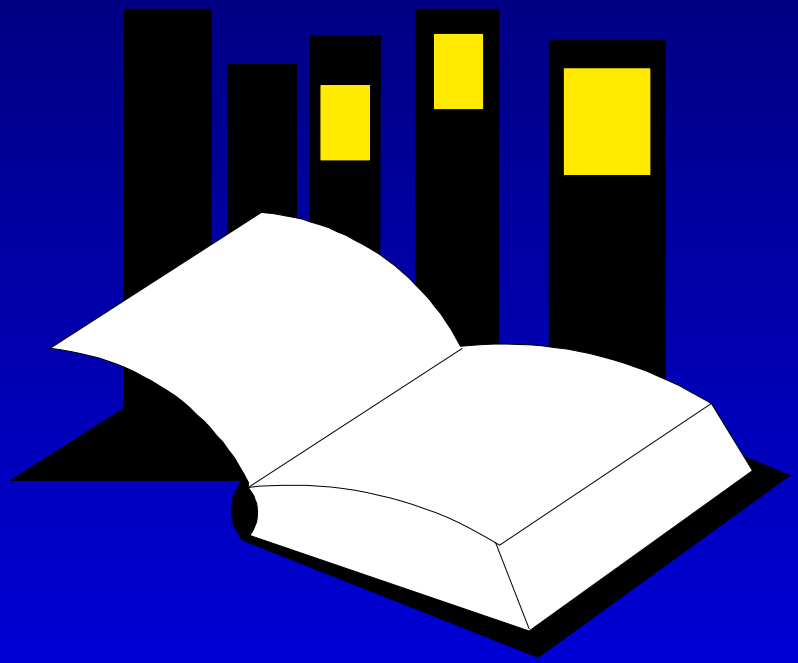
Hash Tables

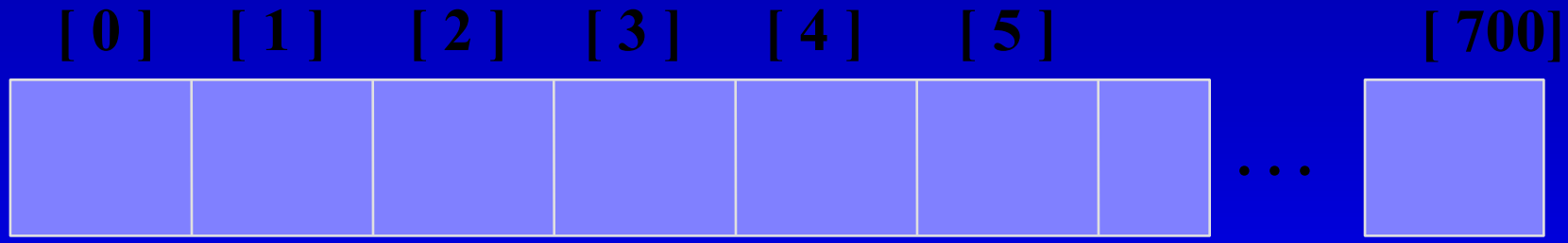


Data Structures and Other Objects

- We discussed several ways of storing information in an array, and later searching for the information.
- Hash tables are a common approach to the storing/searching problem.
- This presentation introduces hash tables.

What is a Hash Table ?

