



Maps

Chris Piech
CS106A, Stanford University

CS106A Winter 2018 Contest



Piech, CS106A, Stanford University



Why is this so fast?



mantis shrimp colors



All

Videos

Shopping

Images

News

More

Settings

Tools

About 1,870,000 results (0.54 seconds)

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 ...](http://www.sci-news.com/biology/science-color-vision-mantis-shrimp-01719.html)
www.sci-news.com/biology/science-color-vision-mantis-shrimp-01719.html



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<String>

Array: double[]

Matrix: int[][]

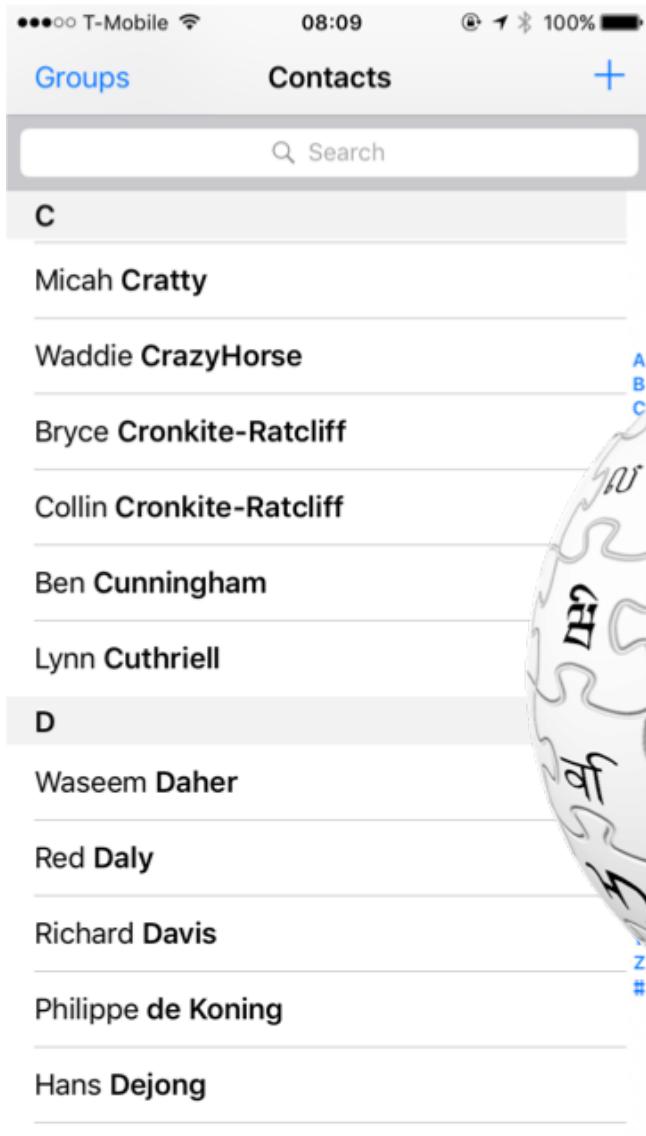


ArrayList
index -> value

Arrays
index -> value

Matrix
(row, col) -> value

Maps can have any type for key



The Stanford University AXESS website. The header features the text "Stanford University" and "AXESS" in large letters. Below the header are three navigation links: "STUDENT", "EMPLOYEE", and "STARS". On the right side of the header is a "QUICK LINKS" sidebar with links to "Student ePay", "Course & Section Evaluations", "Health Insurance Waiver", "P.O. Box Renewal", and "Direct Deposit". The main content area contains a large graphic of a human brain composed of puzzle pieces. Various mathematical symbols are overlaid on the brain, including Greek letters like Omega (Ω), Pi (Π), and Sigma (Σ), along with other symbols like W, I, and J. The brain graphic is set against a background of yellow and orange gradients.

Many examples



HashMap
key -> value

Simple Example

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

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

animalSoundMap

Values:

Keys:

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

animalSoundMap

Values:

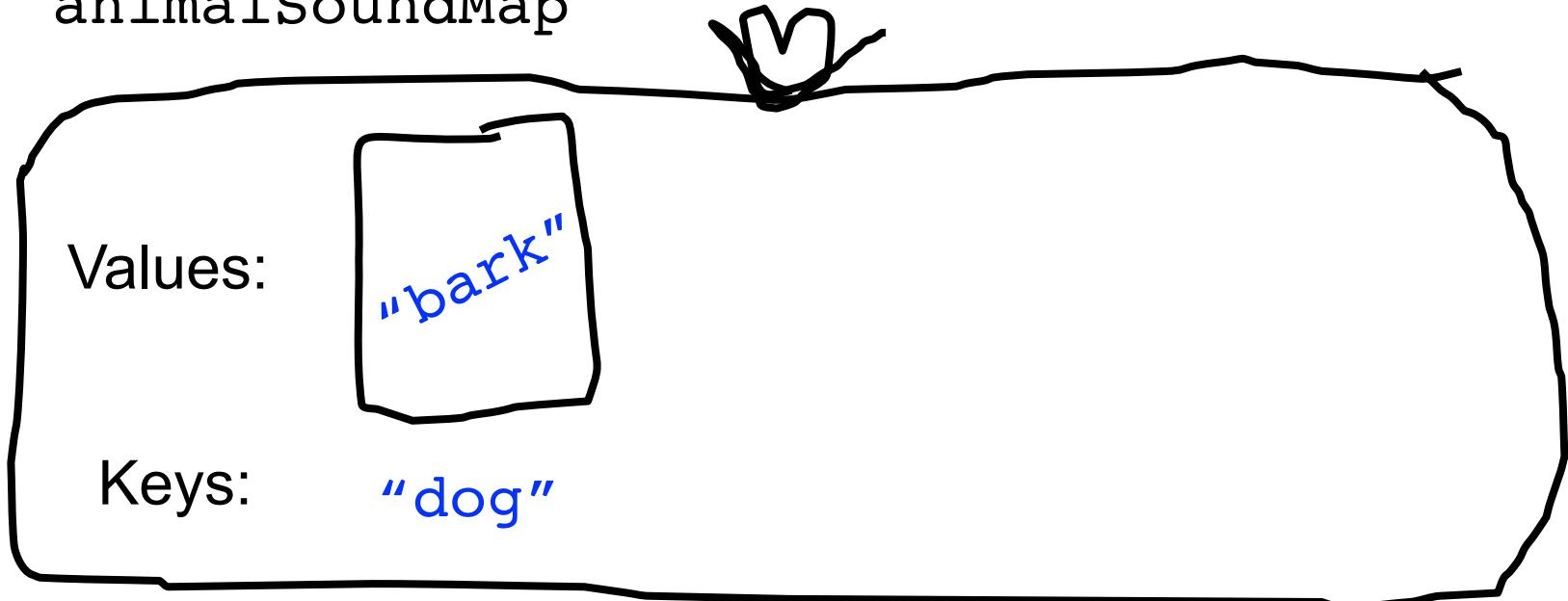
Keys:

