NUMBER CHART CHESS
The Rook

Abstract

This resource uses the context of chess and the moves of the rook to look at place value and the addition and subtraction of numbers. Students explore the different ways that the rook can move between numbers on a number chart using the movements that are possible on a regular chess board. This builds to an understanding of how the number chart can be used as a tool to aid and model addition and subtraction using 10s and 1s.

Mathematical Purpose

Students explore the place value patterns on the number chart as they move along rows and columns. Students use place value to aid and model the difference between numbers.

Australian Curriculum: Mathematics Year 3

Number & Algebra

ACMNA053 - Apply place value to partition, rearrange and regroup numbers to at least 10 000 to assist calculations and solve problems

ACMNA054 - Recognise and explain the connection between addition and subtraction

ACMNA055 - Recall addition facts for single-digit numbers and related subtraction facts to develop increasingly efficient mental strategies for computation

This resource is a stand-alone task.

The context of chess on a number chart is used in other resources in Year 4 and Year 8.

TASK

Introduce the context of chess. Ask the students who have played chess to share their knowledge of the rules. Show the students the different chess pieces or pictures of them. Ask the students to name the pieces and how they can move on the chessboard.

Show the students a large copy of a 1 – 100 chart.

Create a story/scenario where the chess pieces have escaped from the chess board and been found on a 100 chart.

Provide the students with a copy of the 'chess' number chart and a rook chess piece. A counter, cube or picture of a rook could be used if a chess piece is not available.

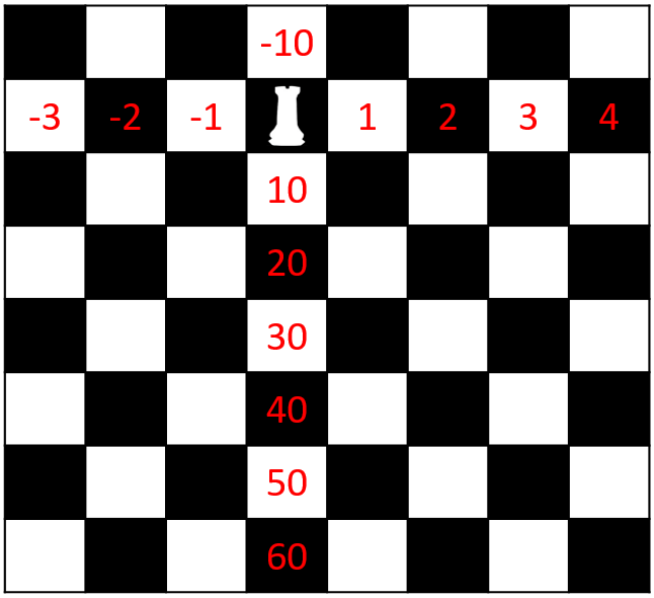
The PowerPoint 'Number Chart Chess - The Rook' provides a slideshow with the moves of the rook and the associated questions.

Discuss the moves of the rook. It can only move along rows or columns.

How does the value of the numbers change as the Rook moves on the number chart?

EXPLORE

Allow the students to explore how the value of the number changes as the rook moves on the number chart. As the rook moves along a row the value of the numbers increases or decreases by one. As they move up and down a column the value increases or decreases by ten.



Discuss how the value of the numbers change and how this corresponds to the patterns that can be seen on the chart.

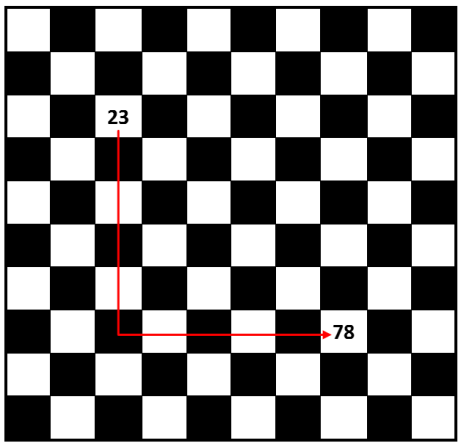
Pose the challenge:

The rook starts at 23 and moves to 78.

