Major Category 2: Computer System
Middle Category 3: Computer Component

1. Processor

[Goal]

- Understand the types of computers and their configurations so that you can apply them to your tasks.
- Understand the types, architecture, structure, scheme, and operating principles of the processor so that you can apply them to your tasks.
- Understand the indexes for processor performance so that you can apply them to your tasks.
- Understand high-speed and high-reliability technologies for processors so that you can apply them to your tasks.

(1) Types of computers

Understand the characteristics and intended purposes of the personal computer (PC), workstation, supercomputer, and the other computers.

Sample terms desktop PC, notebook PC, server, mobile devices (smartphone, tablet computer, etc.), general purpose computer, control computer, microcomputer

(2) Computer configuration

Understand that the computer consists of five components. Understand how basic control and data flows between the components.

Sample terms arithmetic and logical unit, control unit, storage unit, input unit, output unit

(3) Types of processors

Understand the types of processors, their basic characteristics, and intended purposes.

Sample terms CPU, GPU

(4) Processor architecture

Understand that the processor architectures include RISC and CISC. In addition, understand the characteristics of the instruction structures on an architecture-by-architecture basis.

Sample terms wired logic control, microprogram control

(5) Processor structure and features

Understand the roles of the control unit and processing unit as components of the processor; the roles of the accumulator, register, and instruction decoders as components of the control unit and processing unit; and how the processor performance is related to the system performance.

Sample terms accumulator, complementer, instruction address register (instruction counter, program counter, and sequential control counter), instruction register, general register, index register, base register, stack pointer

(6) Operating principles of the processor

(a) Mechanism of operations

Understand that combinations of basic logic circuits, such as AND, OR, and NOT, implement half and full adders to perform operations.

Sample terms sequential circuit, combinatorial circuit, NAND circuit

(b) Instruction and addressing

Understand the types of typical machine language instructions, the configuration of instruction words, procedure for executing instructions (instruction fetch, instruction decode, data fetch, and instruction execution), and address modification. Understand the binary representation of machine language operations, along with the correspondence to assembler symbol representation.

Sample terms arithmetic operation instruction, logical operation instruction, transfer instruction, comparison instruction, branch instruction, shift instruction, input/output instruction

(c) Interrupt

Understand the mechanism of interrupts and the types of interrupts categorized as internal or external interrupts.

Sample terms SVC (SuperVisor Call) interrupt, input/output interrupt

(7) Processor performance

Understand the meaning of the words such as clock frequency, CPI (Cycles Per Instruction), and MIPS.

Sample terms cycle time, FLOPS, instruction mix

(8) High-speed technology for processors

Understand the overview of typical high-speed technologies for processors.

Sample terms pipeline, super-pipeline, superscalar, VLIW, single-core processor, multicore processor

(9) Parallel processing

Understand the types and characteristics of typical parallel processing.

Sample terms SISD, SIMD, MISD, MIMD

(10) Multiprocessor system

It is possible to enhance a system in terms of speed and reliability by equipping it with multiple processors. Understand the typical types and characteristics of such systems.

Sample terms loosely coupled multiprocessor system, tightly coupled multiprocessor system, Amdahl's law, synchronization, cluster

2. Memory

[Goal]

- Understand the types and characteristics of memory so that you can apply them to your tasks.
- Understand the mechanism of main storage including its configuration, memory system configuration, and storage hierarchy so that you can apply them to your tasks.
- Understand the types of storage media and their characteristics so that you can apply them to your tasks.

(1) Types of memory and the characteristics

Understand that memory comes in different types: semiconductor memory circuits, magnetic memory, optical memory, and so on. In addition, understand the types of semiconductor (IC) memory, along with the characteristics (volatility, non-volatility, access speed, capacity, cost, and physical size), and typical purpose.

Sample terms RAM, ROM, DRAM, SRAM, flash memory

(2) Main memory configuration

Understand the configuration of main memory along with address selection, access, and other procedures for accessing data within main memory.

Sample terms memory unit, address selection mechanism, read/write mechanism

(3) Memory system configuration and storage hierarchy

Understand how the storage hierarchy is configured along with the purpose and concept of combining storage units with different characteristics to form a hierarchy. Understand how data in cache memory is written to main memory.

