



Maps

Chris Piech
CS106A, Stanford University

CS106A Winter 2018 Contest



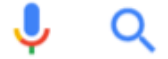
Piech, CS106A, Stanford University



Why is this so fast?



mantis shrimp colors



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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 ...](#)

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[ ][ ]
```



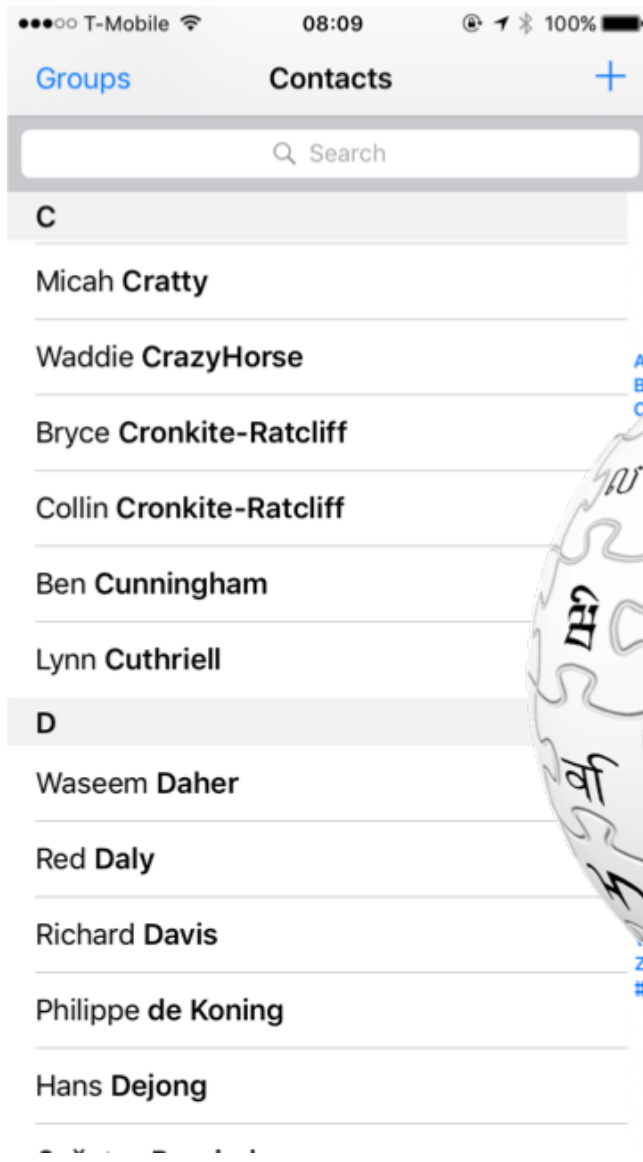
ArrayList
index -> value

Arrays

index -> value

Matrix
(row, col) -> value

Maps can have any type for key