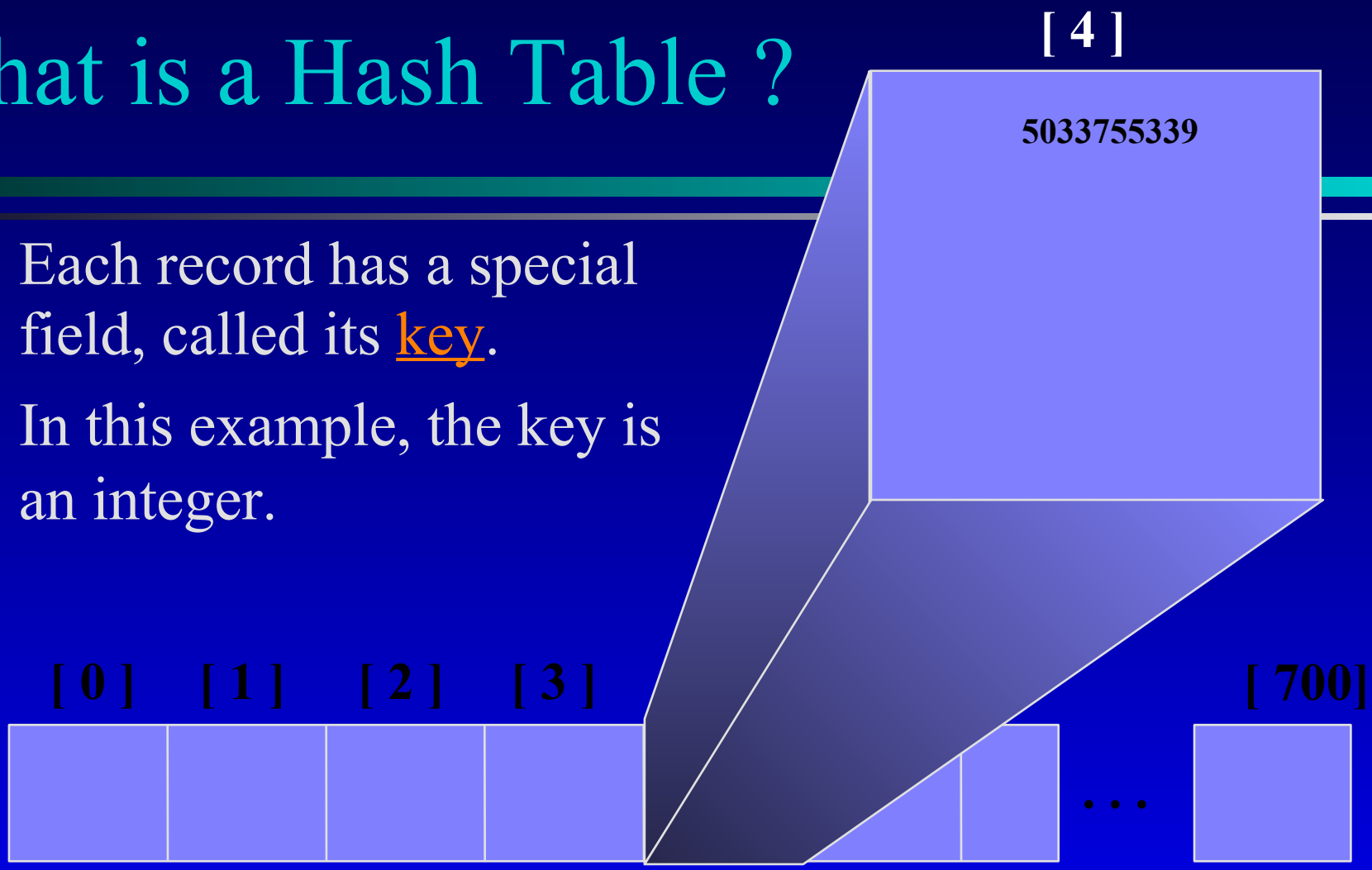
- The simplest kind of hash table is an array of records.
- This example has 701 records.



