More Sophisticated Behaviour

Technical Support System V3.0

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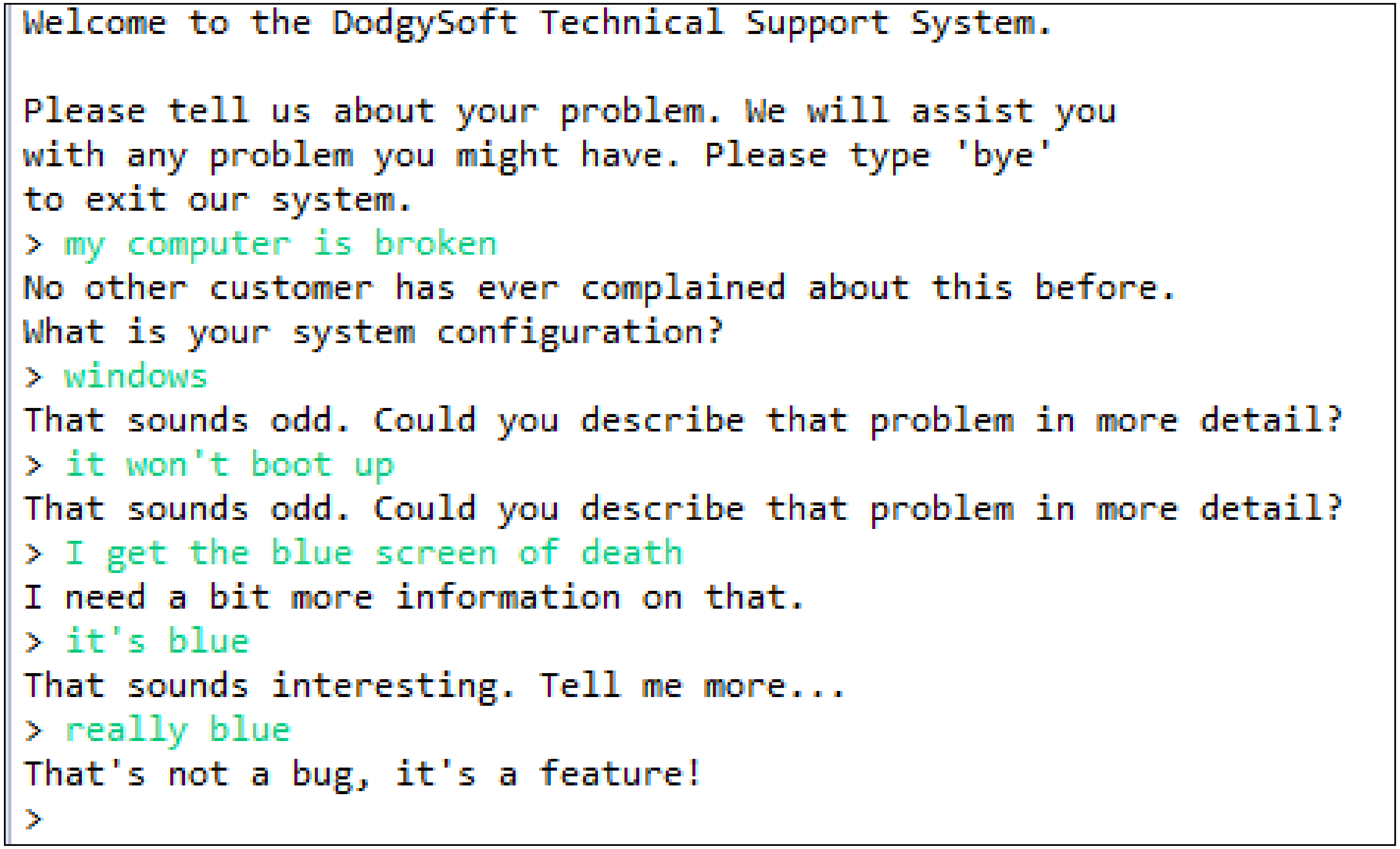
Topic List

- 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 <u>random</u> 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.

