

Introduction to Hash Tables



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

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

- Describe why hash tables are valuable
- Understand the role of a hash function

Thought Experiment

You have to keep track of integers which are part of a set. You know the possible integers will always be between 0 and 999,999. If you store this as an array of 1,000,000 booleans, how long does it take to add an integer to your set?

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B. $O(\log N)$

C. $O(1)$

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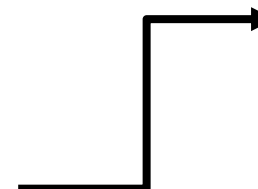
C. $O(1)$

[illegible]

Arrays are fast!

If you know where in memory the array starts, you can easily determine the address of any element using the index.

index	data

A diagram showing an array structure. It consists of a vertical column of 10 blue squares, each representing an index. To the right of these squares is a column of 10 white rectangles, each representing a data element. An arrow points from the left to the fourth blue square from the top, indicating the index of a specific element.

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Accessing an address is an $O(1)$ operation

[illegible]

If I want to add something into an array, could I find a way to translate it into an index?

[illegible]

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Your array has 5 elements. How would you "hash"?

Key	Function	Hash Code
-----	----------	-----------

3

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Key	Function	Hash Code
3	=	3


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Key	Function	Hash Code
3	=	3
11		

Your array has 5 elements. How would you "hash"?

Key	Function	Hash Code
3	=	3
11	$11 \bmod 5$	1

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$K \bmod N$ is a common hash function

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'a'

Your array has 5 elements. How would you "hash"?

Key	Function	Hash Code
'a'	$97 \bmod 5$	2

Your array has 5 elements. How would you "hash"?

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-----	----------	-----------

"Hi"

Your array has 5 elements. How would you "hash"?

Key	Function	Hash Code
"Hi"	$(72+105) \bmod 5$	2

Which of these statements is true about a hash function?

- A. If two elements are considered equal, then their hash values should also be the same
- B. If two elements have the same hash value, then they should also be considered equal
- C. Both A and B
- D. Neither A nor B

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- B is false because of "collisions"**

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13	$13 \bmod 5$	3

So a key part of creating hash functions is trying to minimize collisions

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We'll address how to handle collisions next...