More Sophisticated Behaviour

Technical Support System V3.0

Produced by: Dr. Siobhán Drohan
Ms. Mairéad Meagher

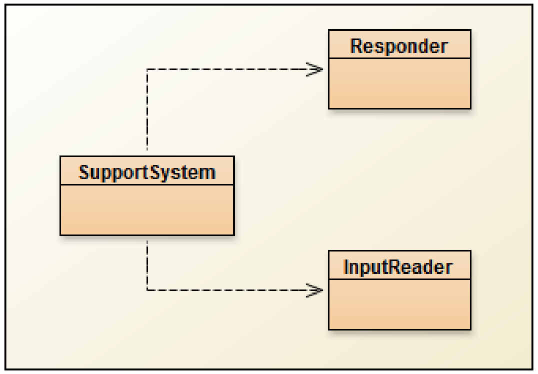
Waterford Institute *of* Technology
INSTITIÚID TEICNEOLAÍOCHTA PHORT LÁIRGE

Department of Computing and Mathematics
http://www.wit.ie/

Topic List

1. Recap: Technical Support System **V2**

2. Technical Support System **V3**
   - Overview
     - 3 classes:
       - **Responder**
       - **InputReader**
       - **SupportSystem**



3. Class Development
   - Responder class
     - Generating a related response
     - ArrayList
     - Map and **HashMap**
   - InputReader class
     - Tokenizing Strings
     - Set and **HashSet**
   - Responder class
     - Finishing the class
   - SupportSystem class
     - A small change.

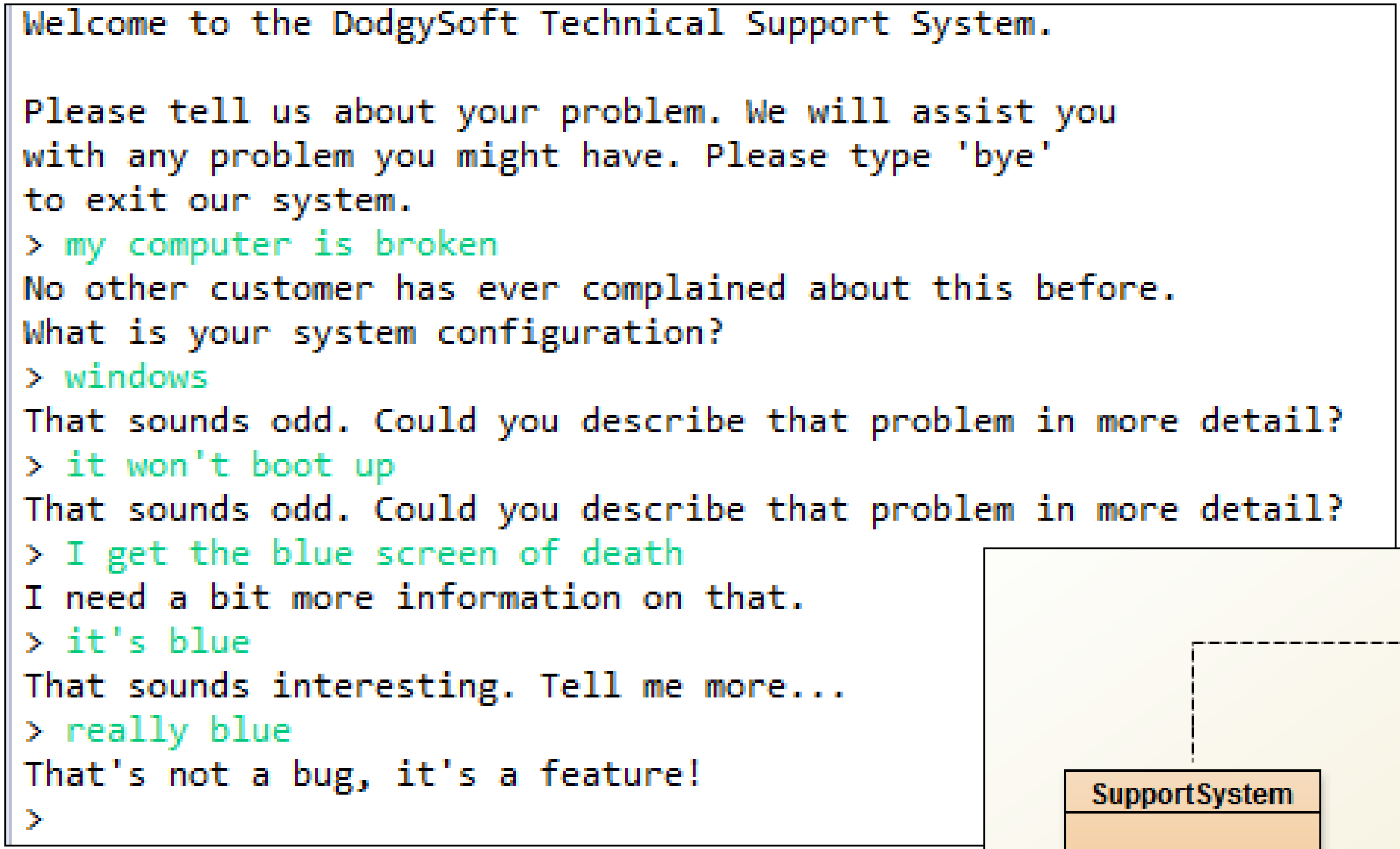
Recap: Technical Support System **V2**

- A console based, textual dialog system.

- In this version, the system provides a **random** response from a list of pre-defined responses e.g.:

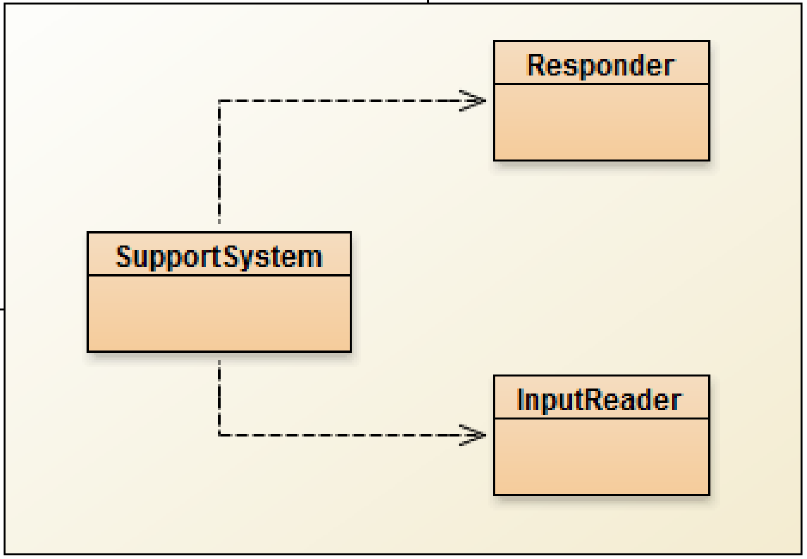
  - "That sounds interesting. Tell me more..."
  - "I need a bit more information on that."
  - "Have you checked that you do not have a dll conflict?"
  - "That is explained in the manual. Have you read the manual?“
  - " That's not a bug, it's a feature!"
  - "Could you elaborate on that?“
  - etc.

