

## Week 6

# 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

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.

# 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, ... (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]

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

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

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## 3 Exam-style questions

**3.1** The binary number 1000 in decimal is [1]

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

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**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

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**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)  $10 = 8 + 2 = 1010_2$ .

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 有损压缩

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]

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

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### 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

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**3.2** A JPEG image file uses \_\_\_\_\_ compression. [1]

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

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**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).

## 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** 模式和 **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]

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**2.2** Define metadata. [1]

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

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### 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

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**3.2** Two variables that rise together show [1]

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

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**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]

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## 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).

## 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]

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### 3 Exam-style questions

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**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

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**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.