

# Everything is numbers

## Digital technologies - detailed explanations

Strand: Digital Technologies Knowledge and Understanding

**Content description:** Investigate how digital systems represent text, image and audio data in binary (ACTDIK024).

**Explanation:** Access to data is becoming ubiquitous, and the vast quantities of data that you can store, transmit and access from your computer and through the Internet is truly mind boggling. While students might be familiar with quantities of data measured in terms of megabytes, gigabytes or even terabytes, the petabyte and exabyte are real measures of data that bring with them increasingly complex challenges associated with storage and transmission.

Our mobile computing devices are now so powerful that they can store, process and transfer large amounts of data through high-speed networks very efficiently, but there are still limits on what can be achieved that prevent us from breaking into areas such as lifelike three-dimensional environments generated in real time. Representation of real-life data is still very costly in terms of both size and quality – 60 seconds of 4 K High-definition video still requires at best 1.91 GB of storage, and in raw format can be as large as 84.9 GB. What this means is that the true, immersive experience of the Star Trek holodeck is still yet to be realised, but when it does it will require data storage and transmission algorithms superior than those in use today.

Students who understand the digital representation of data become more aware of the challenges and limitations of our current technology, but also are better equipped to use that data for interesting purposes. Processing of data in new and efficient ways through programming activities (or through the use of purpose-built software tools) relies on an understanding of its composition. As we access and analyse large data sets in fields such as medicine, science and language processing, we open up new possibilities for improving our society based on evidence that may not have been possible to efficiently process before. Machine Learning is one area of ICT research that demonstrates this concept.

Strand: Digital Technologies Processes and Production Skills

**Content description:** Evaluate how student solutions and existing information systems meet needs, are innovative, and take account of future risks and sustainability (ACTDIP031).

**Explanation:** There are many costs associated with the storage of data, particularly when it needs to be easily accessed. Storing data in data centres so that it is accessible 'in the cloud' not only requires large areas of land and disk drive arrays, it also places significant demands on our existing power generation capacity, which is only growing as more people become more comfortable with storing their data online. Thus, devising methods of representing data efficiently for both storage and transmission is not only a technical problem, but an environmental one. It is driving many large corporations (Google, Apple) to invest in renewable energy, and to increase their emphasis on sustainability more generally.

The growth of data therefore requires innovative solutions to the limitations associated with both current hardware and software processing algorithms. Moore's Law provides us with an indication of the rate at which research and development in hardware allows us to boost our capability and capacity in terms of data storage and processing. However, the pace of growth has slowed recently as we encounter technical challenges associated with our current scientific understanding. When we consider this alongside population growth and the rate at which data is generated online from those that can access the Internet, the need for improvements in software and algorithms is clear. Compression is a critical component of this, and is explored in greater detail during the 9–10 Band of the Australian Curriculum: Digital Technologies.

Students who understand how existing systems evolve to meet our needs and influence other aspects of our society (such as investment in renewable energy) are better placed to draw connections between the learning that occurs in one subject area with others. Learning that developments in one industry do not occur in isolation, and that there are consequences to those

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developments (including those that are indirect or unintended) helps build a stronger connection to their wider community, and helps make the impact their decisions have on others more tangible. It is an important part of being an active, global citizen.

