Data Structures & Algorithms

Week 3 - Hashing (HashTables, HashMaps, Dictionaries)

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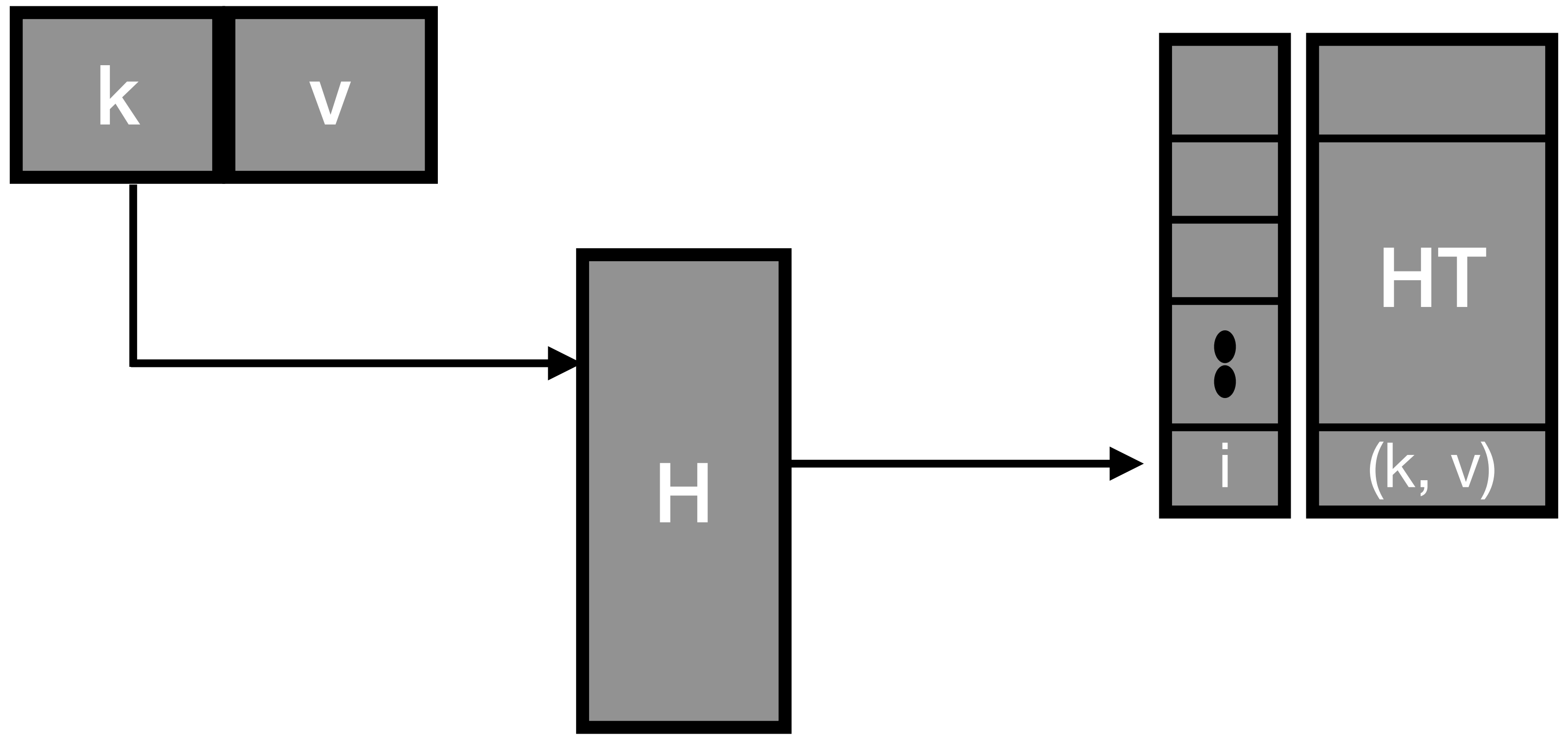

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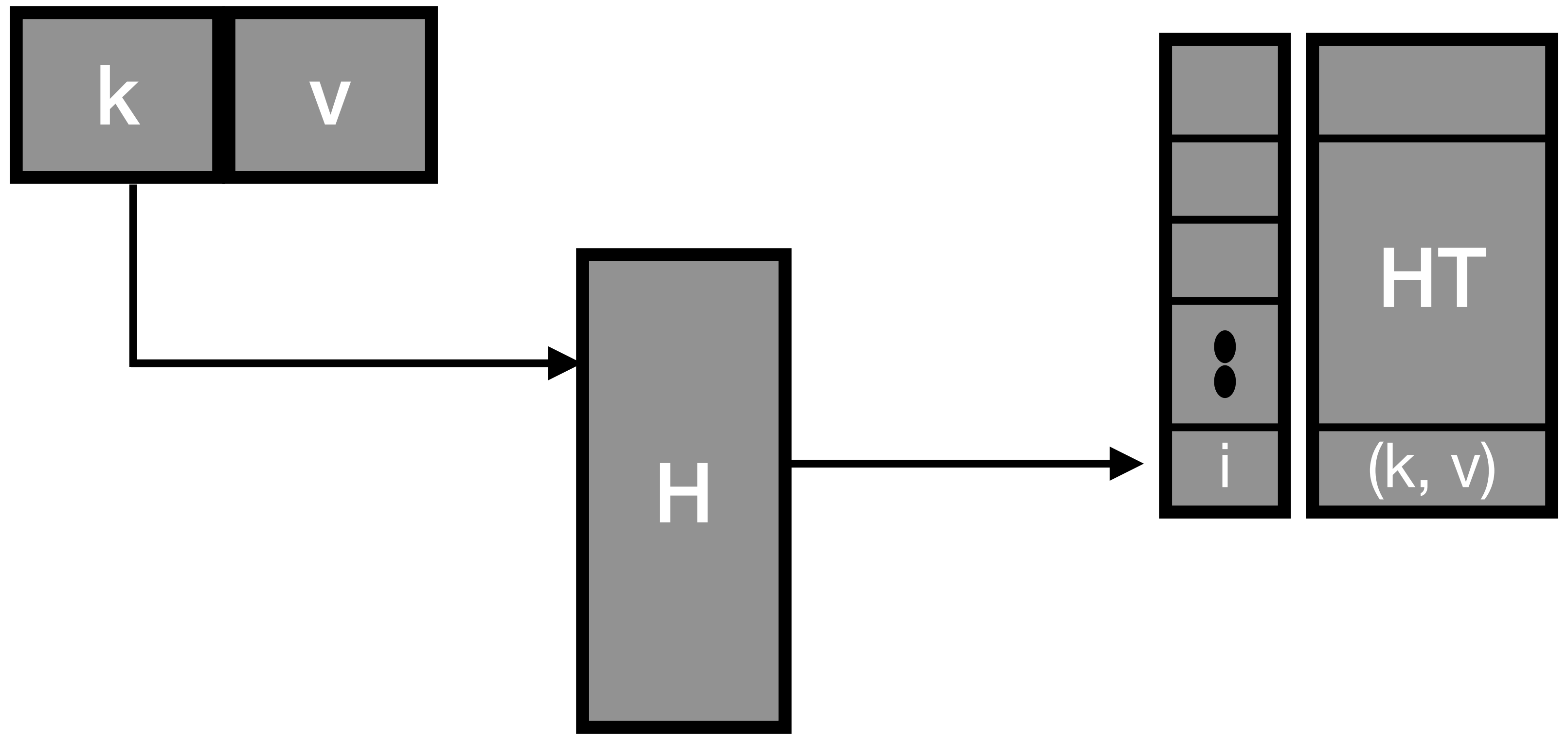

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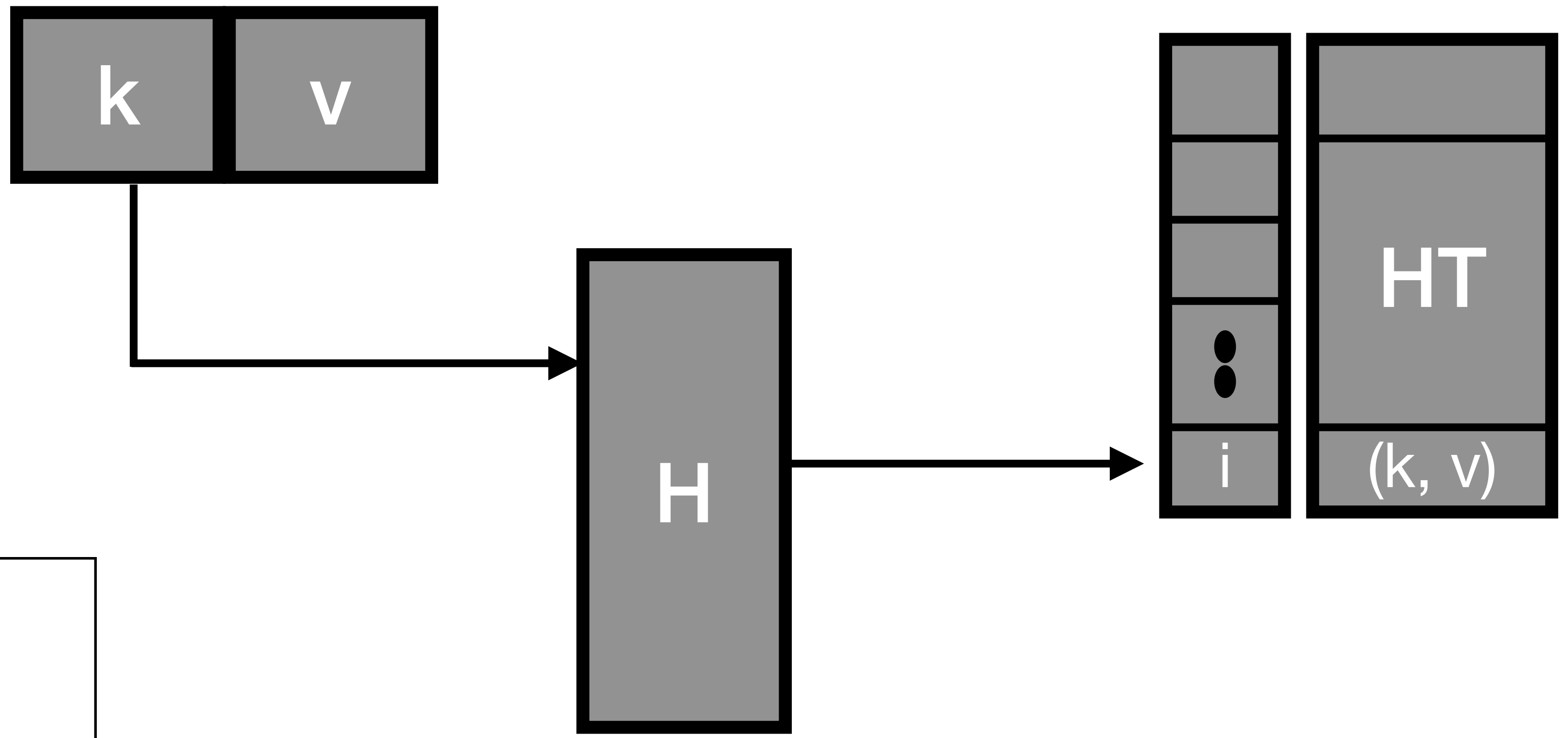

	LL, no dup	**Sorted Array wit h Binary Search**	**Hash Table**
Insert	O(n)	O(log n)	O(1)
Delete	O(n)	O(log n)	O(1)
Contains	O(n)	O(log n)	O(1)

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  - **Open Hashing**: Chaining
  - **Closed Hashing:** Linear probing, Quadratic probing, Double Hashing

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- **Dynamic:** Dynamic resizing of HT should be possibles

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    - $\forall x, y : d_H(x, y) = 1 \Rightarrow P(H(x)_j \neq H(y)_j) \geq 0.5$

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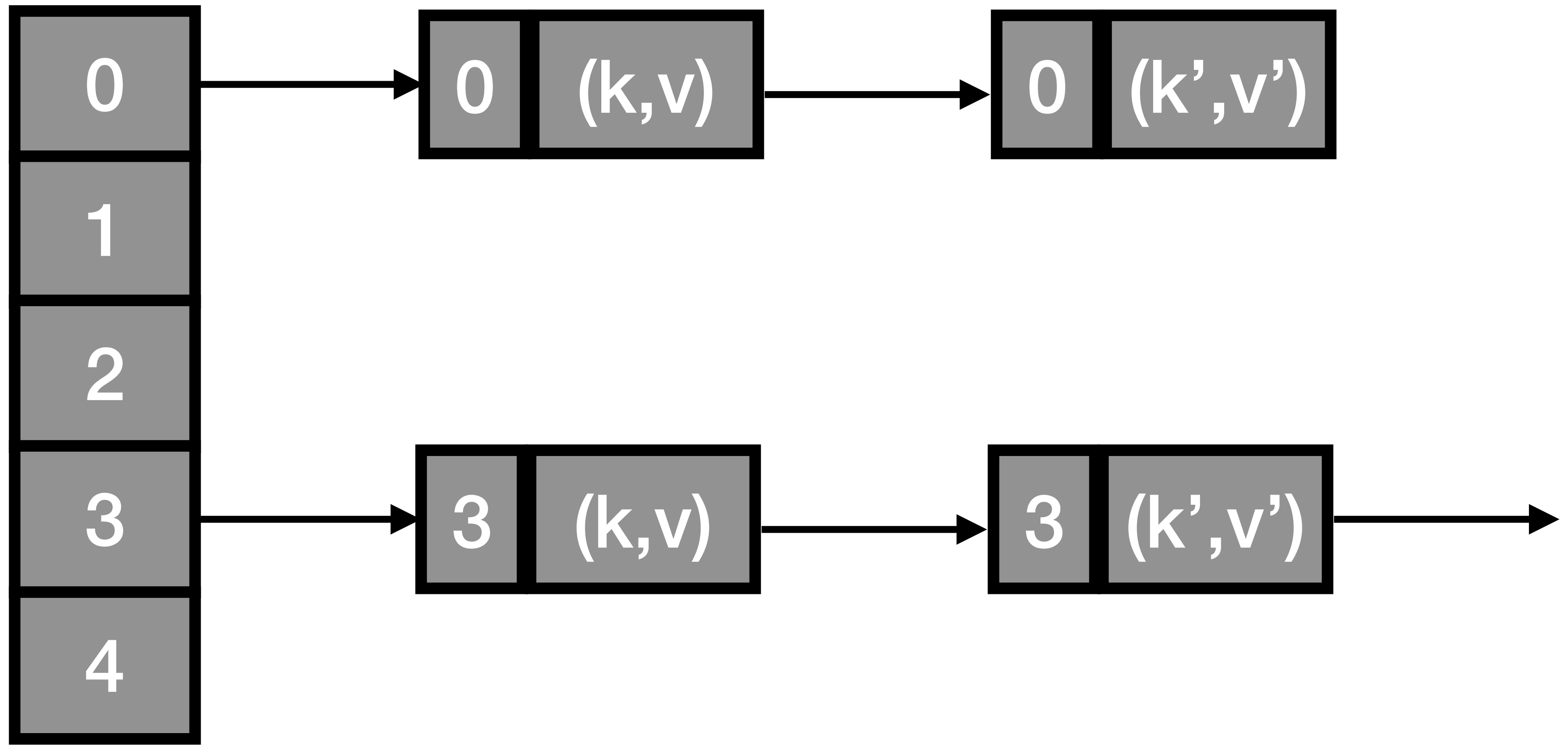