How can the rook get from 23 to 78 in two moves?
How does the value of the numbers change as the rook moves?
Record how the value of the numbers change as the rook moves.

There are only two ways for the rook to move from 23 to 78.

STRUCTURE OF NUMBER – Year 3



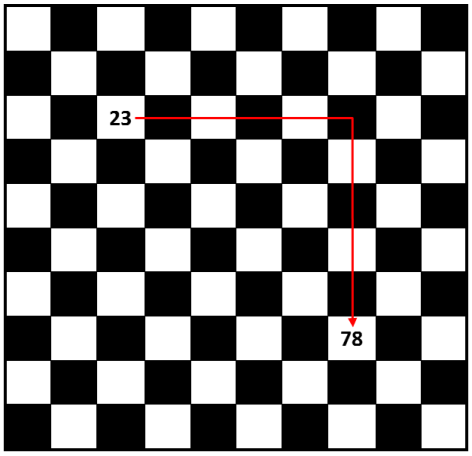
23	+10	+10	+10	+10	+10	+1	+1	+1	+1	+1
23	33	43	53	63	73	74	75	76	77	78

23 + 10 + 10 + 10 + 10 + 10 + 1 + 1 + 1 + 1 + 1 = 78

23 + (10 + 10 + 10 + 10 + 10) + (1 + 1 + 1 + 1 + 1) = 78

23 + (50 + 5) = 78

23 + 55 = 78



23	+1	+1	+1	+1	+1	+10	+10	+10	+10	+10
23	24	25	26	27	28	38	48	58	68	78

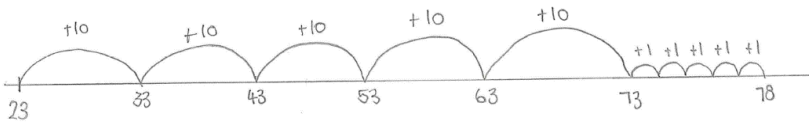
23 + 1 + 1 + 1 + 1 + 1 + 10 + 10 + 10 + 10 + 10 = 78

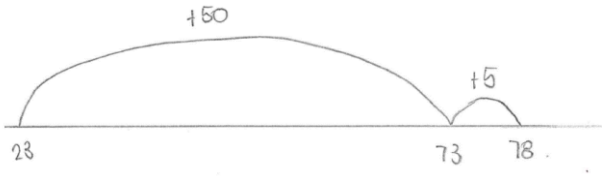
23 + (1 + 1 + 1 + 1 + 1) + (10 + 10 + 10 + 10 + 10) = 78

23 + (5 + 50) = 78

23 + 55 = 78

Using two moves to get from 23 to 78 is a nice illustration of the jump strategy for addition. This can be shown on the number line:





Discuss the values of the rook's move. Although the two moves differ, the value of the move is still the same. This illustrates the ***commutative property*** of addition:

$$10 + 10 + 10 + 10 + 10 + 1 + 1 + 1 + 1 + 1 = 1 + 1 + 1 + 1 + 1 + 10 + 10 + 10 + 10 + 10$$

$$50 + 5 = 5 + 50$$

Pose the challenge:

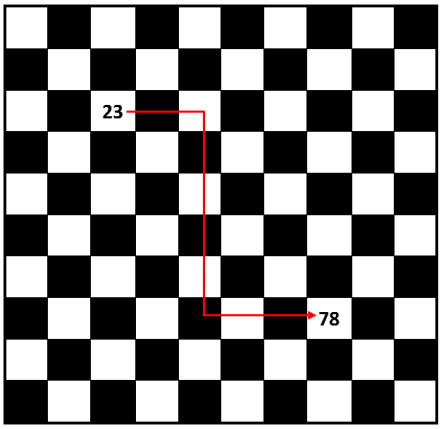
How can the rook get from 23 to 78 in three moves?
What is the longest path that you can find? What is the shortest?
How does the value of the numbers change as the rook moves?

