More Sophisticated Behaviour

Technical Support System V3.0

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Based on Ch. 5, Objects First with Java - A Practical Introduction using BlueJ, © David J. Barnes, Michael Kölling

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Topic List

- Recap: Technical Support System V2
- Technical Support System V3
  - Overview of the System.
  - Responder class: starting to generate a related response:
    - ArrayList
    - Map and HashMap
  - InputReader class: Tokenizing Strings:
    - Set and HashSet
  - Responder class: finishing the class.
  - SupportSystem class: a small change.

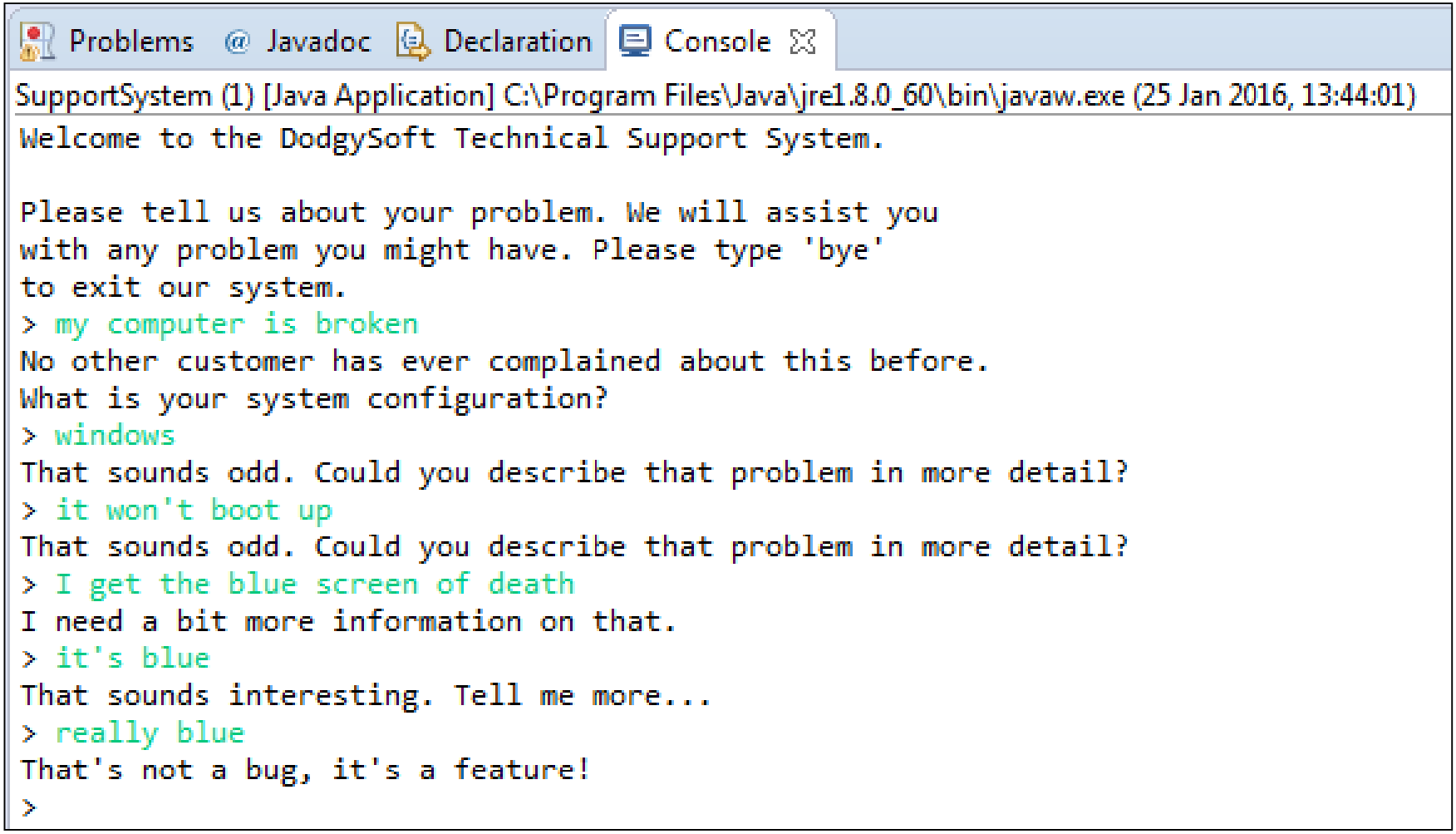
Technical Support System V2

- A console based, textual dialog system.

