

1 Information representation – Part 2

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
bitmap	位图	_____	_____	_____
pixel	像素	_____	_____	_____
image resolution	图像分辨率	_____	_____	_____
colour depth	颜色深度	_____	_____	_____
vector graphic	矢量图形	_____	_____	_____
sampling	采样	_____	_____	_____
sampling rate	采样率	_____	_____	_____
Compression	压缩	_____	_____	_____
lossless	无损	_____	_____	_____
lossy	有损	_____	_____	_____
run-length encoding	行程编码	_____	_____	_____

Recall

In **Part 1** you represented numbers (binary, denary, hexadecimal, two's complement, BCD) and text (character sets). Part 2 looks at how **images and sound** are stored as numbers, and how files are made smaller.

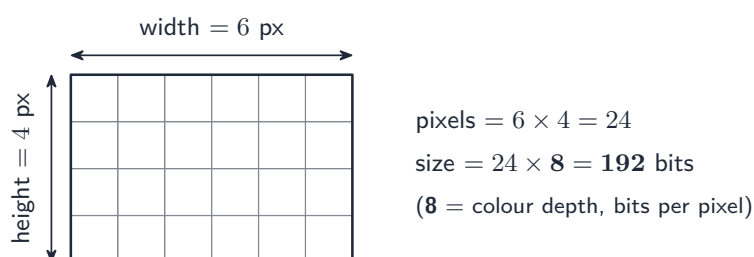
New ideas

■ 1 Bitmap images (and vectors)

A **bitmap** 位图 image stores the colour of every **pixel** 像素 in a grid. Two settings decide its quality and size:

- **image resolution** 图像分辨率 — the width $\times$ height in pixels;
- **colour depth** 颜色深度 — the number of bits per pixel (1 bit $\rightarrow$ black/white, 8 $\rightarrow$ 256 colours, 24 $\rightarrow$ "true colour").

$$\text{file size (bits)} = \text{width} \times \text{height} \times \text{colour depth.}$$

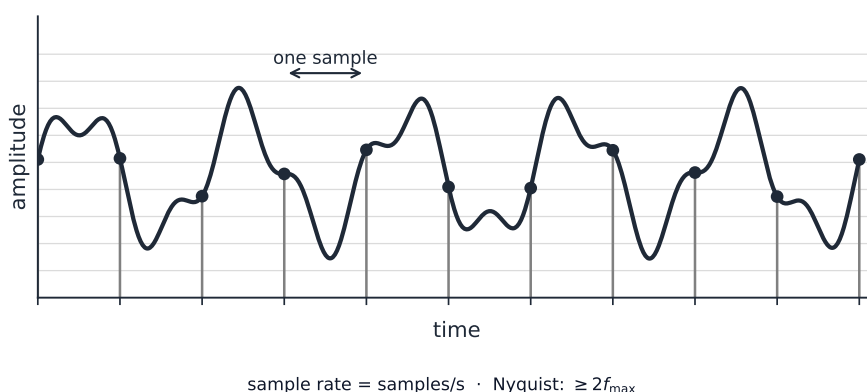


A **vector graphic** 矢量图形 instead stores *instructions* to draw shapes (with properties like colour and position). It scales to any size without blur — great for logos — but cannot store a photograph.

Watch out: doubling the resolution does not double the file size — the width *and* the height both double, so the size goes up about *four* times.

■ 2 Sound

Sound is **analogue** (a smooth wave). To store it the computer takes **sampling** 采样 — reading the wave's height at regular time steps. The **sampling rate** 采样率 is the number of samples per second (CD quality is 44.1 kHz).



A higher sampling rate (or more bits per sample) gives better quality but a bigger file.

■ 3 Compression

Compression 压缩 makes a file smaller, saving storage and transmission time. Two kinds:

- **lossless** 无损 — the original is recovered **exactly** (text, programs, PNG, ZIP);
- **lossy** 有损 — some detail is dropped for a **much smaller** file (JPEG, MP3, streamed video).

One lossless method is **run-length encoding** 行程编码 (RLE): store " n copies of x " instead of repeating x — good for big flat areas.

WWWWBBWW $\xrightarrow{\text{RLE}}$ 4W 2B 2W

lossless — recovered exactly (RLE, PNG, ZIP)
lossy — smaller, some detail lost (JPEG, MP3)

Practice

1.1 A bitmap image is 100 pixels wide, 100 high, with a colour depth of 24 bits. Find its file size in bits, then in bytes. [3]

1.2 State whether a bitmap or a vector graphic is better for a company logo, and give one reason. [2]

1.3 State the effect on (a) the quality and (b) the file size of using a higher sampling rate. [2]

1.4 State whether lossless or lossy compression should be used for (a) a program file, (b)

streaming a video.

[2]

1.5 Use run-length encoding to compress the pixel row W W W W B B W W (write your code as count–value pairs).

[2]

1.6 Explain *why* a photograph cannot be stored well as a vector graphic.

[2]