

Searching for Data



Binary Search



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by Christine Alvarado, Mia Minnes, and Leo Porter, 2015.

By the end of this video you will be able to...

- Explain the binary search algorithm
- Write code to perform binary search
- Describe the conditions necessary for binary search
- Explain why binary search is better than linear search

Linear Search:

search through each position in the array, in order

Montreal Canada YMX	Lagos Nigeria LOS	Essen Germany ESS	Chicago USA ORD	Beijing China PEK	Sydney Australia SYD	Quito Ecuador UIO	Agra India AGR
0	1	2	3	4	5	6	7

Thought questions

- If we're very unlucky, how many elements will our search have to look through? i.e. How many times does the loop run?
- Can we do better?

Binary Search:

Cut the list in half, only search half the list

Montreal Canada YMX	Lagos Nigeria LOS	Essen Germany ESS	Chicago USA ORD	Beijing China PEK	Sydney Australia SYD	Quito Ecuador UIO	Agra India AGR
0	1	2	3	4	5	6	7

Binary Search:

Cut the list in half, only search half the list

Agra India AGR	Beijing China PEK	Chicago USA ORD	Essen Germany ESS	Lagos Nigeria LOS	Montreal Canada YMX	Quito Ecuador UIO	Sydney Australia SYD
0	1	2	3	4	5	6	7

List must be sorted on what you are searching (city)

Binary Search:

Cut the list in half, only search half the list

Agra India AGR	Beijing China PEK	Chicago USA ORD	Essen Germany ESS	Lagos Nigeria LOS	Montreal Canada YMX	Quito Ecuador UIO	Sydney Australia SYD
0	1	2	3	4	5	6	7

toFind

Beijing

low

0

high

7

Binary Search:

Find the middle element

Agra India AGR	Beijing China PEK	Chicago USA ORD	Essen Germany ESS	Lagos Nigeria LOS	Montreal Canada YMX	Quito Ecuador UIO	Sydney Australia SYD
0	1	2	3	4	5	6	7

toFind

Beijing

low

0

high

7

mid

Binary Search:

Compare to the middle element

Agra India AGR	Beijing China PEK	Chicago USA ORD	Essen Germany ESS	Lagos Nigeria LOS	Montreal Canada YMX	Quito Ecuador UIO	Sydney Australia SYD
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0

1

match?

3

4

5

6

7

toFind

Beijing

low

0

high

7

mid

3

Binary Search:

Compare to the middle element

Agra India AGR	Beijing China PEK	Chicago USA ORD	Essen Germany ESS	Lagos Nigeria LOS	Montreal Canada YMX	Quito Ecuador UIO	Sydney Australia SYD
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0

1

higher or lower?

4

5

6

7

toFind

Beijing

low

0

high

7

mid

3

Binary Search:

Cut the list in half. Only look in lower half

Agra India AGR	Beijing China PEK	Chicago USA ORD	Essen Germany ESS	Lagos Nigeria LOS	Montreal Canada YMX	Quito Ecuador UIO	Sydney Australia SYD
0	1	lower!		4	5	6	7

toFind

Beijing

low

0

high

2

mid

3

Binary Search:

Repeat for new range

Agra India AGR	Beijing China PEK	Chicago USA ORD	Essen Germany ESS	Lagos Nigeria LOS	Montreal Canada YMX	Quito Ecuador UIO	Sydney Australia SYD
0	1	2	3	4	5	6	7

toFind **Beijing**

low **0**

high **2**

mid **1**

Binary Search:

Repeat for new range

Agra India AGR	Beijing China PEK	Chicago USA ORD	Essen Germany ESS	Lagos Nigeria LOS	Montreal Canada YMX	Quito Ecuador UIO	Sydney Australia SYD
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0

1

match?

3

4

5

6

7

toFind

Beijing

low

0

high

2

mid

1

Binary Search:

Repeat for new range

Agra India AGR	Beijing China PEK	Chicago USA ORD	Essen Germany ESS	Lagos Nigeria LOS	Montreal Canada YMX	Quito Ecuador UIO	Sydney Australia SYD
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0

1

match!

3

4

5

6

7

toFind

Beijing

low

0

high

2

mid

1

Binary Search: Basic Algorithm

Initialize low = 0, high = size of list-1

while ???:

 mid = (high+low)/2

 if the city to find equals the city at mid,

 return the airport code

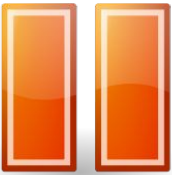
 if the city is alphabetically less than the city at mid

 high = mid-1

 else low = mid+1

return a value to indicate not found

What while-loop condition will stop the loop when the city is not found?



Agra India AGR	Beijing China PEK	Chicago USA ORD	Essen Germany ESS	Lagos Nigeria LOS	Montreal Canada YMX	Quito Ecuador UIO	Sydney Australia SYD
0	1	2	3	4	5	6	7

toFind low high mid