Maps

Chris Piech
CS106A, Stanford University

Why is this so fast?

Google

mantis shrimp colors

All Videos Shopping Images News More Settings Tools

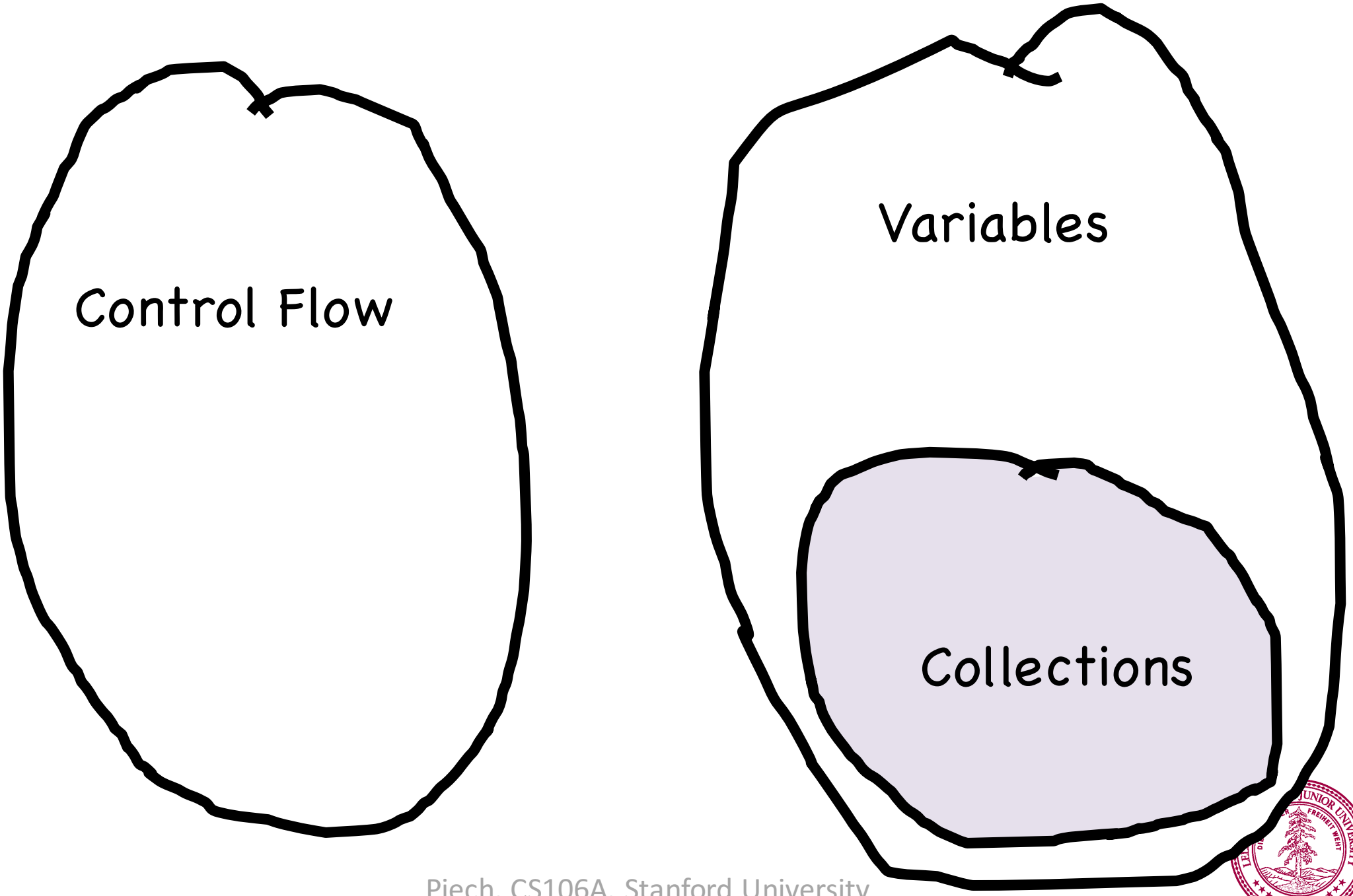
About 1,870,000 results (0.54 seconds)

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 ...
www.sci-news.com/biology/science-**color**-vision-**mantis-shrimp**-01719.html

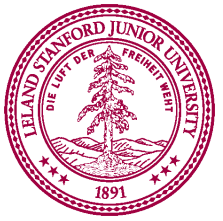
Where are we?

CS106A High Level



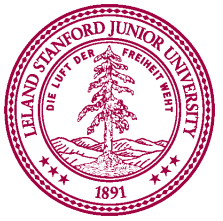
Collections High Level

```
List:    ArrayList<type>
Array:   type[]
Matrix:  type[][]
```

Collections High Level

```
List:    ArrayList<String>
Array:   double[]
Matrix:  int[][]
```

ArrayList
index -> value

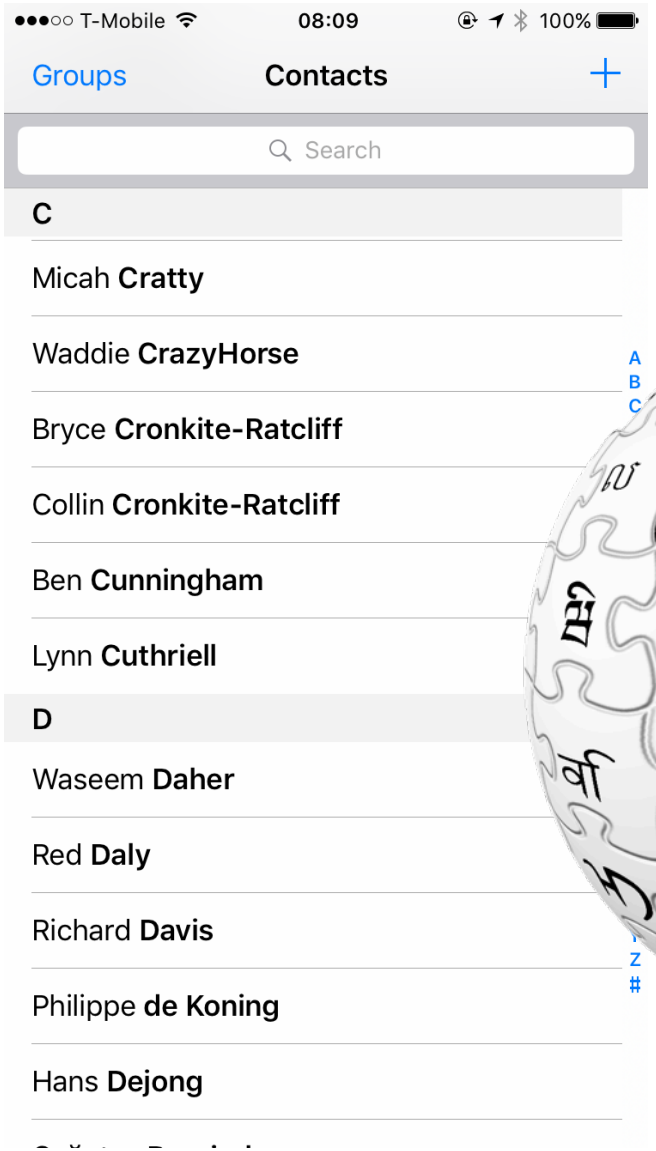
Arrays

index -> value

Matrix

(row, col) -> value

Maps can have any type for key



Many examples

HashMap

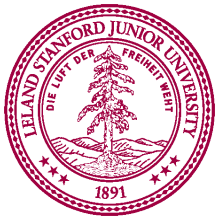
key -> value

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"]