Recap: Technical Support System **V2**



```
Welcome to the DodgySoft Technical Support System.

Please tell us about your problem. We will assist you
with any problem you might have. Please type 'bye'
to exit our system.
> my computer is broken
No other customer has ever complained about this before.
What is your system configuration?
> windows
That sounds odd. Could you describe that problem in more detail?
> it won't boot up
That sounds odd. Could you describe that problem in more detail?
> I get the blue screen of death
I need a bit more information on that.
> it's blue
That sounds interesting. Tell me more...
> really blue
That's not a bug, it's a feature!
>
```



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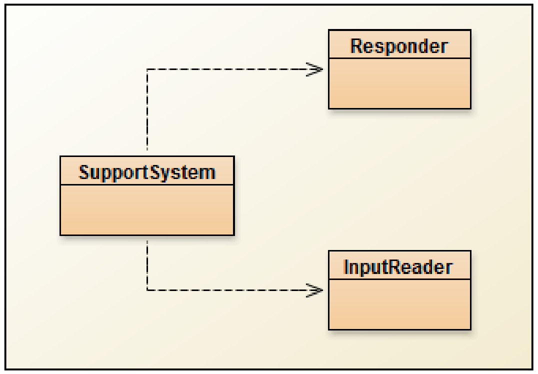


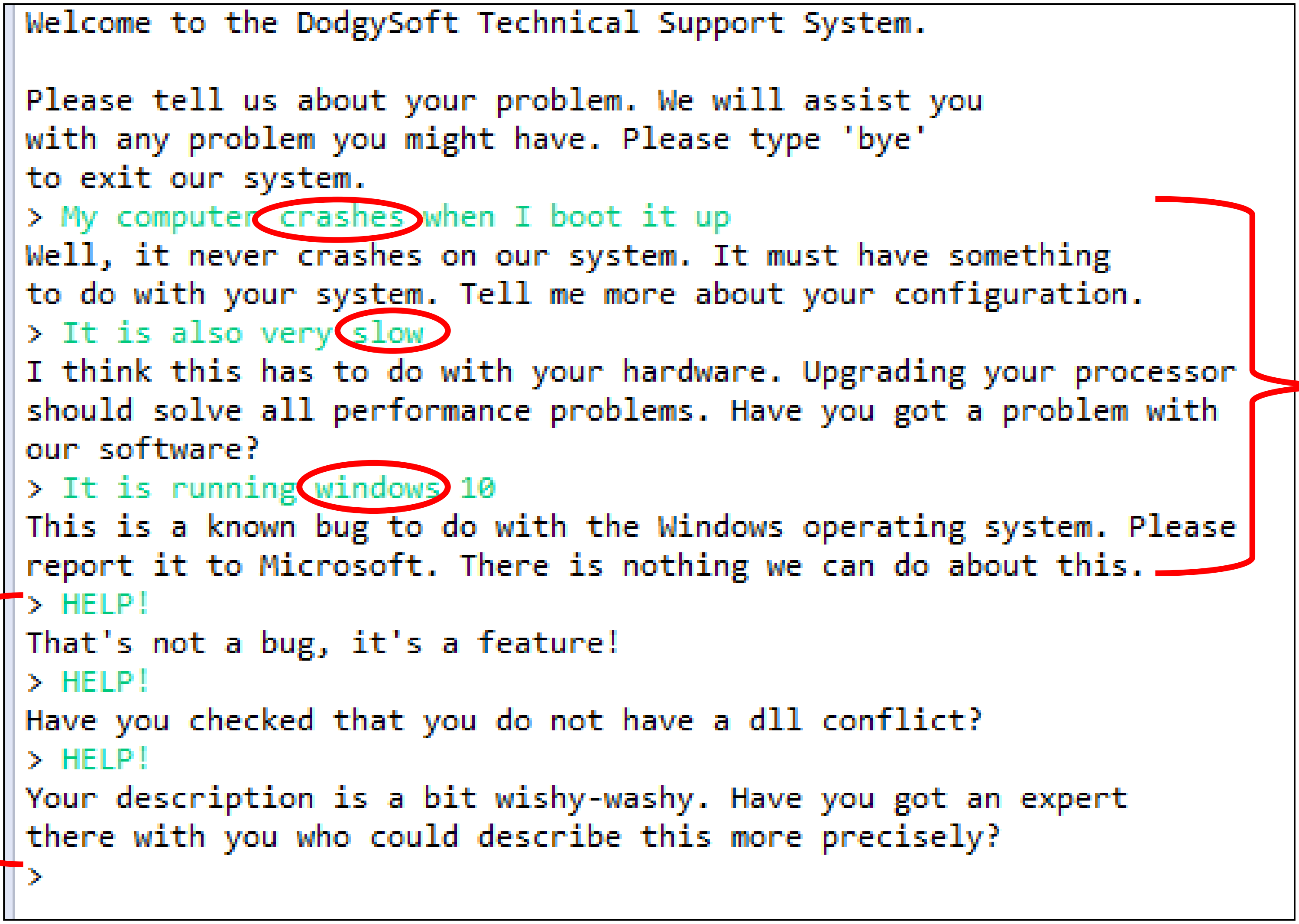
Technical Support System **V3**

- A console based, textual dialog system.

- Based on the user input,
  - the system provides a **context-sensitive**, generated response from a list of pre-defined responses.

  - If the system cannot find a suitable generated response, it returns a **random** one.