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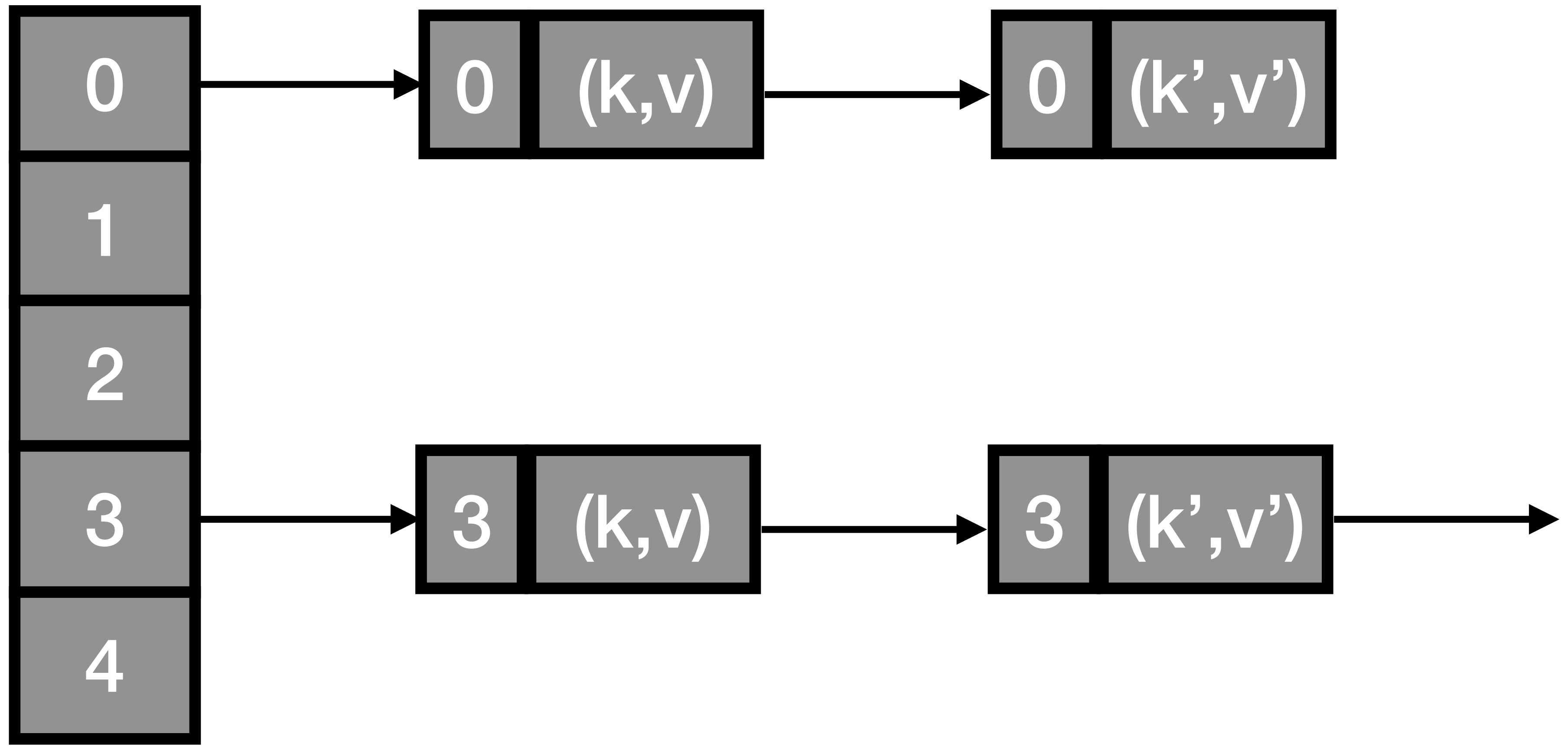

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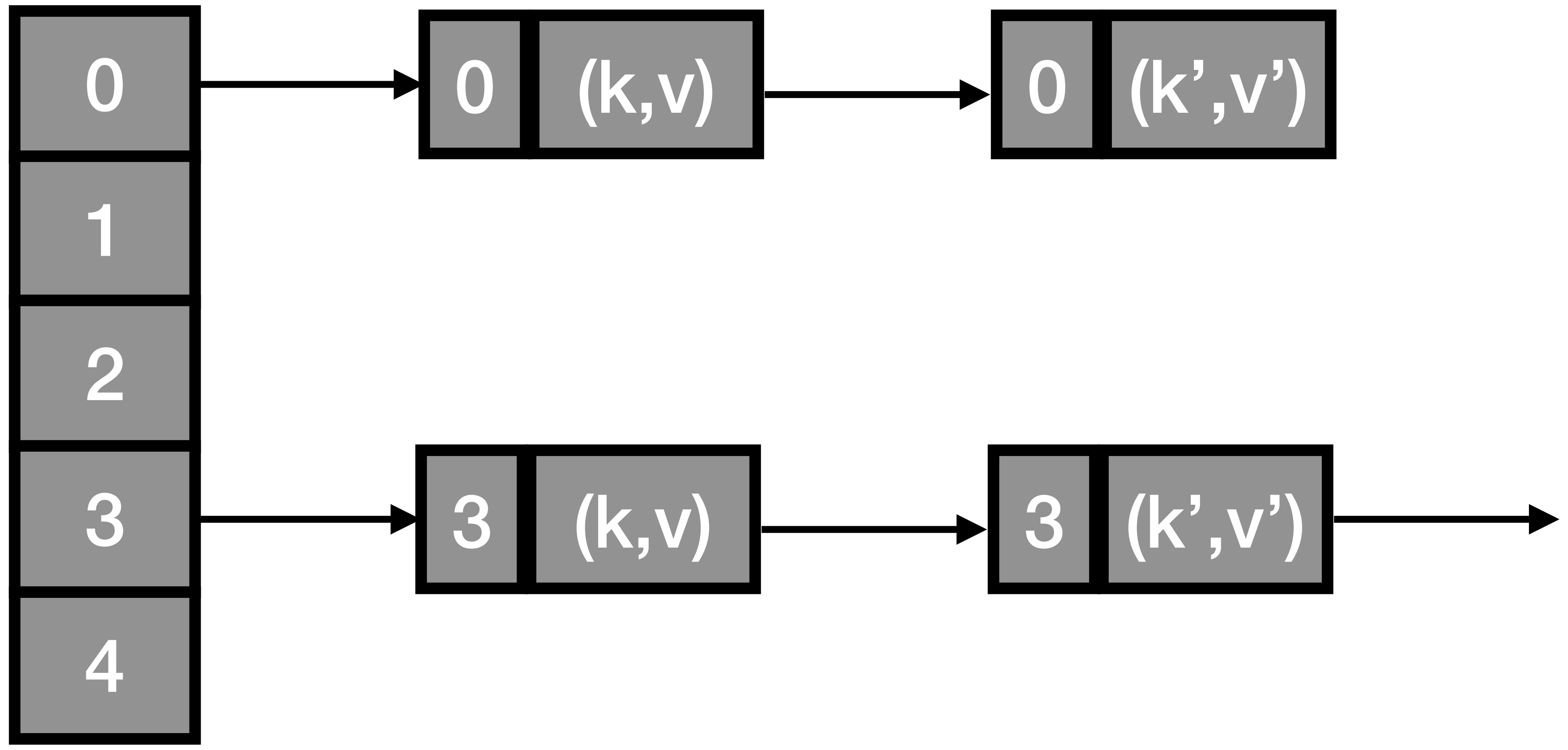

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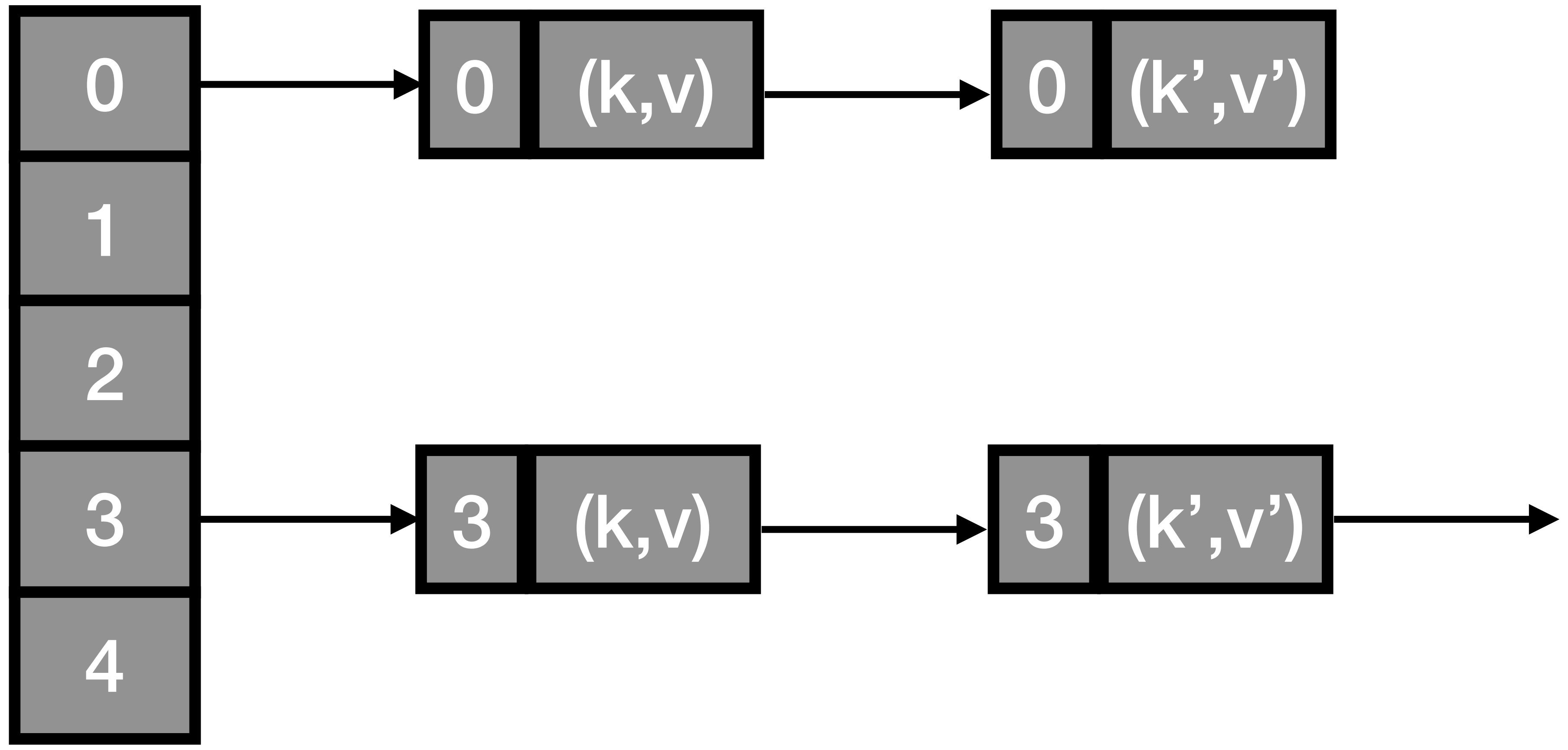

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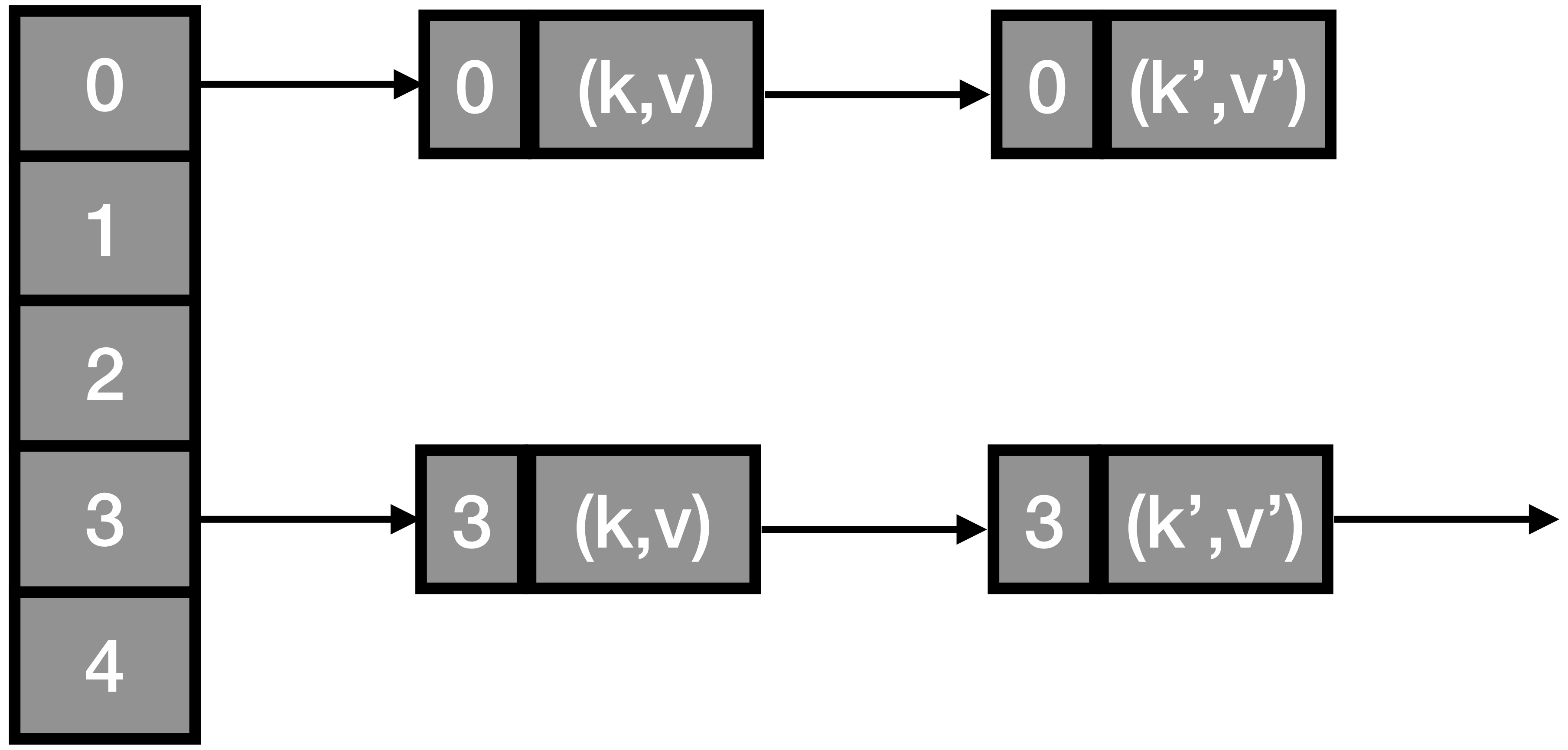

