Collections, Part Three

Lexicon

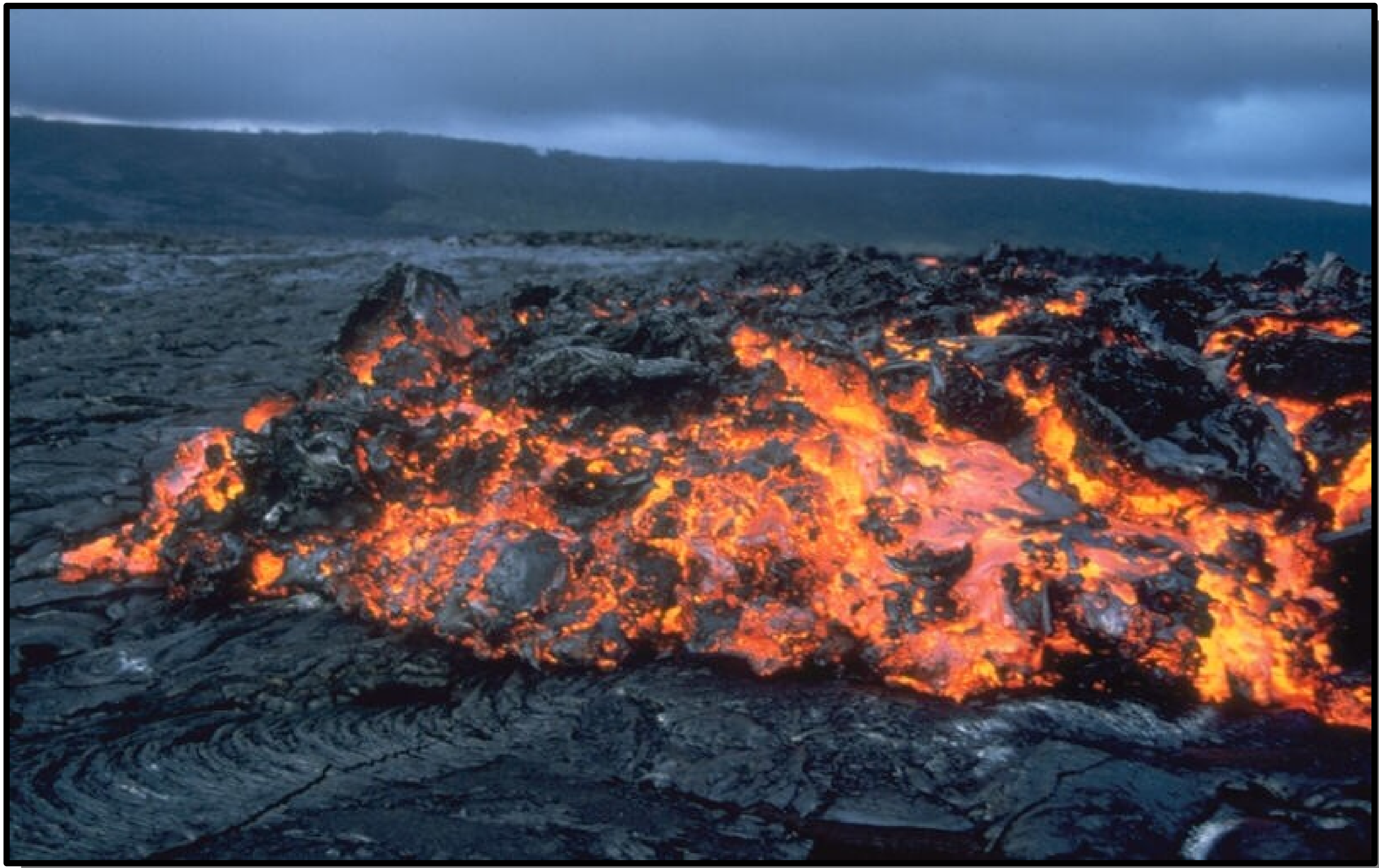
Lexicon

- A `Lexicon` is a container that stores a collection of words.
- No definitions are associated with the words; it is a “lexicon” rather than a “dictionary.”
- Contains operations for
  - Checking whether a word exists.
  - Checking whether a string is a prefix of a given word.

Tautonyms

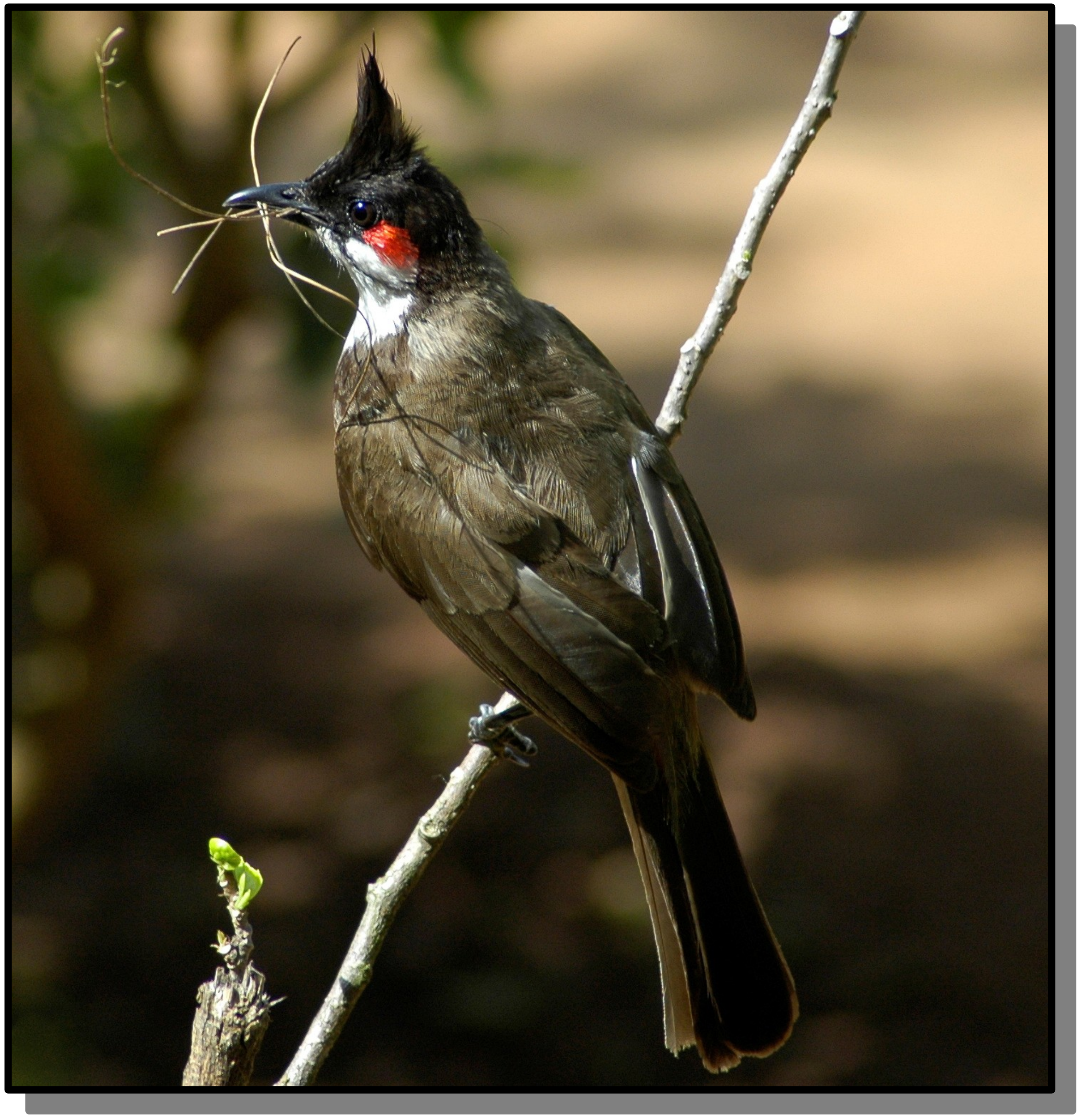
- A ***tautonym*** is a word formed by repeating the same string twice.
    - For example: murmur, couscous, papa, etc.
- What English words are tautonyms?

Some Aa



http://upload.wikimedia.org/wikipedia/commons/f/f1/Aa_large.jpg

One Bulbul



More than One Caracara

http://www.greglasley.net/images/CO/Crested-Caracara-F3.jpg

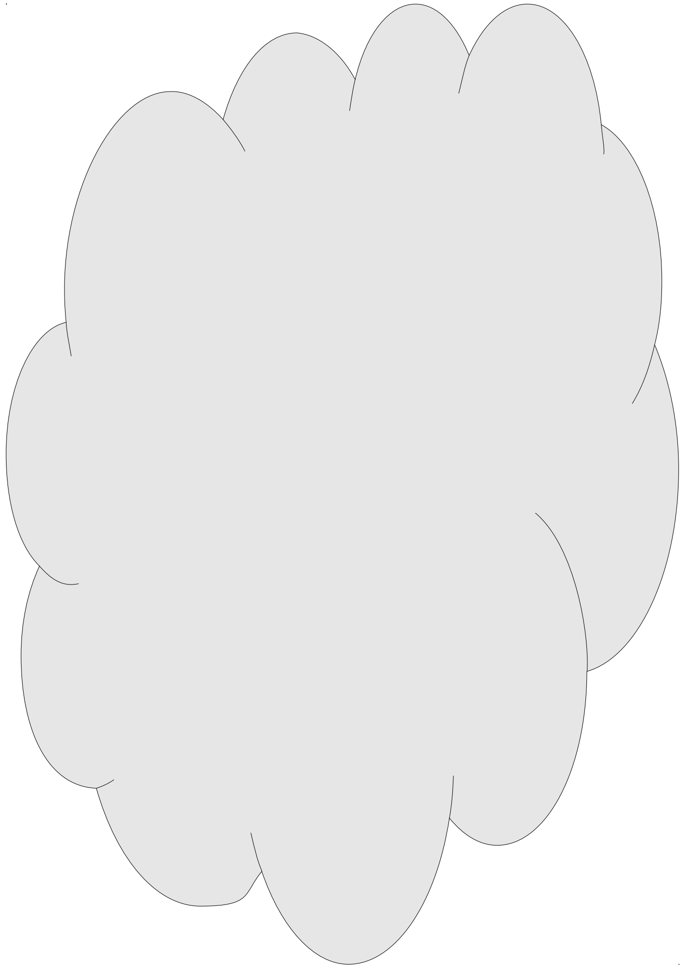
Introducing the Dikdik

And a Music Recommendation

Set

Set

- The **Set** represents an unordered collection of distinct elements.
- Elements can be added and removed, and you can check whether or not an element exists.



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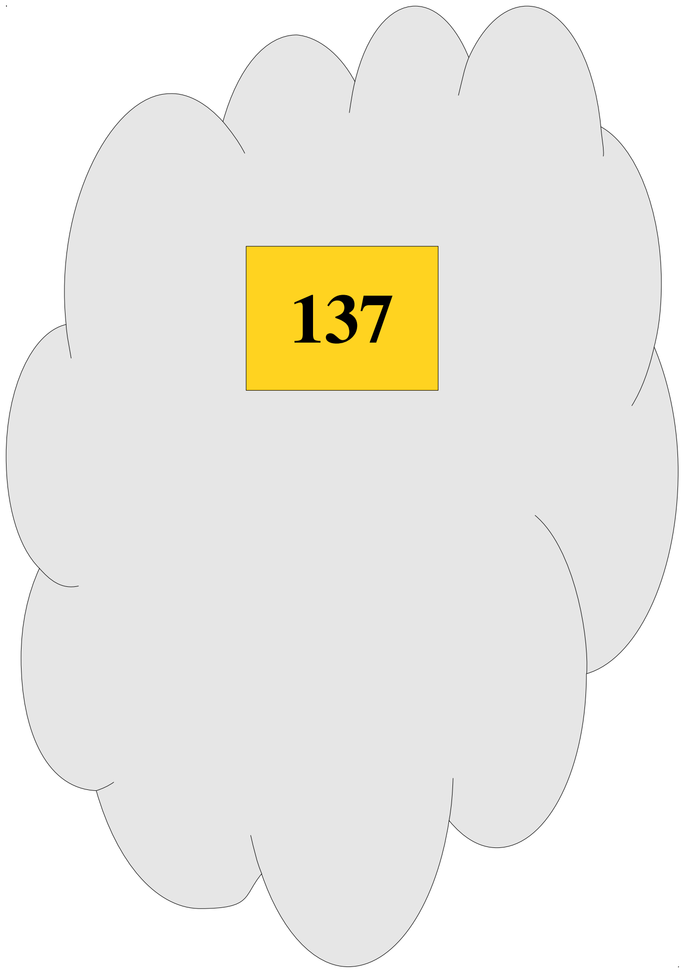

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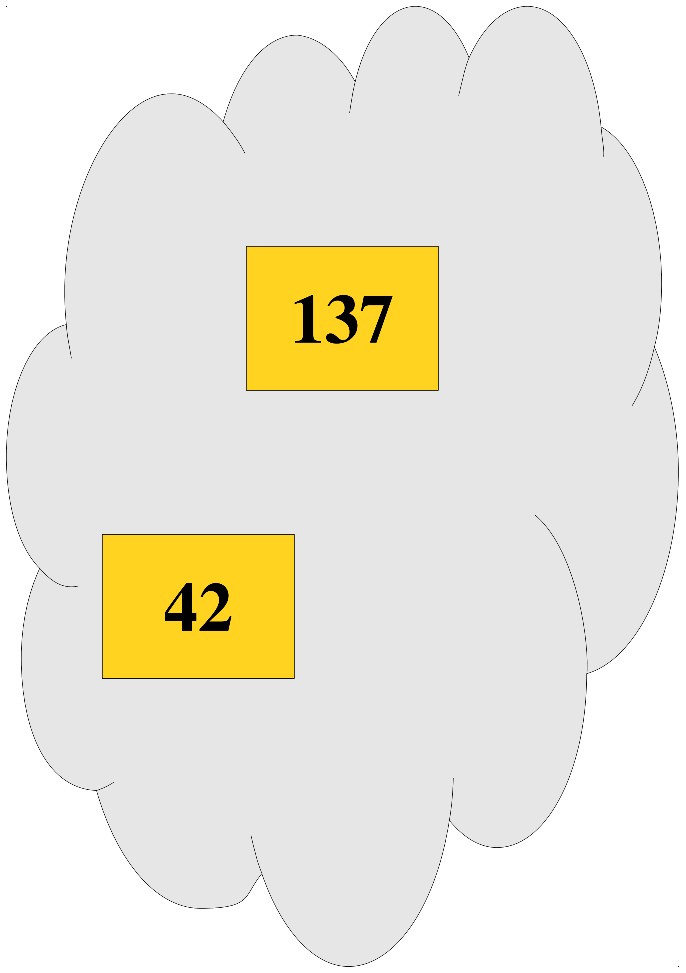

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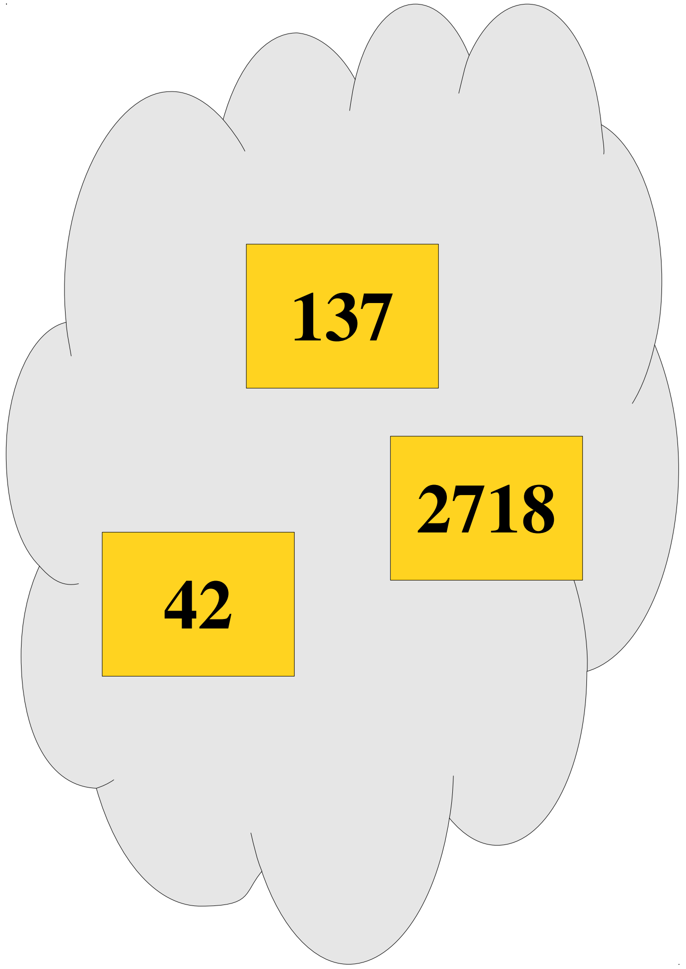

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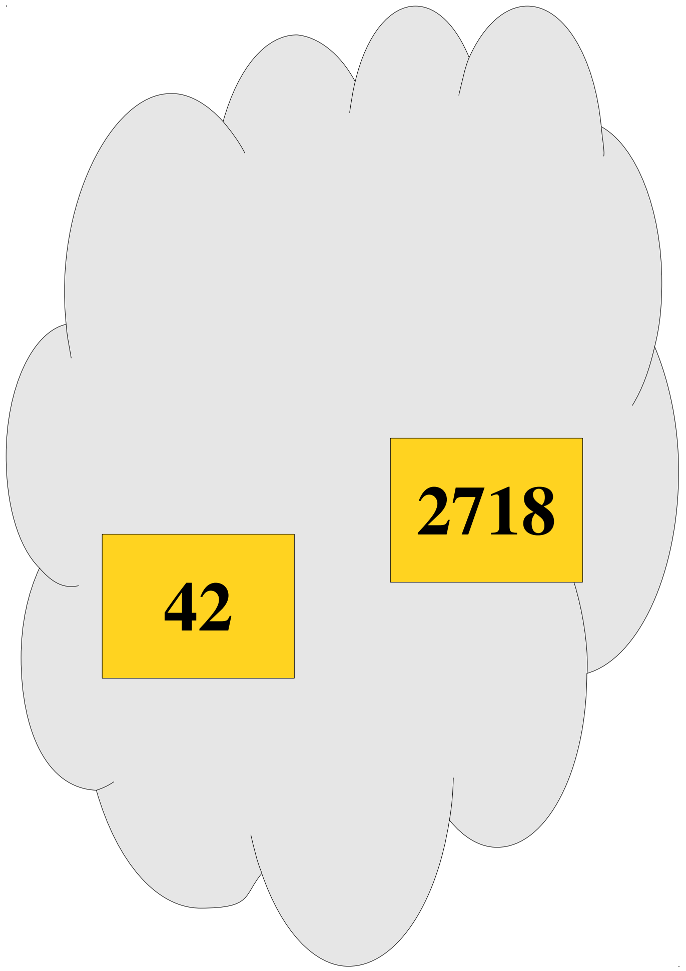

Operations on Sets

- You can add a value to a set by writing

```
set += value;
```

- You can remove a value from a set by writing

```
set -= value;
```

- You can check if a value exists by writing

```
set.contains(value)
```

- Many more operations are available (union, intersection, difference, subset, etc.), so be sure to check the documentation.

Map

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- Given a key, can look up the associated value.

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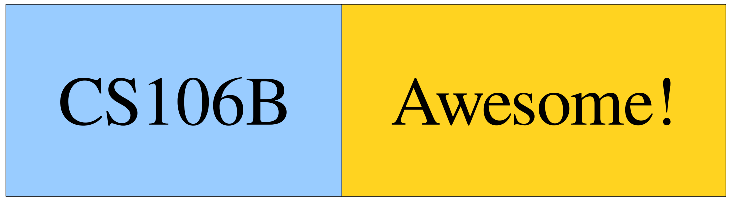

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CS106B	Awesome!
Dikdik	Cute!

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Using the `Map`

- You can create a map by writing

```
Map<KeyType, ValueType> map;
```

- You can add or change a key/value pair by writing

```
map[key] = value;
```

  If the key doesn't already exist, it is added.

- You can read the value associated with a key by writing

```
map[key]
```

  If the key doesn't exist, it is added and associated with a default value.