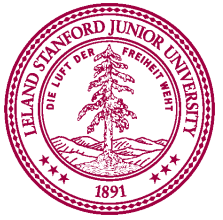


Simple Example

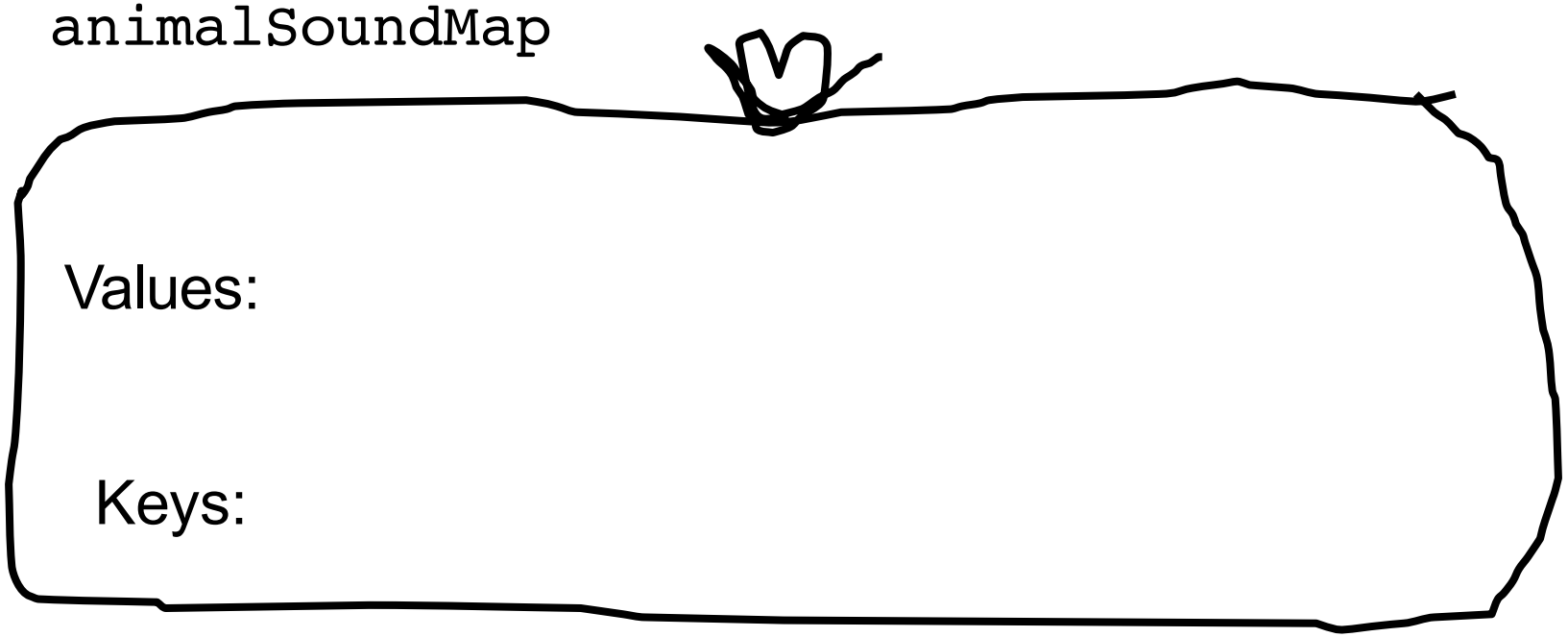
1. Make a new HashMap of animal sounds

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

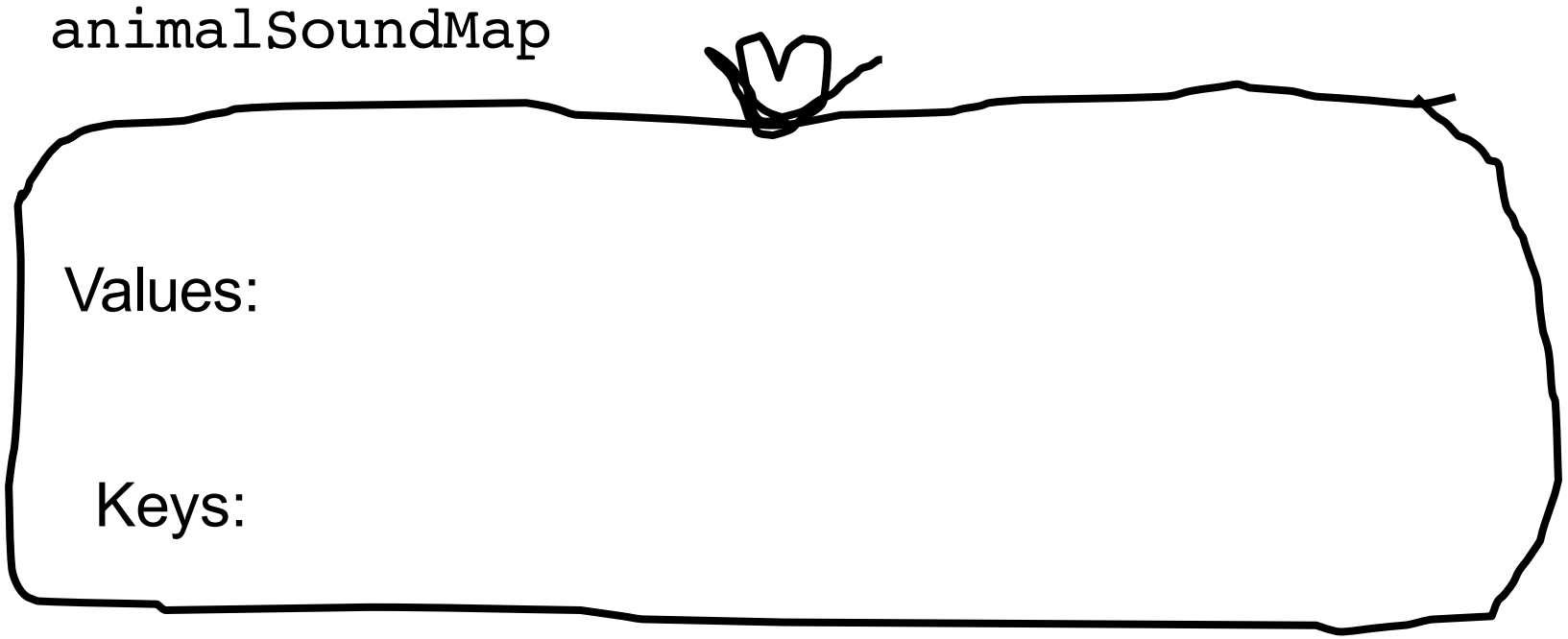


1. Make a new HashMap of animal sounds

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

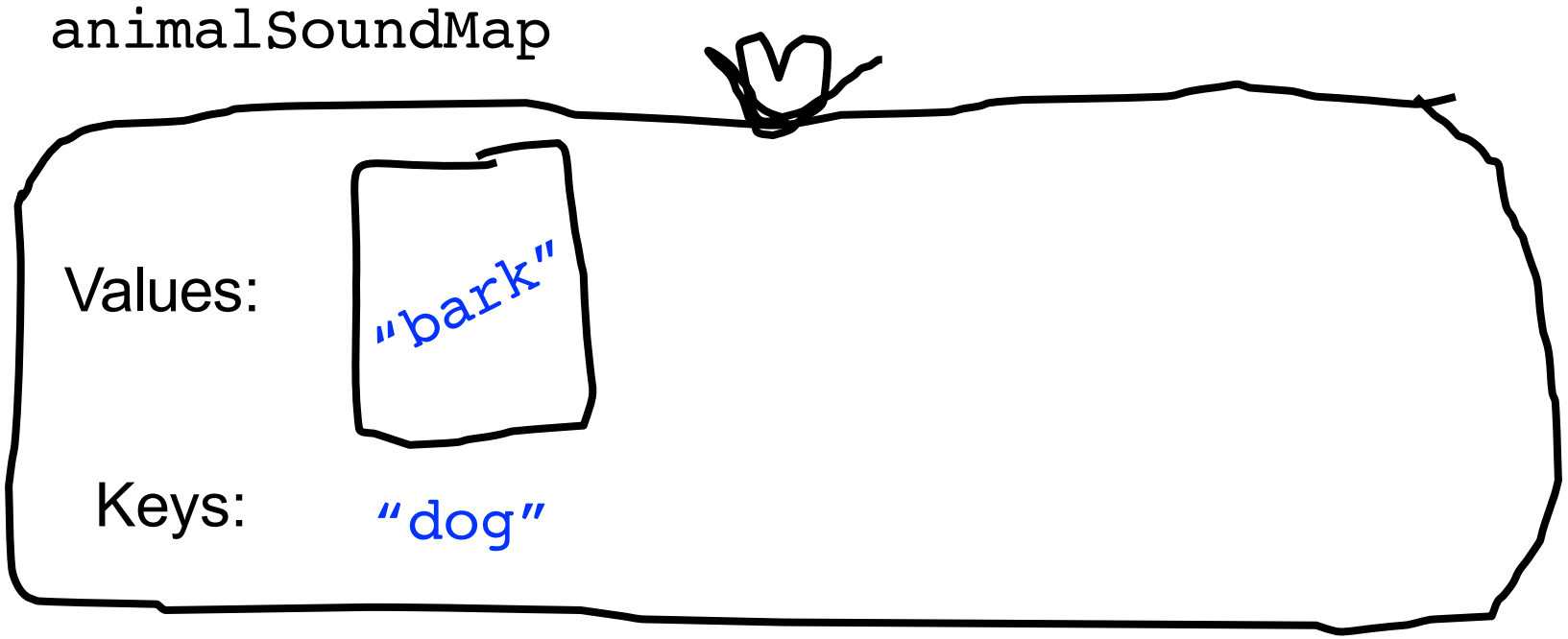


1. Make a new HashMap of animal sounds

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"]