Note: The length of the route is measured by how many squares are passed through.

There are many ways that the rook use three moves to get to 78.

There are multiple routes that only pass through 10 squares. This is the shortest route. Any 10 square route uses addition of five 10s and five 1s in differing combinations. For example:

23	+1	+1	+10	+10	+10	+10	+10	+1	+1	+1
23	24	25	35	45	55	65	75	76	77	78



$23 + 1 + 1 + 10 + 10 + 10 + 10 + 10 + 1 + 1 + 1 = 78$

$23 + (1 + 1) + (10 + 10 + 10 + 10 + 10) + (1 + 1 + 1) = 78$

$23 + 2 + 50 + 3 = 78$

$23 + (2 + 3) + 50 = 78$

$23 + 5 + 50 = 78$

$23 + 55 = 78$

The longest route is 14 squares. Passing through 14 squares uses a combination of addition and subtraction. For example:

STRUCTURE OF NUMBER – Year 3

23	+1	+1	+1	+1	+1	+1	+1	+10	+10	+10	+10	+10	- 1	- 1
23	24	25	26	27	28	29	30	40	50	60	70	80	79	78

23 + 1 + 1 + 1 + 1 + 1 + 1 + 1 + 10 + 10 + 10 + 10 + 10 – 1 - 1 = 78

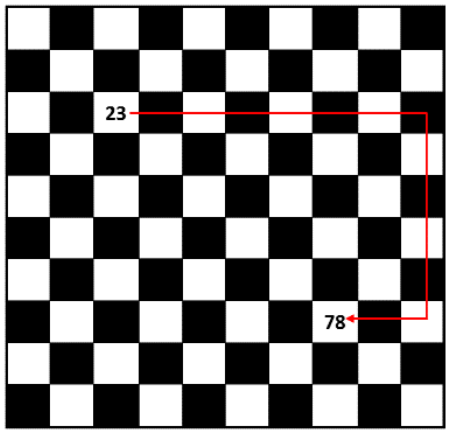
23 + (1 + 1 + 1 + 1 + 1 + 1 + 1) + (10 + 10 + 10 + 10 + 10) – (1 – 1) = 78

23 + 7 + 50 - 2 = 78

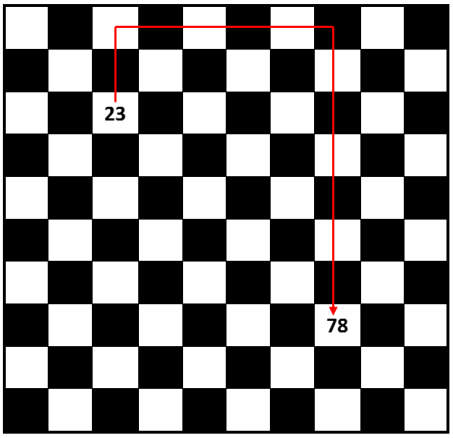
23 + (7 – 2) + 50 = 78

23 + 5 + 50 = 78

23 + 55 = 78



23	- 10	- 10	+1	+1	+1	+1	+1	+10	+10	+10	+10	+10	+ 10	+ 10
23	13	3	4	5	6	7	8	18	28	38	48	58	68	78



23 – 10 – 10 + 1 + 1 + 1 + 1 + 1 + 10 + 10 + 10 + 10 + 10 + 10 + 10 = 78

23 – 10 – 10 + (1 + 1 + 1 + 1 + 1) + (10 + 10 + 10 + 10 + 10) = 78

23 – 20 + 5 + 70 = 78

23 + 5 + (70 – 20) = 78

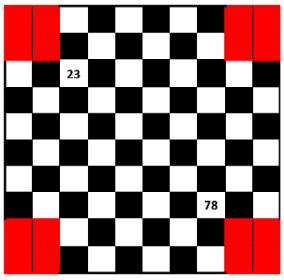
23 + 5 + 50 = 78

23 + 55 = 78

Questioning to direct the investigation and challenge students thinking and reasoning.