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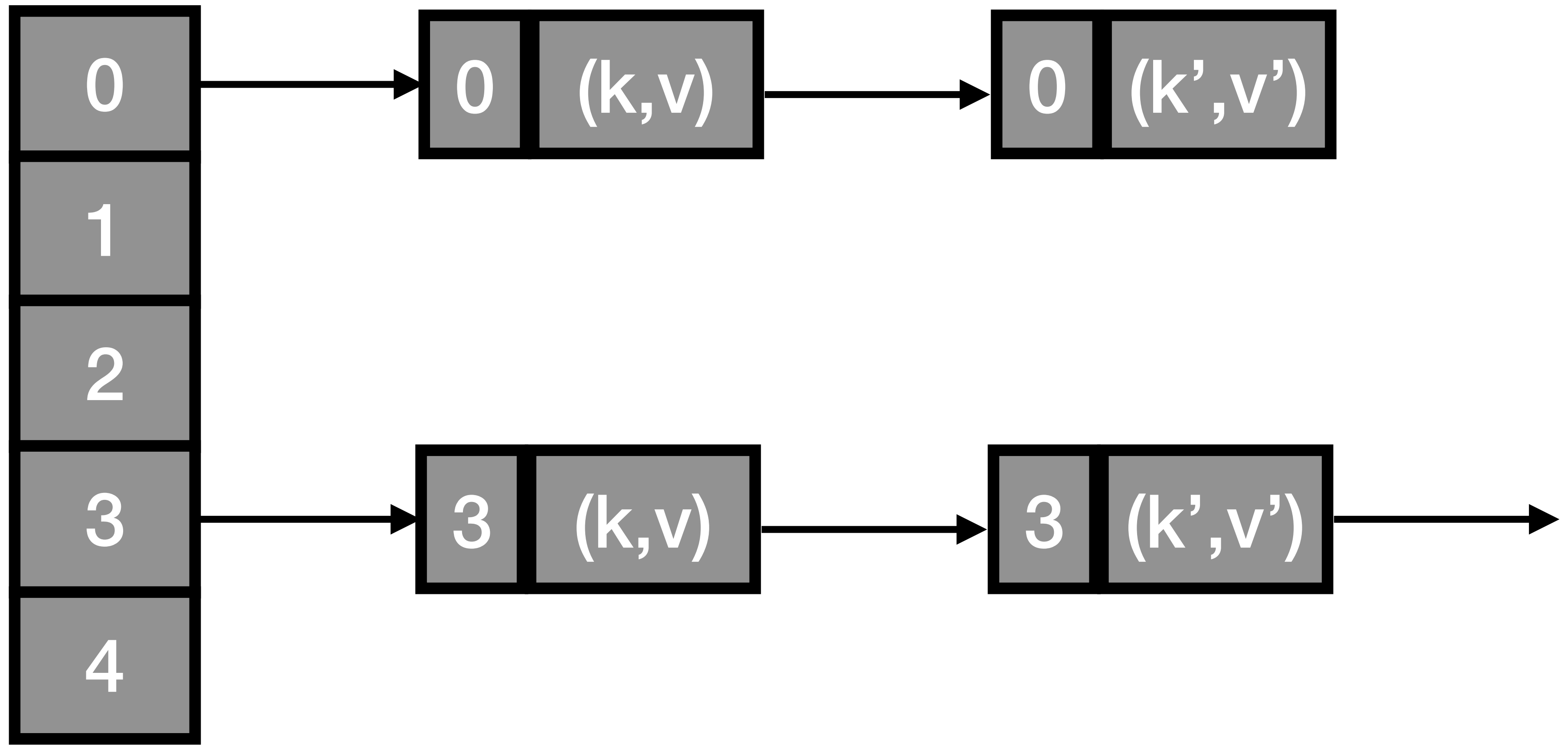

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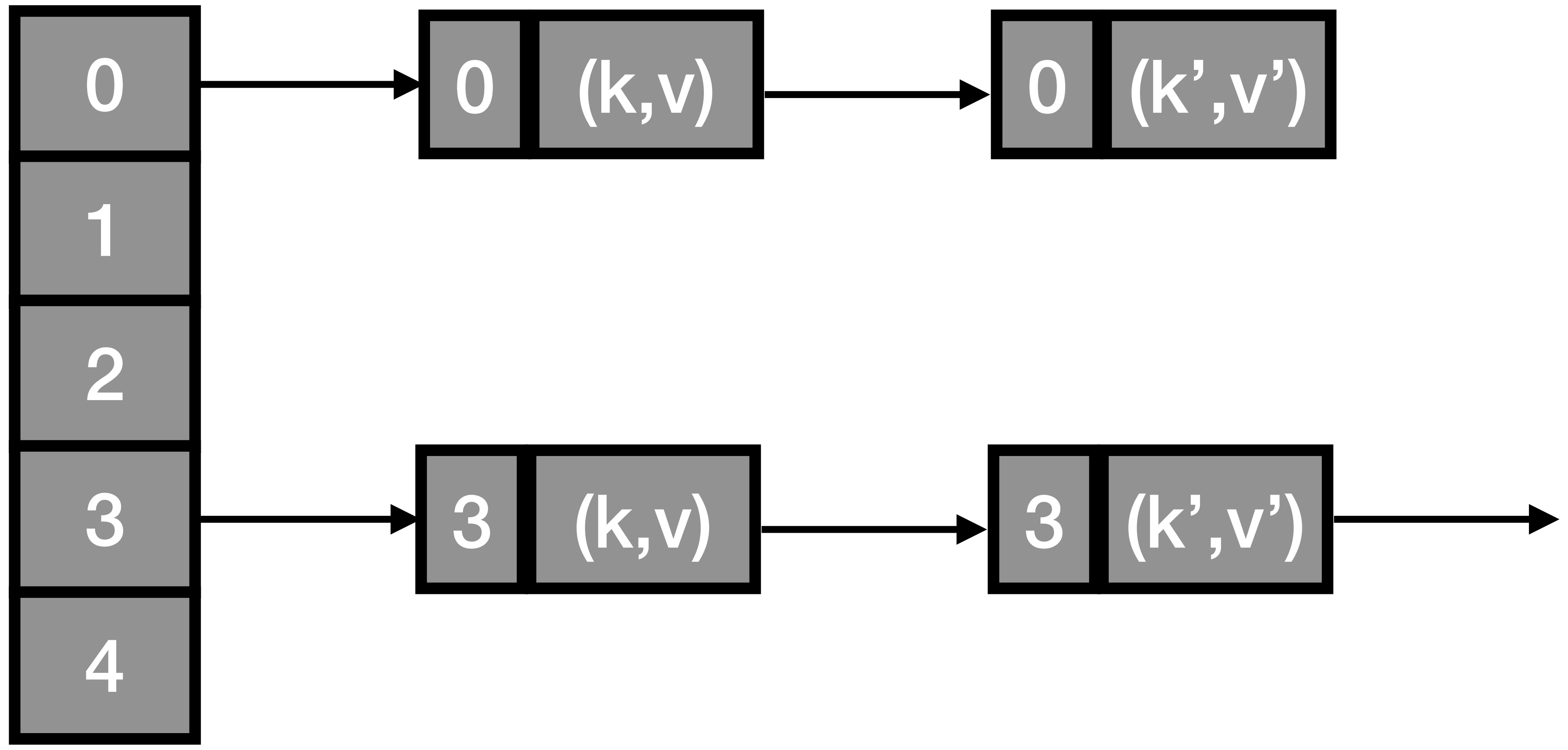

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  - Threshold for resizing: When $\alpha > 0.7$, **HT** is doubled in size

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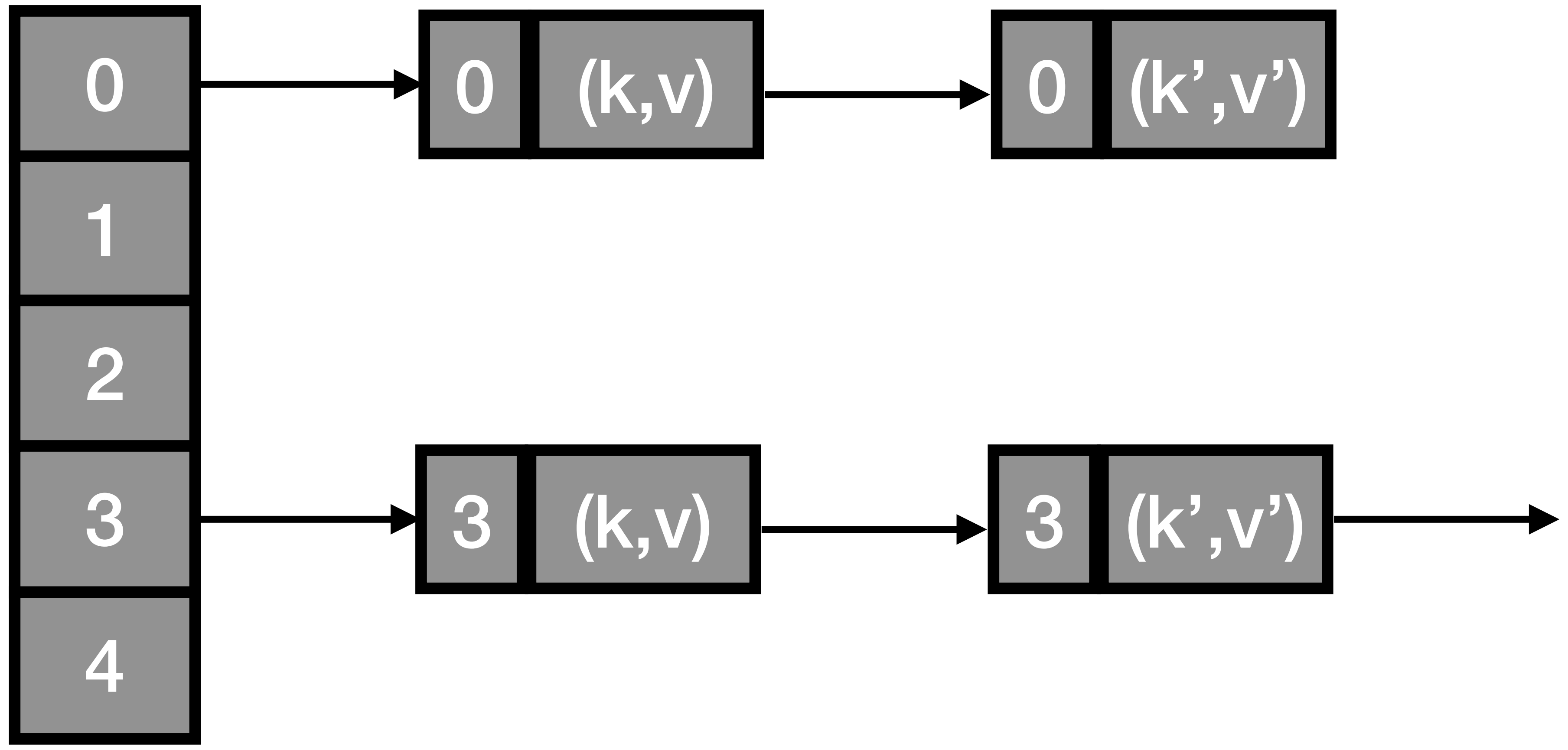