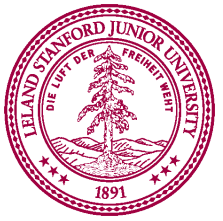
Simple Example



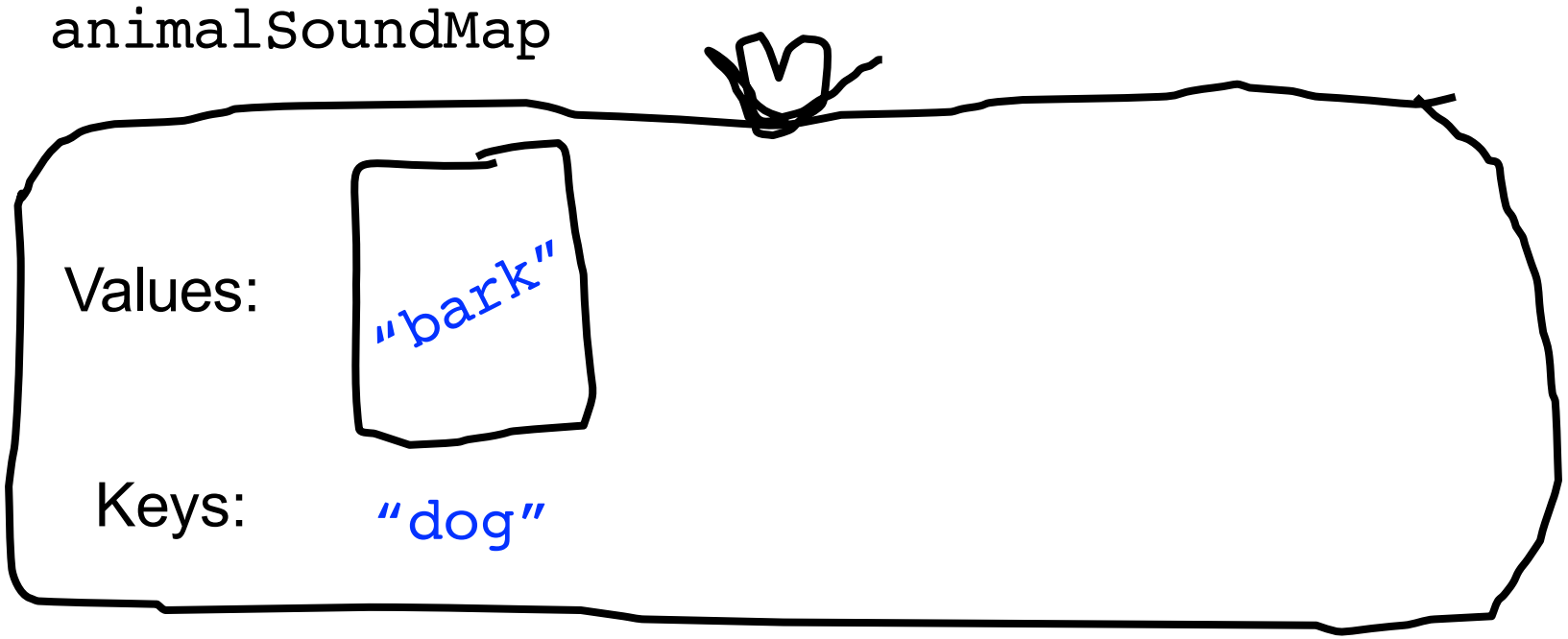
1. Make a new HashMap of animal sounds

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"]



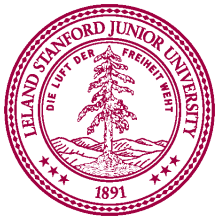
Simple Example



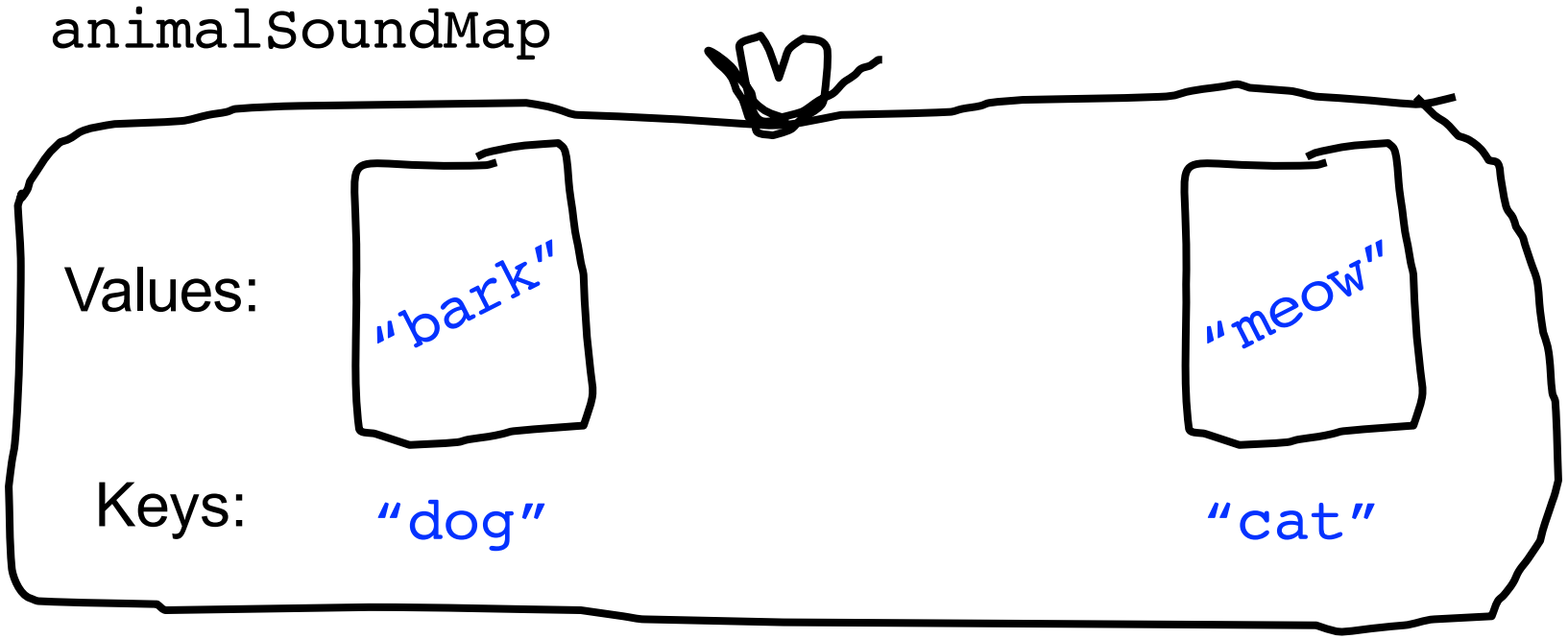
1. Make a new HashMap of animal sounds

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"]