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"]



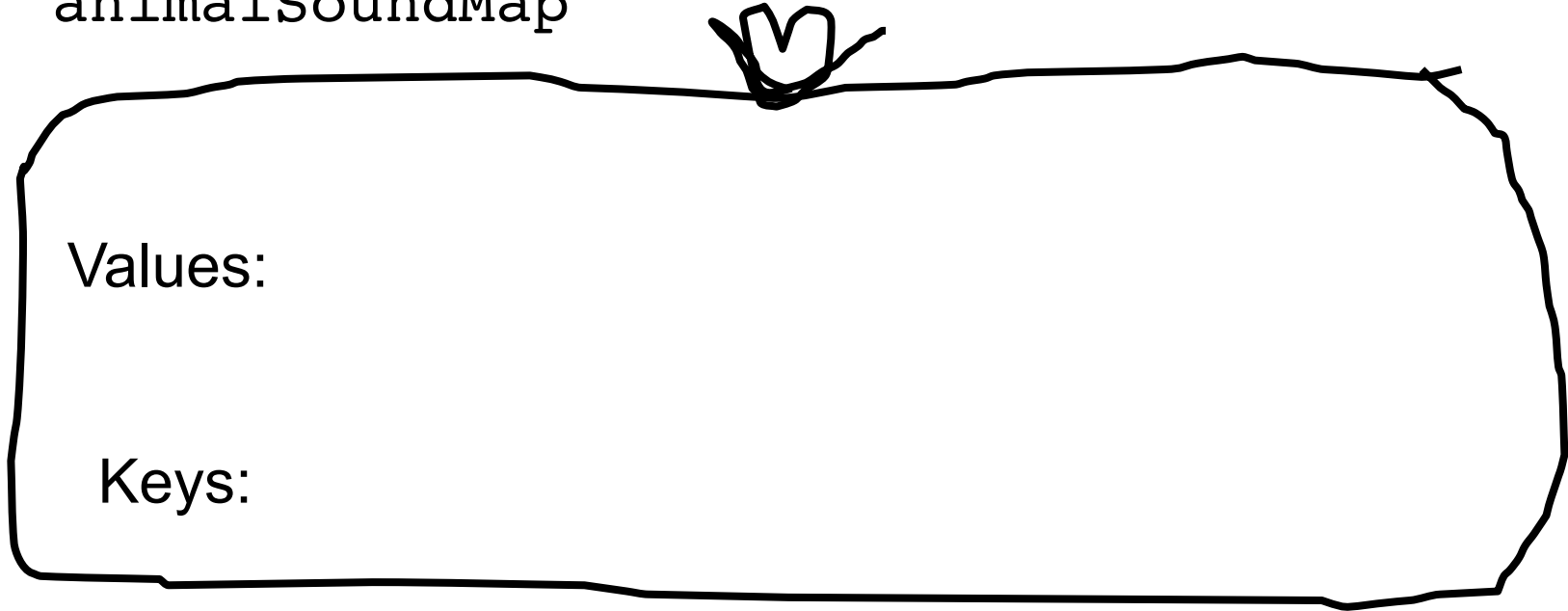
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Simple Example

animalSoundMap

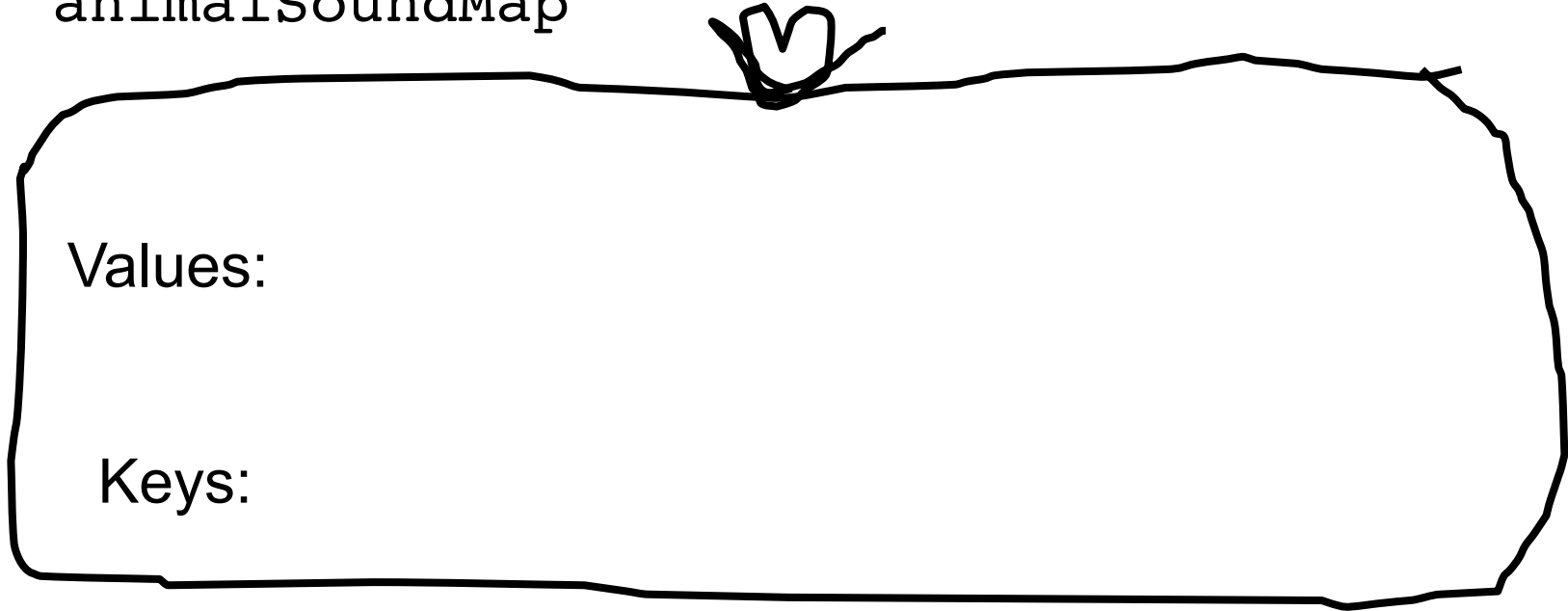


1. **Make a new HashMap of animal sounds**
2. Add elements:
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Simple Example

animalSoundMap

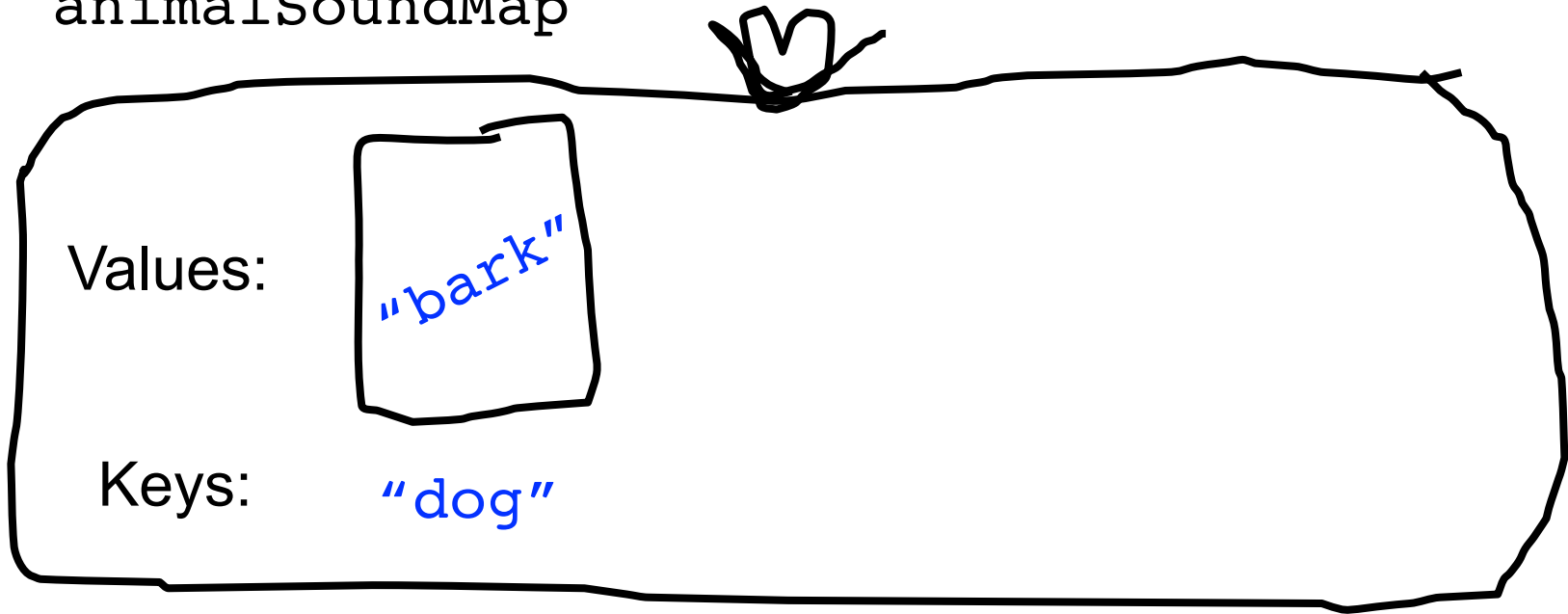


1. Make a new HashMap of animal sounds
2. Add elements:
`Put [key = "dog", value = "bark" ]`
`Put [key="cat", value="meow" ]`
