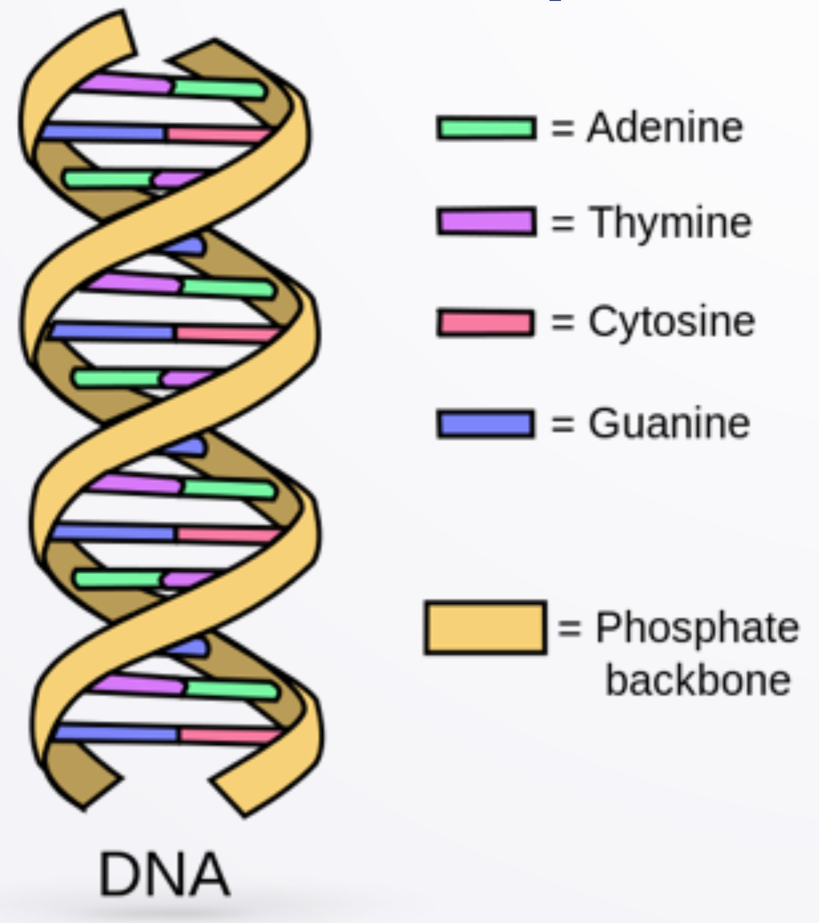
Using and Improving GladLibs

HashMap

New Structures

- GladLib program works!
  - Design flaws, but can be modified
- Counting frequencies, 'CGAT' to 'AB..YZ'
  - Extended to words with two ArrayLists
  - From 4 to 26 to 5,280* counters!



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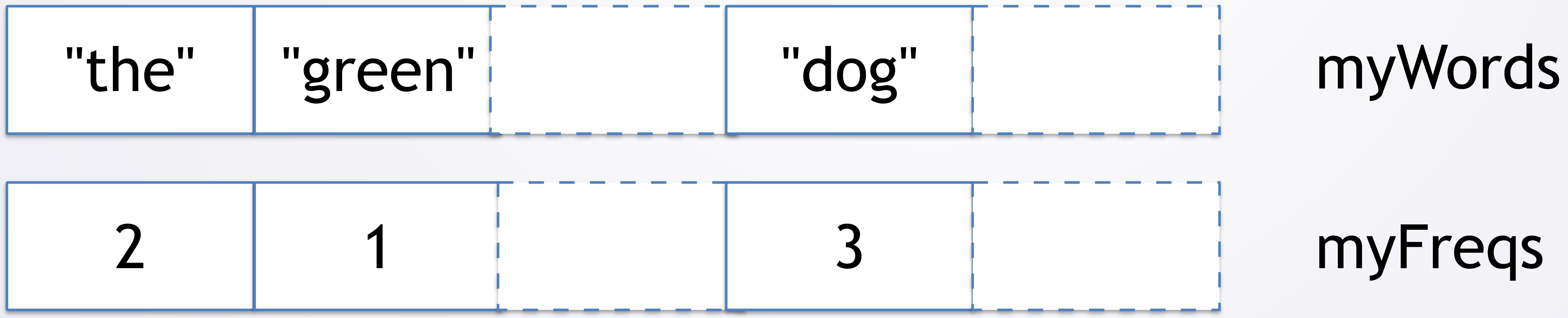

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- Counting frequencies, 'CGAT' to 'AB..YZ'
  - Extended to words with two ArrayLists
  - From 4 to 26 to 5,280* counters!