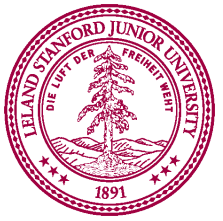
Simple Example



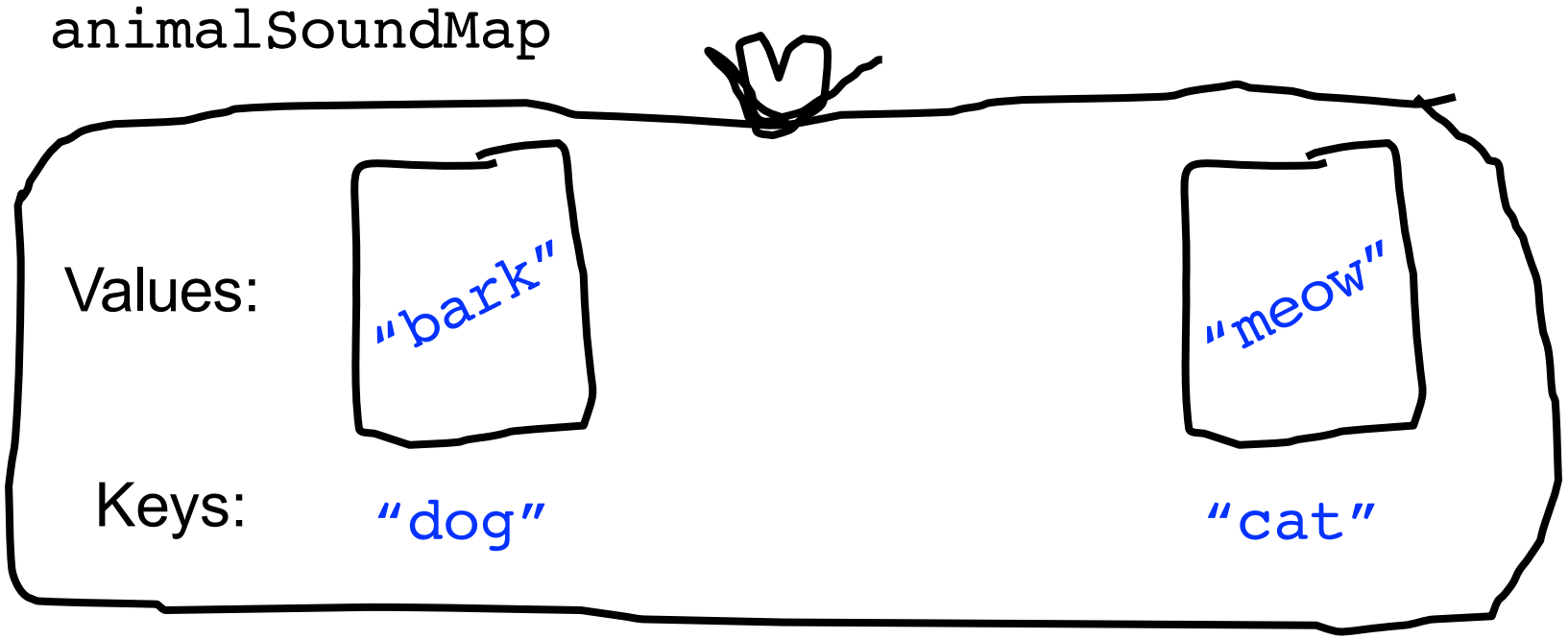
1. Make a new HashMap of animal sounds

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

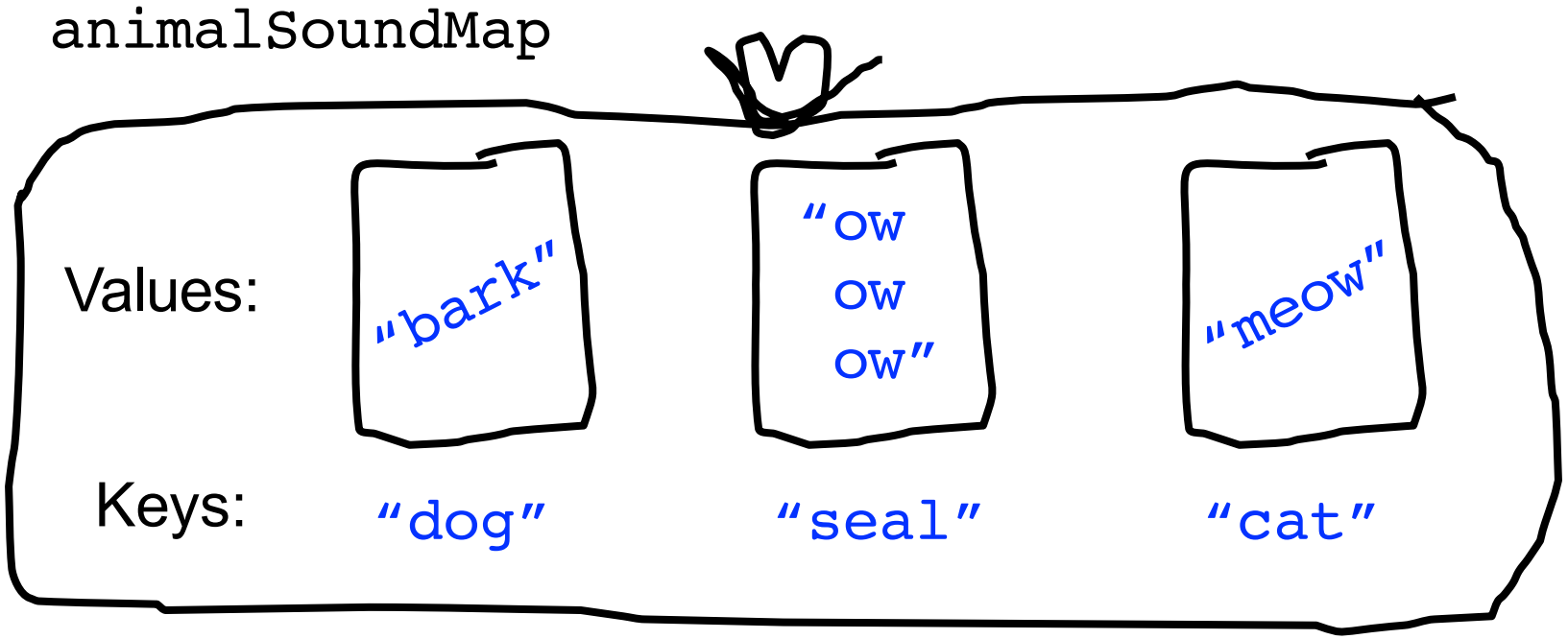


1. Make a new HashMap of animal sounds

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

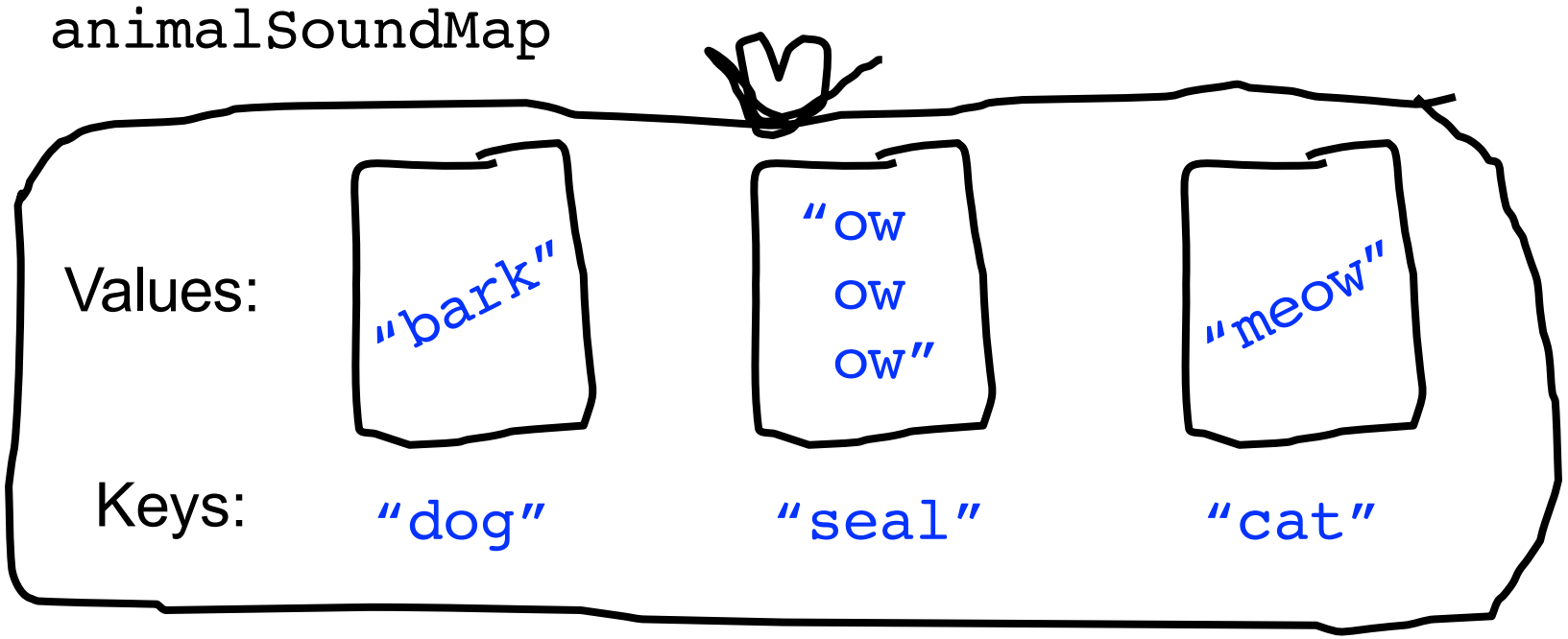


1. Make a new HashMap of animal sounds

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

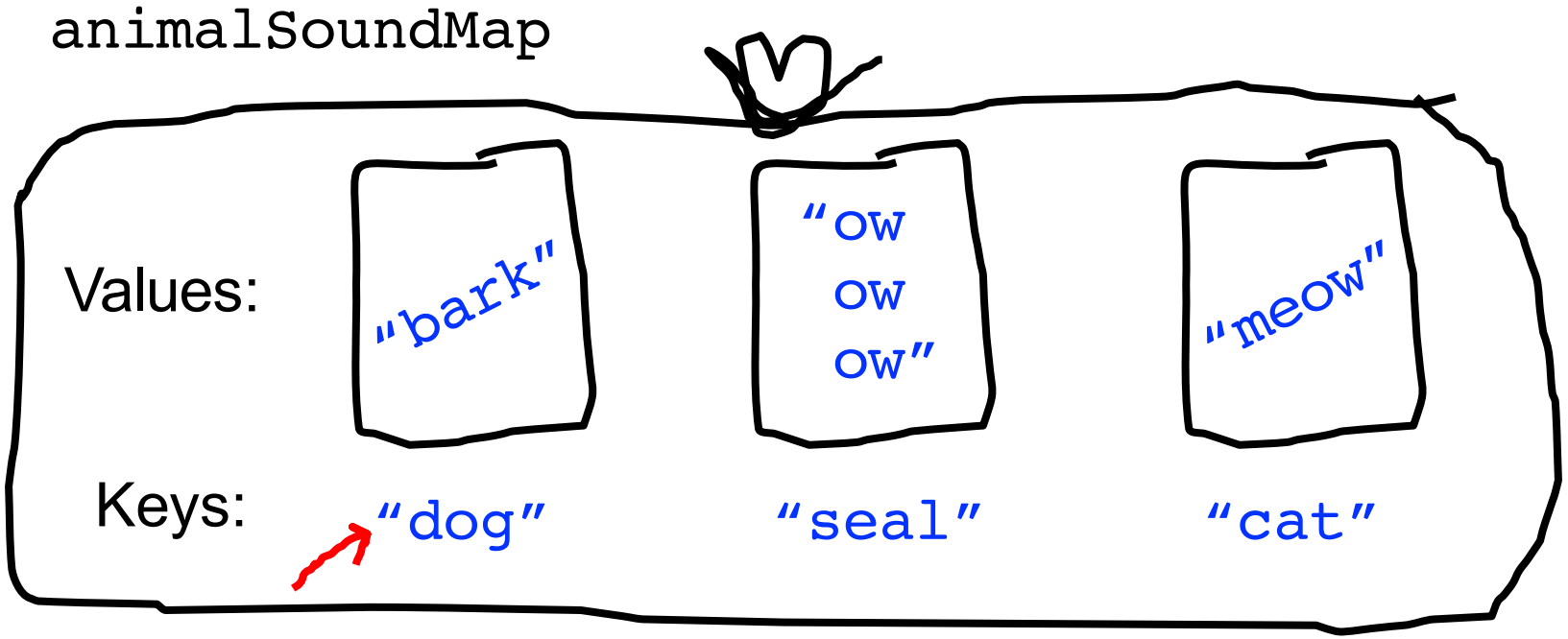


1. Make a new HashMap of animal sounds

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"]