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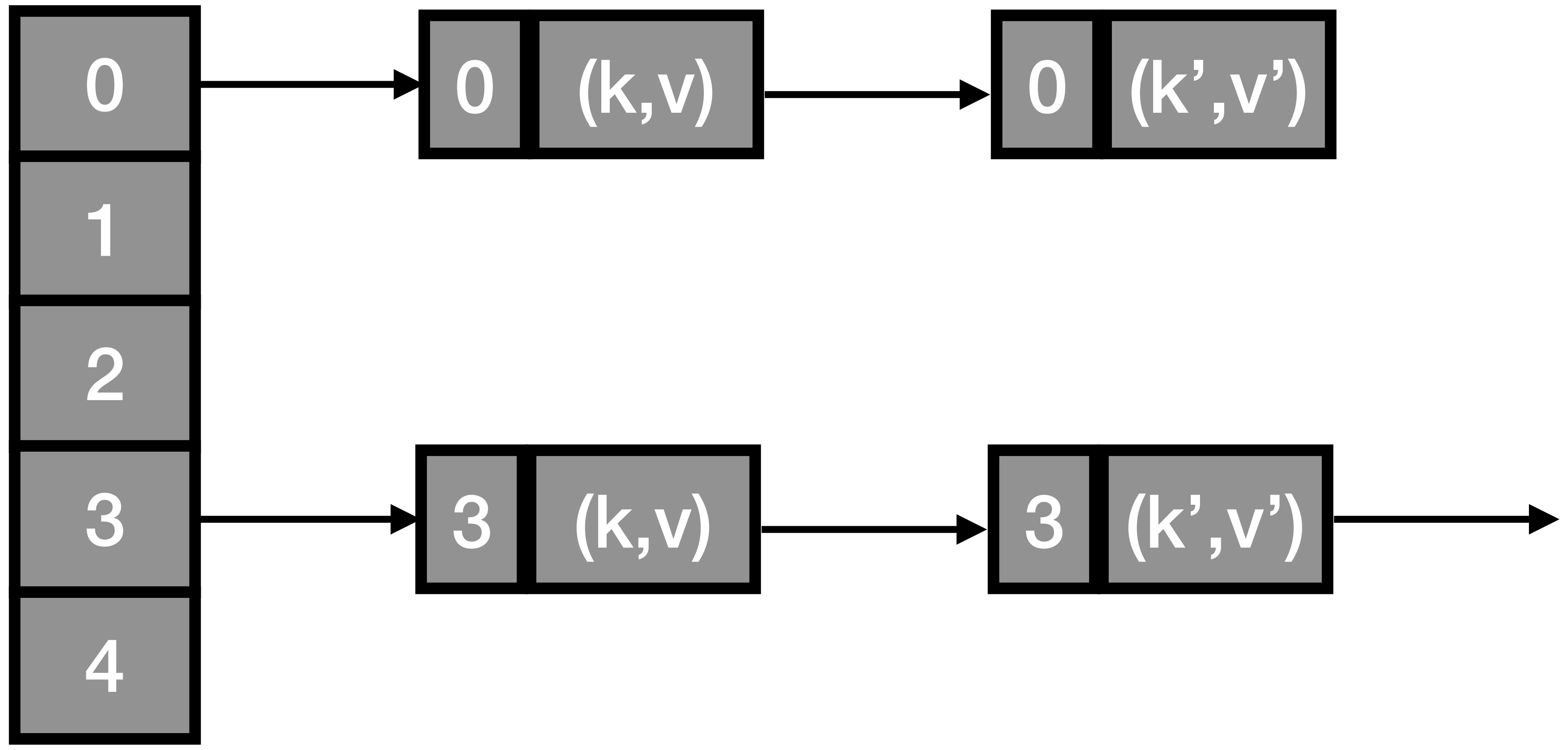

- Assumption: We use a **simple uniform** hash function

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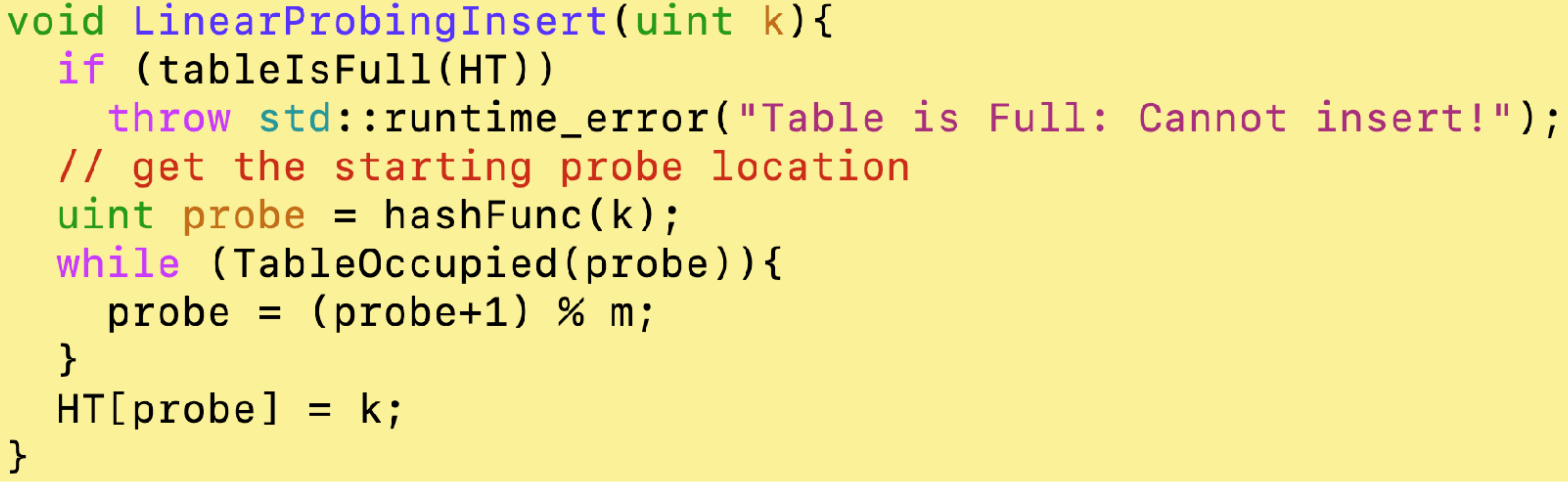

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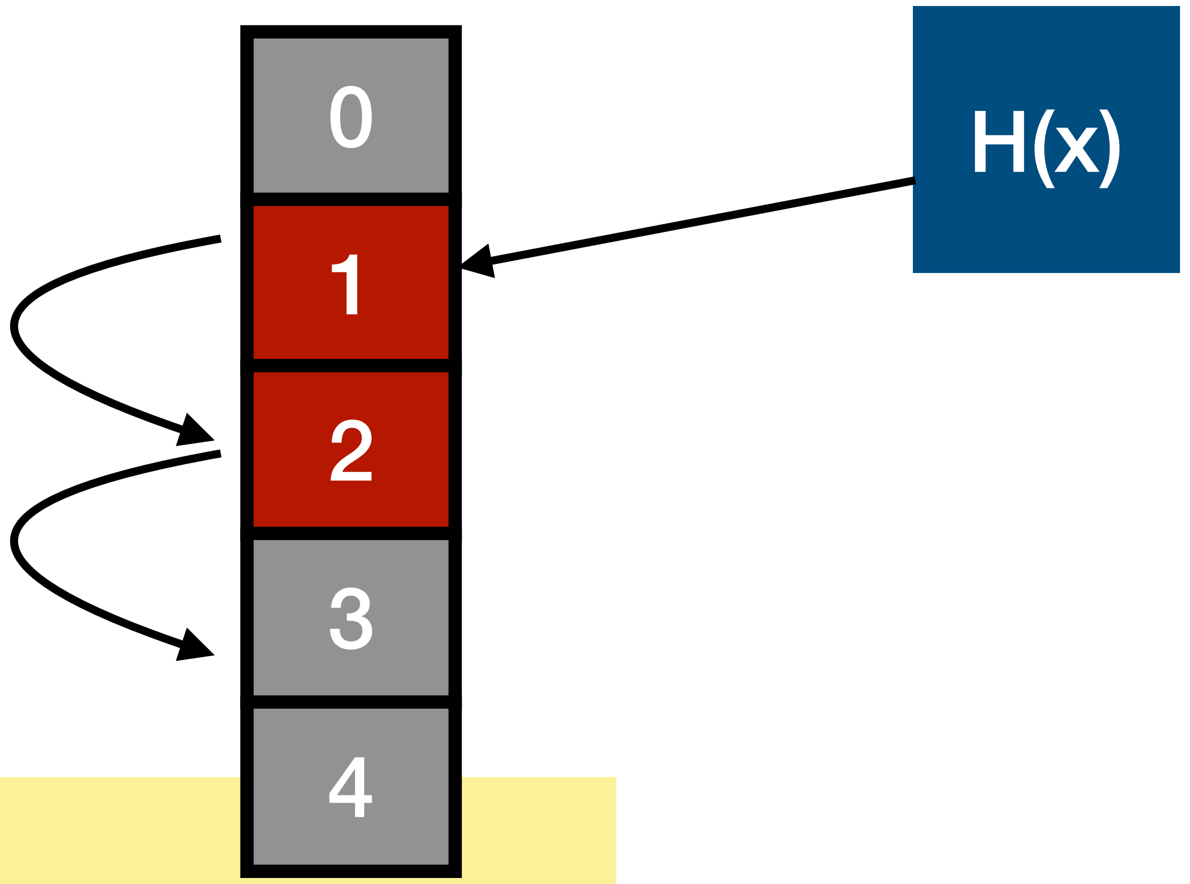

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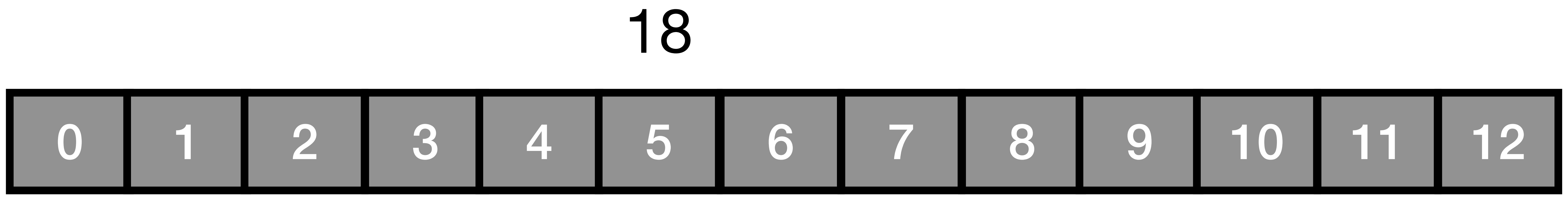

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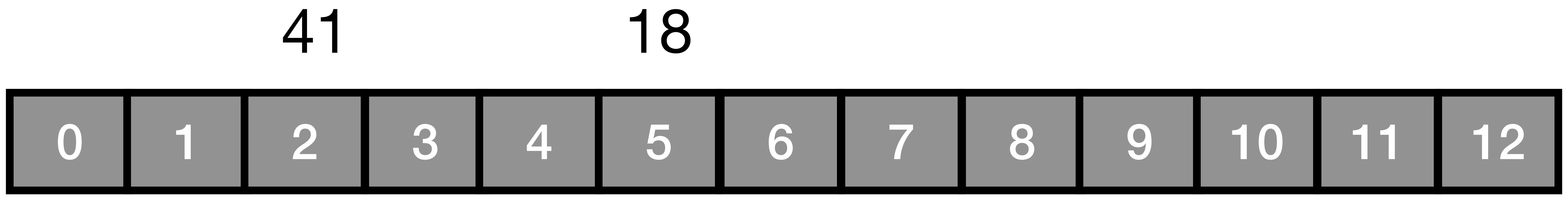

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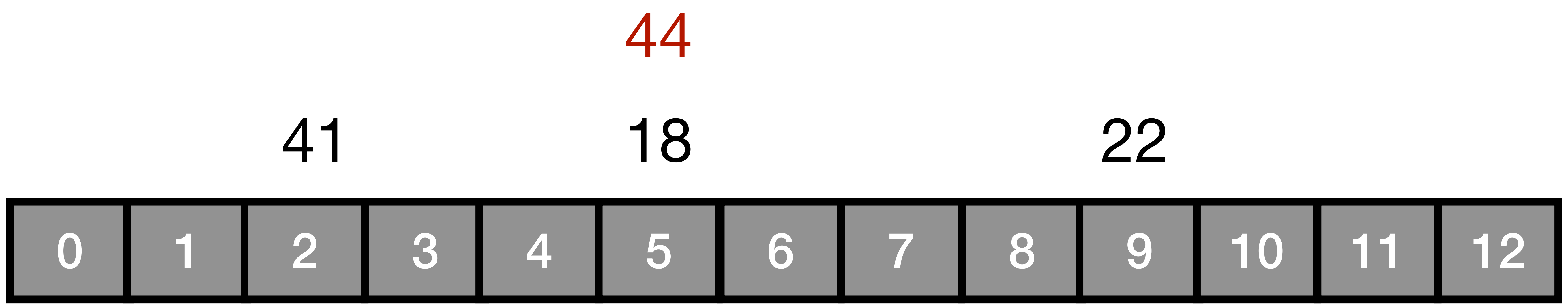

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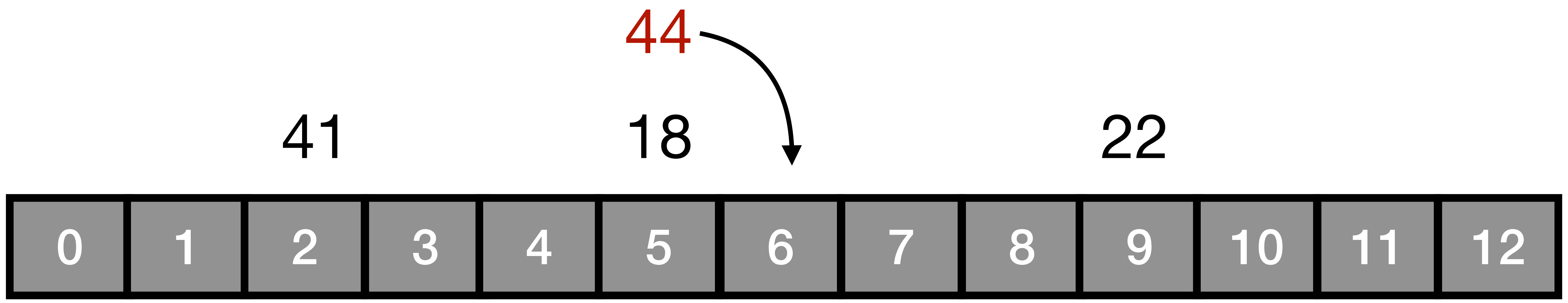

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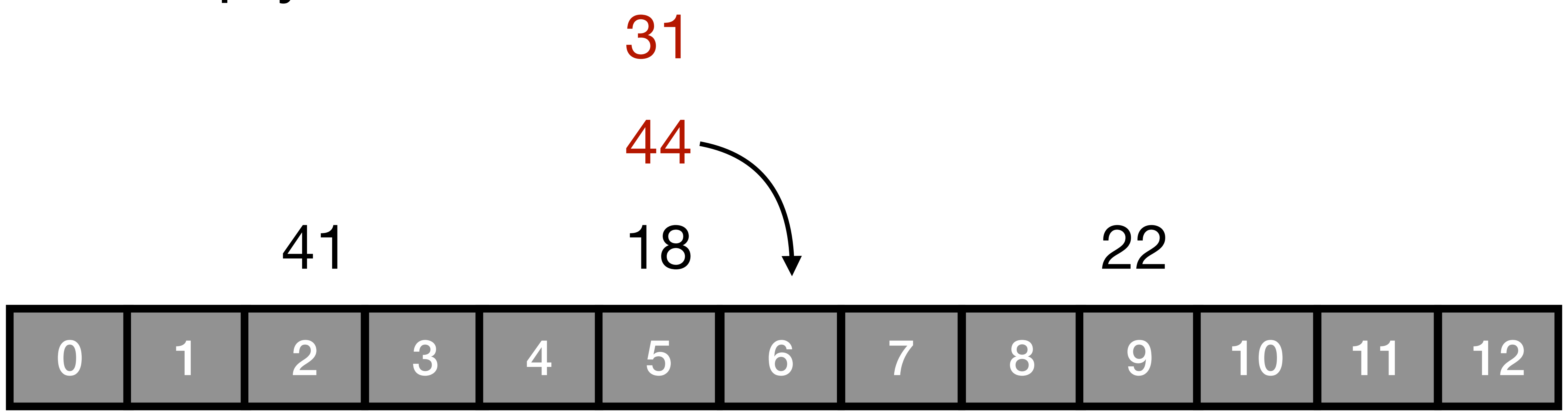