`Put [key="sea1", value="ow ow ow" ]`
3. Get elements:
`Get [key = "dog"]`



Simple Example

animalSoundMap

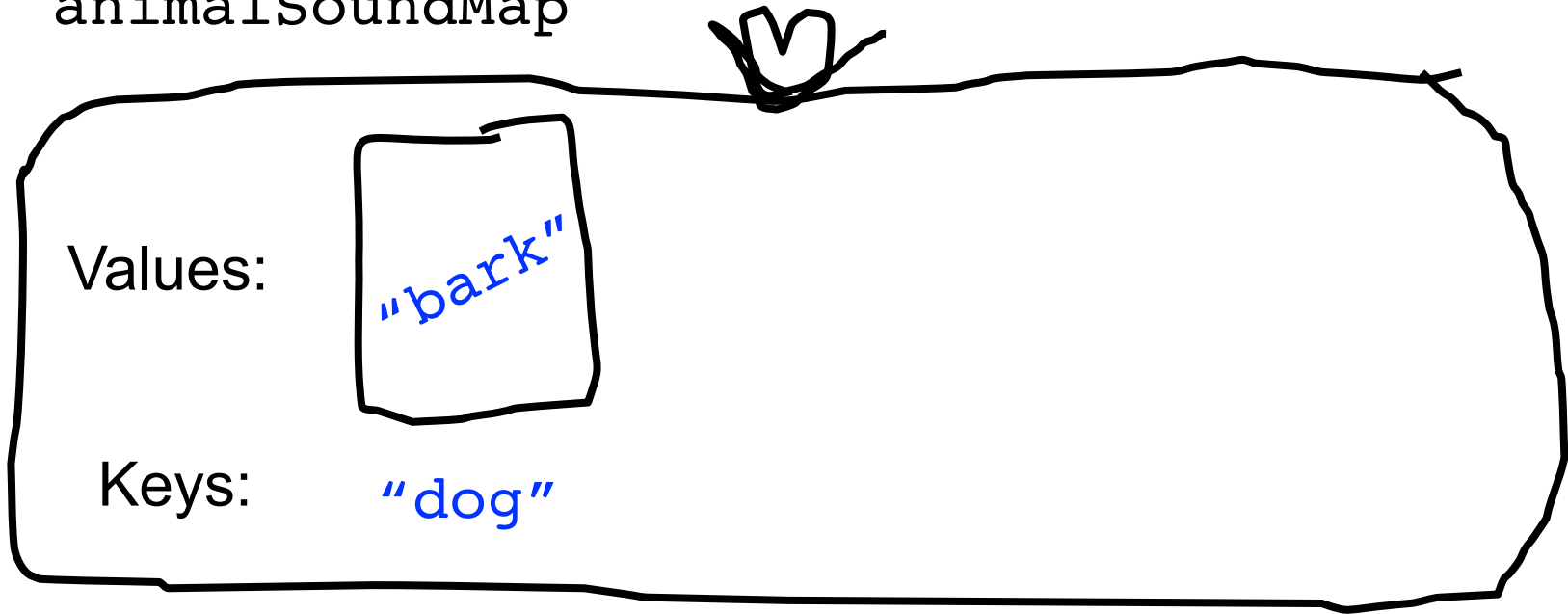


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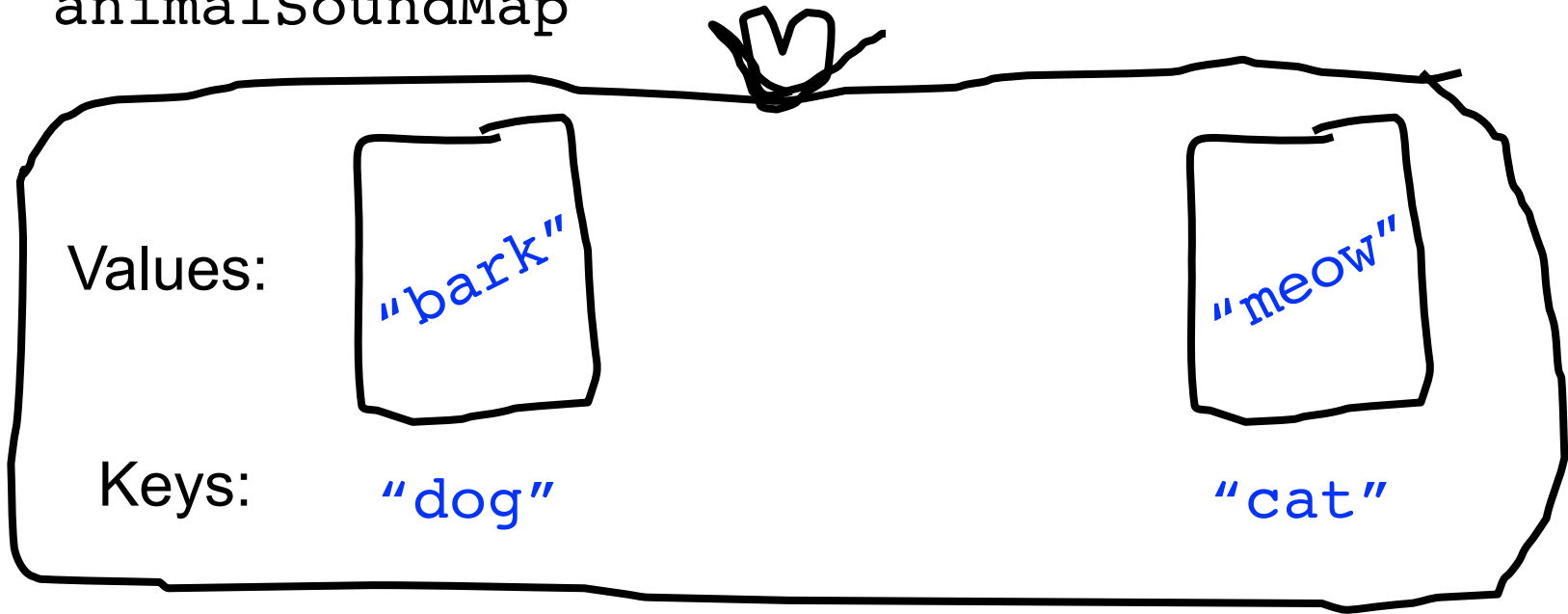


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Simple Example

animalSoundMap

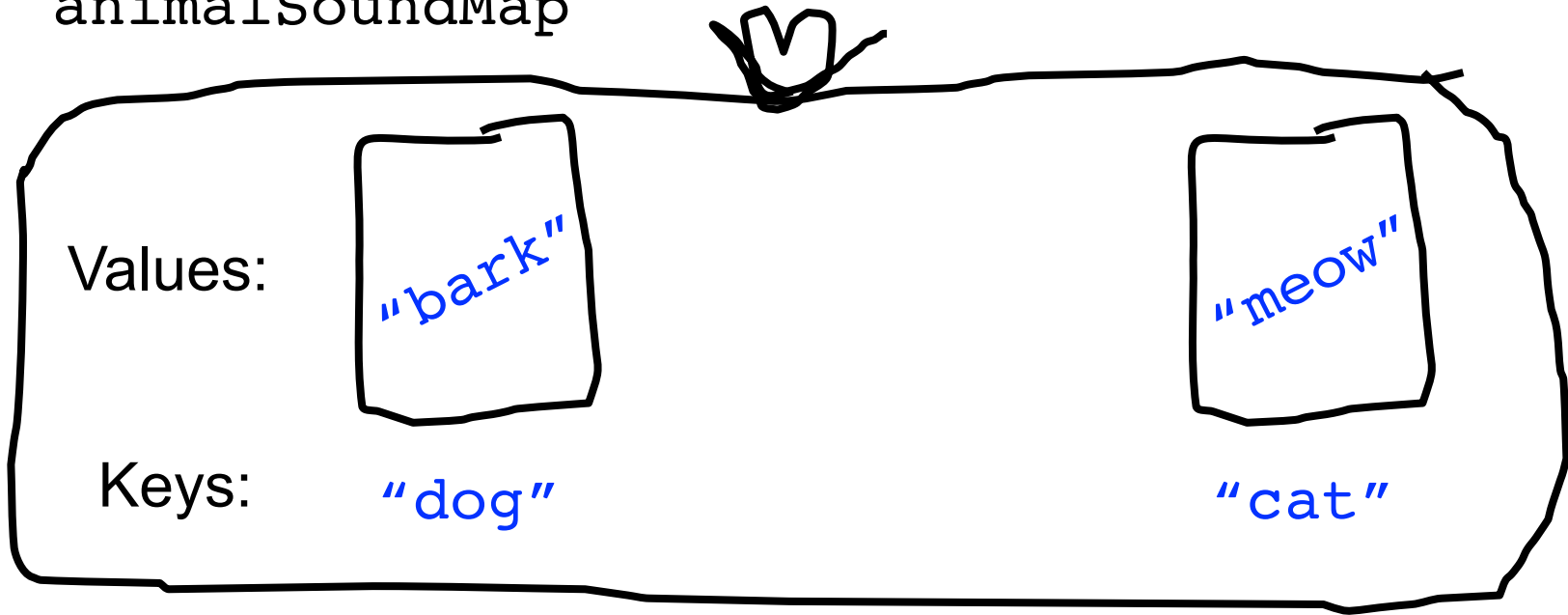


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Simple Example

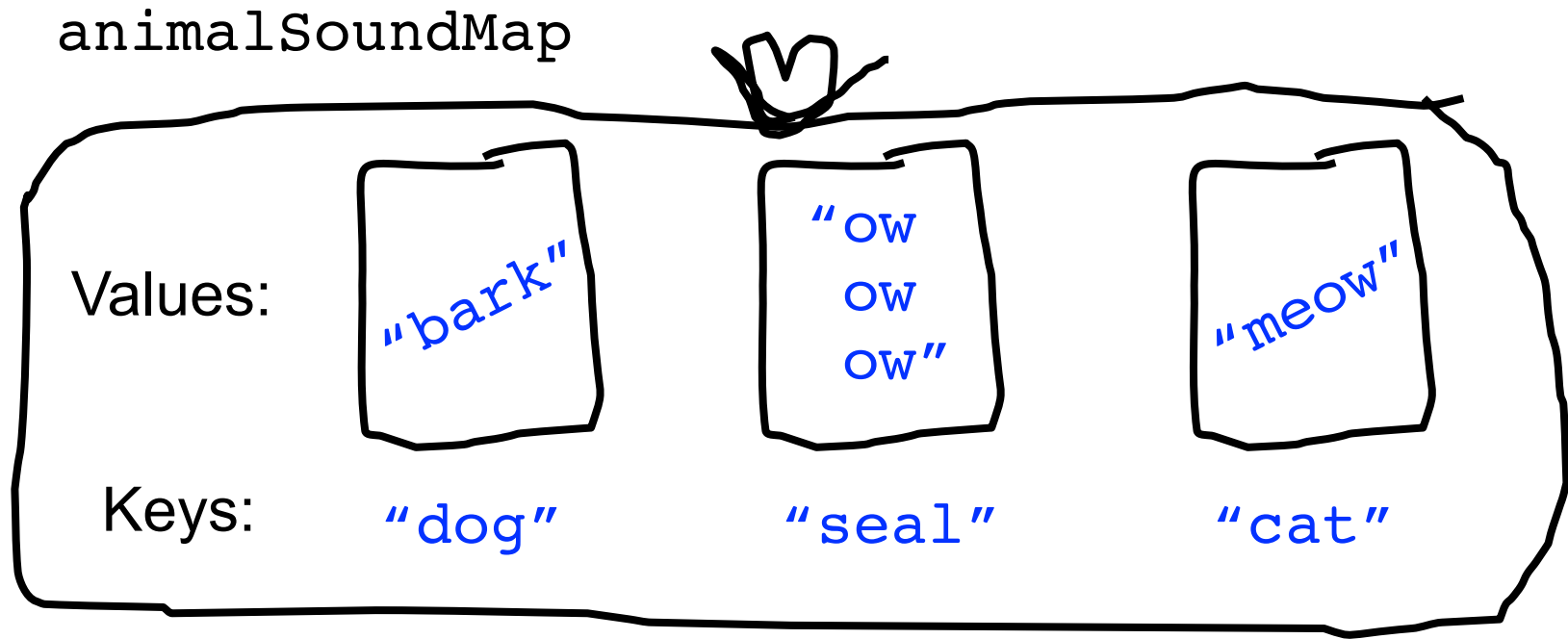
animalSoundMap