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

animalSoundMap

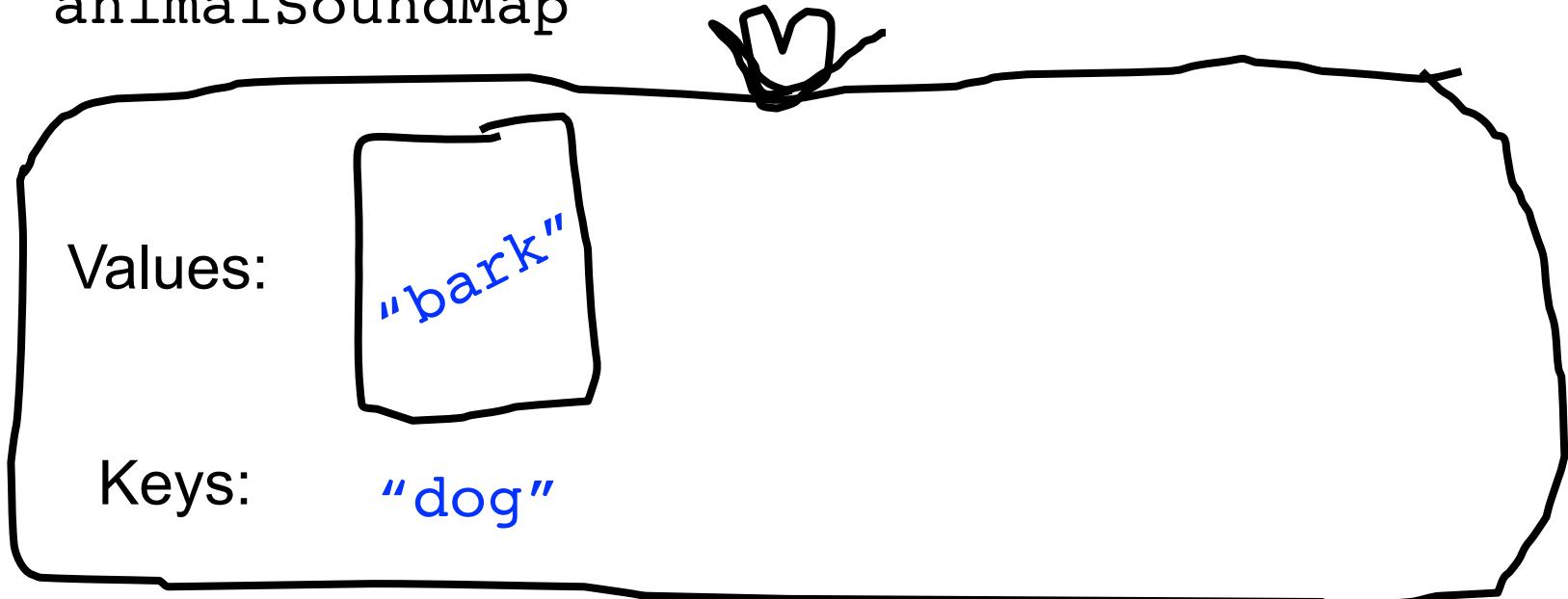


1. Make a new HashMap of animal sounds
2. Add elements:
Put [key = "dog", value = "bark"]
Put [key="cat", value="meow"]
Put [key="seal", value="ow ow ow"]
3. Get elements:
Get [key = "dog"]



Simple Example

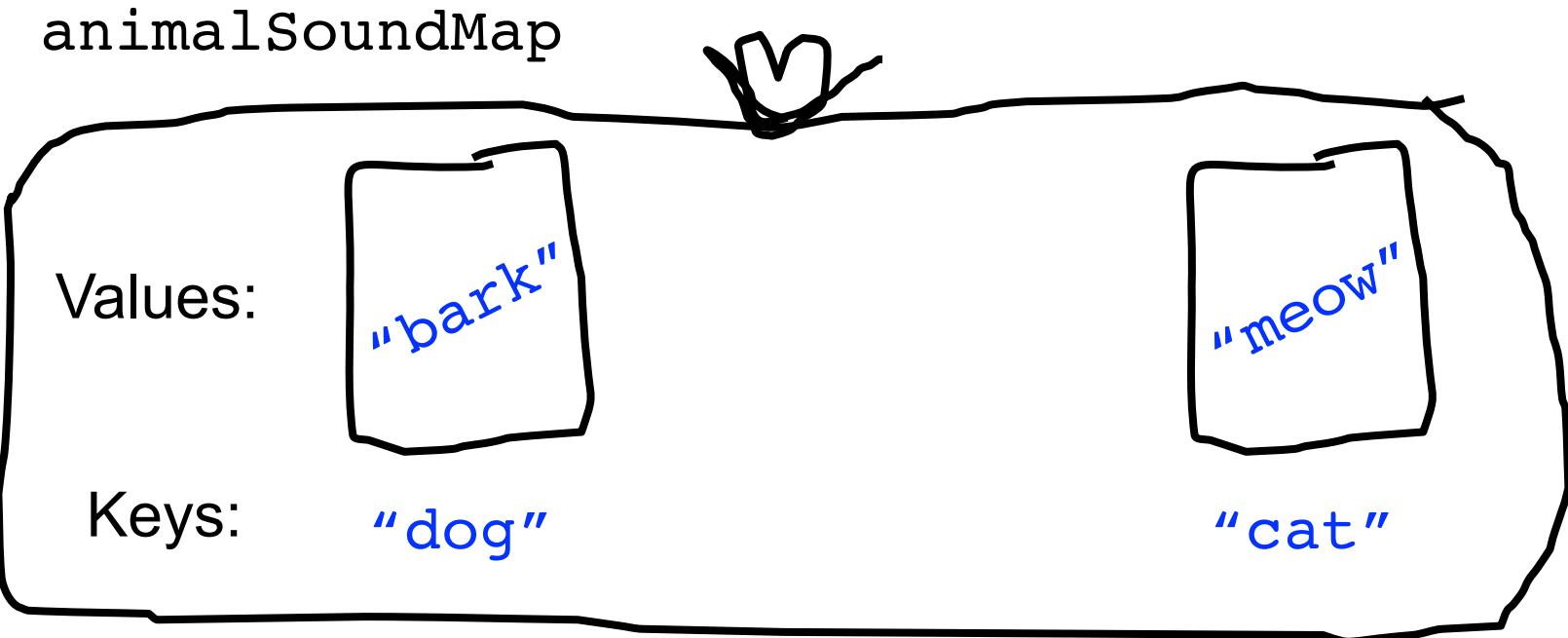
animalSoundMap



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"]