Technical Support System **V3**



```
Welcome to the DodgySoft Technical Support System.

Please tell us about your problem. We will assist you
with any problem you might have. Please type 'bye'
to exit our system.
> My computer crashes when I boot it up
Well, it never crashes on our system. It must have something
to do with your system. Tell me more about your configuration.
> It is also very slow
I think this has to do with your hardware. Upgrading your processor
should solve all performance problems. Have you got a problem with
our software?
> It is running windows 10
This is a known bug to do with the Windows operating system. Please
report it to Microsoft. There is nothing we can do about this.
> HELP!
That's not a bug, it's a feature!
> HELP!
Have you checked that you do not have a dll conflict?
> HELP!
Your description is a bit wishy-washy. Have you got an expert
there with you who could describe this more precisely?
>
```

Context Sensitive

Random

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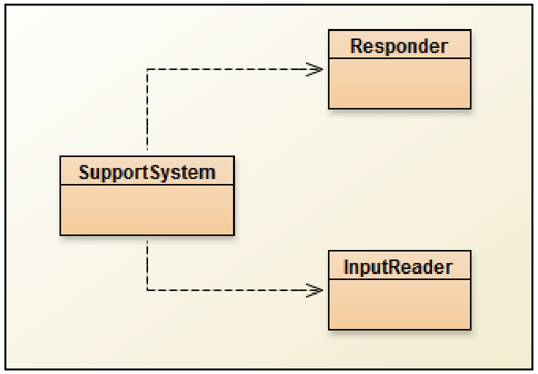

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How do we influence the generated response?

- What if we had a **set of words**
  - that are likely to occur in a typical question?
- What if we then **associated** these words
  - with particular **responses**?
- Then, if the user input contains a known word,
  - generate a related response!

Key	**Value**
Word	Response

ArrayList

Q: Can we use an ArrayList for this purpose?

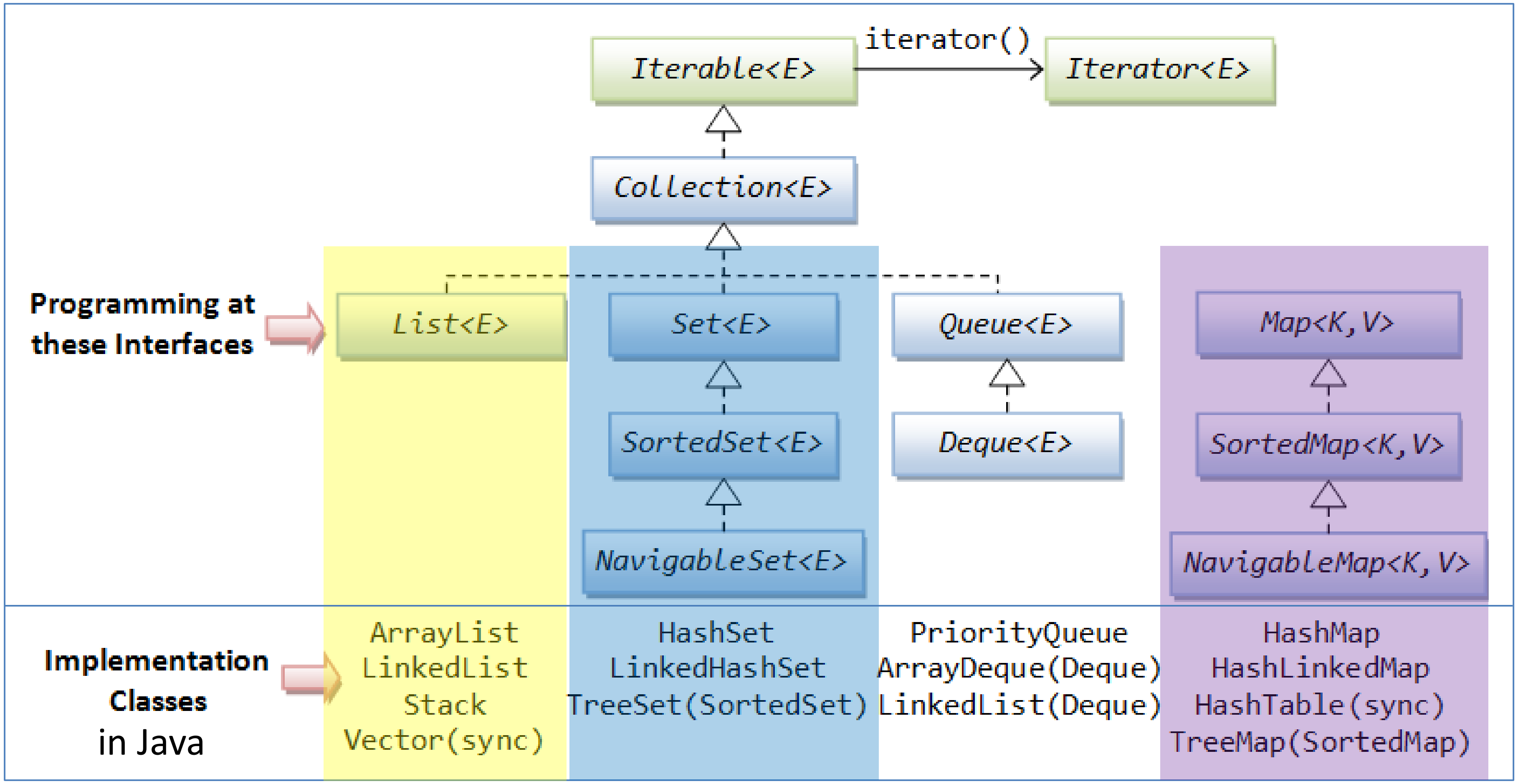
i.e. Will it let us store "**key=value**" pairs?

A: **No**!

