SE1A2 : Introduction to Computer Systems

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Objectives

To introduce main features of computers:

hardware (includes logic), software & their interaction

Structure, representation and operation are described

Information coding and processing

System & User and High & Low level programming

By the end, students should have/know

model of computers, their operation and where used,

how high level languages map on to hardware,

understand logic and be able to design suitable circuits

Cybernetics

Books and Notes

Notes for course on BlackBoard and on link from

http://www.cyber.rdg.ac.uk/people/R.Mitchell/teach.htm

But – you should still attend lectures and make notes

Spare copies of notes will be in School Information Office G44.

Books

***The Principles of Computer Hardware*,**
Alan Clements, OUP

***Microprocessor Systems - an Introduction*,**
R.J.Mitchell, Macmillan – out of print, but copies in Library.

If you know of a better book – tell us.

Topics and Exam Questions

On exam, questions correspond to lectures:

Computers, Structure, Operation; Info Processing 2Q

[In the past two different lecturers did these topics; now one]

Logic 2Q

2 hour Exam worth 75% of module, answer 3Q from 4

Labs worth 25%; details to be given separately

In addition, you will be given 'self assessment' questions – you attempt them to see whether you understand the material.

It is worth discussing your answers with others on the course

Remember - the complete learning process includes lectures, practicals, assignments and you reading in your own time

Laboratory Practicals

Laboratory practicals for Part 1 modules involving lectures in Cybernetics and Electronic Engineering are on Mondays.

These practicals are for various modules, including SE1A2.

Take place in G21 in Electronic Engineering or G56 in Cybernetics

Location depends on lecturer associated with the practical

In weeks 1 and 2, labs are for module CY1A2 only

Thereafter, labs are for all relevant modules

Students are expected to find the timetable and hence determine when they have a lab and what it is on.

Bring relevant notes/books to the lab.

Introduction to Computer Systems

A computer is an information processor but often considered a number cruncher

History tells us why, and introduces concepts.

First consider development of calculators

Schikard 1623, Pascal 1642, Moreland 1666, Liebnitz 1693, DeColmar 1820....

First ‘programmable’ machine - Jacquard Looms - holes in cards for specifying patterns on cloth

Babbage - difference engine & analytical engine

first programmable ‘computer’

Cybernetics

Law of Constant Differences - for x^2

$2^2 - 1^2 = 3$

$(3^2 - 2^2) - (2^2 - 1^2) = 2$

$3^2 - 2^2 = 5$

$(4^2 - 3^2) - (3^2 - 2^2) = 2$

$4^2 - 3^2 = 7$

$(5^2 - 4^2) - (4^2 - 3^2) = 2$

$5^2 - 4^2 = 9$

In general $(x^2 - (x-1)^2) - ((x-1)^2 - (x-2)^2) = 2$

Or $x^2 = (x-1)^2 + (x-1)^2 - (x-2)^2 + 2$

For finding x^3, need more advanced formula, etc.

To program: set up difference rule, initial values & run...

Babbage's Engines...

These formulae provide appropriate *algorithm*.

To solve problems, we need algorithms (like recipes)

More general machine - Analytical Engine

Basis of modern computer.

Mill - for doing (decimal) calculations

I/O - read programs from punched cards, output to printer

Store - for storing data

Ada Lovelace appreciated need for programs.

The first Computer Scientist?

1850's. onwards - hardware

1890s Hollerith's punched cards - for US census.

1930s Differential Analysers, ballistic trajectories.
Turing develops ideas of computability.

1940s Automatic Sequence Controlled Calculator
Colossus and ACE (Automatic Computing Engine)

1946 Electronic Numerical Integrator & Calculator ENIAC -
First electronic calculator - 18000 valves - 150kW of power

1946 Von Neumann suggests computer structure - uses binary

1948 Bell Labs invent transistor

1960s Integrated circuits -> PDP8;

1970s/80s LSI, VLSI -> microprocessors, etc.

Software and Microprocessors

As computers improve - start thinking of programming –

FORTRAN the first high level language.

Other languages BASIC, ALGOL, Pascal, BCPL, C, LISP, SmallTalk, LISP, APL, Cobol, Prolog, Modula-2, ADA, C++, ...

Microprocessors: 4004, 8008, 8080, 6800, Z80, 6502, 6809, 8086, Z8000, 68000, etc. 80x86, 680x0, Pentium, RISC, ...

First micros were invented for calculators!

1970's Personal computers - first for hobbyists, .. Apple, ZX80..