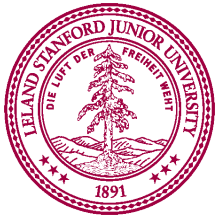
Simple Example



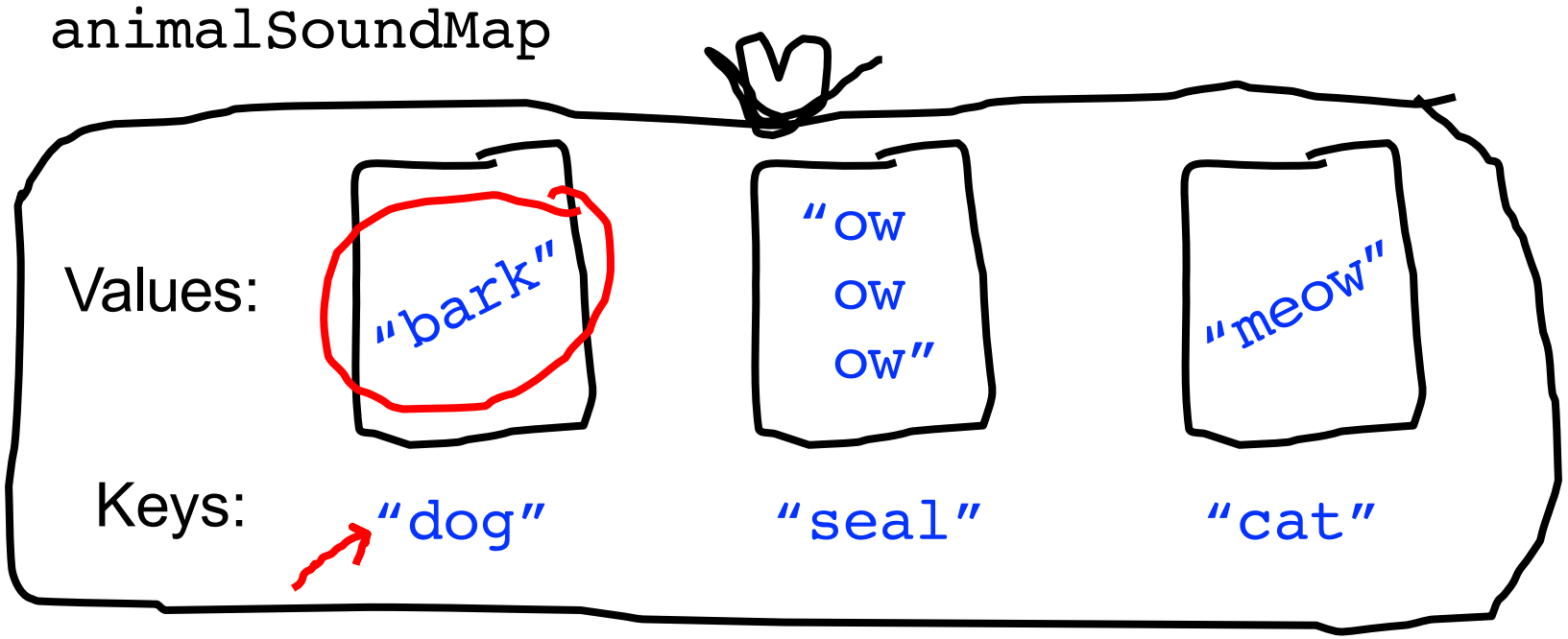
1. Make a new HashMap of animal sounds

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

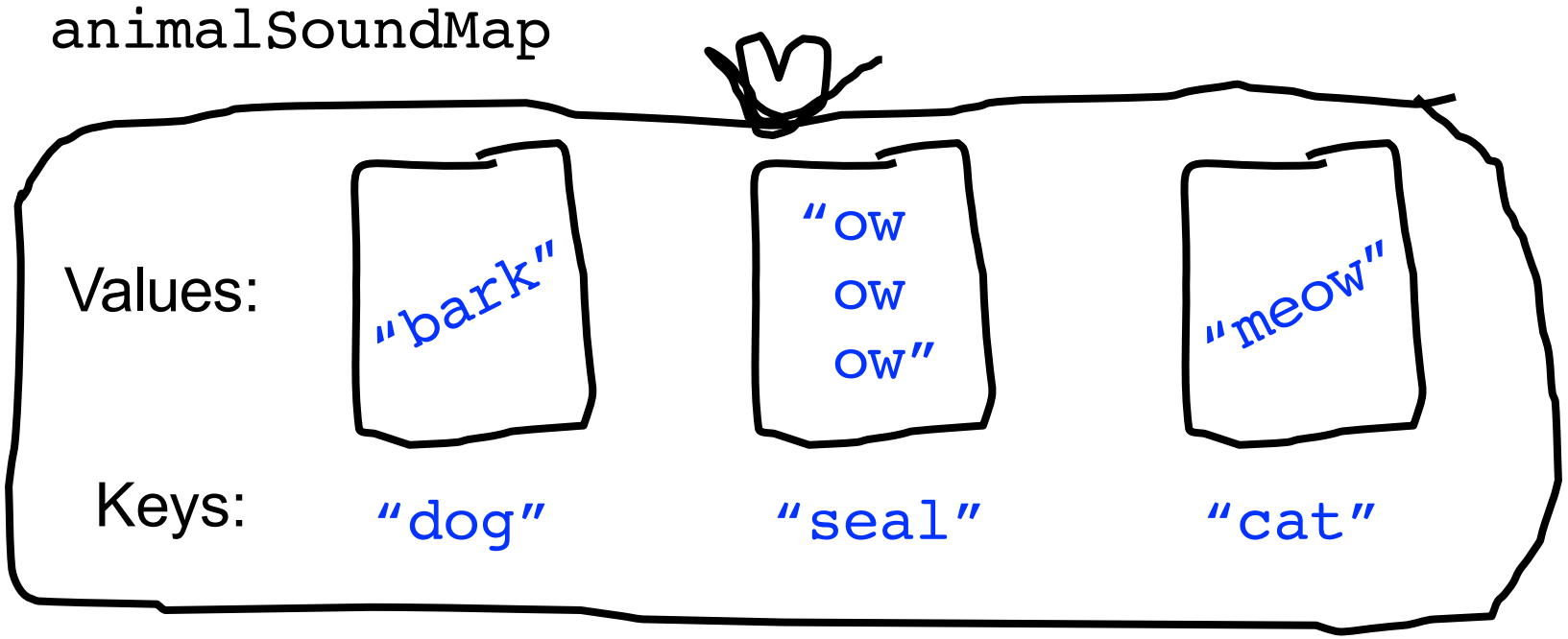


1. Make a new HashMap of animal sound

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"]

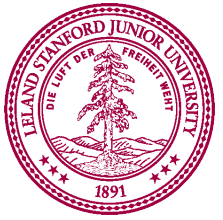
Simple Example



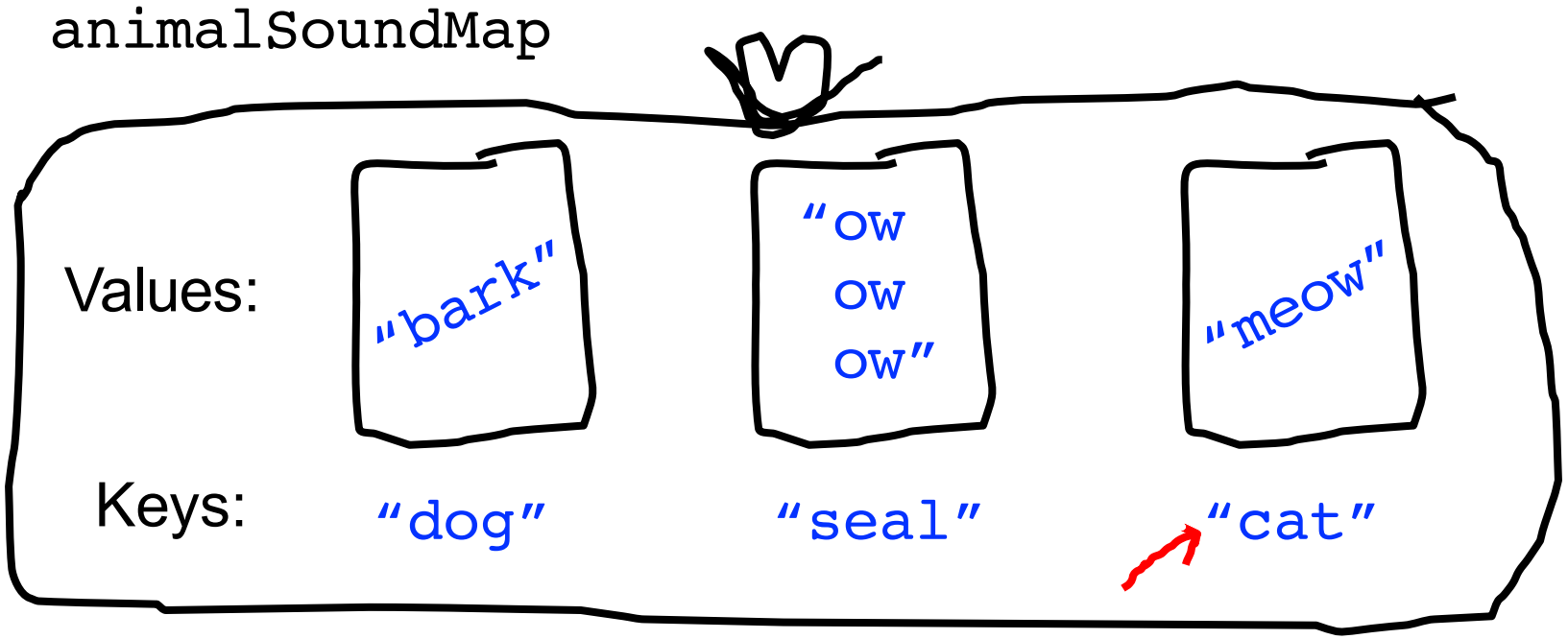
1. Make a new HashMap of animal sound

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"]