- You can check whether a key exists by calling

```
map.containsKey(key)
```

Map Autoinsertion

```
Map<string, int> freqMap;
while (true) {
    string text = getLine("Enter some text: ");
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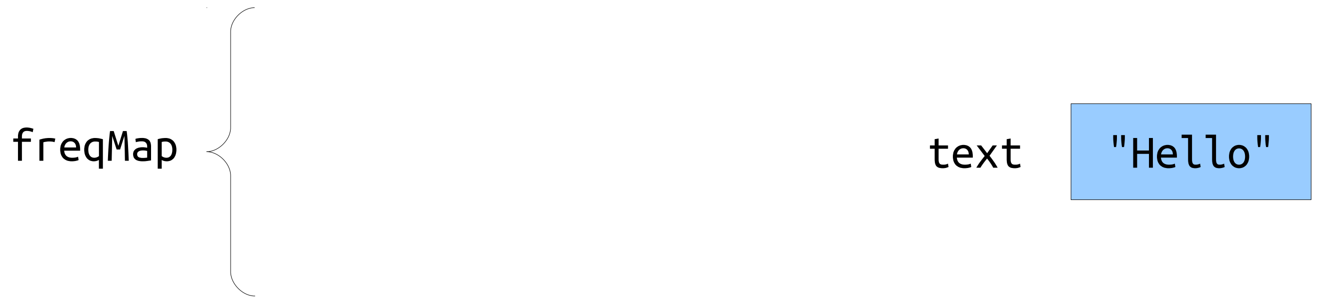

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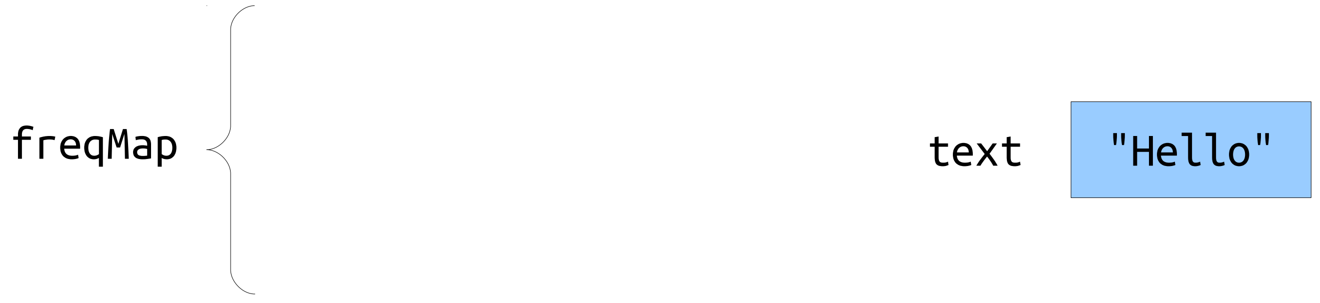

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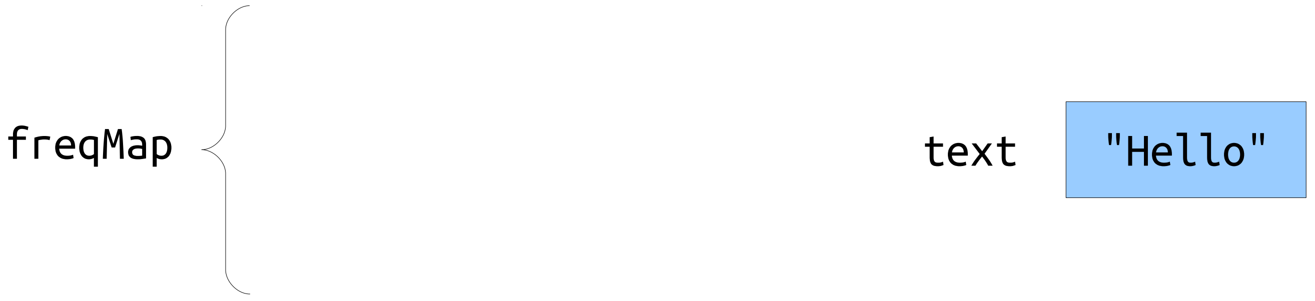

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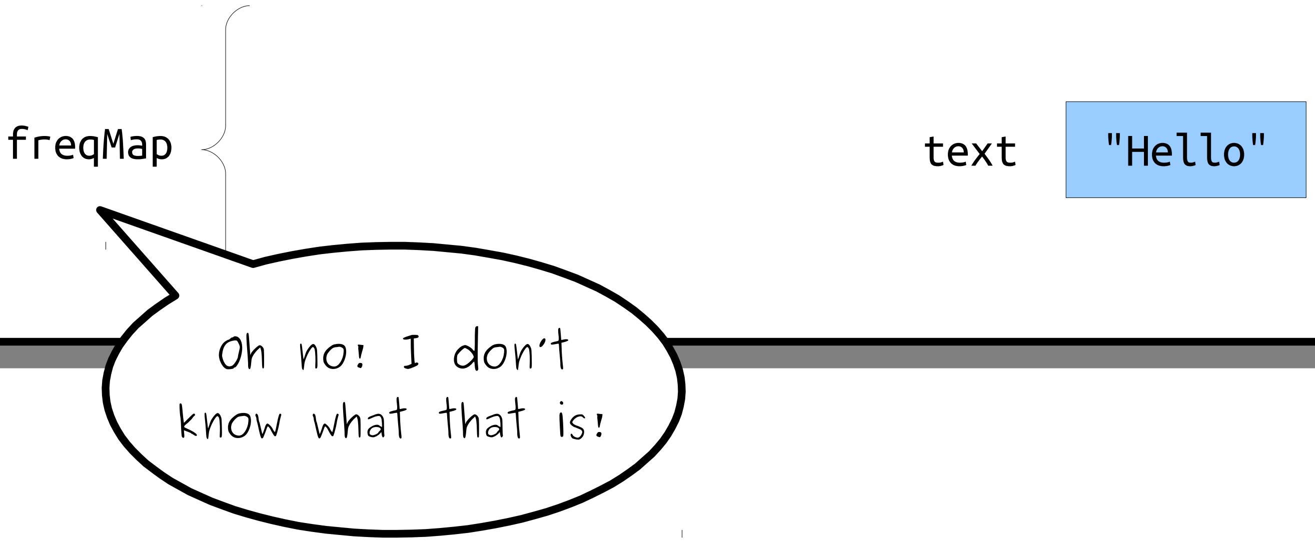

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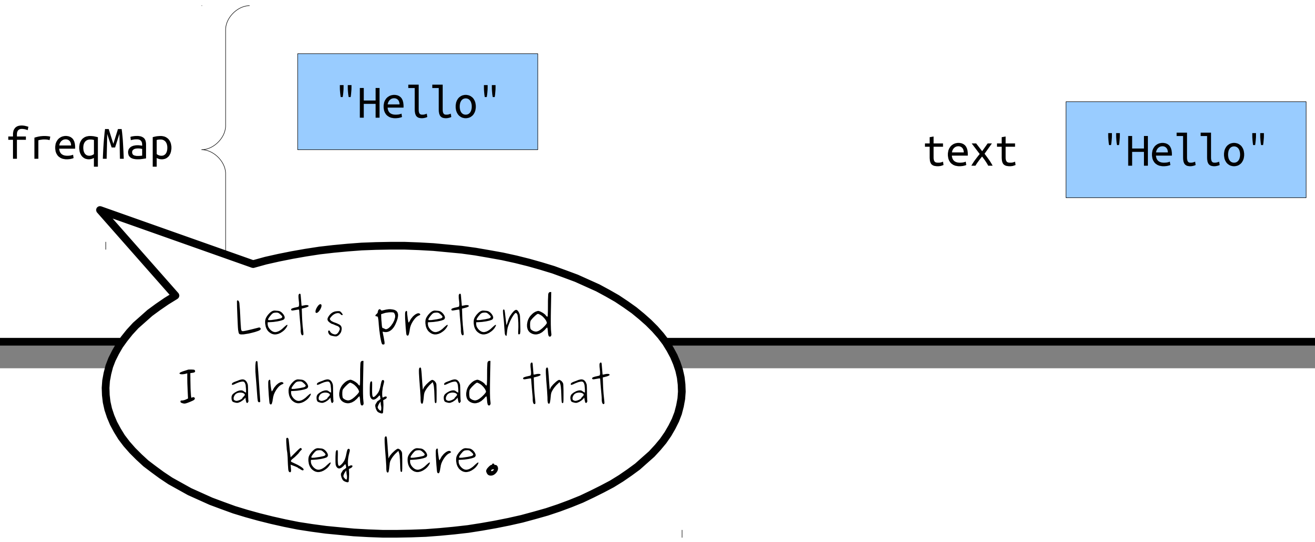

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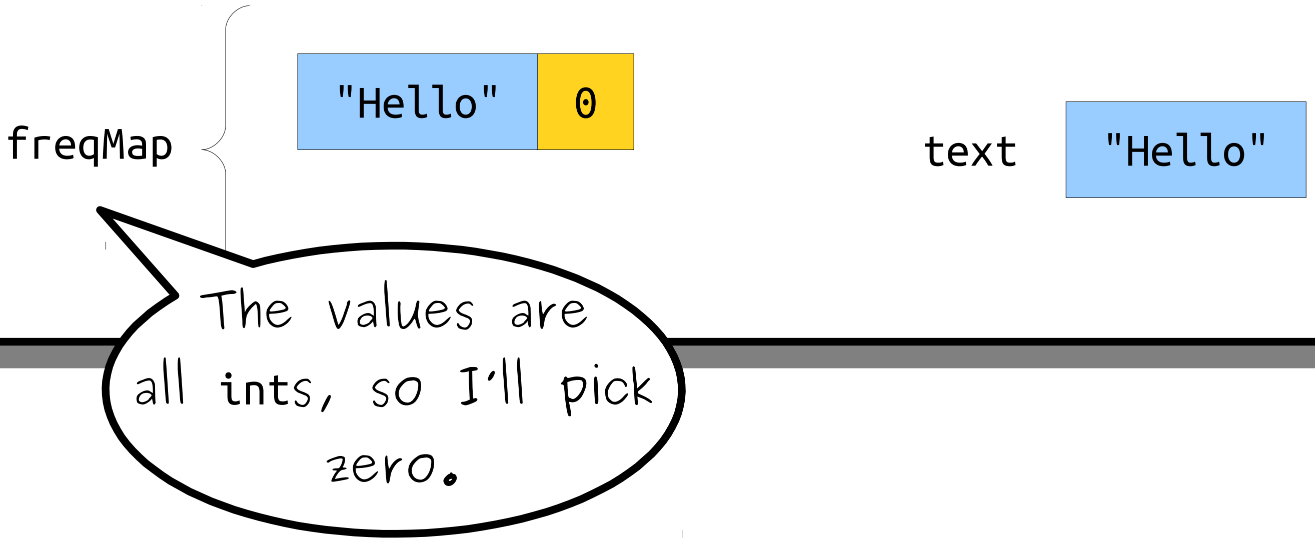

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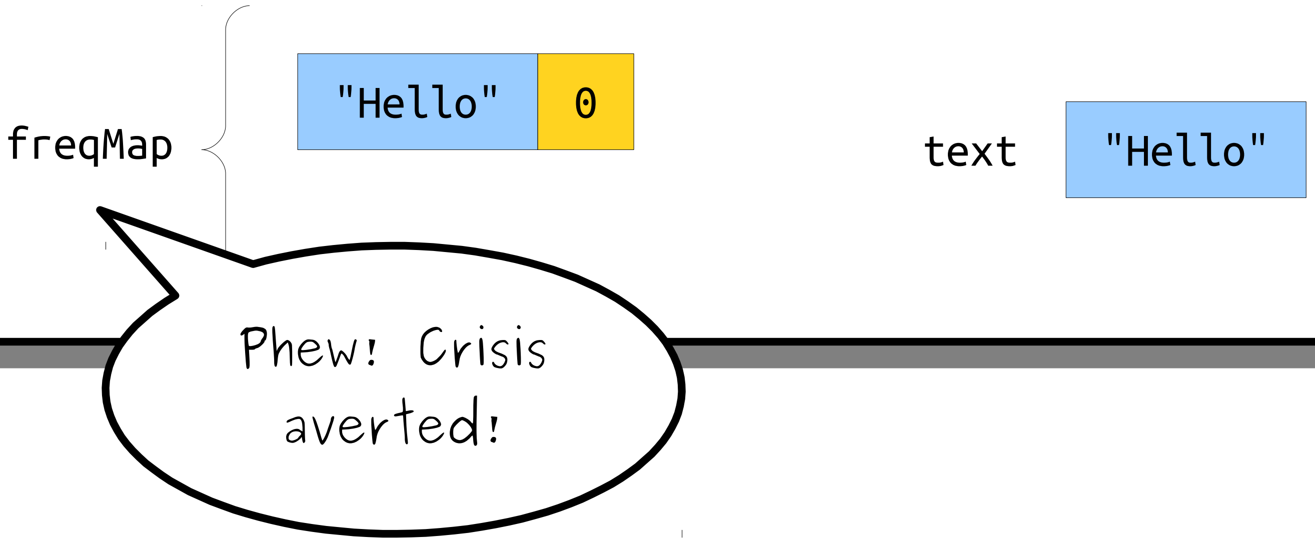

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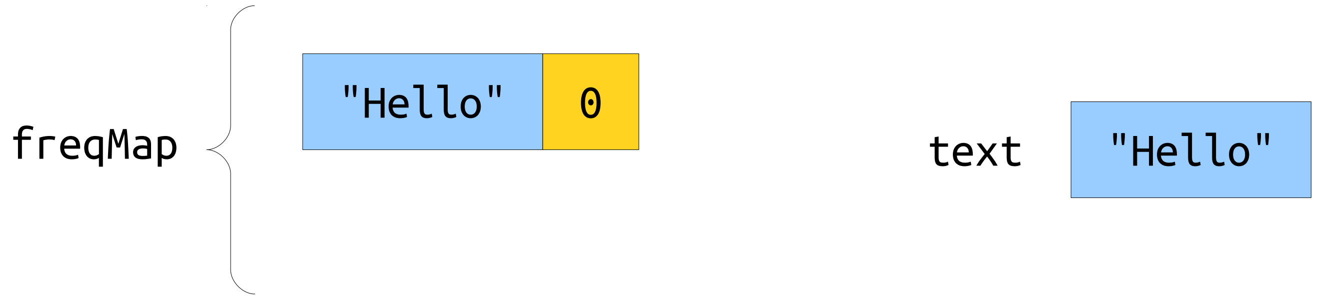

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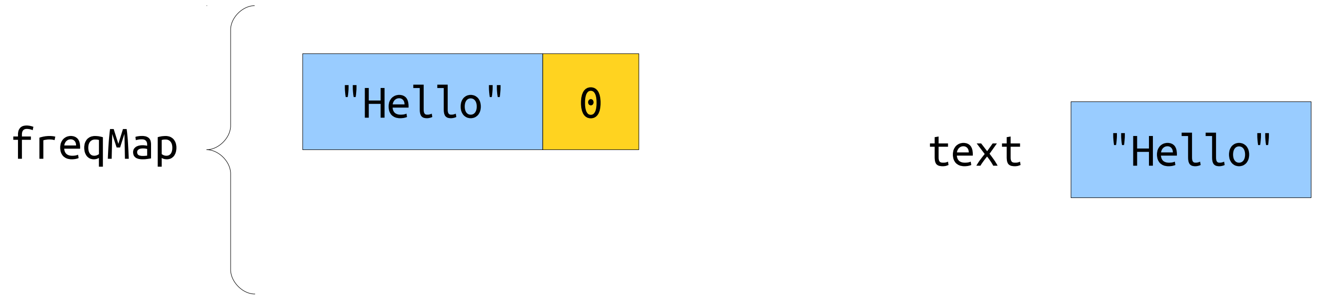

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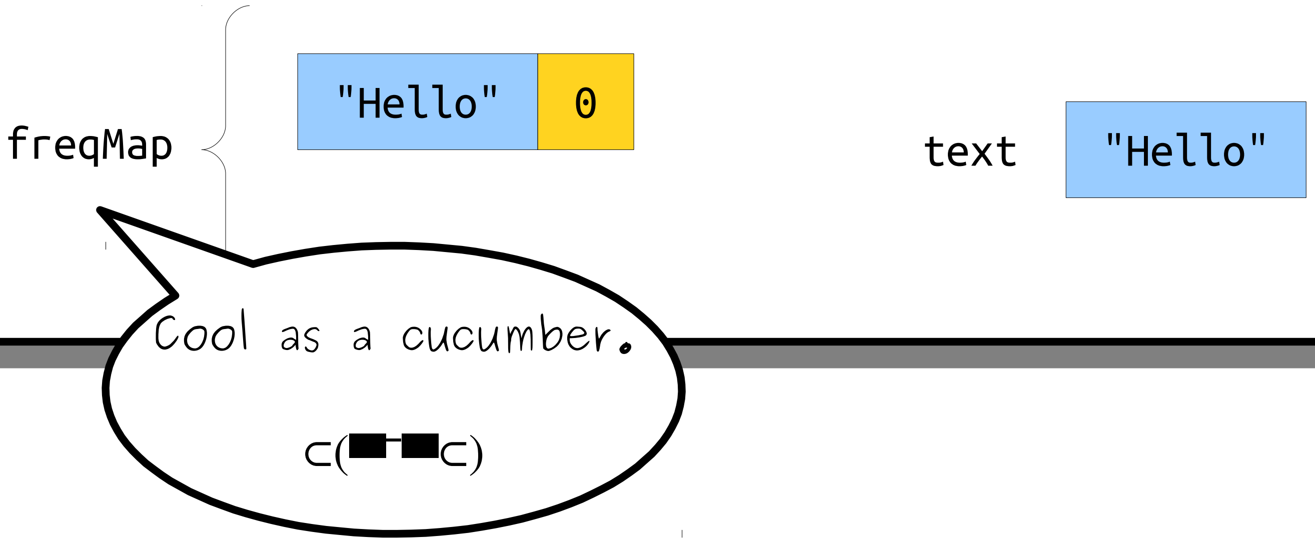

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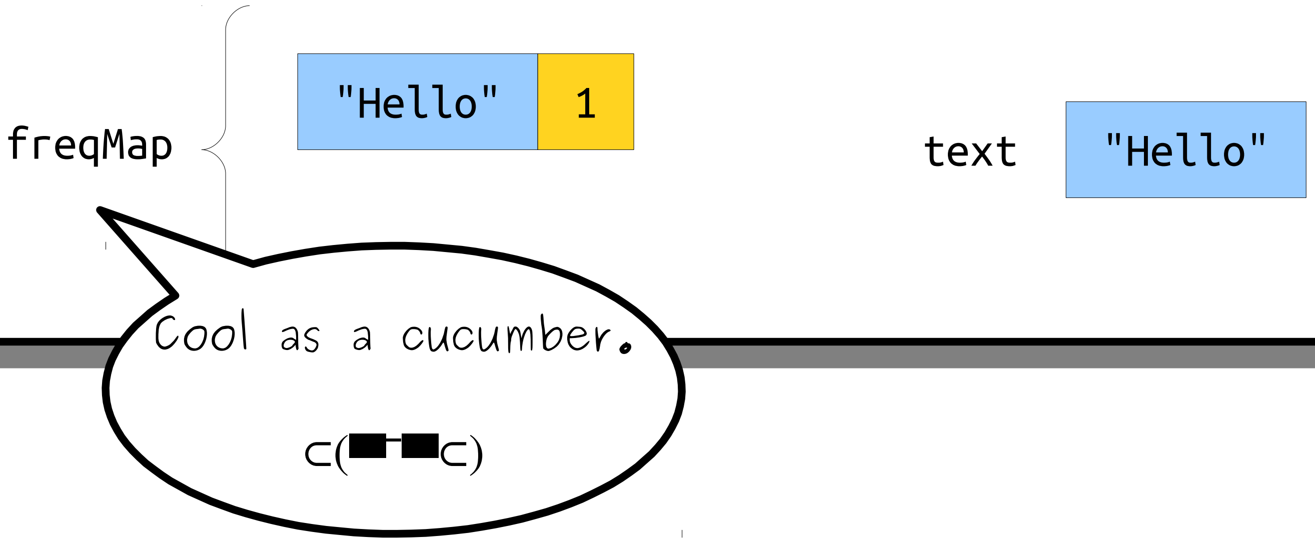

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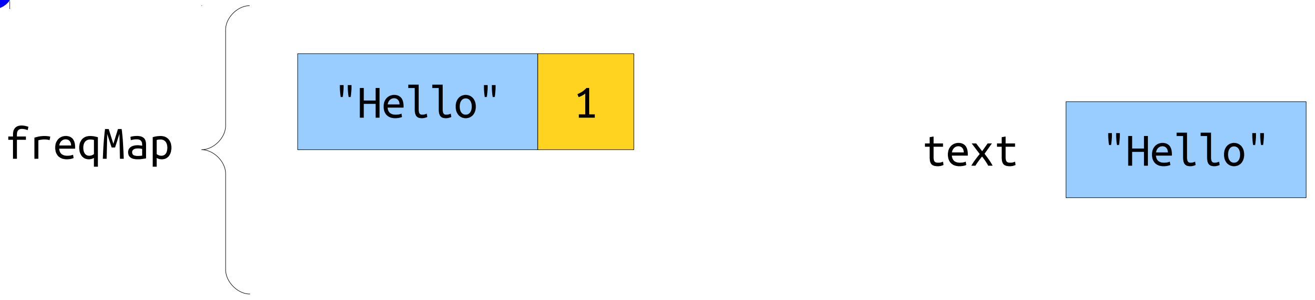