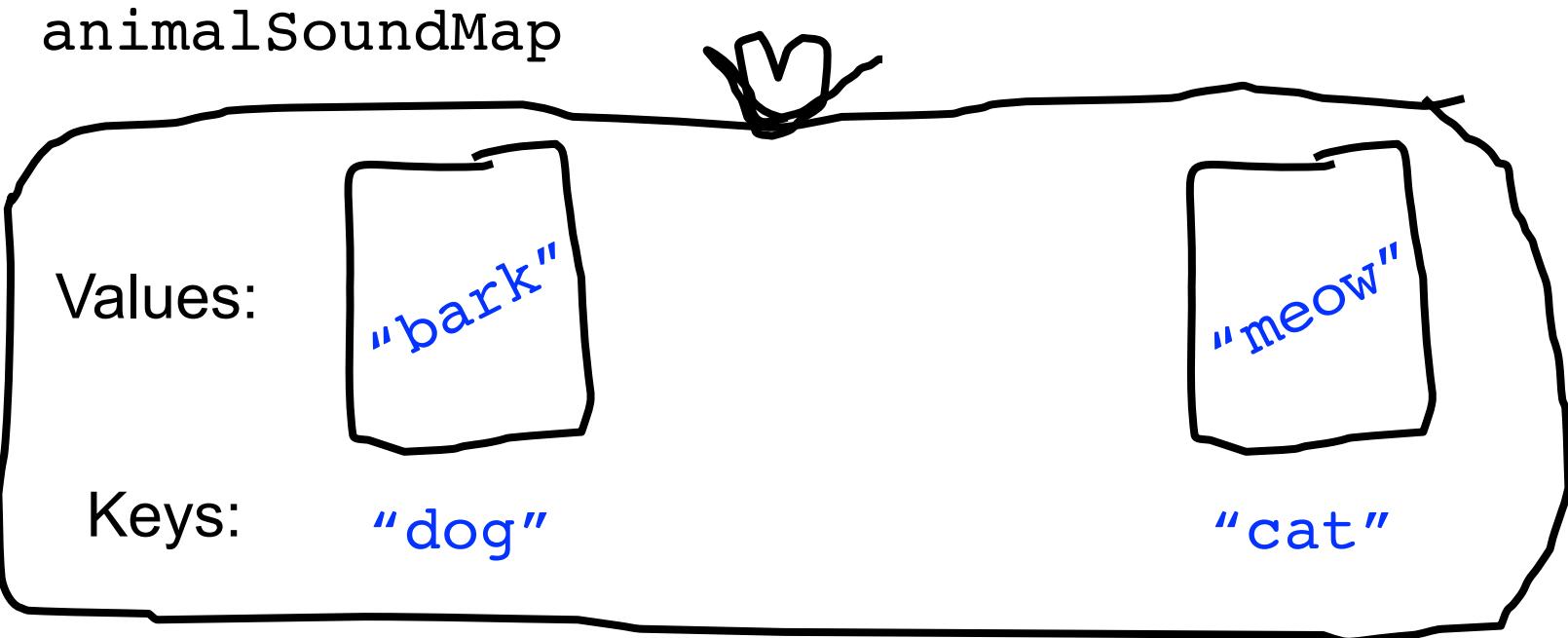
Simple Example



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

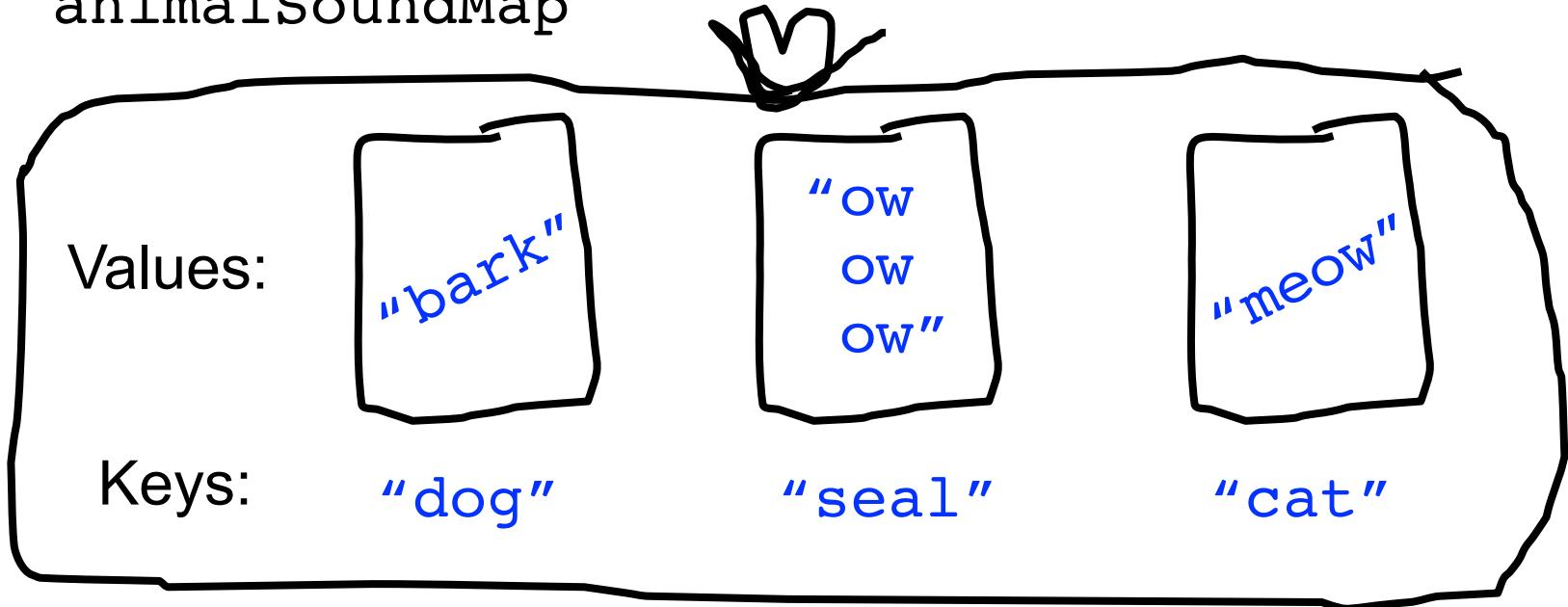


1. Make a new HashMap of animal sounds
2. Add elements:
Put [key = "dog", value = "bark"]
Put [key="cat", value="meow"]
Put [key="seal", value="ow ow ow"]
3. Get elements:
Get [key = "dog"]



Simple Example

animalSoundMap

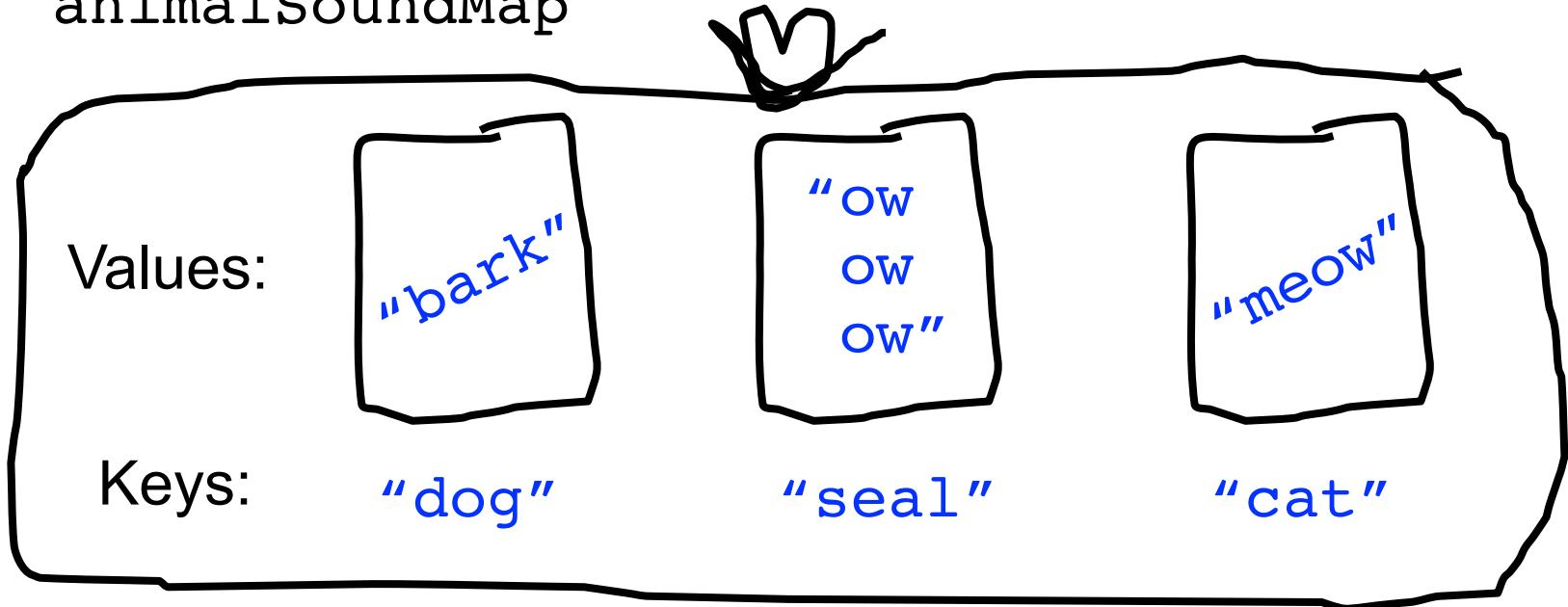


1. Make a new `HashMap` of animal sounds
2. Add elements:
Put [key = "dog", value = "bark"]
Put [key="cat", value="meow"]
Put [key="seal", value="ow ow ow"]
3. Get elements:
Get [key = "dog"]