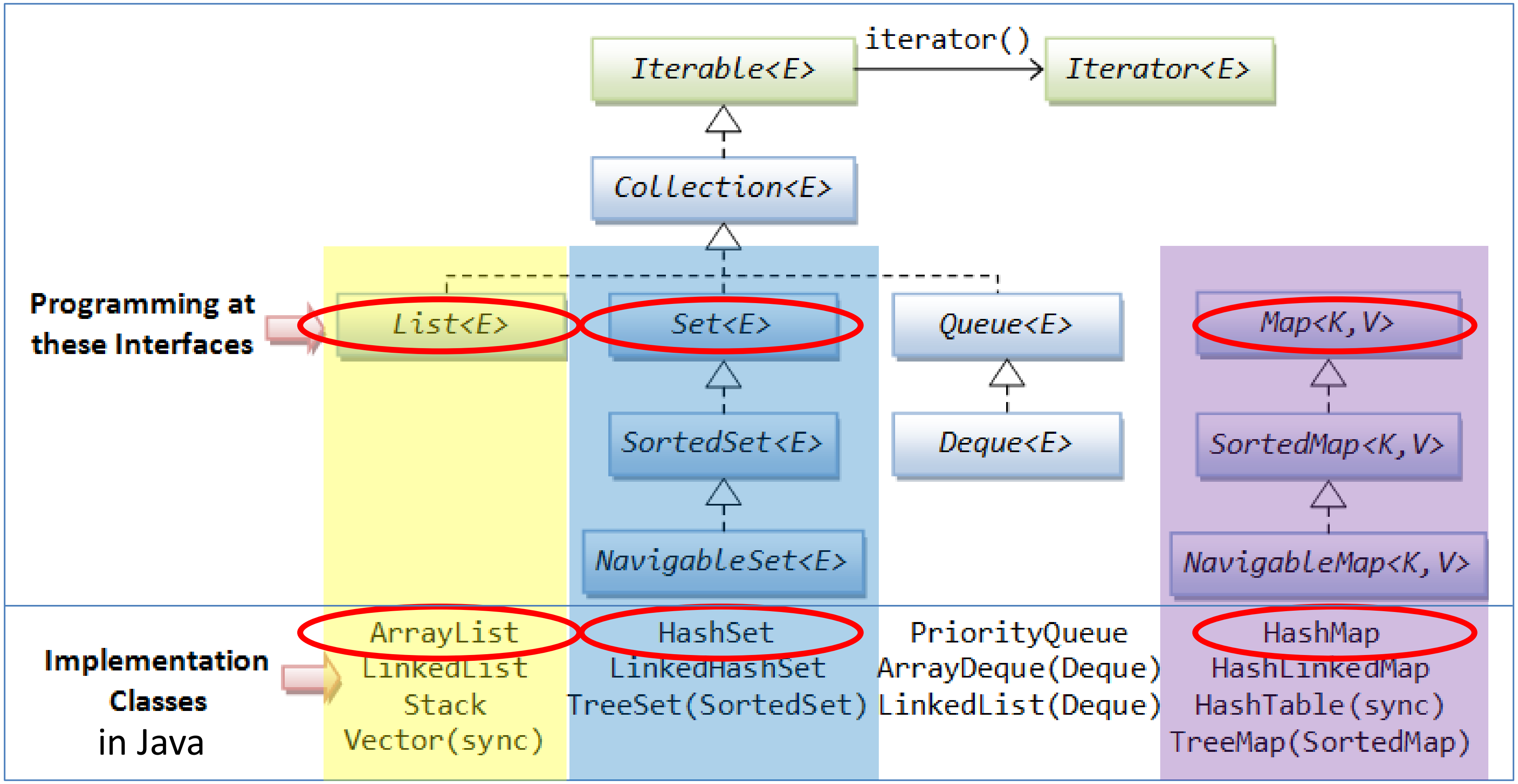
i.e. We need a different data structure.

A **Map** stores "**key=value**" pairs

RECAP: Java's **Collections** Framework



RECAP: Java's **Collections** Framework



Collection Interface Concrete Implementation Classes

Class	Map	Set	List	Ordered	Sorted
HashMap	X			No	No
Hashtable	X			No	No
TreeMap	X			Sorted	By natural order or custom comparison rules
LinkedHashMap	X			By insertion order or last access order	NO
HashSet		X		No	No
TreeSet		X		Sorted	By natural order or custom comparison rules
LinkedHashSet		X		By insertion order	No
ArrayList			X	By index	No
Vector			X	By index	No
LinkedList			X	By index	No
PriorityQueue				Sorted	By to-do order

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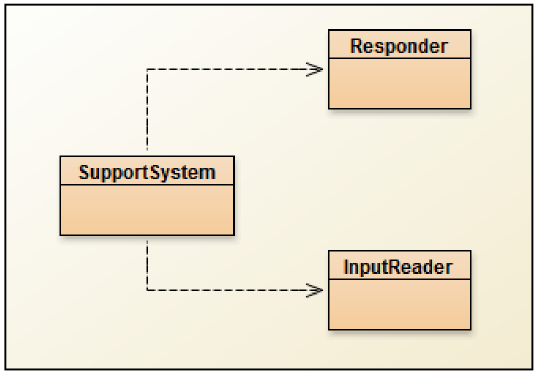

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Maps

- Maps are collections
  - that contain pairs of values.

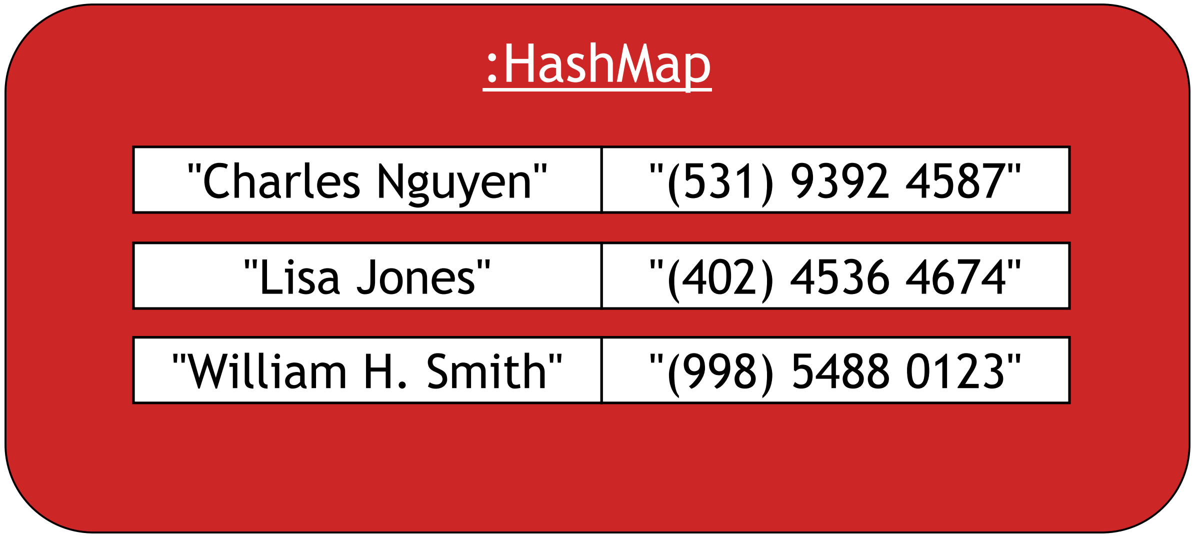
- **Pairs** consist of :
  - **key**
  - **value**.