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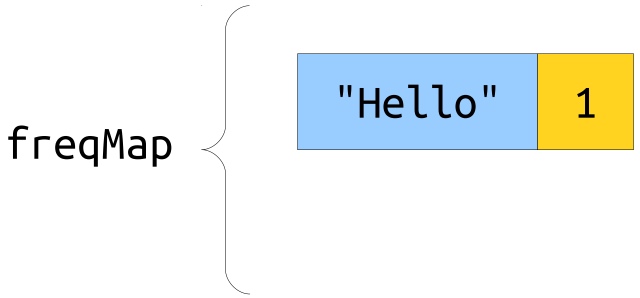

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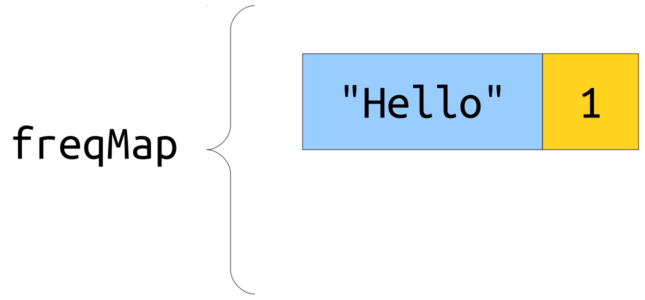

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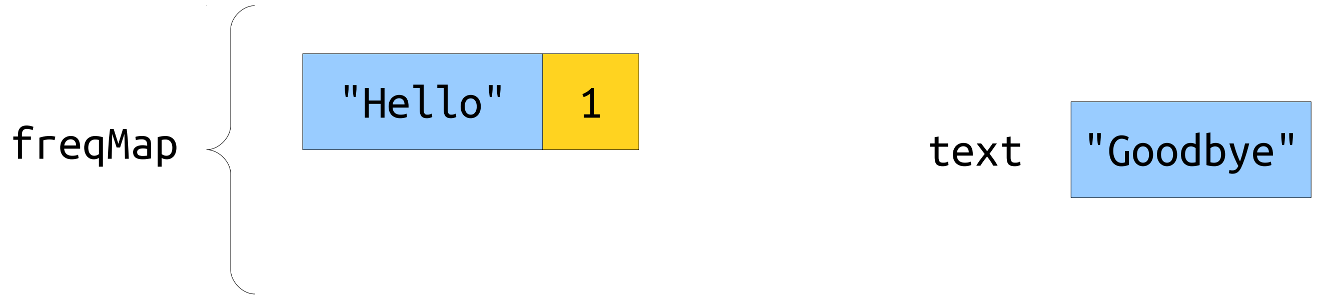

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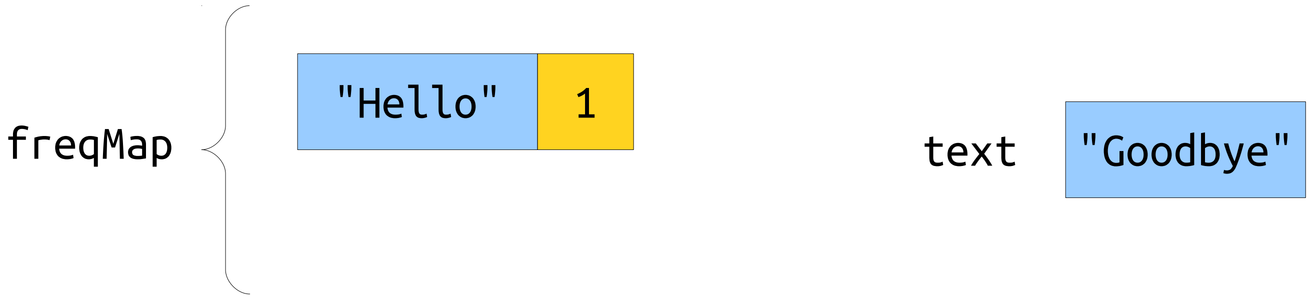

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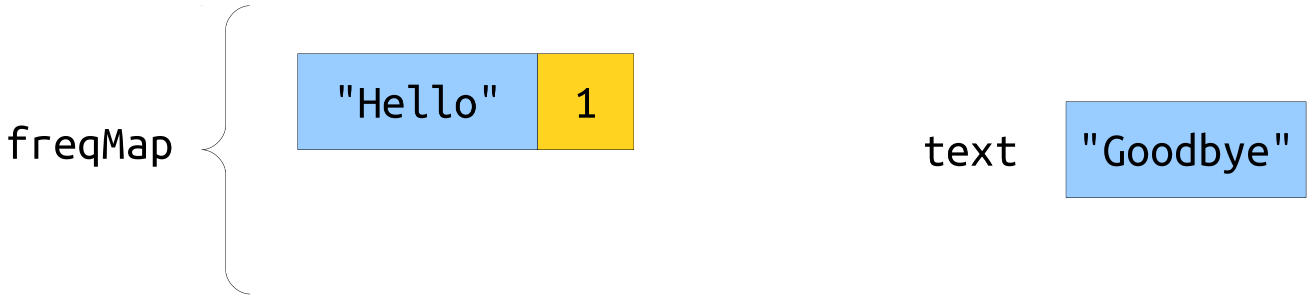

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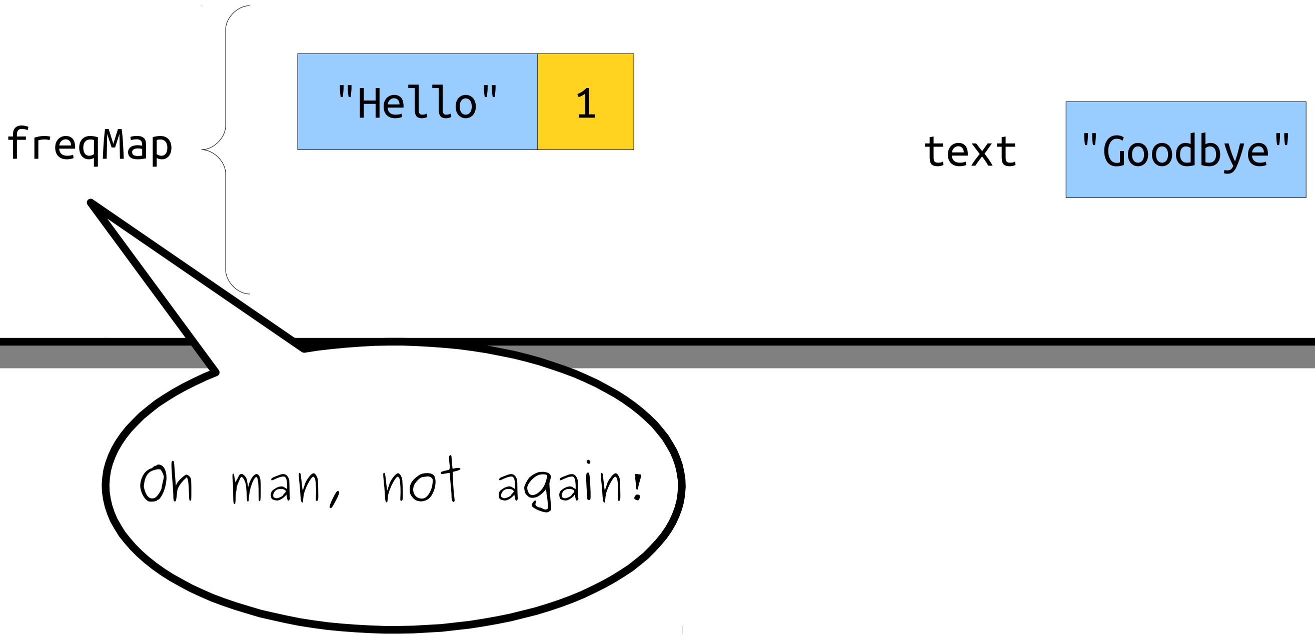

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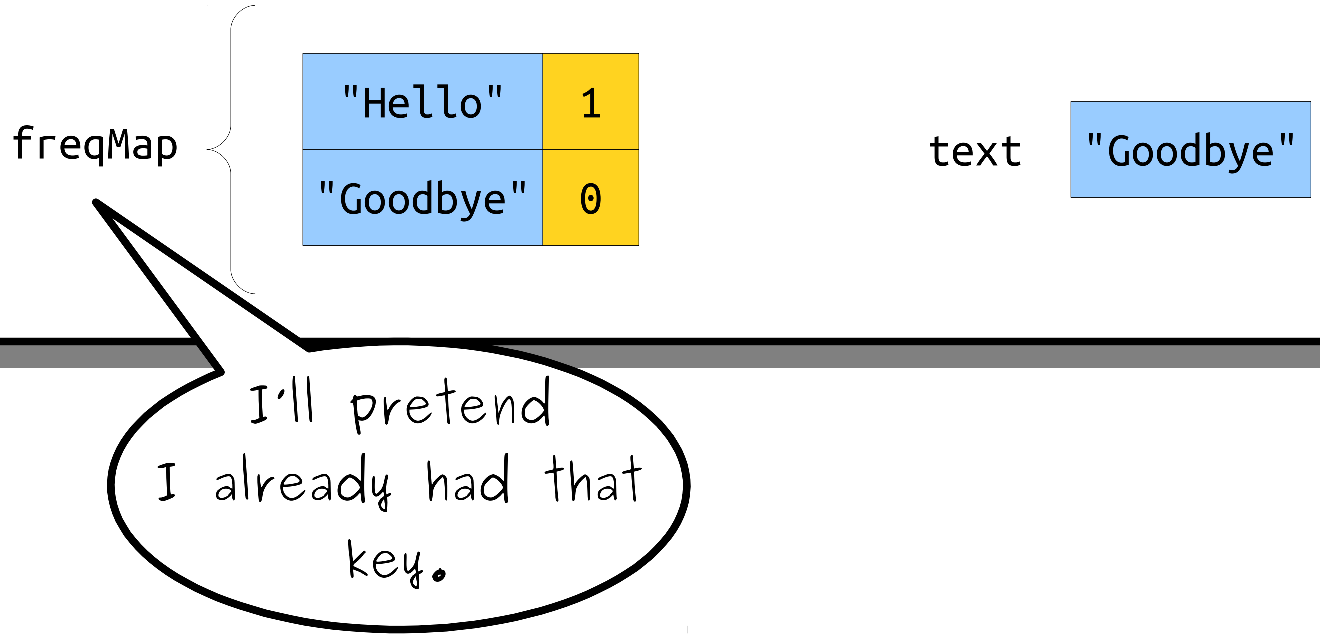

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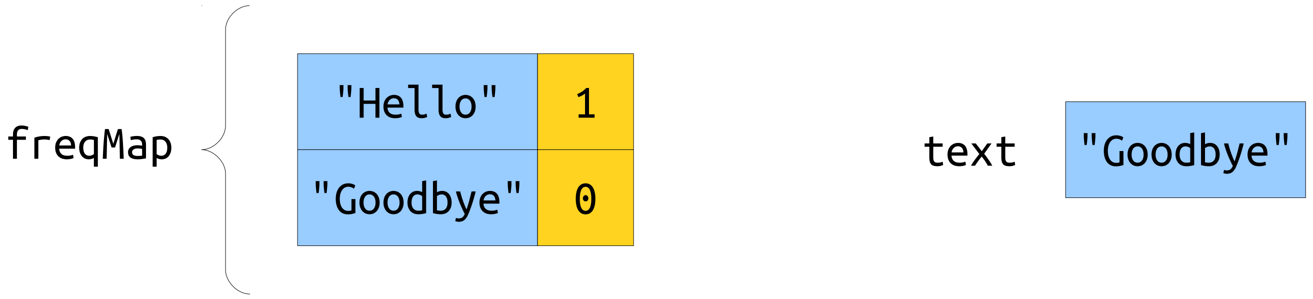

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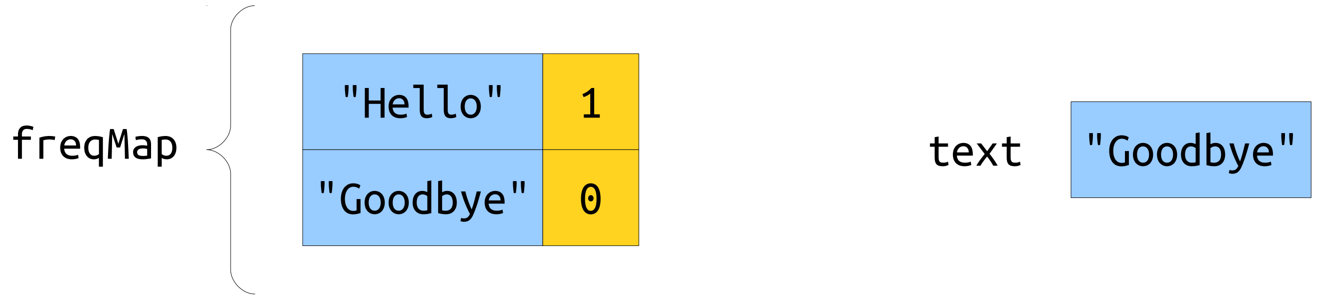

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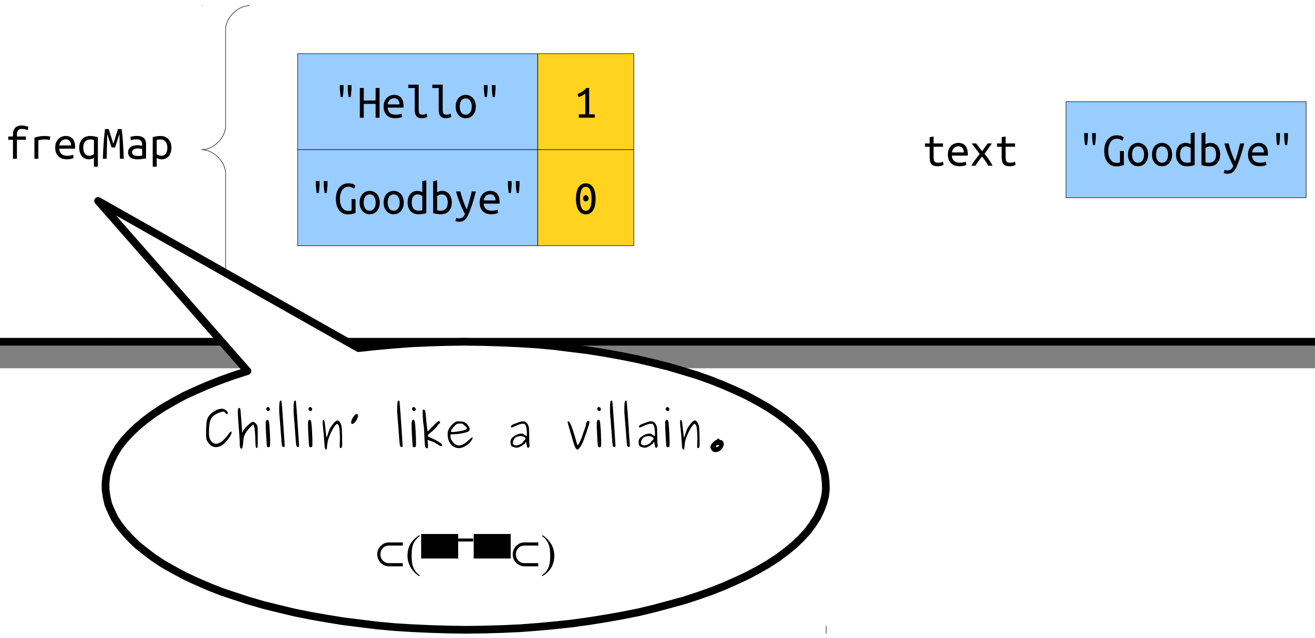

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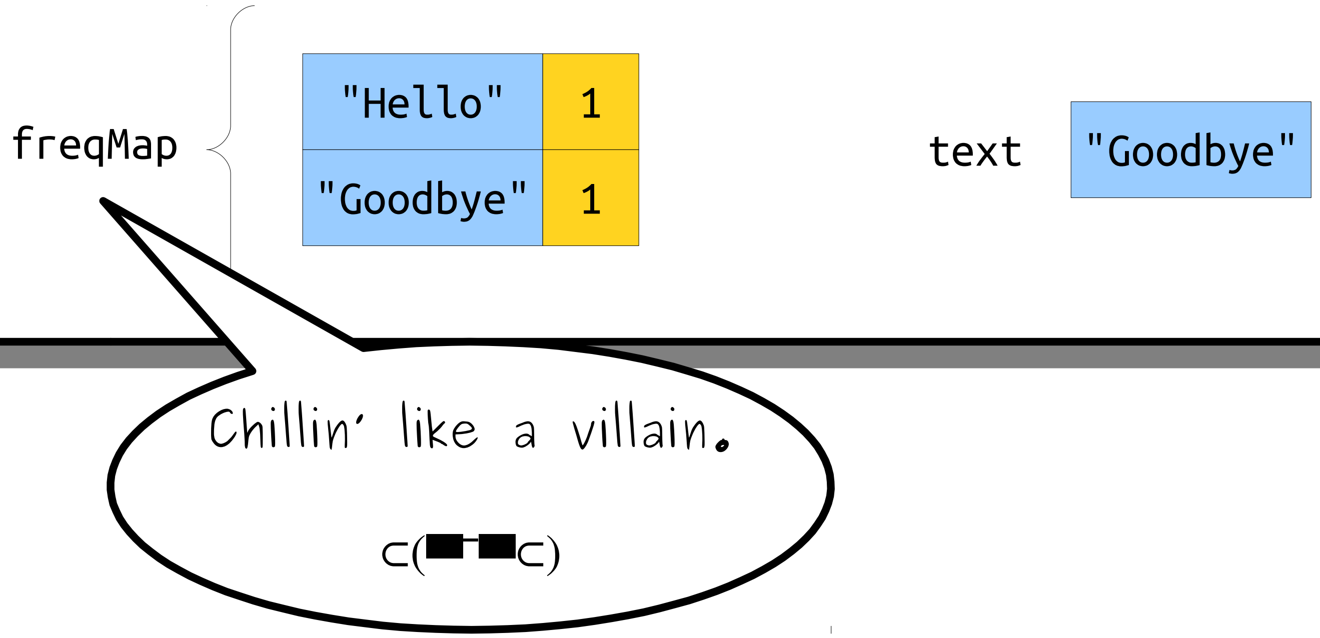

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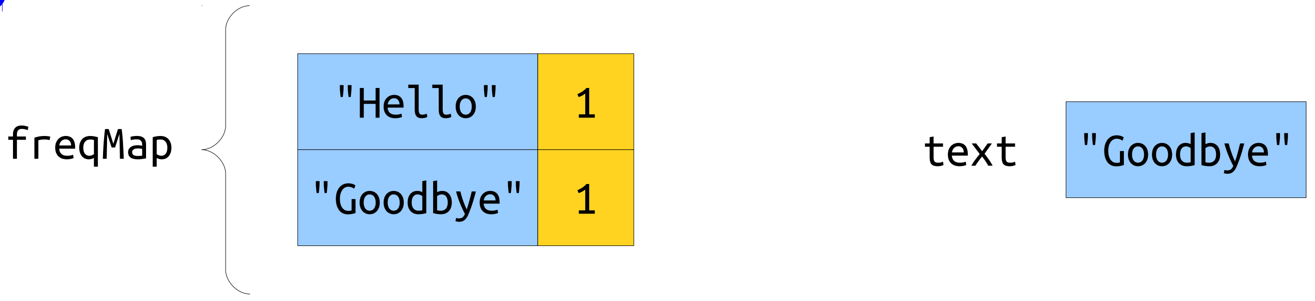

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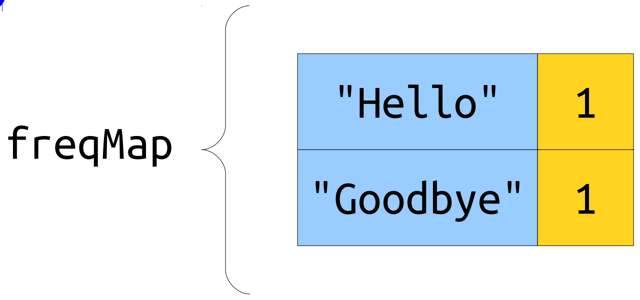

Sorting by First Letters

Map Autoinsertion