Simple Example

animalSoundMap

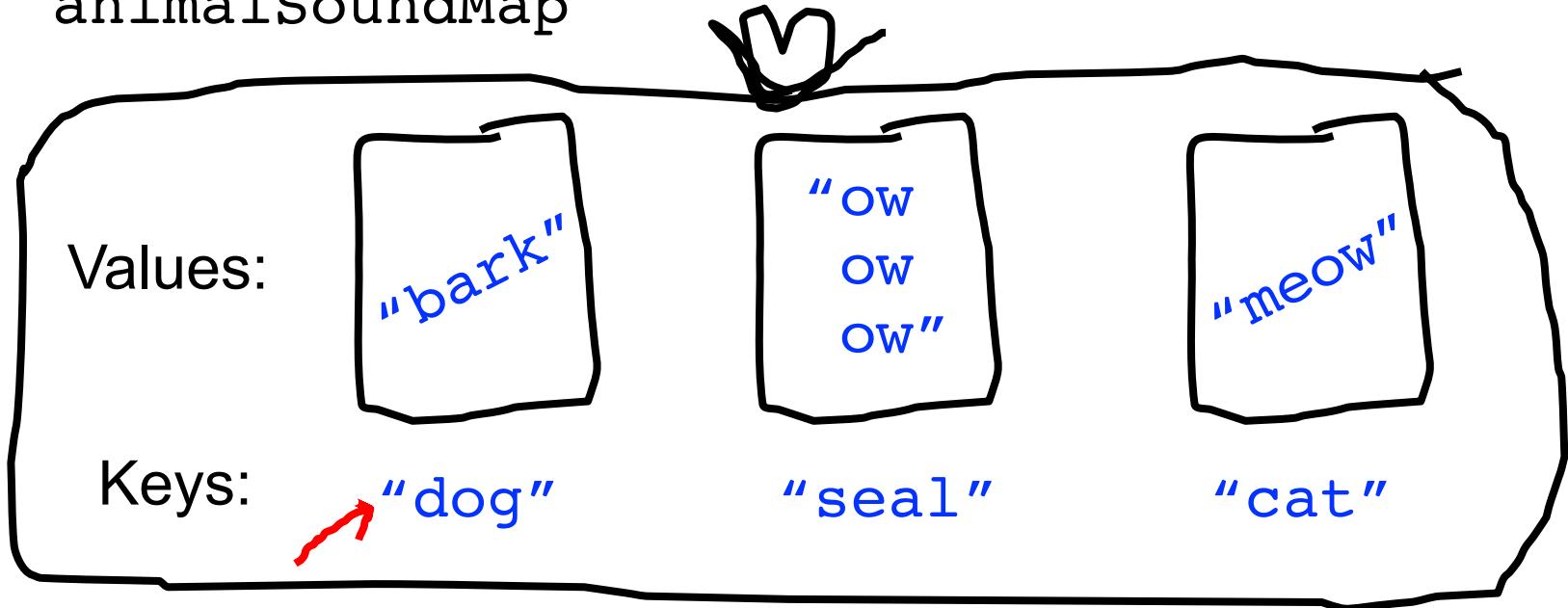


1. Make a new HashMap of animal sounds
2. Add elements:
Put [key = "dog", value = "bark"]
Put [key="cat", value="meow"]
Put [key="seal", value="ow ow ow"]
3. Get elements:
Get [key = "dog"]



Simple Example

animalSoundMap

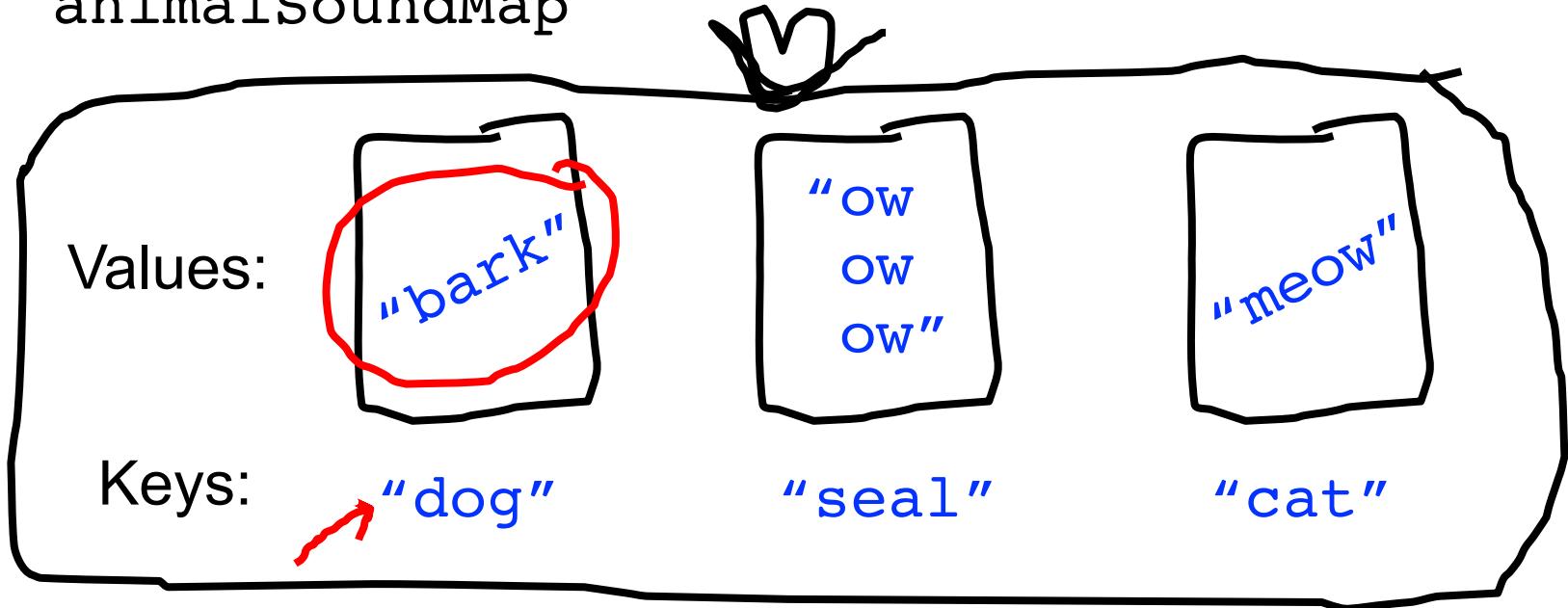


1. Make a new HashMap of animal sounds
2. Add elements:
Put [key = "dog", value = "bark"]
Put [key="cat", value="meow"]
Put [key="seal", value="ow ow ow"]
3. Get elements:
Get [key = "dog"]