An array of records

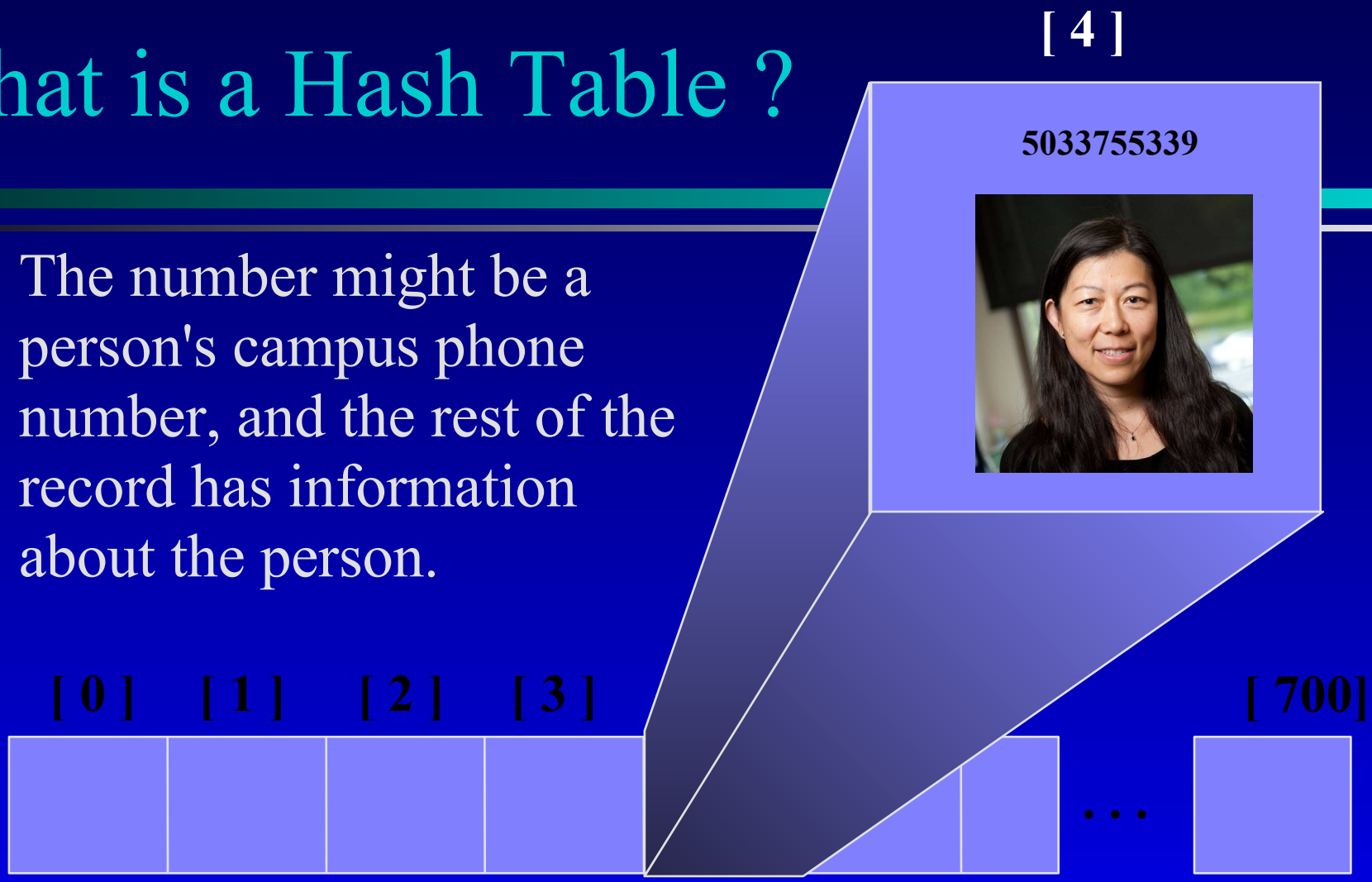
What is a Hash Table ?

- Each record has a special field, called its key.
- In this example, the key is an integer.



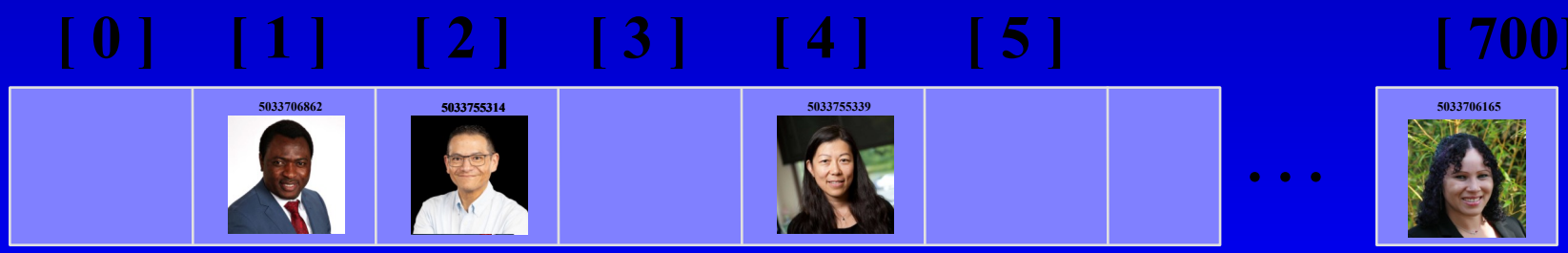
What is a Hash Table ?

- The number might be a person's campus phone number, and the rest of the record has information about the person.



What is a Hash Table ?

- When a hash table is in use, some spots contain valid records, and other spots are "empty".



Inserting a New Record

- In order to insert a new record, the **key** must somehow be **converted to** an array **index**.
- The index is called the **hash value** of the key.

Inserting a New Record

- Typical way create a hash value:

  (Number mod 701)

What is (580625685 mod 701) ?

Inserting a New Record

- Hash with modular arithmetic:

  (Phone# mod 701)

What is (5033706454 mod 701)?

Inserting a New Record

- The hash value is used for the location of the new record.