Sample terms auxiliary memory, disk cache, write through, write back

(4) Access method

Understand the memory interleave for speeding up main memory.

Sample terms bank

(5) Memory capacity and performance

Understand the relationship between memory capacity and performance, including access time and cycle time, cache memory hit ratio, effective access time, and so on.

(6) Types of storage media and their characteristics

Understand the characteristics of storage media, including the types of removable storage media, storage capacity, portability, usage, and purposes.

Sample terms read-only, write-once, rewritable, hard disk, SSD (Solid State Drive), CD (CD-ROM, CD-R), DVD (DVD-ROM, DVD-RAM, DVD-R), Blu-ray disc, flash memory (USB memory, SD card), streamer, RAM file

3. Bus

[Goal]

- Understand the overview of the types of buses along with their characteristics and configurations.

(1) Types of buses and their characteristics

Understand that buses are transmission paths used for exchanging data within the computer. In addition, understand the types and characteristics of buses along with the overview of classifications, such as internal bus (CPU internal bus), external bus, and expansion bus, and the transfer method.

Sample terms address bus, data bus, control bus, system bus, memory bus, input/output bus, serial bus, PCI, parallel bus

(2) Bus system configuration

Understand that the bus system configuration is available in two types: one architecture separates instruction fetch from data access, and the other uses the same bus for both instruction fetch and data access.

(3) Bus capacity and performance

Understand the bus width and clock frequency, which determine the performance of buses.

Sample term bus access mode

4. Input/output interface

[Goal]

- Understand the types of typical input/output interfaces and their characteristics so that you can apply them to your tasks.
- Understand the basic roles and functions of device drivers.

(1) Input/output interfaces

(a) Types of input/output interfaces and their characteristics

Understand the types of typical input/output interfaces along with the characteristics, including the transfer method, transmission speed, number of connectable units, and usage.

Sample terms USB, RS-232C, IEEE 1394, SCSI, serial ATA, HDMI, Bluetooth, Zigbee, IrDA, NFC

(b) Data transmission methods and topologies

Understand the difference between the serial and parallel data transmission methods. In addition, understand the types and characteristics of the topologies used for connecting peripherals.

Sample terms analog, digital, star connection, cascade connection, hub, daisy chain, terminator, tree connection

(c) Input/output control methods

Understand the DMA (Direct Memory Access) method, which is a transfer method that can transfer data without any intervention of the CPU, and the channel control method. Understand the roles of the input/output interruptions.

Sample terms program control, DMA (Direct Memory Access)

(2) Device driver

Understand the basic role of device drivers, the functions of plug and play and hot plug, and synchronization with devices.

5. Input/output device

[Goal]

- Understand the types of typical I/O devices along with their characteristics so that you can apply them to your tasks.
- Understand the types of typical auxiliary storage devices along with their characteristics so that you can apply them to your tasks.

(1) Input devices

Understand the types of typical input devices along with their characteristics.

Sample terms pointing device (mouse, touch panel, touch screen, joystick, trackball, digitizer, pen tablet, etc.), keyboard, sound input device, image input device (scanner, OCR, OMR, digital camera, etc.), biometric authentication device, barcode reader, magnetic card reader, IC card reader, A/D converter

(2) Output devices

Understand the types and characteristics of typical display devices as well as the types and characteristics of typical printers. Understand how to calculate the sizes of image data, for example.

Sample terms CRT display, liquid crystal display, TFT liquid crystal, STN liquid crystal, OLED (Organic Light Emitting Diode) display, plasma display, interlaced mode, non-interlaced mode, VGA, SVGA, XGA, electronic paper, impact printer, non-impact printer, serial printer, line printer, page printer, laser printer, inkjet printer, 3D printer, plotter, D/A converter, projector, sound output device

(3) Auxiliary storage devices

Understand the types of typical auxiliary storage devices and storage media along with their characteristics.

Sample terms hard disk drive, SSD (Solid State Drive), SD card, CD-R/RW drive, Blu-ray drive, DVD- R/RW drive, magnetic tape unit, track, cylinder, blocking factor, IBG (Interblock Gap), sector, defragmentation

(4) Other I/O devices

Understand the types of typical communication control units, drive units, and imaging devices, along with their characteristics.

Sample terms wired LAN interface card, wireless LAN interface card