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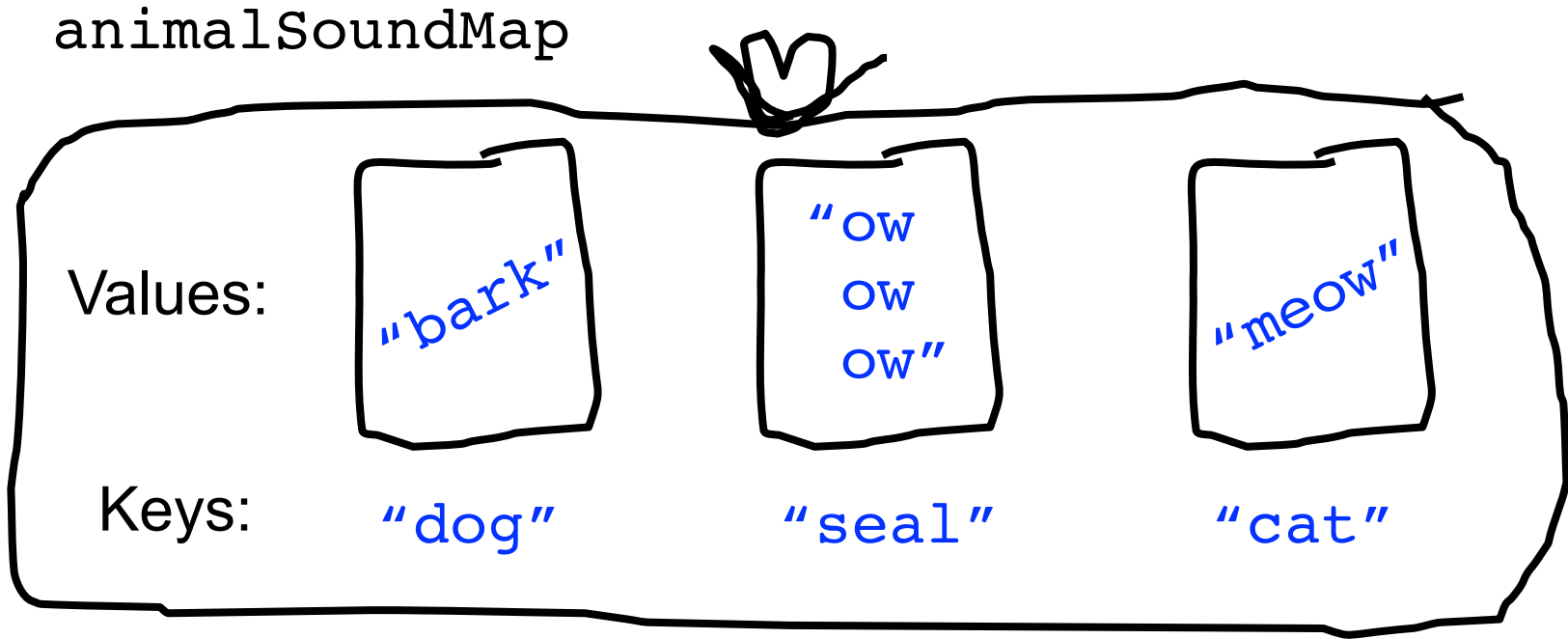
Simple Example



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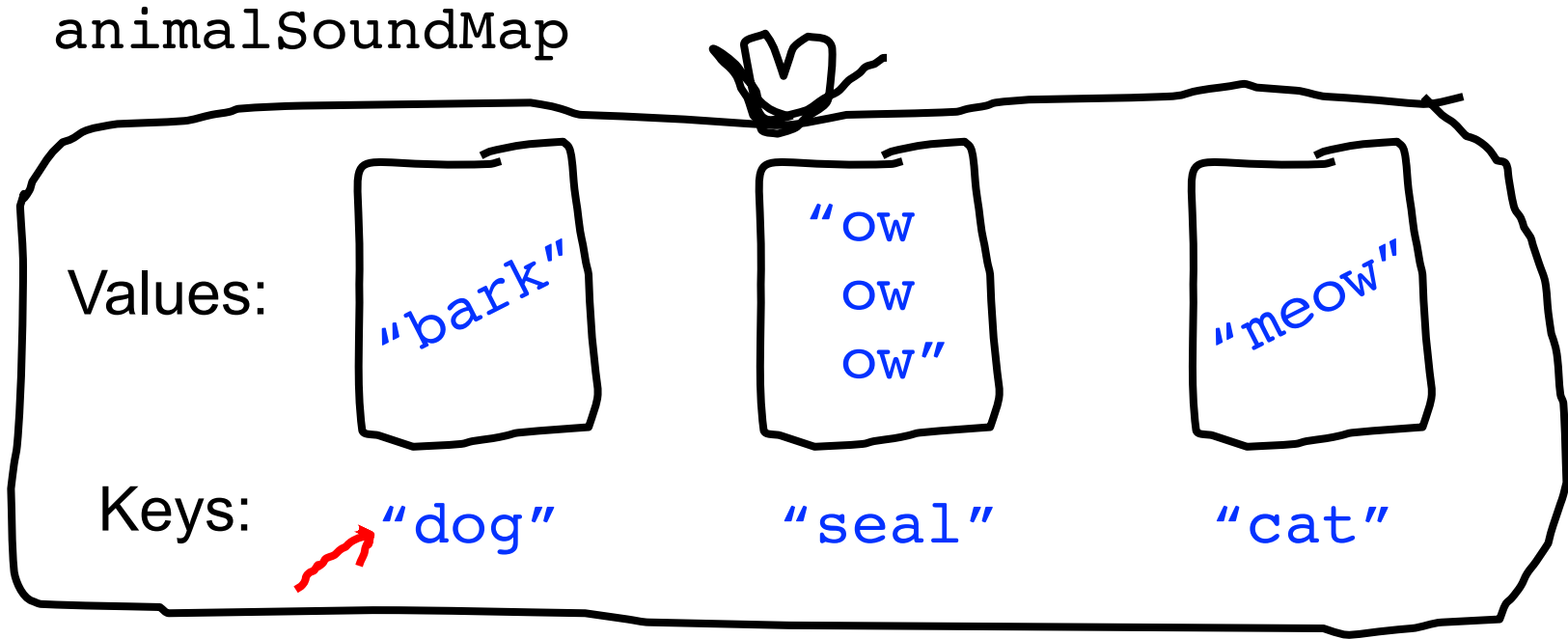
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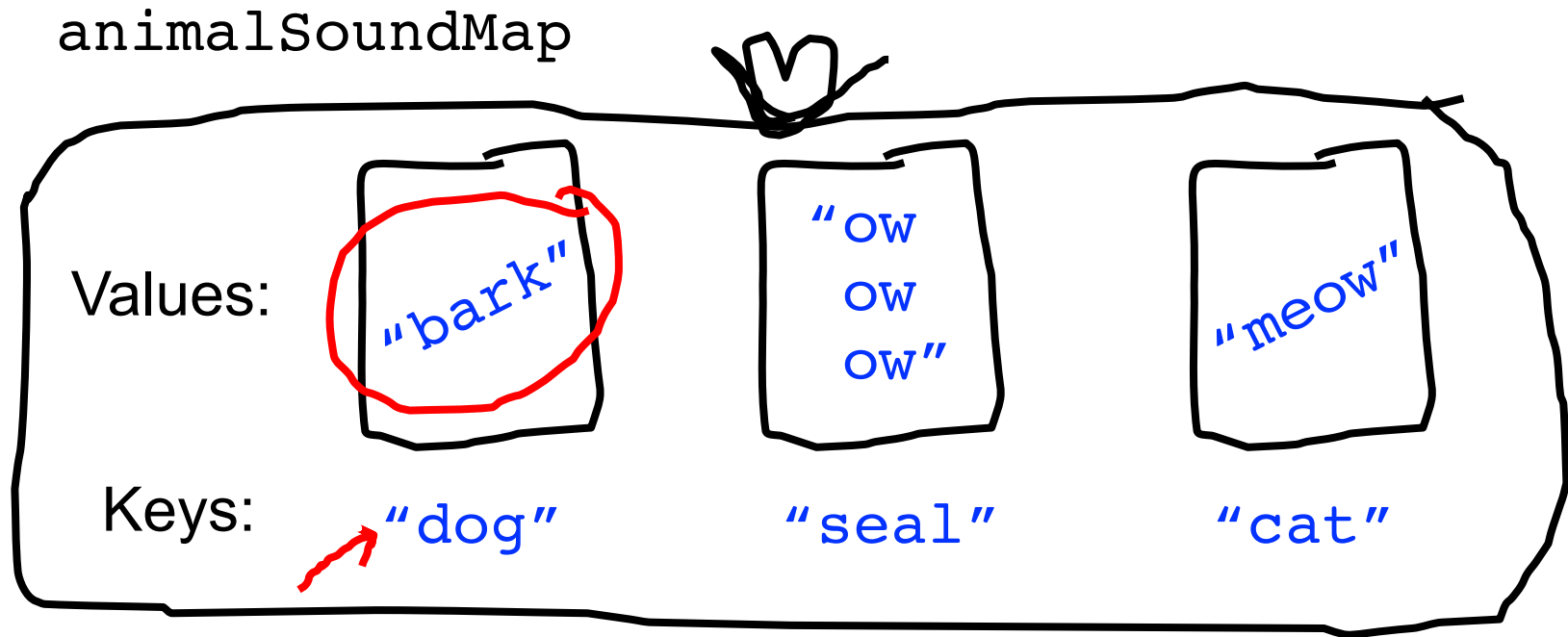
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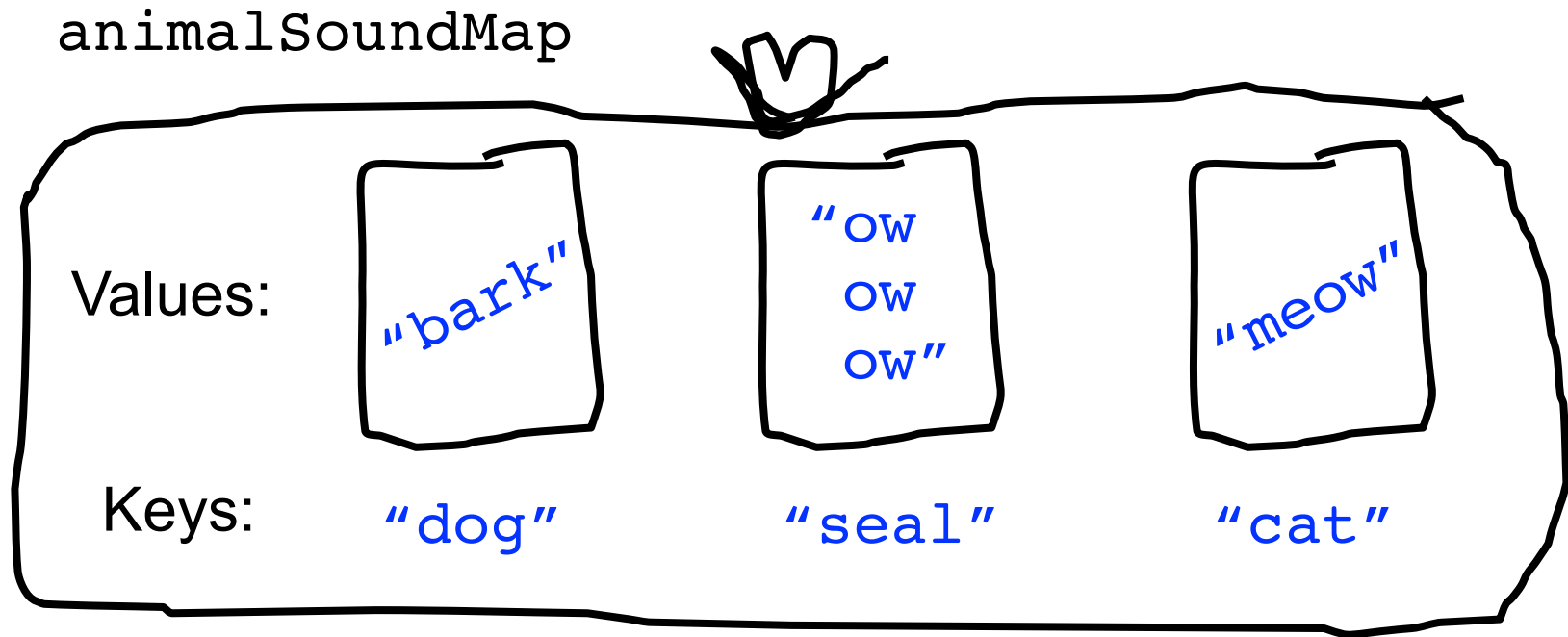
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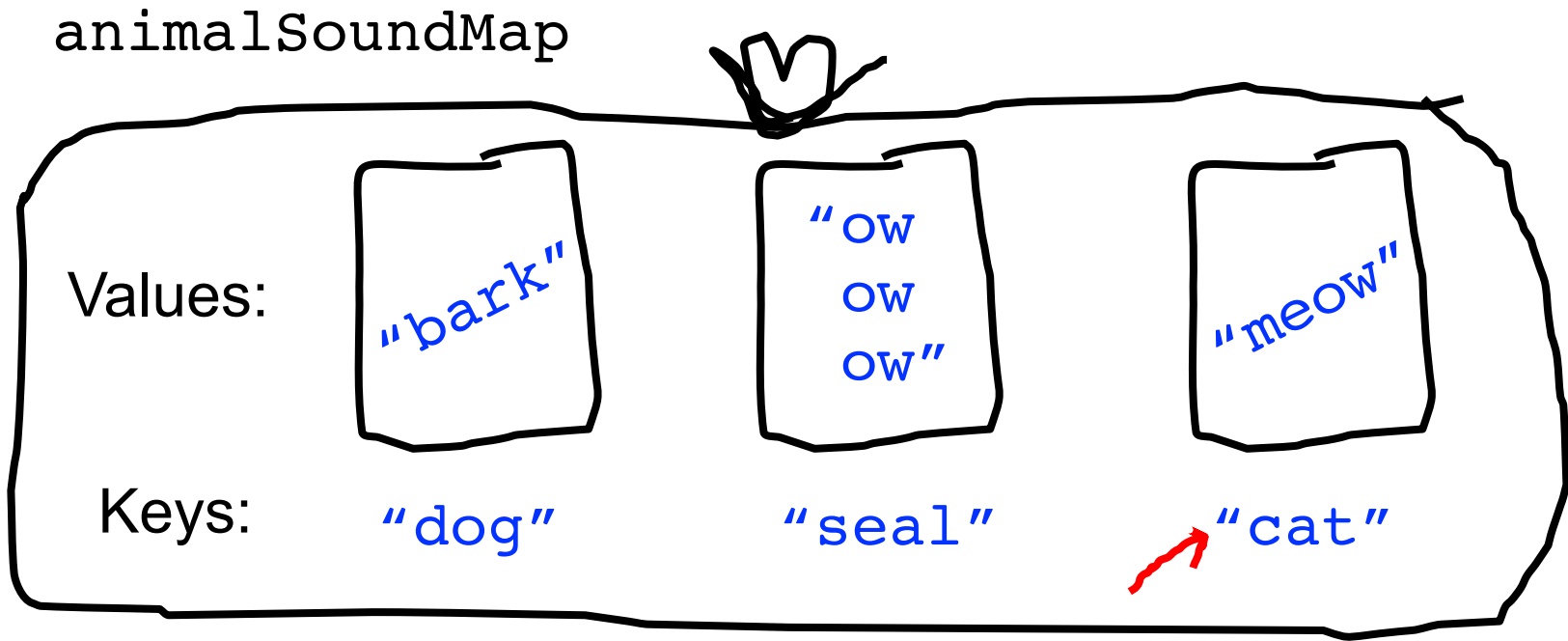
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Put [key="seal", value="ow ow ow"]