What is similar and what is different about the various ways of using three moves to get to 78? Why is it that the value of a move is always 55, regardless of how many squares you pass through?

- The difference between 23 and 78 will always be 55, regardless of how you get there. This gives the opportunity to look at ***compensation***. For every extra 10 or 1 that is added above 55, then they will be subtracted.



Which squares are impossible to pass through when getting from 78 to 23 in three moves?

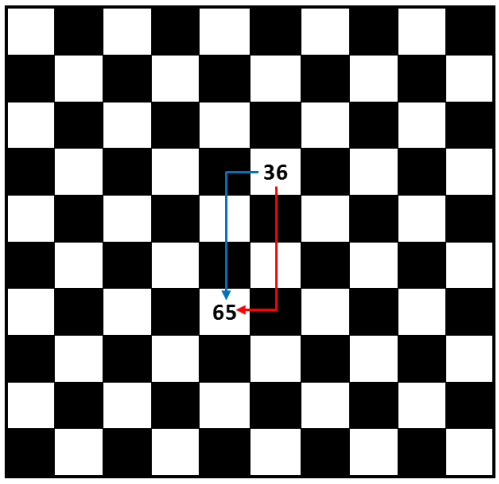
- It is not possible to land in the 2x2 squares in the very corners of the board.

Extending prompt: *Assuming a 90^0 turn is made after each move, how many different ways can you get to 78 from 23?*

- There are 16 different ways that you can get between these two numbers using three moves with a 90^0 turn after each move.

Pose the following questions for further exploration:

How can the rook get from 36 to 65? Record how the value of the numbers change as the rook moves.



Using two moves, there are two ways to get from 36 to 65. Both require subtraction and addition. Once again, this is an opportunity to look at compensation strategies when performing mental or written calculations.

Red path:

36	+ 10	+ 10	+ 10	- 1
36	46	56	66	65

36 + 10 + 10 + 10 – 1 = 65

36 + 30 – 1 = 65

Blue path:

36	-1	+ 10	+ 10	+ 10
36	35	45	55	65

36 – 1 + 10 + 10 + 10 = 65

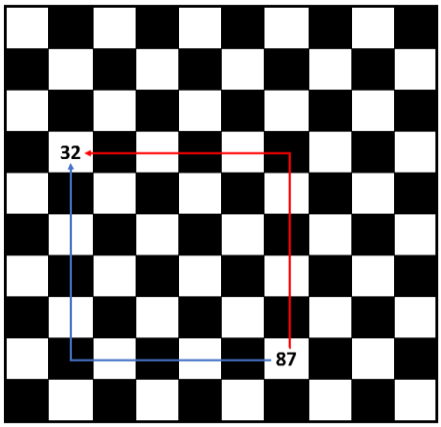
35 + 30 = 65

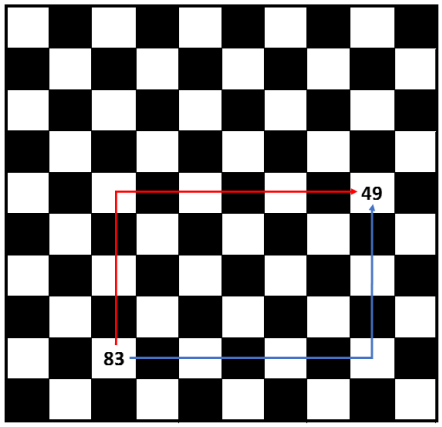
Questioning to direct the investigation and challenge students thinking and reasoning.

What is similar and what is different about the way the rook uses two moves to get from 23 to 78 and 36 to 65?

