# Welcome to A Level Computer Science

**Mr Gorvin**

# OCR A level course structure

| | Component 1: Computer systems | Component 2: Computational thinking, algorithms and programming | Practical programming experience |
|---|---|---|---|
| How is it assessed | Written exam<br>2 hour 30 minutes | Written exam<br>2 hour 30 minutes | Marked by your teacher and moderated by examboard. |
| How much is it worth | 140 marks<br>Worth 40% | 140 marks<br>Worth 40% | 70 marks<br>Worth 20% |
| Other information | A series of short-answer and extended-answer questions. | A series of short-answer and extended-answer questions. | Assesses student's ability to use the knowledge and skills gained through the course to solve or investigate a practical problem. |

# Key Information:

## Unit 1: Computer systems

Students are introduced to the internal workings of the (CPU), data exchange, software development, data types and legal and ethical issues. The resulting knowledge and understanding will underpin their work in the NEA programming project.

It covers:

- Characteristics of processors, input, output and storage devices
- Software development
- Networking and the Internet
- Programming techniques
- Cyber security
- Effect of digital technology on society

## Unit 2: Algorithms and programming

This builds on component 01 to include computational thinking and problem-solving.

It covers:

- What is meant by computational thinking (thinking abstractly, thinking ahead, thinking procedurally etc.)
- Problem solving and programming – how computers and programs can be used to solve problems
- Algorithms and how they can be used to describe and solve problems.

## Programming Project

Students are expected to apply the principles of computational thinking to a practical coding programming project. They will analyse, design, develop, test, evaluate and document a program written in a suitable programming language.

# A Level Computer Science (OCR)

Craig'n'Dave

## YEAR 12

| Term | Topics | Assessment |
|---|---|---|
| 1 | • Introduction to the course<br>• SLR 1 Structure and function of the processor (8 lessons)<br>• SLR 2 Types of processor (4 lessons)<br>• SLR 3 Input, output and storage (5 lessons)<br>• Plus 19 dedicated programming lessons | • Completed SLRs 1-3 form the basis for assessment.<br>• SLR 1-3 exam questions |
| 2 | • SLR 4 Systems software (8 lessons)<br>• SLR 5 Application generation (6 lessons)<br>• SLR 6 Software development (4 lessons)<br>• Plus 24 dedicated programming lessons<br>• Buffer week before Christmas | • Completed SLRs 4-6 form the basis for assessment.<br>• SLR 4-6 exam questions |
| 3 | • SLR 7 Types of programming language (6 lessons)<br>• SLR 9 Compression, encryption and hashing (5 lessons)<br>• SLR 10 Databases (8 lessons)<br>• Plus 17 dedicated programming lessons | • Completed SLRs 7, 9 and 10 form the basis for assessment.<br>• SLR 7, 9 and 10 exam questions |
| 4 | • SLR 11 Networks (9 lessons)<br>• SLR 12 Web technologies (10 lessons)<br>• Plus 17 dedicated programming lessons | • Completed SLRs 11 and 12 form the basis for assessment.<br>• SLR 11 and 12 exam questions |
| 5 | • SLR 13 Data types (14 lessons)<br>• SLR 14 Data structures (8 lessons)<br>• Plus 8 dedicated programming lessons | • Completed SLRs 13 and 14 form the basis for assessment.<br>• SLR 13 and 14 exam questions |
| 6 | • SLR 15 Boolean algebra (8 lessons)<br>• SLR 16 Computer-related legislation (3 lessons)<br>• SLR 17 Ethical, moral and cultural issues (4 lessons)<br>• Plus 27 project lessons | • Completed SLRs 15-17 form the basis for assessment.<br>• SLR 15-17 exam questions |

