(COMPUTERS IN MEDICINE) MEDICAL INFORMATICS

Sub Code: ML 752
Hrs/Week : 04
Total Hrs : 52

Text: COMPUTER IN MEDICINE - R.D. Lele
TMH, 1989, /2005.

1. Introduction,
historical review of computers & their use in medical field
Hospital information system - need for computerization in hospitals - cost effectiveness - Help of computerization to Physicians
- 8Hrs.

Digital computer
- Making calculations easier
- Handling information better

The ancient Chinese used the abacus to perform calculations by moving beads along Parallel wires.
From the Latin word for beads, calculi, has come the English word calculate

In 1642, Blaise Pascal, a french mathematician, thought of the idea of a machine that could perform mathematical operations. He deviced a way to automate addition, starting with the basic concept of the abacus; instead of wires and beads, he used a series of wheels, each having ten positions to one wheel was completed. Numbers 0 through 9 were displayed in a window for each wheel.

As a revolution of one wheel was completed, it advanced the adjacent wheel to left on notch, Providing a mechanism for 'carrying over'. Pascal and others like Gottfried Leibniz in 1670, modified this machine until it could perform other operations such as Subtraction, multiplication and divison. In 1679, leibniz introduced binary arithmatic.

In 1801, Jacquard, a French inventor, developed an automatic loom.

Jacquard conceived of the idea of 'instructing' the loom as to which of the lengthwise (wrap) threads should be lifted, thereby varying the pattern as the shuttle traversed across the loom. The sequence in which the wrap threads were lifted or not lifted determined the Pattern that was being woven; the instructions were imparted to the loom by a series of a given wrap thread was determined by the Presence or absence of a hole in a particular location on the card. Thousands of cards could be used repeatedly to reproduce the pattern.

Historical Review of the development of the computer.

The Present-day digital computer has descended from two lines of development:
- Making calculations easier
- handling information better.

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In 1822, Charles Babbage, an Englishman developed an interest in devising m/c to calculate navigational tables because of the occurance of frequent errors in these tables.

Babbage was influenced by Jacquard and realised the value of the Punch card as a method of storing data and instructions for his calculating m/c. The device was finally completed a years after his death.

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In 1944, IBM, mark-I
Harvard for next 15 years

World War II

~~Acknowledgment~~

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Many computer designers credit Babbage with establishing the basic Principles on which modern computers are built. Babbage had realized that he would need software for his analytical engine, so he hired a young woman named Ada Lovelace, daughter of the famous British Poet Lord Byron, as a World's first Programmer who invented the iterative loop, and if-then conditional branching. The Programming language "Ada" is named after her.

In 1848, George Boole another British mathematician developed a system of binary logic in which all Questions could be answered as "true" or "false", "yes" "no". It was almost a hundred years before a computer was developed on binary numbers using Boolean logic or Boolean algebra. The binary system allow the use of electronic circuitry to perform complex logical calculations, using YES/NO TRUE/FALSE, PRESENT/ABSENT, AND/OR/NOT o IF/THEN/ELSE.

The 1880 census in U.S put a tremendo burden on manual tabulations. This stimu -ated two engineers Herman Holerith an James Powers, Working with the census Bureau, to develop a Punch card counting machine.

A manually Punched card, the size of ten rupee note (or a dollar bill), was Placed on a pool of mercury. A series of single wires lowered onto the card would make contact with the mercury if a hole were present at that specific location. The result would register on dials and these would be used for calculati

Hollerith's device tabulated the results of the 1890 US census in six weeks instead of the seven years it had taken to compile the earlier census by hand. Hollerith Patented the invention and formed the Computer Tabulating Recording company, which in 1924 Changed its name to the International Business Machine (IBM) corporation.

It is interesting to note that Thomas Watson, chairman of IBM, said in 1943, "I think there is a world market for may be five computers"

VACUUM TUBES

The Vacuum tube was first breakthrough leading to modern computer. Thomas Edison had discovered the diode Vacuum tube and discarded it as Worthless.

In 1904, John Ambrose Fleming created the first commercial diode Vacuum tube, which could act as a switch, turning on and off thousands of times faster than mechanical contraptions like gears and Switches.