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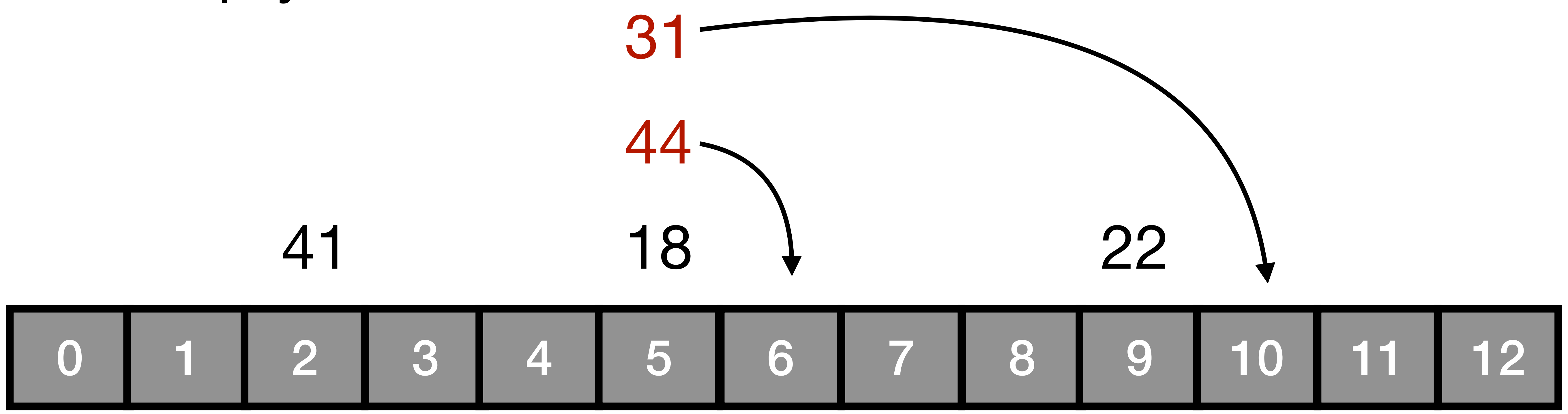

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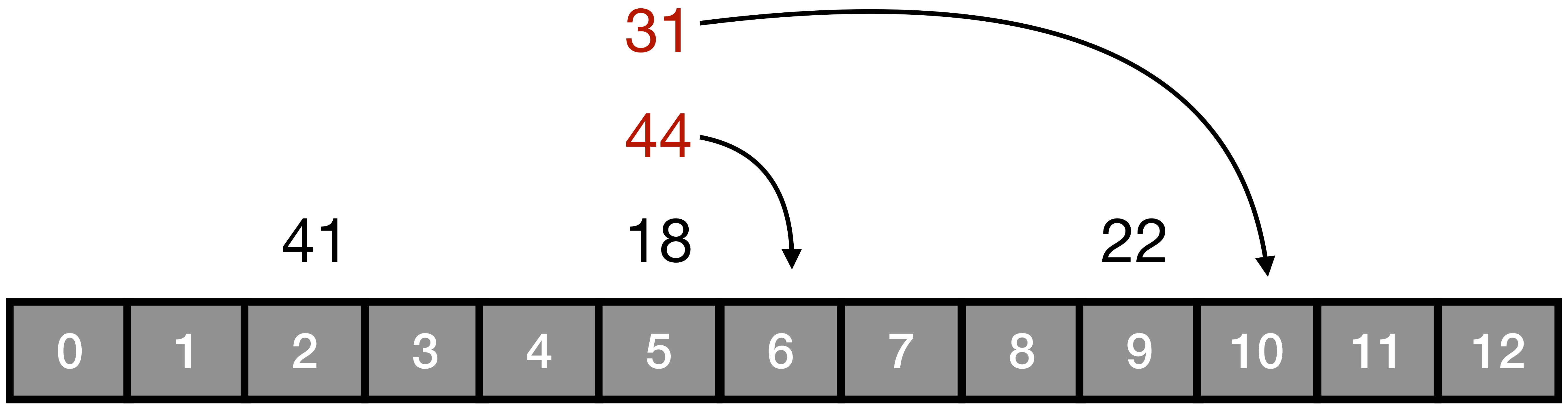

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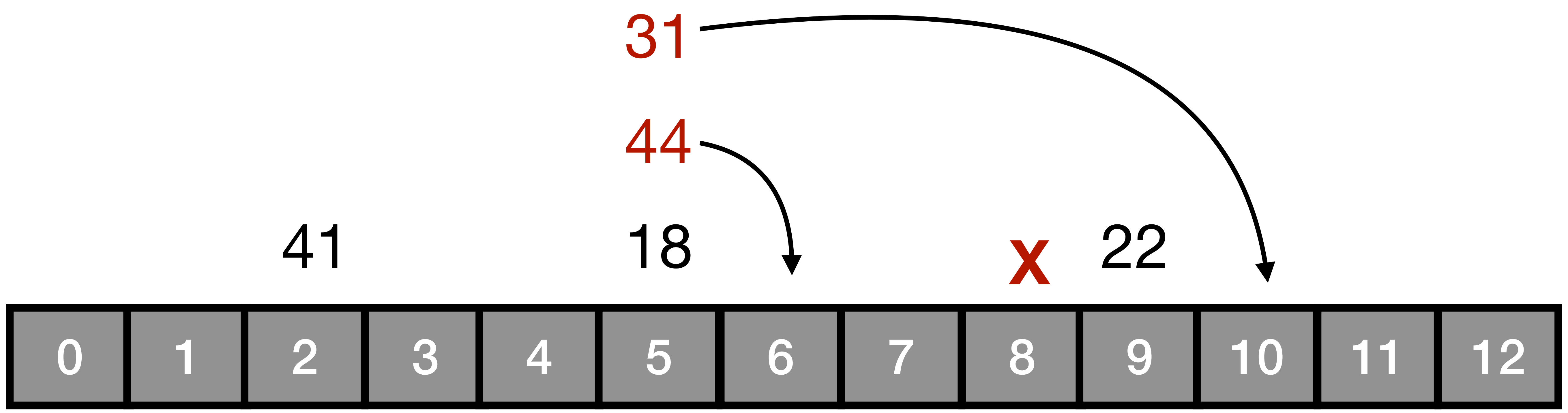

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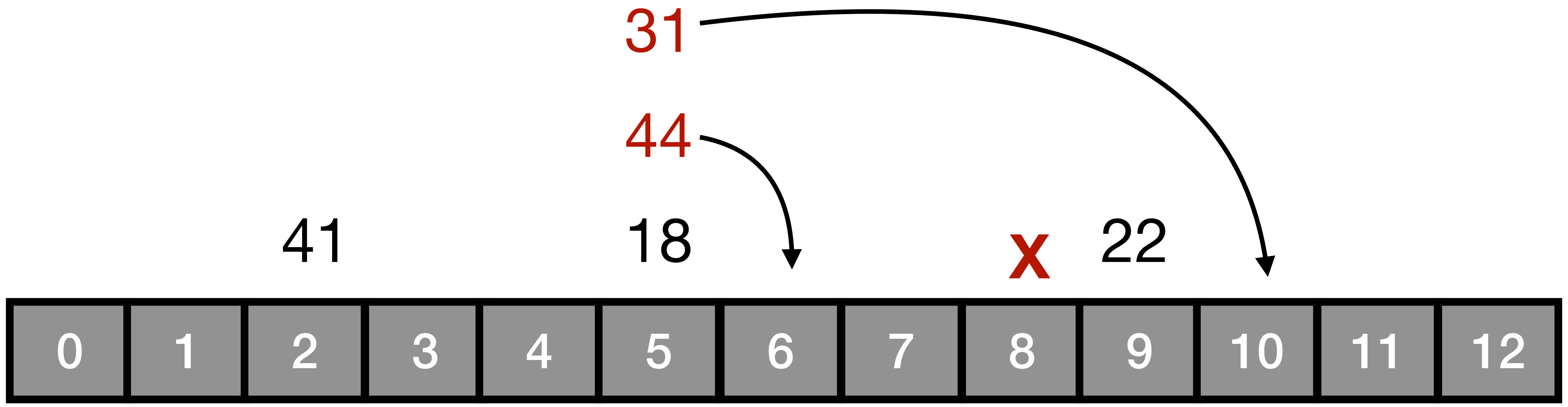

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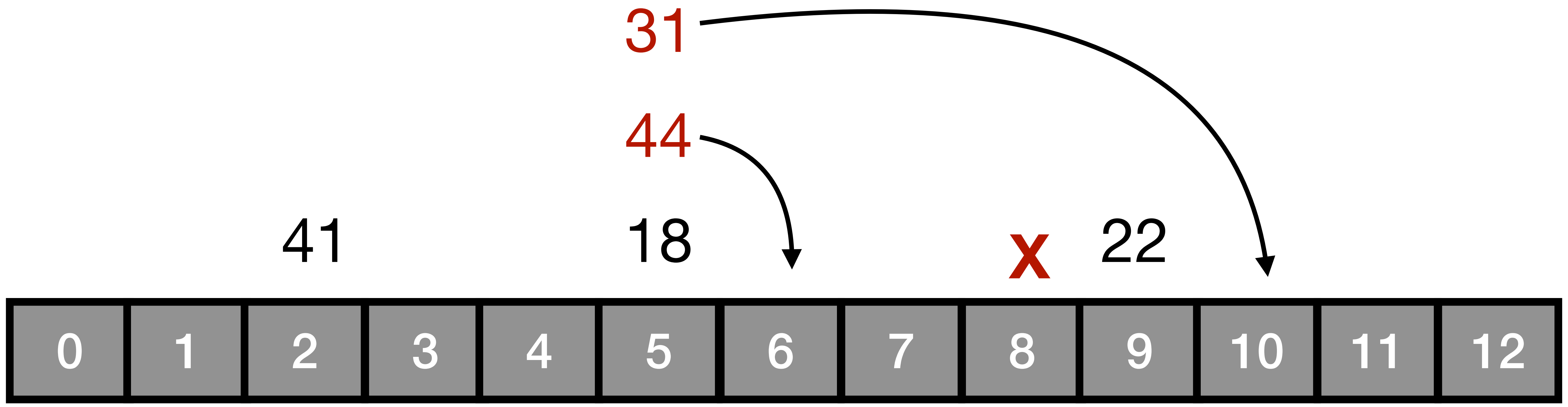
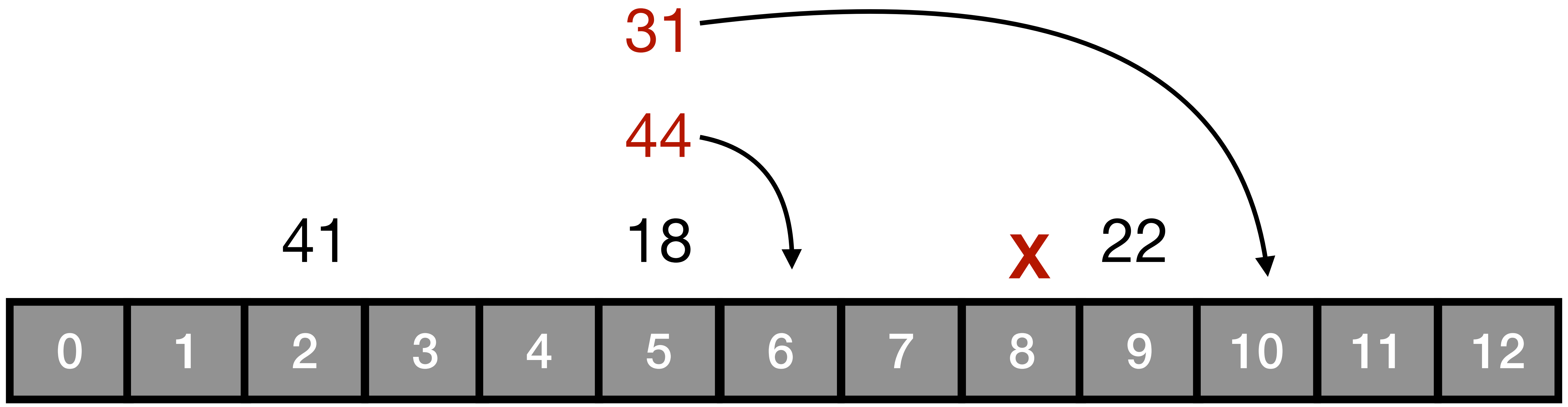


- **Q: What happens to the efficiency of lookup if there are too many marks?**

Collision Resolution (2): Linear Probing

- Example: $H(k) = k \mod 13$
- Keys: 18, 41, 22, 44, 59, 32, 31
- **Deletion Algorithm**: Go to the hash value and mark it (**X**)
- Lookup ignores the marked cells; Insert uses the marked cells to place the value



- **Q: What happens to the efficiency of lookup if there are too many marks?**
- **Q: What is the solution to the above problem?**

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- **EXERCISE: Try with different table sizes, different levels of loading (the number of keys inserted), and different input distributions.**

