A-Level Computer Science

Revision Sheet · 考前速记

Learn these by heart before the exam. 考试前把这些内容背熟。

Data representation

Binary → denary: add the place values of the 1s. 1 byte = 8 bits; 1 nibble = 4 bits.

Hex: each digit = 4 bits (0-F). Easy shorthand for binary – group bits in fours.

Two's complement 补码: represents negative integers; flip all bits and add 1. The most significant bit has a negative weight

Overflow: the result needs more bits than are available, so it wraps and is wrong.

Floating point 浮点数: a number stored as mantissa $\times$ 2^{exponent}; more exponent bits = larger range, more mantissa = more precision

Character sets: ASCII (7-bit), Unicode (many more, for all languages).

Networks and the internet

Protocols: TCP/IP (reliable, in-order), HTTP(S) (web), FTP (files), SMTP (send mail).

Packet switching 分组交换: data is split into packets that travel independently and are reassembled at the destination

Encryption 加密: symmetric = one shared key; asymmetric = a public key to encrypt, a private key to decrypt

The client-server model: clients request, servers provide. The internet uses layered protocols.

Boolean logic and architecture

$A \cdot A = A, \quad A + A = A, \quad A + \bar{A} = 1, \quad A \cdot \bar{A} = 0$ 布尔代数

$\overline{A \cdot B} = \bar{A} + \bar{B}, \quad \overline{A + B} = \bar{A} \cdot \bar{B}$ De Morgan's laws 德摩根定律

Von Neumann architecture 冯诺依曼结构: program and data share memory; the fetch-decode-execute cycle uses registers (PC, MAR, MDR, CIR, ACC)

Interrupt: a signal that pauses the CPU so it can service a higher-priority task.

Algorithms and data structures

Big O complexity 时间复杂度: linear search O(n); binary search O(log n, sorted only); bubble/insertion sort $O(n^2)$; merge sort O(n log n)

Stack vs queue 栈与队列: stack = Last In First Out (push/pop); queue = First In First Out (enqueue/dequeue)

Linked list: nodes each holding data + a pointer to the next; a tree has a root, parent and child nodes.

Recursion: a routine that calls itself; needs a base case to stop and uses the call stack.

Abstraction 抽象: hiding unnecessary detail to focus on the essentials; decomposition breaks a problem into smaller parts

Databases and programming

Normalisation 规范化: organising tables to remove redundancy: 1NF (atomic values), 2NF (no partial key dependency), 3NF (no non-key dependency)

SQL: SELECT ... FROM ... WHERE; primary key uniquely identifies a row; foreign key links tables.

OOP (object-oriented programming) 面向对象编程: objects from classes; encapsulation (hide data), inheritance (reuse), polymorphism (same call, different behaviour)

Programming paradigms: procedural, object-oriented, declarative (logic), low-level (assembly).

Testing: normal, boundary and erroneous data; white-box (code paths) vs black-box (inputs → outputs).