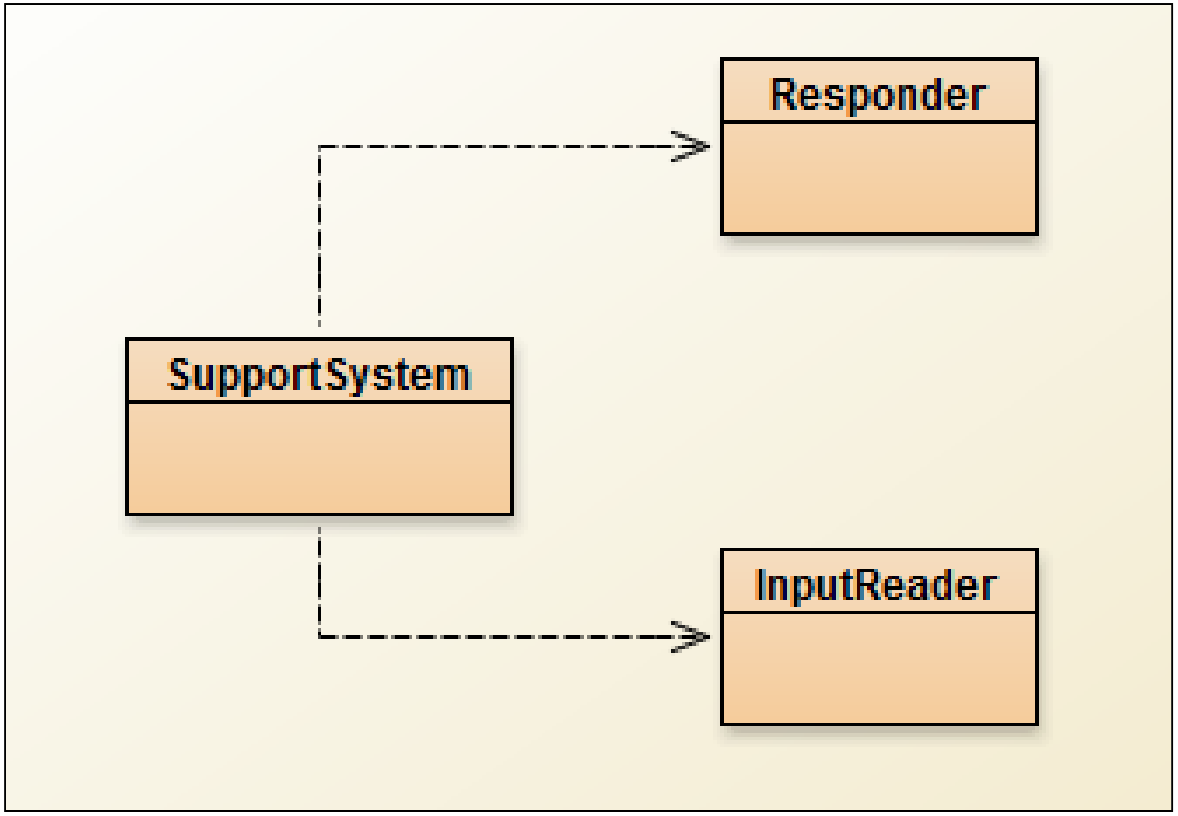
Technical Support System V2



```
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!
>
```