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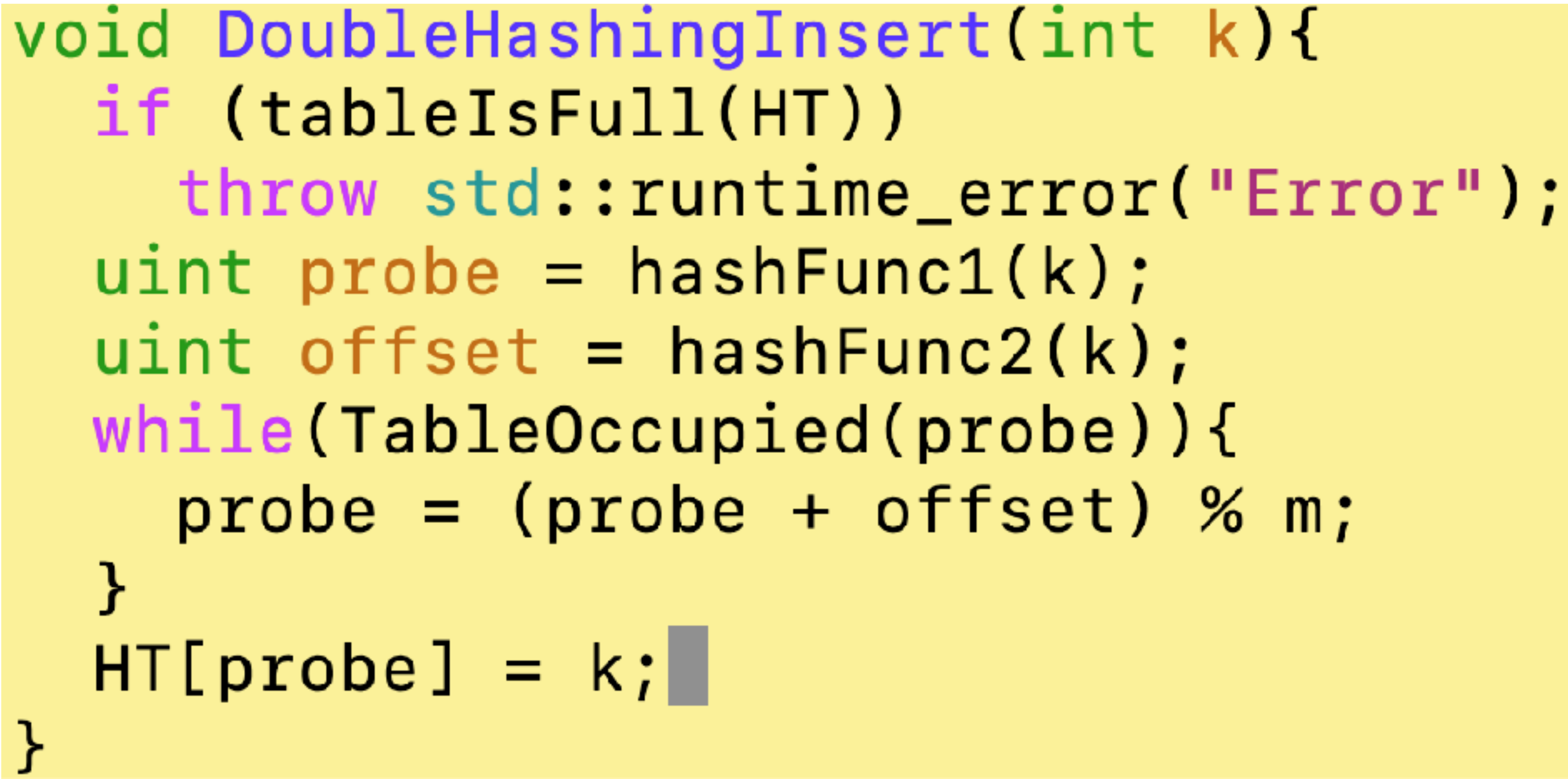

```
void DoubleHashingInsert(int k){
  if (tableIsFull(HT))
    throw std::runtime_error("Error");
  uint probe = hashFunc1(k);
  uint offset = hashFunc2(k);
  while(TableOccupied(probe)){
    probe = (probe + offset) % m;
  }
  HT[probe] = k;
}
```

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0	1	2	3	4	5	6	7	8	9	10	11	12

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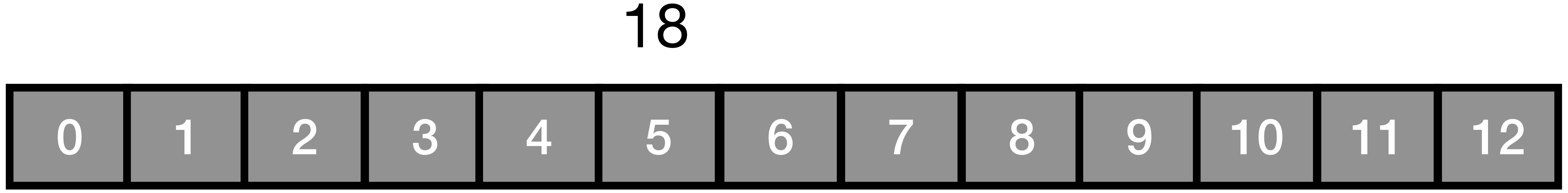

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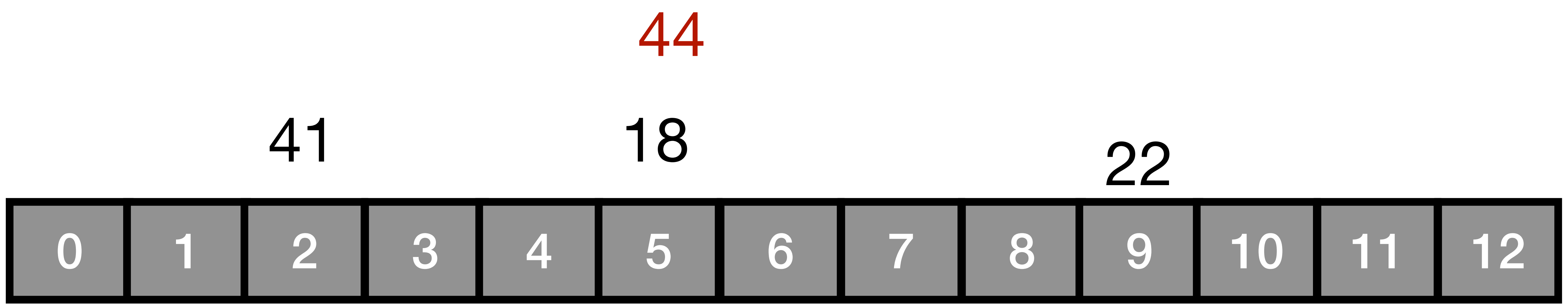

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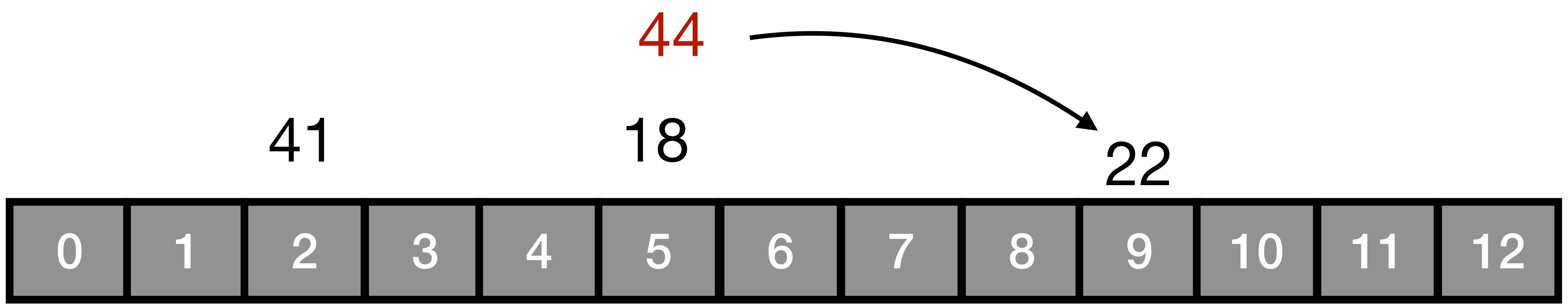

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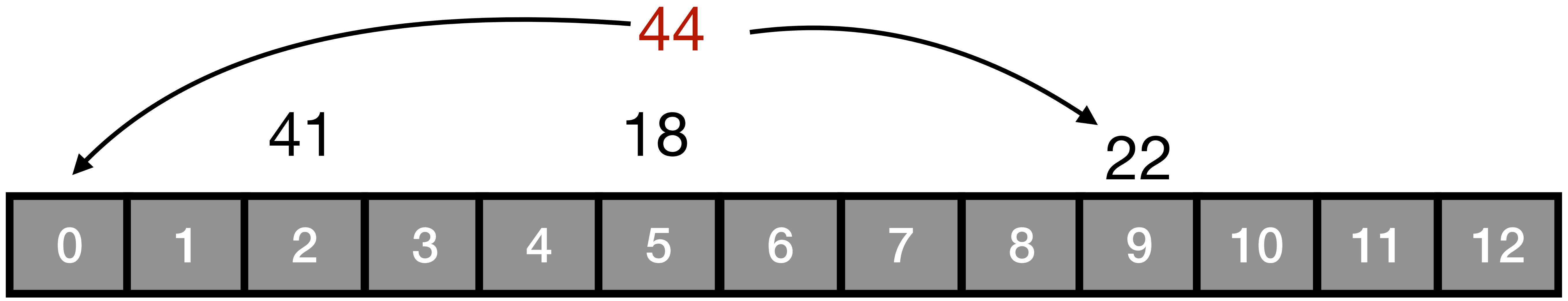

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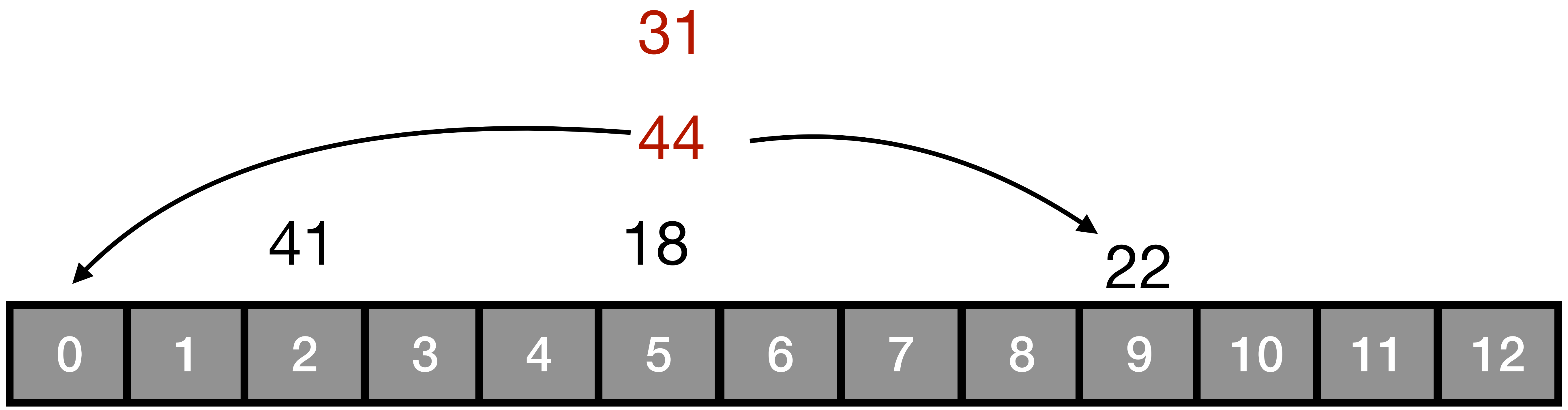
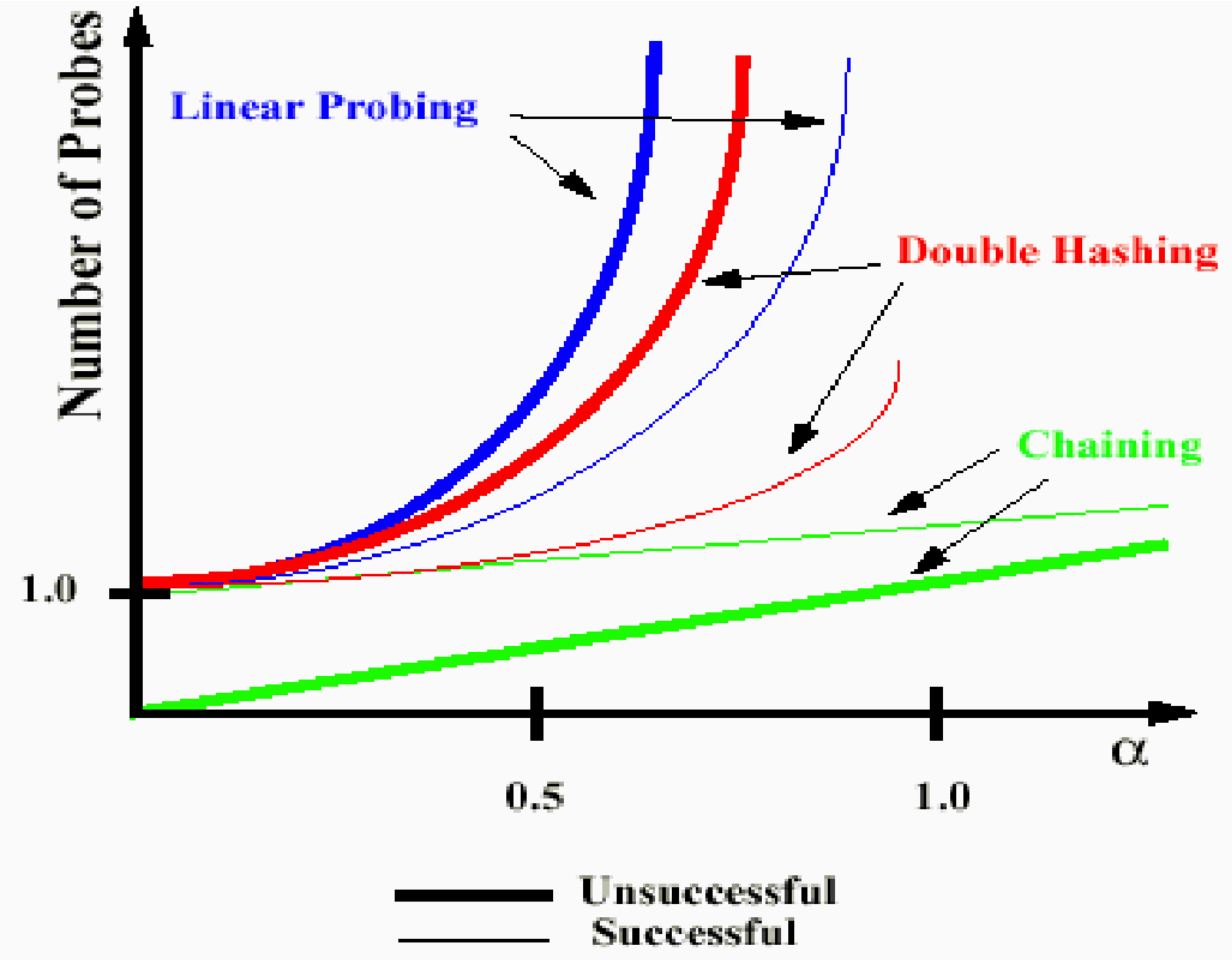
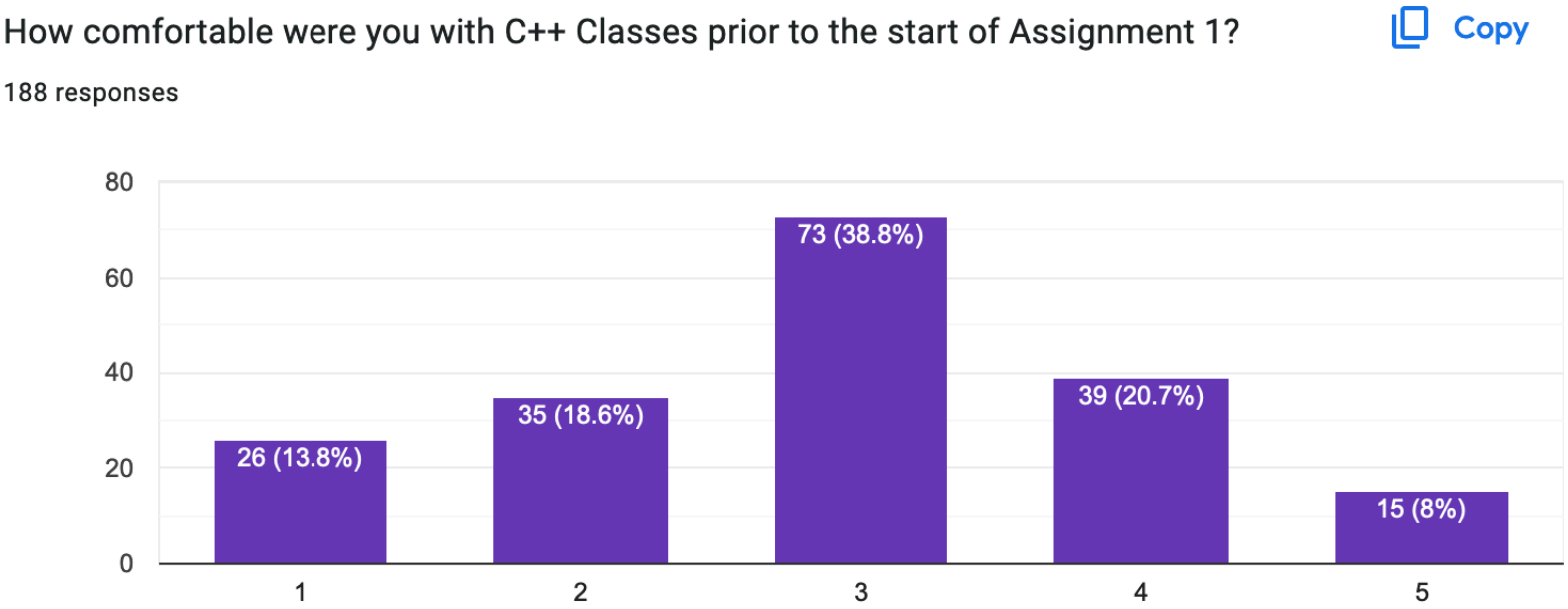


