2.1 Algorithms

Keywords & Definitions

Algorithm: A step-by-step set of rules or instructions

Pseudocode: A set of instructions in the style of a programming language but using plain English

Decomposition: Breaking a complex problem down into smaller problems

Abstraction: Picking out the important bits of information from the problem

Search algorithm: A set of instructions that you can follow to find an item in a list

Sorting algorithm: A set of instructions that you can follow to order a list of items

Computational Thinking

Decomposition:

Breaking a complex problem down into smaller problems

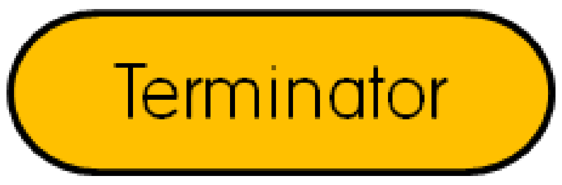
Abstraction:

Picking out the important bits of information from the problem

Algorithmic Thinking

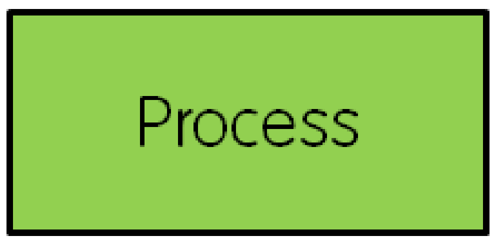
A logical way of getting from the problem to the solution.

Creating a flowchart



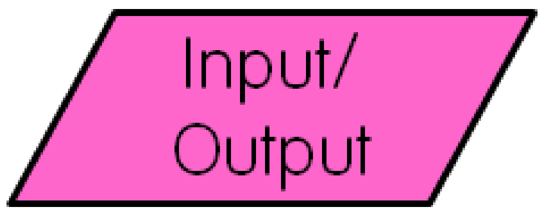
Terminator

Start or stop - ALL: flowcharts should have one of these at the beginning



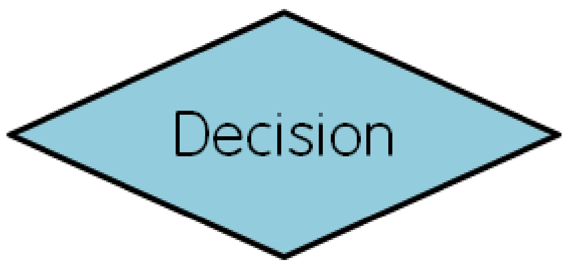
Process

Action/step that takes place. For example if the computer is doing a calculation



Input/ Output

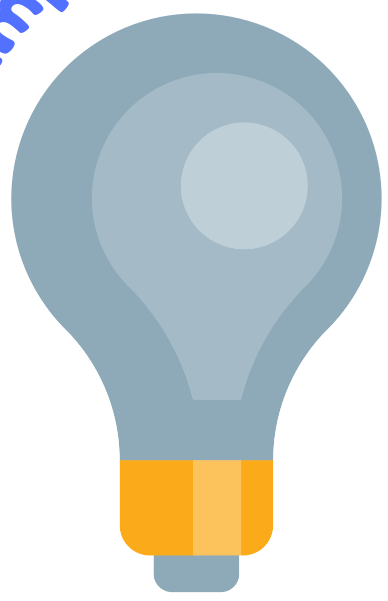
The user has to input data (answer a question) or when something is printed on the screen