- From parallel ArrayLists to HashMap
  - Code in GladLib easier to modify
  - Much faster to count word frequencies

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Starting with Parallel ArrayLists

- Seen code using parallel arrays to count word occurrences, calls **`.indexOf(s)`**

```
public void findUnique(){
        FileResource resource = new FileResource();
        for(String s : resource.words()){
            s = s.toLowerCase();
            int index = myWords.indexOf(s);
            if (index == -1){
                myWords.add(s);
                myFreqs.add(1);
            }
            else {
                int freq = myFreqs.get(index);
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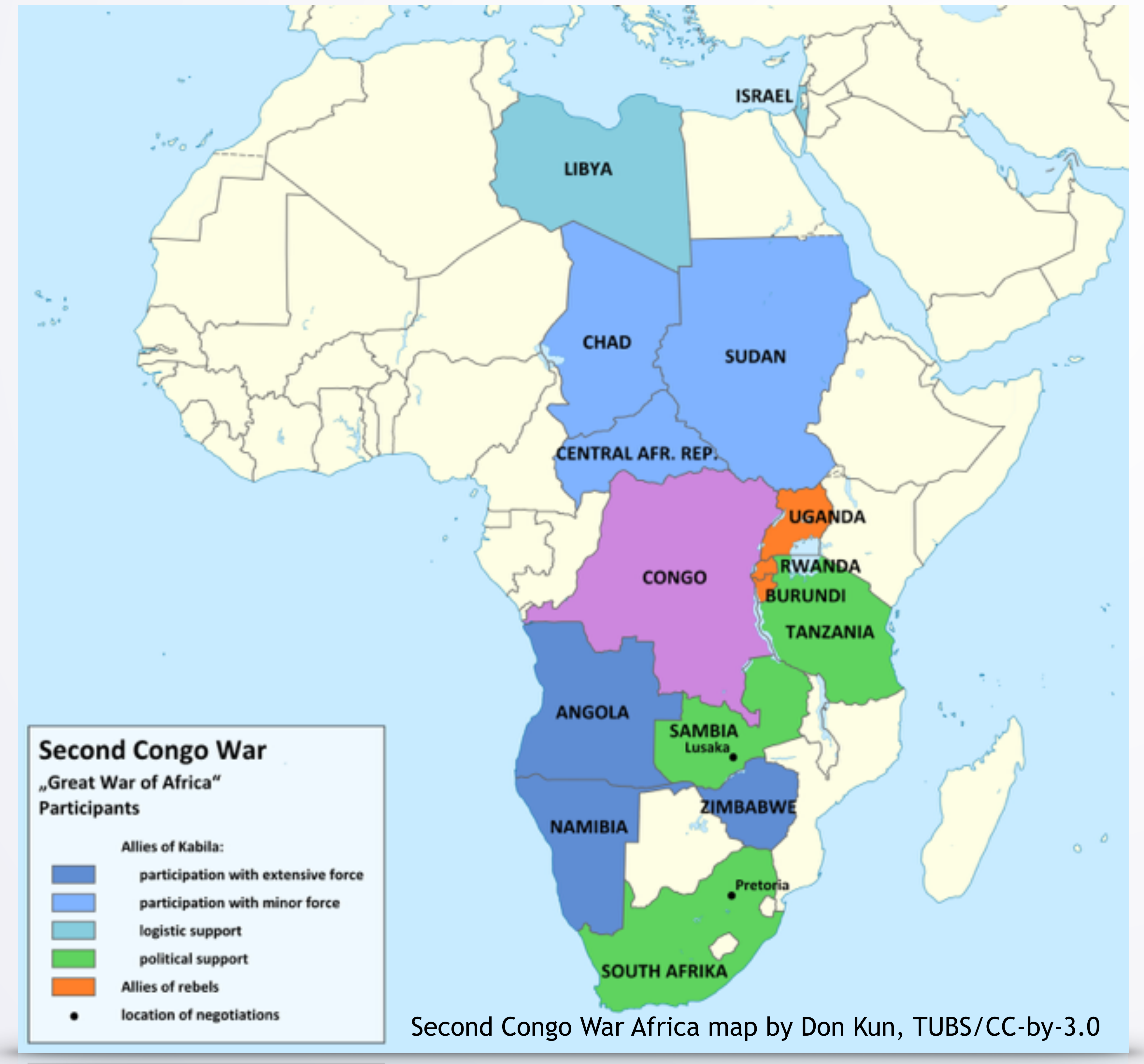
Motivating HashMap

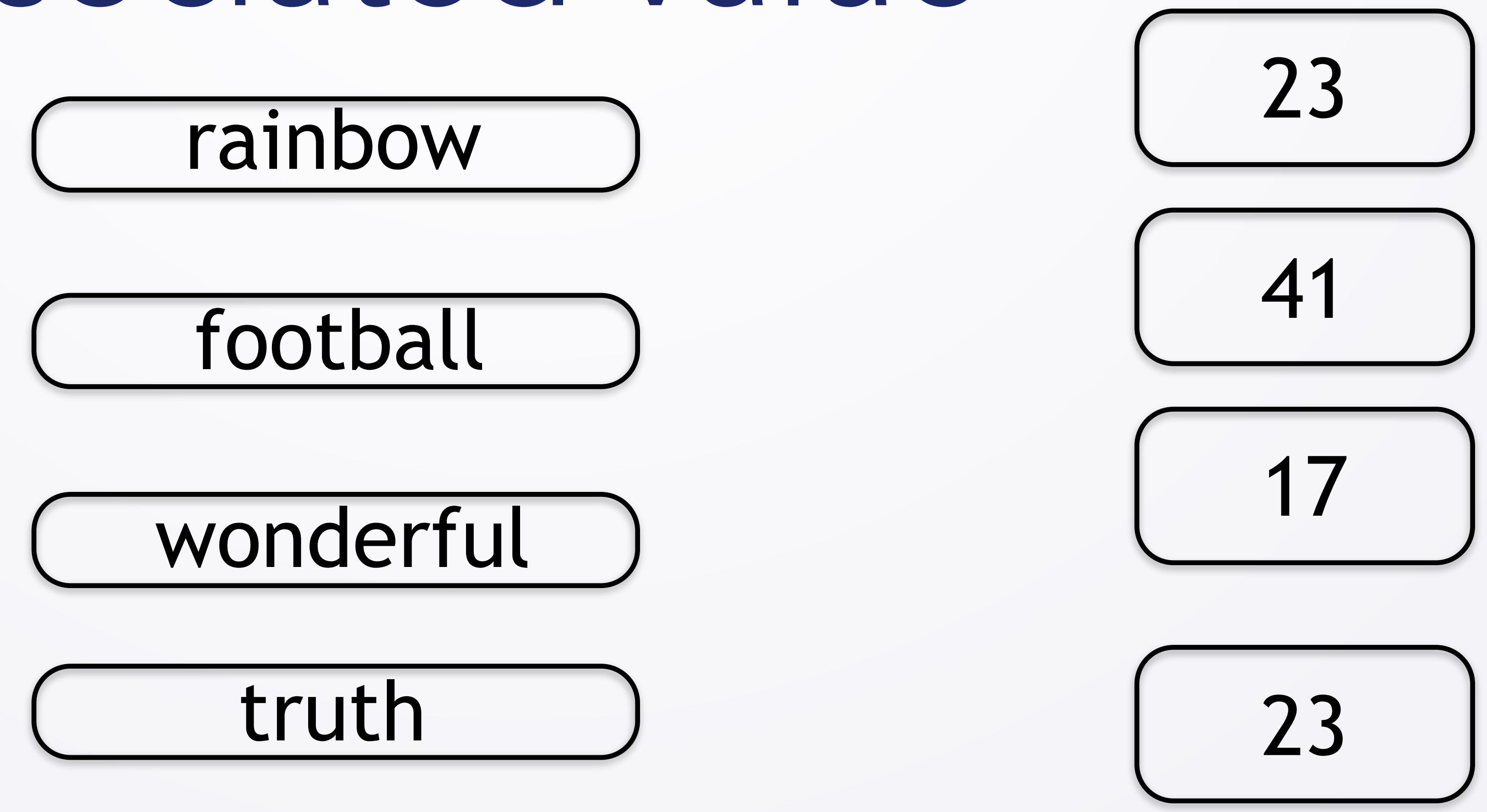
- A HashMap is a class that associates keys with values, generally called a map



Second Congo War Africa map by Don Kun, TUBS/CC-by-3.0

Motivating HashMap

- A HashMap is a class that associates keys with values, generally called a map
    - More mathematical than geographical
    - Key is element in domain, value is what key maps to in range
- Look up key, get associated value