Class Diagram V2



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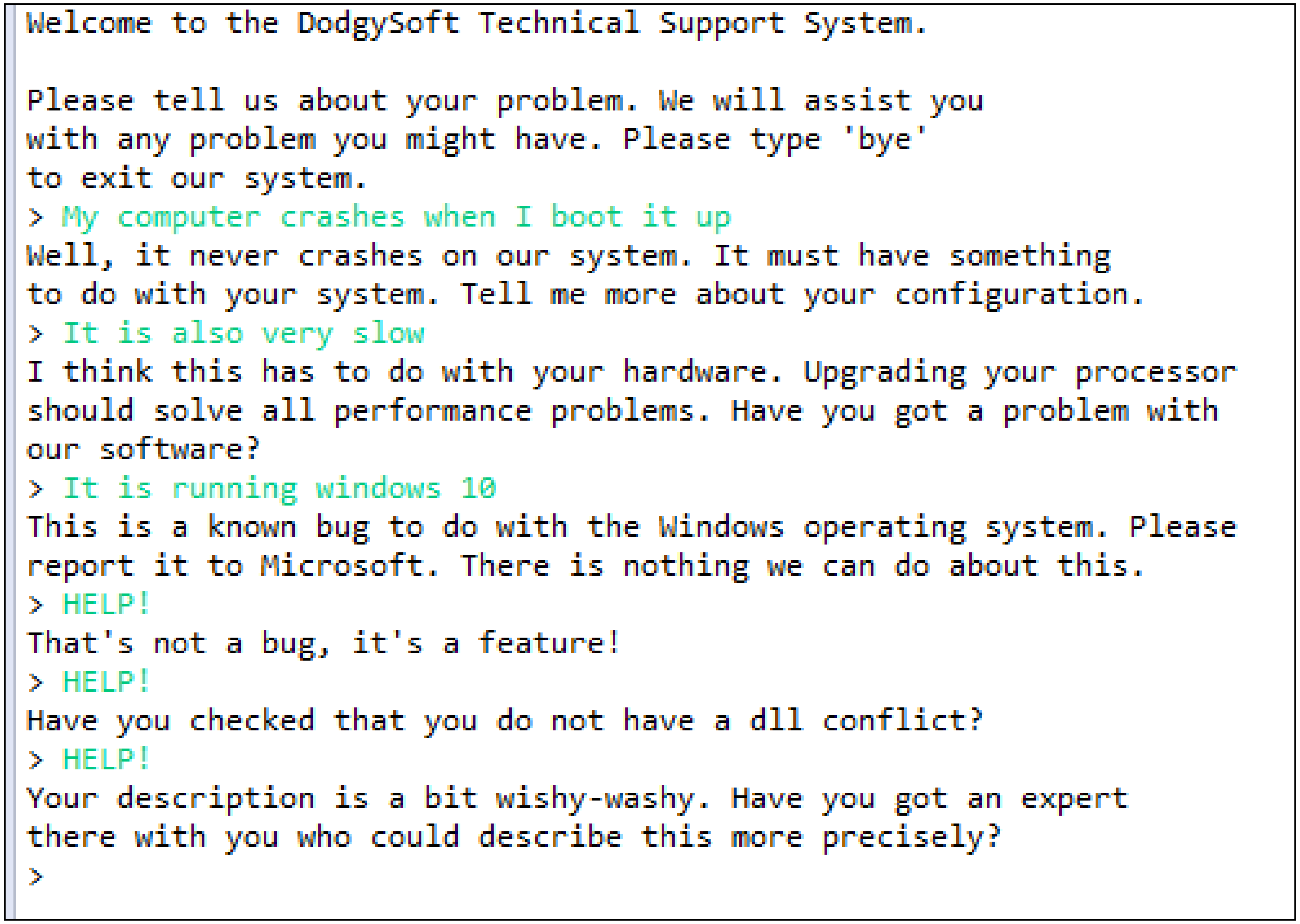
Technical Support System V3