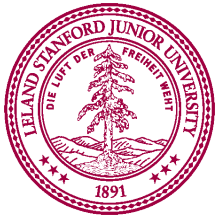
Simple Example



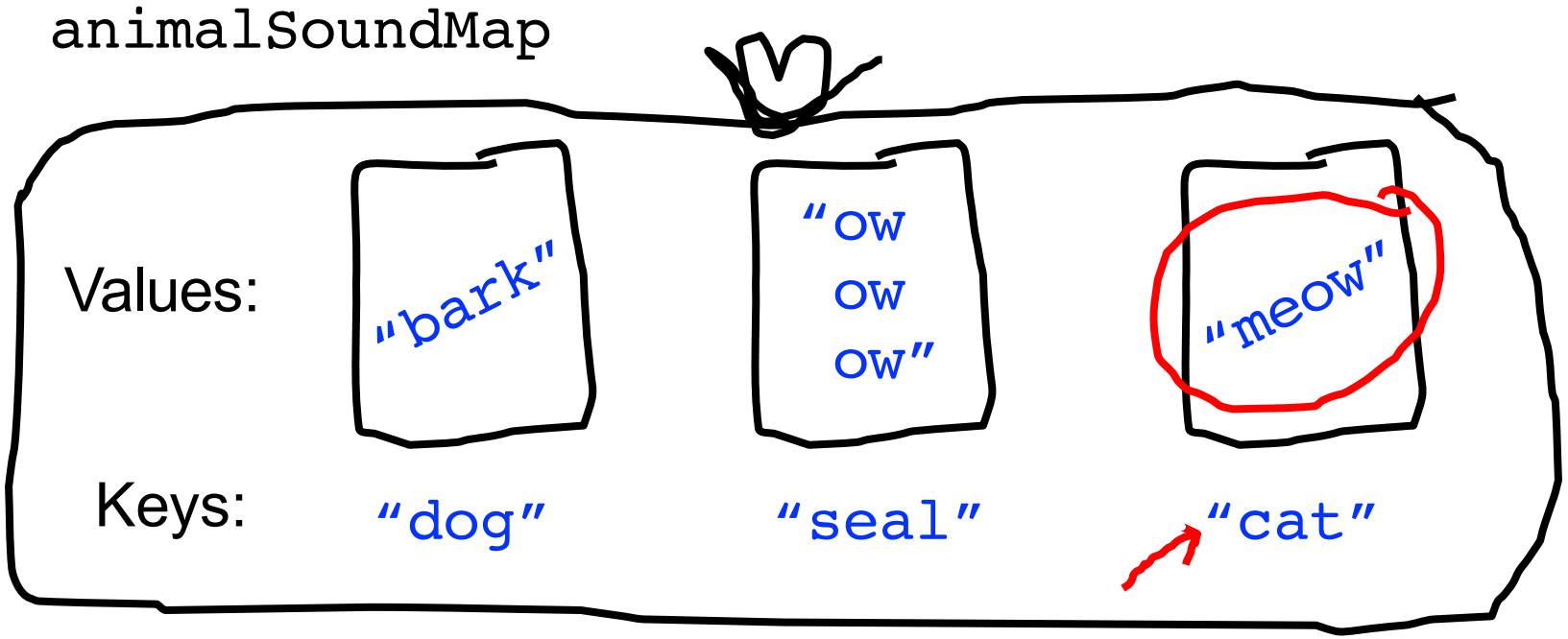
1. Make a new HashMap of animal sound

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"]



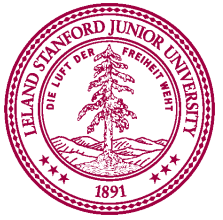
Simple Example



1. Make a new HashMap of animal sound

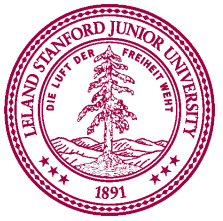
2. Add elements:
   Put [key = "dog", value = "bark"]
   Put [key="cat", value="meow"]
   Put [key="seal", value="ow ow ow"]