1980s IBM try to get involved -> Microsoft -> Dos, Windows

Workstations - Sun, DEC, HP, etc. -> Unix

Information Revolution - e-mail - WWW - Java ...

Binary - the basis of computers

Computer is an information processor under instruction it performs logical operations on binary data

Bit = BInary digiT - is ‘0’ or ‘1’.

Consider adding two bits, a and b – can do using ‘logic’:

a	b	Sum	Carry
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

Carry is 1 if a is 1 AND b is 1 or a AND b

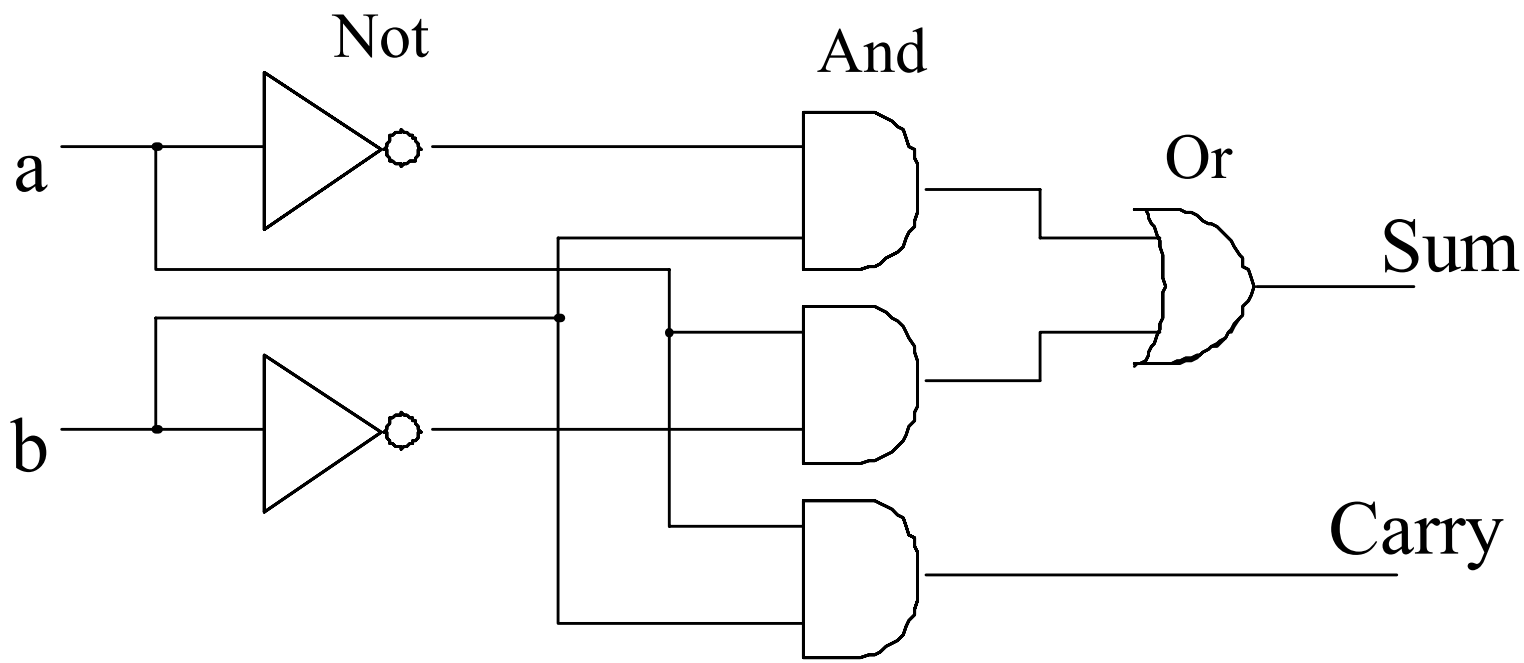
Sum is 1 if ((a is 0) AND (b is 1)) OR ((a is 1) AND (b is 0))

i.e. (NOT (a) AND b) OR (a AND NOT(b))

Circuit for this - uses AND, OR, NOT gates

Carry = a AND b

Sum = NOT(a) AND b OR a AND NOT(b)



Summary

Thus we have seen that history shows why people think computers are for numbers

In fact computers are information processors

Information is represented in binary

And processed by logic circuits

Next week we will look more at information representation, including multi bit values.

We have seen that Babbage invented the structure of a computer, we will in subsequent weeks look at the modern implementation of computers.

We have also met algorithms – more will be said of these.