Inserting a New Record

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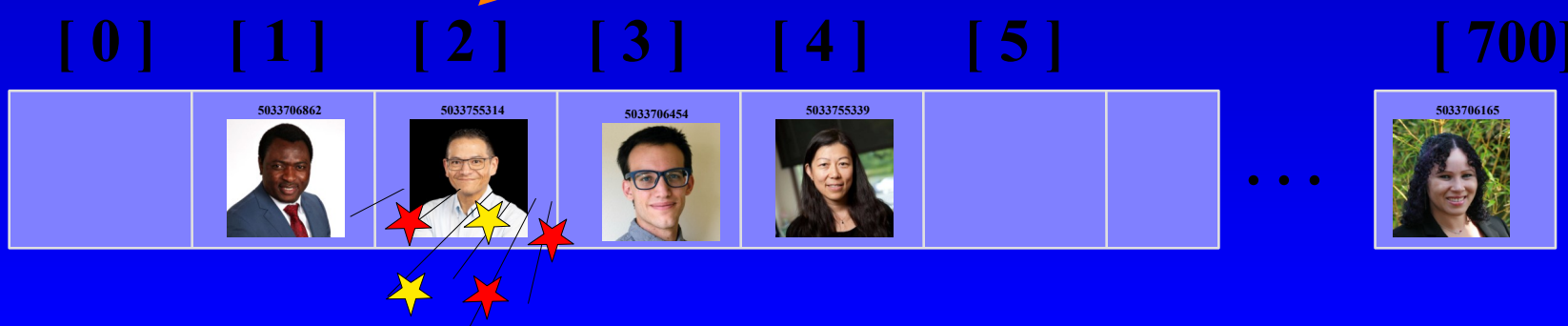
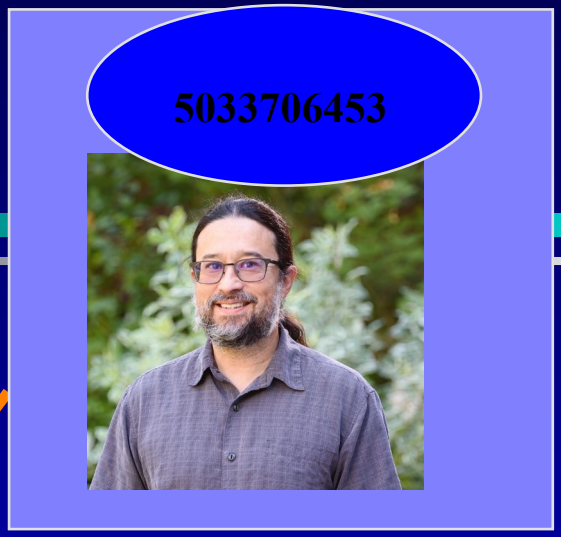
Collisions

- Here is another new record to insert, with a hash value of 2.



Collisions

- This is called a **collision**, because there is already another valid record at [2].



When a collision occurs, move forward until you find an empty spot.

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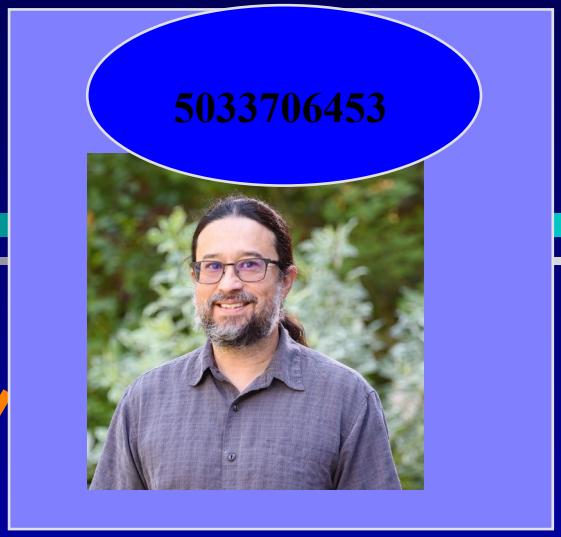