3. Get elements:
Get [key = "cat"]



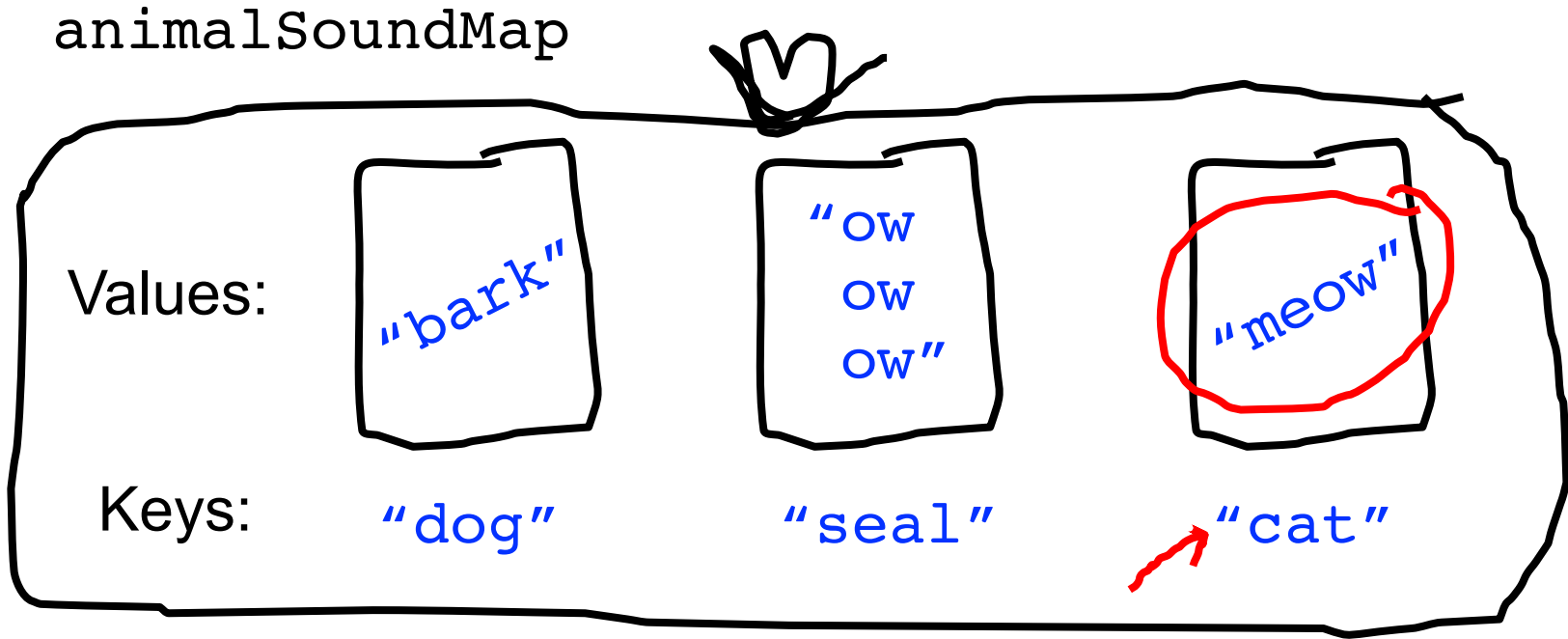
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Put [key="seal", value="ow ow ow"]
3. Get elements:
Get [key = "cat"]



Simple Example



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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

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My First Map

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



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My First Map

