Maps
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Why is this so fast?

Humans and many other primates have three; some birds and reptiles have four photoreceptors. Certain butterflies can even have six. But the mantis shrimp has 12 different types of photoreceptors in their eyes – and scientists haven’t understood why until now. Jan 27, 2014

Study Offers Insights into Unique Color Vision of Mantis Shrimp...
Where are we?
Where are we?

• Karel the Robot
• Java
• Console Programs
• Graphics Programs
• Text Processing
• **Data Structures**
• GUIs
• Defining our own Variable Types
Collections High Level

List: ArrayList<type>

Array: type[]

Matrix: type[][]
Collections High Level

List:  ArrayList\langle String\rangle
Array:  double[ ]
Matrix:  int[ ][ ]
ArrayList
index -> value
Arrays

index → value
Matrix
(row, col) -> value
Maps can have any type for key.

Many examples.
HashMap
key -> value
1. Make a new HashMap of animal sounds

2. Add elements:
   Put [key = “dog”, value = “bark”]
   Put [key=“cat”, value=“meow”]
   Put [key=“seal”, value=“ow ow ow”]

3. Get elements:
   Get [key = “dog”]
Simple Example

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3. Get elements:
   Get [key = “dog”]
1. Make a new HashMap of animal sound

2. Add elements:
   Put [key = "dog", value = "bark"]
   Put [key="cat", value="meow"]
   Put [key="seal", value=\"ow ow ow\"]

3. Get elements:
   Get [key = "cat"]
1. Make a new HashMap of animal sound

2. Add elements:
   Put [key = “dog”, value = “bark” ]
   Put [key=“cat”, value=“meow” ]
   Put [key=“seal”, value=“ow ow ow” ]

3. Get elements:
   Get [key = “cat”]
1. Make a new HashMap of animal sound

2. Add elements:
   Put [key = "dog", value = "bark"]
   Put [key="cat", value="meow"]
   Put [key="seal", value="ow ow ow"]

3. Get elements:
   Get [key = "cat"]
HashMap<String, String> animalSoundMap = new HashMap<String, String>();
My First Map

Key Type

Value Type

HashMap<String, String> animalSoundMap =
new HashMap<String, String>();
My First Map

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My First Map

HashMap<String, String> animalSoundMap = new HashMap<String, String>();

animalSoundMap.put("dog", "bark");
HashMap<String, String> animalSoundMap =
    new HashMap<String, String>();

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animalSoundMap.put("dog", "bark");
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animalSoundMap.put("dog", "bark");

animalSoundMap.get("dog");
HashMap<String, String> animalSoundMap = new HashMap<String, String>();

animalSoundMap.put("dog", "bark");

animalSoundMap.get("dog");
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animalSoundMap.put("dog", "bark");

animalSoundMap.get("dog");
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2. Add elements:
   Put [key = “dog”, value = “bark”]  
   Put [key=“cat”, value=“meow”]  
   Put [key=“seal”, value=“ow ow ow ow”]  

3. Get elements:
   Get [key = “dog”]
My First Map

```java
// 1. Make a new map
HashMap<String, String> animalSoundMap = new HashMap<String, String>();

// 2. Put things into the map
animalSoundMap.put("dog", "woof");
animalSoundMap.put("cat", "meow");
animalSoundMap.put("seal", "ow ow ow");

// 3. Get things out of the map
animalSoundMap.get("dog"); // "woof"
```
My First Map

animalSoundMap

Values:  “bark”  “ow ow ow”  “meow”

Keys:  “dog”  “seal”  “cat”

// 1. Make a new map
HashMap<String, String> animalSoundMap =
    new HashMap<String, String>();

// 2. Put things into the map
animalSoundMap.put("dog", "woof");
animalSoundMap.put("cat", "meow");
animalSoundMap.put("seal", "ow ow ow");

// 3. Get things out of the map
animalSoundMap.get("dog"); // "woof"
animalSoundMap.get("fox"); // ?
brothers Vegard and Bård Ylvisåker

Circa 2013
But there’s one sound.

// 1. Make a new map
HashMap<String, String> animalSoundMap =
    new HashMap<String, String>();

// 2. Put things into the map
animalSoundMap.put("dog", "woof");
animalSoundMap.put("cat", "meow");
animalSoundMap.put("seal", "ow ow ow");

// 3. Get things out of the map
animalSoundMap.get("dog"); // "woof"
animalSoundMap.get("fox"); // ?
My First Map

animalSoundMap

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// 2. Put things into the map
animalSoundMap.put("dog", "woof");
animalSoundMap.put("cat", "meow");
animalSoundMap.put("seal", "ow ow ow");

// 3. Get things out of the map
animalSoundMap.get("dog"); // "woof"
animalSoundMap.get("fox"); // null
1. Make a HashMap

   `HashMap<keyType, valueType> myMap =
   new HashMap<keyType, valueType>();`

2. Put and get values into a map

   `myMap.put(key, value);
   myMap.get(key) // returns the corresponding value`

3. Some useful other methods

   `int size = myMap.size();`
   `myMap.containsKey(key); // returns true or false if key is in map`
   `myMap.keySet();`
   `myMap.remove(key); // make like a tree and leave!`

4. Iterate using a foreach loop

   `for(keyType key : myMap.keySet()){ // not ordered`
   `   myMap.get(key); // do something with the key/value pair`
   }`
Phone Book

- Micah Cratty
- Waddie CrazyHorse
- Bryce Cronkite-Ratcliff
- Collin Cronkite-Ratcliff
- Ben Cunningham
- Lynn Cuthriell
- Waseem Daher
- Red Daly
- Richard Davis
- Philippe de Koning
- Hans Dejong

Contact: 6701678
Make a keyboard
Why is this so fast?

Google search results for "mantis shrimp colors"

About 1,870,000 results (0.54 seconds)

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\[ \text{key} \rightarrow \text{Hash Fn} \rightarrow \text{array index} \]

```cpp
int hash(string key);
```

* Learn more in CS106B