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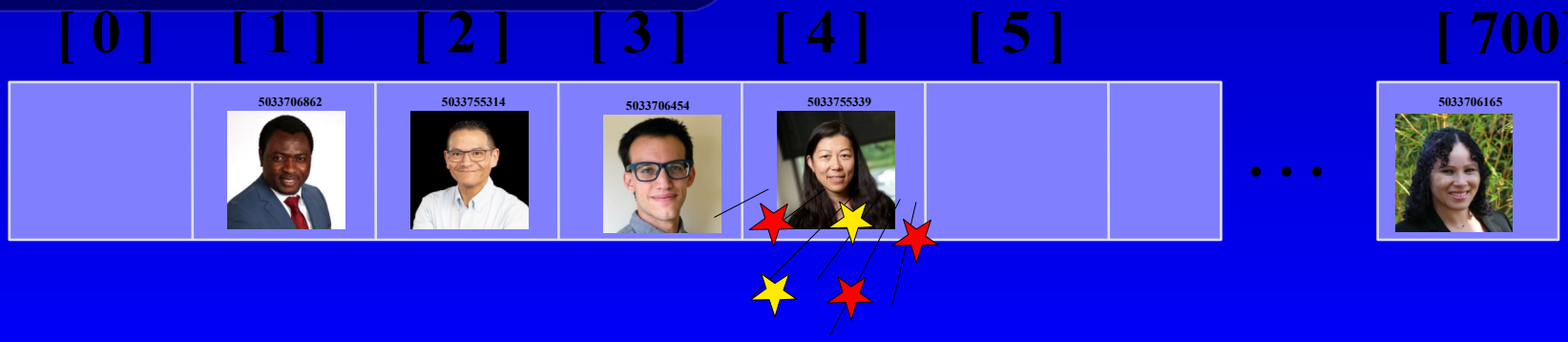

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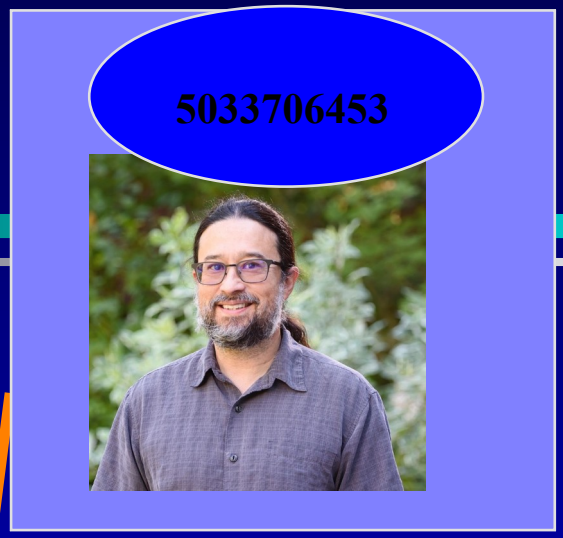

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Collisions

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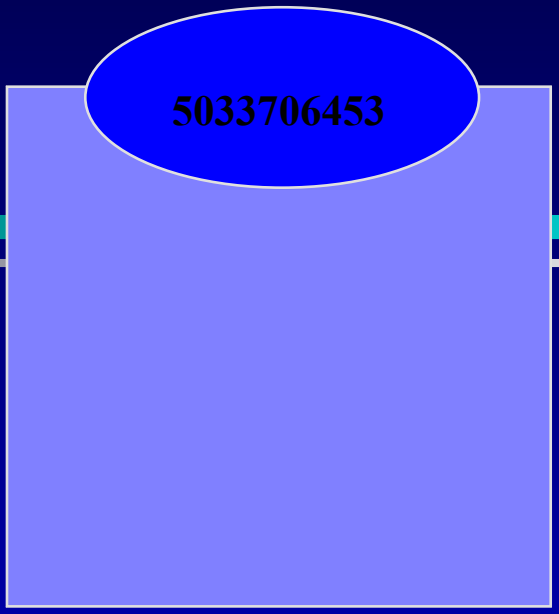
The new record goes in the empty spot.