Key	Value
Word	Response

- **Lookup** works by supplying a key, and retrieving a value.
  - E.g. telephone book
    - use the **name** to look up a **phone number.**

Using Maps

- A **MAP** with String keys & String values.



"Charles Nguyen"	"(531) 9392 4587"
"Lisa Jones"	"(402) 4536 4674"
"William H. Smith"	"(998) 5488 0123"

ArrayList **Vs** Map

ArrayList

1. each entry stores
   one object

2. you use an **integer index**
   to **lookup** the object

Map

1. each entry has a
   pair of objects (key=value).

2. you use the **key object**
   to **lookup** the value object

More on **Map**

- Maps are **ideal for one-way lookup using the key**.

- Using Maps to Look up a value associated with a key is easy!
  - However, **reverse lookup** (finding a key for a value) is not so easy.
    - E.g. looking up a number in the phonebook, to find the persons name

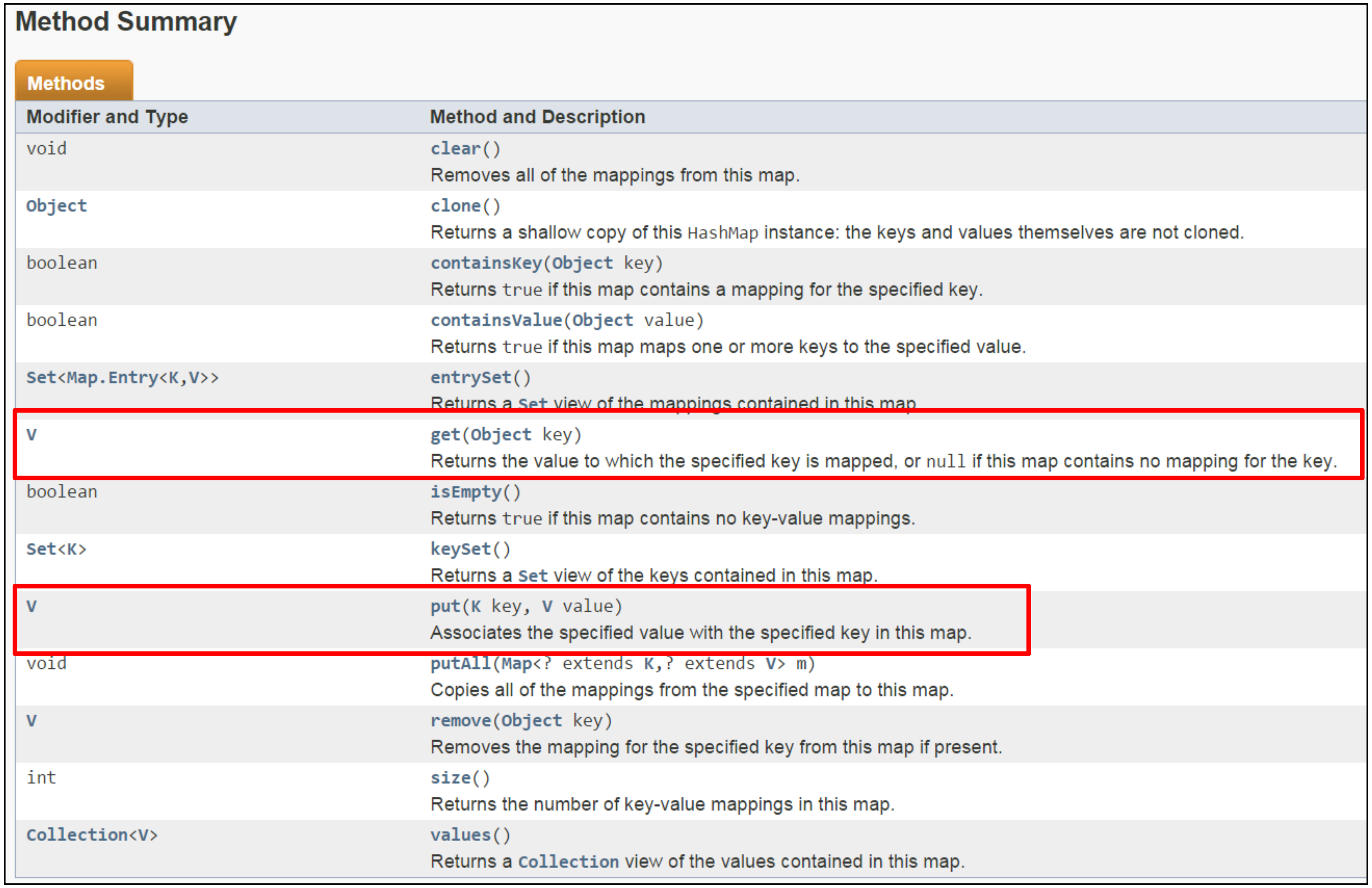
- A map cannot contain duplicate keys;
  - **A key** can map to **at most one value**.

- Java provides 4 Map classes:
  - HashMap, HashTable, TreeMap & Linked HashMap
  - We will use the **HashMap** class.

