A. INTRODUCTION

- There are 5 computer generations

- Turing and Von Neumann model

- Define a program, controller

- 4 subsystems of von neumann model are cu, i/o, memory, alu.

- Data organization

- Algorithms, machine language, software engineering, operating systems

- History of computer and some specific type of computers

- Addition and subtraction: Pascal, +Mul and Sub: Leibniz Wheel

- Storage and programming: Jacquard loom, used punch cards

- Polynomial equations: Difference Engine

- Special purpose computer: ABC (linear equations)

- EDVAC

- From here, 5 generations begin. Third generation: minicomputers, fourth generation: microcomputers.

- Silico sapiens means robots

- Timeline of computer generation: 1950 – 1959 – 1965 – 1975 – 1985 - Present

- John McCarthy: AI, Computer thinking

B. NUMBER SYSTEMS

- Decimal, octal, binary, hexadecimal

- Change from this type to that type

C. DATA STORAGE

- Data types (5) and multimedia, saved as bits (binary digits)

- Storing numbers: sign and magnitude, unsigned, one and two’s compliment, floating point

- Storing integers: **fixed-point representation**, unsigned: >0, sign-and-magnitude: first bit for sign: 0 (+), 1(-), two’s complement

- Storing reals: floating-point representation, normalization

- Sign, exponent and mantissa

- Excess, bias (shift the exponent to positive side, 2^m-1 -1 is the bias value, the IEEE

- Storing text: for characters we need at least n bits to represent 2^n symbols, ASCII, Unicode

- Storing audio: sampling, quantization, encoding. Text is a sample of digital data. Audio is analog data

- Sampling: choose some points, Quantization: rounds the value down or up, Encoding

- Bit depth and bit rate.

- Sound encoding: mp3, mpeg

- Storing images: bitmap (ragged, pixels) and vector graphics (geometrical shapes)

- Image encoding: JPEG, GIF

- Storing video: video is representation of images(frames), in space (single image), in time (series of images)

- Bit flag

- EBCDIC (extended binary coded decimal interchange code)

- Convert analog into digital => pulse code modulation, Convert digital to analog => modem

D. OPERATIONS

- Logic operations: AND, OR, NOT, XOR

- Modify a bit pattern -> mask

- Shift operations: simple shift (0 -> lost), circular shift (circle), arithmetic shift (right: right is lost and left is copy twice, left: 0 -> lost)

- Arithmetic operations: + - (two complement) A – B = A + (B’ +1)

E. COMPUTER ORGANIZATION

- CPU: include ALU, control unit (signals), registers

- ALU: Logic, shift, arithmetic

- Registers: data, instruction, program counter

- Main memory: address, address space, RAM and ROM

- RAM: SRAM (flip flop gates, fast but expensive), DRAM (capacitors, refreshed, opposite)

- ROM: PROM (human use, cannot be overwritten), EPROM (erase using UV, physical removal), EEPROM (electronic impulses, no remove)

- Speed: registers (fastest, most expensive), cache, main memory, disk

- I/O subsystems: nonstorage (keyboard, mouse), storage (magnetic disk, tape), optical (CD)

- CD ROM: uses lazer, aluminum, read real

- CD R: gold, read virtual, use dye, write once read many

- CD RW: silver, erasable.

- DVD.

- Subsystems interconnection: Data bus, address bus, control bus

- Controllers: SCSI (daisy chain), FireWire (transfer data in packets), USB, HDMI.

- Addressing: Isolated I/O (address of I/O device in controller is DIFFERENT than address of memory blocks, although same number of address), memory-mapped I/O

- Program execution: fetch decode cycle (machine cycle), programmed I/O (checking for the data in I/O to be transferred), interrupt-driven I/O (I/O will inform the CPU to transfer data), DMA

- Architectures: CISC, RISC, pipelining, parallel

F. COMPUTER NETWORKS AND INTERNET

- Define a network, host, router, switch

- Internet service providers (ISP) are backbones and provider networks

- LAN, WAN (point-to-point and switched wan)

- For communication to happen, we need both hardware and software.

- TCP/IP: law to connect devices

- Application: service (message) to users. WWW, URL, HTTP, FTP, TELNET (hacking), SSH, DNS

- client-server paradigm and peer-to-peer paradigm

- Port number 16 bit

- Transport: process to process (segment). TCP (reliable, slower due to detect) and UDP

- Network: host to host: IP, port (datagram)

- IPv4: 32 bit, Packets used by the IP are called datagram, IPv6: 128 bits

- Datalink: node to node (frame). ETHERNET (wired)

- Physical: wifi, cable (bits)

- Transmission media: guided and unguided

G. OPERATING SYSTEMS

- History: Batch systems (punching cards, 1950), timesharing, personal, parallel, distributed,real-time

- Bootstrap program (a program used when starting the computer)

- Components: User interface, Memory manager, Process manager, Device manager, File manager

- Memory manager: monoprogramming, multiprogramming

- Non-swapping: **store all programs into memory.** Partitioning: no divide program, size of memory segment different, storage continuous, contigous (each program has a typical space). Paging: divide program into equal frames, when in memory called pages, store random

- Swapping: virtual memory, a part in memory, other in disk . Demand segment: different program size, segment in memory equal, store random. Demand paging: divide program to equal frames/pages, load one by one)

- Program: A **program** is a nonactive set of instructions stored on disk (or tape). It may or may not become a job. A program becomes a **job** from the moment it is selected for execution until it has finished running and becomes a program again

- State diagram to differentiate program, job and process

- Scheduling: job scheduler (makes a program ready or terminate), process scheduler (control the process)

