# Introduction to Algorithms

What is an **algorithm**?

What is **computer science**?

What are some features of algorithms studied by computer scientists?

What is the **search problem**?

How does the built-in list **index** function work? How does it signal a value was not found?

What is the **idea** of linear search?

How can linear search be **implemented** in Python?

Graphical user interface, text, application

Description automatically generated

Does the order of the elements in lst matter to linear\_search?

What is reverse linear search? When is different than regular linear search? Why might you use it?

Graphical user interface, text, application

Description automatically generated

What are some other ways you could implement linear search?

What is **binary search**? What does it assume about the list it’s searching?

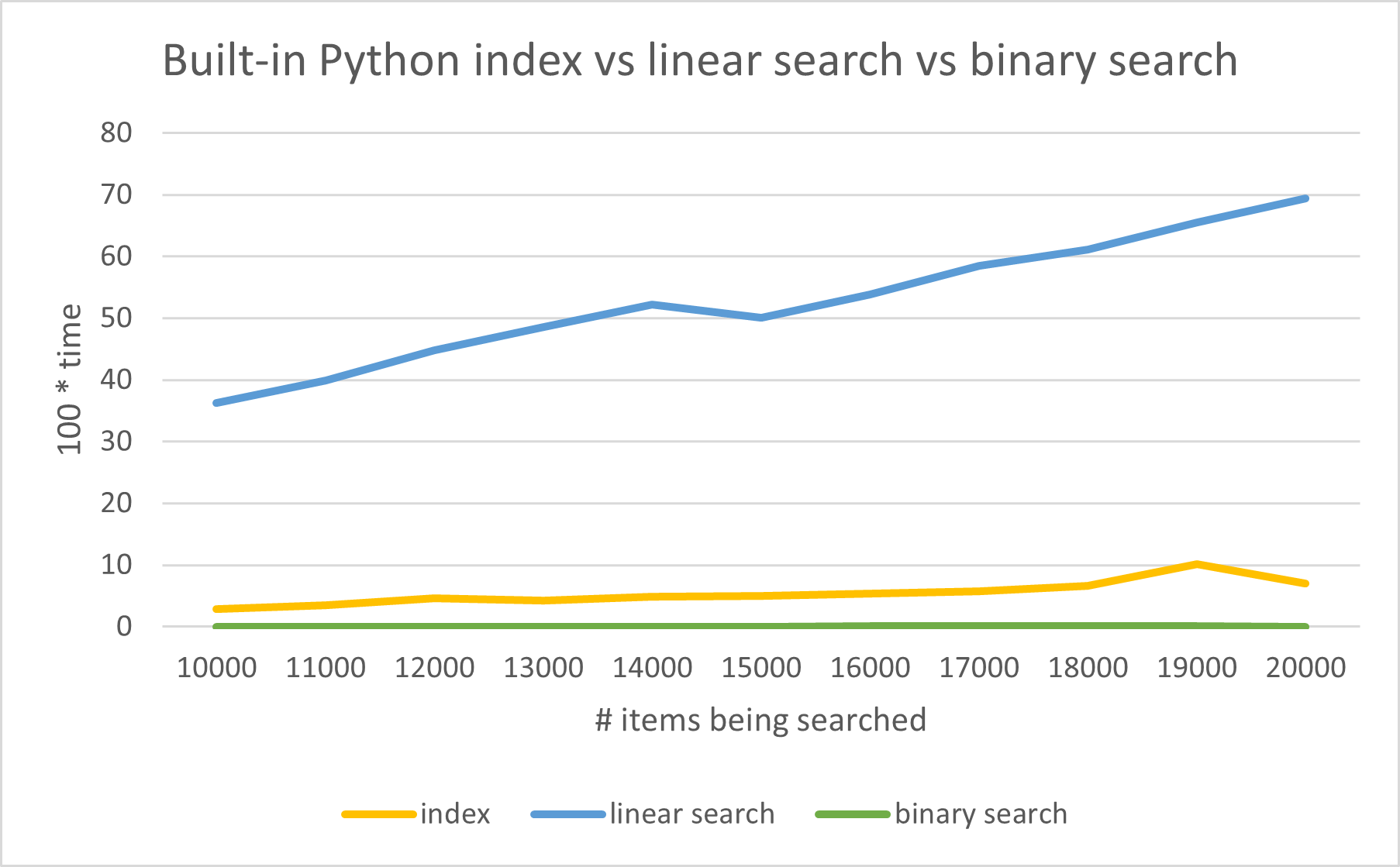
How would **binary search** find 5 in the list [0, 2, 3, 4, 8, 9, 9] ?

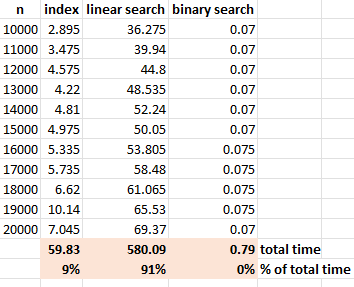
How can you implement **binary search** in Python?

Text

Description automatically generated

How does the performance of **linear search** and **binary search** compare?





Why do computer scientists often **not** use **actual time** when analyzing the **theoretical** performance of an algorithm?

What is a **key instruction**? What is the usual key instruction for **search** algorithms?

If you do **linear search** on a list of **100** elements, what is:

* The **best case** number of comparisons?
* The **worst case** number of comparisons?
* The **average case** number of comparisons?

If you do **linear search** on a list of **n** elements, what is:

* The **best case** number of comparisons?
* The **worst case** number of comparisons?
* The **average case** number of comparisons?

