Performing a binary search - Solution

Task 1 . Searching for an instrument

Charlie has created a program that stores all of the instruments that a music shop currently sells or hires out.

A sample of data is shown in **Figure 1**.

| Banjo | Cello | Drums | Flute | Guitar | Harp | Oboe | Piano | Violin |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |

**Figure 1**

**List** the instruments that will be compared to the instrument “Harp” when performing a binary search on the data shown in **Figure 1**.

| Guitar, Oboe, Harp |
| --- |

**List** the instruments that will be compared to the instrument “Flute” when performing a binary search on the data shown in **Figure 1**.

| Guitar, Cello, Drums, Flute |
| --- |

**List** the instruments that will be compared to the instrument “Trumpet” when performing a binary search on the data shown in **Figure 1**.

| Guitar, Oboe, Piano, Violin |
| --- |

**Describe** the stages of a binary search to find the instrument “Drums” when performing a binary search on the data shown in **Figure 1**.

| Compare Drums to Guitar.  Drums is less than Guitar, so discard the items on the right and search the left side.  Compare Drums to Cello.  Drums is greater than Cello, so discard the items on the left and take the right side.  Compare Drums to Drums. Search item has been found. |
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Task 2 . Best and worst-case scenario

The performance of an algorithm relates to the number of steps it takes to complete. For binary search, this depends on the number of comparisons that need to be made.

The **best-case scenario** occurs when the item you are looking for results in the **smallest possible number of comparisons**. The **worst-case scenario** takes place when the item you are looking for results in the **greatest possible number of comparisons**.

Another sample of data is shown in **Figure 2**.

| Crow | Deer | Eagle | Horse | Lion | Moose | Rhino | Tiger | Zebra |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |

**Figure 2**

Which animal would you search for to incur the **best-case** scenario in **Figure 2**?

| Lion |
| --- |

How many comparisons would need to be made in the **best-case** scenario in **Figure 2**?

| 1 |
| --- |

Which animal could you search for to incur the **worst-case** scenario in **Figure 2**?

| Horse or Zebra |
| --- |

How many comparisons would need to be made in the **worst-case** scenario in **Figure 2**?

| 4 |
| --- |

If the number of animals in **Figure 2** was doubled from 9 to 18, how many extra comparisons would need to be made at most? Why is that?

| If the number of items in a list of items doubles, then the maximum number of comparisons when carrying out a binary search would increase by one. Therefore, doubling the amount of data from 9 to 18 would increase the worst-case scenario to 5 comparisons instead of 4. |
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Explorer Task .

**Explain** how the amount of data that needs to be searched changes after each comparison. Use an example of a list with 100 items to support your answer.

| With every comparison in binary search, the algorithm eliminates half of the data. This means that for 100 items, the first comparison would halve the data to 50 items. The amount of data would continue to be halved until the search item was found or the list had been exhausted. |
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