- The main difference is that 36 to 65 requires subtraction. It is not possible to move using only addition.

How can the rook get from 87 to 32? What about 83 to 49?
Record how the value of the numbers change as the rook moves.





Questioning to direct the investigation and challenge students thinking and reasoning.

What is similar and what is different about the way the rook uses two moves to get from 87 to 32 and from 83 to 49?

- The main difference is that 87 to 32 requires subtraction only, whereas 83 to 49 is a mix of addition and subtraction.

Look at the two moves of the rook. Which one better reflects an efficient strategy for subtracting two numbers? Why?

- 87 to 32 is the best representation. In 83 to 49, 49 is placed further to the right on the chart as its ones digit is higher than in 83. As the rook is unable to move in one horizontal line from one decade to the next, a combination of addition and subtraction is required. The difference between the two numbers is still accurate, but it is not necessarily an efficient strategy for subtraction that would commonly be used.

How would you use the number chart to subtract 83 and 49 more efficiently?

- Some strategies that might be used:
    - Counting back from 83 to 79 and then subtracting 3 tens
    - Subtracting 3 tens from 83 to get to 53 and then counting back to 49.

REFLECT

The focus of the reflection is to look at how moving in ±10 and ±1 highlights the place value parts of the numbers and how partitioning by place value assists the addition and subtraction of numbers. Allow selected students to present their work to build to a discussion on place value and computation.

Questioning to focus the class discussion and reflection:

How do the value of the numbers change as the rook moves on the number chart? How does this reflect the patterns on the number chart?

- The rook always moves ±10 or ±1. This highlights the place value parts of the numbers and therefore the place value patterns that exist on the number chart.

How do the moves of the rook relate to mental computation strategies?

- The rook's moves shows how the jump strategy can be used to add and subtract numbers on the number chart.

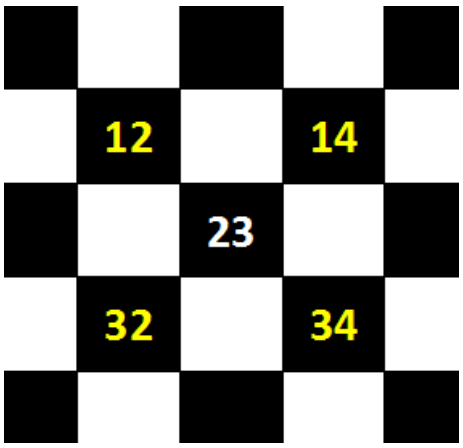
How can the number chart be used for modelling addition and subtraction?

- Generalising the rook's moves on the chart to recognising the chart as a useful tool to aid and model addition and subtraction is important.

SUSTAIN

Activity 1

The bishop starts on 23 and moves just one space. What numbers might the bishop have landed on? How has the value of the numbers changed for each move?
The rook also starts on 23. What moves does the rook need to make to land on the same squares as the bishop? How does the value of the numbers change with each move?
How are the moves of the rook similar to and different from the bishop?



Starting at 23, the bishop can move to 12, 14, 34 and 32.

23 – 11 = 12

23 + 11 = 34

23 – 9 = 14

23 + 9 = 32

To move to the same squares from 23, the rook would need to make two movements. Each time the rook would make one move of ±10 and one move of ±1. This helps illustrate why the bishops moves are ±11 and ±9.

For the rook to get from 23 to 12:

23 (– 10 – 1) = 12
23 – 11 = 12

For the rook to get from 23 to 14:

23 (– 10 + 1) = 14
23 – 9 = 14

For the rook to get from 23 to 32:

23 (+ 10 – 1) = 32
23 + 9 = 12

For the rook to get from 23 to 34:

23 (+ 10 + 1) = 34
23 + 11 = 34

Activity 2

Use the moves of the rook to explain how the number chart can be used to add two numbers or to find the difference between two numbers.