How do digital systems represent data?

The story of binary

Outcome

ACTDIK015: Examine how whole numbers are used to represent all data in a digital system

Students will be able to explain how digital systems use whole numbers as a basis for representing a variety of data types.

What data are stored on a computer?

What are data?

Data can be represented as text, images and sound.

To understand how computers represent these data, we need to understand how computers work.

1. What makes a computer a computer?
2. Binary and data
3. How big are data?

1. What makes a computer a computer?

Brainstorm: Teachers could use the Visible Thinking Routine: Think Puzzle Explore, a routine that sets the stage for deeper inquiry. This would help lay the groundwork for classroom discussion and sharing or a more detailed independent inquiry.

Scaffold: Video explaining the core elements of a computer:

- Input
- Storage
- Processing
- Output

Activity: Identify some examples of computer output and investigate how the computer represents these data.

2. Binary and data

Brainstorm: Teachers could use the Visible Thinking Routine: Think Puzzle Explore, a routine that sets the stage for deeper inquiry. This would help lay the groundwork for classroom discussion and sharing or a more detailed independent inquiry.

Scaffold: Video explaining how data are stored using binary:

- text
- images
- sound

2. Binary and data (text)

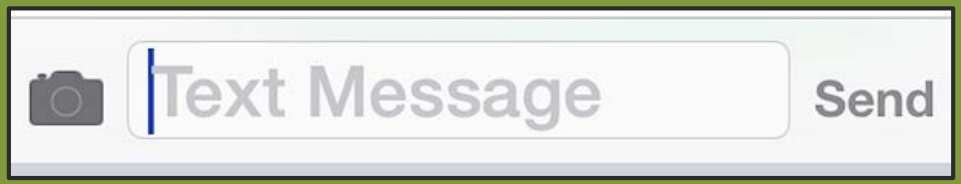
Resources:

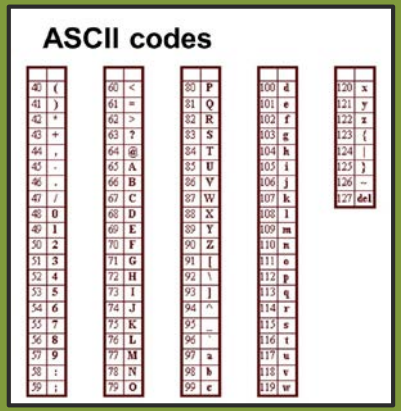
- To connect students' *prior knowledge* of megabytes and gigabytes as representing how powerful computers are and/or how much storage is available with an understanding of binary numbers, introduce and define terms such as 'bit' and 'byte'. Introduce ASCII as a method of representing characters, and equivalent decimal/binary values. Suggested workflow resource: http://dabblingindata.weebly.com/bits-of-binary.html
- Some great resources used to teach the concept of binary:
  - https://www.digitaltechnologieshub.edu.au/teachers/lesson-ideas/introduction-to-binary
  - https://classic.csunplugged.org/binary-numbers/
  - https://code.org/curriculum/course2/14/Teacher

Assessment opportunity:

Create a simple text message and send it to a friend in binary.

Sending text using binary





2. Binary and data (images)

Resources:

- https://studio.code.org/s/pixelation/stage/3/puzzle/1
- http://csfieldguide.org.nz/en/interactives/pixel-viewer/index.html

Assessment opportunity:

Students answer the following questions:

1. Why does video content take longer to download than images?
2. What makes a good-quality image?

How are data linked to the quality of images?

Why does video content take longer to download than images?

What makes a good-quality image?

2. Binary and data (sound)

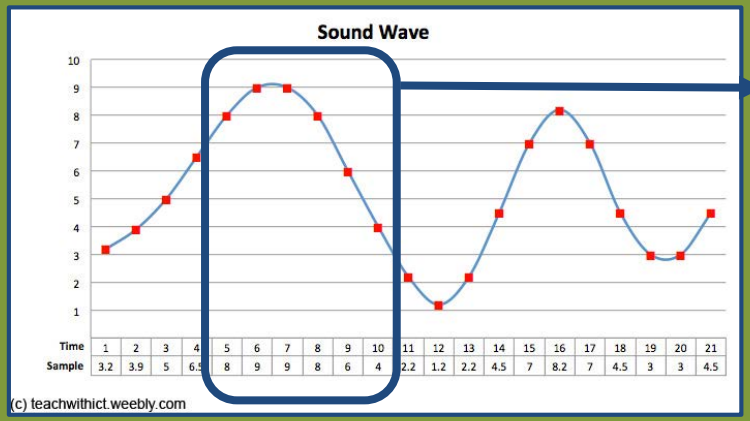
Resources:

- https://www.bbc.com/bitesize/guides/zpfdwmn/revision/3

Assessment opportunity:

Convert a sound wave to binary.

Binary conversion of sound wave:



Time	5	6	7	8	9	10
Sample						
Binary						

3. How big are data?

Resources:

Mnemonic *Burger King Makes Great Toast* for memorising the order of data sizes: byte, kilobyte, megabyte, gigabyte and terabyte.

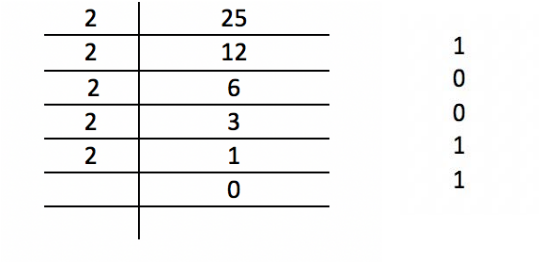
Assessment opportunity:

Infographic representing the different measurements of data.

Inquiry question: Do data have weight?

Convert from decimal to binary

Resources:



2	25
2	12
2	6
2	3
2	1
	0

1
0
0
1
1

Read from the last digit – Decimal 25 = Binary 11001

Dividing by 2 to convert to binary (examples of dividing by 2 to convert from decimal to binary)

Years 5–6 assessment task: How do digital systems represent data?

Assess

Students will create a digital or analog portfolio and a video/oral presentation that illustrates their understanding.

Students will be asked to complete the following:

- Slide presentation or document of no more than five slides/pages
- Aligned video/audio presentation of no more than two minutes
- Use of desktop or tablet applications to support the presentation **or** use of paper-based options and oral presentation methods and opportunities
- This task will be completed over five to six 50-minute lessons over five to six weeks (including the various teaching and learning lessons and associated formative tasks – see slide deck link and Background Information section of this outline).

Marking guide

Please refer to assessment rubric in the sample assessment task document.

This document will guide the final rubric to ensure a task-specific criteria. It is in DRAFT form at present.

Questioning

Factual questions:

- How do computers store data?
- How do we multiply and divide by two?

Conceptual question:

- What is the relationship between decimal and binary?

Debatable questions:

- Does a bit of data weigh anything?
- Can computers truly be intelligent?