Vacuum tubes were at the heart of the Mark 1 developed by IBM in 1944, Wh was the electronic realization of Babbag analytical Machine.

Mark-1 remained in operation at Har for the next 15 years.

In 1945, John Von Neumann first Propose the idea of a general Purpose digital comp with a Stored Program, which became the b of most computers that followed.

ENIAC- 1943-45

MANCHESTER mark-1 1948 Store a Program electronical

making Programmers set switches manually.

ENIAC- [Electronic Numeric Integrator and calculator]

1945. US army 5,000 additions/sec which was 1,000 times faster than Calcul

ENIAC, $ 500,000 weight 30 ton 100 feet lag - 8 feet high, 17,468 Va tubes

200 kW Power

TRASISTORS :→

1936 - Konard Kusc, a German Created Programmable digital computing m/c which used binary system and Valves.

1947 - Bell Lab's William shokley Patented the modern Solid-State, reliable transistor.

INTEGRATED CIRCUIT

IC, LSI, CPU, 1969 IBM

LSI - 10,000 to 20,000

Gordon Moore co-founder of Intel

VLSI 2000. 25 million transistors fabricated over a 0.18 μ process.

↳ 2017 Single chip 19 trillion transistors, 20 times the number of neurons in the human brain. 0.13 μ process.

PERSONAL COMPUTER (PC)

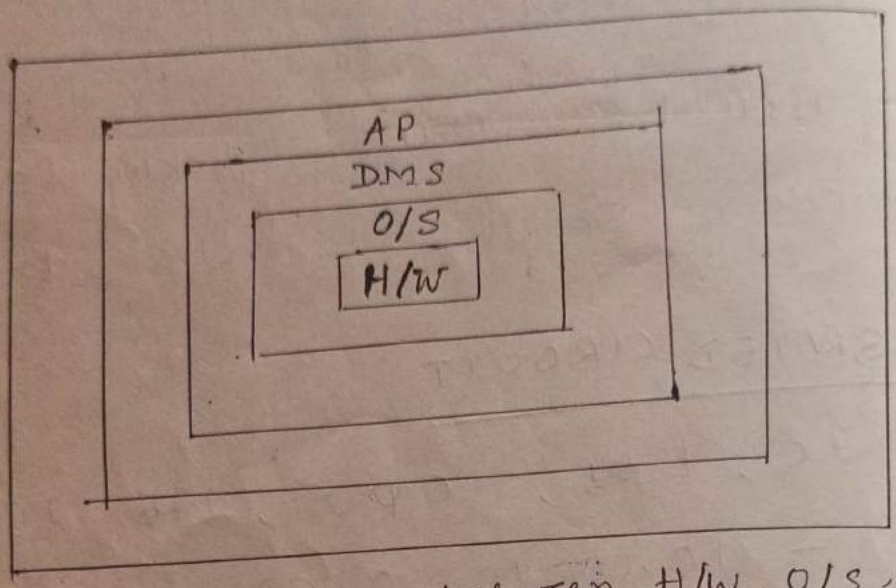

Fig: Relationship between H/W, O/S, DMS

AP

H/W → hardware
O/S → Operating system
DMS → Data management system
AP → Application program

Figure depicts the relationship between the computer Hardware (H/W), O/S, DMS an AP.

CP/M, MS-DOS and other operating syst for early microcomputers all relied on users typing in commands from th keyboard.

In 1960s, Dough Engelbart at stan Research Institute invented the graph user interface (GUI) Bonounced as gooe

complete with windows, icons, menus and mouse.

Stephen Jobs
Steve Wozniak — 1976 — computer complete with a GUI display.

built in keyboard and disk storage

They called it the APPLE - macintosh

microsoft influenced by the success of macintosh.

microsoft called GUI - based system WINDOWS-95.

[Narrowest trace 0.10 μ]

IBM - copyrighted BIOS-

- The crucial Basic Input-output System - computer code residing in a single chip that defined how S/W was to interact with the PCs H/W.

COMPUTERS IN DATA PROCESSING:

Computers themselves have evolved largely in response to the demand for the Processing of data: large Quantities of Characters, such as numbers or letters, representing information of almost every conceivable kind.