```
Lexicon english("EnglishWords.dat");

Map<char, Lexicon> wordsByFirstLetter;
for (string word: english) {
   wordsByFirstLetter[word[0]].add(word);
}
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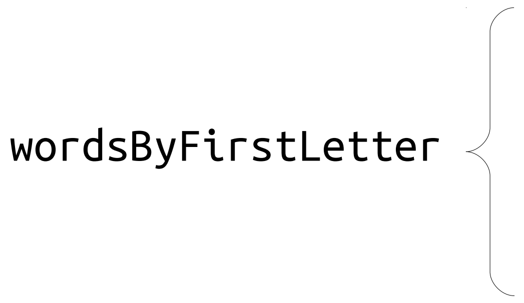

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wordsByFirstLetter
word
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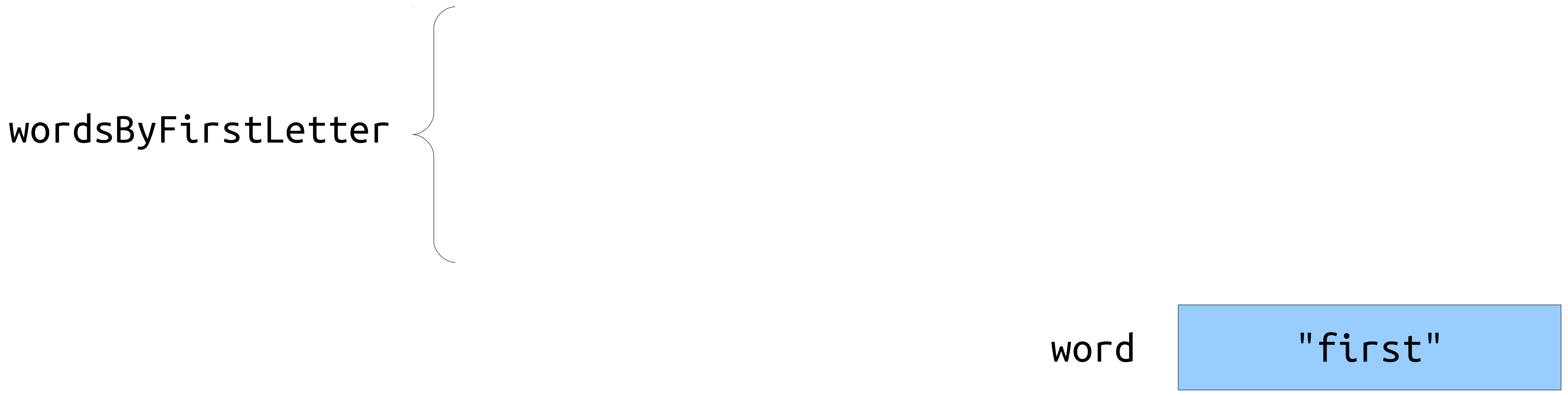

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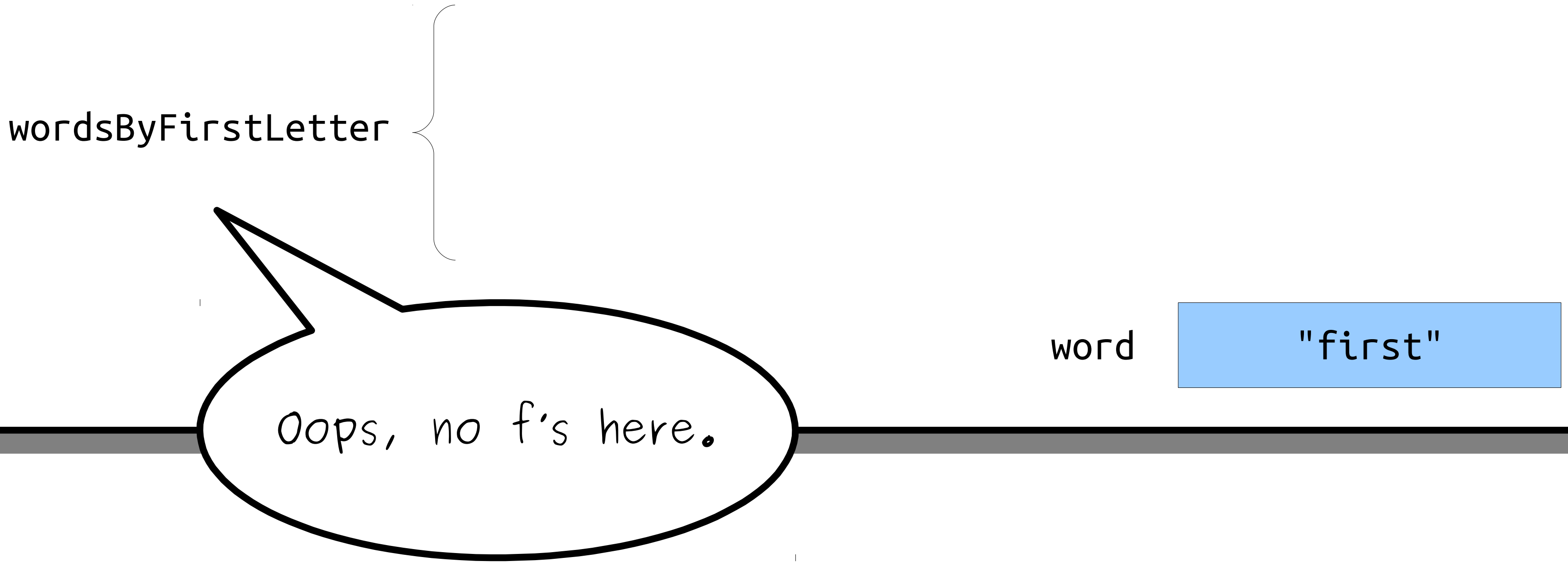

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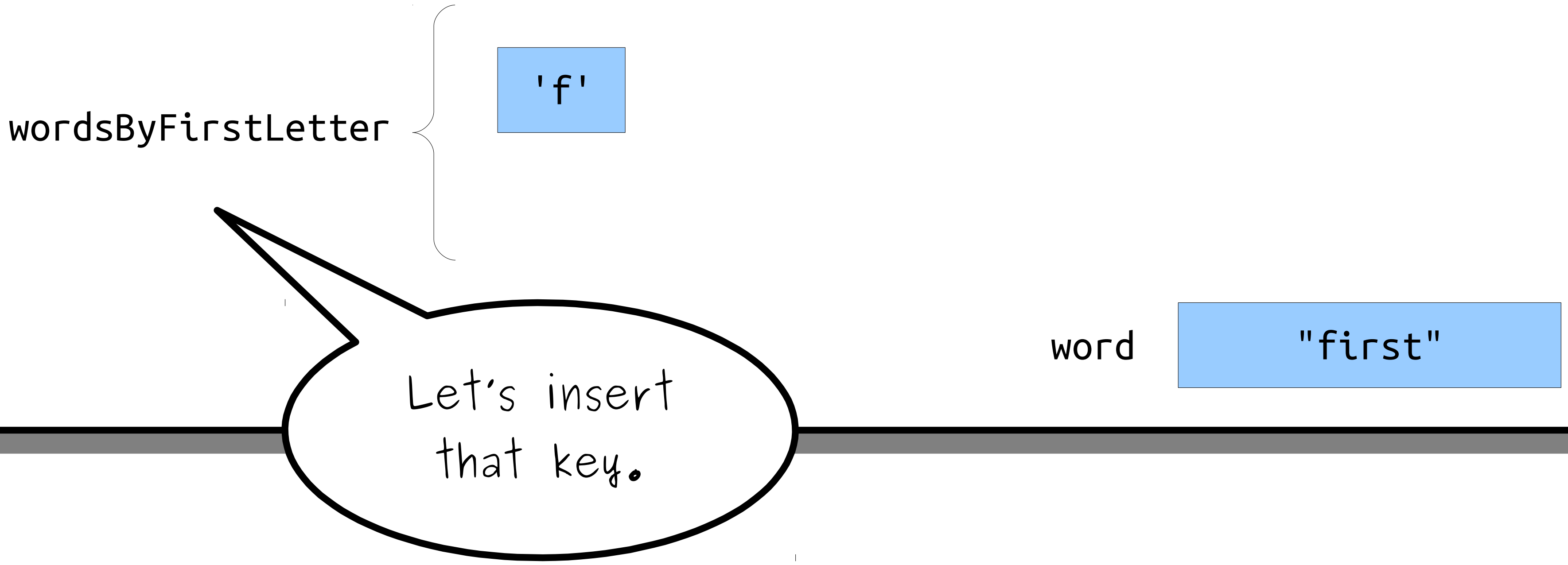

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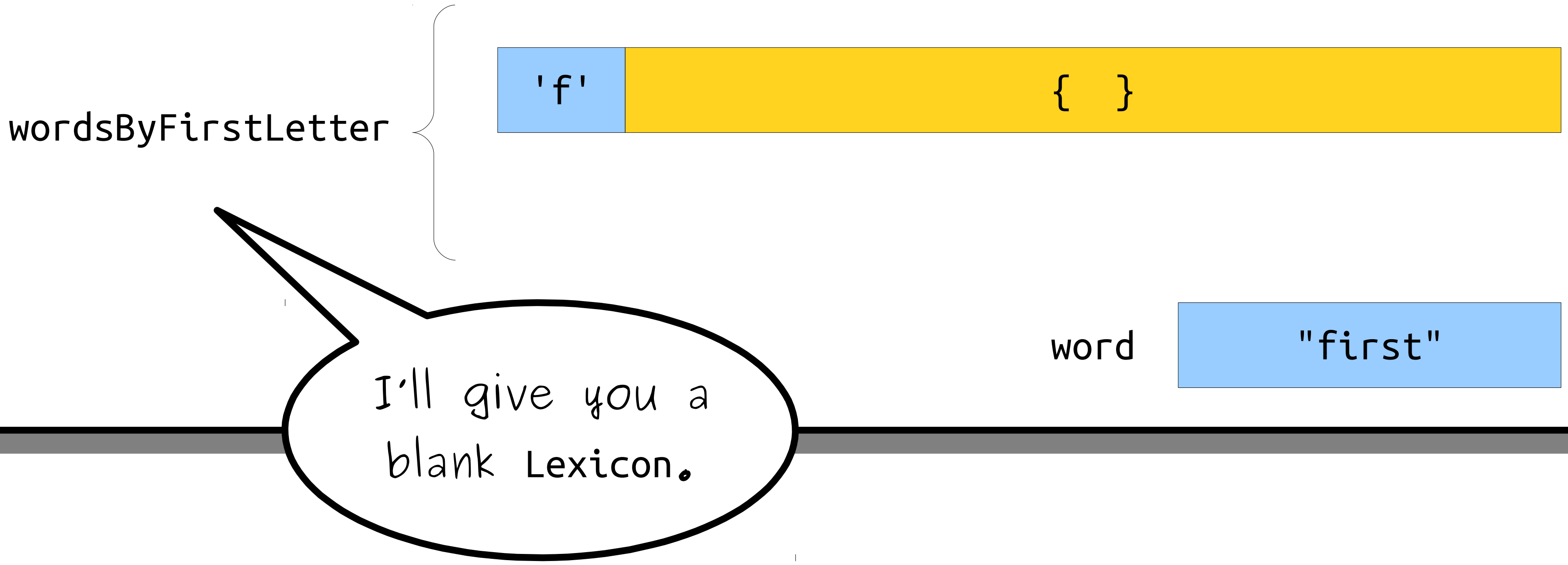

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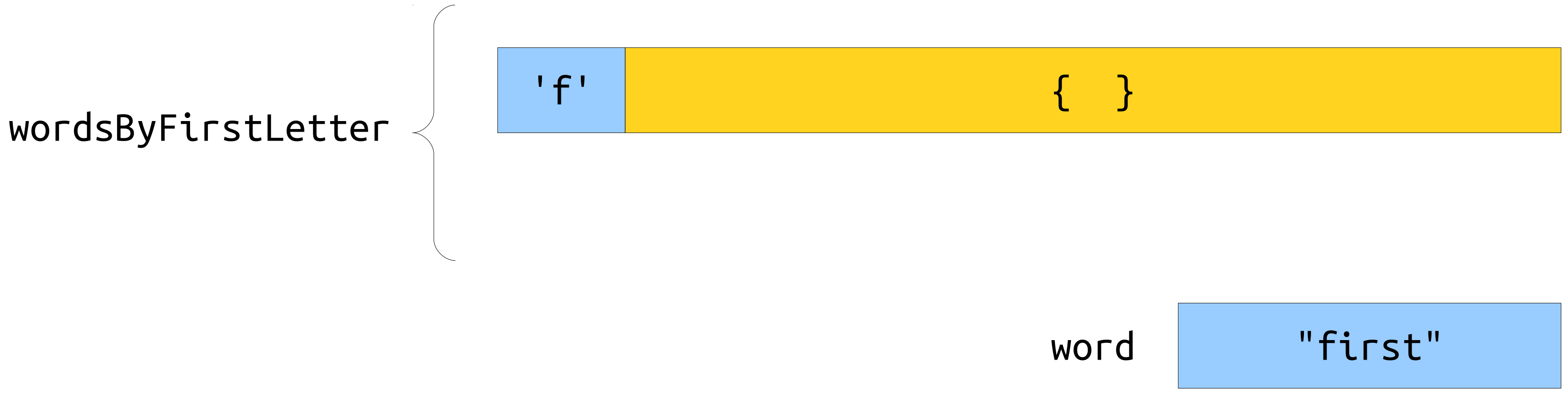
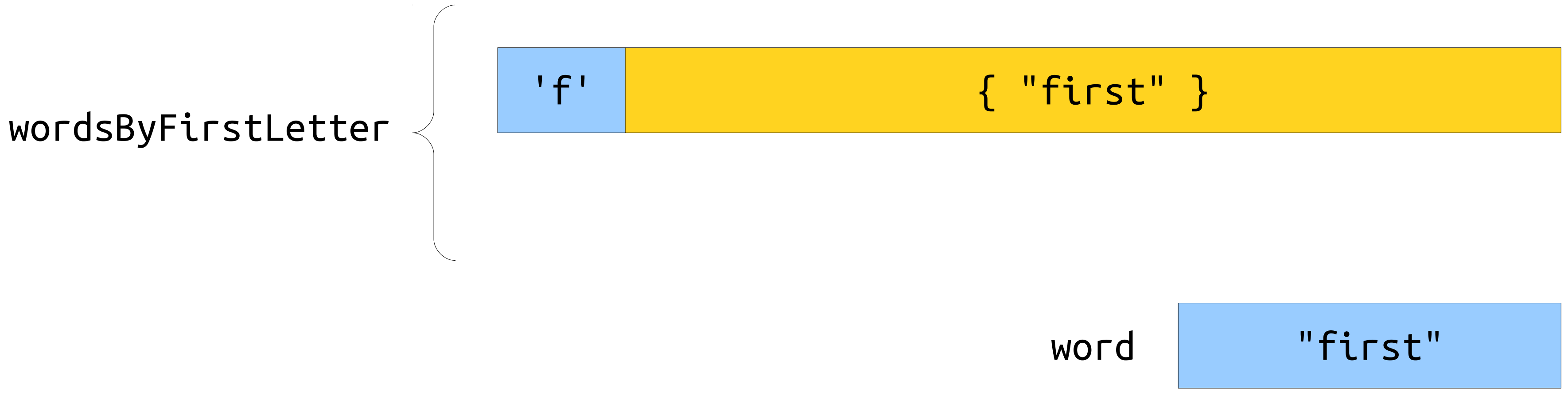


Map Autoinsertion

```
Lexicon english("EnglishWords.dat");

Map<char, Lexicon> wordsByFirstLetter;
for (string word: english) {
    wordsByFirstLetter[word[0]].add(word);
}
```



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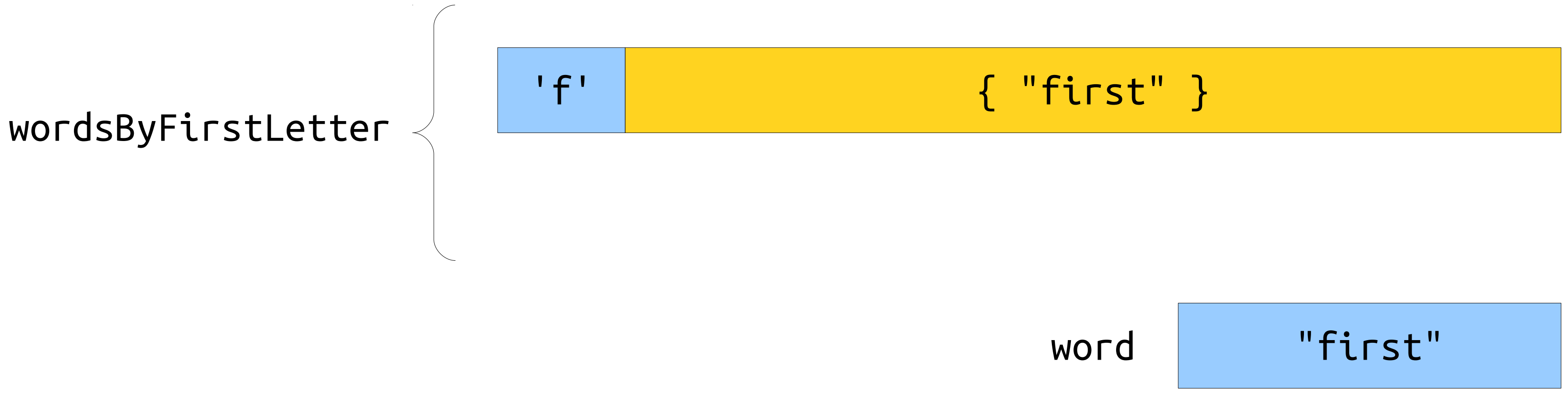

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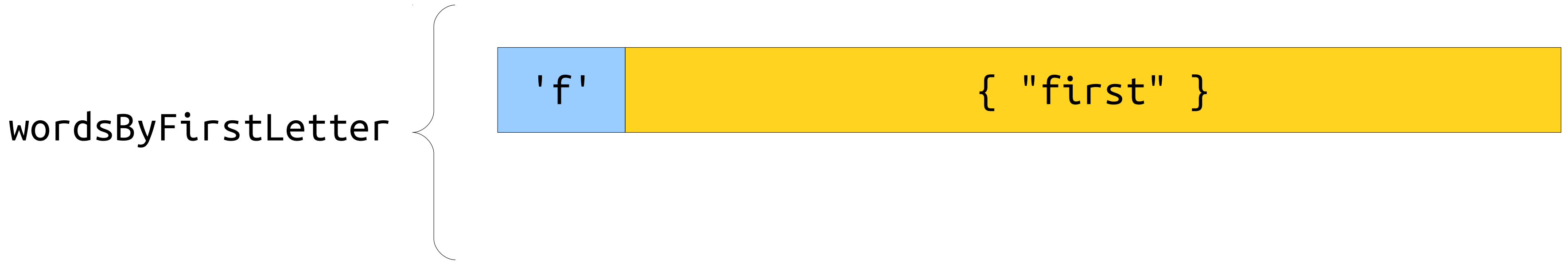

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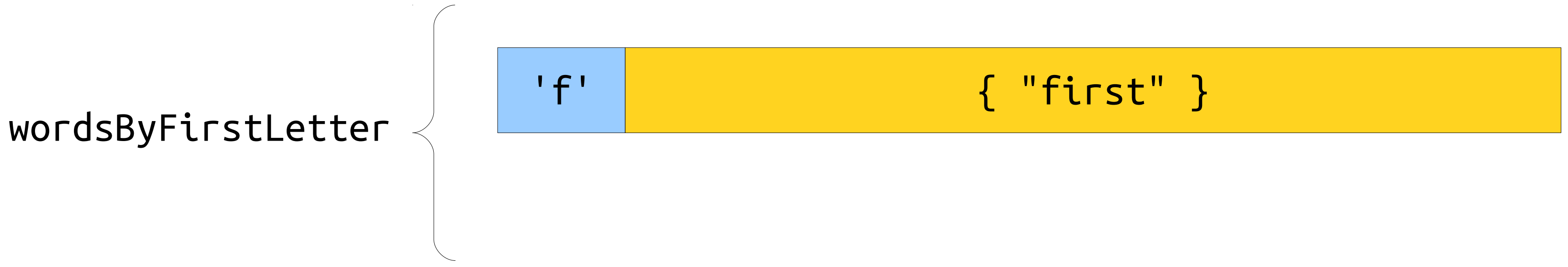

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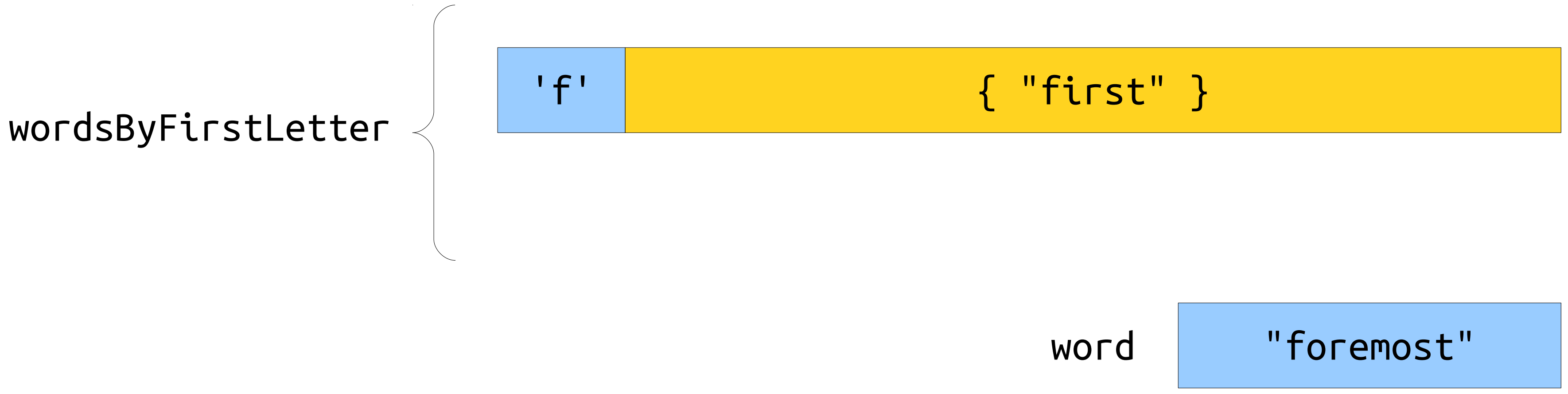