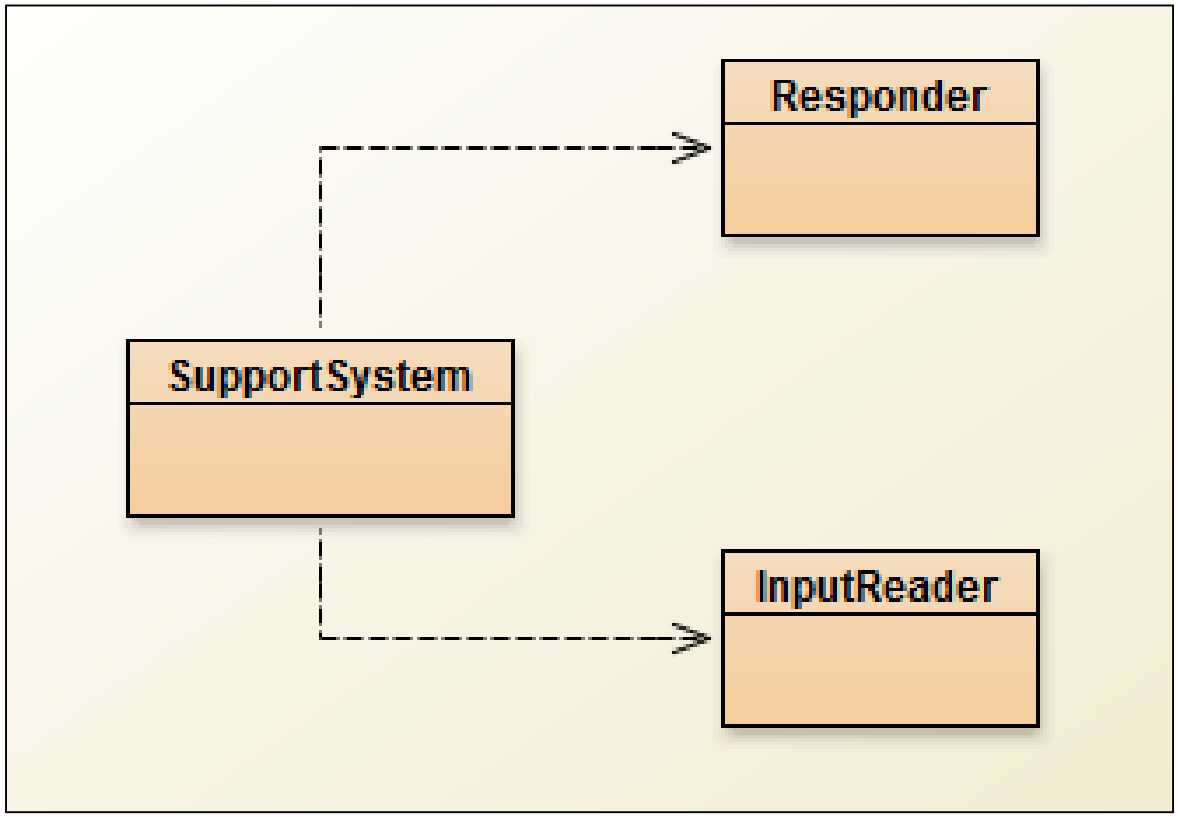
- In this version, the system providesd a random response from a list of pre-defined responses e.g.:

  - "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.