Simple Example

animalSoundMap

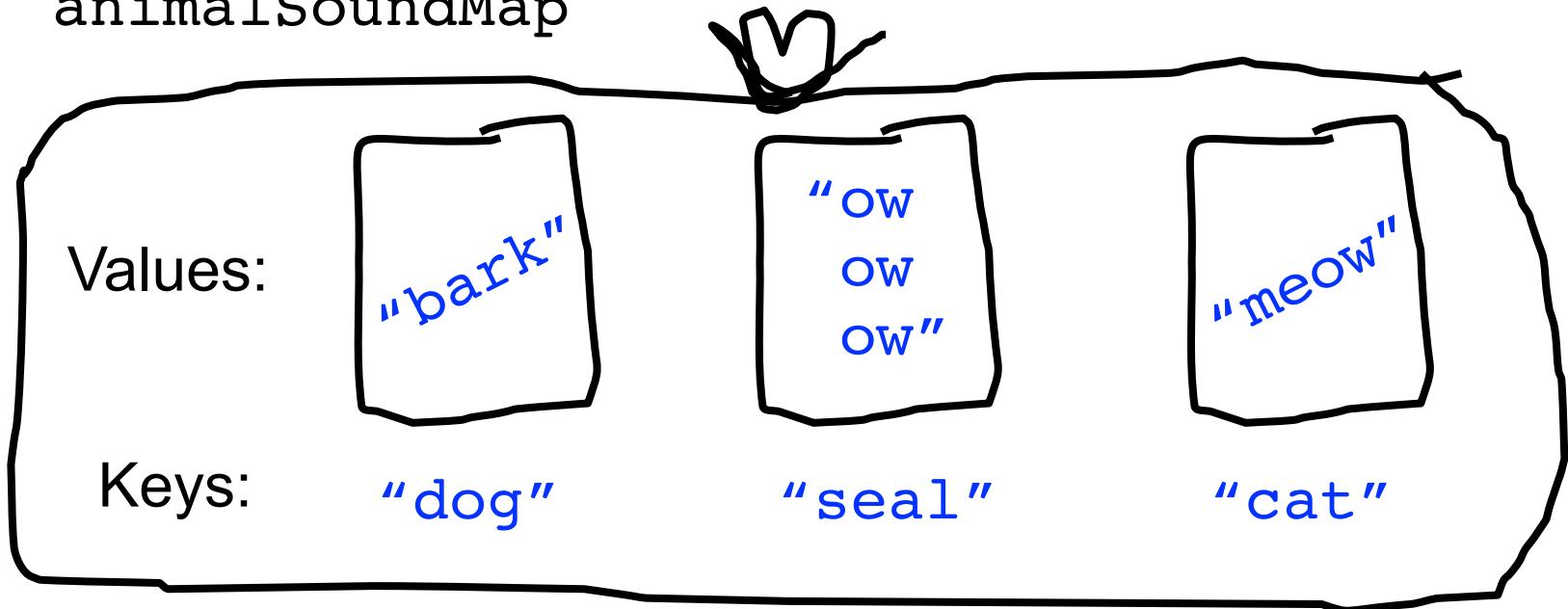


1. Make a new `HashMap` of animal sound
2. Add elements:
Put [key = "dog", value = "bark"]
Put [key="cat", value="meow"]
Put [key="seal", value="ow ow ow"]
3. Get elements:
Get [key = "dog"]



Simple Example

animalSoundMap

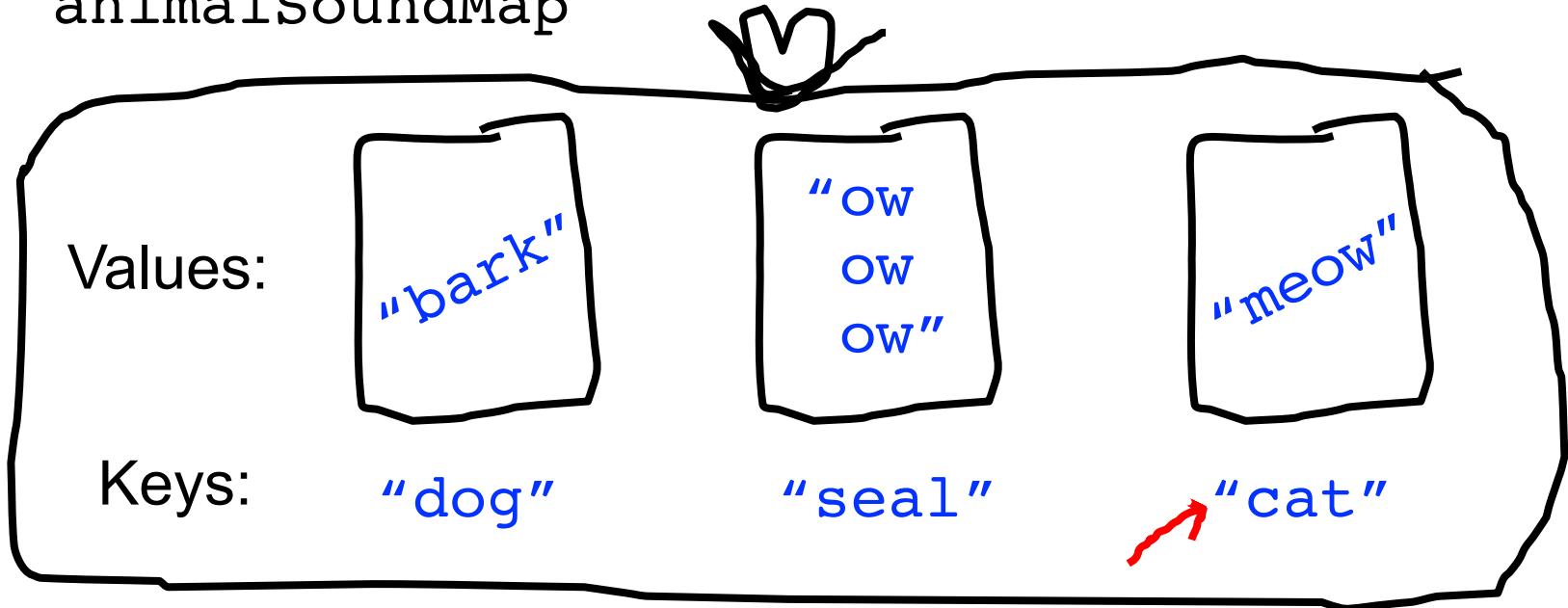


1. Make a new `HashMap` of animal sound
2. Add elements:
Put [key = "dog", value = "bark"]
Put [key="cat", value="meow"]
Put [key="seal", value="ow ow ow"]
3. Get elements:
Get [key = "cat"]



Simple Example

animalSoundMap

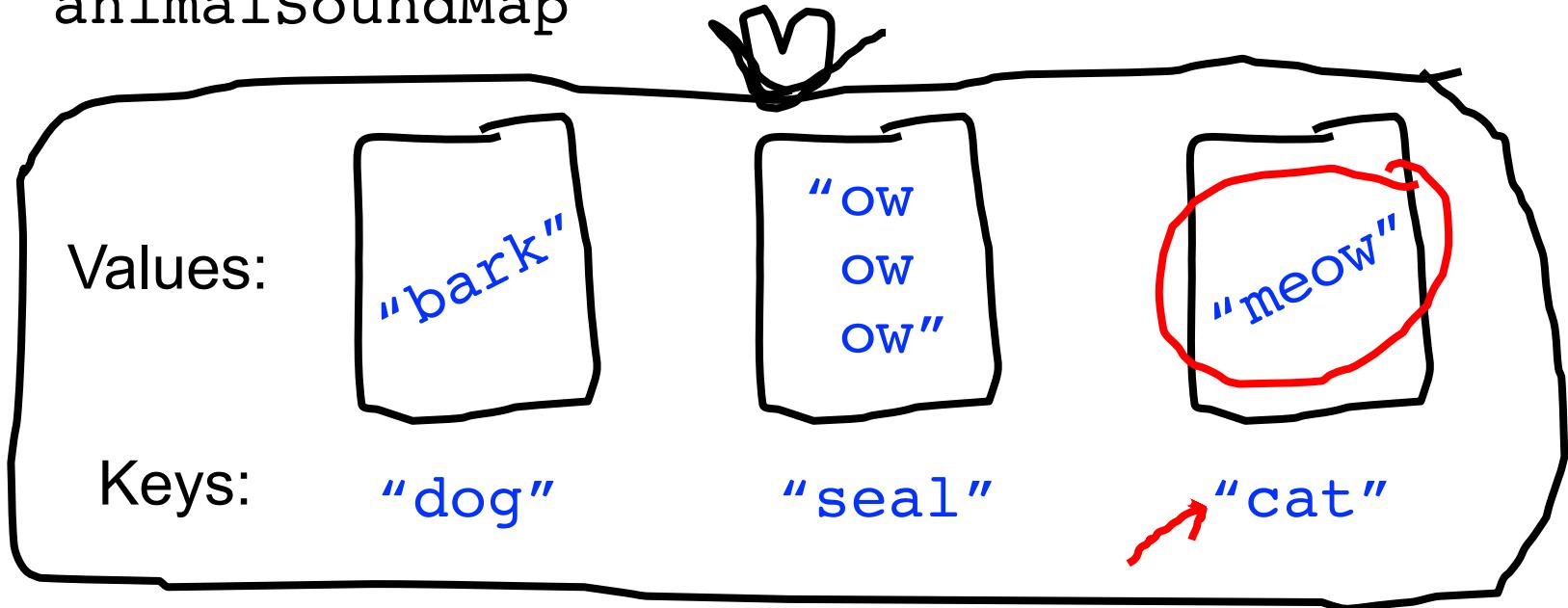


1. Make a new HashMap of animal sound
2. Add elements:
Put [key = "dog", value = "bark"]
Put [key="cat", value="meow"]
Put [key="seal", value="ow ow ow"]
3. Get elements:
Get [key = "cat"]