- 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?
>
```

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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?

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

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- Lookup works by supplying a key, and retrieving a value.

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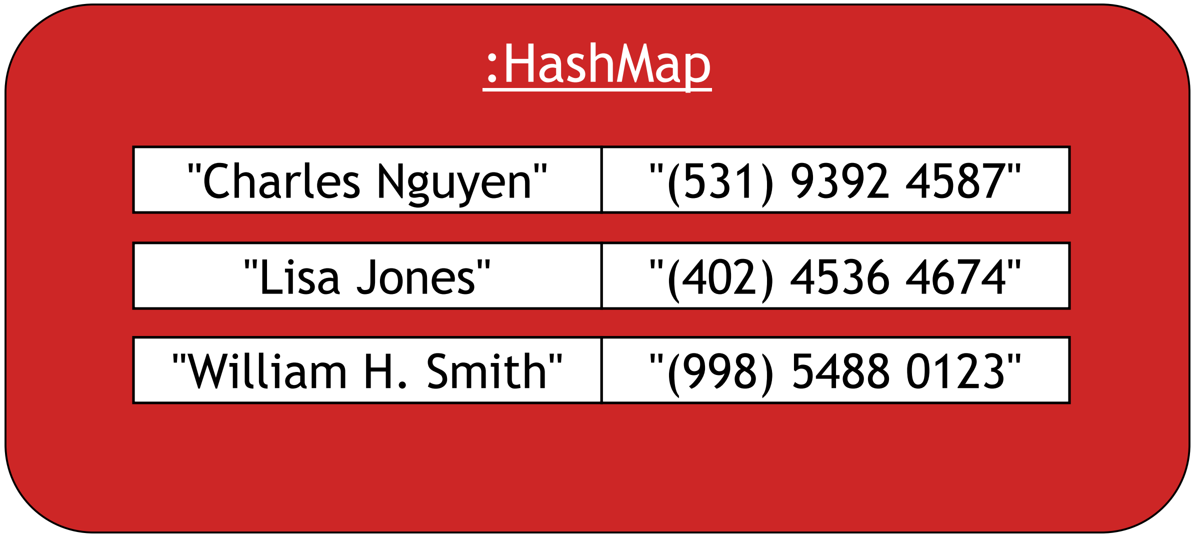
- Pairs consist of a key and a value.
- Lookup works by supplying a key, and retrieving a value.

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

