

# 19 Binary search – Part 2

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

## Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

| English       | 中文   | Write it 3 times (English) |
|---------------|------|----------------------------|
| binary search | 二分查找 | _____                      |

## Recall

If a list is already sorted, you can search it far faster than checking every element.

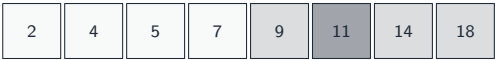
## New ideas

Read these first. Each idea has a short worked example. Then do the Practice.

### ■ 1 Binary search



look at middle



keep half

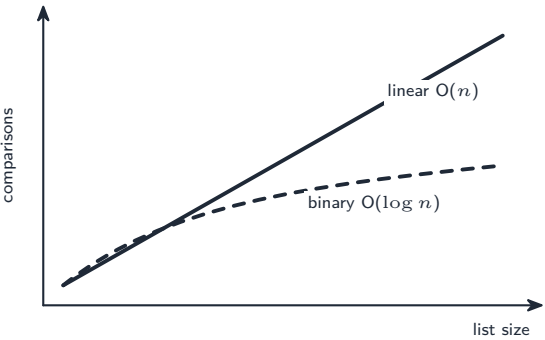


found

A **binary search** 二分查找 needs the data **sorted**. It looks at the middle; if that is not the target, it throws away the half that cannot contain it — halving the range each step.

*Worked example.* To find 7 in the sorted list [1, 3, 5, 7, 9]: the middle is 5; since  $7 > 5$ , discard the left half and search [7, 9]; the middle there is 7 — found in just two steps.

### ■ 2 Why it is faster



For a million items, linear search may need a million comparisons; binary search needs only about 20. The cost is that you must sort first.

*Worked example.* Each step halves the range, and  $2^{20} \approx$  a million, so a million sorted items take only about 20 steps — against up to a million for linear search.

**Watch out:** binary search only works on *sorted* data. On an unsorted list it can discard the half that actually holds the target, giving a wrong answer — so you must sort first, which itself takes time.

## Practice

Try these in order.

19.1 What must be true of the list before a *binary search*? [1]

19.2 Which element does binary search look at first? [1]

19.3 What does it do to the range each step? [1]

19.4 Roughly how many comparisons to search a million sorted items? [1]

**19.5** What is the cost of being able to use binary search? [1]

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**19.6** Explain why a binary search can give a wrong result on an *unsorted* list. [2]

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**19.7 Challenge.** A list grows from 1000 to 2000 items. Explain why binary search needs only about one extra comparison, while linear search needs about twice as many. [2]

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