Embedded micro electronics:
tailored to its specific applications

QUA>

CLASSES OF COMPUTERS:

1) Micro computer
2) Mini
3) Mainframe
4) Super

1) traditionally defined as self-contained, single user desktop systems with single CPU and single task

The OS of PC's, MS-DOS, Windows

2) Minicomputers are desktop m/c with a single CPU, with multiuser single task or multitasking

OS of PC's are RST 8/E, AUS/IS, PRIMOS, VMS
N/W

3) Single or multiple CPU, multi-user, multitasking m/c providing computer power for several terminals located both locally and at remote sites. Such a system allows multiple users

to run multiple applications simultaneously

Room sized m/c,s still found in major corporate data centres distinguish themselves from PCs in terms of their I/O capacity.

A mainframe with 1000 disks and thousand of gigabytes of data is not unusual. They are being used as high-end web servers, Servers for large-scale electronic commerce sites and servers for business-to-business transactions.

The OS for mainframes are processing many jobs at once.

They typically offer three kinds of service: batch, transaction and time sharing.

Batch Processing:

This includes claims processing in an insurance company and sales reporting for a chain of stores, where there is no ~~dialog~~ ~~or~~ online user interaction once the job is submitted.

- Transaction Processing:

This include a large number of small requests such as airline reservations, cheque processing in banks.

Each unit of work is small but the s must handle hundreds or thousands per seconds. Each transaction has to be complete in itself and cannot be half do The response time in this case is critical.

- Time sharing:

This system allows multiple remote u to work on the computer at once, such a Querying a big database.

Mainframes (now much smaller size). A single CPU unit has given pl to distributed computing units (servers spread out over a n/w.

Supercomputers

Super computers are multiple CPU, multiuser, multitasking m/c. Earth (Climate research) Simulator Yokohama, Janpan by NEC.

world's fastest it does 35.86 trillion calc / sec

Weapon design ② Nos

Los Alamos National lab

lawrence livemore National lab

Srinidhi Varadharajan @ Virjinia

$ 3 million 2,200 IBM µP

7.41 tera flops

Bluegene 1st petaflop IBM

Bluegene L 1/10th of Earth stimulator size

130,000 Processor

Bioinformatics for analysing DNA and amino acid sequences and 3-D structures of Protiens.

PERSONAL COMPUTER (PC) SPECIES:

Personal digital Assistant (PDA), Modem, fax, internet, voice phones, Video and audio recording & Playback (CD, VCD) Rewritable DVD, accelarated 3D graphics Universal Serial bus, GPS devices.

COMPUTER REVOLUTION & MEDICINE:

- Data acquisition
- In Medical Practice
- Data acq. from patient and subsequent storage, retrieval and manipulation of data are enhanced by computer.

- In Medical decision-making
- Improve accuracy
- cost effective

X-ray, US, ECG, Loss of limb, Para
Speech impediments, deafness and
blindness

'Information explosion' (Internet)

Capacity for data storage & retrie
has become a boon.
Medical information 'online @ anytim
from any part of the globe.

It is therefore essential for medic
Practitioners to become computer liter

Four fascinating

1) Artificial Intelligence in Medic
2) Artificial Neural Networks (ANNs)
Robotics.
3) Machine learning and
4) Machine translation.

(a) AI in Medicine;→

Not easy to characterize AI,

(1) Intelligence "an ability ~~to solve problems~~ use accrued knowledge to make correct decisions"

(2) an ability to solve problems, or to creat
products that are valued within on
more cultural settings

Howard Gaidner, 1983.

He Proposed 7 relatively independent dimesions of intelligence :

3 Object - related dimensions
① Spatial
② logical
③ Mathematical and
bodily kinesthetic

2 Obiect - free dimensions
① Linguistic
② Musical

and 2 cultural dimesions
① Interpersonal
② Intrapersonal.

