3.1.4 Sorting algorithms 1

Lesson plan and printable activities

Teacher notes

A ‘bubble sort’ is sometimes referred to as a ‘sinking sort’. It is a simple sorting algorithm that repeatedly steps through the list to be sorted, comparing each pair of adjacent items and swapping them if they are in the wrong order. The pass through the list is repeated until no swaps are needed. At this point, the list is sorted. The sorted elements ‘bubble’ to the top of the list. Although the algorithm is simple, it is too slow for many problems.

Materials needed

1. 3.1.4 Lesson 1 PowerPoint.
2. Bubble sort activity worksheet.

Lesson aims

1. To get students to think about how to sort datasets using simple algorithms.

Lesson objectives

1. Understand and explain how the bubble sort algorithm works.

Starter activity (10 minutes)

1. **Slides 2–3:** Students are introduced to bubble sort via the Hungarian dancing YouTube video. Watch from 0:50 minutes to 4:00 minutes. Encourage them to pay attention to what is happening by first following dancer number 8. After the video, give them two minutes discussion time with a partner before sharing their findings. Slide 3 has the key points they will hopefully have spotted.

Main activities (30 minutes)

1. **Slide 5:** Introduction to what a bubble sort does.
2. **Slide 6:** YouTube video – watch from 0:48 minutes to 3:08 minutes. This is another representation of the algorithm. This one is a little easier to follow and the presenter explains the process as he is going along. After the video, students have five minutes to write down their own version of the algorithm.
3. **Slide 7:** Go through the algorithm. Students will need this information for the worksheet later. A printed version is included in this document.
4. **Slide 8:** A demonstration of the algorithm.

Plenary activity (10 minutes)

5. **Slides 10–11:** Summarise the lesson with the quiz. Answers appear after each question

Lesson

3.3 Fundamentals of data representation

3.1.4 Sorting algorithms 1

Lesson

What is this all about?

Watch this video made by Sapientia University in Romania from 0:50 minutes to 4:00 minutes:

youtube.com/watch?v=lyZQPjUT5B4

Look carefully at what is happening – the numbers on the dancers will help.

When the video has finished you will have two minutes to discuss what was happening with your partner.

What did you notice?

- The dancers were gradually being arranged in order from 1 to 9.
- Dancer 9 was put in place first, followed by 8, 7, etc. – down to 1.
- It took quite a long time!
- They were following an algorithm called a '**Bubble Sort**'.

Objective

Understand and explain how the bubble sort algorithm works.

What is a bubble sort?

A bubble sort algorithm is a *simple* method used to arrange a data set in order.

An array of data is traversed continually and adjacent pairs of elements are swapped, if required, until the array is placed in the desired order.

A bubble sort is likely to require multiple passes through the array and this makes this method *inefficient*.

Creating the algorithm

Here is another short video clip. Watch carefully from 0:48 minutes to 3:08 minutes:

youtube.com/watch?v=NiyEqLZmngY&nohtml5=False

When it has finished you will have five minutes to come up with your own version of the bubble sort algorithm.

Bubble sort algorithm

Did you get something like this?

Step 1: Compare the first two numbers. If the smaller number is on the right, swap these two numbers. Write the remainder of the list.

Step 2: Move to the next number in the list and compare these two numbers. If the smaller number is on the right, swap these two numbers. Write the remainder of the list.

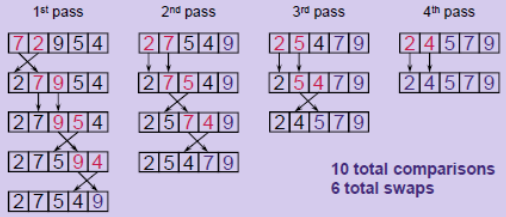
Step 3: Repeat Step 2 until the last two numbers have been compared. This completes the FIRST PASS.

Step 4: SECOND PASS. Repeat steps 1, 2 and 3. No need to compare the last two places.

Step 5: THIRD PASS. Repeat step 1, 2 and 3. No need to compare the last three places.

STOP: When a complete pass produces no swaps.

Bubble sort example



10 total comparisons
6 total swaps

How many comparisons and swaps?

4 comparisons	3 comparisons	2 comparisons	1 comparisons
3 swaps	2 swaps	1 swaps	0 swaps

Over to you…

Complete the worksheet.

Bubble sort quiz

1. After the first pass, one number will definitely be in the correct position. Which number is that and in which position?

   It will be the largest number and it will be in the last position.

2. After each pass through the data, are there more or less comparisons made?

   Each pass through the data requires one less comparison that the pass before.

Bubble sort quiz

3. Eventually the algorithm stops. How does it know when to stop?

   There will be no swaps.

4. Write down a list of five numbers which will need just one pass through the list and no swaps.

   e.g. 1 2 3 4 5

Bubble sort quiz

5. Write down a set of five numbers that will need the maximum number of comparisons and swaps before it is sorted. How many comparisons are needed in total.

		5	4	3	2	1	Comparisons	Swaps
Pass	1	4	3	2	1	5	4	4
	2	3	2	1	4	5	3	3
	3	2	1	3	4	5	2	2
	4	1	2	3	4	5	1	1
						Totals	10	10

6. What is the maximum number of comparisons for a list of 10 numbers?

   45

Bubble sort algorithm

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Step 2: Move to the next number in the list and compare these two numbers. If the smaller number is on the right, swap these two numbers. Write the remainder of the list.

Step 3: Repeat Step 2 until the last two numbers have been compared. This completes the FIRST PASS.

Step 4: SECOND PASS. Repeat steps 1, 2 and 3. No need to compare the last two places.

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STOP: When a complete pass produces no swaps.

Bubble sort activity

1a. Use a bubble sort to rearrange the following numbers into ascending order:

13, 16, 10, 11, 4, 12, 6, 7

1b. State the number of comparisons and the number of swaps for each of the first three passes.

2a. Use a bubble sort to rearrange the following numbers into ascending order, showing the list of numbers after each pass:

6, 2, 3, 5, 4

2b. Write down the number of comparisons on the first pass.

Bubble sort activity – answers

1a.

13	16	10	11	4	12	6	7
13	10	11	4	12	6	7	16
10	11	4	12	6	7	13	16
10	4	11	6	7	12	13	16
4	10	6	7	11	12	13	16
4	6	7	10	11	12	13	16
4	6	7	10	11	12	13	16

1b.

	Comparisons	Swaps
1st	7	6
2nd	6	6
3rd	5	3

(Taken from AQA General Certificate of Education Mathematics 6360 MD01 Decision 1 January 2010)

2a.

(6	2	3	5	4)
2	3	5	4	6
2	3	4	5	6
2	3	4	5	6

On reverse:

(6	2	3	5	4)
2	6	3	4	5
2	3	6	4	5
2	3	4	6	5
2	3	4	5	6

2b. 4

(Taken from AQA General Certificate of Education Mathematics 6360 MD01 Decision 1 June 2010)