3. Get elements:
   Get [key = "cat"]



My First Map

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

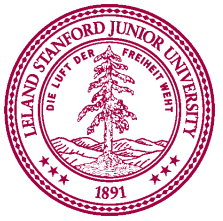



My First Map

Key Type

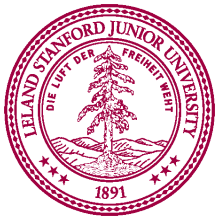
Value Type

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

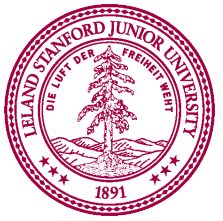
My First Map

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

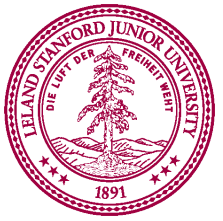
My First Map

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

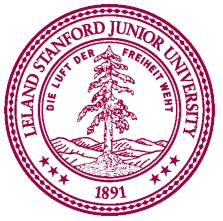
My First Map

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

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

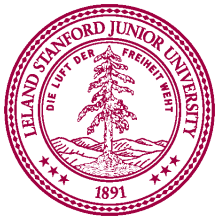
My First Map

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

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

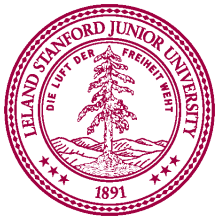
My First Map

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

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

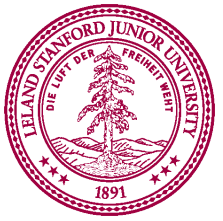
My First Map

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

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

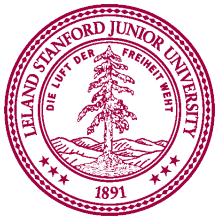
My First Map

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

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

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

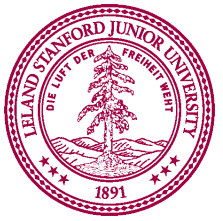
My First Map

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

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

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

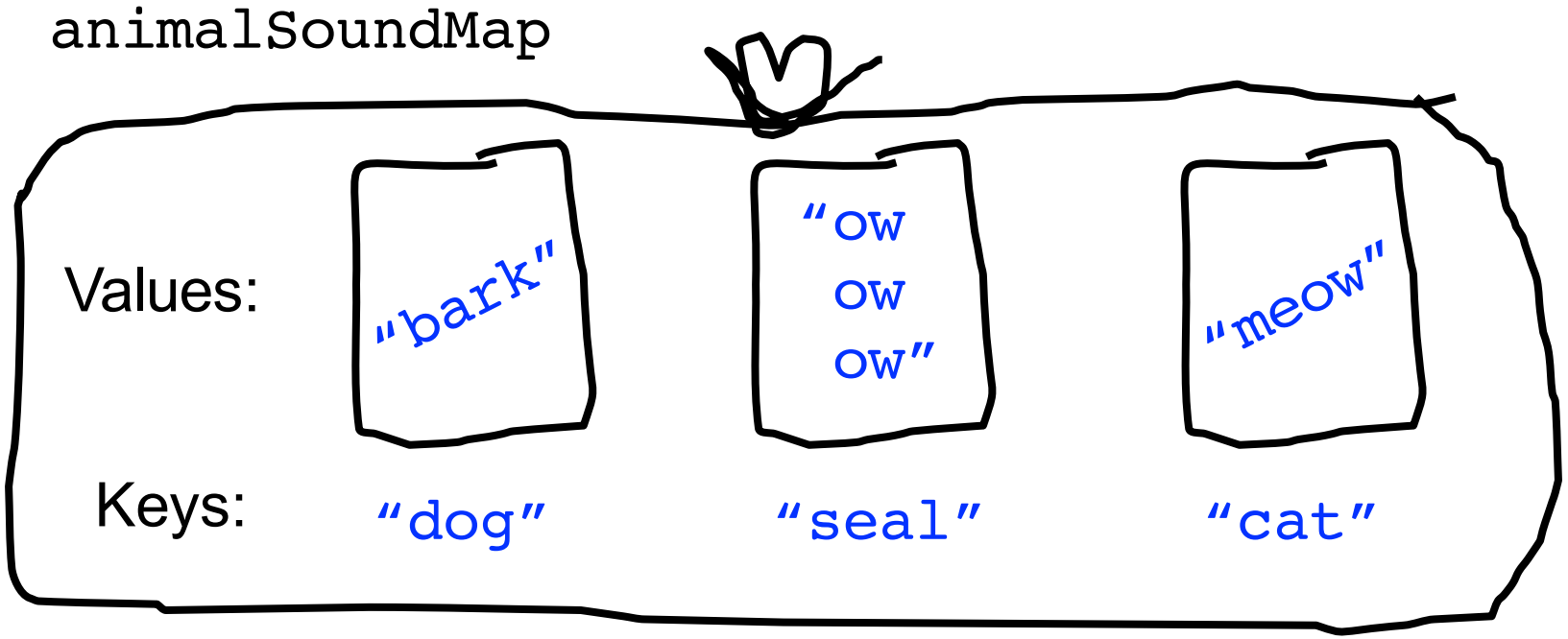



My First Map

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

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

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

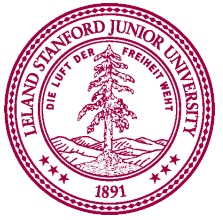
My First Map



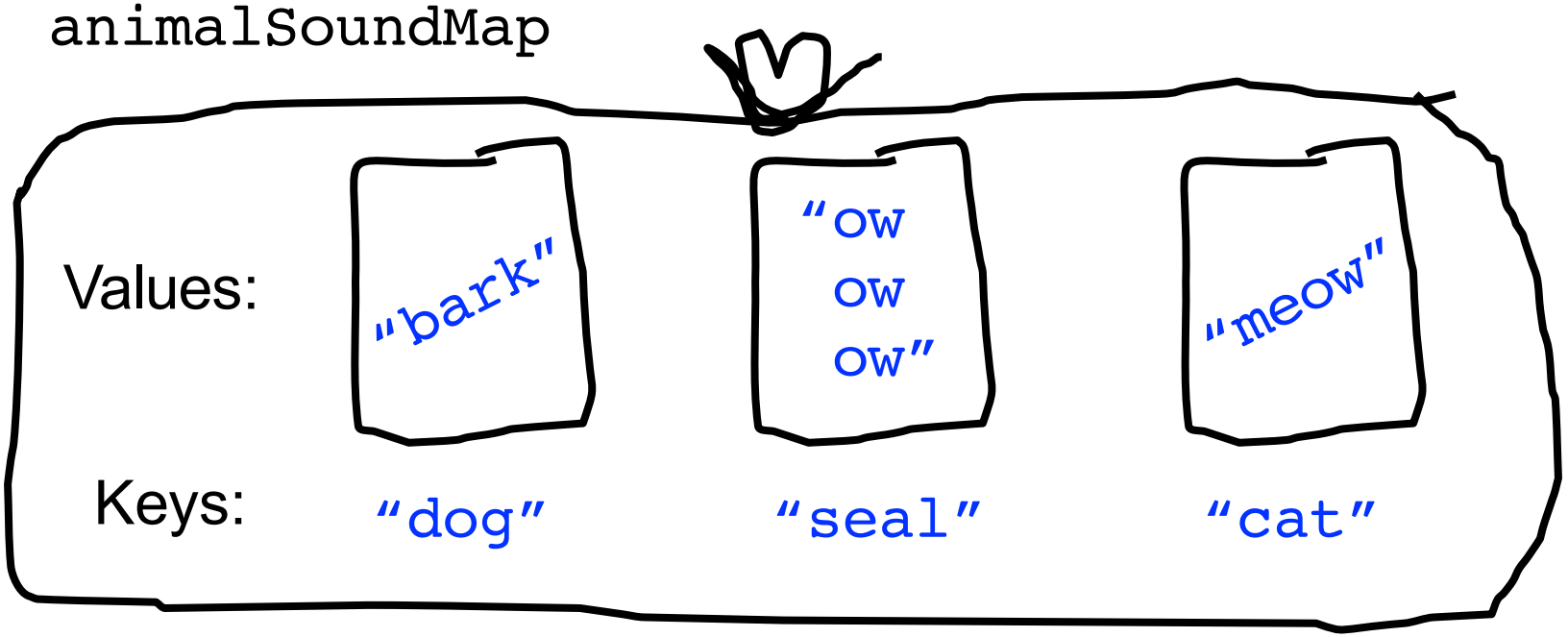
1. Make a new HashMap of animal sound

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

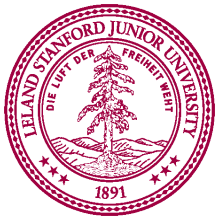
3. Get elements:
   Get [key = "dog"]



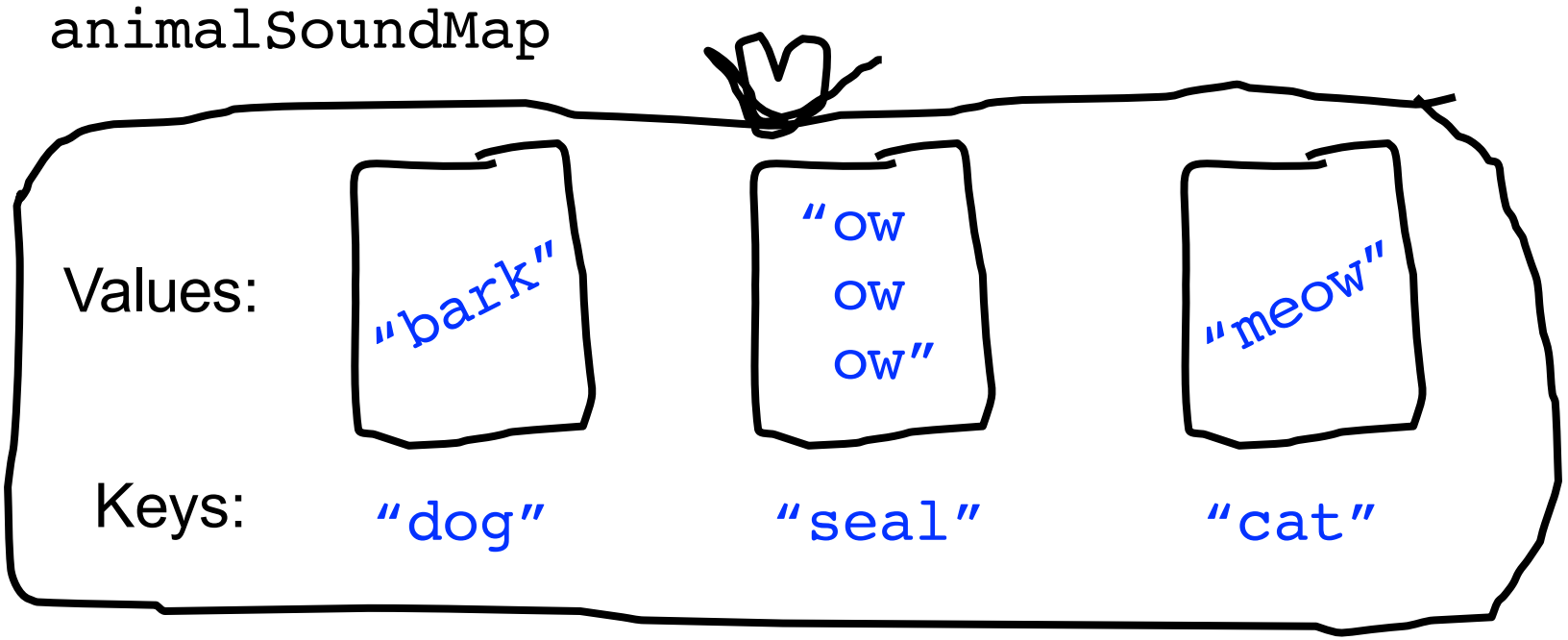
My First Map



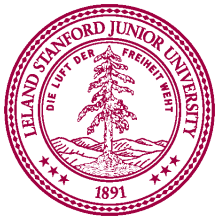

```
// 1. Make a new map
HashMap<String, String> animalSoundMap =
                new HashMap<String, String>();

// 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




```
// 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"); // ?
```

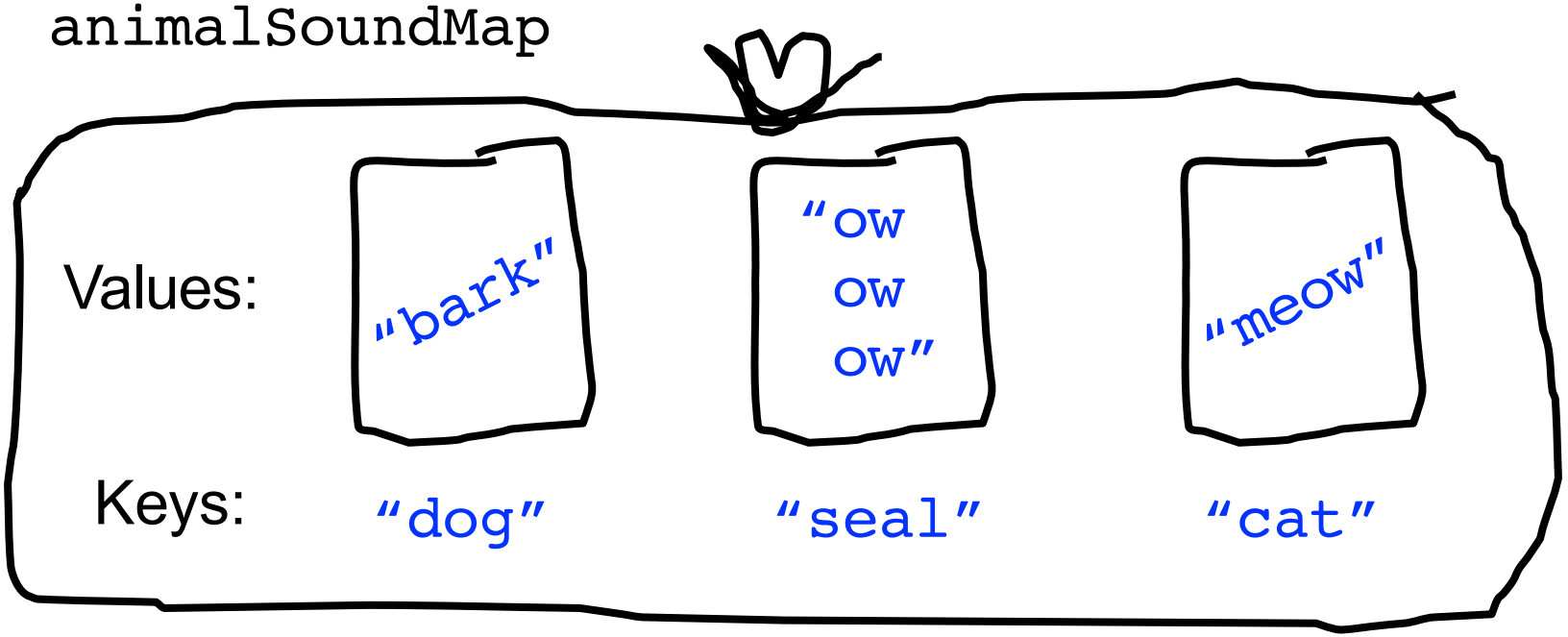


brothers Vegard and Bård Ylvisåker

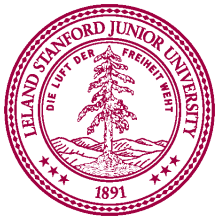
Circa 2013

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

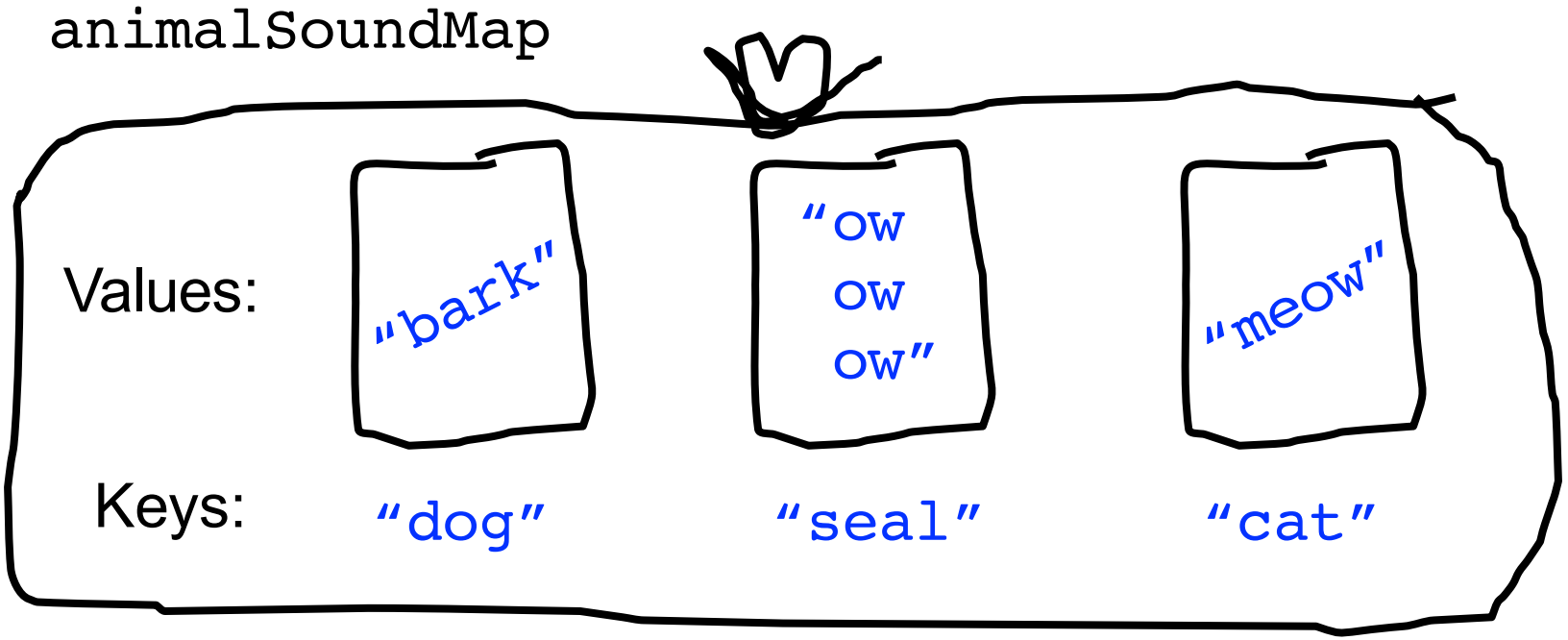
My First Map



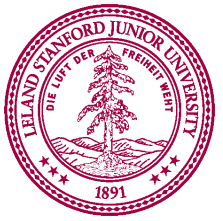

