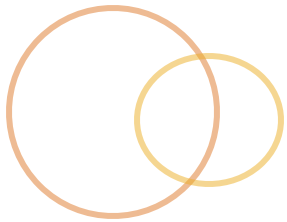
Basic Language Enhancements

Presentation Topics



In this presentation we will cover:

- Static imports
- Autoboxing
- For-each loops
- Varargs

Objectives

When you are done, you should be able to:

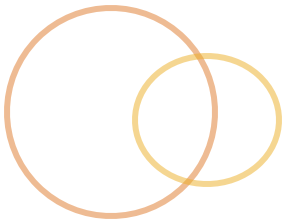
- Identify three basic language enhancements
- Describe when two enhancements are applicable
- Create a basic prototype using all four basic language enhancements

Static Imports

Static Imports

- What are they?
  - Mechanism for importing static variables and methods
  - Very similar to standard import syntax
- Why do they exist?
  - Simplify access to static variables and methods in code
  - Restore cohesion problem found in “work-around” solutions (aka – implementing an interface to gain access to static variables)

Static Imports [cont.]



- How do they work?
  - Like normal import mechanism
    - Development-time short-cut
    - Compiler converts short-cuts into fully qualified names
  - In static imports
    - Compiler converts “static” short-cuts into fully qualified names

Working With Static Imports

- Two types of static import
  - Single static import declaration
  - Static “on-demand” import declaration
- Look similar to . . .
  - Single type import declaration
  - “On-demand” type import declaration
- . . . but work a little different
  - Single static import - imports single static variable or function
  - “On-demand” static import - imports all static variables and functions

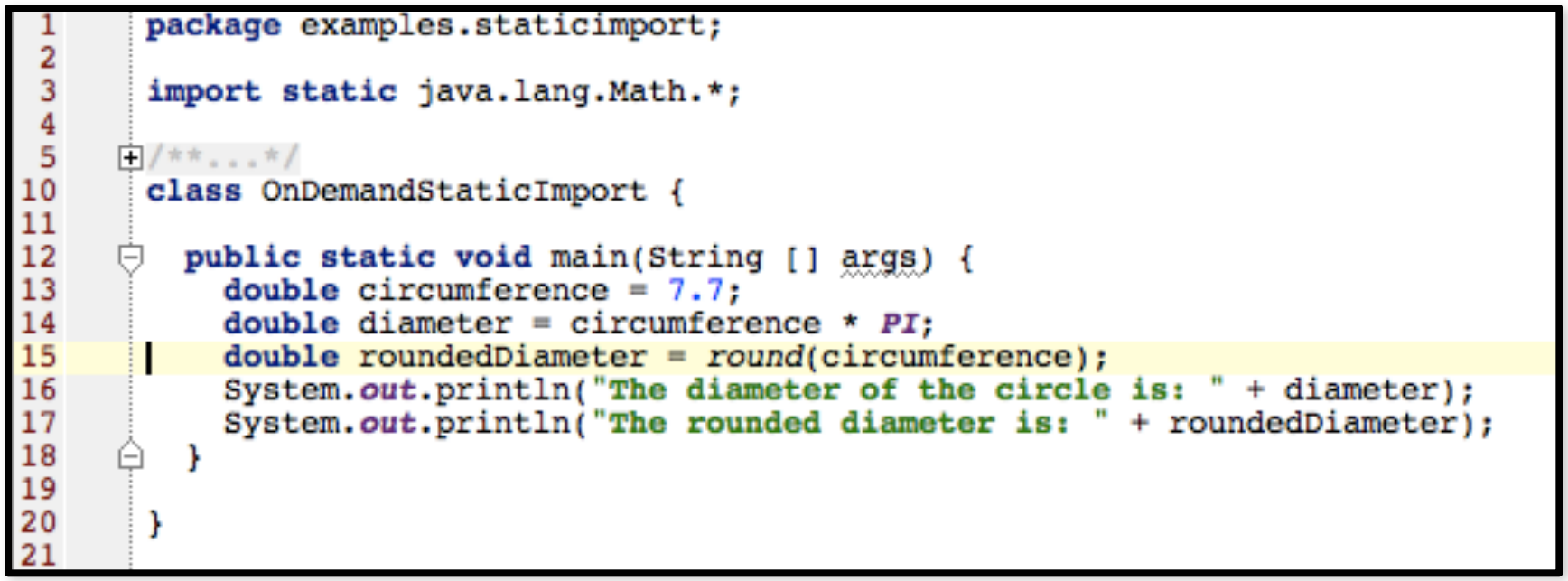
Static Import Example [old way]

```
1   package examples.staticimport;
2
3   /**...*/
7   class StaticImport {
8
9     public static void main(String [] args) {
10      double circumference = 7.7;
11      double diameter = circumference * Math.PI;
12      double roundedDiameter = Math.round(diameter);
13      System.out.println("The diameter of the circle is: " + diameter);
14      System.out.println("The rounded diameter is: " + roundedDiameter);
15    }
16
17  }
18
```

Single Static Import Example

```
1   package examples.staticimport;
2
3   import static java.lang.Math.PI;
4   import static java.lang.Math.round;
5
6   /**...*/
11  class SingleStaticImport {
12
13    public static void main(String [] args) {
14      double circumference = 7.7;
15      double diameter = circumference * PI;
16      double roundedDiameter = round(circumference);
17      System.out.println("The diameter of the circle is: " + diameter);
18      System.out.println("The rounded diameter of the circle is: " + diameter);
19    }
20
21  }
22
```