Technical Support System V2



Class Diagram V2



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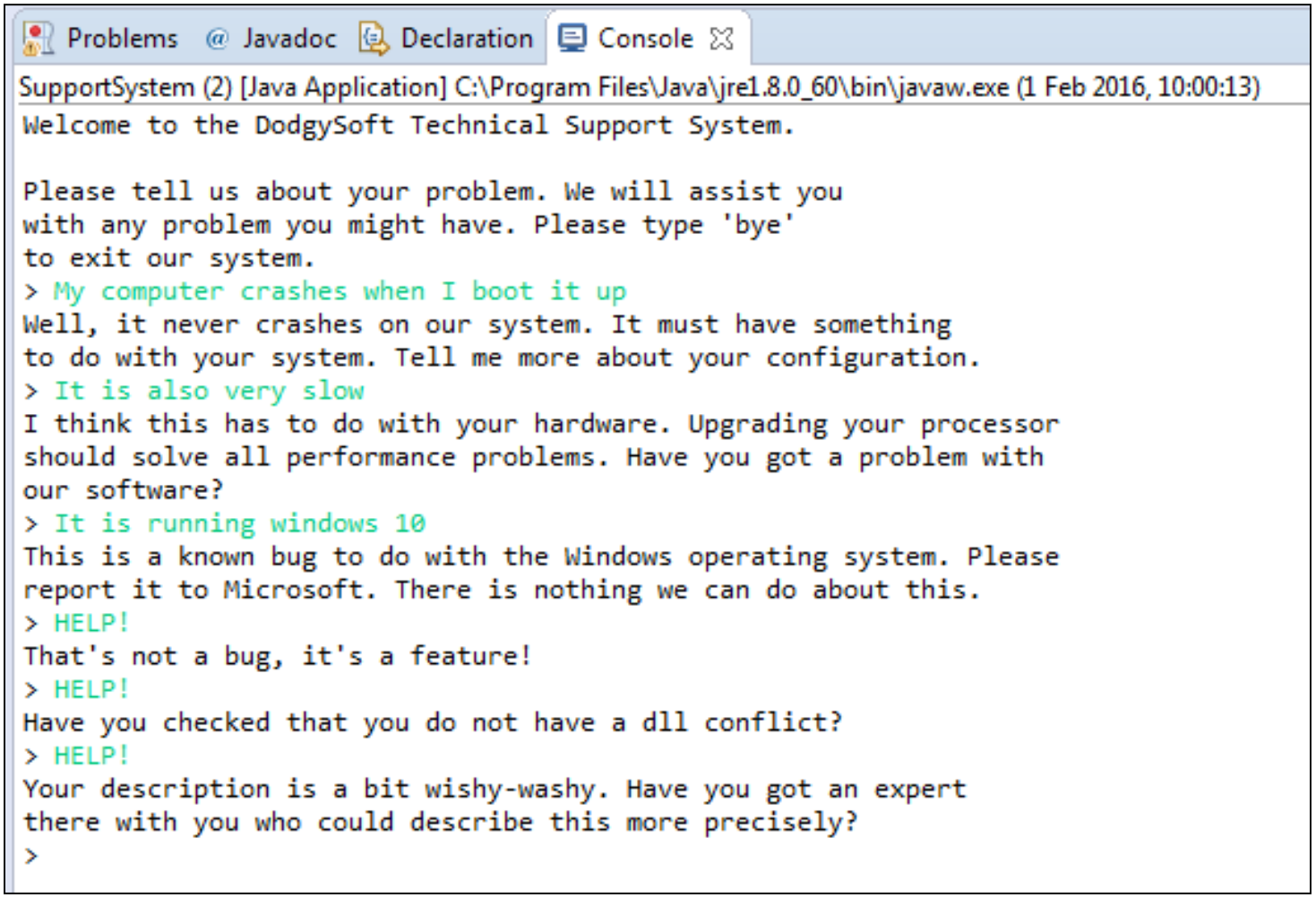
  - SupportSystem class: a small change.

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



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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 input from the user contains one of our known words, generate a related response!

ArrayList

- Can we use an ArrayList for this purpose?
- Will it let us store “key=value” pairs?
- No! We need a different data structure.
- A Map will store “key=value” pairs though!

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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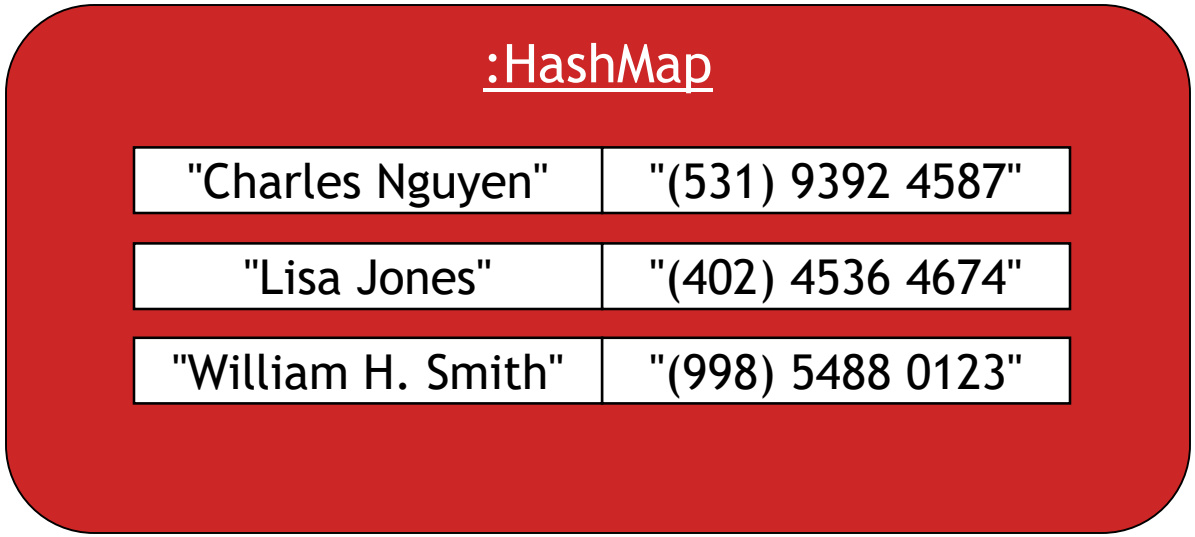
Maps

