Activity P06:

Sorting Data Variances

TAHI RUA TORU TECH

KIA HIHIKO AOTEAROA!

Discovery

As we use computers more and more and the amount of data we use increases, we want them to process information as quickly as possible. One way to increase the speed of a computer is to write programs that use fewer computational steps (as shown in the lessons on sorting and searching algorithms). Another way to solve problems faster is to have several computers work on different parts of the same task at the same time, which is what this unit explores.

What is it?

A parallel Sorting Network enables us to explore how much faster we can sort values into order if we can make simultaneous comparisons. The main six-way parallel network used in these lessons sorts a list of values more than twice as quickly as a system that can only perform one comparison at a time.

Why?

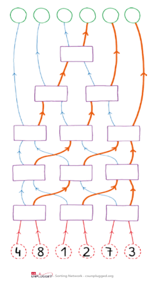
These activities use a fun team activity to demonstrate an approach to parallel sorting. It can be done on paper, but we like to get students to do it on a large scale, running from node to node in the network.

Link to Digital Technologies Curriculum

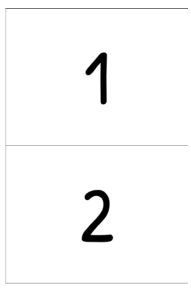
This activity builds on the components of the first **Designing and Developing Digital Outcomes** Progress Outcome in Activity 5 while expanding on abstraction in the context of **Computational Thinking** by making it clear that the same algorithmic approach can be used for different types of data.

Mathematics: Numeracy
Literacy: Speaking
Performing Arts: Drama

Downloadable Resources
(One Per Class):



Sorting Network



Sorting Network Cards

There are other variations of the sorting network cards based around larger numbers, letters, words, fraction Maori Colours and numbers etc. Available here.

Activity Background

Show the students the Sorting Network again (if the network needs redrawing then students often enjoy doing this, and drawing it accurately from the diagram is a useful exercise). Tell them that they will be trying it with some variations this time.

The Activity

This part of the lesson explores changing the way the numbers are used.

Variation 1: Identical value

In this variation, students try the Sorting Network with a set of cards where some cards have an identical value, such as 1, 2, 3, 3, 4, 5. They will probably ask what to do when comparing the identical cards - ask them what they think, and they are likely to realise that it won't make any difference (if 3 and 3 meet, then it won't matter which one goes left and which goes right!). Ask them to predict will happen at the end of the network (they may realise that the identical values will end up adjacent).

Now run the numbers through the network to check. Here's a brief reminder of the Sorting Network instructions; full details are in lesson 1.

1. Six students start in the input circles, each holding a card with one of the numbers on it.
2. They all step forward at the same time, and when they meet someone in a box, they compare their cards.
3. The person with the smaller card follows the line out to the left, and and the larger card to the right (this is reversed in the second variation for this lesson).
4. This continues until all the students reach the output circles, at which point they should be in sorted order.

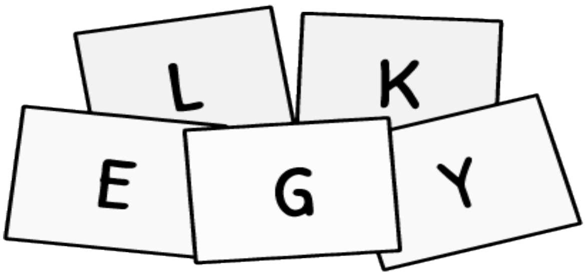
Variation 2: Larger to the left

This time, the person with the larger number goes to the left instead of the right and follows the line to the next square, while the person with the lower number goes to the right instead of the left and follows the line to the next square.

Ask the students to predict what will happen (they should be able to work out that the values will come out in reverse sorted order i.e. from largest to smallest instead of smallest to largest).

Have them try it out with some numbers to check it.

Variation 3: Letters of the alphabet



Give the students cards with letters on them. Ask how we could compare these (students should observe that they could be in alphabetical order). Have them test this by sorting the cards.

Using the Network Backwards

This is an experiment that addresses a question that students may have asked: does the Sorting Network correctly sort the values if we start at the other end?

Have students try this with some simple values (such as the numbers 1 to 6). Chances are that it will work for many starting orders of the values. However, encourage them to keep trying until they find an initial order for which it doesn't work. This will require considerable reasoning to achieve.

If they struggle to find an example, you could give the one below, and then challenge them to find a different one that doesn't come out sorted.

Extending The Lesson

This kind of algorithm needs to run on special hardware to take advantage of doing multiple comparisons at the same time. It is only used for specialist applications at present, for example it is sometimes done on the graphics processor (GPU) of a computer, because these processors are good at doing parallel computation. Sorting Networks were invented long before powerful GPUs came along; this is an exciting thing about Computer Science - some of the our discoveries are ahead of the hardware that is available, so we're ready to make use of the hardware when it does become commonly available!

Note that this is not a conventional sorting algorithm, as the sorting that is done on a conventional system can make only one comparison at a time; conventional sorting algorithms are explored in another lesson.