```
// 1. Make a new map
HashMap<String, String> animalSoundMap =
                new HashMap<String, String>();

// 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"); // ?
```



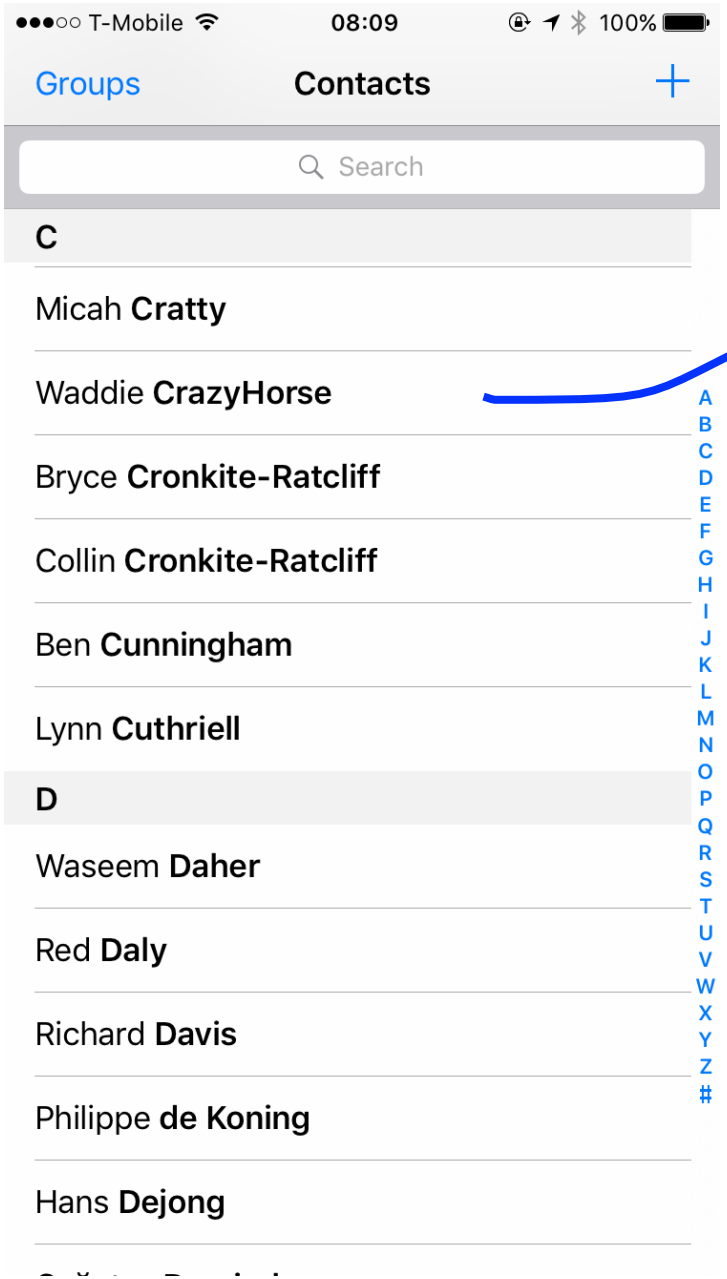
My First Map




```
// 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
```



Phone Book



6701678

HashMaps on one slide

1. Make a HashMap

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

2. Put and get values into a map

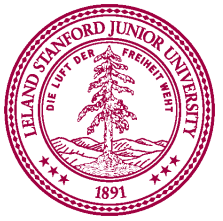
```
myMap.put(key, value);
myMap.get(key) // returns the corresponding value
```

3. Some useful other methods

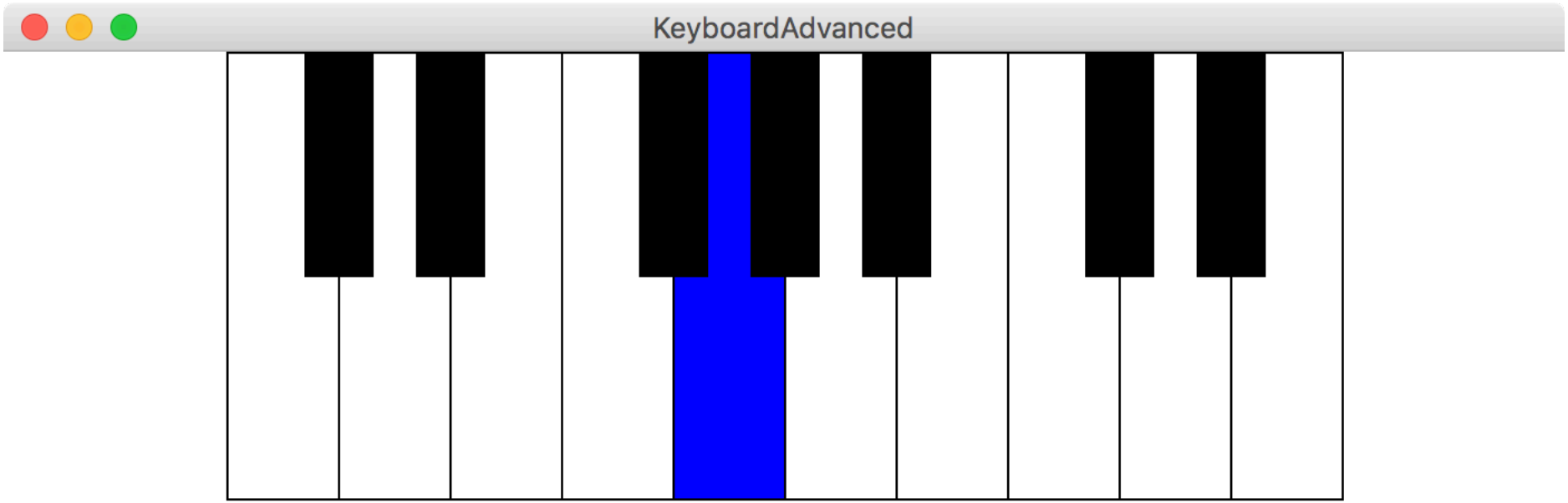
```
int size = myMap.size();
myMap.contains(key); // returns true or false if key is in map
myMap.keySet();
myMap.remove(key); // make like a tree and leave!
```

4. Iterate using a foreach loop

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



Make a keyboard



Why is this so fast?

Google

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 ...
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