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map.get("rainbow")
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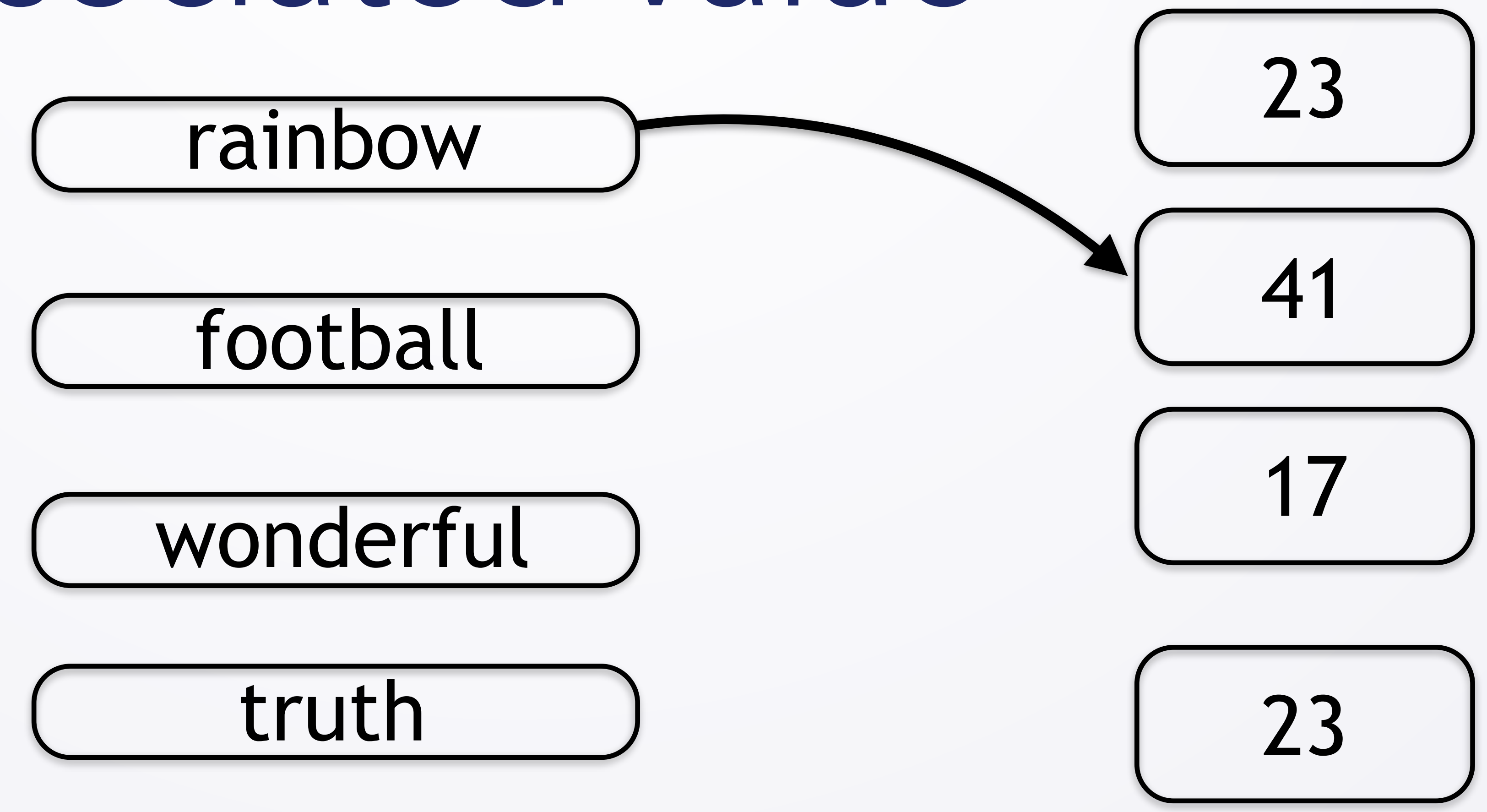

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map.get("rainbow")
map.get("truth")
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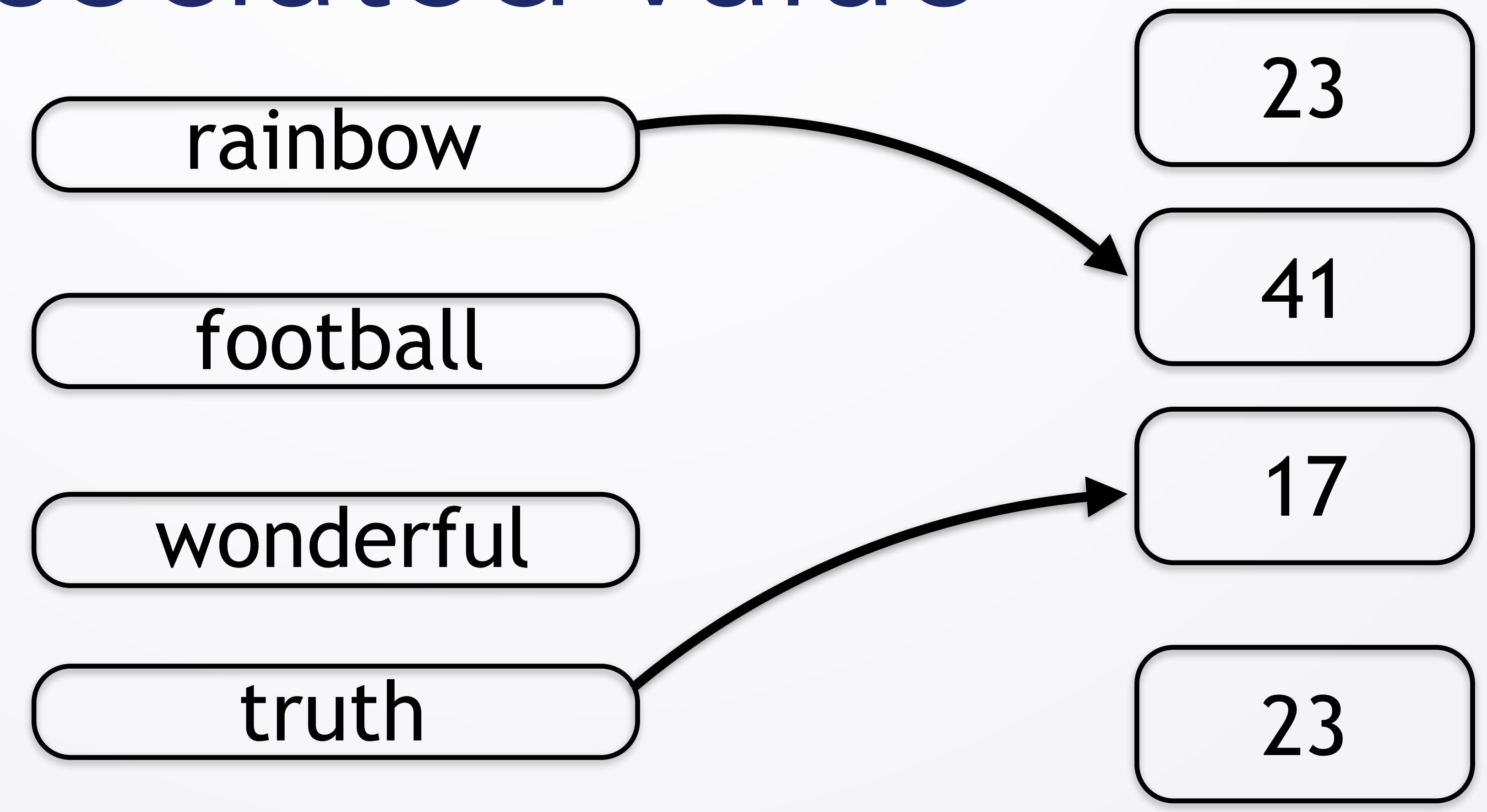

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map.get("truth")
map.get("football")
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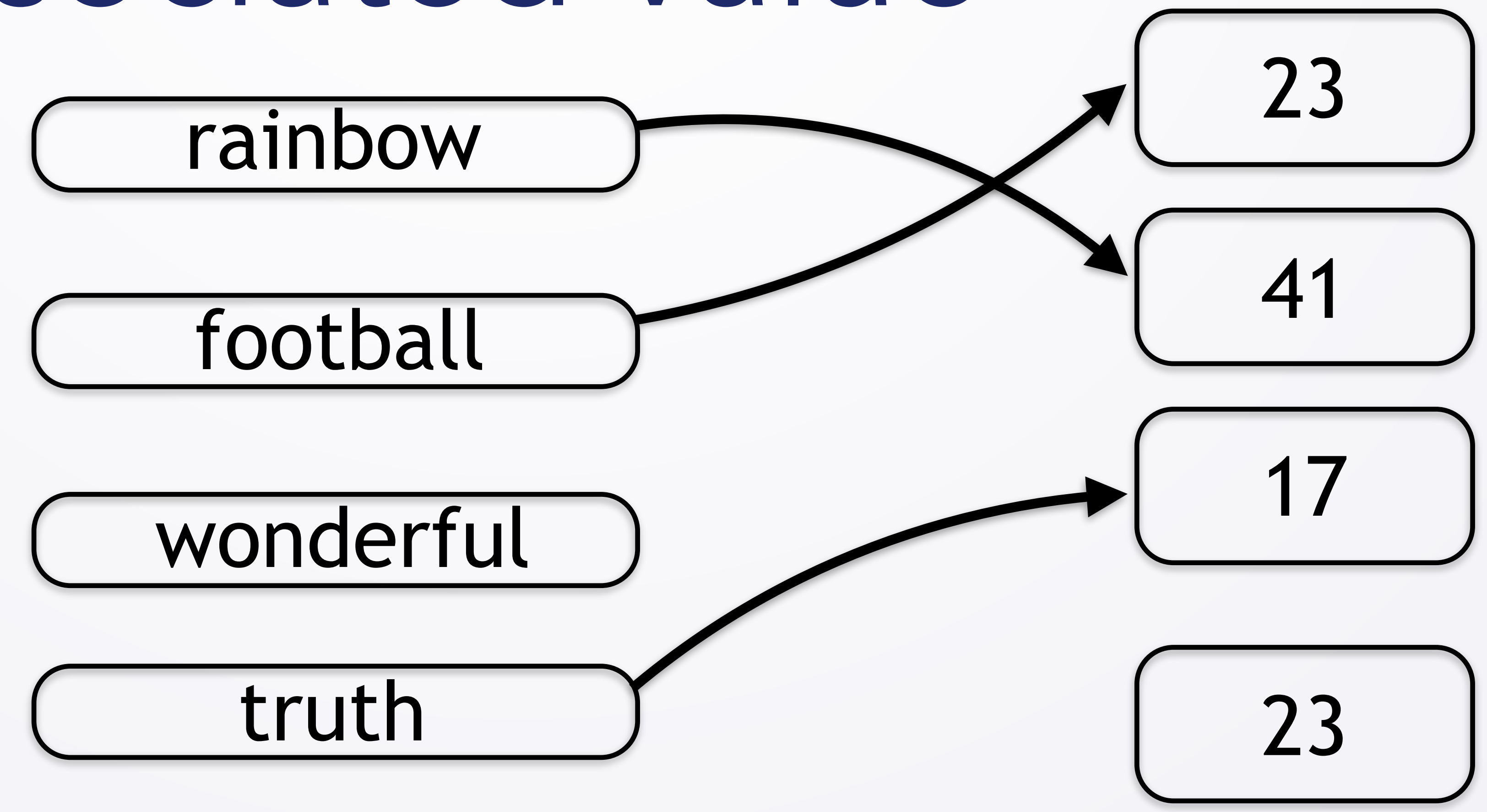

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map.get("truth")
map.get("football")
