Activity D05:

Sorting Data

TAHI RUA TECH TORU

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?

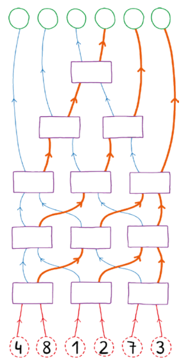
These activities use a fun team activity to demonstrate an approach to parallel sorting. It can be done on paper, but we like to get students to do it on a large scale, running from node to node in the network.

Link to Digital Technologies Curriculum

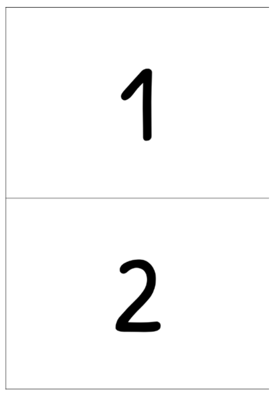
This activity introduces some of the core components of the first **Designing and Developing Digital Outcomes** Progress Outcome such as identifying inputs and outputs of a system and manipulating digital content to meet technological challenges. The activity also draws on **Computational Thinking** heavily.

Mathematics: Numeracy
Literacy: Speaking
Performing Arts: Drama

Downloadable Resources
(One Per Class):



Sorting Network



Sorting Network Cards

Activity Background

Use the Sorting Network template to draw a 6 person Sorting Network on a paved surface outside using chalk (other alternatives include using masking/painters tape on a carpet or wooden floor, tape on a tarpaulin, or line marking paint on grass). Note that the Sorting Network needn't use different colours or line thicknesses, but if suitable chalk or tape is available, this can help students remember which way to go. It should be large enough that two students can comfortably stand in the rectangles; the more spread out it is, the more effective the exercise is. In a very confined situation, it could be done on a desk top using game counters instead of students moving around, but this is much less engaging.

Show the students the Sorting Network drawn on the ground, and tell them "This chalk computer can do some things very fast, let's investigate what it does."

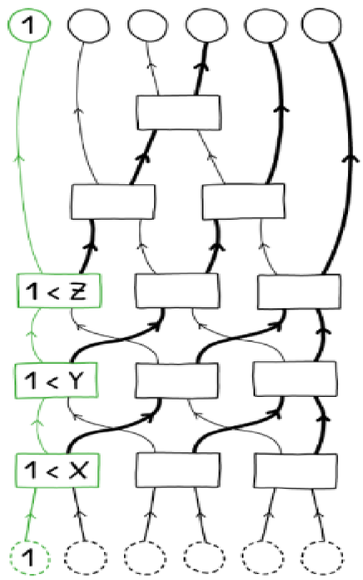
The Activity

1. Organise students into groups of six. Only one team will use the network at a time.
2. The current team should stand on the circles at the “input” end of the Sorting Network.
3. Give each of the six students a card to hold (initially use the set of cards containing the numbers from 1 to 6; the cards should be given to the students out of order). These cards are the inputs into this cool chalk computer (this is a special kind of computer that can process several operations at the same time).
4. Get the first two students to follow the lines from their circles until they meet at a box (the others should pay attention).
5. When the two have entered the box, they should say “Hello” to each other (this is to make sure that they stop and both engage in this step), and then compare cards to decide who has the lower number and who has the higher number.
6. The student with the lower number should follow the line out to the left and go to the next box, while the person with the higher number follows the line leaving to the right to go to the next square.
7. Now get the next pair of students to do the same, meeting at a box and leaving it with the smaller to the left and the larger to the right.
8. You can now get the remaining pair of students to do this (remind them to say hello when they meet).
9. Once they have the idea, tell them to repeat this process until they get to the end of the network. If someone gets left behind, have the students go back to the beginning; they will need to pay attention when they meet at a square, and ensure that both people who have met know the outcome.
10. When they have all reached the circles at the other end of the network have them turn and face the starting circles and read what’s on their card, from left to right. They should be in the correct order from smallest to largest; if not, they may need to try again and work more carefully.
11. When each group has been through the Sorting Network, introduce a Sorting Network race to see which group can successfully complete the task in the shortest amount of time (either with two Sorting Networks racing teams at the same time, or one network with the times measured using a stopwatch).

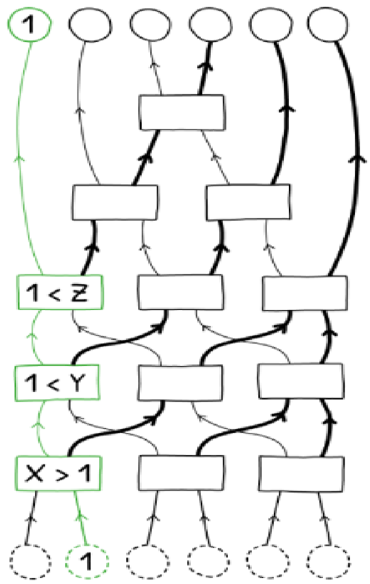
Extending The Lesson

The outcome we want to achieve is that the numbers come out in the correct order with the smallest number being in the left-most box and the second smallest number finishing next to it, right through to the largest number being in the right-most box. If we want to make sure it works for all possible inputs, then we would need to try it for every order that the values might start in - it turns out that there are 720 (6x5x4x3x2x1) different orderings that 6 items can start in, so that's a lot of cases to test. For sorting more than 6 items, there are way too many different orderings to try out, so we must make a mathematical proof of why it works. Here are some elements of such a proof:

Let's disregard the numbers for now and look at the Sorting Network from the point of view of following the paths. If the smallest number was in node 1, what path would it take and does it end up in the leftmost node at the end?



Now repeat this by asking if the smallest number was in node 2, what path would it take and does it still end up in the leftmost node at the end?



Repeat this until you've tested all 6 nodes. If the smallest number ends up in the left-most node regardless of where it starts, that's part-way to being sure that the structure always works.

You can repeat this with the largest number - no matter where it starts, it will always end up in the right-most node.