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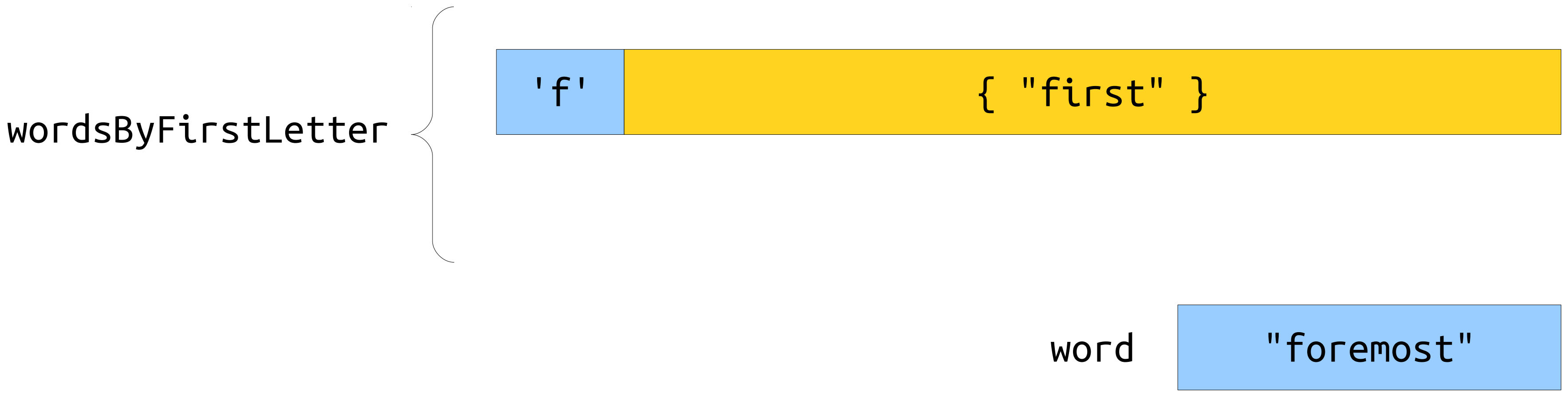

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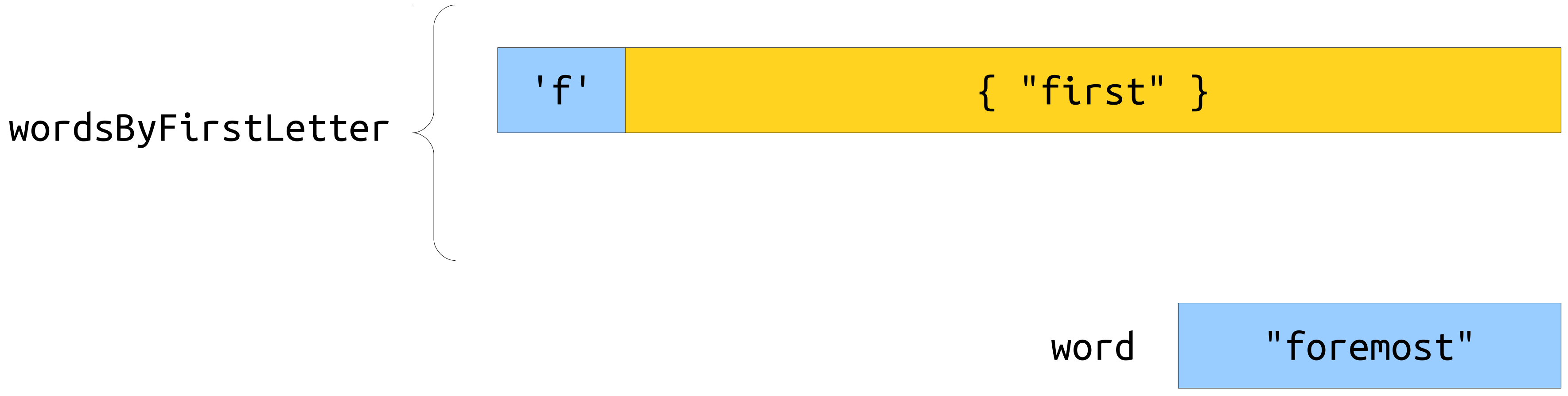

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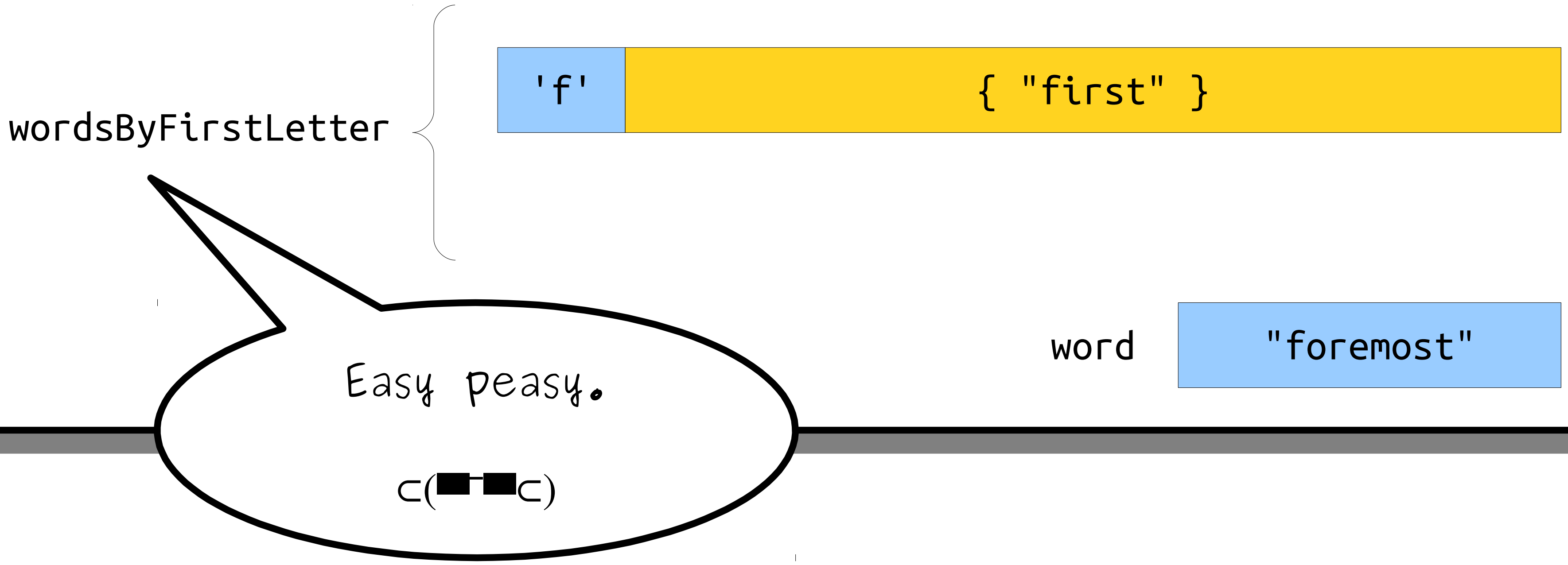

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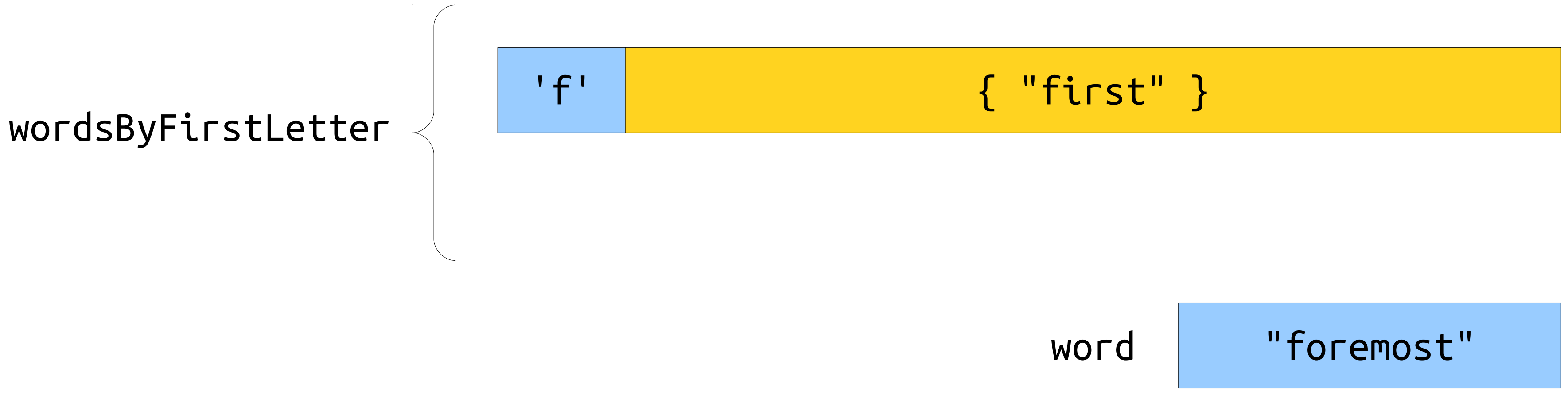

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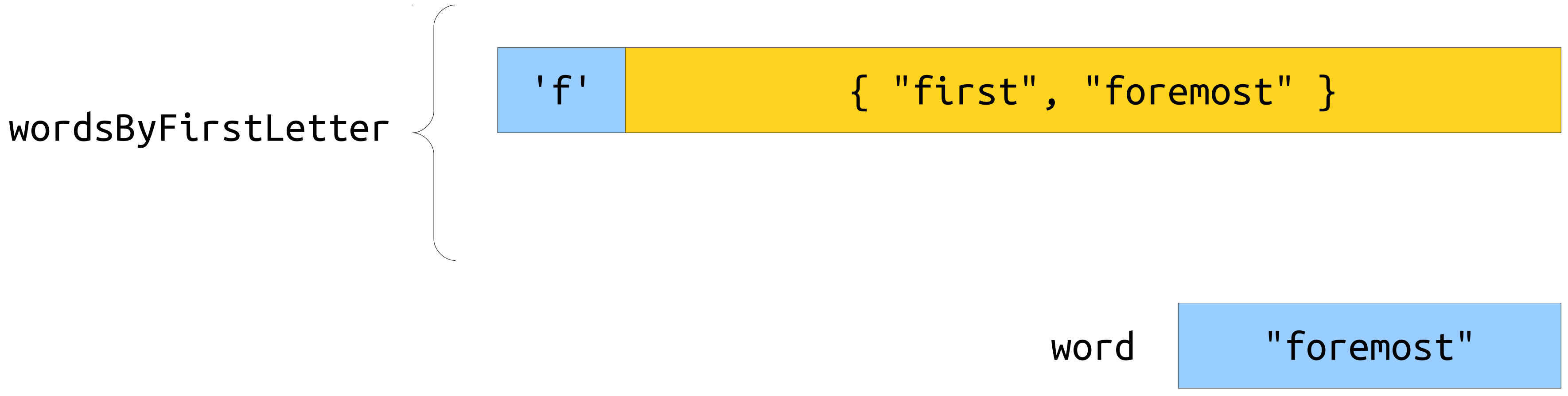

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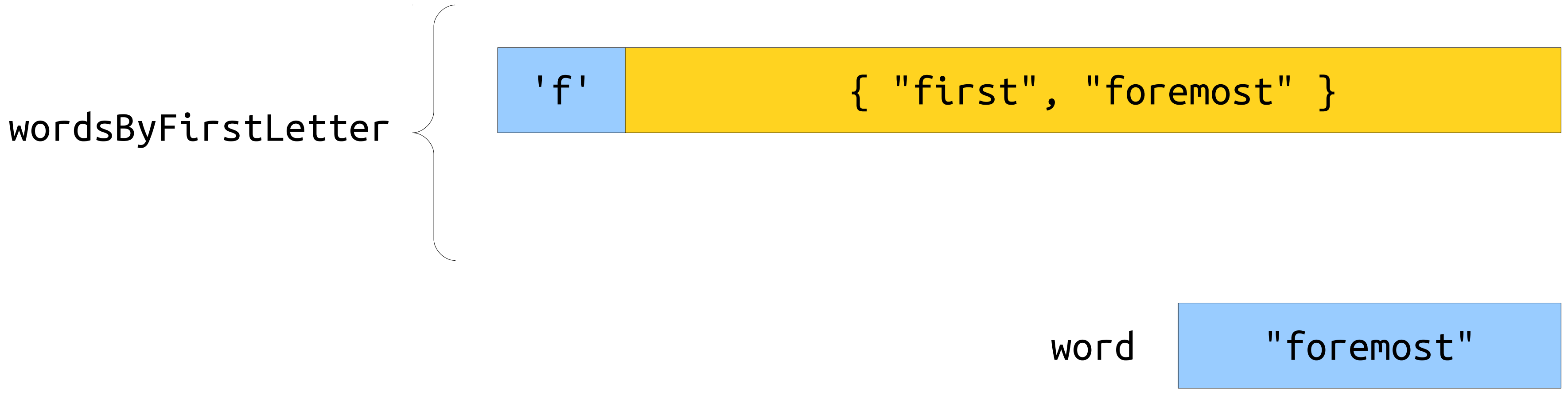

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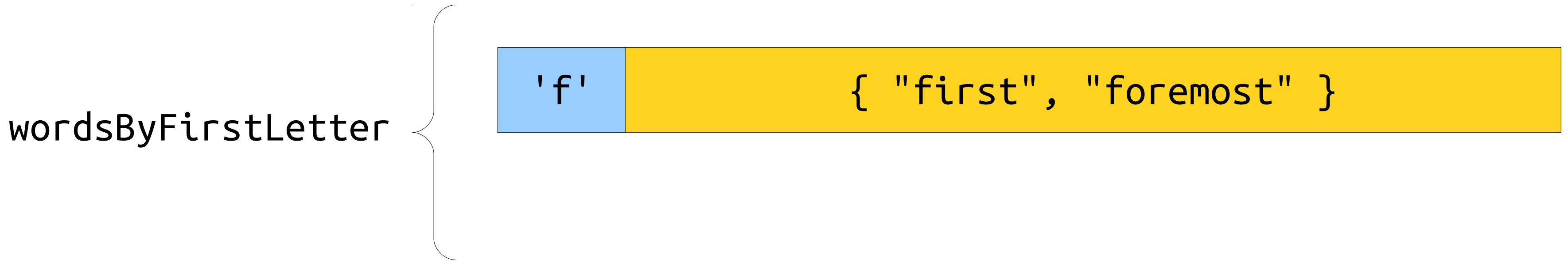

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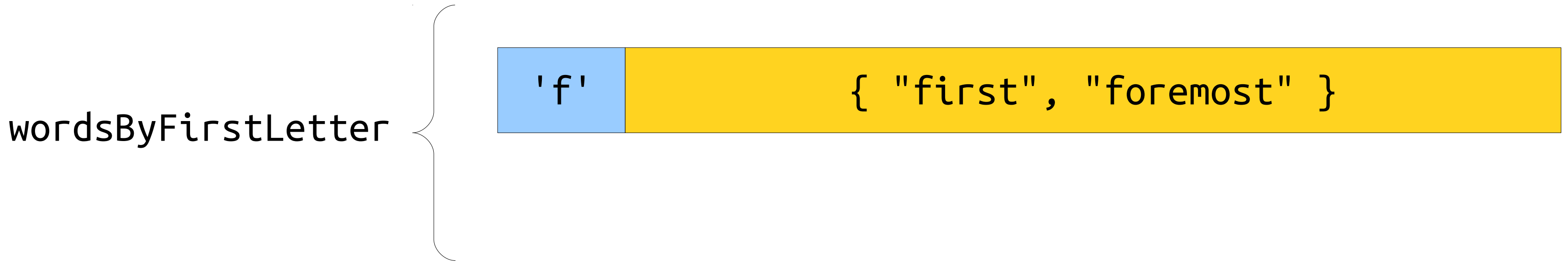

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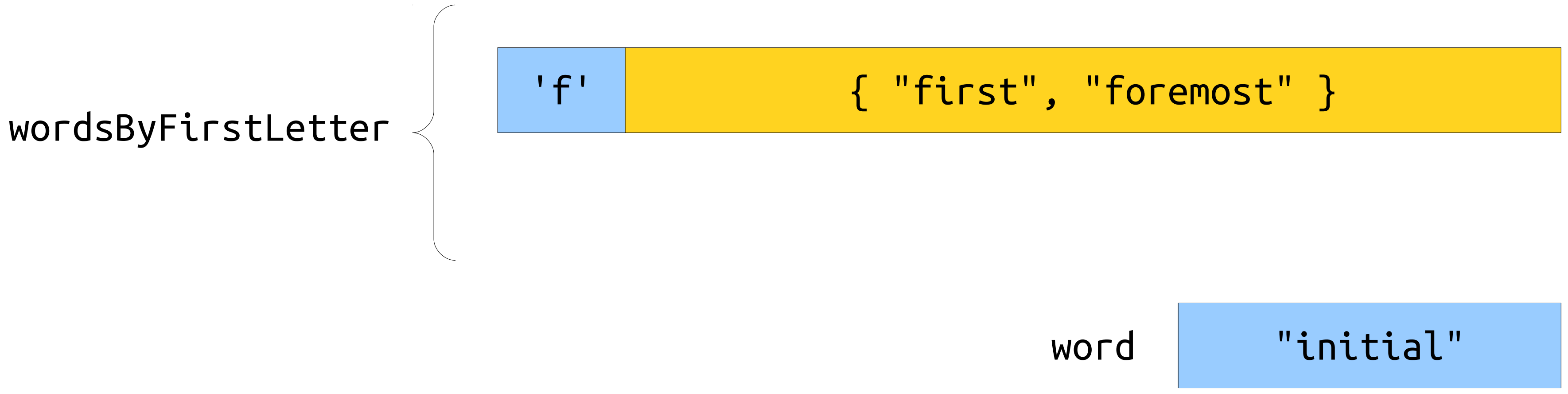

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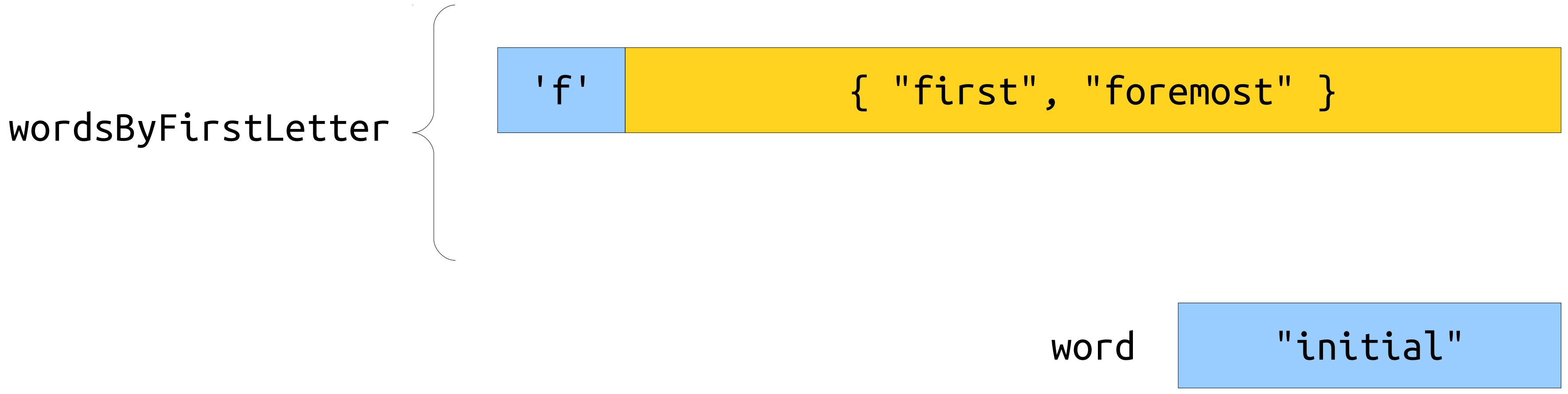