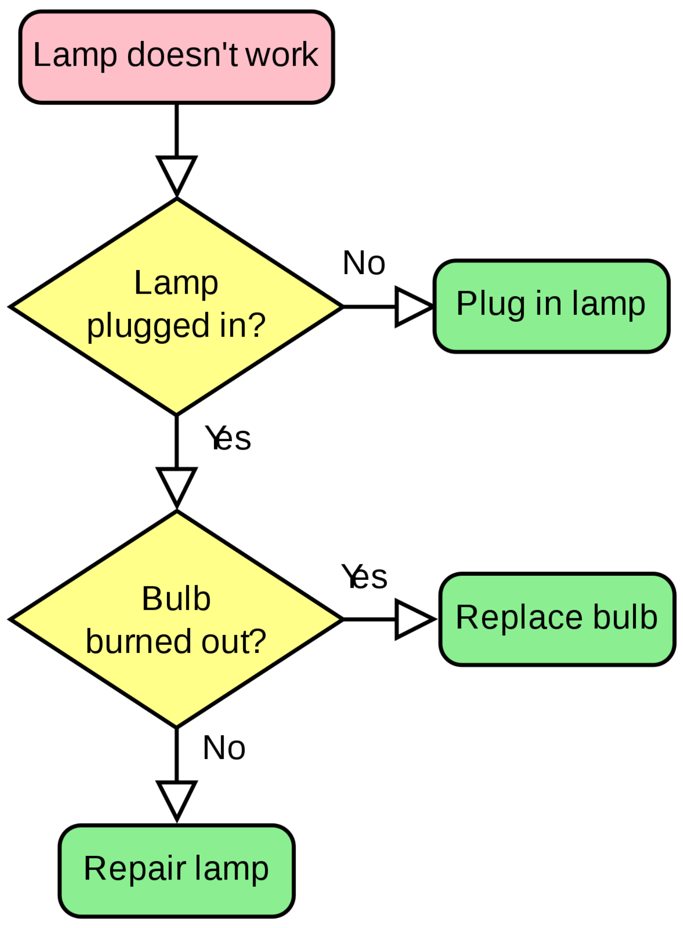


Decision

When the program has to make a decision, this could be an IF..ELSE decision

Basic Flowchart Example





Lamp doesn't work

Lamp plugged in?

No

Plug in lamp

Yes

Bulb burned out?

Yes

Replace bulb

No

Repair lamp

2.1 Algorithms

Searching Algorithms

Binary Search

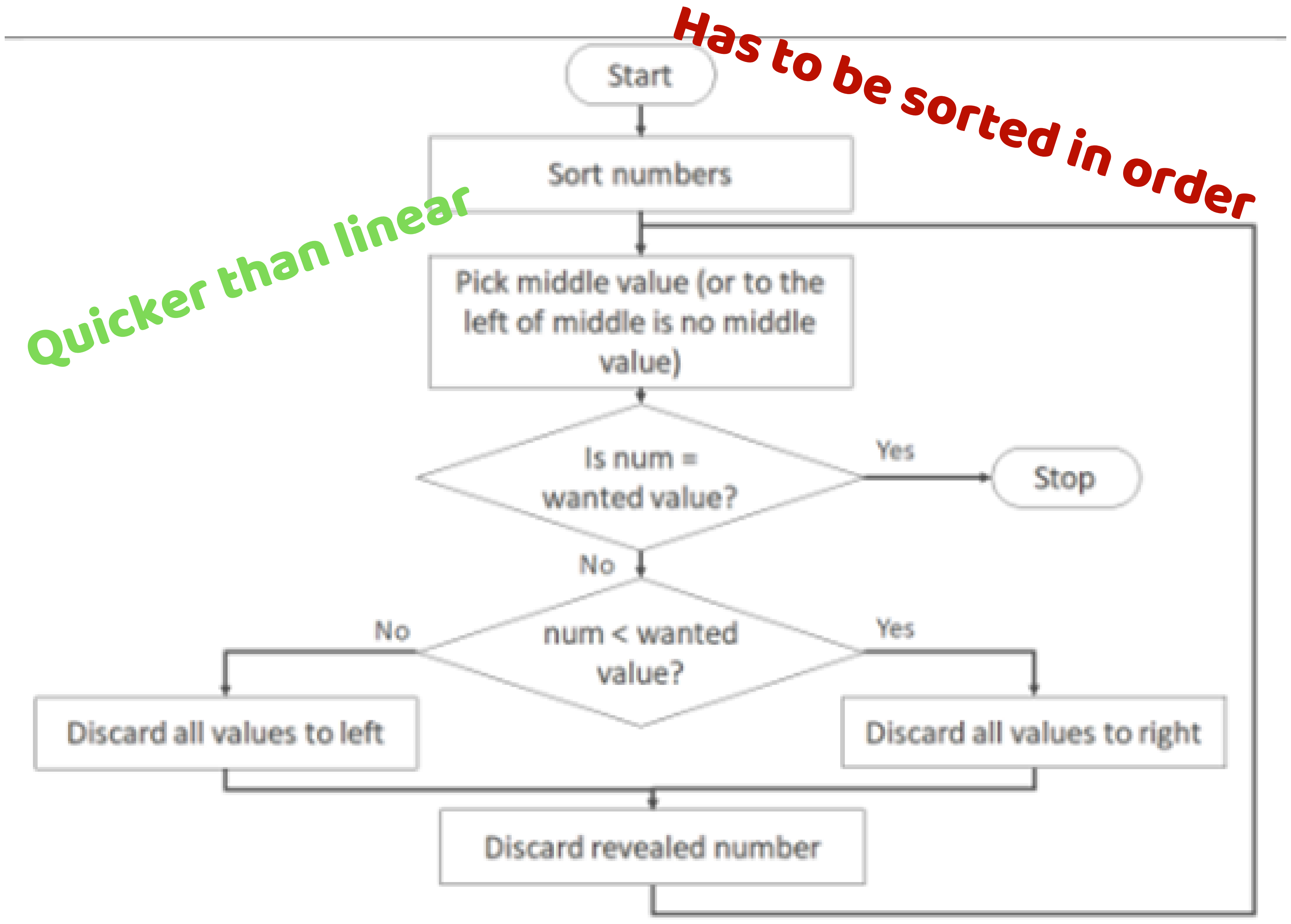
Use binary search to find the number 6:

1 2 3 4 5 6 7 8

1. Look at the number 4 first (this is the middle number)

2. 8 is higher than 4 so get rid of the first half of the list

3. look at number 6


Start
Sort numbers
Pick middle value (or to the left of middle is no middle value)
Is num = wanted value?
Yes
Stop
No
num < wanted value?
No
Yes
Discard all values to left
Discard all values to right
Discard revealed number

Has to be sorted in order

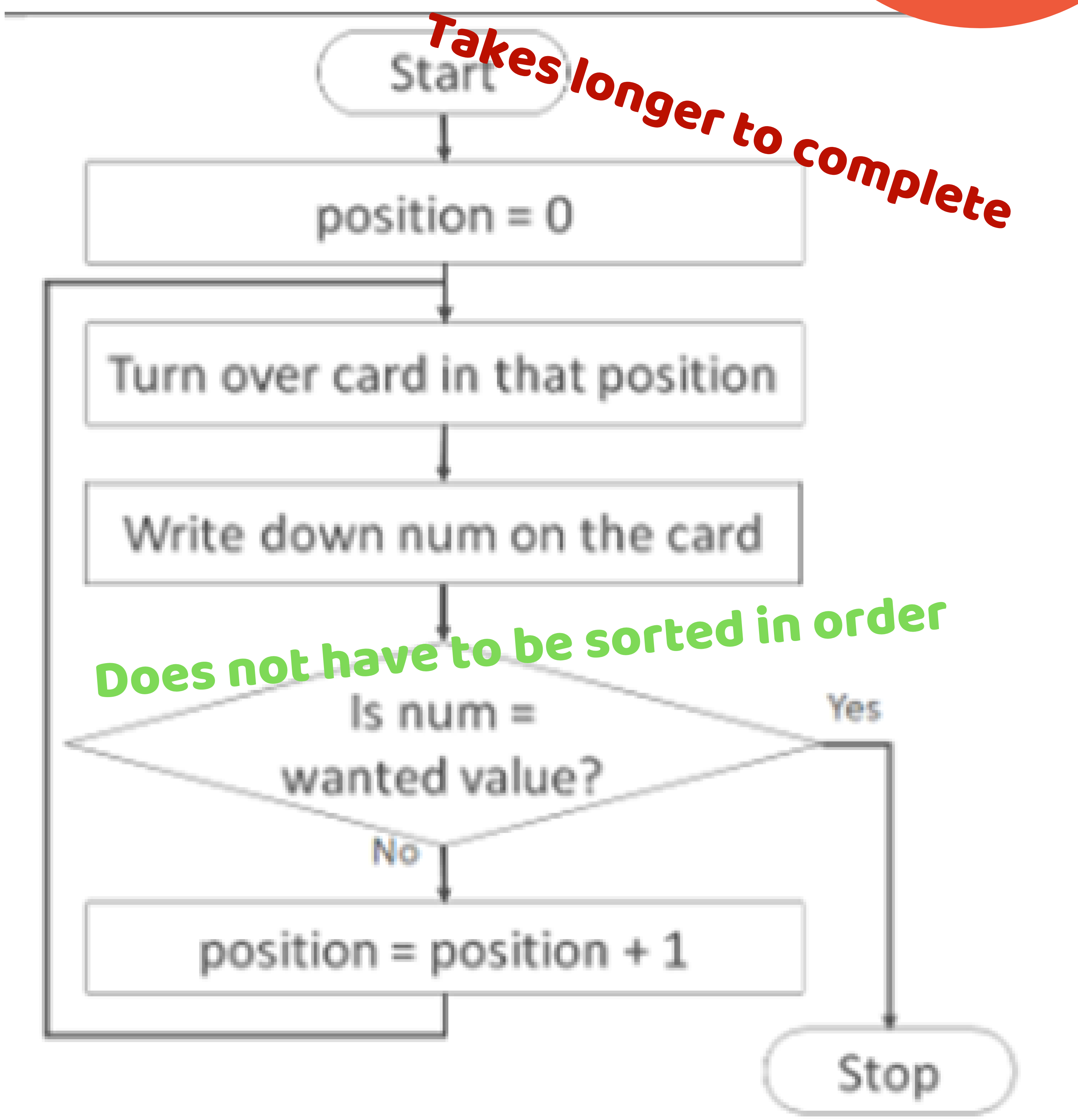
Quicker than linear

Linear Search

Use linear search to find the number 6:

1 2 3 4 5 6 7 8

1. Look at 1
2. Look at 2
3. Look at 3
4. Look at 4
5. Look at 5
6. Look at 6



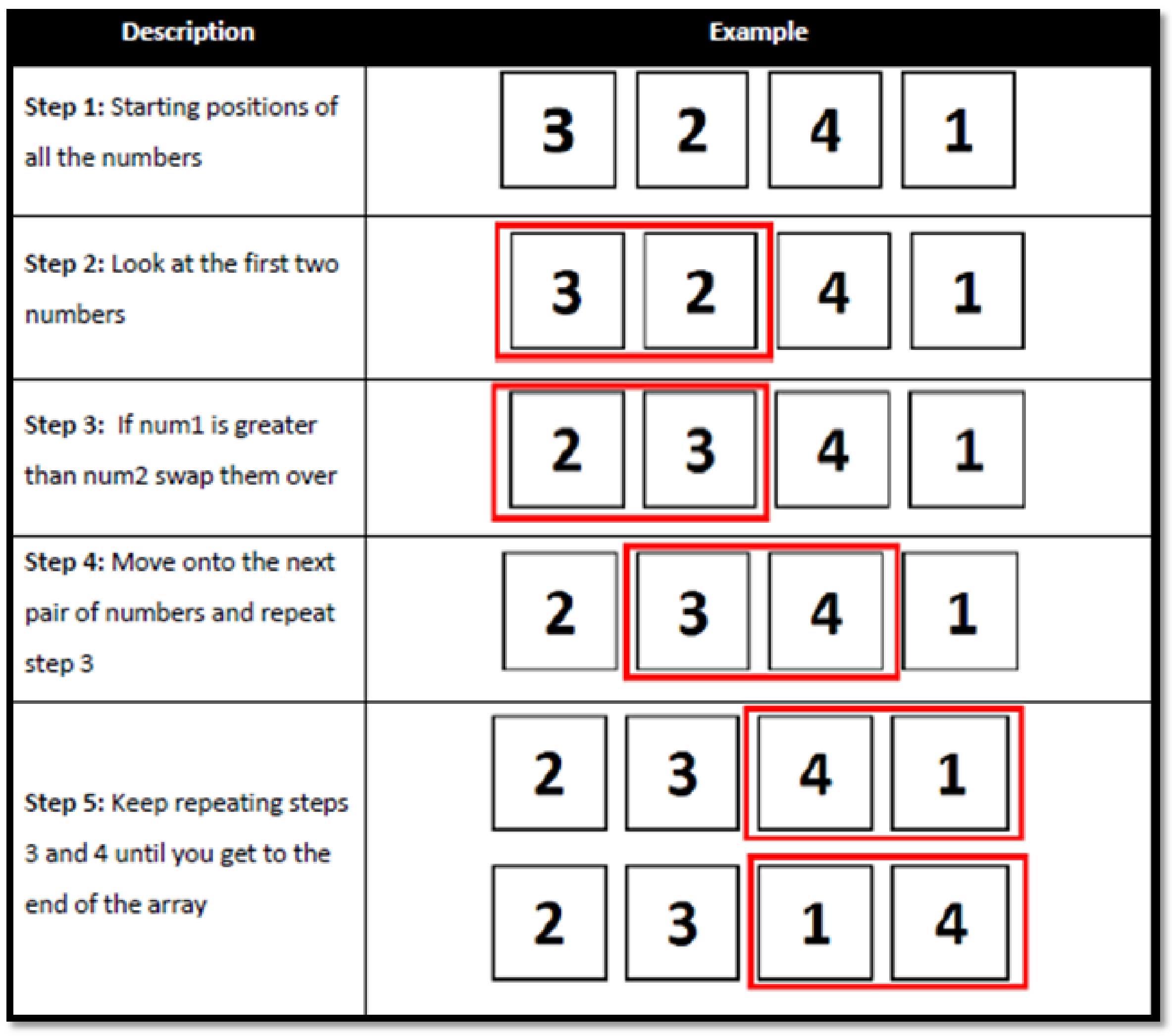
Takes longer to complete

Does not have to be sorted in order

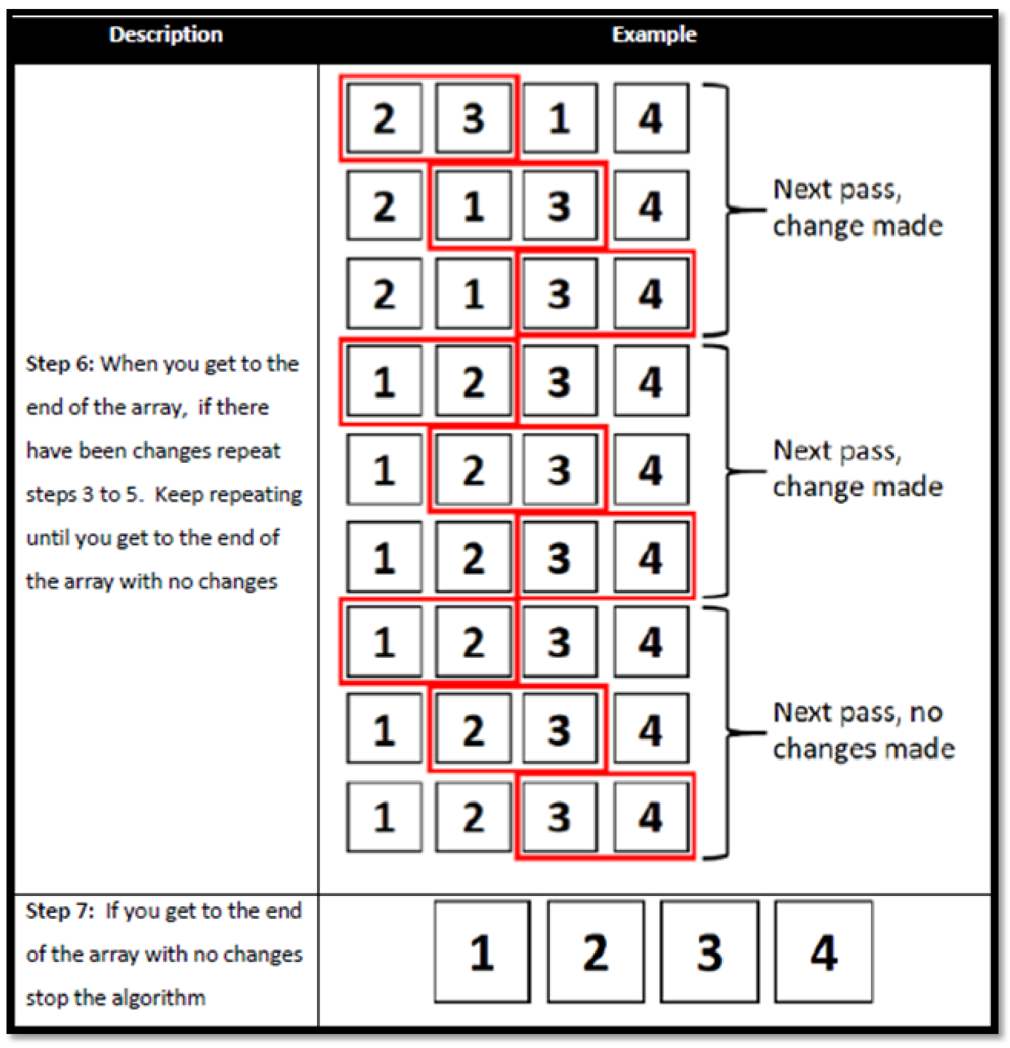