- Queuing

- Synchronization

- Deadlock (no restriction, take control until there is any, unable to force) and starvation (too much restrictions)

- UNIX, Linux and Windows

- Conditions for deadlock: Mutual exclusion. Only one process can hold a resource ❑ Resource holding. A process holds a resource even though it cannot use it until other resources are available ❑ No preemption. The operating system cannot temporarily reallocate a resource ❑ Circular waiting. All processes and resources involved form a loop

H. ALGORITHMS

- Algorithm, refinement, generalization

- Three constructs: sequence, decision, repetition

- Representation: pseudocode, UML

- Well-defined, ordered, unambigous steps, produce a result, halt

- Basic algorithms

I. PROGRAMMING LANGUAGES

- History: Machine code, assembly, high-level

- Translation: Compiler (translate source code to machine code), Interpreter (translate each line)

- Translation process: lexical analyzer, syntax, semantic, code generator

- Programming paradigms: procedural (FORTRAN, COBOL (business), C, Pascal), object-oriented (Java (app), C++ …), Functional (LISP, Scheme), Declarative (Prolog)

- Object-oriented: Class, method (same as functions), inheritance(an object can inherit from another object), polymorphism (define several operations with the same name that can do different things in related classes)

- Common concepts: identifiers, data types: simple and composite, variables, literals(pi), constants, i/o, expressions…

- Symbolic languages like LISP developed in 1950

J. SOFTWARE ENGINEERING

- The SDLC: Analysis (requirements, users), Design (UML), Implementation (code), Test (Glass box, Black box). User Documentation.

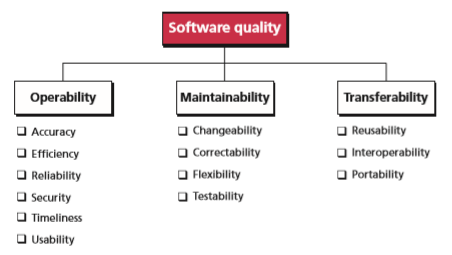
- Waterfall model: flows in only one direction

- Incremental model: series of steps with effectiveness increase

- Data flow diagrams show the movement of data in the system. Entity relationship diagram, State diagram (change in response to events)

- Object-oriented analysis: use-case diagram, class diagrams, state chart

|  |  |  |
| --- | --- | --- |
| Phase | Procedural | Object-oriented |
| Design | Structure chart, modularity (coupling and cohesion) | elaborating the details of classes |

* Implementation: 
* Testing: glass box and black box
* Documentation

K. DATA STRUCTURES

- Arrays -> Index, Records -> Fields, Linked lists (node including data and link)

- Memory layout: Row/ Column- major storage

L. ABSTRACT DATA TYPES

- Inside the ADT have two different parts: data structure and operations

- Stack (LIFO), and queue (FIFO)

- Linear lists, trees (pre: NLR, in: LNR, post: LRN, binary), graphs

- queue (queueName): create an empty queue, enqueue: rear, dequeue: front, empty: check the status

- General linear lists: 6 main

M. FILE STRUCTURE

- Sequential file (tuần tự): employee’s personal info, new master file (most current data), old master, transaction file (add, delete, change, key), error report file

- T<M => T to N; T=M => Change or delete; T>M => O to N

- Indexed file: made of data file and index (key and address)

- Hashed file: Direct hashing (trực tiếp), modulo division hashing (phần dư), digit exctraction hashing

- Collision: same keys that hash to same address -> synonyms, two or more synonyms -> collision, home address, prime area

- Collision resolution: open addressing, linked list resolution, bucket hashing

- Directories: tree, subdirectory, root directory (phần cao nhất), home directory (chính), working directory (hiện tại), parent directory (thư mục cha), pathname

- Text file: char, binary file: collection of data, only open with a program,

N. DATABASES

- Advantages: Less redundancy, Inconsistency avoidance, Efficiency, Data integrity, Confidentiality

- DBMS: 5 components: phần cứng, mềm, dữ liệu, người dùng (end users and application program), và thủ tục

- Three level: internal (hardware approach), conceptual (logic), external (user)

- Database models:

+ Hierachical model (tree)

+ Network model (graph)

+ Relational (relations, 2d table)

* Relational database model: Name, Attribute (column), Tuples (row, cardinality)
* Operation relations: SQL, Unary op, Binary op, Insert, Delete, update, select, project, join (common attributes), union (must have same attribute, each tuple is either on any relation), intersection (each tuple is member of both relations), difference (first but not second)
* Database design: ERM, E-R diagram, normalization (more solid structure)

O. SECURITY

- Security goals: Confidentiality (snooping, traffic analysis), integrity (modification, masquerading (cải trang), replaying, repudiation (cancelling to transfer data)), threat to availability (denial of service)

- Security attacks

- Snooping refers to unauthorized access to or interception of data

- Traffic analysis help them guess the nature of the transaction

- Replaying (fake sending message to receive payment)

- Denial of service (chặn)

- Cryptography and steganography: Symmetric and asymmetric

- Digital signature

- Entity authentication

- Firewall: packet-filter, proxy

- Based on the definition, in a block cipher, a single key is used to encrypt the whole block even if the key is made of multiple values.

P. SOCIAL AND ETHICAL ISSUES

- Moral rules (đạo đức)

- Utilization (hành động)

- Social contract (sự chấp nhận từ xã hội)

- Trademark: identifies a company’s product or service (thương hiệu)

- Trade secret (bí mật)

- Patent (bằng sáng chế)

- Copyright (ban quyen)

- Privacy

- Penetration of attack (xâm nhập): virus, worms, trojan horses

- Motives, protection, cost, hackers