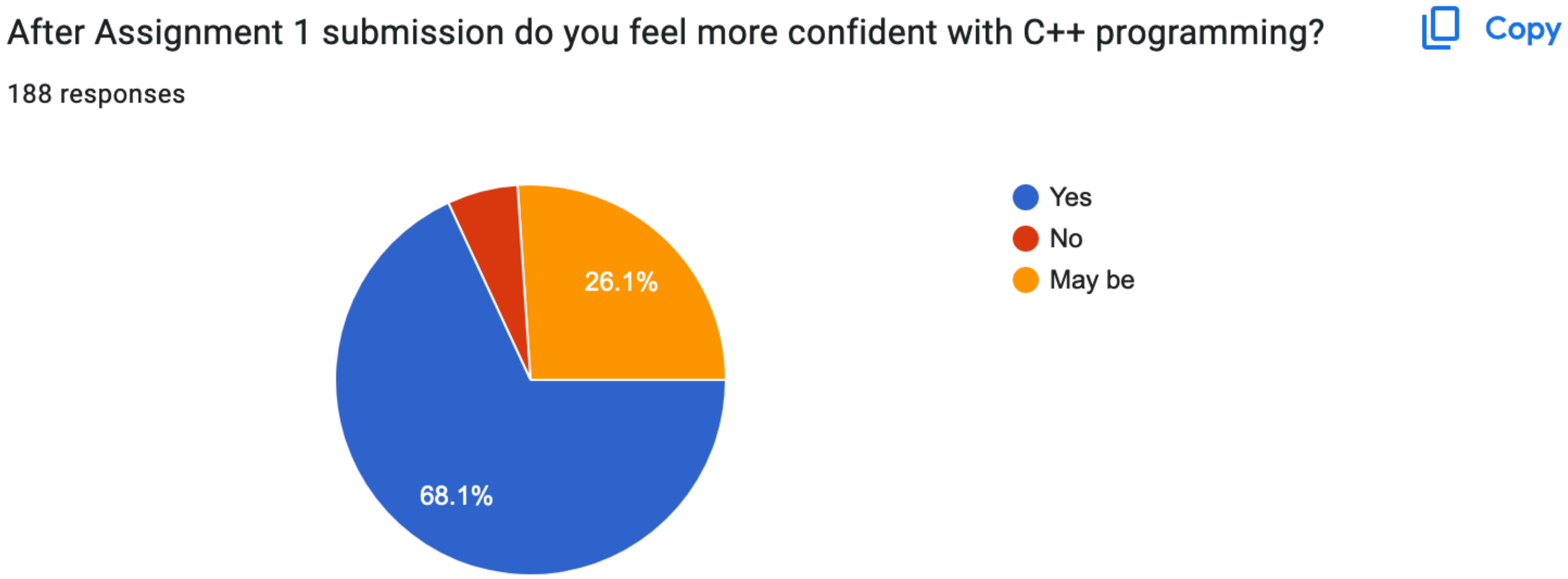
Expected Number of Probes





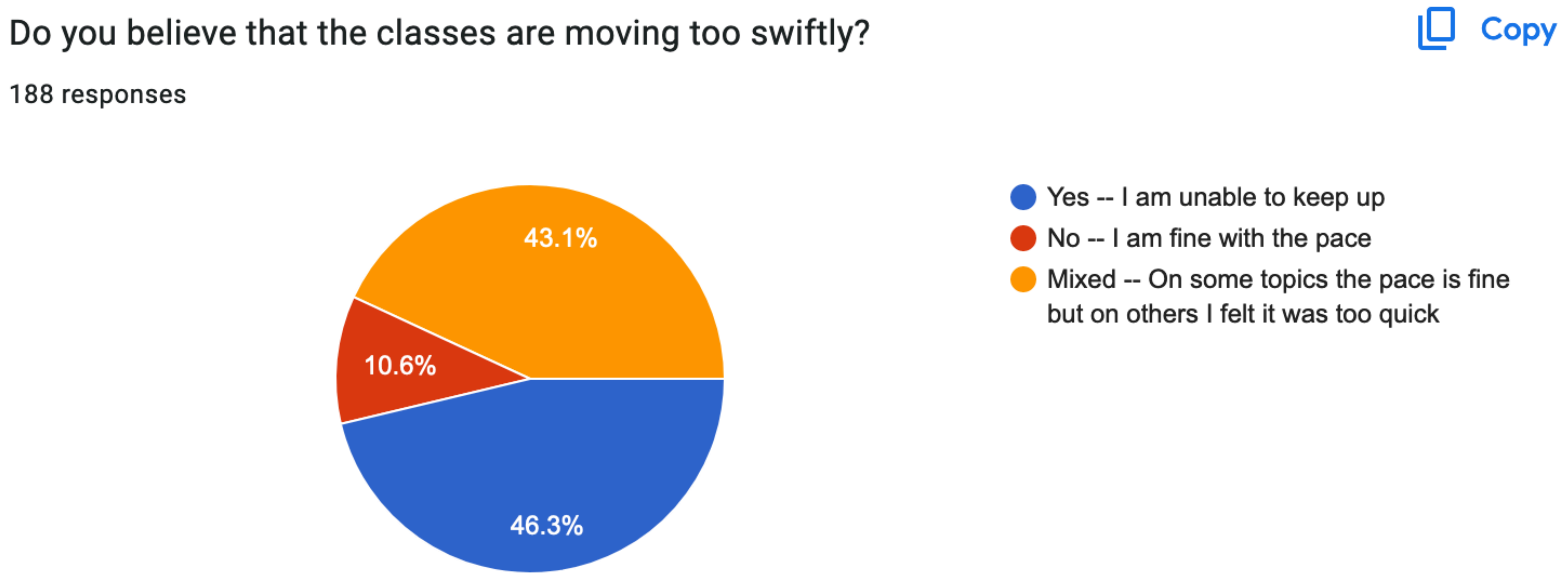
How comfortable were you with C++ Classes prior to the start of Assignment 1?

188 responses



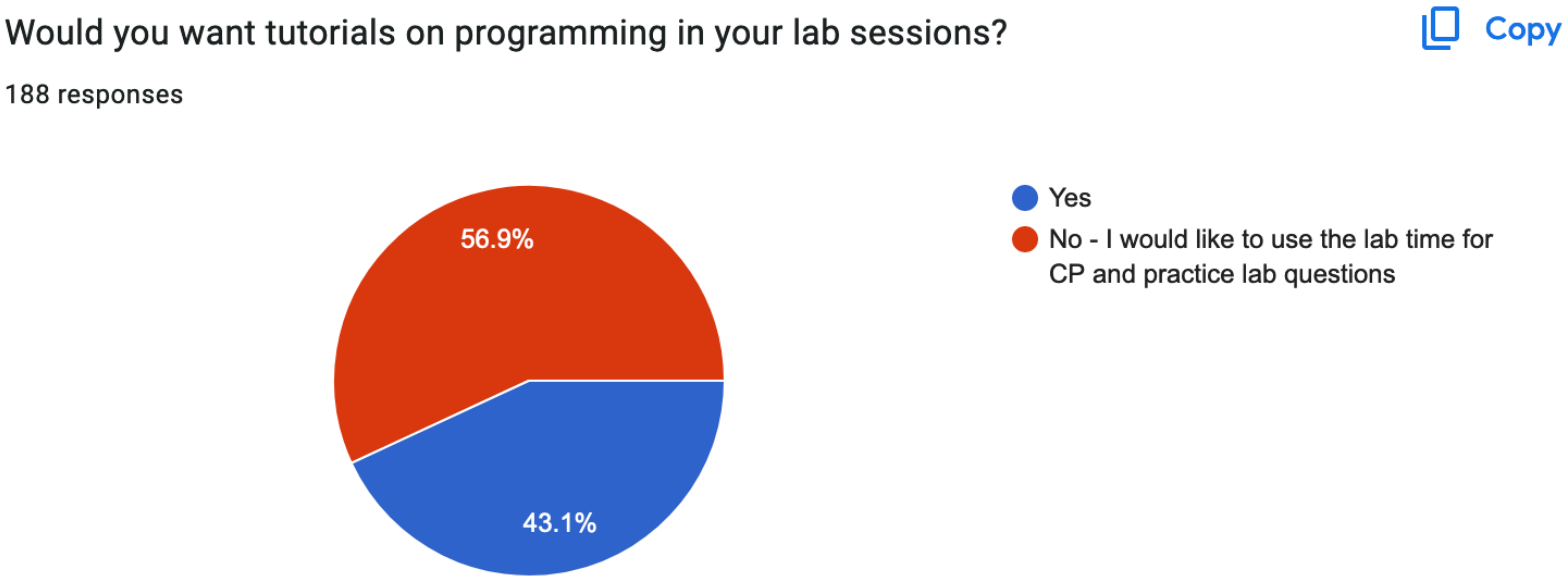
After Assignment 1 submission do you feel more confident with C++ programming?

188 responses



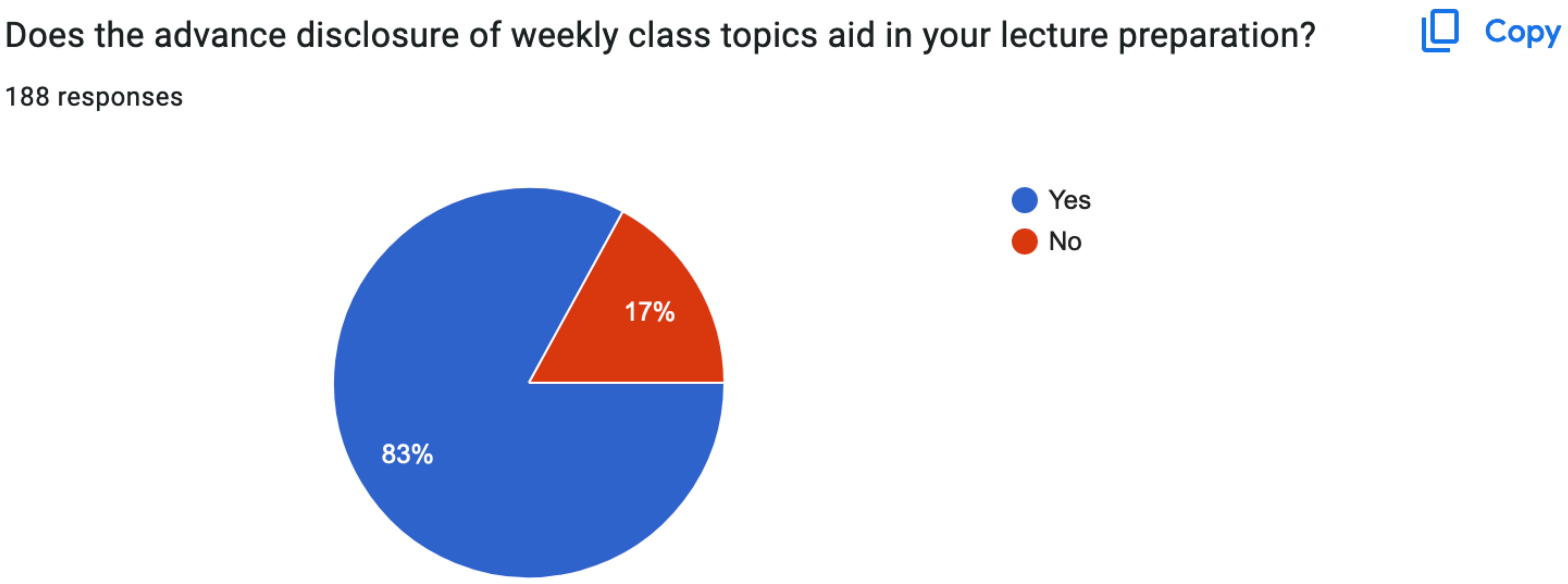
Do you believe that the classes are moving too swiftly?

