Hash Tables

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CSC220 Programming II – Spring 2024

Implementations of Map

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- 2-3 Tree (BTree): add, find, and remove in O(log n) worst case time.

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- When you look up a name, it is nice to be able to go forward or back a few names in case you misspelled it.
- If you want Milenkovic in a hash table, you better not look for Milenkovich because it will be far far away.

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public int hashCode()
Returns a hash code for this string. The hash code for a
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 s[0]*31^(n-1) + s[1]*31^(n-2) + ... + s[n-1]

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WHAT???

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An int can only hold integers in the range from -2147483648 to 2147483647.

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```
int hashIndex (String name, int m) {
  int code = name.hashCode();
  int index = code % m;
  if (index < 0)
    index += m;
  return index;
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- Entries in the same list in the first table will be in different lists in the second table.

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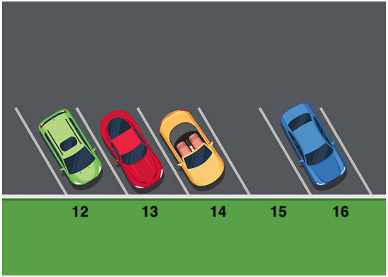
- If you reach the end of the lot, you go back to the beginning.

Add



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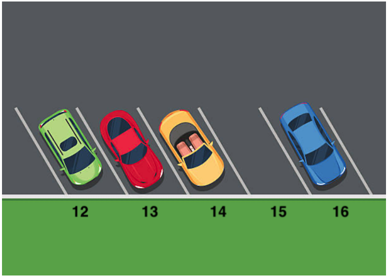

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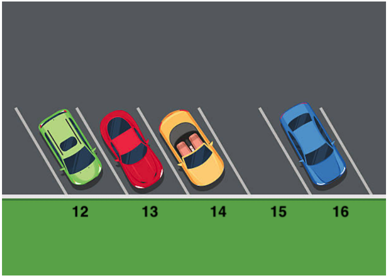

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- Suppose my assigned number is 12.

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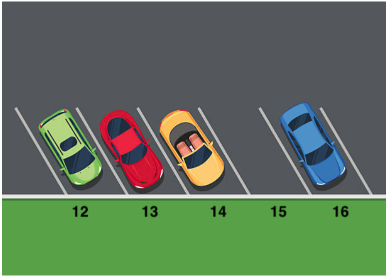

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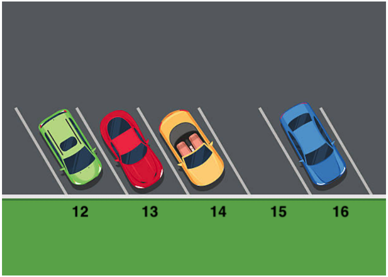

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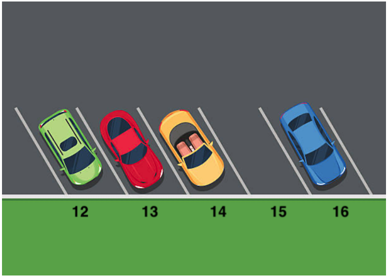

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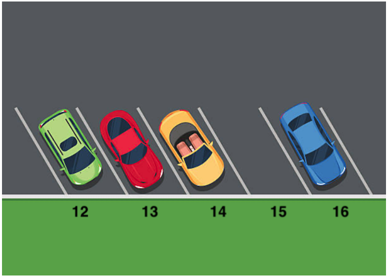

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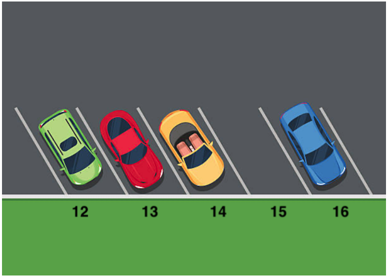

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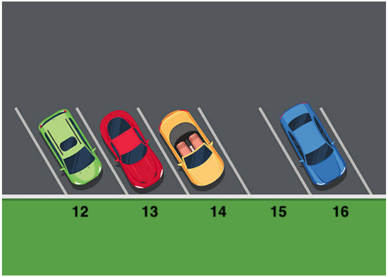