- Maps are collections that contain pairs of values.
- Pairs consist of a key and a value.
- Lookup works by supplying a key, and retrieving a value.

- An example: a telephone book...use the name to look up a phone number.

Using maps

- A map with Strings as keys and values.



ArrayList Vs Map

- In an ArrayList each entry stores one object whereas in a Map, each entry has a pair of objects (key=value).

- In ArrayList, you use an integer index to look up the object, whereas in a Map, you use the key object to look up the value object.

More on Map

- Looking up a value associated with a key is easy!
- However, reverse lookup (finding a key for a value) is not so easy.
- Ideal for one-way lookup using the key.

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

- 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);
```

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

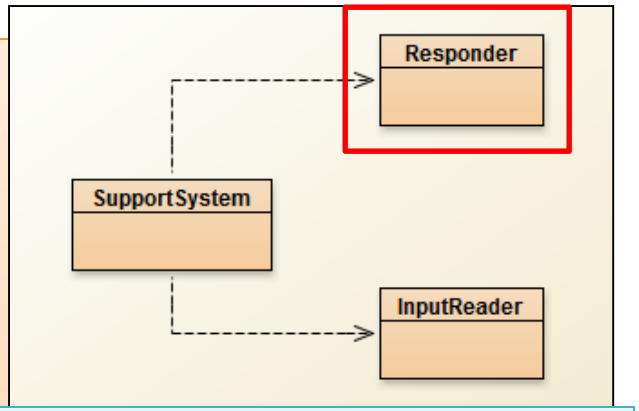
```
responseMap.put("crashes",  "Well, it never crashes on our system. It must have something\n" + "to do with your system. Tell me more about your configuration.");
```

- 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)

V3.0 Responder changes (in red)

```
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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  - SupportSystem class: a small change.

Tokenizing Strings

- We have a HashMap containing a series 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 for this type of data.

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):

- does not maintain any 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

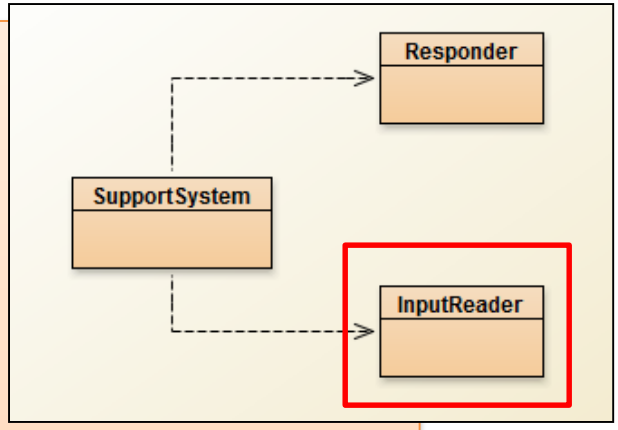
```
//V2 Code
import java.util.Scanner;

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;
   }
}
```



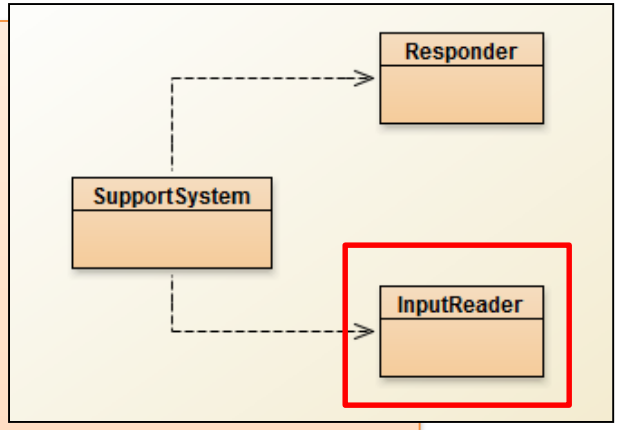
This class will be changed to split the input into a primitive array of Strings.

```
//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;
     }
}
```