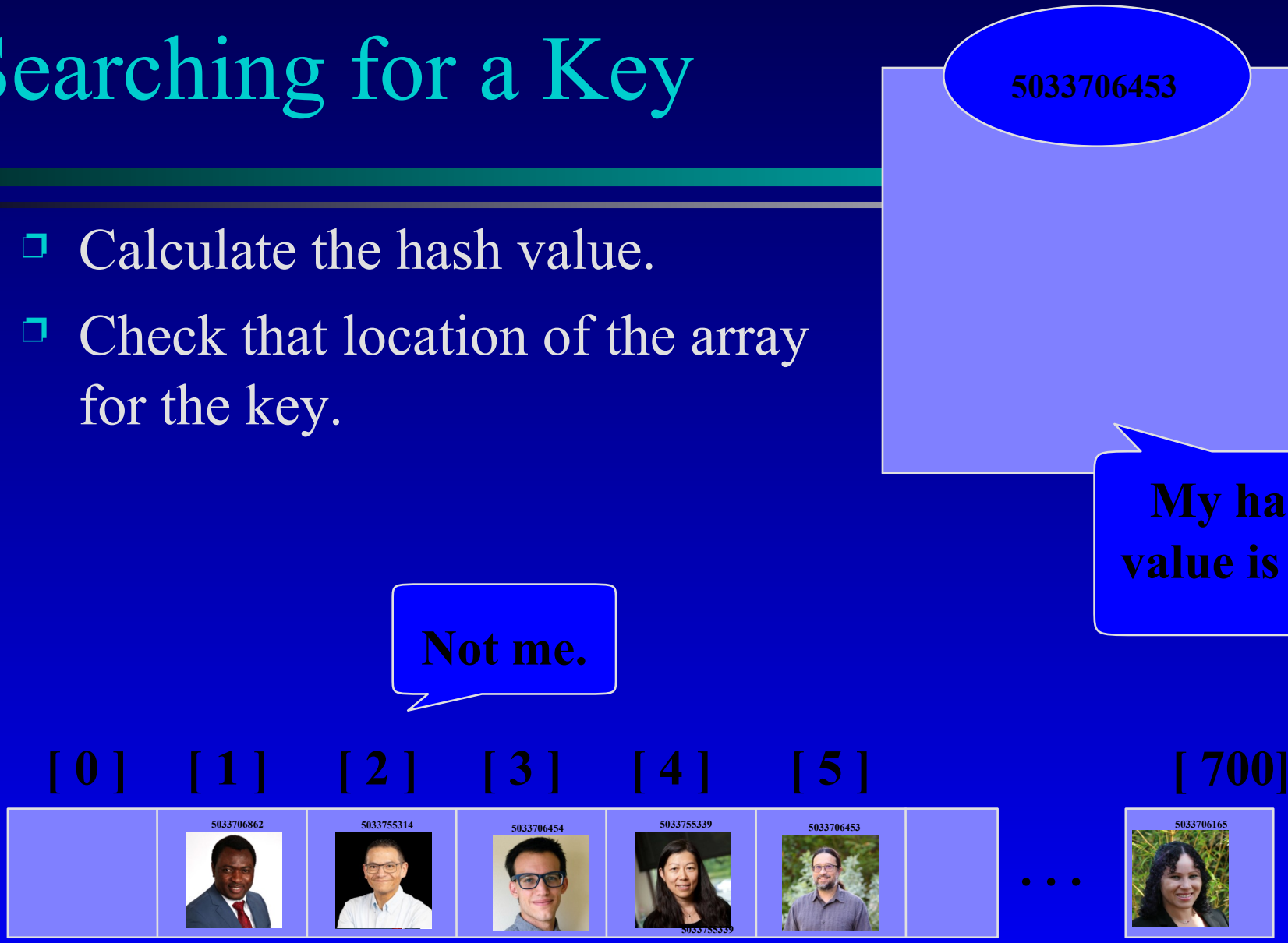
Searching for a Key

- The data that's attached to a key can be found fairly quickly.



Searching for a Key

- Calculate the hash value.
- Check that location of the array for the key.



Searching for a Key

- Keep moving forward until you find the key, or you reach an empty spot.

