Chapter 2
History of Supercomputing and Supercomputer Centers

Jeffrey S. Cook
Independent Researcher, USA

Neha Gupta
Northeastern University, USA & Osmania University, India

ABSTRACT

This chapter begins with the definition of supercomputers and shifts to how the supercomputers have evolved since the 1930s. Supercomputing need is stressed, including issues in time and cost of resources currently faced by the researchers. The chapter transitions to an overview of the supercomputing era with a small biography of Seymour Cray. The timeline of Cray's history and various Cray inventions are discussed. The works of Fujitsu, Hitachi, Intel, and NEC are clearly demonstrated. A section on Beowulfs and S1 supercomputers is provided. A discussion on applications of supercomputing in healthcare and how Dell is emerging in its supercomputing abilities in 21st century are cohesively explained. The focus is shifted to the petaflop computing in the 21st century, current trends in supercomputing, and the future of supercomputing. The details of some of the global supercomputing centers in the Top500 list of fastest supercomputers in the world are also provided.

INTRODUCTION

Supercomputer is a computer which is the most predominant in terms of computational rate, memory, or cost. Historically, a supercomputer is associated with the fastest computer available or the largest in size. Supercomputing can be put in exact words like "ultra mass computing performing at ultra high speed". There are quantum computers but they exist only on paper and grid computers are comparable to supercomputers but are a lot cheaper. There have been tremendous amounts of development in supercomputing arena since the inception of supercomputers in around 1930's. However, till date there is no accurate information on who the inventor of supercomputers is and how it was made technologically in the beginning. Many people consider Seymour Cray to be the father of supercomputing while others consider various other scientists to be the discoverers while tracing the roots of supercomputing.

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Demand for supercomputing capabilities is rising all over the world, driven primarily by the need for effective, reliable solutions to increasingly complex social, scientific, environment, business challenges and problems (Yamada,2014). This is in turn leading to a high-tech computational modeling and simulation power beyond the scope of R&D labs. Supercomputing has evolved from the not so popular research calculators or transistors to the popular CDC's by Cray Inc in 1960s and 70s and presently the most mature peta-scale forms in 21st century.

Along with the evolution of supercomputer architectures, the new computational algorithms emerged mostly from the basics of Mathematics that led to significant progress in research. Some of these algorithms include Red/black, Multigrid, scatter/gather hardware and vectorized libraries (Burns, 2013). Thinking machines also emerged from Massachusetts Institute of Technology (MIT) with the first general purpose Massively Parallel Processing Unit (MPP).The concept here was to add sufficient processors to emulate the brain but approximately 10^{14} neurons. This is commonly referred to as Artificial Intelligence (AI). Minicomputers emerged and have briefly sustained. In the late 1980's and early 1990's, the era of powerful microprocessors was observed (Burns, 2013).

There are two approaches to the design of supercomputers. One is the Massively Parallel Processing unit (MPP) which is to aggregate thousands of commercially available microprocessors utilizing parallel processing techniques (Supercomputer, 2014). A variant of this, called a Beowulf cluster or "cluster computing" employs large numbers of personal computers interconnected by a local area network. The other approach, called vector processing, is to develop specialized hardware to solve complex computations (Supercomputer, 2014).

Computers incorporate very large scale integrated (VLSI) circuits with millions of transistors per chip for both logic and memory components. Several computers use high-speed complementary metallic oxide semiconductor (CMOS) technology. Many supercomputers now use conventional, inexpensive device technology of commodity microprocessors and rely on massive parallelism for speed (Supercomputer, 2014).

THE ISSUE OF COST AND TIME

Construction of supercomputers is an awesome but very expensive process. The most recent development costs of supercomputers varied between 150 to 500 million dollars (USD $) or more. Particularly, this entire process draws on all the resources a company has. This is one of the main reasons that the development of a supercomputer is kept very hush-hush (Robat, 2013). Some of the companies contributing to the computing developments include Amdahl, Burroughs, CDC, Cray, Fujitsu, Hitachi, Hewlett-Packard, IBM, Intel, NEC, SGI, Sun, Texas Instruments, Thinking Machines, Univac (Robat, 2013).

THE BEGINNING OF THE ERA OF SUPERCOMPUTING

The history of supercomputers dates back to 1930's. In 1939, Atanasoff-Berry supercomputer was created at Iowa State. Later in 1940, Konrad Zuse-Z2 supercomputer uses telephone relays instead of mechanical logical circuits. In 1942, ENIAC (Electronic Numerical Integrator and Computer) supercomputer was introduced whereas in 1943, Colossus, a British Vacuum tube computer was developed. In 1944, Manchester Mark I 1944 supercomputer was installed. In 1946, Harvard Mark II and in 1948 Manchester Mark I (1st stored program digital computer) was installed at Whirlwind, MIT. In 1950, Alan Turing-Test of Machine Intelligence was done using UNIVAC (Universal Automatic Computer) I. In 1951, William Shockley invented the Junction Transistor.

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