Simple Example

animalSoundMap



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"]



My First Map

```
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

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



My First Map

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



My First Map

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



My First Map

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



My First Map

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



My First Map

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



My First Map

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

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

```
animalSoundMap.get("dog");
```



My First Map

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



My First Map

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

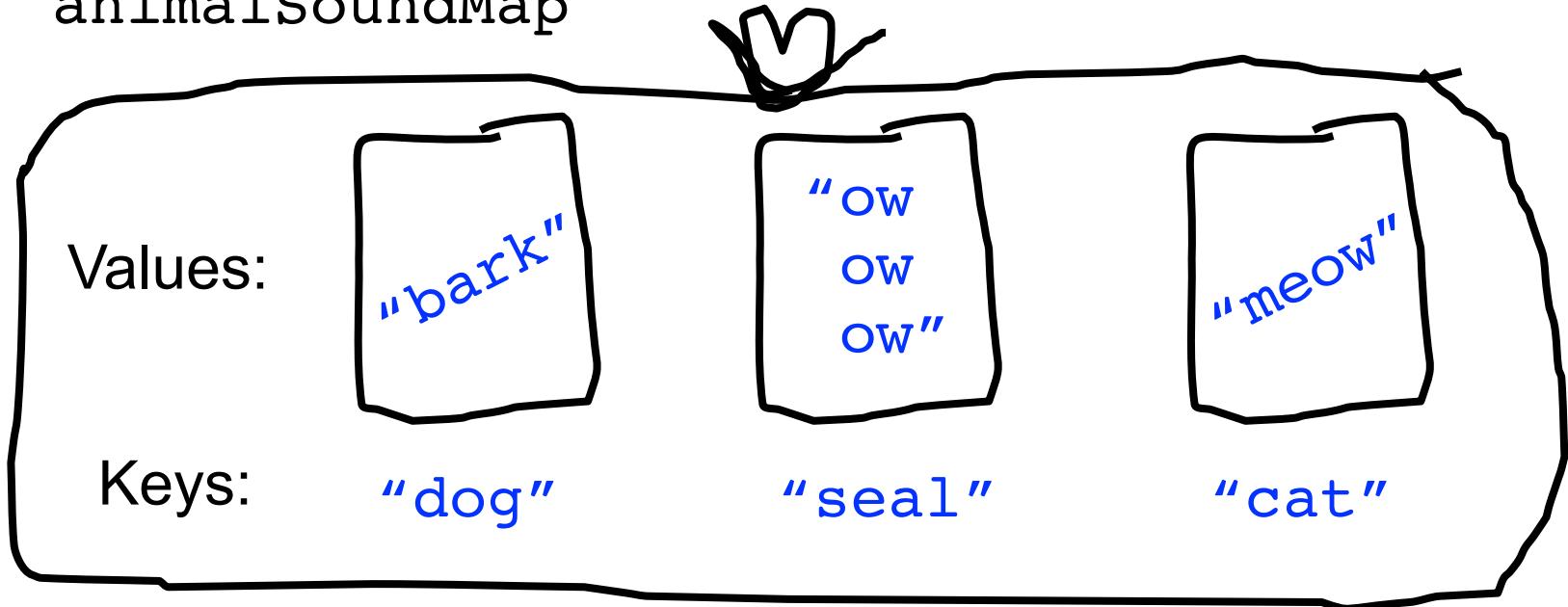
```
animalSoundMap.put("dog", "bark");
```

```
animalSoundMap.get("dog");
```



My First Map

animalSoundMap

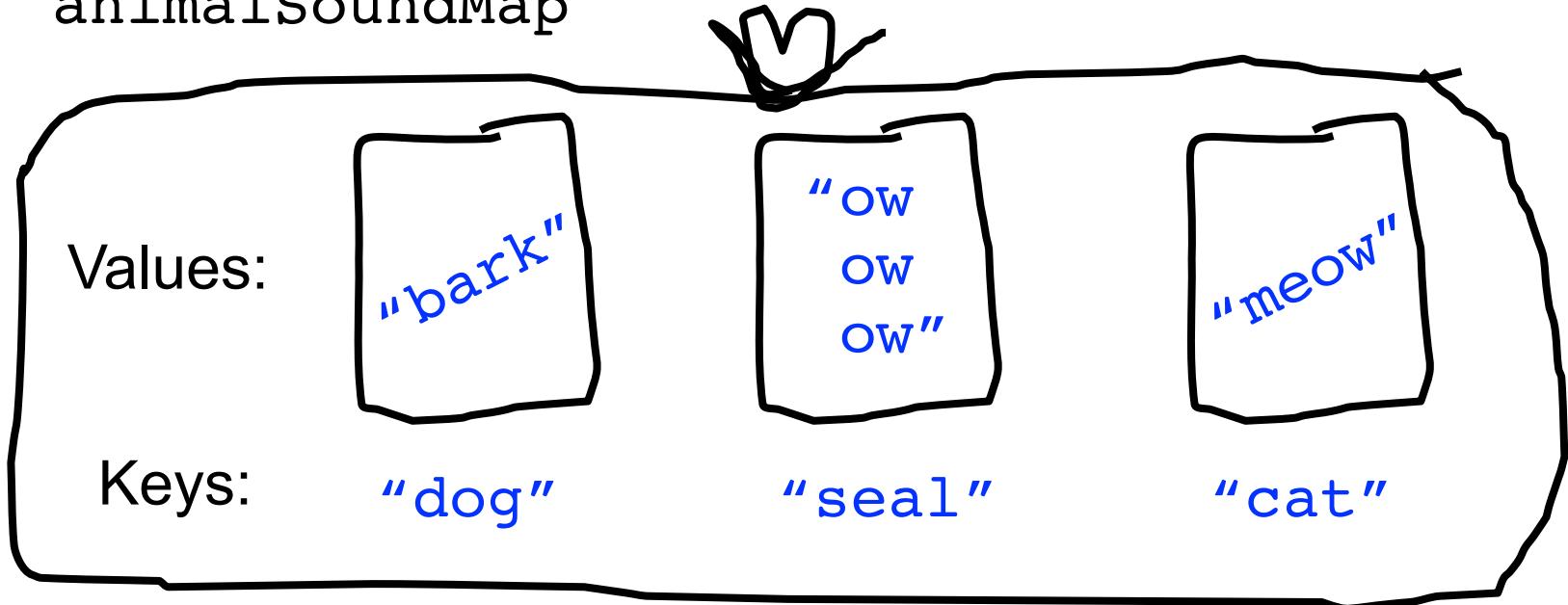


1. Make a new HashMap of animal sound
2. Add elements:
Put [key = "dog", value = "bark"]
Put [key="cat", value="meow"]
Put [key="seal", value="ow ow ow"]
3. Get elements:
Get [key = "dog"]



My First Map

animalSoundMap



// 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");
```