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```



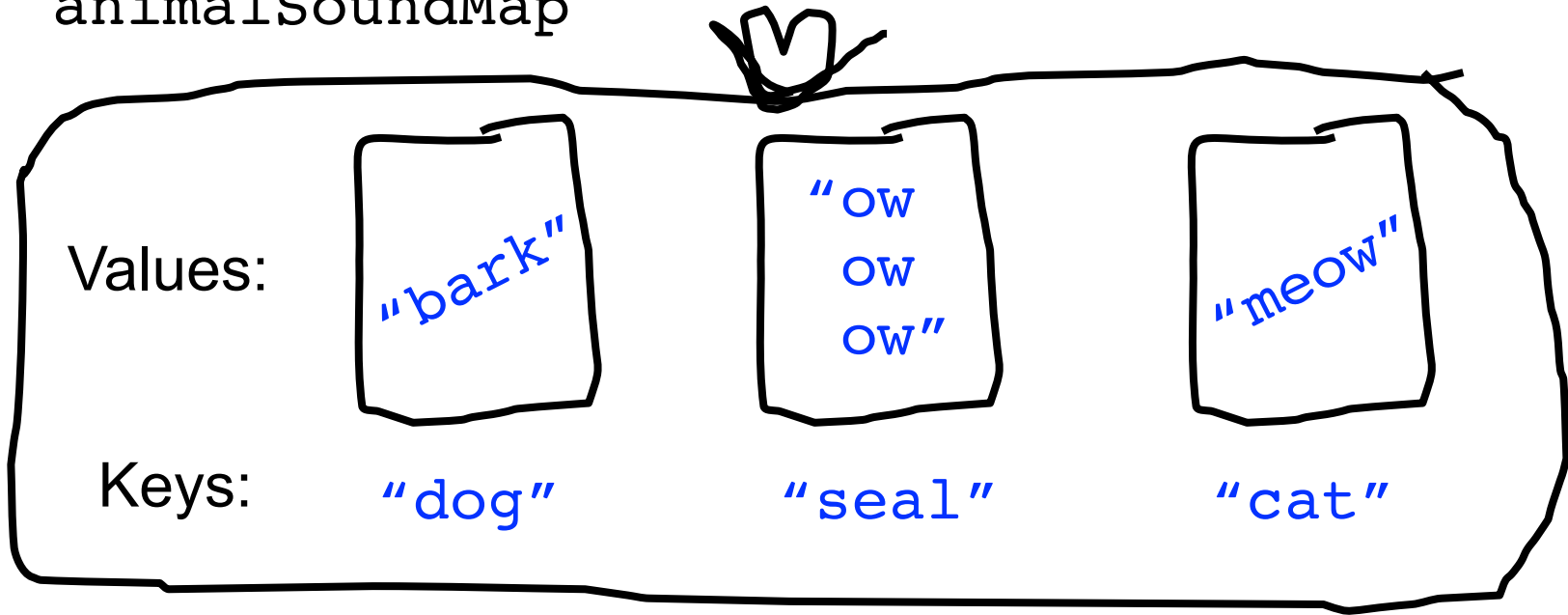
My First Map

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



My First Map

animalSoundMap

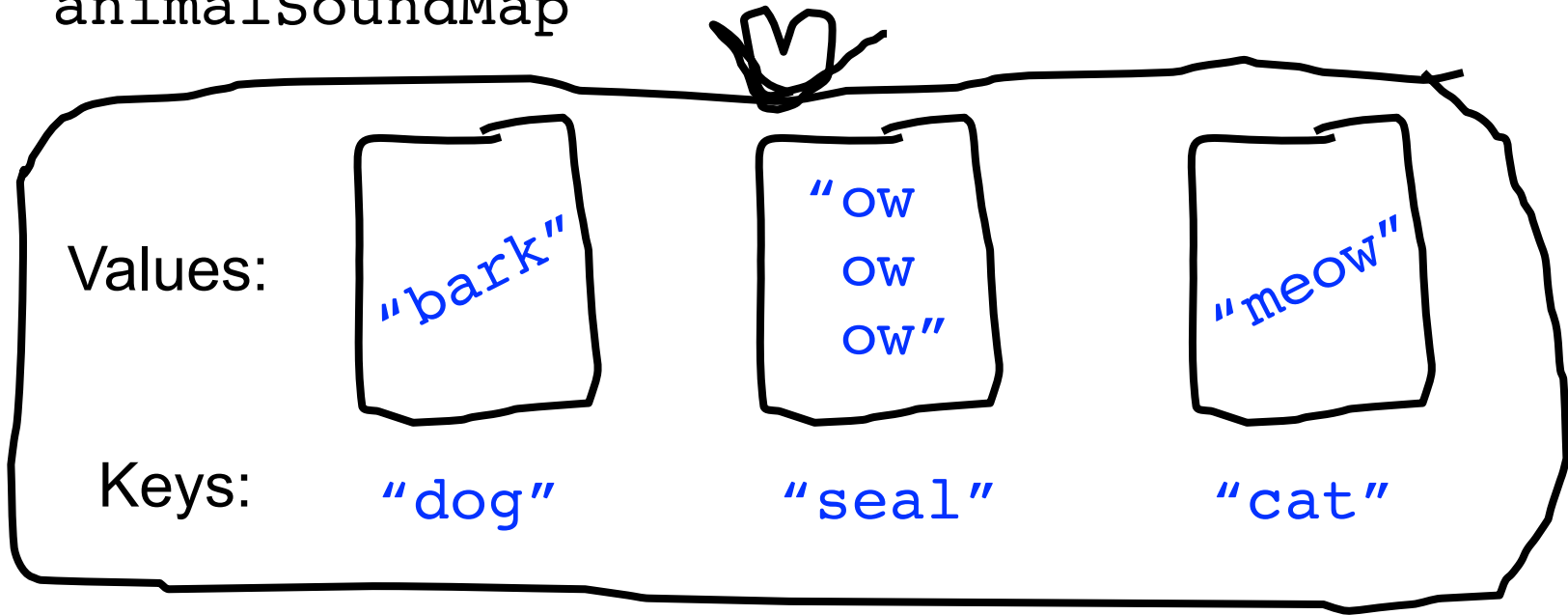


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My First Map

animalSoundMap



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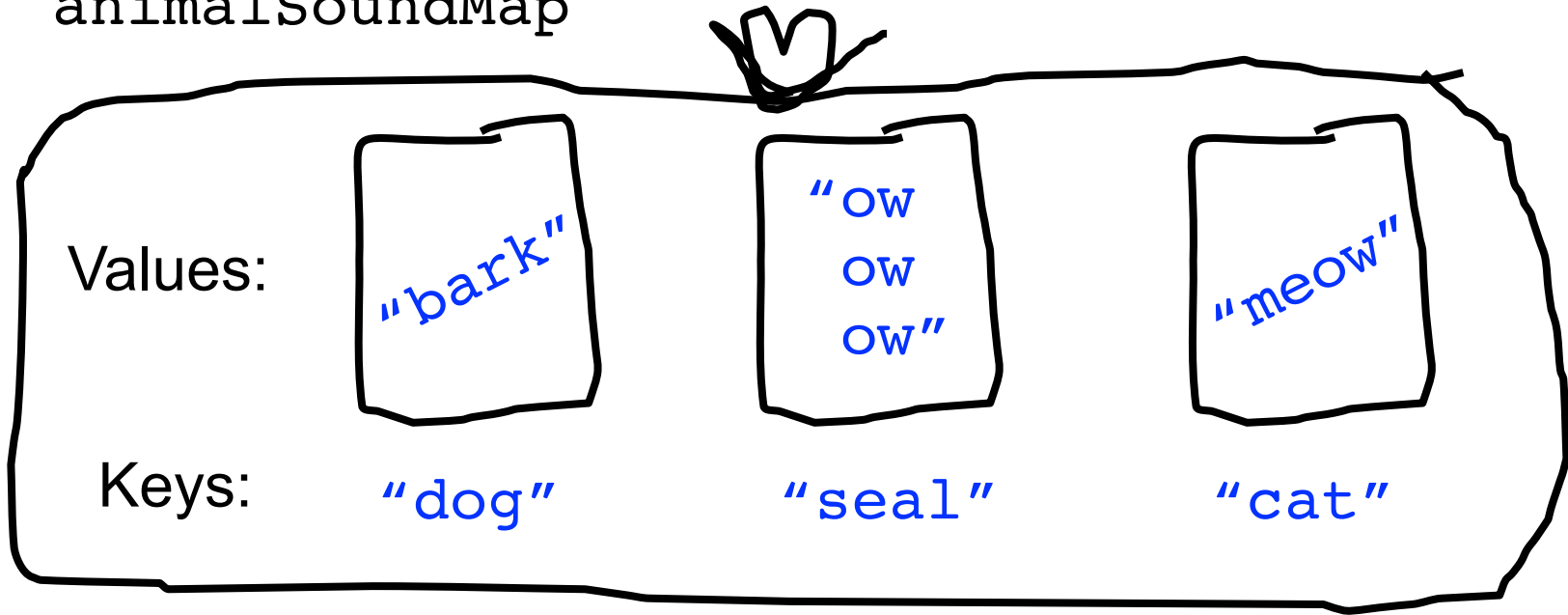
```
// 2. Put things into the map
animalSoundMap.put("dog", "woof");
animalSoundMap.put("cat", "meow");
animalSoundMap.put("seal", "ow ow ow");
