Week 5

AP Computer Science Principles

Homework bundle for this week

本周作业合集

exercises.lol

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2. Data

Starter Quiz · 课前小测

AP Computer Science Principles Name: _____ Score: _____

1. A single 0 or 1, the smallest piece of data, is called a _____.

   _____

2. Compression means storing the same data using:

   ☐ fewer bits

   ☐ more bits

   ☐ a faster computer

   ☐ more colors

3. Turning raw data into something that answers a real question produces:

   ☐ information

   ☐ more raw data

   ☐ a bug

   ☐ a byte

4. A program that takes scores in and gives back the average is doing:

   ☐ processing — steps that turn data into new information

   ☐ compression

   ☐ sampling

   ☐ nothing

5. What is the binary number 1011 in decimal?

   _____

6. Which data type must use lossless compression?

   ☐ a program file (text/code)

   ☐ a music track for casual listening

   ☐ a small web thumbnail

   ☐ a streamed video

7. Removing duplicate rows and filling missing values is part of cleaning data.

   ☐ True ☐ False

8. Repeating the same steps for each item of a list is called _____.

   _____

9. What is decimal 13 in binary?

   ☐ 1101

   ☐ 1011

   ☐ 1110

   ☐ 1001

10. Lossy compression trades data quality for smaller file size.

    ☐ True ☐ False

2. Data

Answers · 答案

AP Computer Science Principles

1. **bit**

   Eight bits group into a byte.

2. **fewer bits**

   Fewer bits means smaller files that store and send faster.

3. **information**

   Information is data made useful — patterns and trends answering a question.

4. **processing — steps that turn data into new information**

   Input → processing → output produces a new fact, the average.

5. **11**

   Place values 8,4,2,1 with 1-bits at 8,2,1: 8+2+1 = 11.

6. **a program file (text/code)**

   One changed byte could break a program, so it must be lossless.

7. **True**

   Cleaning fixes problems so the analysis can be trusted.

8. **iteration**

   A loop visits each element in turn.

9. **1101**

   8 + 4 + 1 = 13, so bits 8,4,1 are on: 1101.

10. **True**

    Smaller size usually means losing some detail.

AP COMPUTER SCIENCE PRINCIPLES • EXERCISE SHEET

2.1 Binary Numbers

Name: _____ Class: _____ Date: _____ **Total: 10 marks**

KEY WORDS binary 二进制 • bits 位 • decimal 十进制 • byte 字节 • overflow error 溢出错误

Objective

Build the skills to answer exam questions on **binary numbers**.

You must be able to:

- explain why computers represent all data using **bits** 位, each a 0 or 1
- convert a whole number between **binary** 二进制 and **decimal** 十进制
- describe how a fixed number of bits can cause an **overflow error** 溢出错误
- relate 8 bits to one **byte** 字节

1 Worked examples

Study these first. Each one shows the method for a question type used later.

■ Bits and bytes

A computer stores everything as **bits** (0 or 1). **8 bits = 1 byte**.

■ Binary to decimal

Each bit has a place value $1, 2, 4, 8, 16, \ldots$ (powers of 2). Add the place values where the bit is 1:

$$1101_2 = 8 + 4 + 0 + 1 = 13.$$

■ Decimal to binary

Subtract the largest powers of 2 that fit: $6 = 4 + 2 = 110_2$.

2 Practice

2.1 Convert the binary number 1010 to decimal. [2]

2.2 Convert the decimal number 6 to binary. [2]

2.3 State how many bits are in one byte. [1]

3 Exam-style questions

3.1 The binary number 1000 in decimal is [1]

- **A** 4
- **B** 8
- **C** 16
- **D** 2

3.2 A value too large for the available bits causes an [1]

- **A** logic error
- **B** overflow error
- **C** syntax error
- **D** case with no error

3.3 Convert between the two bases.

(a) Binary 1111 to decimal. [1]

(b) Decimal 10 to binary. [2]

Solutions

2.1 $1010_2 = 8 + 0 + 2 + 0 = 10$.

2.2 $6 = 4 + 2 = 110_2$.

2.3 8.

3.1 B.

3.2 B.

3.3 (a) $1111_2 = 8 + 4 + 2 + 1 = 15$. (b) $10 = 8 + 2 = 1010_2$.

AP COMPUTER SCIENCE PRINCIPLES • EXERCISE SHEET

2.2 Data Compression

Name: _____ Class: _____ Date: _____ **Total: 9 marks**

KEY WORDS compression 压缩 • lossless 无损 • lossy 有损 • lossless compression 无损压缩 • lossy compression 有

Objective

Build the skills to answer exam questions on **data compression**.

You must be able to:

- explain why **compression** 压缩 reduces the bits needed to store or transmit data
- distinguish **lossless** 无损 from **lossy** 有损 compression
- describe the trade-off between file **size** and data **quality**
- explain how removing **redundancy** 冗余 speeds up transmission

1 Worked examples

Study these first. Each one shows the method for a question type used later.

■ Compression

Reduces the number of **bits** needed to store or send data, saving space and time.

■ Lossless vs lossy

- **Lossless** restores the original data **exactly** (used for text, program files; e.g. ZIP).
- **Lossy** discards some data, so it cannot be restored exactly, but achieves **smaller** files (e.g. JPEG, MP3).