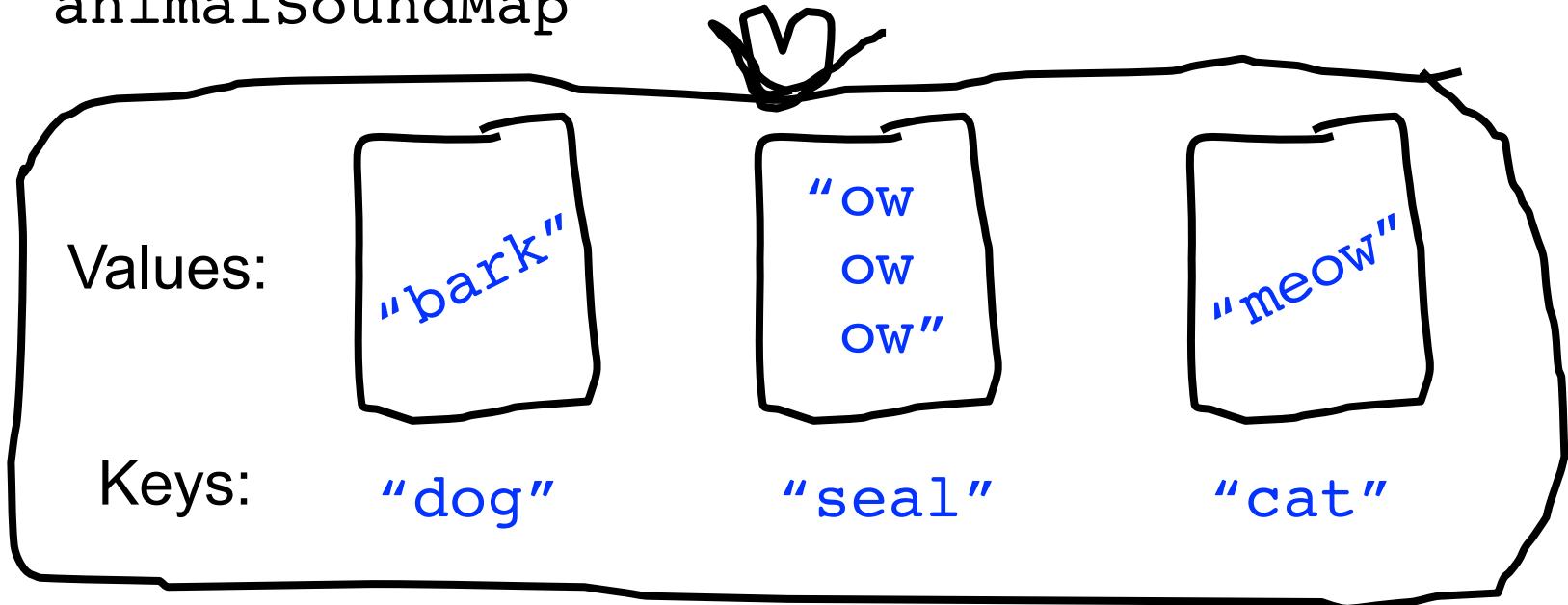
// 3. Get things out of the map

```
animalSoundMap.get("dog"); // "woof"
```



My First Map

animalSoundMap



// 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



N

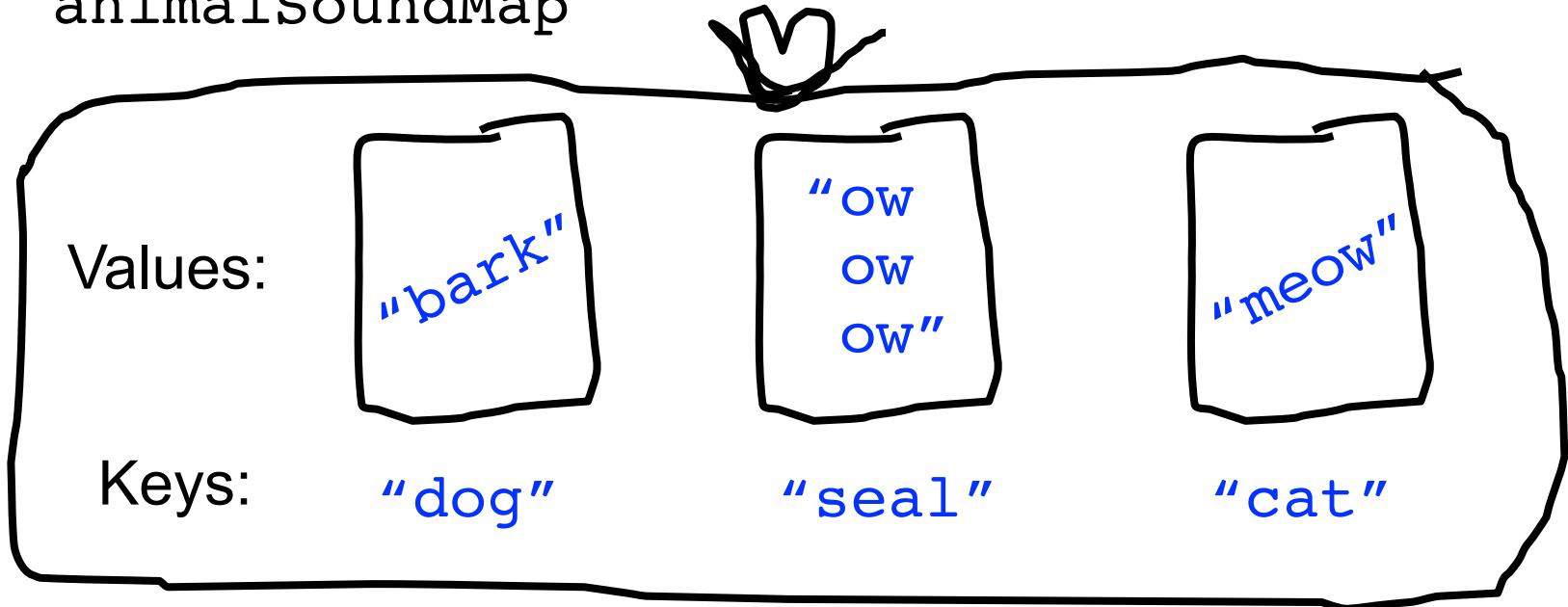
But there's one sound

Ylvis – “The Fox”. Permission asked. Pending.



My First Map

animalSoundMap



// 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");
```

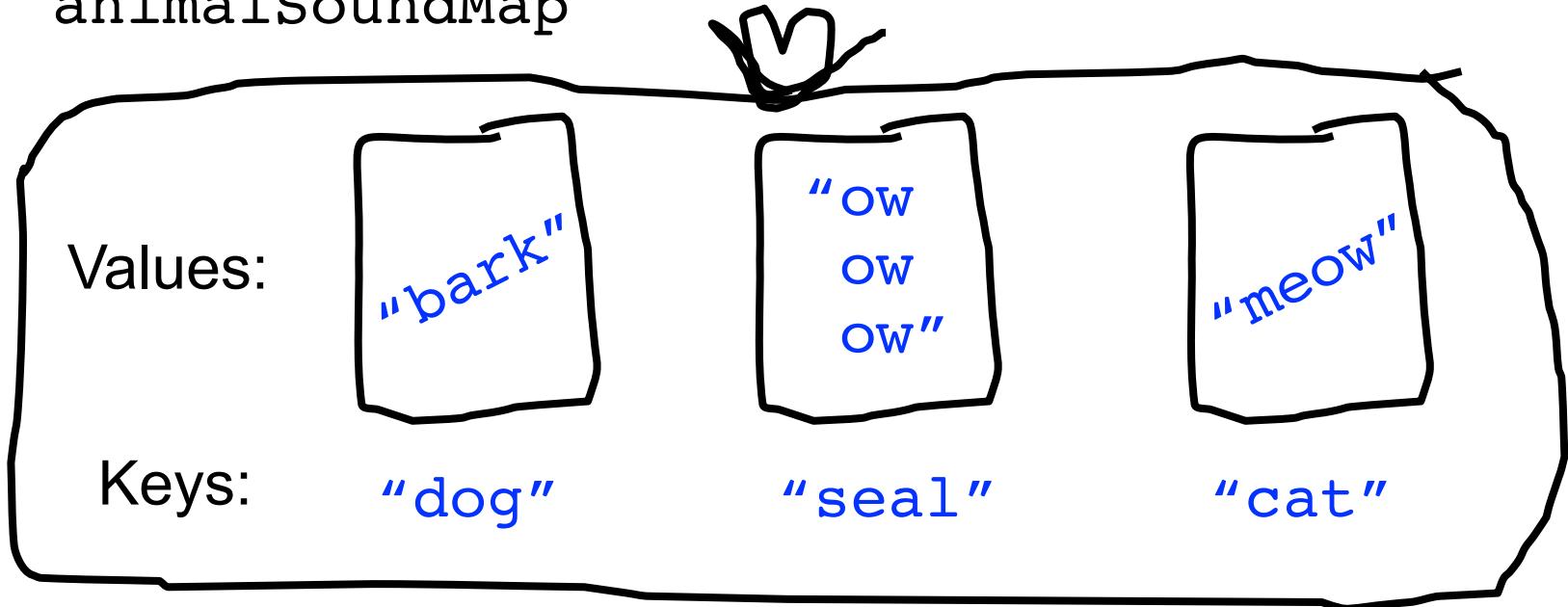
// 3. Get things out of the map