HashMap Methods

java.util

Class HashMap<K,V>


Method Summary

Methods

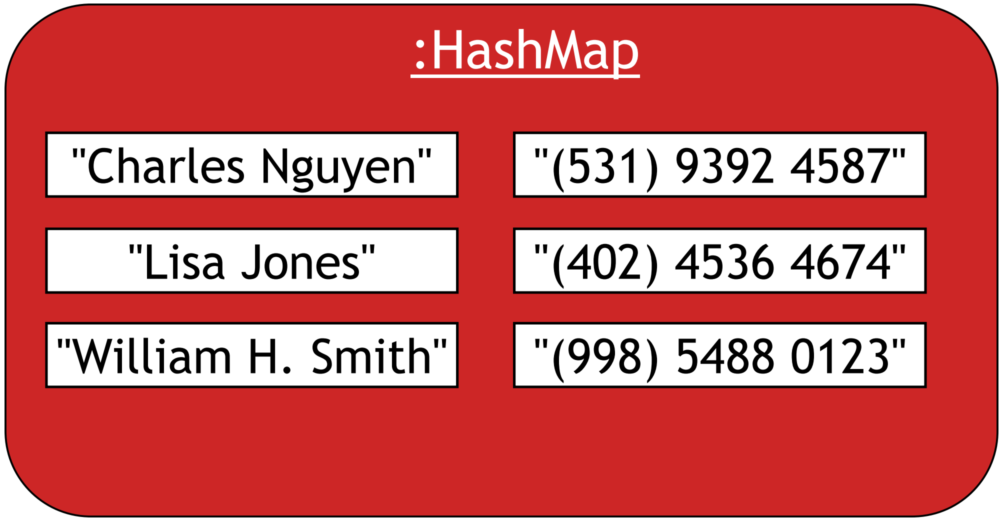
Modifier and Type	Method and Description
`void`	`clear()` Removes all of the mappings from this map.
`Object`	`clone()` Returns a shallow copy of this `HashMap` instance: the keys and values themselves are not cloned.
`boolean`	`containsKey(Object key)` Returns `true` if this map contains a mapping for the specified key.
`boolean`	`containsValue(Object value)` Returns `true` if this map maps one or more keys to the specified value.
`Set<Map.Entry<K,V>>`	`entrySet()` Returns a `Set` view of the mappings contained in this map.
`V`	`get(Object key)` Returns the value to which the specified key is mapped, or `null` if this map contains no mapping for the key.
`boolean`	`isEmpty()` Returns `true` if this map contains no key-value mappings.
`Set<K>`	`keySet()` Returns a `Set` view of the keys contained in this map.
`V`	`put(K key, V value)` Associates the specified value with the specified key in this map.
`void`	`putAll(Map<? extends K,? extends V> m)` Copies all of the mappings from the specified map to this map.
`V`	`remove(Object key)` Removes the mapping for the specified key from this map if present.
`int`	`size()` Returns the number of key-value mappings in this map.
`Collection<V>`	`values()` Returns a `Collection` view of the values contained in this map.

Using **HashMap**

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

phoneBook.put("Charles Nguyen", "(531) 9392 4587");
phoneBook.put("Lisa Jones", "(402) 4536 4674");
phoneBook.put("William H. Smith", "(998) 5488 0123");

String phoneNumber = phoneBook.get("Lisa Jones");
System.out.println(phoneNumber);
```

Lookup

```
Console Output:

(402) 4536 4674
```



HashMap in Tech Support System **V3**

In the **Responder** class,

we will now use **HashMap** to store **“Key-Value” pairs** for context-sensitive responses e.g.

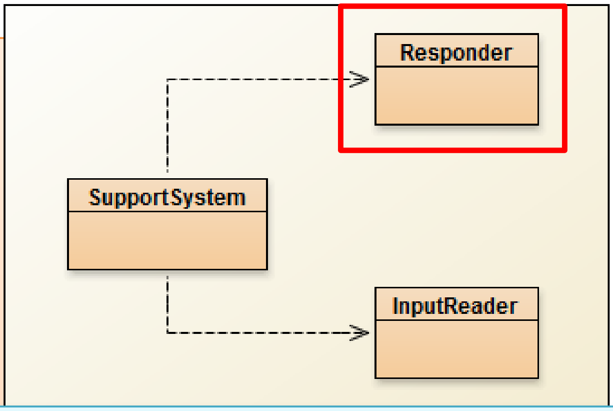
Key	Value
windows	This is a known bug to do with the Windows operating system. Please report it to Microsoft. There is nothing we can do about this.
slow	I think this has to do with your hardware. Upgrading your processor should solve all performance problems. Have you got a problem with our software?
bug	Well, you know, all software has some bugs. But our software engineers are working very hard to fix them. Can you describe the problem a bit further?
performance	Performance was quite adequate in all our tests. Are you running any other processes in the background?

HashMap in Tech Support System V3

```
responseMap.put("crashes",  "Well, it never crashes on our system. It must have something\n" + "to do with your system. Tell me more about your configuration.");
```

- Whenever someone enters the word “crashes”, we can look up and print the attached response.
- Lets look at the HashMap code in the Responder class!

```
import java.util.HashMap;
import java.util.ArrayList;
import java.util.Random;

public class Responder
{
    // Used to map key words to responses.
    private HashMap<String, String> responseMap;
    // Default responses to use if we don't recognise a word.
    private ArrayList<String> defaultResponses;
    private Random randomGenerator;

   public Responder()
    {
        responseMap = new HashMap<String, String>();
        fillResponseMap();
        defaultResponses = new ArrayList<String>();
        fillDefaultResponses();
        randomGenerator = new Random();
    }
```



V3.0 Responder changes (in red)

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```
private void fillDefaultResponses() {
   defaultResponses.add("That sounds odd. Could you describe that problem in more detail?");
   defaultResponses.add("No other customer has ever complained about this before. \n" +
                        "What is your system configuration?");
   defaultResponses.add("That sounds interesting. Tell me more...");
   defaultResponses.add("I need a bit more information on that.");
   defaultResponses.add("Have you checked that you do not have a dll conflict?");
   defaultResponses.add("That is explained in the manual. Have you read the manual?");
   defaultResponses.add("Your description is a bit wishy-washy. Have you got an expert\n" +
                        "there with you who could describe this more precisely?");
   defaultResponses.add("That's not a bug, it's a feature!");
   defaultResponses.add("Could you elaborate on that?");
}

private String pickDefaultResponse()
{
   // Pick a random number for the index in the default response list.
   // The number will be between 0 (inclusive) and the size of the list (exclusive).
   int index = randomGenerator.nextInt(defaultResponses.size());
   return defaultResponses.get(index);
}
```