map.get("wonderful")
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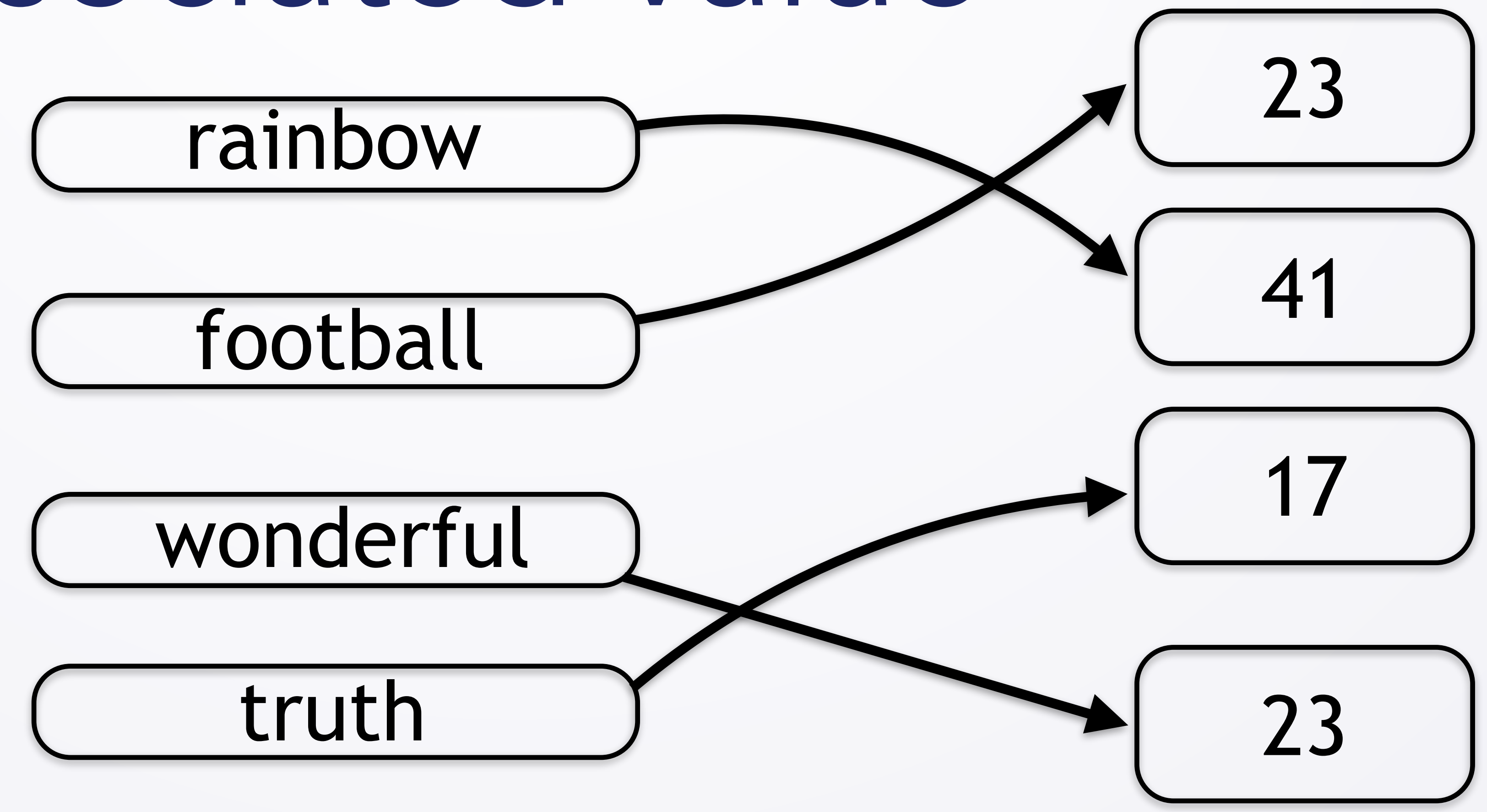

Updating Values in HashMap

- One HashMap replaces two ArrayLists

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public void countWordsMap(){
    FileResource resource = new FileResource();
    HashMap<String,Integer> map = new HashMap<String,Integer>();

    for(String w : resource.words()){
      w = w.toLowerCase();
      if (!map.containsKey(w)){
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Accessing All Values in Map

- Printing all values in parallel arrays uses for loop with index accessing word and freq

```
public void printWords(){
    for(int k=0; k < myFreqs.size(); k++){
      System.out.println(myFreqs.get(k)+"\t"+myWords.get(k));
}
```

Accessing All Values in Map

- Printing all values in parallel arrays uses for loop with index accessing word and freq
- Printing all values in map requires looping over keys, get value associated with key

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public void printWords(){
    for(String s : myMap.keySet()){
      System.out.println(myMaps.get(s)+"\t"+s);
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    - Iterable **`.keySet()`**, similar to **`.words()`** or **`.lines()`** or **`.data()`**

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Maps are Very Efficient!

- When files are large, efficiency matters

	Total Words	*Different Words*	*Time ArrayList*	*Time HashMap*
Julius Caesar	*20,869*	*4,443*	*0.25*	*0.03*
Confucius	*34,582*	*6,558*	*0.4*	*0.05*
Scarlet Letter	*85,754*	*13,543*	*1.3*	*0.1*
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  - Look up in map is independent of number of keys! ArrayList requires looking at all elements

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