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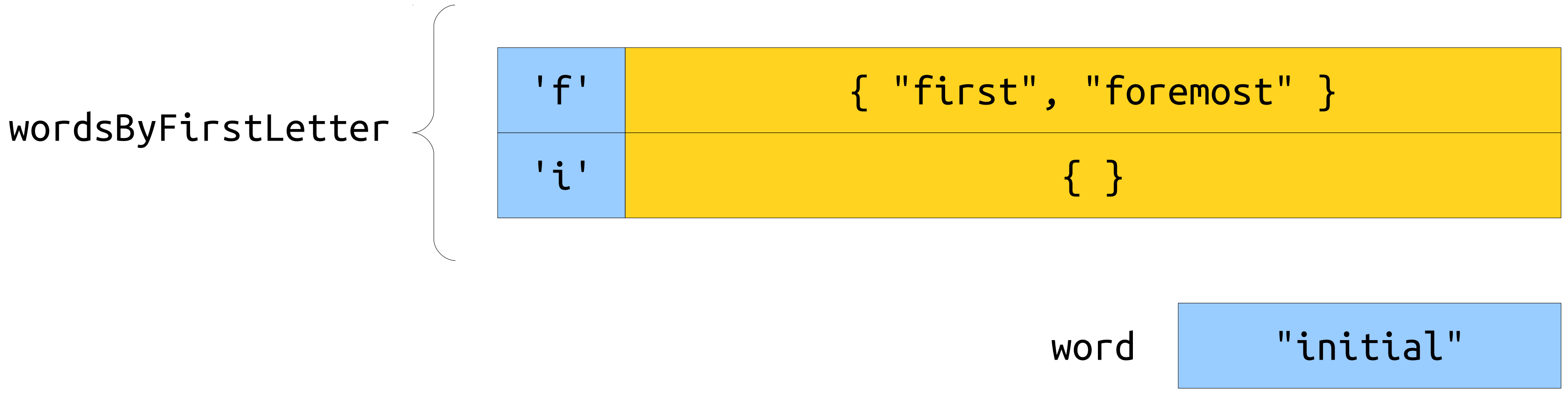

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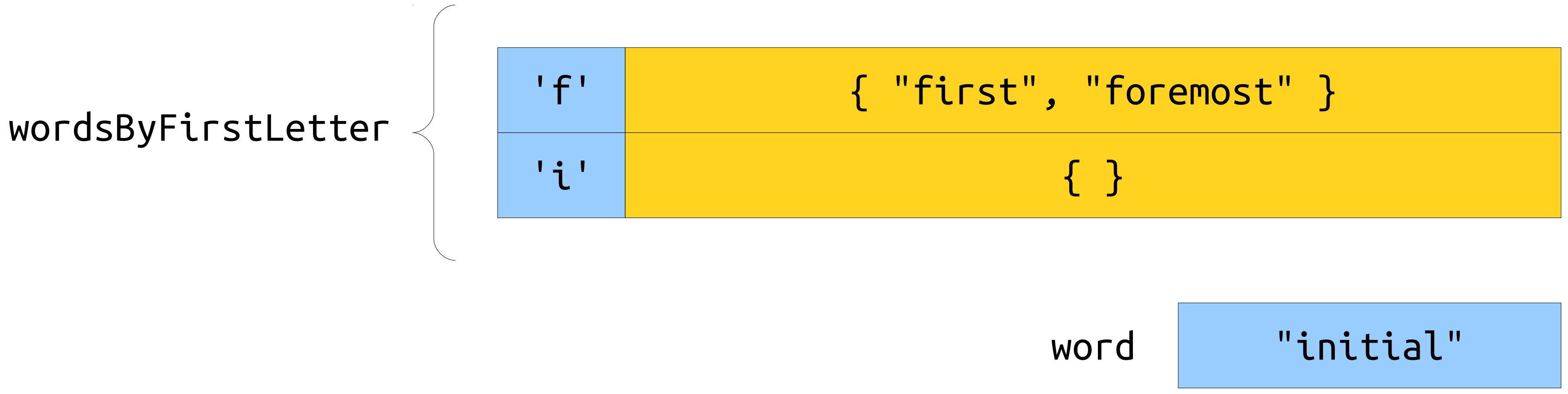

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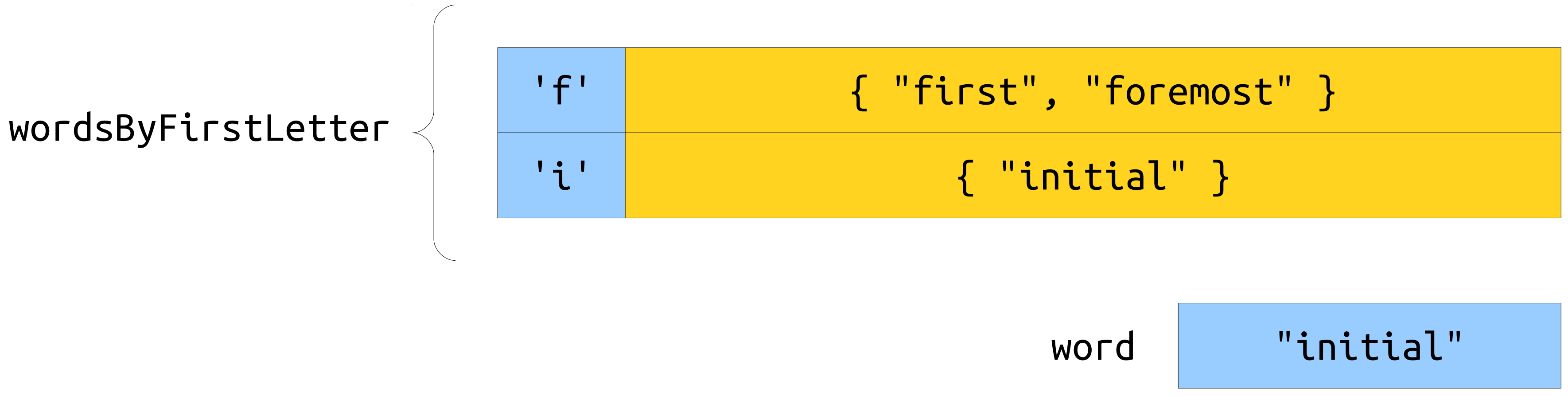


Anagrams

- Two words are ***anagrams*** of one another if the letters in one can be rearranged into the other.
- Some examples:
  - “Senator” and “treason.”
  - “Praising” and “aspiring.”
  - “Arrogant” and “tarragon.”
- ***Question for you:*** does this concept exist in other languages? If so, please send me examples!

Anagrams

- ***Nifty fact:*** two words are anagrams if you get the same string when you write the letters in those words in sorted order.
- For example, “praising” and “aspiring” are anagrams because, in both cases, you get the string “aiignprs” if you sort the letters.

Anagram Clusters

- Let’s group all words in English into “clusters” of words that are all anagrams of one another.
- We’ll use a `Map<string, Lexicon>`.
  - Each key is a string of letters in sorted order.
  - Each value is the collection of English words that have those letters in that order.

Assignment 2 Demo

Assignment 2

- Assignment 2 (Word Play) goes out today. It’s due a week from today at the start of class.
  - Play around with properties of words and discover some new things along the way!
  - Solidify your understanding of container types and procedural decomposition.
- ***Start this one early.*** You’ll want to have some time to let things percolate and to ask for help when you need it.
- ***You must complete this assignment individually.*** Working in pairs is not permitted yet.

Assignment 2

- Our illustrious and industrious head TA Anton will be holding an assignment review session (YEAH Hours) tonight from 7PM in room 420-041.
- Highly recommended!

Next Time

- ***Thinking Recursively***
  - How can you best solve problems using recursion?
  - What techniques are necessary to do so?
  - And what problems yield easily to a recursive solution?

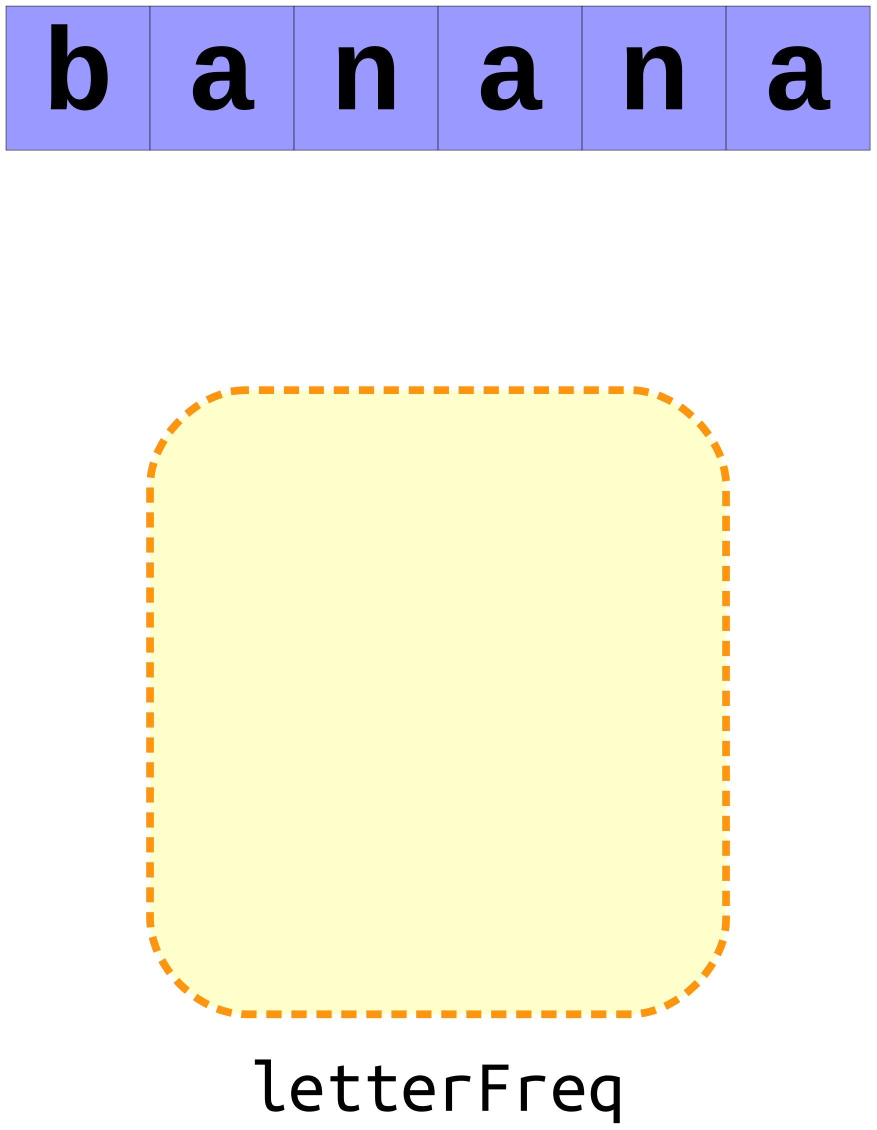
Extra Content: How to Sort a String

Counting Sort

Counting Sort

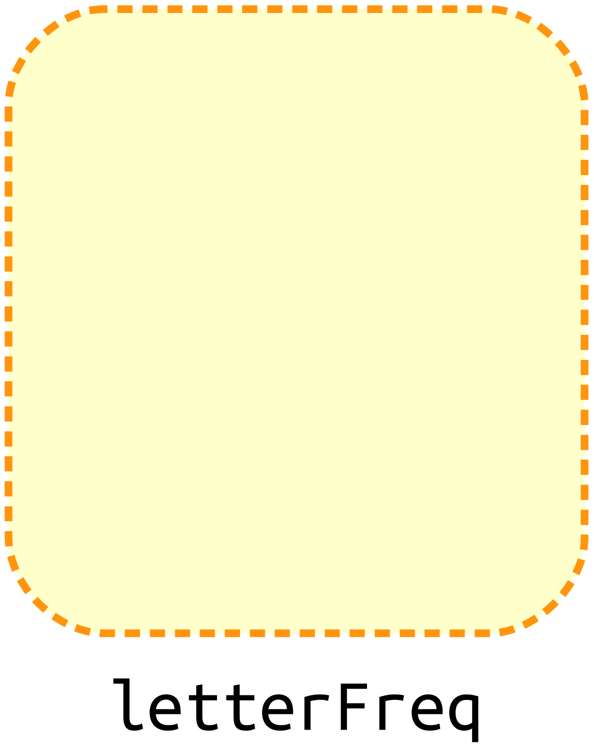
b	**a**	**n**	**a**	**n**	**a**

Counting Sort



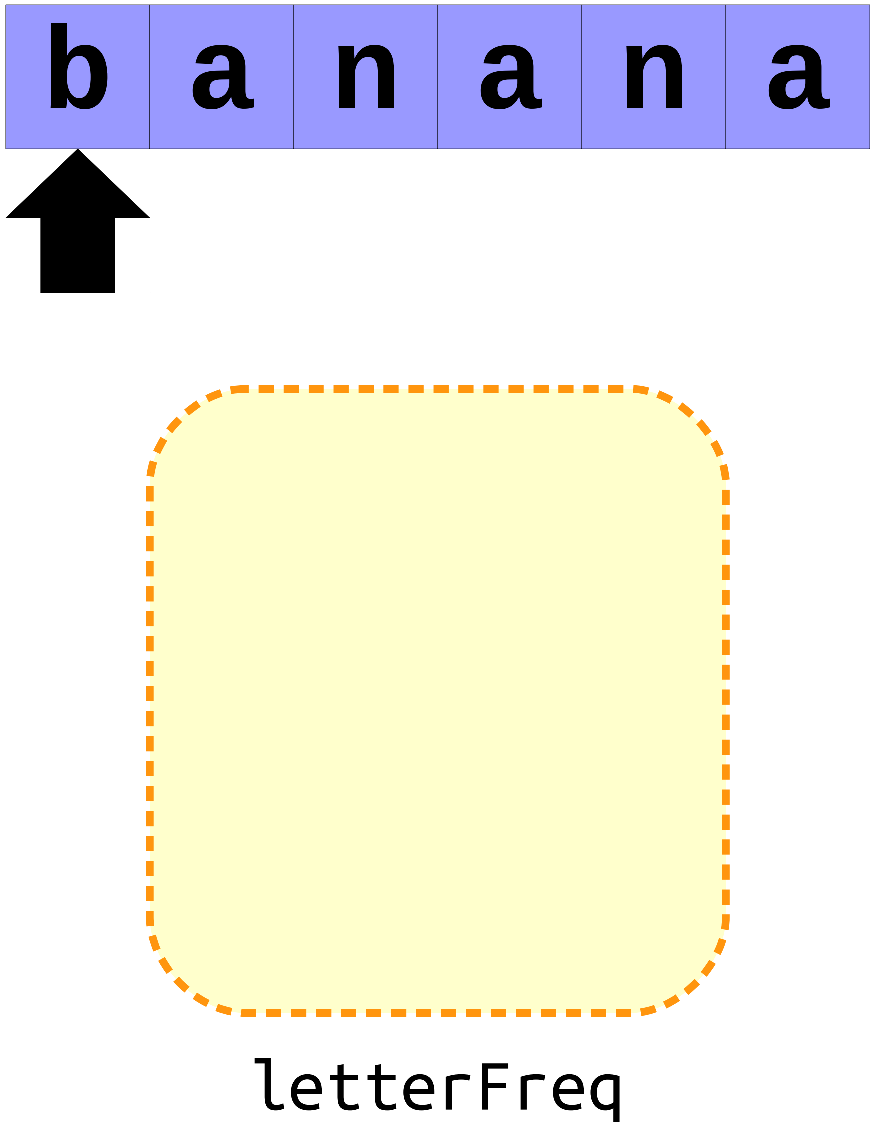
Counting Sort

b	a	n	a	n	a



```
for (char ch: input) {
    letterFreq[ch]++;
}
```

Counting Sort



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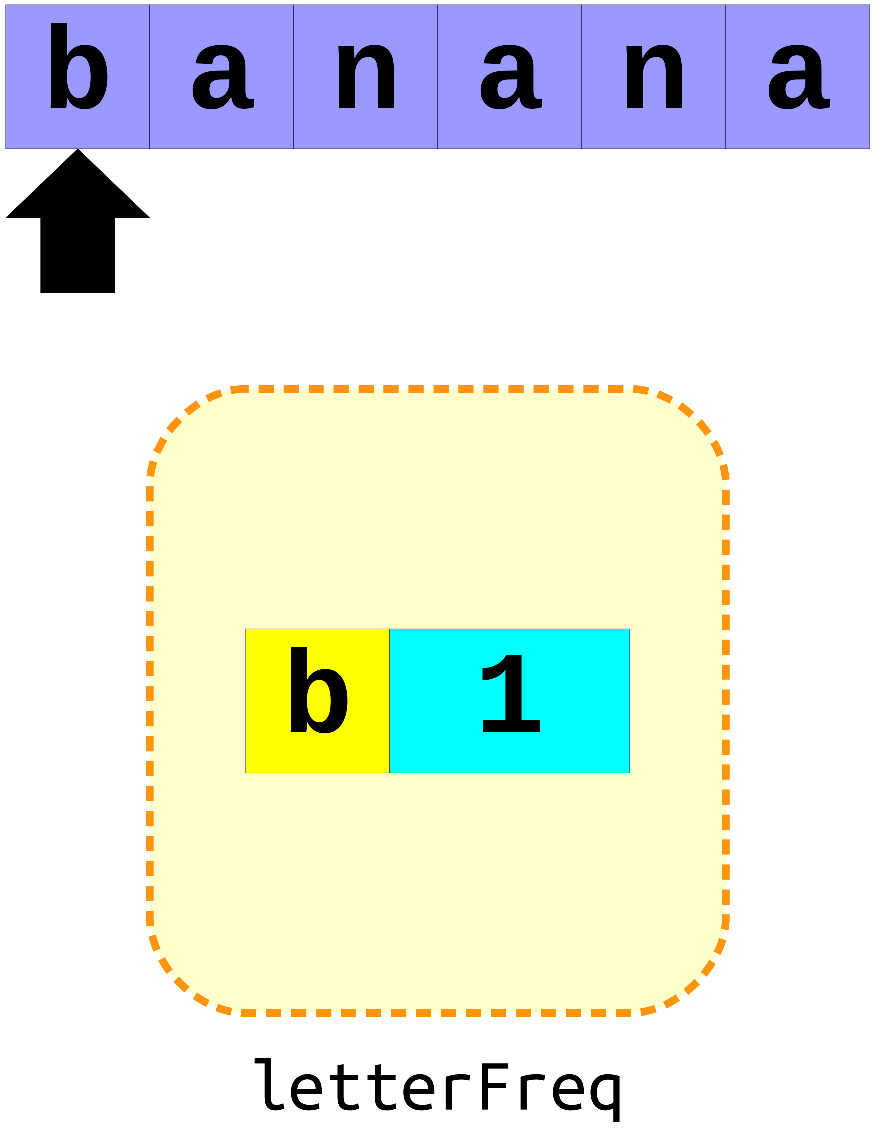
}
```

Counting Sort



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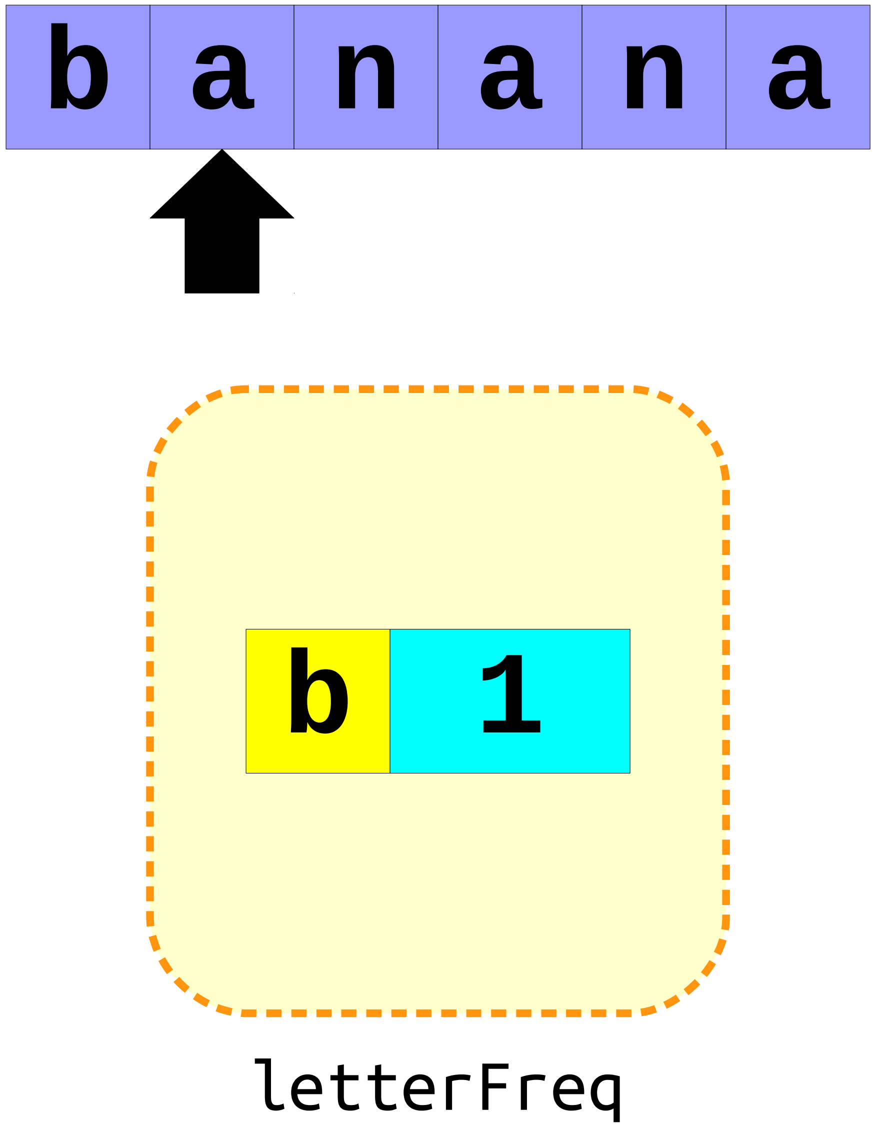
```

