

INTRODUCTION

EE3232 DIGITAL SYSTEMS III CLASS NOTES CHAPTER 1

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SUMMARY

- Computing devices - history.
- Information transfer.
- Information transfer - the issues.
- Course overview.

COMPUTING DEVICES - HISTORY

- **Wilhelm Schickhard** (1592-1635) designed and built a mechanical calculator in 1623.
- **Blaise Pascal** (1623-1662) built a mechanical calculator for adding / subtracting 6-digit 10's complement numbers.
- **Gottfried Leibniz** (1645-1716) built a mechanical calculator in 1671 with add-sub-multiply-divide.
- **Charles Babbage** (1812) designed a mechanical computer called the **Difference Engine** to compute 6-th order polynomials with 20-digit numbers.
- **Motivation** : to compute the numerical value of polynomial equations automatically (rather than by hand).
- **Why** : improve reliability, speed the generation of tables.
- Over 30 years Babbage enhanced his design into a more general computing device, the **Analytic Engine**.

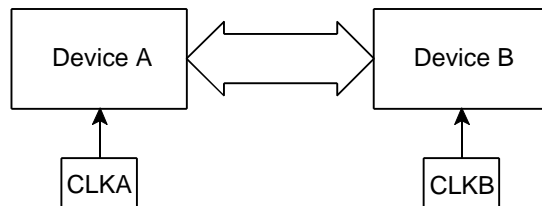
- Contemporaries of Babbage : Laplace, Bessel, Jacobi, Boole and DeMorgan.
- **Properties of the analytic engine:**
 - ▶ Double precision arithmetic,
 - ▶ Automatic rounding,
 - ▶ Various alarms (or interrupts),
 - ▶ Plates for printing results,
 - ▶ Memory for storing 1000 - fifty digit numbers,
 - ▶ Conditional tests and branches,
 - ▶ Indexers for loop control,
 - ▶ Addition and subtraction with carry look ahead and
 - ▶ Multiply and divide operations.
 - ▶ All mechanical design - hand crank driven.
- **Charles X. Thomas** (1785-1870) commercialized the Arithometer, a mechanical calculator in 1820.
- **D.E. Felt** (1862-1930) designed the Comptometer in 1885, with keys for data / command entry and paper for printing.
- **Herman Hollerith** (1860-1929) invented the punched card tabulating machine that was used in the 1890 US census.
- In 1896 he formed the Tabulating Machine Company.
- In 1911 the company merged to form the Computing-Tabulating-Recording Company which was re-named **International Business Machines** in 1924.
- **Konrad Zuse** in 1931 built the Z1 a mechanical computer that used **binary** arithmetic.
- In 1941 he built the Z3 a general purpose program controlled computer that supported floating point math.
- **Howard Aitken** (1900-1973) designed an electro-mechanical computer, the Harvard Mark IV, in 1937.
- It was controlled by punched paper tape with the instruction format: A1 A2 OPCODE.
- **Lee DeForest** (1873-1961) invented the triode vacuum tube in 1906.
- It permitted electrical signals to be switched at rates far exceeding any mechanical device.
- **John W. Mauchly** and **J. Presper Eckhert** (U. Of Pennsylvania), in 1946 built the first electronic (vacuum tube) digital computer - ENIAC, the Electronic Numerical Integrator and Calculator.

COMPUTING DEVICES - HISTORY

- **Turing** in the U.K. built a military computer at the same time.
- The first semiconductor microprocessor, the INTEL 4004 was fabricated in 1971.
- **Reference** : J.L. Baer, "Computer System Architecture", Computer Science Press, 1980.

INFORMATION TRANSFER

- A recurring theme throughout the course : how is digital information exchanged between two devices.



INFORMATION TRANSFER - THE ISSUES

- ▶ Is information transmitted **bit-serial** ?
- ▶ Is information transmitted **byte-serial** ?
- ▶ Electrical characteristics?
- ▶ At what **time** should the information be transmitted?
- ▶ At what **time** should the information be received?
- ▶ What form of **synchronization** is required?
- ▶ What if there are **multiple** transmitters and receivers?
- ▶ Are there **speed** (or bandwidth) limitations?

COURSE OVERVIEW

- ▶ **The SBC188** : Microcomputer & development tools.
- ▶ **The System Bus** : hardware and software interfaces.
- ▶ **Parallel IO** : (PPI's, keypads, displays, IR receiver).
- ▶ **Polled Handshaking IO** : (PPI's, parallel printers).
- ▶ **Serial IO** : (UART's, displays, mouse, card reader).
- ▶ **Analog IO** : (ADC's, DAC's, data acquisition).
- ▶ **Interrupt Driven IO** : (Interrupt Controllers).
- ▶ **Direct Memory Access** : (DMA Controllers).
- ▶ **Secondary Storage using Magnetic Disks**.
- ▶ **CPU - Memory - IO, Interfacing and Timing**.