```

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



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



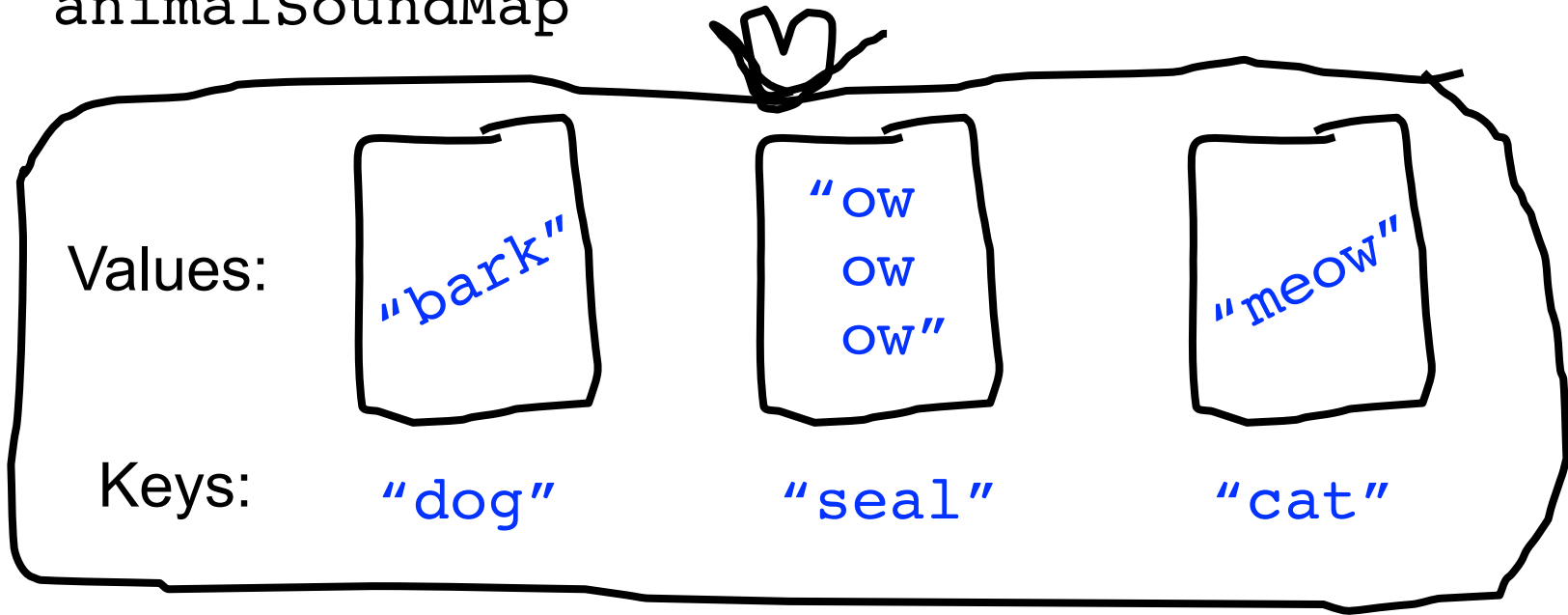
But there's one sound

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



My First Map

animalSoundMap



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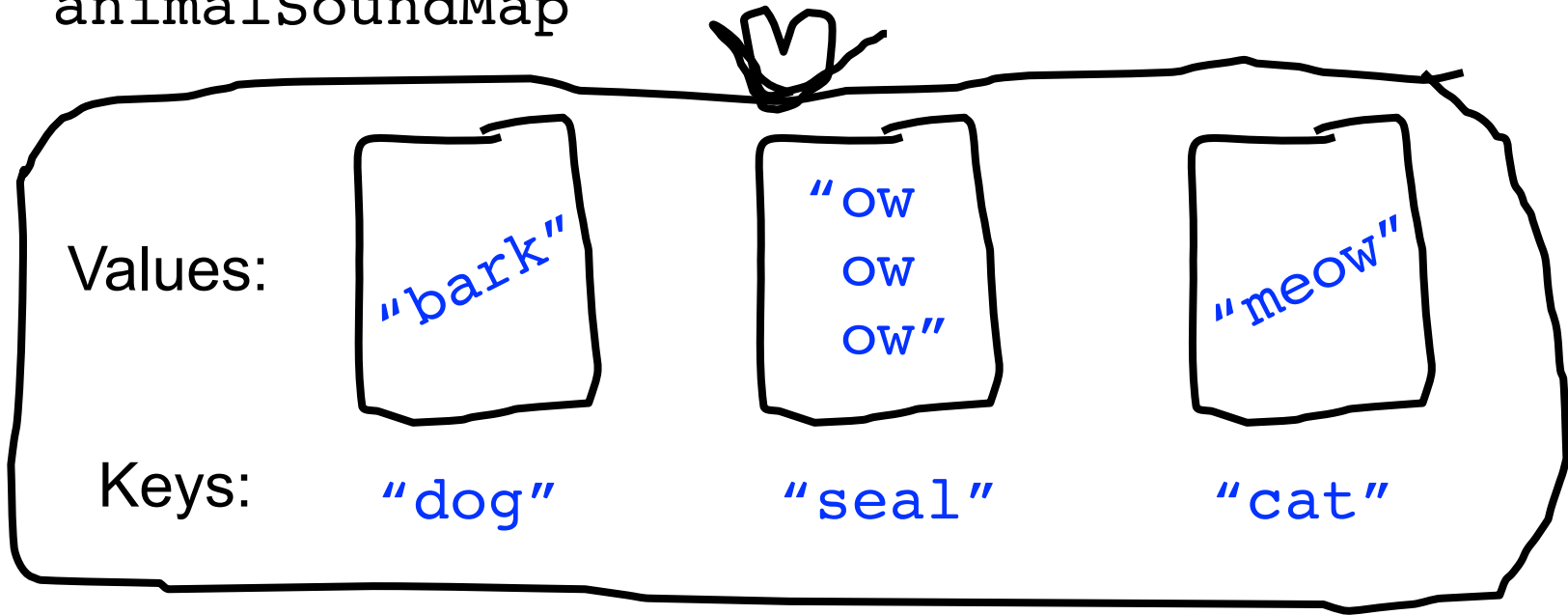
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// 3. Get things out of the map
animalSoundMap.get("dog"); // "woof"
animalSoundMap.get("fox"); // ?
```