V3.0 Responder changes (in red)

```
  private void fillResponseMap()
   {
      responseMap.put("crash",
                  "Well, it never crashes on our system. It must have something\n" +
                  "to do with your system. Tell me more about your configuration.");
      responseMap.put("crashes",
                  "Well, it never crashes on our system. It must have something\n" +
                  "to do with your system. Tell me more about your configuration.");
      responseMap.put("slow",
                  "I think this has to do with your hardware. Upgrading your processor\n" +
                  "should solve all performance problems. Have you got a problem with\n" +
                  "our software?");
      responseMap.put("performance",
                  "Performance was quite adequate in all our tests. Are you running\n" +
                  "any other processes in the background?");
      responseMap.put("bug",
                  "Well, you know, all software has some bugs. But our software engineers\n" +
                  "are working very hard to fix them. Can you describe the problem a bit\n" +
                  "further?");
      responseMap.put("buggy",
                  "Well, you know, all software has some bugs. But our software engineers\n" +
                  "are working very hard to fix them. Can you describe the problem a bit\n" +
                  "further?");
      responseMap.put("windows",
                  "This is a known bug to do with the Windows operating system. Please\n" +
                  "report it to Microsoft. There is nothing we can do about this.");
      //  and so on…
 }
```

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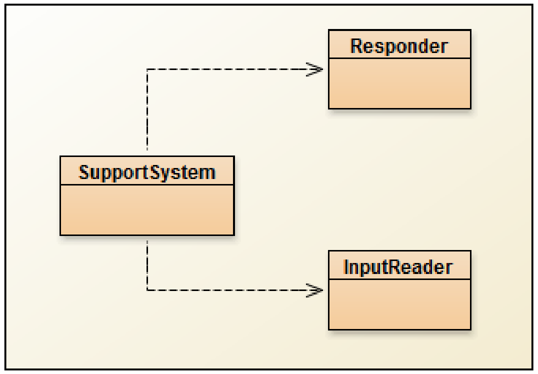

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Tokenizing Strings

- We have a HashMap
  - containing a series of words with appropriate responses.
- Now we need to search the String of words the user entered on the console
  - to see if they typed in any of the words stored in the HashMap.
- We need to “split” the String of words entered by the user
  - into individual words
  - and store them in a collection (e.g. Array)
    - **Tokenizing Strings**.
- We need a new data structure to store these words just once

A **Set** stores **uniques** values

Set

- A **Set** is a collection
  - that stores each individual element at most once
    - (i.e. unique elements).

- It does not maintain any specific order.

- The coding for **Set** is very similar to ArrayList coding.

Using sets

```
import java.util.HashSet;
import java.util.Iterator;
...
HashSet<String> mySet = new HashSet<String>();

mySet.add("one");
mySet.add("two");
mySet.add("three");

Iterator<String> it = mySet.iterator();
while(it.hasNext()) {
    call it.next() to get the next object
    do something with that object
}
```

Compare this to ArrayList code!

What is the **Difference** between **Set** and **List**?

List (e.g. ArrayList):

- keeps all elements entered in the desired **order**,
- provides access to elements by **index**
- can contain the **same element multiple times**.

Set (e.g. HashSet):

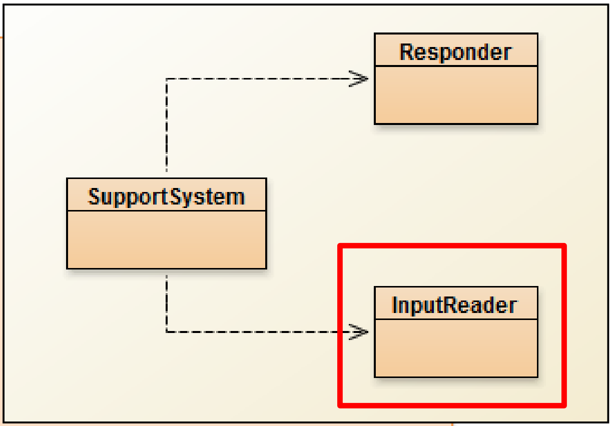
- **No specific order**
- ensures each element is in the set **at most once**
  - (entering an element a second time has no effect).

Returning to Tokenizing Strings

InputReader class

V2 Code

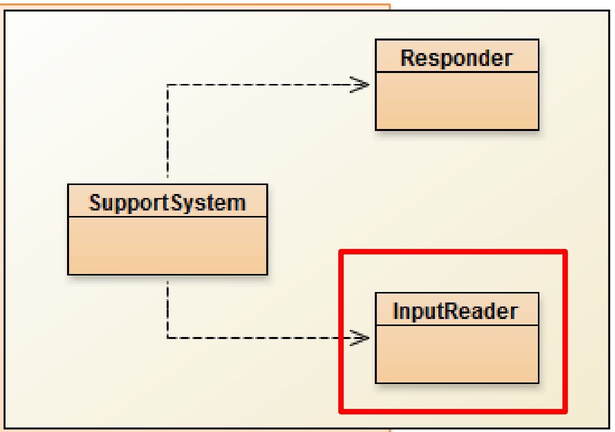
```
// V2 Code
import java.util.Scanner;

public class InputReader{

    Scanner input;

    public InputReader(){
        input = new Scanner(System.in);
    }

    /**
     * Read a line of text from standard input (the text terminal),
     * and return it as a String.
     *
     * @return  A String typed by the user.
     */
    public String getInput() {
        System.out.print("> ");            // print prompt
        String inputLine = input.nextLine().trim().toLowerCase();
        return inputLine;
    }
}
```



In V3, we modify this code
to split out the input (stored in **inputLine**)
into a primitive array of Strings >>>

Changes for V3

```
// V3 Code
import java.util.Scanner;

public class InputReader{

    Scanner input;

    public InputReader(){
      input = new Scanner(System.in);
    }
    public HashSet<String> getInput()
    {
       System.out.print("> ");             // print prompt
       String inputLine = input.nextLine().trim().toLowerCase();

       String[] wordArray = inputLine.split(" ");  // split at spaces

       // add words from array into hashset
       HashSet<String> words = new HashSet<String>();

       for (String word : wordArray) {
          words.add(word);
       }
       return words;
    }
}
```



1) Split up the **inputLine** object at spaces, storing each word in a **wordArray** of String[]

2) Declare & initialise **words** as a HashSet of String

3) For each **word** in the **wordArray**, add that **word** to the **words HashSet**

4) Return the HashSet of **words**

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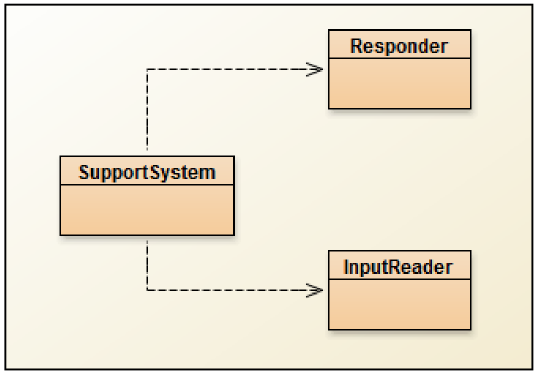