Changes for V3

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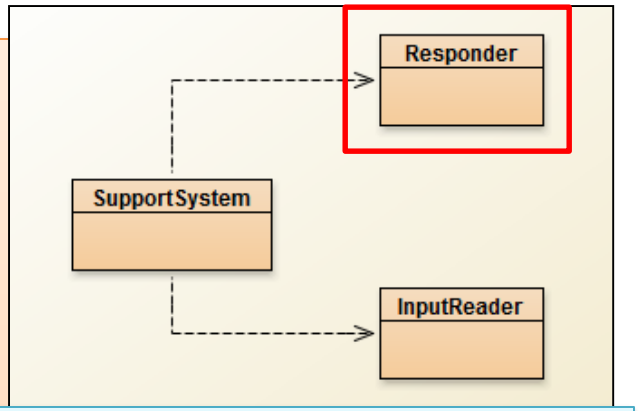
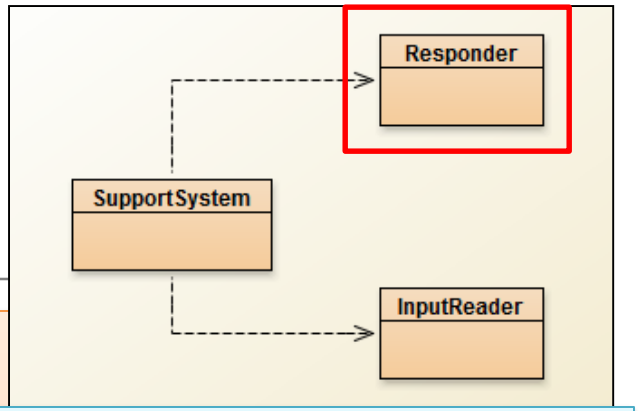
import java.util.HashSet;
import java.util.ArrayList;
import java.util.Iterator;
import java.util.Random;

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

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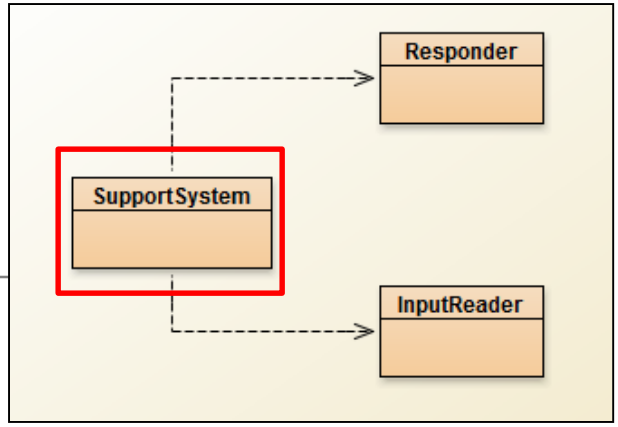
```
//V2 code
public class SupportSystem
{
    private InputReader reader;
    private Responder responder;

    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();
    }
```

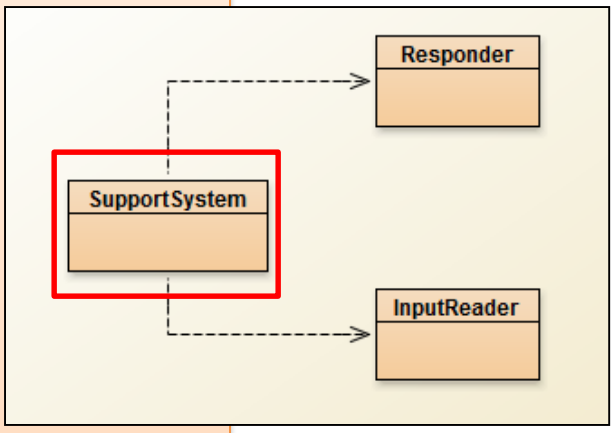


Slight change will be made in this class, mainly in the start() method.

```
//V3 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.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();
    }
```



Use the HashSet and add the relevant import statements at the top!

Any Questions?

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