Using maps

- A map with Strings as keys and values.



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

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.

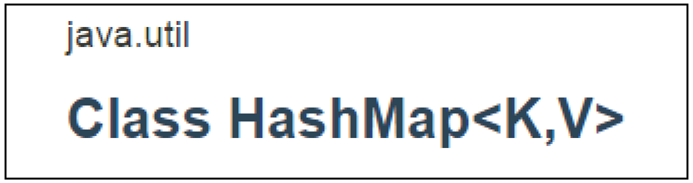
More on Map

- 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.

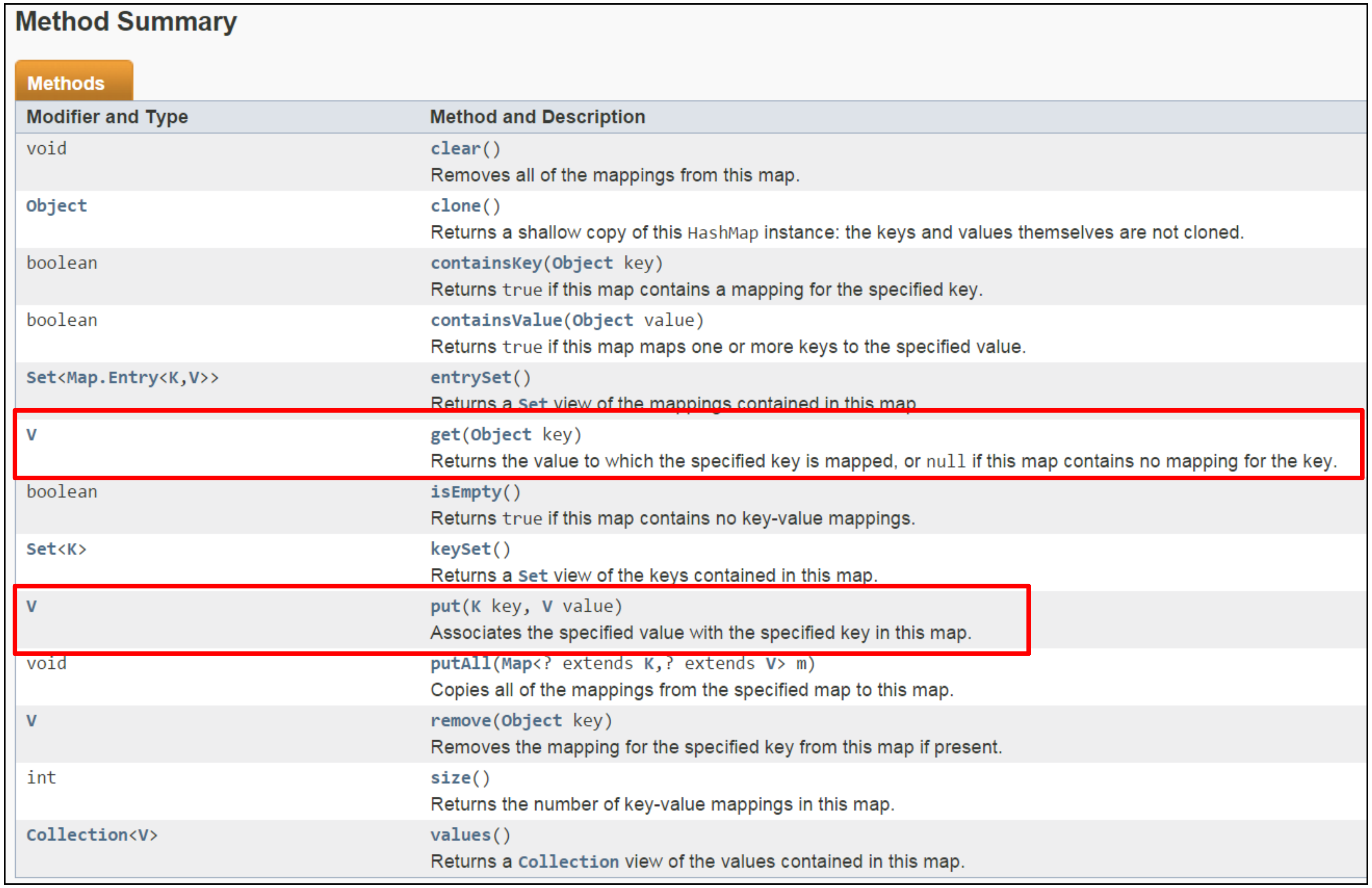
- A map cannot contain duplicate keys; each key can map to at most one value.

- We will use the HashMap class.

HashMap Methods


java.util

Class HashMap<K,V>


Method Summary

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);
```