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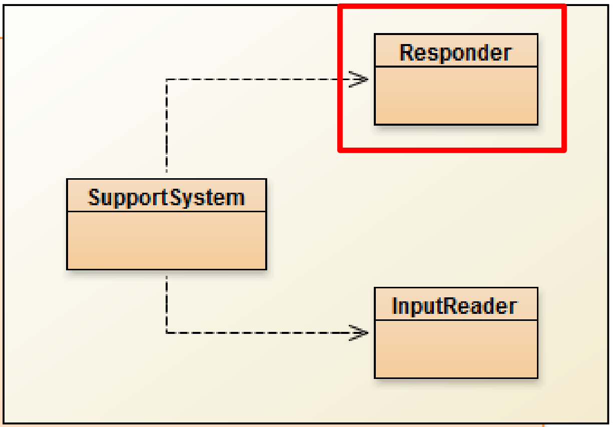
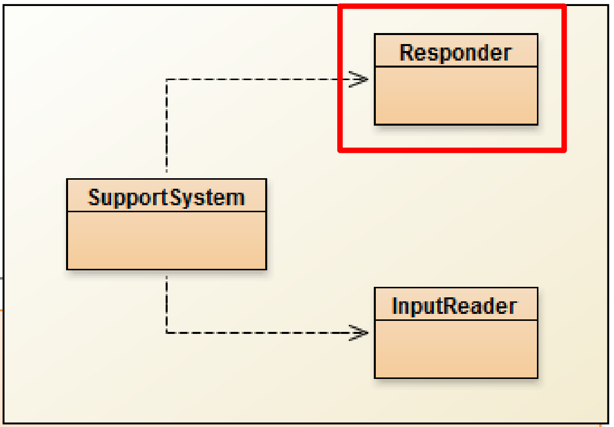


V3.0 Responder Class

MORE changes (in red)
to handle a HashSet of Strings
passed into the **generateResponse()**
method.



```
public String generateResponse (HashSet<String> words)
  {
    Iterator<String> it = words.iterator();

    while(it.hasNext()) {

      String word = it.next();
      String response = responseMap.get(word);
      if(response != null) {
        return response;
      }
    }
    // If we get here, none of the words from the input line were recognized.
    // In this case we pick one of our default responses (what we say when
    // we cannot think of anything else to say...)
    return pickDefaultResponse();
  }
```

V3.0 Responder Class

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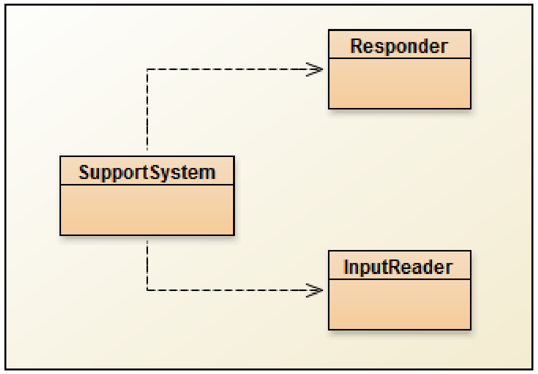

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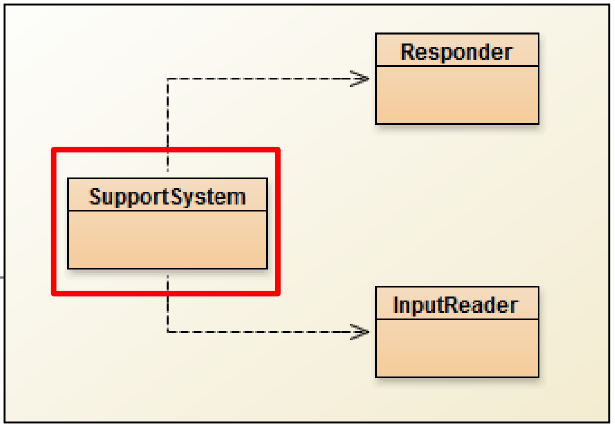
```java
// V2 code
public class SupportSystem
{
   private InputReader reader;
   private Responder responder;

   public SupportSystem() {
       reader = new InputReader();
       responder = new Responder();
   }
   public static void main(String[] argvs){
       SupportSystem app = new SupportSystem();
       app.start();
   }

   public void start(){
        printWelcome();
        String input = reader.getInput();
        while(! input.startsWith("bye")) {
            String response = responder.generateResponse();
            System.out.println(response);
            input = reader.getInput();
        }
        printGoodbye();
   }
```

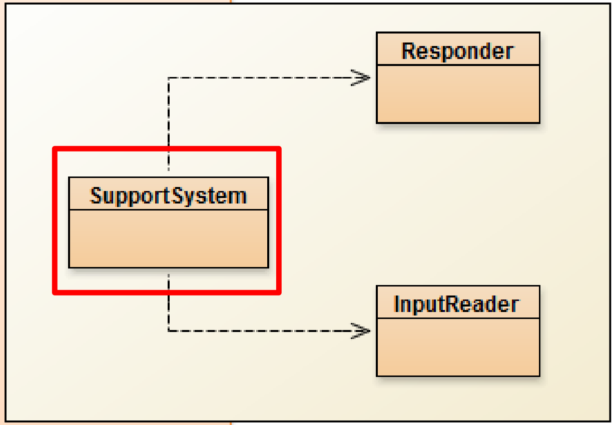


In V3
we change this class,
mainly in the start()
method >>>

V3 Code

```
import java.util.HashSet;
public class SupportSystem
{
   private InputReader reader;
   private Responder responder;

   public SupportSystem() {
       reader = new InputReader();
       responder = new Responder();
   }
   public static void main(String[] argvs){
       SupportSystem app = new SupportSystem();
       app.startSupport();
   }
public void startSupport(){
      printWelcome();
      HashSet<String> input = reader.getInput();
      while(!input.contains("bye")) {
            String response = responder.generateResponse(input);
            System.out.println(response);
            input = reader.getInput();
      }
      printGoodbye();
   }
```



V3 Uses a **HashSet of Strings** called **input** which is passed to generateResponse()

startSupport() replaces start()

Any Questions?