2.1 Algorithms

Sorting Algorithms

Bubble Sort

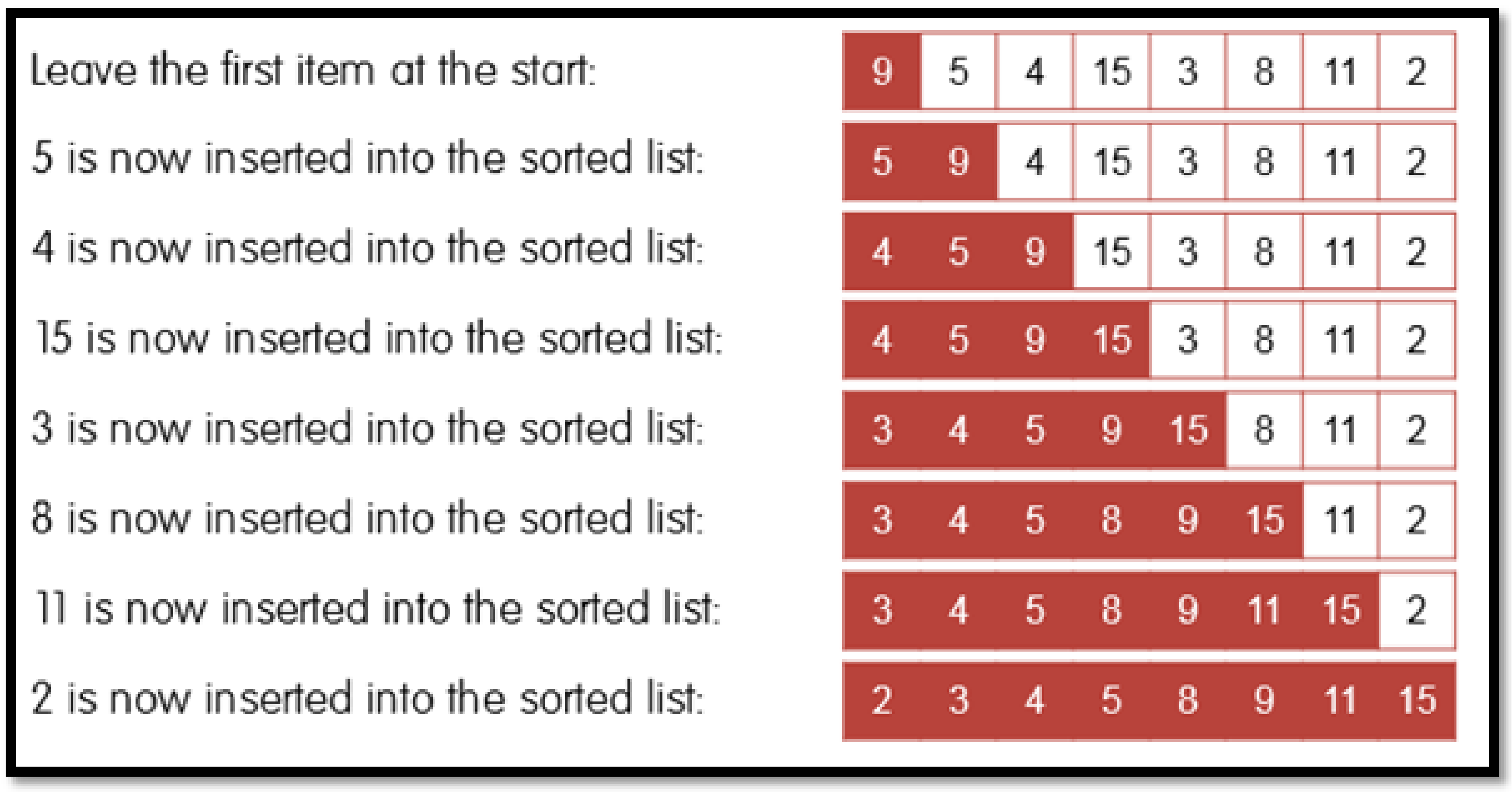


Description	Example
Step 1: Starting positions of all the numbers	3 2 4 1
Step 2: Look at the first two numbers	3 2 4 1
Step 3: If num1 is greater than num2 swap them over	2 3 4 1
Step 4: Move onto the next pair of numbers and repeat step 3	2 3 4 1
Step 5: Keep repeating steps 3 and 4 until you get to the end of the array	2 3 4 1 2 3 1 4