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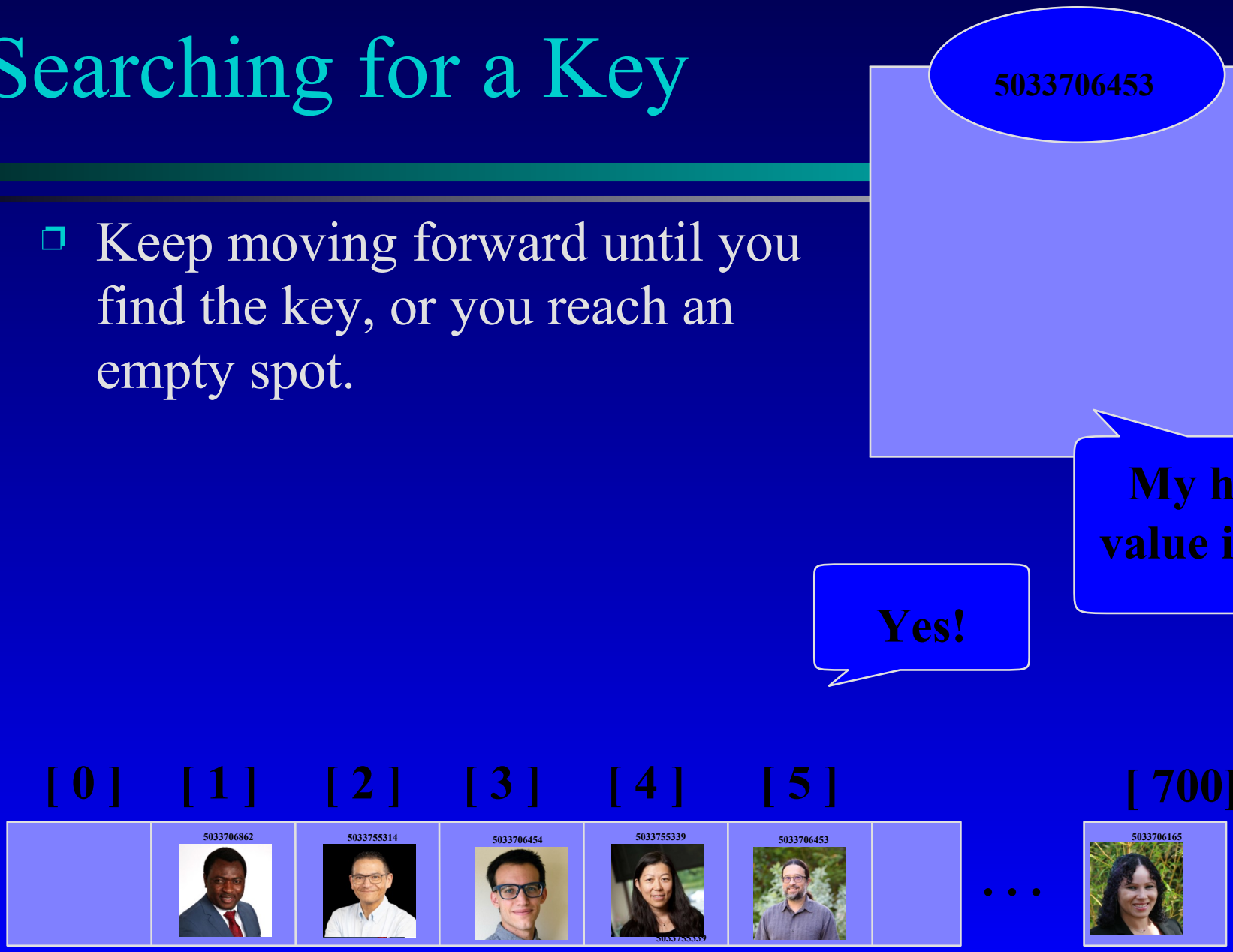
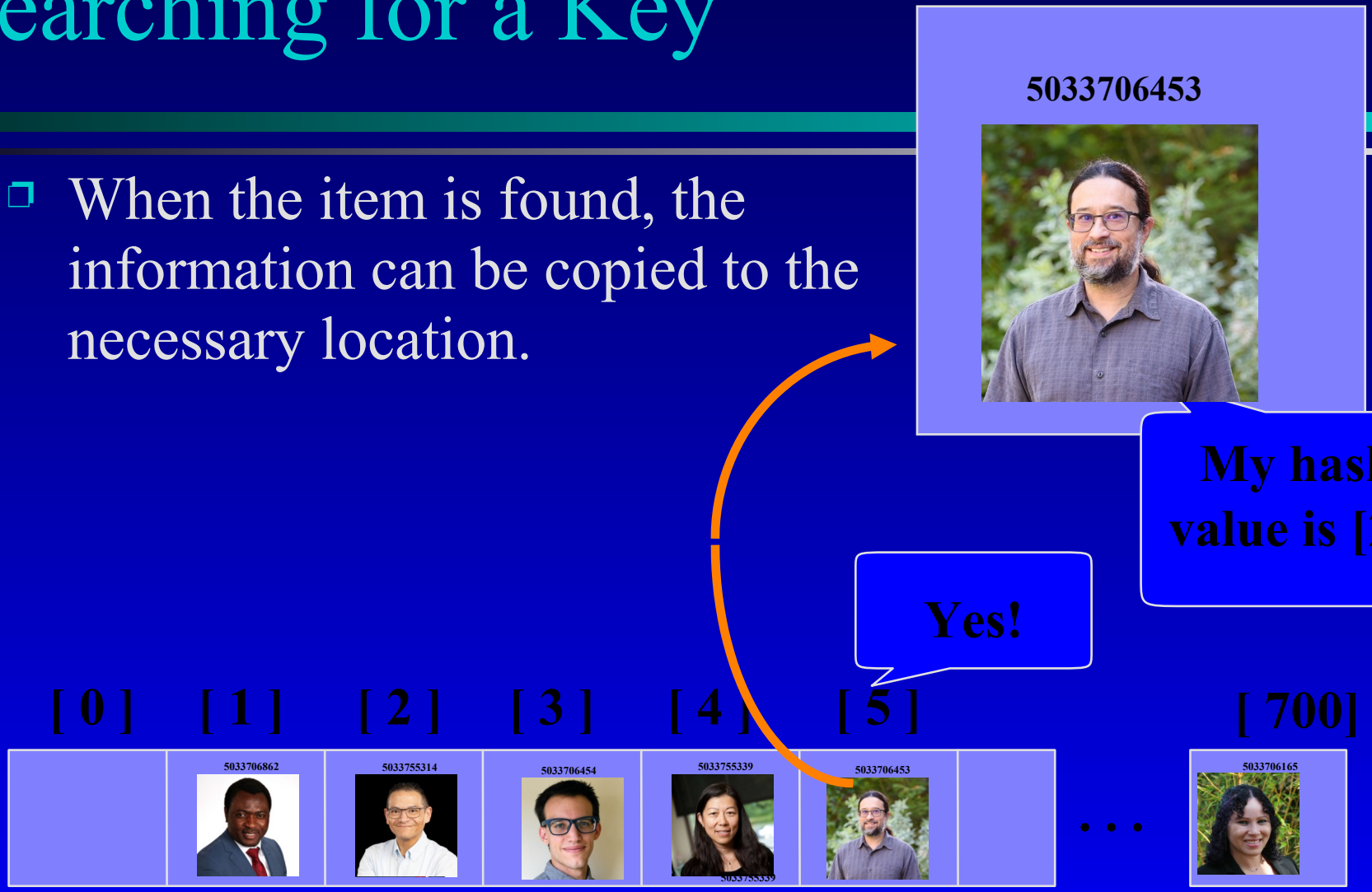