Using HashMap

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

phoneBook.put("Charles Nguyen", "(531) 9392 4587");
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phoneBook.put("William H. Smith", "(998) 5488 0123");

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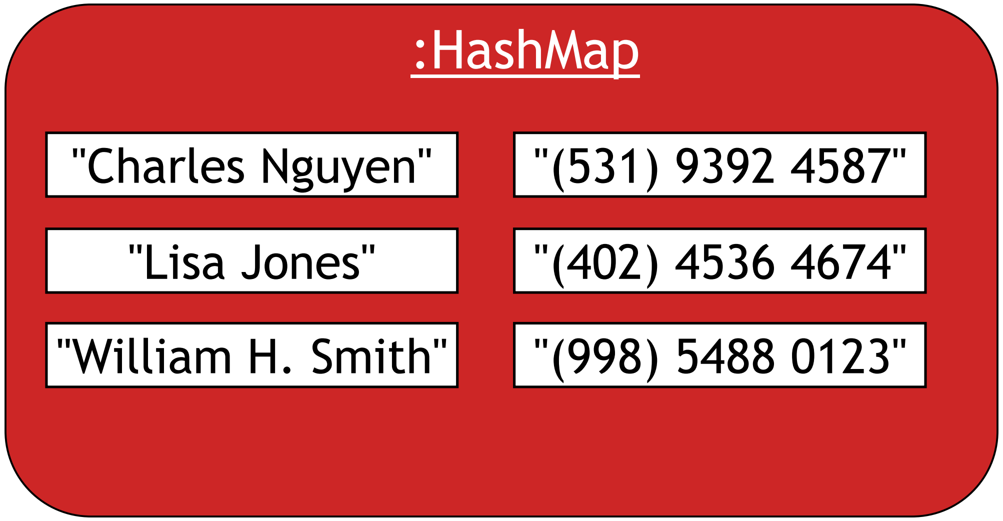



HashMap in Tech Support System V3

In the Responder class, we will now use HashMap to store "Key-Value" pairs for context-sensitive responses e.g.

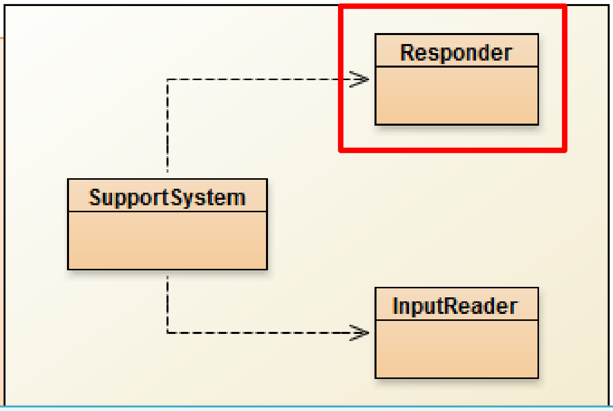
Key	Value
windows	This is a known bug to do with the Windows operating system. Please report it to Microsoft. There is nothing we can do about this.
slow	I think this has to do with your hardware. Upgrading your processor should solve all performance problems. Have you got a problem with our software?
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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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

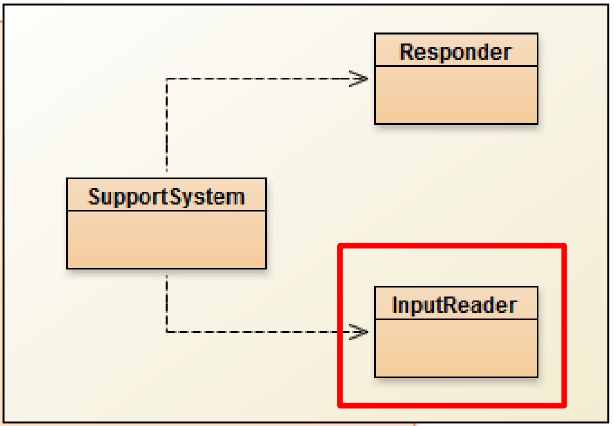
```
//V2 Code
import java.util.Scanner;

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;
    }
}
```

