

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

2	4	5	7	9	11	14	18
---	---	---	---	---	----	----	----

look at middle

2	4	5	7	9	11	14	18
---	---	---	---	---	----	----	----

keep half

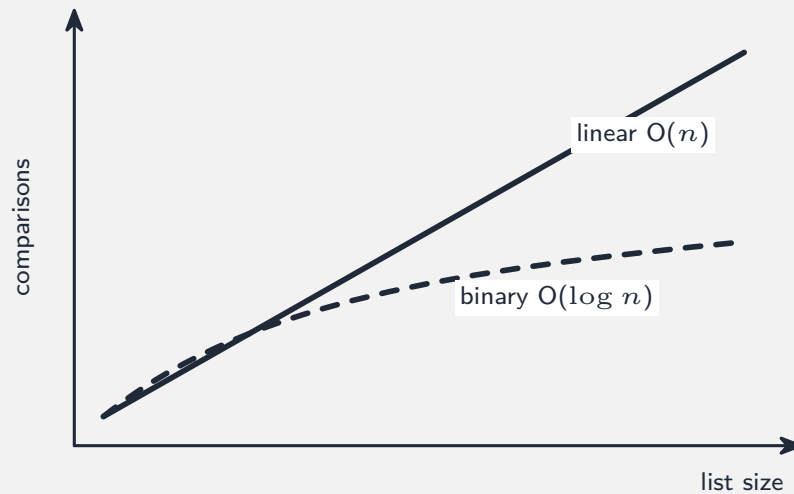
2	4	5	7	9	11	14	18
---	---	---	---	---	----	----	----

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]

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

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]