Counting Sort



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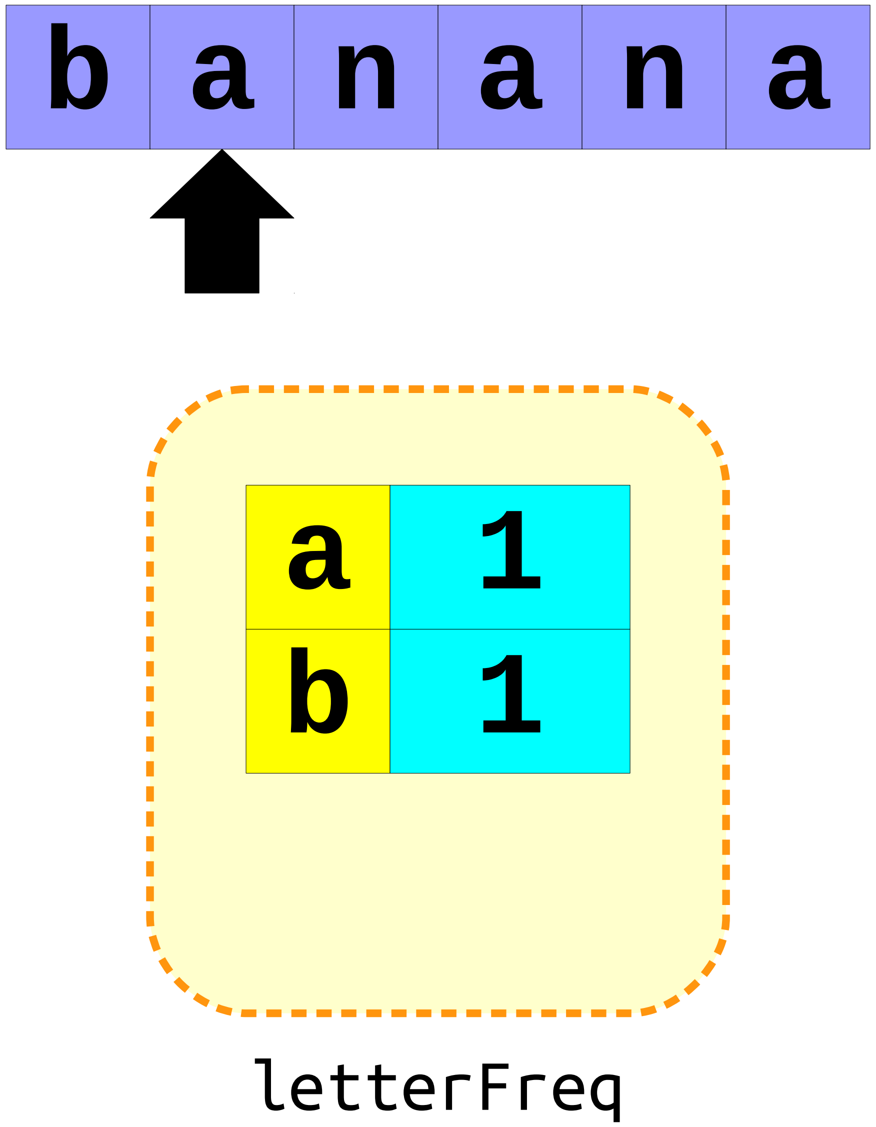
Counting Sort



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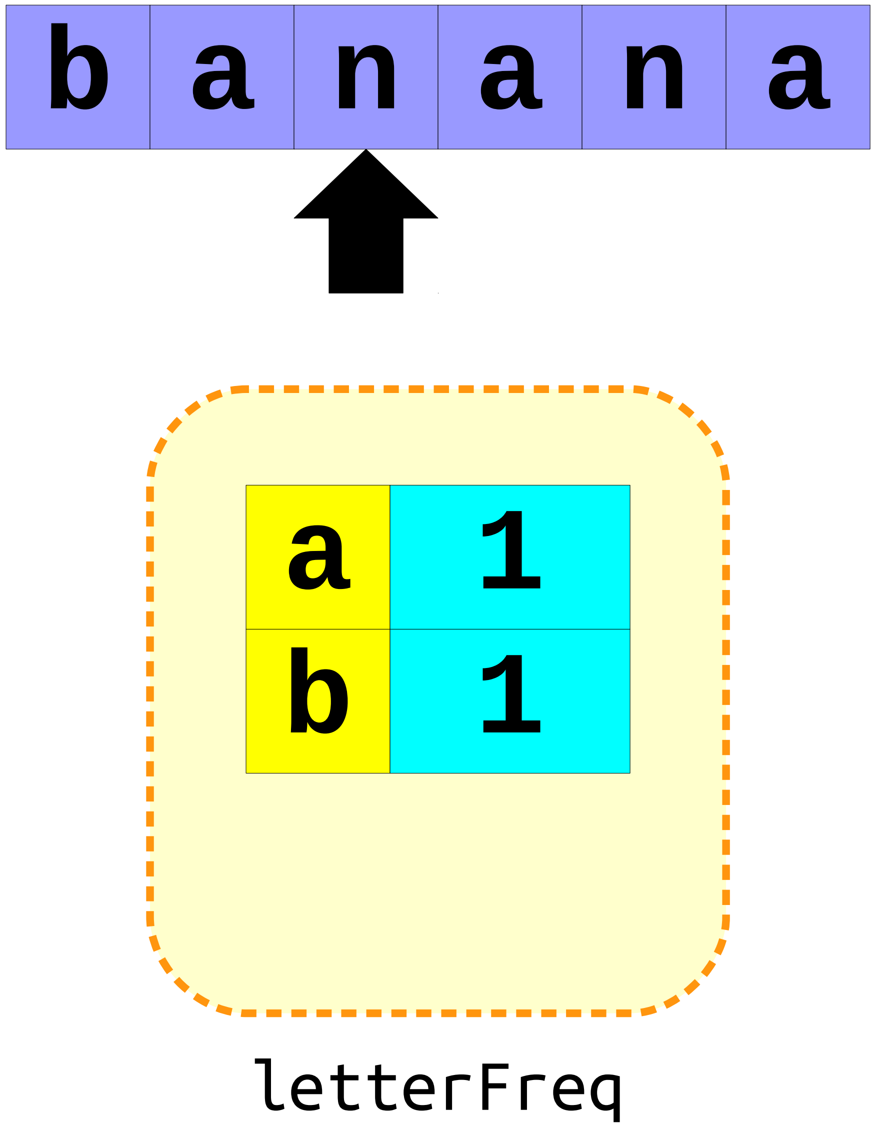
}
```

Counting Sort



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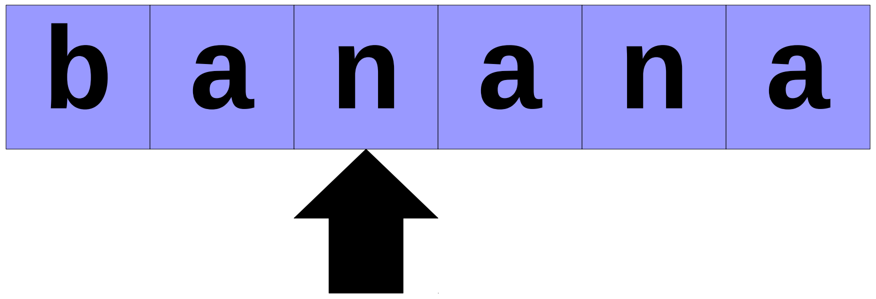
}
```

Counting Sort

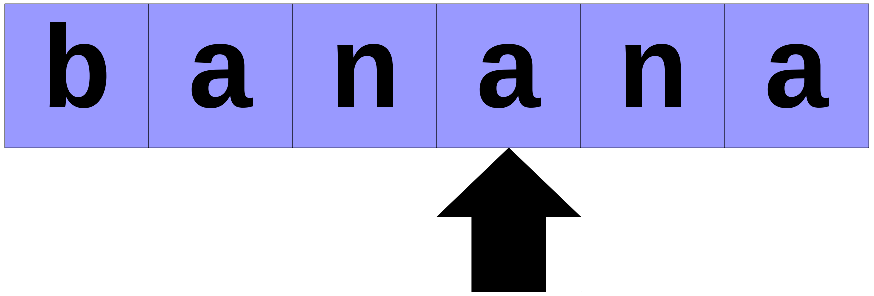


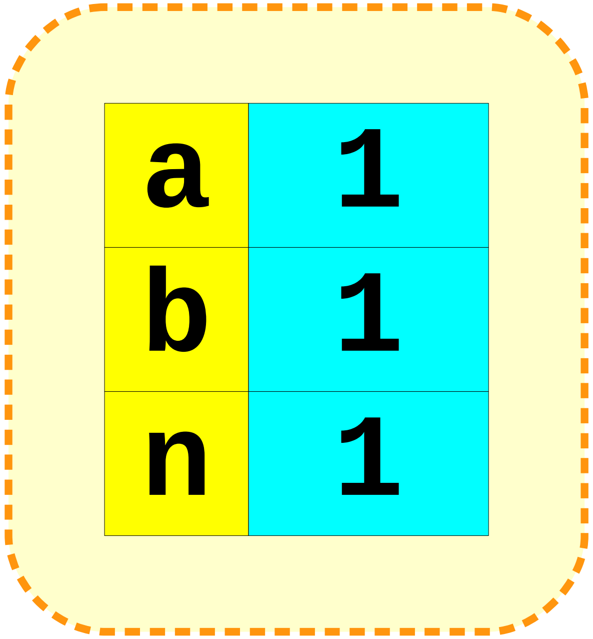
a	1
b	1
n	1

letterFreq

```
for (char ch: input) {
    letterFreq[ch]++;
}
```

Counting Sort



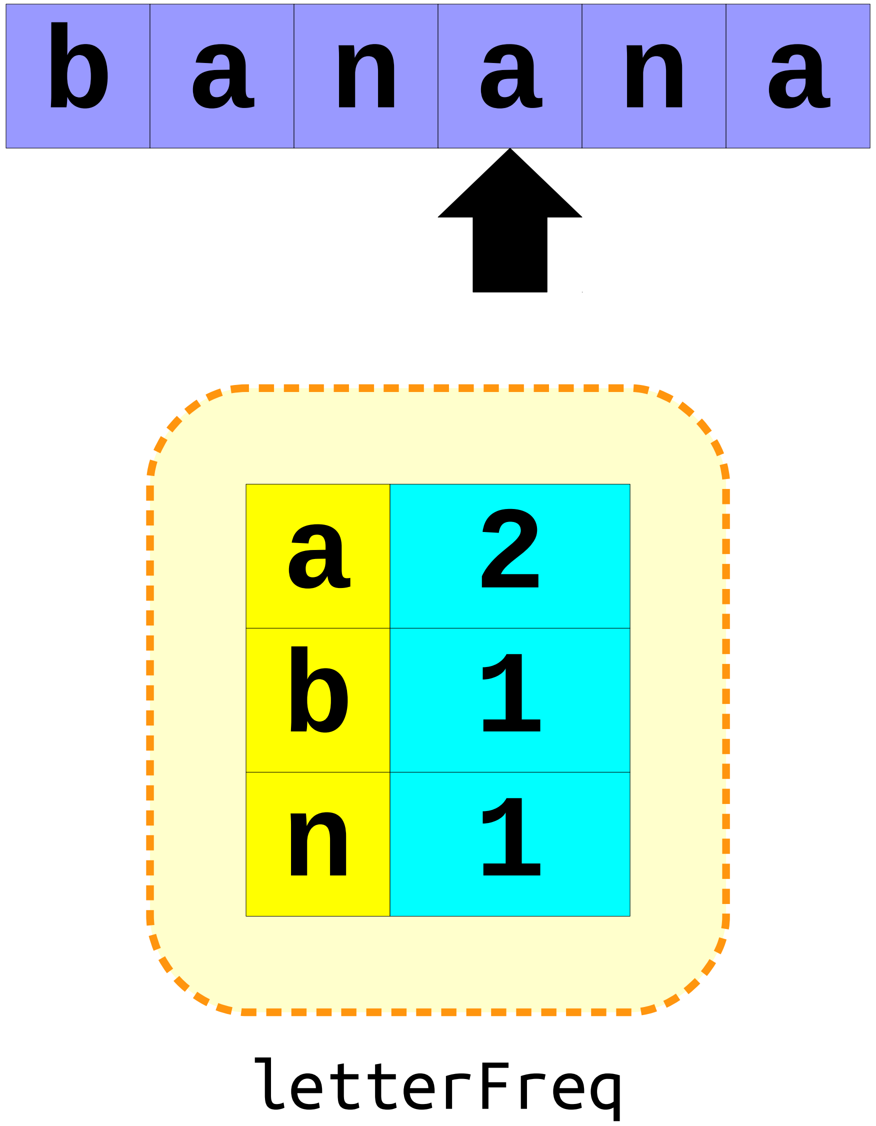


a	1
b	1
n	1

letterFreq

```
for (char ch: input) {
    letterFreq[ch]++;
}
```

Counting Sort



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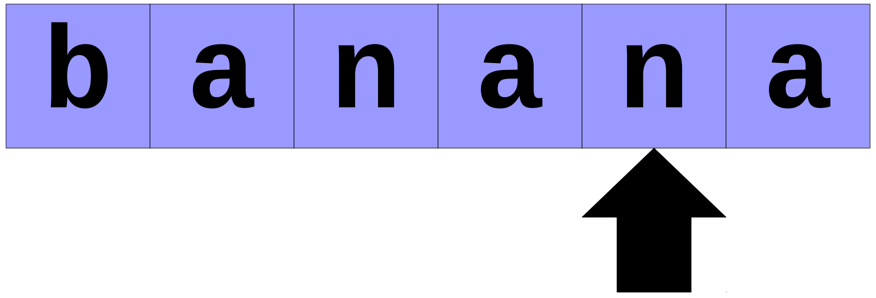
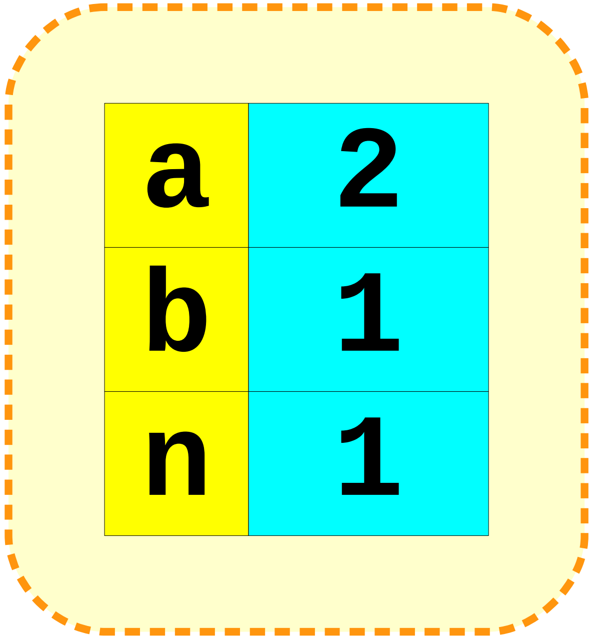
}
```

Counting Sort



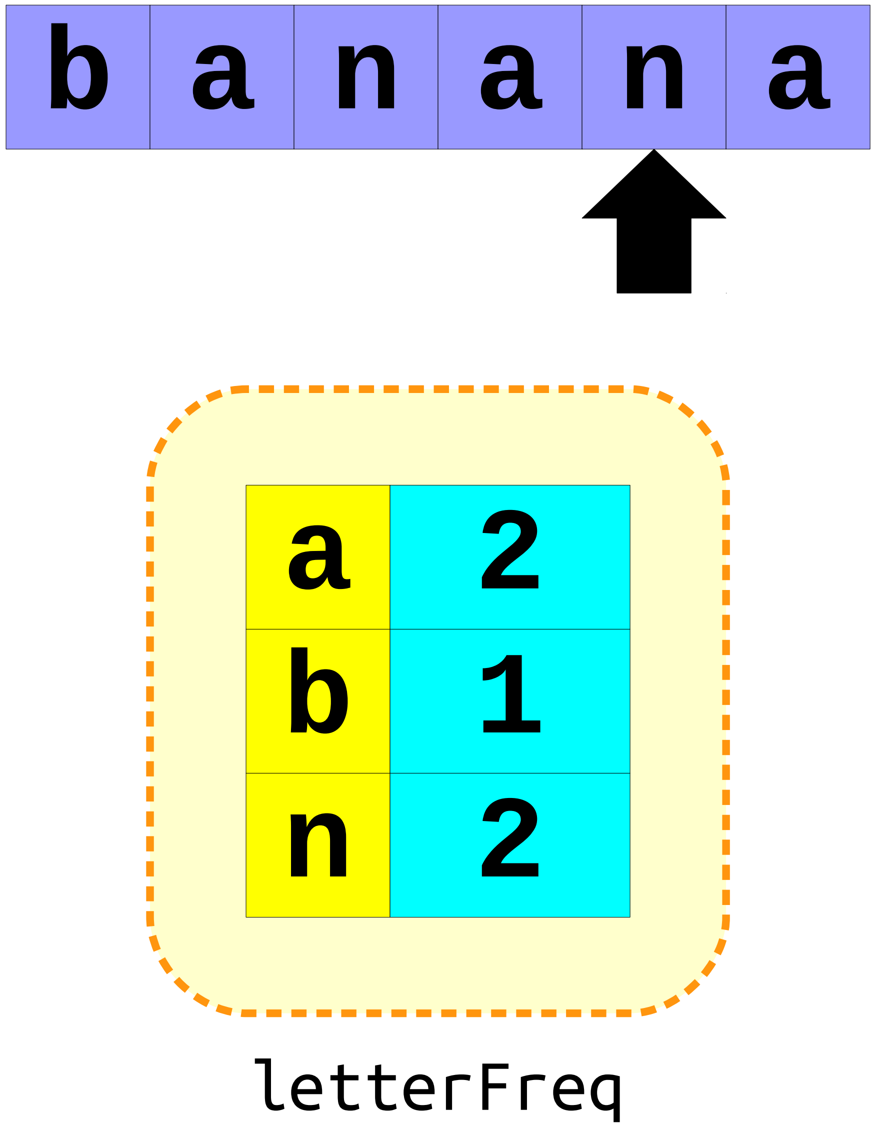


a	2
b	1
n	1

letterFreq

```
for (char ch: input) {
    letterFreq[ch]++;
}
```

Counting Sort



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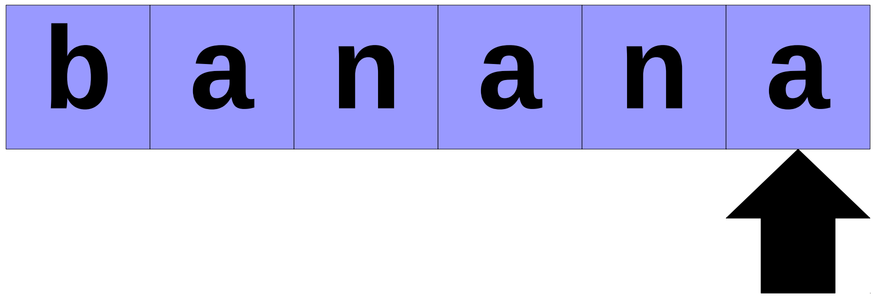
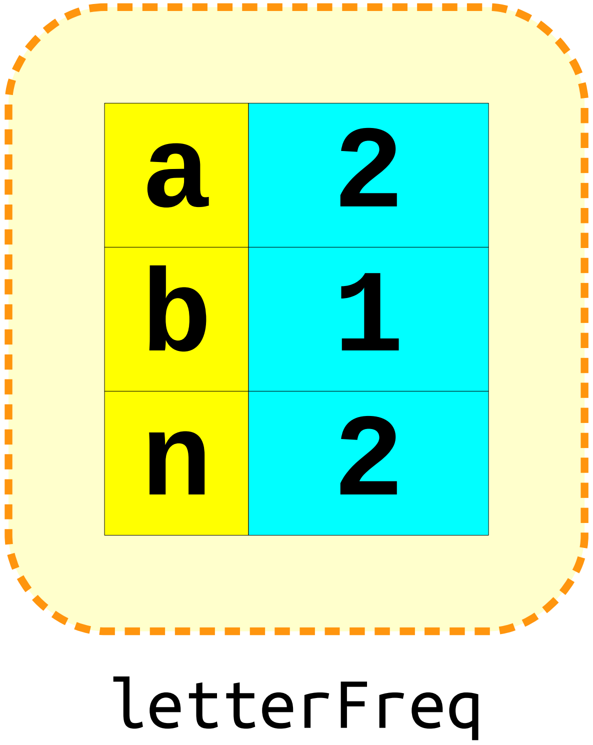
```

Counting Sort

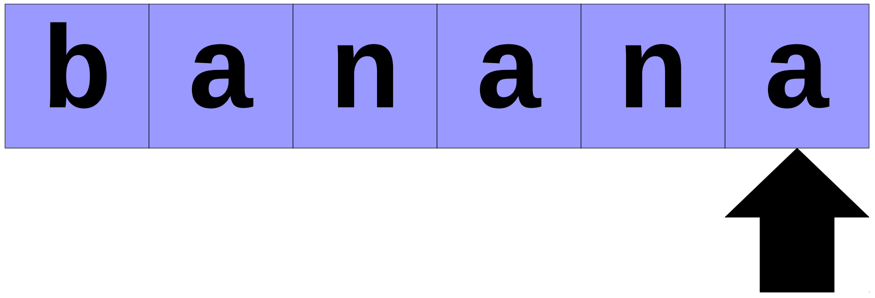




a	2
b	1
n	2

```
for (char ch: input) {
    letterFreq[ch]++;
}
```

Counting Sort



a	3
b	1
n	2

letterFreq

```
for (char ch: input) {
    letterFreq[ch]++;
}
```

Counting Sort

b	a	n	a	n	a

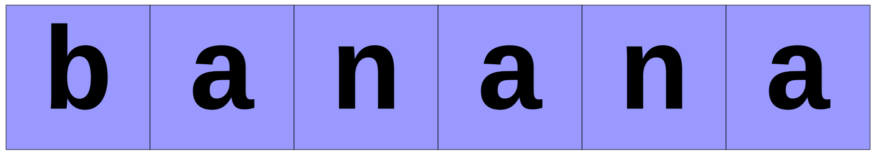
a	3
b	1
n	2

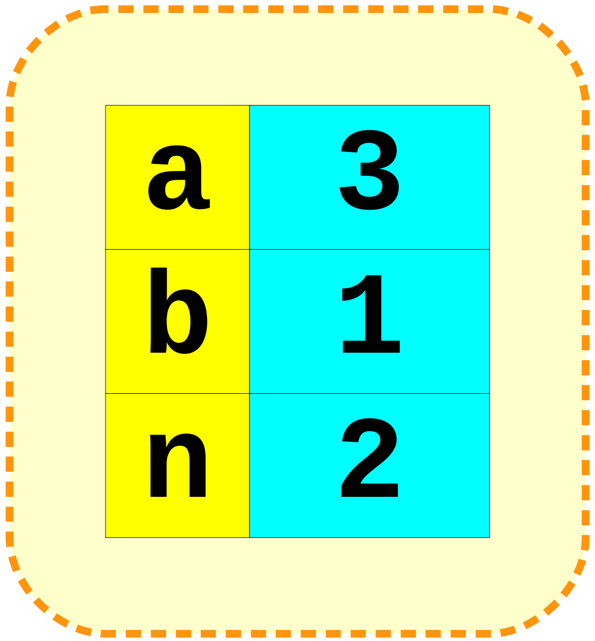
`letterFreq`

Order in Range-Based `for` Loops

- When using the range-based for loop to iterate over a collection:
  - In a `Vector`, `string`, or array, the elements are retrieved in order.
  - In a `Map`, the *keys* are returned in sorted order.
  - In a `Set` or `Lexicon`, the values are returned in sorted order.