■ The trade-off

Smaller size usually means lower quality. Removing redundancy makes transmission **faster** over a network.

2 Practice

2.1 State what data compression does. [1]

2.2 State the difference between lossless and lossy compression. [2]

2.3 State one situation where lossless compression is needed. [1]

3 Exam-style questions

3.1 Lossless compression [1]

- **A** loses some of the data
- **B** restores the original data exactly
- **C** works only on images
- **D** increases the file size

3.2 A JPEG image file uses _____ compression. [1]

- **A** lossless
- **B** lossy
- **C** no
- **D** text

3.3 A user must compress a legal text document, with no loss of data allowed.

(a) State which type of compression to use. [1]

(b) State why lossy compression is not suitable. [1]

(c) State one benefit of compression when sending files. [1]

Solutions

2.1 it reduces the number of bits needed to store or transmit the data.

2.2 lossless compression restores the original exactly; lossy compression discards some data and cannot.

2.3 any one where exact data matters: text, program code, legal or medical files.

3.1 B.

3.2 B.

3.3 (a) lossless. (b) it would lose or change some of the text. (c) faster transmission (or less storage used).

AP COMPUTER SCIENCE PRINCIPLES • EXERCISE SHEET

2.3 Extracting Information from Data

Name: _____ Class: _____ Date: _____ **Total: 9 marks**

KEY WORDS correlation 相关 • causation 因果 • metadata 元数据 • patterns 模式 • visualization 可视化

Objective

Build the skills to answer exam questions on **extracting information from data**.

You must be able to:

- explain how programs find **patterns** 模式 and **trends** 趋势 in large data sets
- use **filtering** and **cleaning** 清洗 to prepare data
- distinguish **correlation** 相关 from **causation** 因果
- describe how **metadata** 元数据 and a **visualization** 可视化 help

1 Worked examples

Study these first. Each one shows the method for a question type used later.

■ Patterns and cleaning

Programs process large data sets to reveal **patterns and trends**. Raw data is first **filtered** and **cleaned** (removing errors and duplicates).

■ Correlation vs causation

Two things moving together is **correlation**; it does **not** prove one **causes** the other — a hidden factor may drive both.

■ Metadata and visualization

Metadata is data about data (e.g. a photo's date and location). A **visualization** (chart or graph) communicates insight. How data is **collected** can introduce bias.

2 Practice

2.1 State the difference between correlation and causation. [2]

2.2 Define metadata. [1]

2.3 State one reason to clean data before analysing it. [1]

3 Exam-style questions

3.1 Data about data, such as a photo's date and location, is called [1]

- **A** metadata
- **B** a variable
- **C** a byte
- **D** a pixel

3.2 Two variables that rise together show [1]

- **A** causation
- **B** correlation
- **C** an error
- **D** nothing at all

3.3 A chart shows that ice-cream sales and drowning incidents both rise in summer.

(a) Name the relationship the chart shows. [1]

(b) State whether one directly causes the other. [1]

(c) Name a likely hidden factor behind both. [1]

Solutions

2.1 correlation is two things changing together; causation is one thing actually making the other happen.

2.2 data about data (e.g. the date, size, or location of a file).

2.3 to remove errors, duplicates, or missing values so the analysis is reliable.

3.1 A.

3.2 B.

3.3 (a) correlation. (b) no. (c) hot weather (more people swim and buy ice cream).

AP COMPUTER SCIENCE PRINCIPLES • EXERCISE SHEET

2.4 Using Programs with Data

Name: _____ Class: _____ Date: _____ **Total: 8 marks**

KEY WORDS filter 筛选 • iteration 迭代 • filtering 过滤 • processes 处理 • data 数据

Objective

Build the skills to answer exam questions on **using programs with data**.

You must be able to:

- explain how a program **processes** 处理 data to produce new information
- use **iteration** 迭代 to examine each element of a data set
- apply a **filter** 筛选 to select records that meet a condition
- describe how **cleaning** data improves reliability

1 Worked examples

Study these first. Each one shows the method for a question type used later.

■ Iteration and filtering

A program uses **iteration** to look at each element of a data set in turn. A **filter** keeps only the records that meet a condition (e.g. "age $<$ 20").

■ Combining and cleaning

A program can **combine or transform** data from more than one source to answer a question, and **cleaning** the data first (removing errors) makes the results more reliable.

2 Practice

2.1 State what a filter does to a data set. [1]

2.2 State why a program uses iteration on a data set. [1]

2.3 State how cleaning data improves the results. [1]

3 Exam-style questions

3.1 A filter applied to a data set [1]

- **A** deletes all the data
- **B** selects the records that meet a condition
- **C** sorts the data randomly
- **D** adds random noise

3.2 Looping through every record in a list is an example of [1]

- **A** a filter
- **B** iteration
- **C** a variable
- **D** metadata

3.3 A program reads 10 000 survey records and keeps only those from teenagers.

(a) Name the operation used to keep only teenagers. [1]

(b) Name the process of looping over all the records. [1]

(c) State one reason to clean the data first. [1]

Solutions

2.1 it selects the subset of records that meet a given condition.

2.2 to examine or process each element in turn.

2.3 it removes errors and inconsistencies, so the results are more reliable.

3.1 B.

3.2 B.

3.3 (a) a filter. (b) iteration. (c) to remove errors or duplicates for reliable results.