Searching for a Key

- When the item is found, the information can be copied to the necessary location.



Deleting a Record

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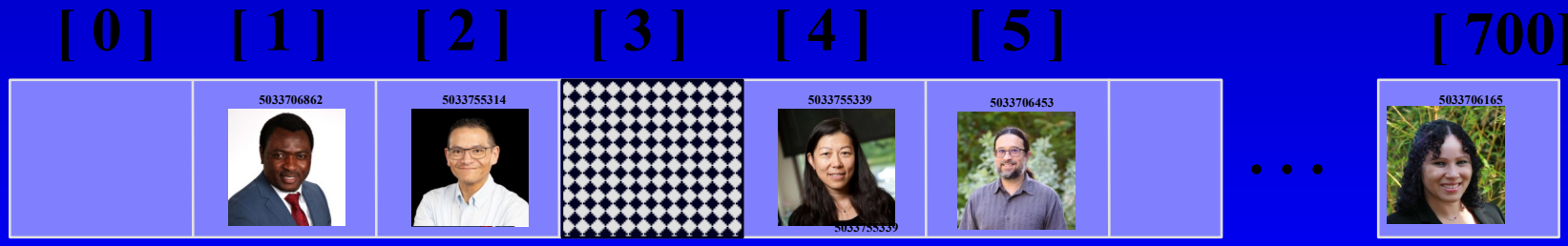
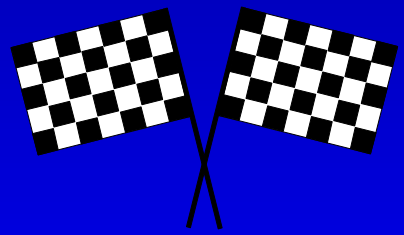
- Records may also be deleted from a hash table.
- But the location must not be left as an ordinary "empty spot" since that could interfere with searches.
- The location must be marked in some special way so that a search can tell that the spot used to have something in it.



Summary

- Hash tables store a collection of records with keys.
- The location of a record depends on the hash value of the record's key.
- When a collision occurs, the next available location is used.
- Searching for a particular key is generally quick.
- When an item is deleted, the location must be marked in a special way, so that the searches know that the spot used to be used.



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