Counting Sort

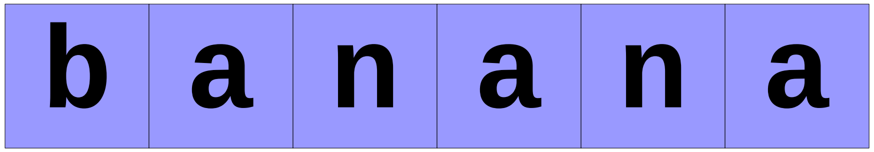


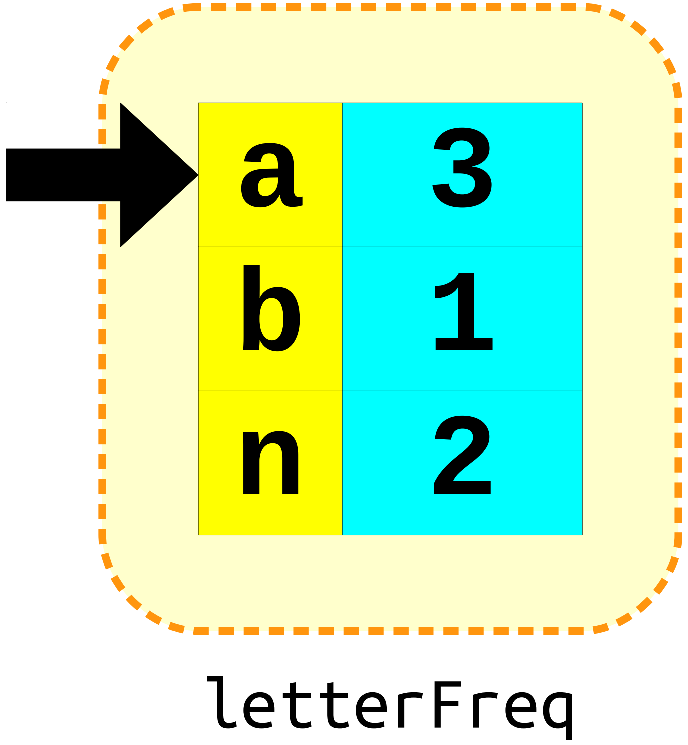


letterFreq

```
for (char ch: letterFreq) {
    for (int i = 0; i < letterFreq[ch]; i++) {
        result += ch;
    }
}
```

Counting Sort





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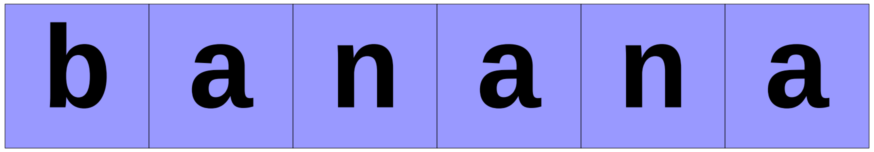
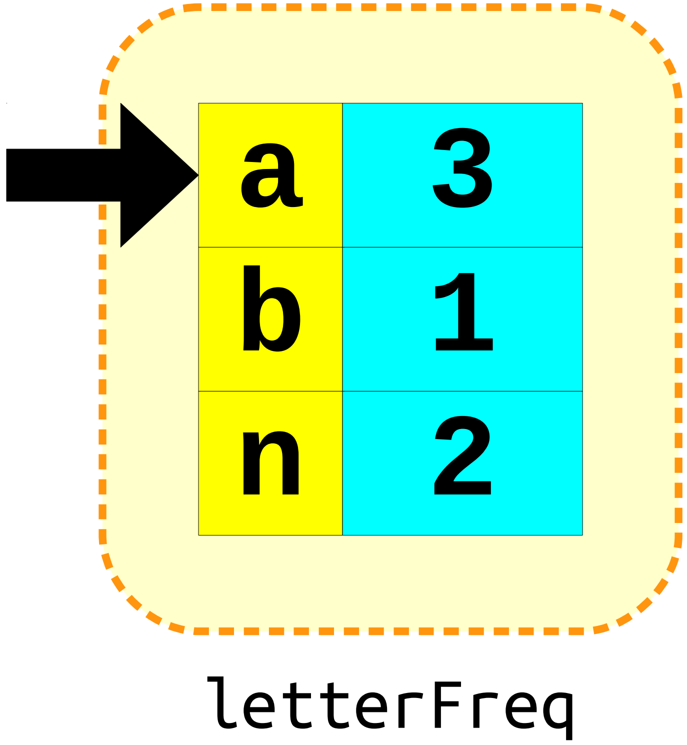
Counting Sort





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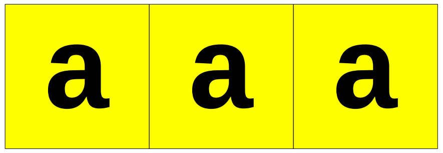

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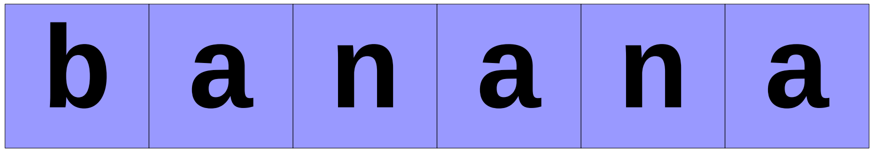

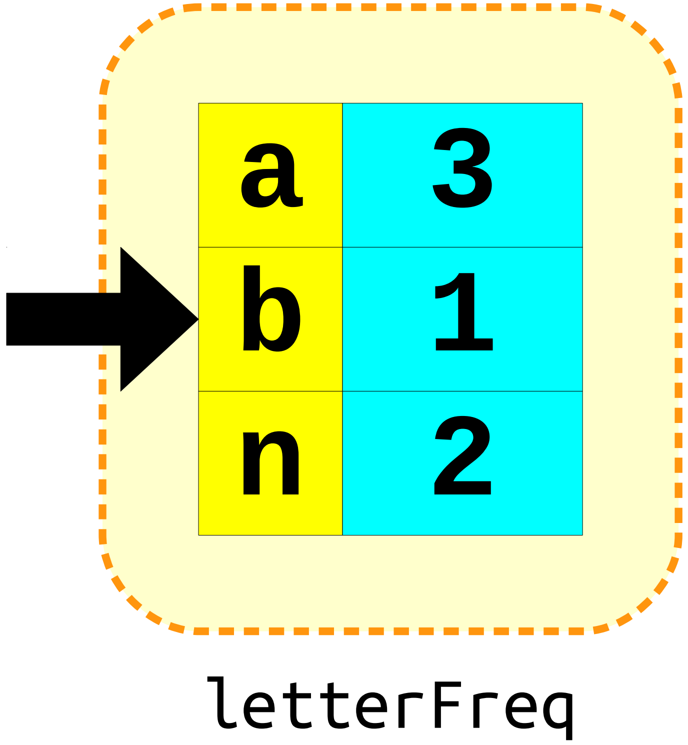

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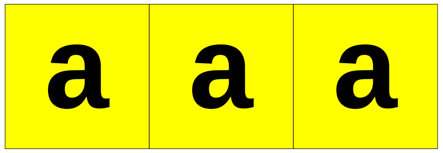

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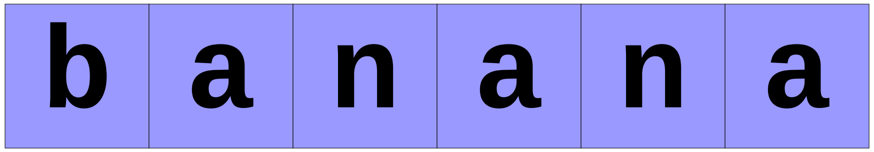

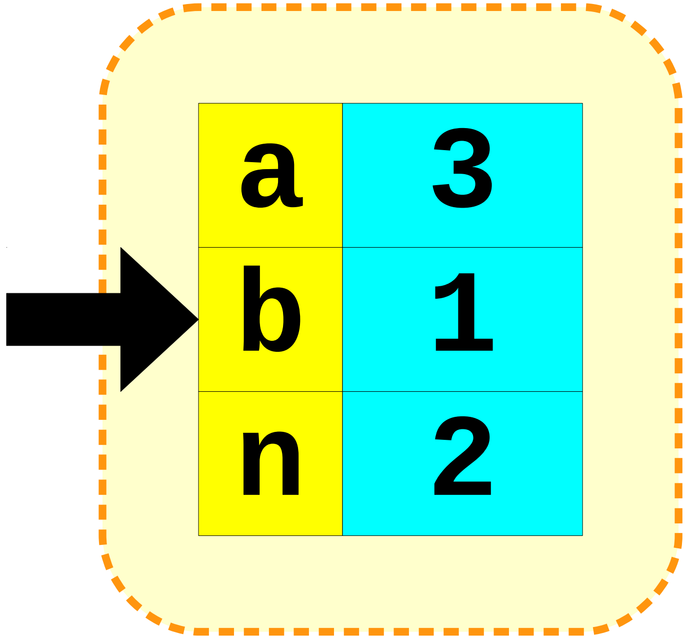

letterFreq

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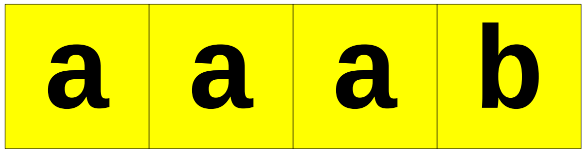
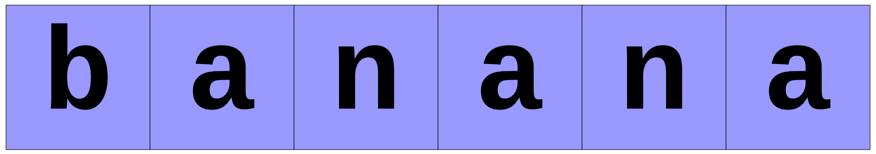
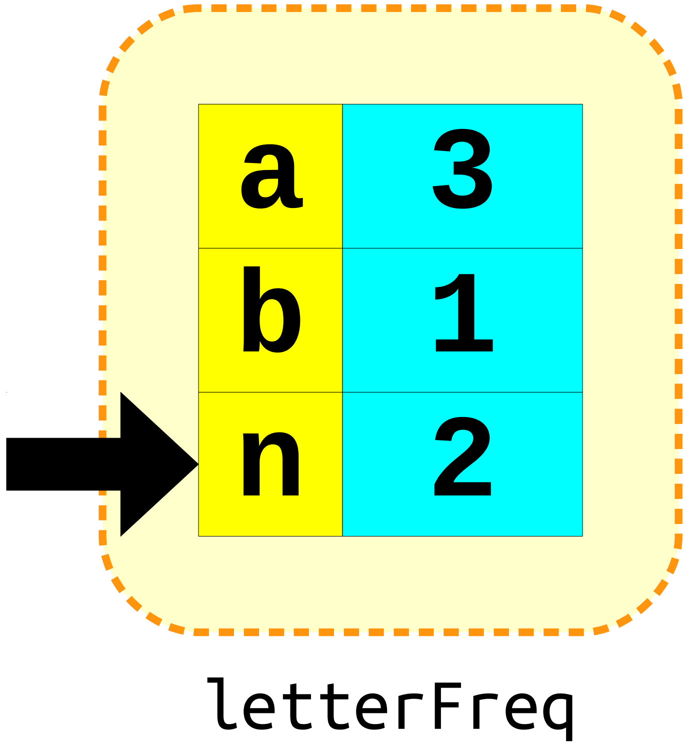


Counting Sort





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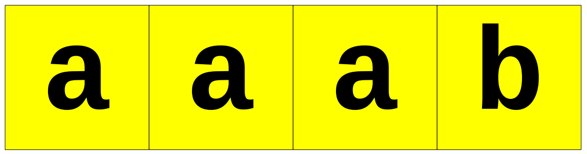
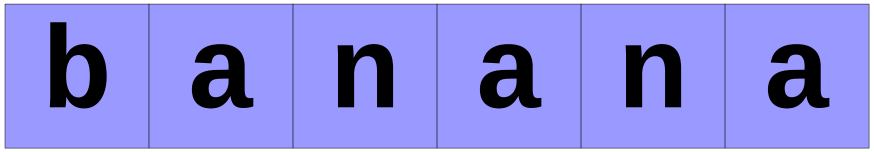
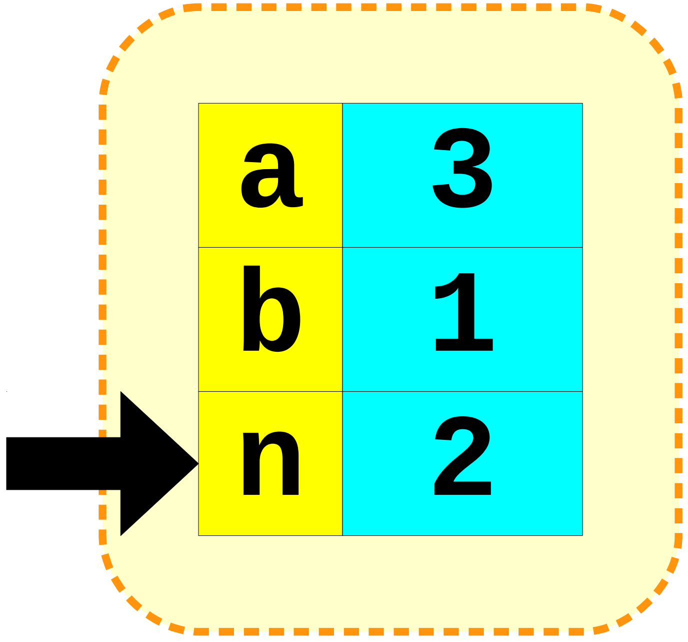
}
```



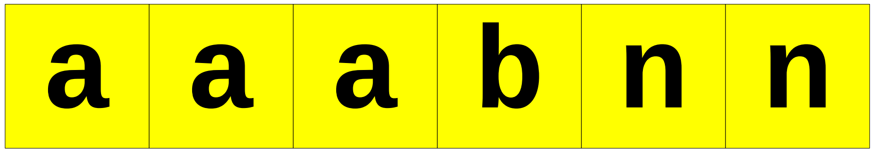
Counting Sort



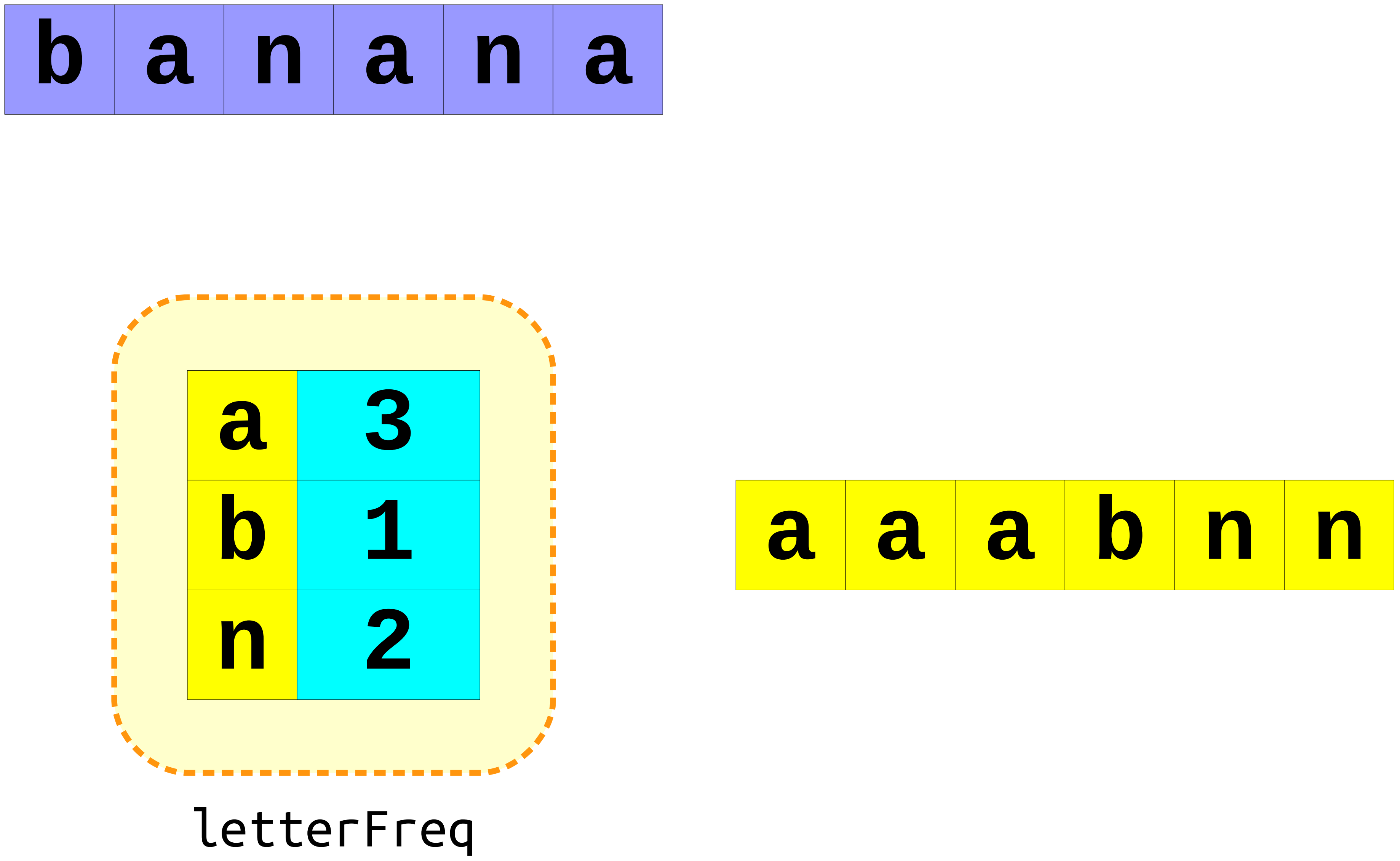


letterFreq

```
for (char ch: letterFreq) {
    for (int i = 0; i < letterFreq[ch]; i++) {
        result += ch;
    }
}
```



Counting Sort



a	3
b	1
n	2