Description	Example
Step 6: When you get to the end of the array, if there have been changes repeat steps 3 to 5. Keep repeating until you get to the end of the array with no changes	2 3 1 4 2 1 3 4 2 1 3 4 Next pass, change made 1 2 3 4 1 2 3 4 1 2 3 4 Next pass, change made 1 2 3 4 1 2 3 4 1 2 3 4 Next pass, no changes made
Step 7: If you get to the end of the array with no changes stop the algorithm	1 2 3 4

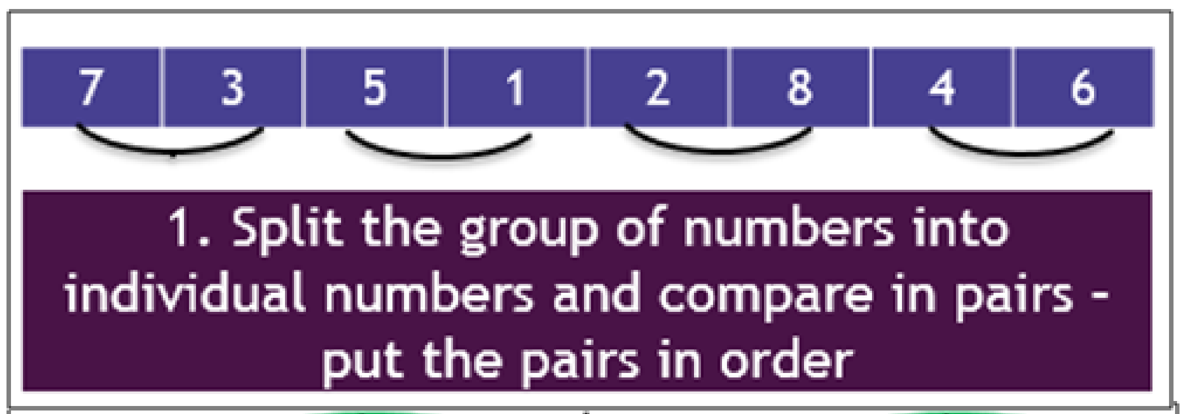
Insertion Sort



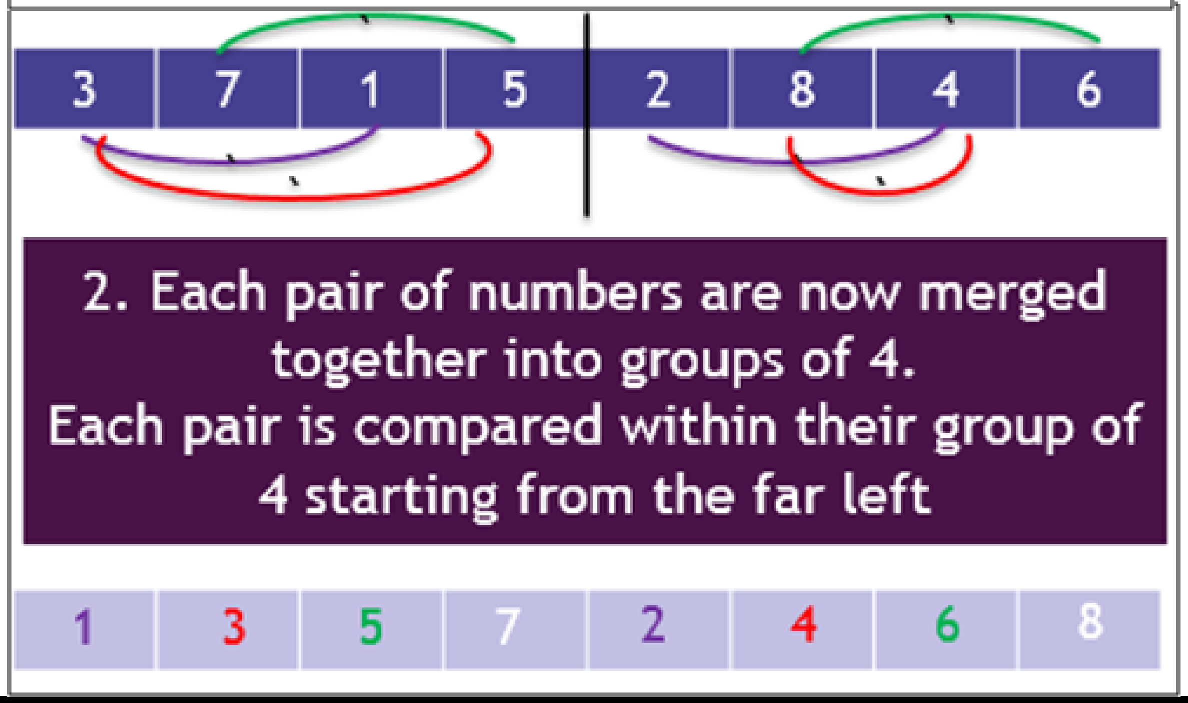
Leave the first item at the start:	9	5	4	15	3	8	11	2
5 is now inserted into the sorted list:	5	9	4	15	3	8	11	2
4 is now inserted into the sorted list:	4	5	9	15	3	8	11	2
15 is now inserted into the sorted list:	4	5	9	15	3	8	11	2
3 is now inserted into the sorted list:	3	4	5	9	15	8	11	2
8 is now inserted into the sorted list:	3	4	5	8	9	15	11	2
11 is now inserted into the sorted list:	3	4	5	8	9	11	15	2
2 is now inserted into the sorted list:	2	3	4	5	8	9	11	15