Which of the three cases do we usually assume practice?

If you do **binary search** on a list of **n** elements, what is:

* The **best case** number of comparisons?
* The **worst case** number of comparisons?
* The **average case** number of comparisons?

How much smaller is compared to ?

|  |  |
| --- | --- |
| n |  |
| 16 | 4 |
| 32 | 5 |
| 64 | 6 |
| 128 | 7 |
| 1048576 | 20 |

In the **worst case**, about how many comparisons does **binary search** do on a list of length **1 million**?

## Sorting

What is the **sorting problem**?

How does Python’s **built-in list sort** function work?

What is **selection sort**? How does it work?

How can you implement **selection sort** in Python?

Text

Description automatically generated

What are some ways **selection\_sort** differs from the built-in list sort?

What is **merging**? How would you merge these two lists together:  
  
[1, 3, 6, 9, 11]  
  
  
  
[0, 4, 8, 9]

How can we merge two lists in Python?

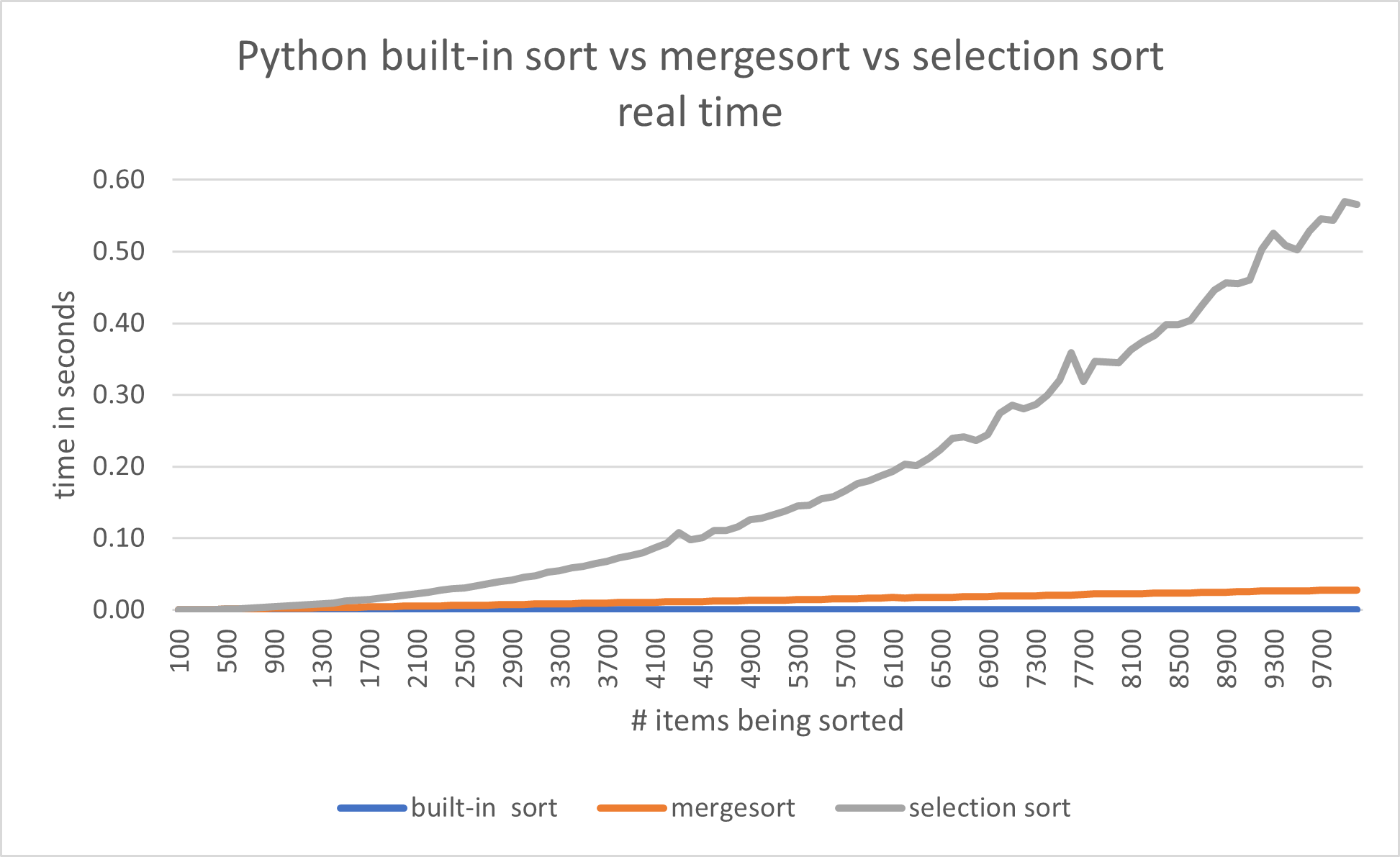
Text

Description automatically generated

What is **mergesort**? How would it sort this list:

[9, 5, 2, 8, 1, 2, 7]

How do the running times of built-in list sort, selection sort, and mergesort compare?



The time it takes for **selection sort** to sort **n** items is proportional to what mathematical expression?

The time it takes for **mergesort** to sort **n** items is proportional to what mathematical expression?

Suppose it takes 10 seconds for **selection sort** to sort **n** items. About how long would it take to sort **2n** items? **3n** items?

Suppose it takes 10 seconds for **mergesort** to sort n items. About how long would it take to sort 2n items?

What kind of sorting algorithm is Python’s built-in list sort?

In practice, which sorting algorithm should you usually use in Python?