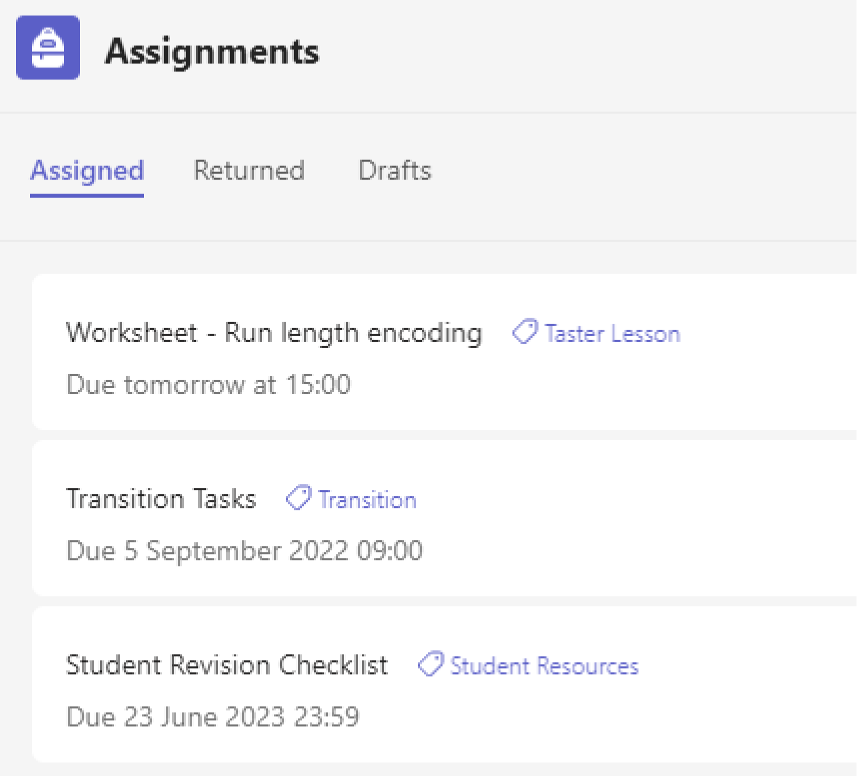
## YEAR 13

| Term | Topics | Assessment |
|---|---|---|
| 1 | • SLR 18 Thinking abstractly (3 lessons)<br>• SLR 19 Thinking ahead (3 lessons)<br>• SLR 20 Thinking procedurally (2 lessons)<br>• SLR 21 Thinking logically (2 lessons)<br>• SLR 22 Thinking concurrently (2 lessons)<br>• Plus 18 dedicated project lessons | • Completed SLRs 18-22 form the basis for assessment.<br>• SLR 18-22 exam questions |
| 2 | • SLR 23 Programming techniques (6 lessons)<br>• Plus 29 dedicated project lessons | • Completed SLR 23 form the basis for assessment.<br>• SLR 23 exam questions |
| 3 | • SLR 24 Computational methods (6 lessons)<br>• SLR 25 Algorithms (7 lessons)<br>• SLR 26 Algorithms (7 lessons)<br>• Plus 9 dedicated project lessons | • Completed SLRs 24 and 26 form the basis for assessment.<br>• SLR 24, 25 and 26 exam questions |
| 4 | • 30 dedicated project lessons | |
| 5 | • Revision | |

The dedicated programming lessons are for students to engage in self-directed programming. We have hundreds of activities, worksheets and programming challenges for them to complete, available through your premium resources account.

For a detailed breakdown of which lessons to deliver week by week, see our Excel delivery calendar OCR A-Level Linear - 1-week model (delivery calendar).xlsx, which this SoL is based on.

- Go to:
  **X:\ICT\Key Stage 5\A Level Computer Science**
- Click on ‘**Microsoft Teams (Login)**’
- Enter login details
- Select Team ‘**Y12 – A Level Computer Science**’
- Go to ‘**Assignments**’

TASTER LESSON

**- Run Length Encoding**

**(Lossless Compression for Images)**

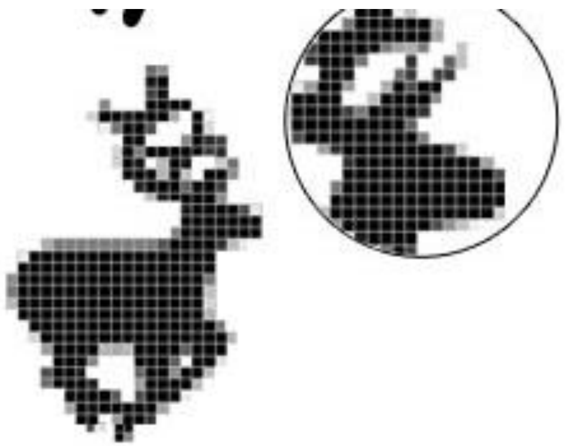
OCR A Level (H046-H446) Run-length and dictionary coding.mp4

Quick Recap…

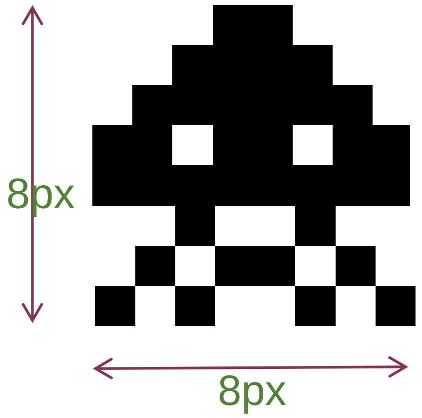
# Bitmap images - Saving as 'Binary'

How does computer save 'Bitmap' image as binary?

- Image divided up into pixels
- A pixel can only be one colour at a time
- The colour of each pixel stored in binary
- The more bits used to store each pixel, the more colours!



Example!




8px X 8px (64 pixels total)
Only black and white used
Single bit used to store each pixel
1=black 0=white

Image can be stored with 64 bits
(or 8 bytes!)

Craig'n'Dave

# Bitmap images - Things you need to know…

Remember, we have now looked at:

**Pixel =** Short for 'Picture Element'. A single block of colour in an image. Pixel stored as binary code.

**Colour depth =** Number of bits per pixel in an image (more bits = more colours can be used)

**Dimensions =** Height x Width in pixels
(e.g. 800px x 500px image = 400,000 pixels)
Can be used to work out total number of pixels!!!


**Resolution =** Concentration of pixels per area
*(e.g. pixels per inch or cm)*

## THE KEY QUESTION

# Is run length encoding a suitable compression algorithm for the storage of photographs?

**DISCUSSION:**
What is compression?

Making the size of a file smaller.