① IQ - (Intelligence Quotient) tests usually measure Spatial and logical - mathemdtical intelligence.
EQ (emotional Quotient) is ~~a measure~~ an important measure of inter - personal relationships in human organizations.
EQ - is outside the scope of AI. Though attempts are being made to teach emotions to robots

② Two - obiect - free intelligence
① linguistic ② Musical
computers have Obiect free intelligence
Deep Blue / Gary kasporov
M/c cannot Communicate beliefs, ideas, and emotions
can be simulated digital speech, music

cognitive continuum theory (CCCT) Provides a means of Bedicating when heuristics fails W.r.t to task environment.
According to CCT, a recurrent gradual movement along a continuum of intuition and analysis occurs in response to changes in task properties such as the dynamic clinical environment.
CCT provides a testable means of measuring and evaluating when heuristics will be successful.

These heuristic rules may be derived from interaction with experts in the concerned domain. considerable AI interest is focused on Problems of Pattern recognition. While Statistical Pattern recognition may not be regarded as AI, Syntactic and semantic Pattern recognition would be considerable as AI.

(b) Neurocomputing

(c) Humanoid Robots and M/c intelligence

(d) A/D computers

(e) man - computer symbiosis

(1) To let computers facilitate formulative thinking
(2) To enable men and computers to co-op in making decisions.

① The computer as a communication Device:

② Telematics

Knowledge engineering is concerned with Problems of the representation and storage knowledge, its access when needed, and the integration of such ~~storage~~ stored knowledge, ~~its access when needed, and~~ with the data derived from specific Problems to effect their solution.

The knowledge to be represented in such a system includes both factual or descriptive knowledge and Problem solving Procedures or normative knowledge. The latter includes means for the management of 'soft' ~~normative knowledge~~ data.

The tools of symbolic logic and fuzzy algebra Permit such data to be handled in a more formal way.

A major technique of knowledge representation is the semantic net, in which fact and their relationships are shown both Quantitative and Qualitative

↓ eg. ~~eg.~~ ↓ eg.

A variety of specialized systems and languages have been devised to support the features important in the development of AI systems.

language → for AI

① LISP

② PROLOG

Medical decision making has been a major focus of AI.

The structure of Medical informatics:

Medical informatics comprises the theoretical and practical aspects of information processing and communication, based on knowledge and experience derived from processing and communication, based on the knowledge & experience derived from process in Medicine and health care.

I/f of Med / Computer tech, 6 diff. levels of complexity

Level 1: comm. and recording

Visualization of bio-sig on CRT, connected to a processor, e.g. during ICU, and a comm. n/w of terminal in a hospital over which a result from a lab is sent to a nursing station or ward or in which e-mail is txd. through the hospital.

Level 2: Storage and retrieval of data bases.
Appn. include a patient registry or billing dept. Reports, discharge letters.

level 3: computation and automation
lab equipment centralized
NM - ECG, EEG, EMG, lung function analysis, etc are e.g. of dedicated computerized data processing and automation.
CT (X-ray txn, emission tomography, with single Photon or Positron, NMR). are the most spectacular examples.

Level 4: Recognition and diagnosis
diagnosis models, i.e. by using truth tables, decision tree, multivariate statistics (including Bayes' Theorem) and expert systems.
Recognition of Objects and patterns in images and signals as in X-rays, ECG interpretation and cell, chromosomes or cervical smear recognition.

levels. Therapy and control
Implantable micro system to be carried by the Patient subcutaneously, e.g. insulin Pump for the diabetic.

level 6. Research and Modelling

CVS physiology in terms of mech (flows, pressures, volumes) and electrical (depolarization & repolarization)

↳ Epidemiology

↳ Semantic or Pragmatic aspects

↳ models and algorithms display a heuristic character most of the time

| Languages:
| FORTRAN
| COBOL - comm
| Business or language
| ALGOL *(

Hospital information system - need for computerization in hospitals

*CONT. BASIC (Beginner's All-Purpose Symbolic Instruction Code)

PASCAL

C LANGUAGE

APL (A programming language

MUMPS: massachusetts General Hospital Utility multi Programming System. - 1967

LISP: List Programming language (AI Program)

Prolog (Programmed logic)

Medicine and Internet:

Introduction:

The internet (Interconnected Networks) is the name for the global network of computers and online services providing World Wide communications, and linking together many diverse resources.

Telecommunication links (telephone, Satellite, fibre optic cabling) have joined Whole network together.

ARPNET (Advanced Research Project Agency) US developed and served test development of advance n/w protocols.