188 responses



Would you want tutorials on programming in your lab sessions?

188 responses



Does the advance disclosure of weekly class topics aid in your lecture preparation?

188 responses

RECOMMENDATIONS

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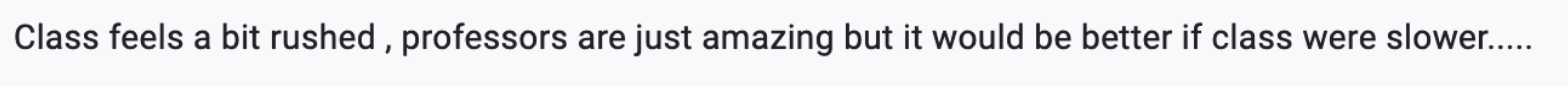

Class feels a bit rushed , professors are just amazing but it would be better if class were slower.....

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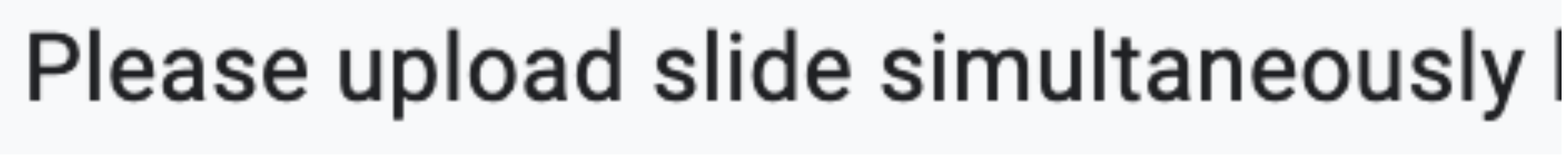

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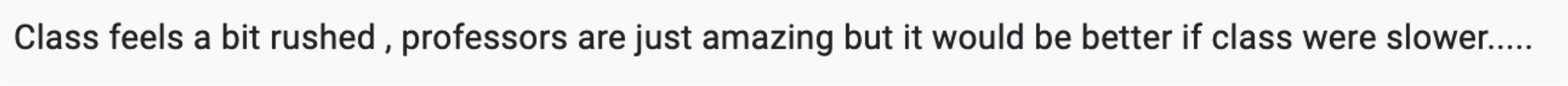

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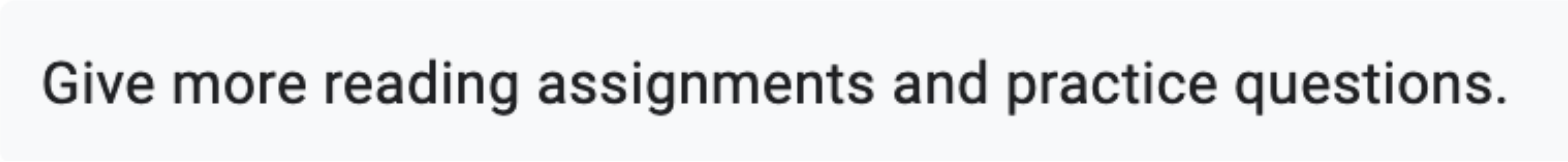
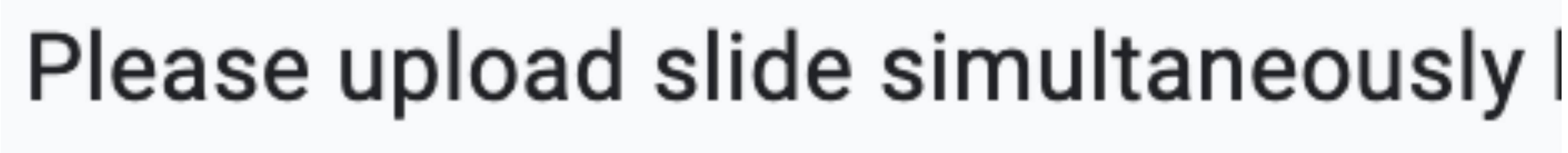


Give more reading assignments and practice questions.

RECOMMENDATIONS



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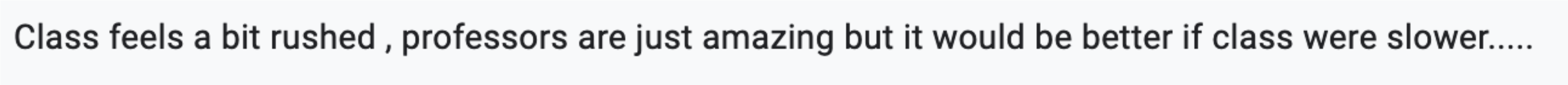

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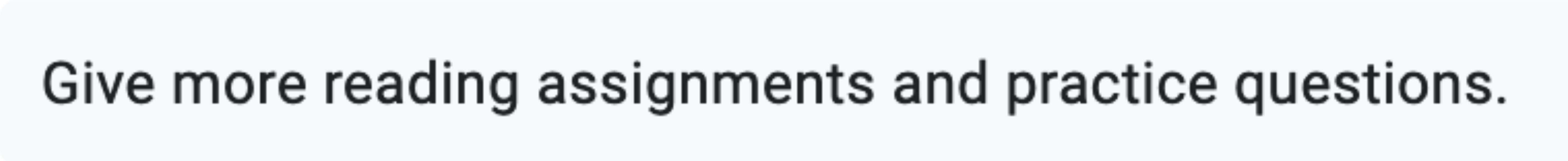

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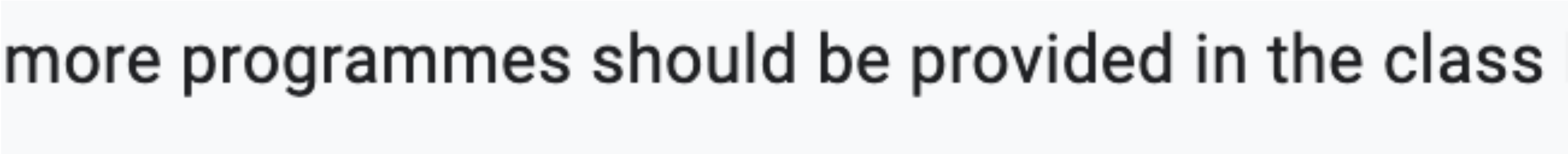

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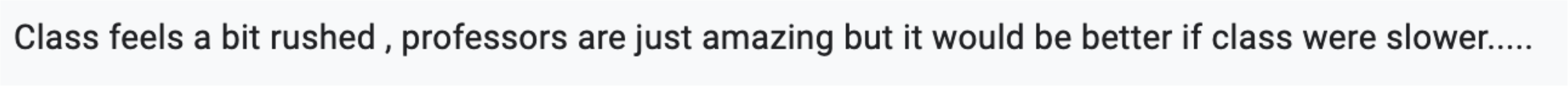

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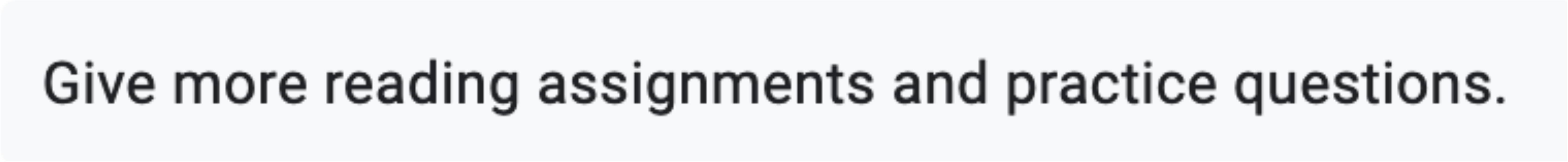

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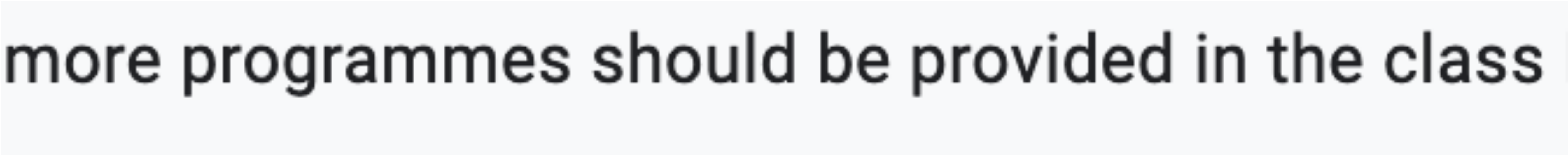

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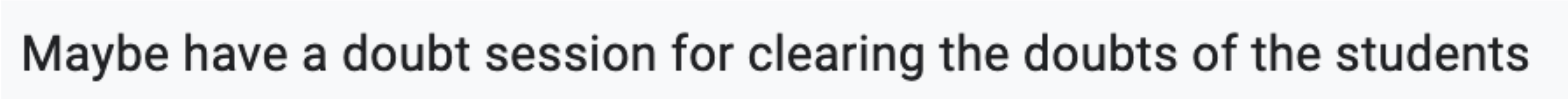
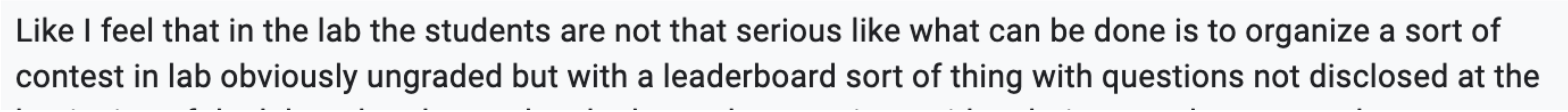
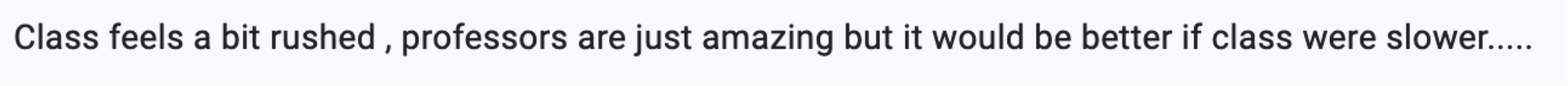


Maybe have a doubt session for clearing the doubts of the students

RECOMMENDATIONS



Like I feel that in the lab the students are not that serious like what can be done is to organize a sort of contest in lab obviously ungraded but with a leaderboard sort of thing with questions not disclosed at the



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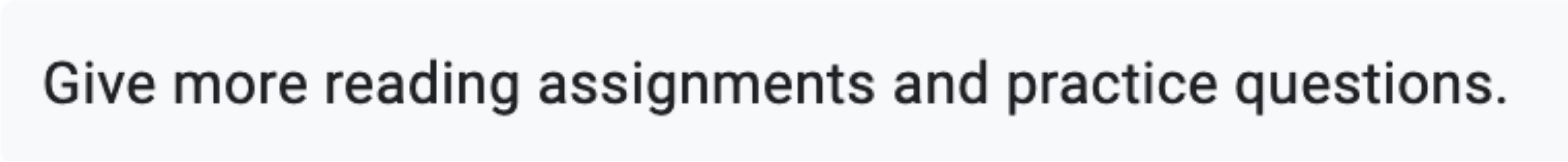

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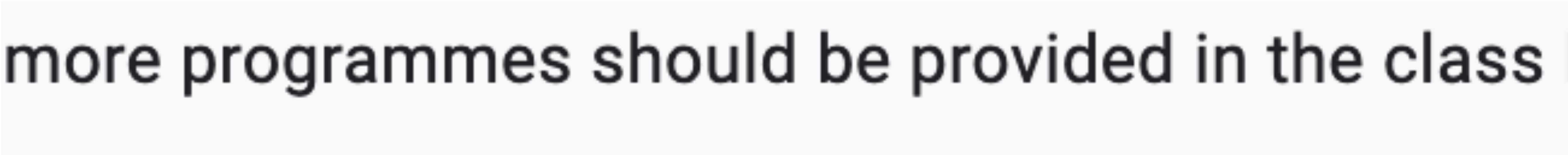

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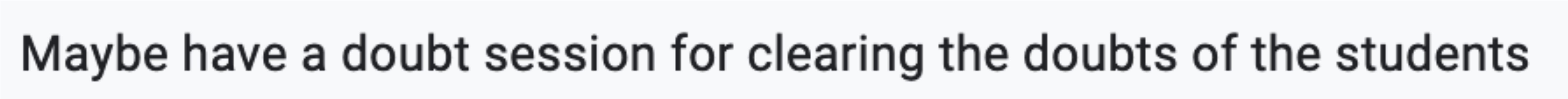

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RECOMMENDATIONS

Certainly, it seems that grasping data structures and algorithms, or indeed any subject, hinges largely on one's personal commitment. Assuming that attending a mere three-hour lecture per week would confer a profound understanding of their intricacies is rather unrealistic. In my view, a more systematic approach to teaching data structures and algorithms would require around nine hours of weekly instruction, delving into sufficient detail to comprehensively elucidate all underlying concepts while effectively fostering motivation.

However, given the constraints imposed by institutional regulations, realizing such an intensive teaching schedule is unfeasible. Thus, in my estimation, a more pragmatic approach involves proactively acquainting oneself with the subject matter through self-guided study from recommended resources prior to class sessions. These interactive sessions could then be optimized for addressing queries and igniting enthusiasm through the exploration of novel topics.

Having shifted my perspective away from harboring overly ambitious expectations from class hours and embracing the aforementioned strategy, I have found myself considerably content with the pace and depth of my learning journey.