Activity D08:

How Many Guesses?

TAHI RUA TECH TORU

KIA HIHIKO AOTEAROA!

Discovery

Searching for a keyword, a value, or a specific piece of data (information) is the basis of many computing applications, whether it's looking up a bank account balance, using an internet search engine, or searching for a file on your laptop. Computers deal with a lot of information so we need efficient algorithms for searching. This unit explores some common algorithms that are used to search for data on computers, with the opportunity to integrate this learning with statistics.

What is it?

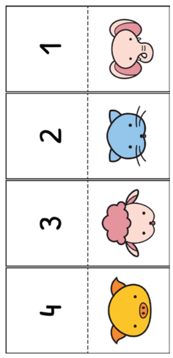
Because computers are often required to find information in collections of data that can be very, very large, using the right algorithm for searching is crucial! A key idea in computer science that we'll be illustrating with searching algorithms is just how fast an algorithm can be; students might think that if you're searching twice as much data then it should take twice as long, but we'll look at a way to search that takes almost the same amount of time to search 2 million items as it would for 1 million..

Why?

We'll also look at the kind of steps that algorithms use to solve the important problem of searching data. When you're telling a computer how to find exactly what you're looking for you need to remember that computers are simple machines, they can only look at one piece of data at a time, and check if it is what you're searching for. Imagine if every time a computer had to search for something, it had to compare every single piece of information it contained to the information it was searching for before it found what you were looking for? It would take a very long time to find what you wanted. That's why computer scientists need to develop quick and efficient ways of doing this.

Mathematics: Statistics
Literacy: Speaking
Performing Arts: Drama

Downloadable Resources
(One Per Class):



Searching Cards

Classroom Resources:

- Paper
- Payment system such as tokens or marbles
- Pens

Link to Digital Technologies Curriculum

This activity introduces the concept of search algorithms, considered within the first Progress Outcome in Computational Thinking. The use of input, output, manipulation and storage of data also introduces the core concepts of Designing and Developing Digital Outcomes.

Activity Background:

This is for students who are learning to identify numbers from 1 to 100. We have 15 different numbers, one on each card. You can't see them but this time they are in order from the lowest number to the highest number. The numbers range from 1 to 100. Can you find number 52

The Activity

Set up a line of cards, with the animal facing upwards. Have a payment system ready such as tokens for your classroom, counters, sweets, or marbles.

The game is even better if you have some real stakes - for example: I have 10 marbles each is worth 2 minutes of game time. For every token you use to find the number I'm thinking of, you will lose a marble.

Let's see how many guesses it takes to find the number: 52

Who would like the first guess? (Choose a student). Which animal should I turn over? Tell us why you chose that guess. (They should be selecting the card that is exactly half way. If they didn't, check with the class if they agree with the choice or could they add to the student's thinking to select the middle card. If they decide not to, that's fine; they will learn the hard way if they use a less efficient approach.)

Turn over the chosen card to show the number under it. If it's the correct one, you can stop, otherwise remove that card and all other cards that the number can't be (which will either be all cards to the right or all cards to the left of the chosen one) and take away one token from your pile. Repeat this process until a student chooses the card with your number on it; if they use all ten tokens then the teacher "wins".

How many guesses did it take to find the number?

With each guess, how many cards were eliminated from being a possibility? (Answer: half the cards could be eliminated with each guess if you picked the middle card.)

Did the students win because they guessed within 4 guesses or did you win because it took them longer?

Repeat this game until the students have won 3 times or you have won 3 times.

Extending The Lesson

If any data is organised in order and a binary search is applied, then you can eliminate a lot of data quickly - cutting the number of items in half each time. As a slightly different example, if we were trying to guess a number between 1 and 100, then asking if the number is over 50 would eliminate 50 options in one question, the second question eliminates 25, the third question 12 or 13, and so on. So in 3 questions you have eliminated 87 numbers. With just 7 questions you can find the one number between 1 and 100.

If you want to challenge students you could talk about how many guesses it would take to guess a number between 1 and 1000. Asking if the number is over 500 would eliminate 500 options in one question, the second question eliminates 250, the third would eliminate 125, and so on. In 3 questions you can eliminate 875 numbers, and you could find the answer in just 10 questions.

It's the same searching for objects that are sorted in descending order - each value that is checked halves the number of possible locations. Dividing problems in half makes them very small very quickly.

This general process is called "divide and conquer" - you break the problem into (two) parts, and deal with each part separately, in turn break them into two parts. Very soon you end up with very easy tasks, such as dealing with just one item. It's a great strategy for reducing any big task or challenge to achievable goals!