My First Map

animalSoundMap



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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

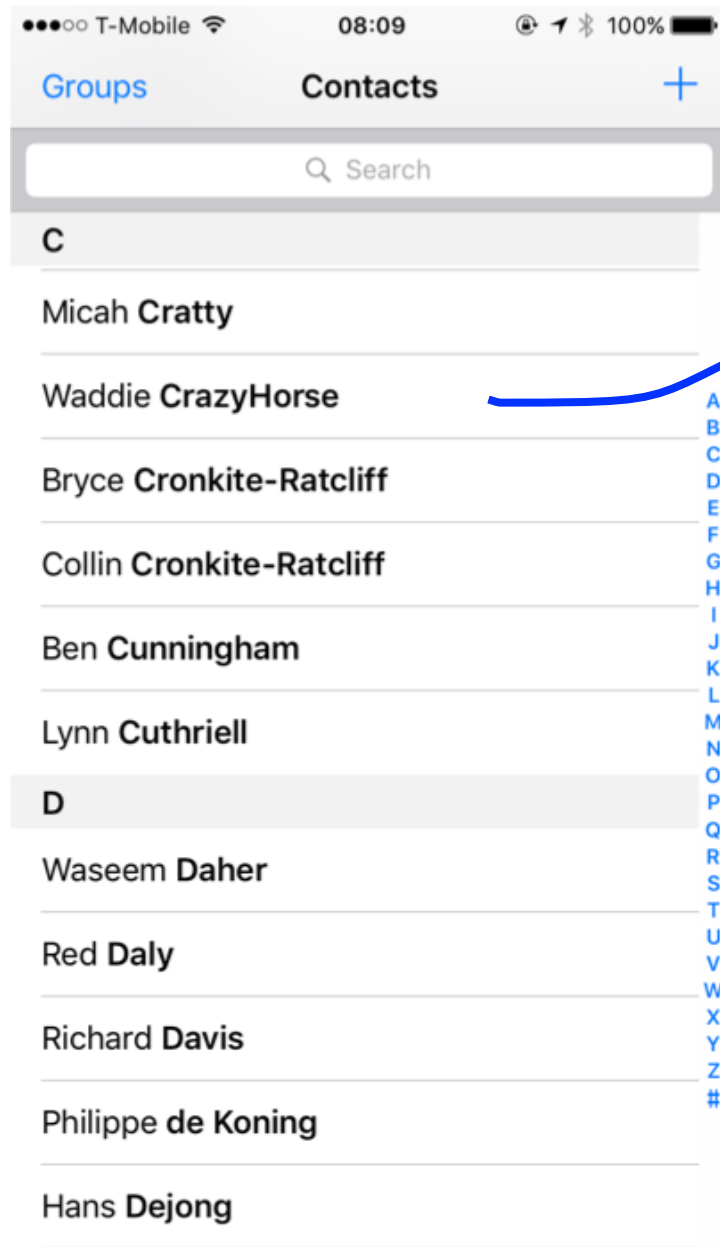
```
int size = myMap.size();  
myMap.containsKey(key); // returns true or false if key is in map  
myMap.keySet();  
myMap.remove(key); // make like a tree and leave!
```

4. Iterate using a foreach loop

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



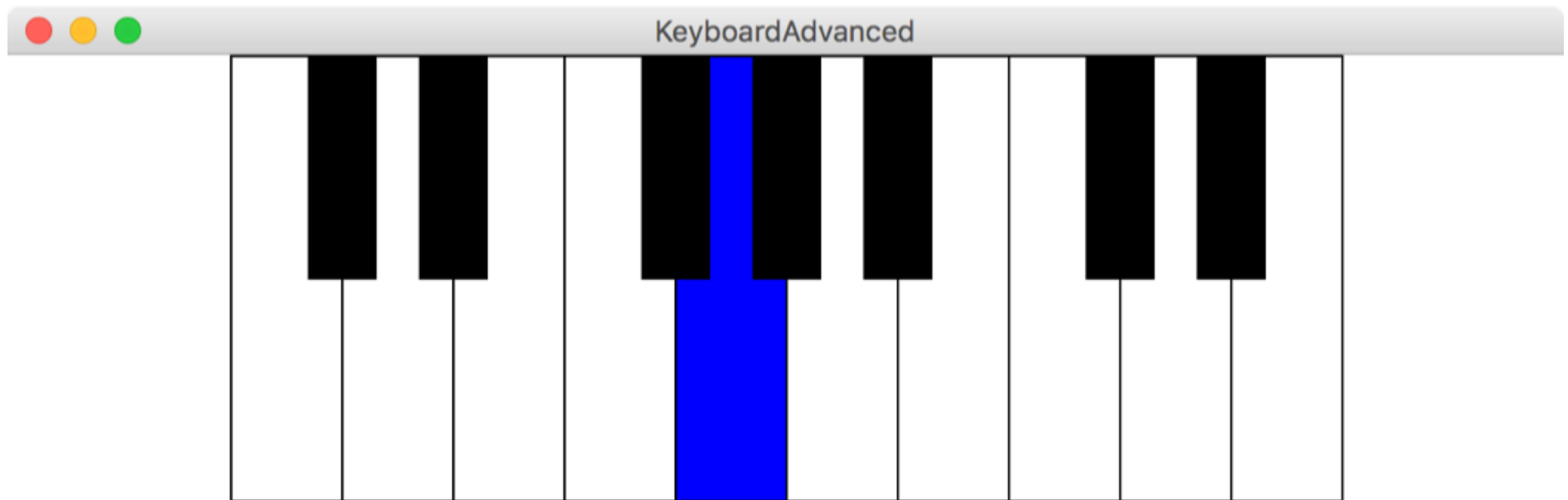
Phone Book



6701678



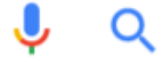
Make a keyboard



Why is this so fast?



mantis shrimp colors



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Why is this so fast?



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

* Learn more in CS106B