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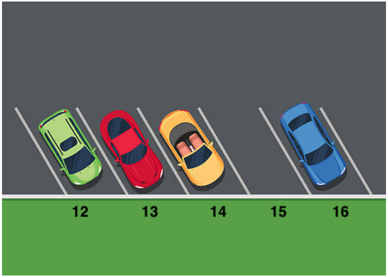

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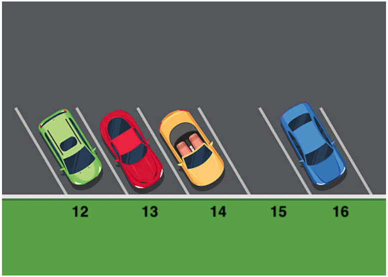

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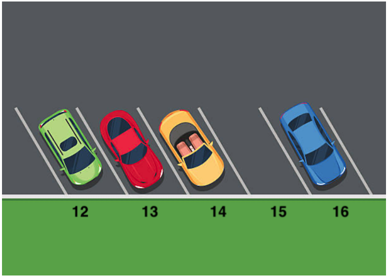

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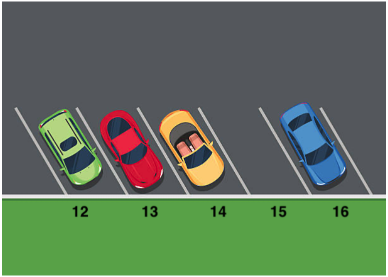

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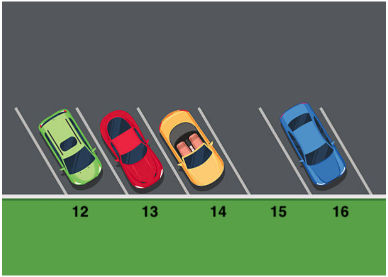

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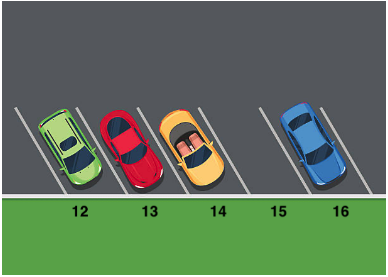

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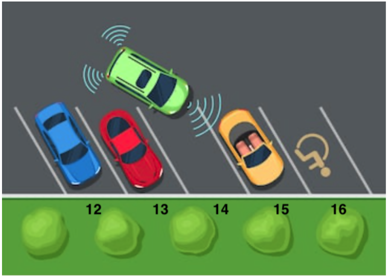

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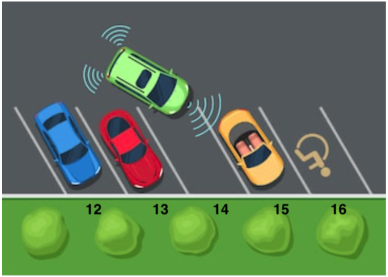

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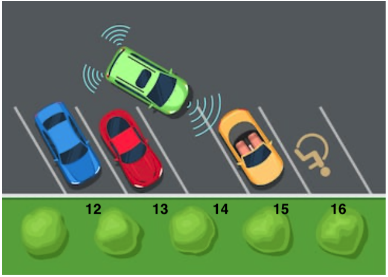

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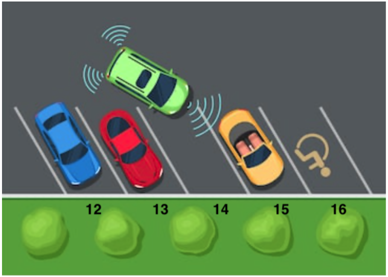

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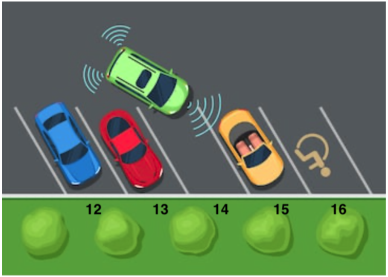

