fathers of computing. Babbage did pioneering work on the Difference Engine as well as designing the Analytic Engine. The difference engine was essentially a mechanical calculator while the analytic engine was essentially the world's first computer. However, the analytic engine was never built. Lady Ada Lovelace who was a friend of Babbage's designed the first programs to run on the analytic engine, and she believed that the machine would be applicable to many disciplines.

Claude Shannon showed how Boolean Logic could be applied to simplify the design of circuits, and how Boolean logic could be employed in computing. Turing's work on computability showed that whatever was computable was computable by his theoretical Turing Machine, and he also made contributions to the Artificial Intelligence field. Von Neumann and others defined the von Neumann architecture which is the fundamental architecture used in modern computers.

Chapter three considers various programming languages developed over the last fifty years. These include the five generations of programming languages such as machine code languages that use actual machine instructions, to assembly languages, to high-level programming languages such as Cobol, Fortran, Pascal, C, C++ and Java. The earliest high-level language developed was called Plankalkül, and this language was developed by the German engineer Zuse. Functional program-

ming languages are discussed as well as the important area of syntax and semantics of programming languages.

Chapter four considers the important field of software engineering. It discusses the birth of software engineering at the NATO conference at Garmisch in 1968. This conference discussed the crisis with software and included problems with projects being delivered late or with poor quality. The software engineering field is concerned with sound techniques to engineer high quality software to meet customers' requirements. It includes methodologies to define requirements, design, development and test software as well as the management of change. Mathematical techniques that may assist in software engineering are also considered, and these include approaches such as Z and VDM. The Capability Maturity Model Integration model is discussed, as this offers a useful framework to enhance the software engineering capability of a company.

Chapter five considers Artificial Intelligence and Expert Systems. Artificial Intelligence is a multi-disciplinary field that is concerned with the problem of producing intelligence in machines. This chapter considers some of the key disciplines in the field including philosophy, psychology, linguistics, neural networks, and so on. The Turing Test was proposed by Alan Turing to judge whether a machine is intelligent. Searles's Chinese room argument is a rebuttal and argues that even if a machine passes the Turing Test it still may not be considered intelligent.

Chapter six is concerned with the Internet revolution and considers the early work done by DARPA on the internet, and the subsequent invention of the world-wide web by Tim Berners-Leee at CERN in the early 1990. The rise of new technology companies such as Amazon is considered, as well as the frenzy that became the dot com bubble and subsequent dot com collapse. Many of these new technology companies had deeply flawed business models which was a significant factor in their eventual collapse. Several of dot com failures are considered including the on-line fashion company Boo.com and also the on-line pet food company Pets.com.

Chapter seven is concerned with the achievements of several of the better known software technology companies. These include IBM, Motorola and Microsoft.

Audience

This book is suitable for students of Computer Science and for the general reader who is interested in the history of computing. Some of the material is technical and mathematical. However, any technical material is presented as simply as possible.

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I would like to express thanks to IBM Archives for permission to include photographs of the IBM PC, IBM 360, Hermann Hollerith, Hollerith's Tabulating Machine from 1890, the photo of the Deep Blue processors, as well as photos of Thomas Watson Senior and Junior. I must thank Brian Randell for permission to use the photo of Dijkstra from the 1968 software engineering conference. I would like to thank the W. Edwards Deming Institute for permission to use a photo of Deming and the Juran Institute for permission to use a photograph of Juran. I must thank Fred Brooks, Watt Humphries and John McCarthy for permission to use their photographs. I must thank Horst Zuse for the use of a photograph of Konrad Zuse. I would also like to thank the School of Computing at the University of Manchester for permission to include a photograph of the Manchester Mark 1. The National Physical Laboratory gave permission to reproduce the NPL ACE machine from 1950. I would like to thank Tommy Thomas for the use of a photo of the replica of the Manchester Mark 1 Baby that was taken at the Manchester Museum of Science and Industry. I would like to thank Wikipedia for using its public domain photographs.

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