THE STRIVING

MUSLIM ACADEMY

Islamic and Academic Education

YEARS 7 TO 9 · COMPUTING

Abstraction and algorithms

Modelling a problem by leaving things out, and the sorting and searching algorithms, traced step by step.

WHAT IS INSIDE

- What an abstraction leaves out
- Bubble sort, traced
- Searching: linear against binary
- How each one is worked

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3 sets · a hint on every question

Written for a parent teaching at home. No training assumed, and nothing else to buy.

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Bubble sort, traced

Work it out on paper before checking the back.



1. **Here is a list: 37, 5, 25, 11, 8. Write the list after one full pass of a bubble sort.**
   A pass compares each neighbouring pair once, left to right, and swaps them if they are the wrong way round.

2. **Here is a list: 27, 3, 13, 26, 34. Write the list after one full pass of a bubble sort.**
   A pass compares each neighbouring pair once, left to right, and swaps them if they are the wrong way round.

3. **Here is a list: 30, 13, 39, 12, 36. Write the list after one full pass of a bubble sort.**
   A pass compares each neighbouring pair once, left to right, and swaps them if they are the wrong way round.

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How each one is worked

Every trace printed in full, so it can be marked step by step.



WHAT AN ABSTRACTION LEAVES OUT

1. A bus timetable is an abstraction of a bus. Name three things about the bus it deliberately leaves out.

1. A timetable keeps arrival times and stops.
2. It drops the colour, the engine, the driver's name, the fuel level, the number of seats.
3. Those are left out because a passenger deciding when to leave the house does not need them.

Answer: **any three of: colour, engine, driver, fuel, number of seats, route taken between stops**

2. Write down the state and the behaviour of a lift, as a model. State means what it knows, behaviour means what it does.

1. State: which floor it is on, which direction it is moving, which buttons are lit, whether the doors are open.
2. Behaviour: move up, move down, open doors, close doors, light a button, clear a button.
3. Everything else about the lift is not in the model.

Answer: **state: floor, direction, lit buttons, doors; behaviour: move, open, close, light and clear buttons**

3. Two abstractions of the same town: a road map and an underground map. Say what each one keeps that the other throws away, and why both are correct.

1. A road map keeps distance and shape, because a driver needs to know how far and which way.
2. An underground map throws away distance and shape and keeps order and connections, because a passenger only needs to know which stop is next and where to change.
3. Both are correct because an abstraction is judged against the question it is for, not against the town.

Answer: **the road map keeps distance and shape, the underground map keeps order and connections, and each suits its own question**

BUBBLE SORT, TRACED

1. Here is a list: 37, 5, 25, 11, 8. Write the list after one full pass of a bubble sort.

1. Compare each pair in turn and swap where the left is bigger.
2. After the first pass the list is 5, 25, 11, 8, 37.
3. The largest value has reached the end, which is what one pass always achieves.

Answer: **5, 25, 11, 8, 37**

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How each one is worked, continued

SEARCHING: LINEAR AGAINST BINARY



1. This sorted list is 1, 2, 23, 30, 35, 44, 50. Using a binary search for 35, write down every value the search looks at, in order.

1. The middle of the whole list is looked at first.
2. Each step halves what is left.
3. The values looked at are 30, 44, 35.

Answer: **30, 44, 35**

2. This sorted list is 5, 28, 35, 41, 47, 49, 55. Using a binary search for 47, write down every value the search looks at, in order.

1. The middle of the whole list is looked at first.
2. Each step halves what is left.
3. The values looked at are 41, 49, 47.

Answer: **41, 49, 47**

3. This sorted list is 8, 15, 33, 39, 43, 44, 51. Using a binary search for 8, write down every value the search looks at, in order.

1. The middle of the whole list is looked at first.
2. Each step halves what is left.
3. The values looked at are 39, 15, 8.

Answer: **39, 15, 8**

4. For the list 19, 28, 34, 35, 37, 51, 57 and the target 19, how many values does a linear search look at, and how many does a binary search look at?

1. A linear search checks from the left until it finds 19, which takes 1 values.
2. A binary search looks at 35, 28, 19, which is 3 values.

Answer: **1 and 3**

5. For the list 11, 18, 19, 37, 41, 42, 47 and the target 19, how many values does a linear search look at, and how many does a binary search look at?

1. A linear search checks from the left until it finds 19, which takes 3 values.
2. A binary search looks at 37, 18, 19, which is 3 values.

Answer: **3 and 3**

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SAMPLE PAGES

You have read a few pages. The pack is longer.

What you are holding is a short sample, taken from different parts of the pack so that you can see how a week is planned and what a child is actually asked to do, before you decide.

The complete pack, and the rest of the academic materials, are on our website: schemes of work for a parent teaching at home, and practice packs for the skills children get stuck on.

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