```
animalSoundMap.get("dog"); // "woof"  
animalSoundMap.get("fox"); // ?
```



My First Map

animalSoundMap



// 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"); // null
```



HashMaps on one slide

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

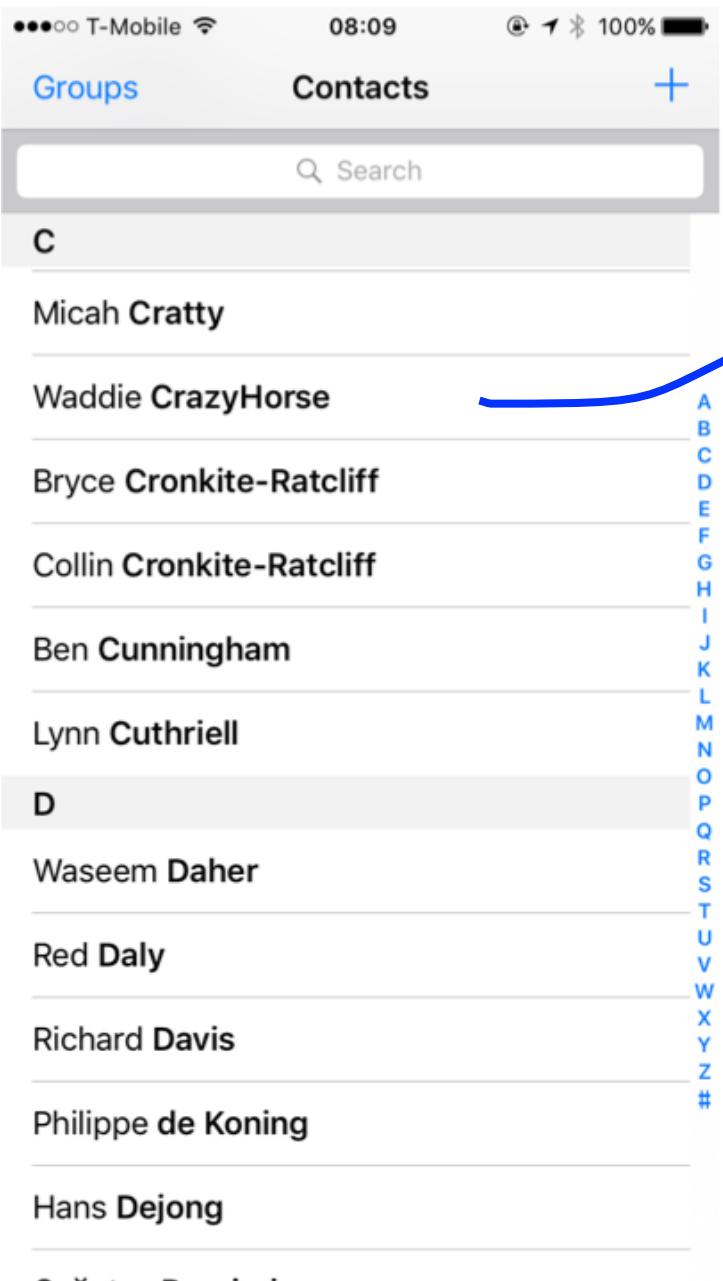
```
int size = myMap.size();  
myMap.containsKey(key); // returns true or false if key is in map  
myMap.keySet();  
myMap.remove(key); // make like a tree and leave!
```

4. Iterate using a foreach loop

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



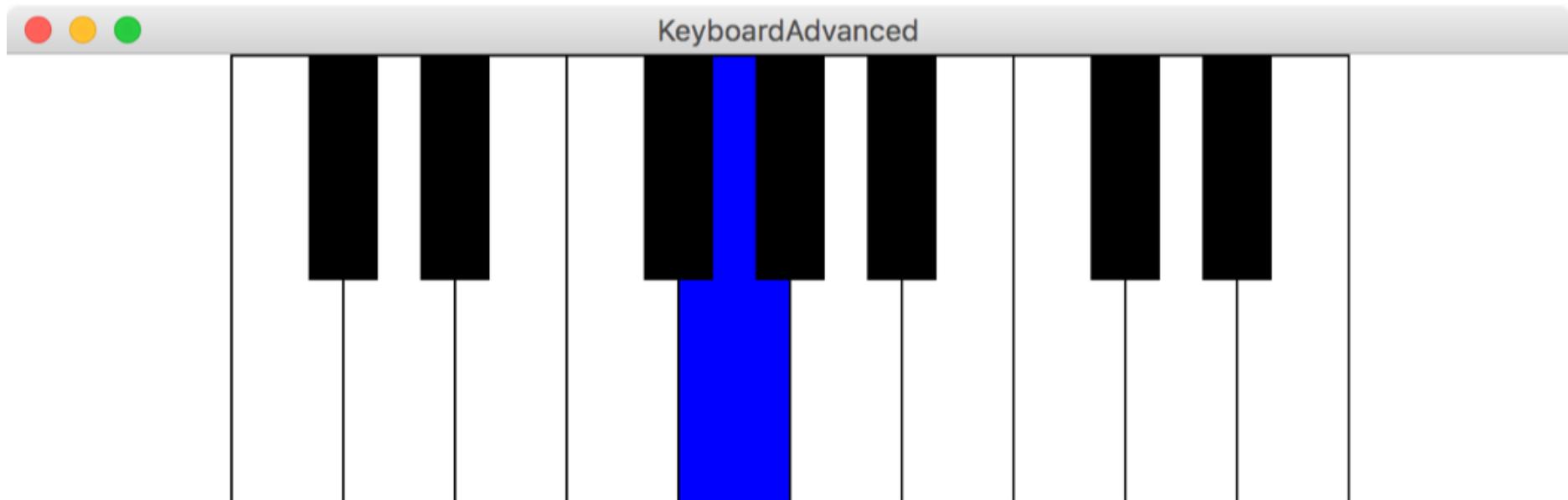
Phone Book



6701678



Make a keyboard



Why is this so fast?



mantis shrimp colors



All

Videos

Shopping

Images

News

More

Settings

Tools

About 1,870,000 results (0.54 seconds)

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 ...](http://www.sci-news.com/biology/science-color-vision-mantis-shrimp-01719.html)
www.sci-news.com/biology/science-color-vision-mantis-shrimp-01719.html



Why is this so fast?



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

* Learn more in CS106B