**DISCUSSION:**
What is important when storing photos?

Small file size.
High quality.

= more photos can be stored e.g. on a mobile phone.
= quicker transfer over the internet.

So, to answer the question, we need to know, what run length encoding is.

Consider this icon of a space ship that could be used in a typical computer game to represent a player life.
A white pixel is represented with a 1. A black pixel is represented with a 0. The data is stored as a stream of 0's and 1's in a file.
The file is currently 32 bytes.

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
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| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

**DISCUSSION:**
How has the file size been calculated as 32 bytes?

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**Task – Worksheet – Q1**

16 x 16 = 256 bits x 1 bit for the colour
(Black and white is one bit, 0 or 1).

Divided by 8 because there are 8 bits in a byte.
= 32 bytes.

# Run Length Encoding Compression Algorithm



Consider this icon of a space ship that could be used in a typical computer game to represent a player life.
A white pixel is represented with a 1. A black pixel is represented with a 0. The data is stored as a stream of 0's and 1's in a file.
The file is currently 32 bytes.

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

## Task – 3 mins

1. Research "run length encoding" and explain how this file could be compressed to the smallest number of bytes.
2. Illustrate the data that would be stored if this file was compressed with run length encoding.

https://www.youtube.com/watch?v=3gHmQW9rgoI

| Run length | Bit |
|---|---|
| | 1 |
| | 0 |

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## Task – Worksheet – Q2 + Q3

# Run Length Encoding Compression Algorithm



Run length encoding:

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

| Run length | Bit |
|---|---|
| 34 | 1 |
| 4 | 0 |
| 11 | 1 |
| 5 | 0 |
| 12 | 1 |
| 4 | 0 |
| 15 | 1 |
| 6 | 0 |
| 10 | 1 |
| 7 | 0 |
| 8 | 1 |
| 11 | 0 |
| 5 | 1 |
| 11 | 0 |
| 6 | 1 |
| 7 | 0 |
| 9 | 1 |
| 6 | 0 |
| 7 | 1 |
| 4 | 0 |
| 11 | 1 |
| 5 | 0 |
| 12 | 1 |
| 4 | 0 |
| 42 | 1 |

**DISCUSSION:**

The run length needs to be stored in binary. What is the largest run length, and how many bits are needed to store this number in binary?

42 is the largest run of the same bit.
In binary: 101010
= 6 bits per run length.

A quick lesson in binary:

| 32 | 16 | 8 | 4 | 2 | 1 |
|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | 1 | 0 |

32 + 2 = 34

# Run Length Encoding Compression Algorithm



Run length encoding:

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

| Run length | Bit | Binary |
|---|---|---|
| 34 | 1 | 100010 |
| 4 | 0 | 000100 |
| 11 | 1 | 001011 |
| 5 | 0 | 000101 |
| 12 | 1 | 001100 |
| 4 | 0 | 000100 |
| 15 | 1 | 001111 |
| 6 | 0 | 000110 |
| 10 | 1 | 001010 |
| 7 | 0 | 000111 |
| 8 | 1 | 001000 |
| 11 | 0 | 001011 |
| 5 | 1 | 000101 |
| 11 | 0 | 001011 |
| 6 | 1 | 000110 |
| 7 | 0 | 000111 |
| 9 | 1 | 001001 |
| 6 | 0 | 000110 |
| 7 | 1 | 000111 |
| 4 | 0 | 000100 |
| 11 | 1 | 001011 |
| 5 | 0 | 000101 |
| 12 | 1 | 001100 |
| 4 | 0 | 000100 |
| 42 | 1 | 101010 |

# Run Length Encoding Compression Algorithm



Black and white means large runs of 0s and 1s

**DISCUSSION:**
What characteristics of the image make it suitable for run length encoding?

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

**DISCUSSION:**
Why could this be less successful with a photograph?

More colours = more bits and greater level of detail

Consider this 16x16 pixel icon of a space ship that could be used in a typical computer game to represent a player life.
A white pixel is represented with a 1. A black pixel is represented with a 0. The data is stored as a stream of 0's and 1's in a file.
The file is currently 32 bytes.

**Task – Worksheet – Q4**

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |
| 1 | 1 | 1 | 1 | 1 | 1 | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

Colour depth: bits per pixel

Resolution: Width and height of image.

3. Calculate the size of the compressed file in bytes.

**HAVE A GO**

19 bytes if runs are stored in 6 bits each.

Some meta-data would be required.

**DISCUSSION:**
What is meta-data?

# Run Length Encoding Compression Algorithm



This icon would be referred to as a "1-bit colour" image.

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

Most photographs would be stored with 24-bit colour.

24 bits needed for each pixel.
8 for red, 8 for green, 8 for blue.

**DISCUSSION:**
What does 24-bit colour mean?

Significantly larger.

**DISCUSSION:**
What is the implication for file size?

## Task – Worksheet – Q5

4. Create a 1 bit black & white 16x16 icon of a star.
5. Calculate the run-length encoded file size.
6. How much was the file compressed as a percentage of the original file size?

**HAVE A GO**