Easiest but would take the longest if the list of numbers was a long one

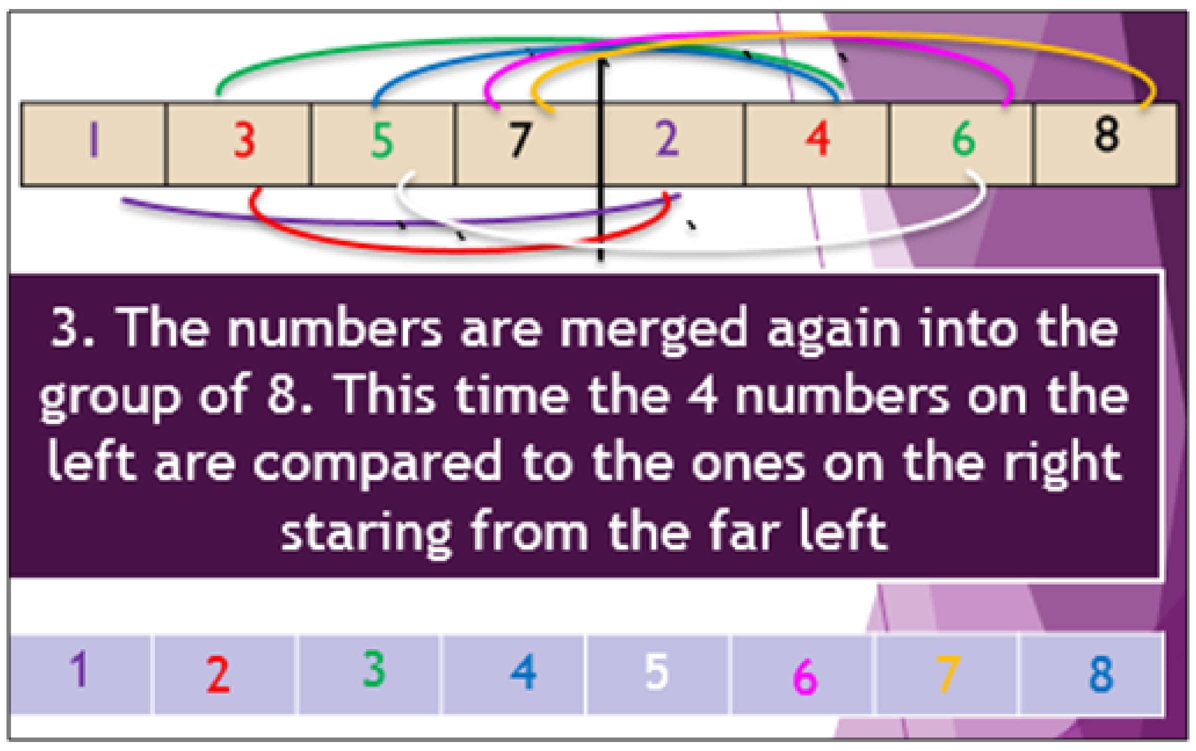
Merge Sort



1. Split the group of numbers into individual numbers and compare in pairs - put the pairs in order



2. Each pair of numbers are now merged together into groups of 4. Each pair is compared within their group of 4 starting from the far left



3. The numbers are merged again into the group of 8. This time the 4 numbers on the left are compared to the ones on the right staring from the far left

More complex but quicker to sort

World of work links

Programmer, IT Technician, Software Engineer, Teacher, Systems Architecture, Data Engineer, Software Developer