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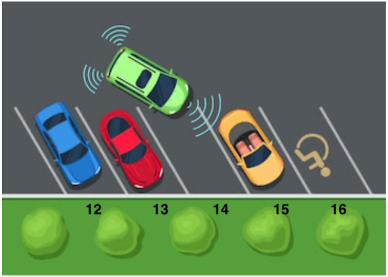

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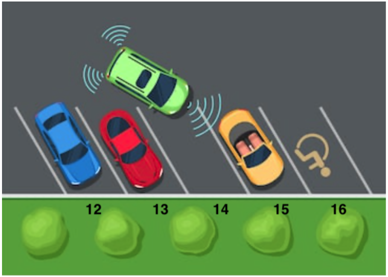

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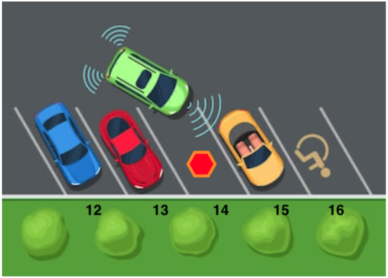
Marking DELETED spaces



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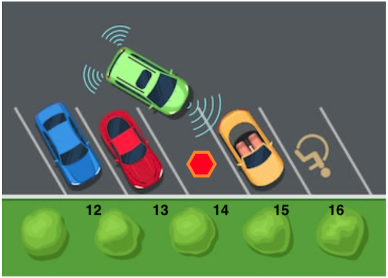

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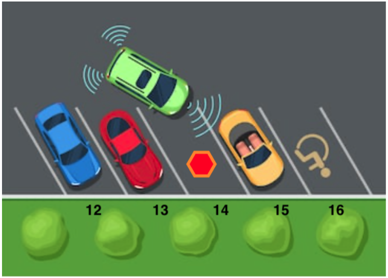

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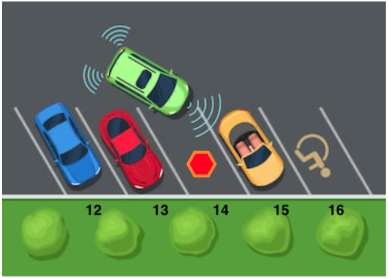

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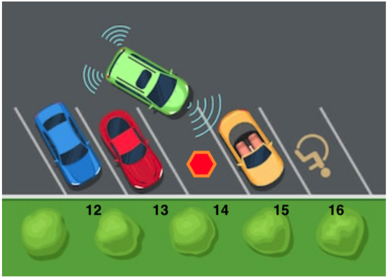

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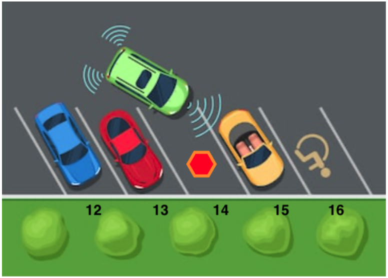

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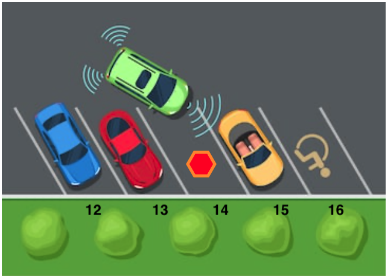

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- I park in the first space that is empty or has a traffic cone.

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The hash index of an item is an int

- in the range 0 to m-1.
- Mod the hash code by m,
- add m if negative.
- Not unique ($\sqrt{m}$ is a lot less than m)!

A hash table is an array of length m.

- Item with hash index i is stored at index i,
- unless there is an item there already.

Separate Chaining

- stores a linked list at each index.
- add, find, remove are n/m expected time.
- Need to reallocate and rehash when n > m.

Open Addressing

- More suitable for real-time programming or operating systems.

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- Needs to rehash and possibly reallocate when less than m/2 spaces are empty.

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- Email your solution to vjm@miami.edu by Tuesday morning.

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- What should it be worth?