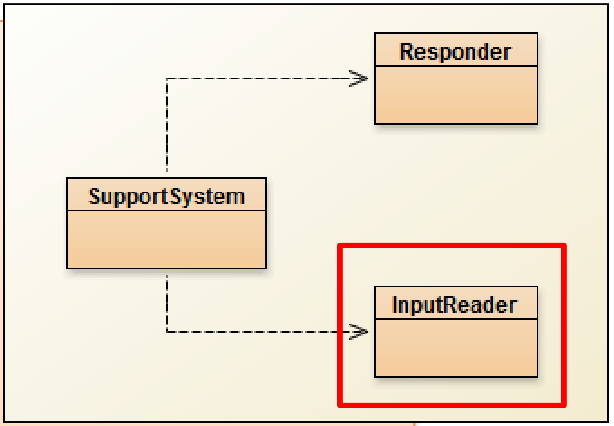


This class will be changed to split the input into a primitive array of Strings.

```
//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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```
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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();
   }
```
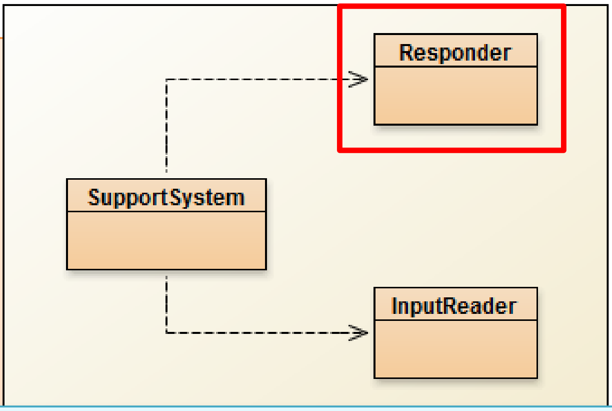
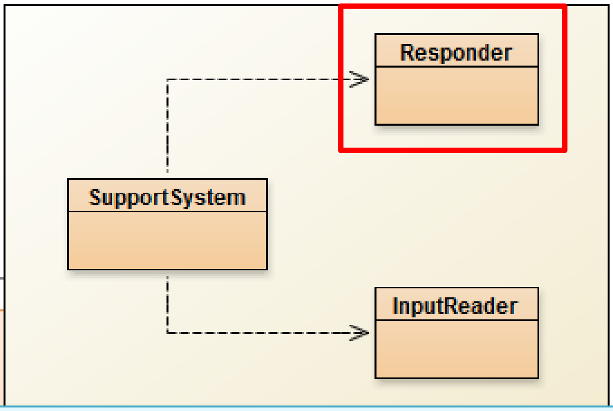



V3.0 Responder

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

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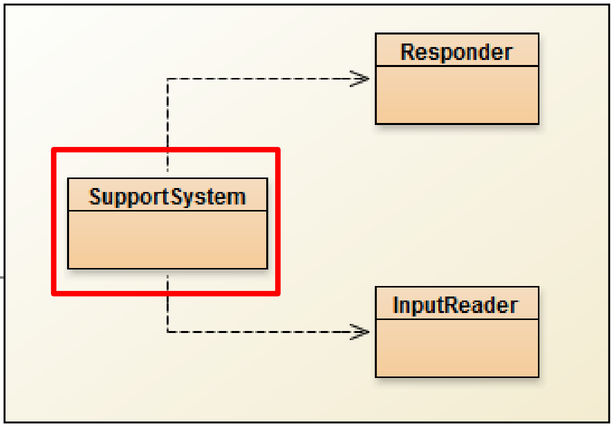
```
//V2 code
public class SupportSystem
{
   private InputReader reader;
   private Responder responder;

   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();
   }
```

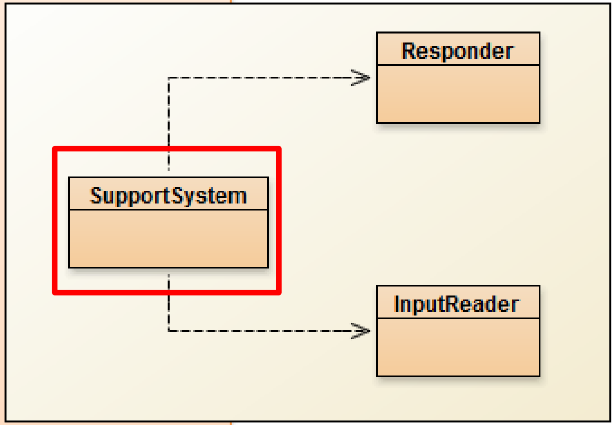


Slight change <u>will</u> be made in this class, mainly in the start() method.

```
//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?