On-Demand Static Import Example

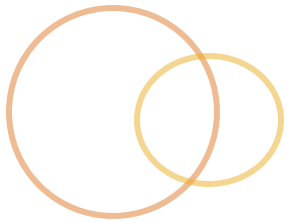


```
1   package examples.staticimport;
2
3   import static java.lang.Math.*;
4
5   /**...*/
10  class OnDemandStaticImport {
11
12    public static void main(String [] args) {
13      double circumference = 7.7;
14      double diameter = circumference * PI;
15      double roundedDiameter = round(circumference);
16      System.out.println("The diameter of the circle is: " + diameter);
17      System.out.println("The rounded diameter is: " + roundedDiameter);
18    }
19
20  }
21
```

Static Import Best-Practices

- Be aware
  - Name-space collisions can occur
  - Code can be hard to read
- Be specific
  - Consider avoiding wildcard notation
  - Use “optimize imports” functionality of IDE
- Avoid abuse
  - Perform proper OOAD anytime you create a static
- Refactor old code

Static Import Lab



- **Description**:
  Create a stand-alone Java application called `Mixer`. `Mixer` can accept any number of command line arguments. If `Mixer` receives 3 or less arguments, `Mixer` should sort the arguments using `Arrays.sort` and print the results. If `Mixer` receives more than 3 arguments, `Mixer` should sort the arguments, count the frequency of each argument, and print the argument and its frequency in sorted order.
- **Duration**: 15 minutes

Static Import Lab Solution

```
44    private static Map getFrequencyMap(String[] args) {
45      Map returnMap = new TreeMap();
46      List list = asList(args);
47
48      for(int i=0;i<args.length;i++) {
49        if(!returnMap.containsKey(args[i])) {
50          int freq = frequency(list, args[i]);
51          returnMap.put(args[i], new Integer(freq));
52        }
53      }
54
55      return returnMap;
56    }
```

Solution source: `labs.solutions.staticimport.Mixer.java`

Autoboxing

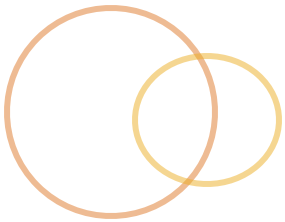
Autoboxing

- Terminologies
  - Boxing - converting primitive to reference
  - Unboxing - converting reference to primitive
  - Auto - short for automatic; opposite of manual
- What is it?
  - General term describing automatic boxing and unboxing of data
  - Should be called Auto-boxing and Auto-unboxing

Autoboxing [cont.]

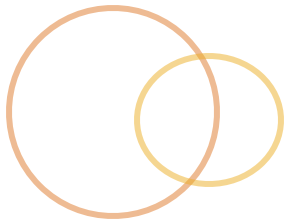
- Why does it exist?
  - Simplify data conversion process from primitive to reference and reference to primitive
  - Simplify code (ease of development)
  - Hide “side-step”
  - Be more “modern”

Autoboxing Support



Primitive Type	Reference Type
`boolean`	`java.lang.Boolean`
`byte`	`java.lang.Byte`
`short`	`java.lang.Short`
`int`	`java.lang.Integer`
`long`	`java.lang.Long`
`float`	`java.lang.Float`
`double`	`java.lang.Double`
`char`	`java.lang.Character`

Autoboxing [cont.]



- How does it work?
  - According to lang spec, occurs at run-time
  - Utilizes wrapper class functionality

Simple Autoboxing Example

```
1   package examples.autobox;
2
3   /**...*/
8   public class SimpleAutoboxingExample {
9
10    public static void main(String[] args) {
11      //box the int value of 32 into
12      //a Integer reference
13      Integer x = 32;
14
15      //unbox the Integer reference into
16      //a int value and multiply by 2
17      int y = x * 2;
18
19      //no boxing going on here
20      System.out.println("The value of y is: " + y);
21    }
22  }
23
```

Collection Autoboxing Example

```
1   package examples.autobox;
2
3   import ...
6
7   /**...*/
12  public class WordCount {
13
14    public static void main(String[] args) {
15      Map wordMap = new HashMap();
16      for(int x=0;x<args.length;x++) {
17        int wordCount = 1;
18        if(wordMap.containsKey(args[x])) {
19          wordCount = ((Integer) wordMap.get(args[x])) + 1;
20        }
21        wordMap.put(args[x], wordCount);
22      }
23
24      Iterator itr = wordMap.keySet().iterator();
25      while(itr.hasNext()) {
26        String key = (String) itr.next();
27        int value = (Integer) wordMap.get(key);
28        System.out.println(key + " has " + value + " occurrences");
29      }
30
31    }
32  }
33
```

Autoboxing Best Practices

- Be aware of performance implications
  - Avoid using boxing / unboxing when possible
  - Only use when there is a type mismatch
  - Don’t get lazy
- Know the edge cases
  - `NullPointerException`
  - `OutOfMemoryError`

Autoboxing Lab

- **Description**: Use the `Mixer` application you wrote in the static import lab as your starting point. Apply autoboxing concepts to streamline the code that put the frequency count into the `Map`. Apply autoboxing concepts to streamline the code when you get the frequency count from the `Map`. Changing the `Mixer` to use autoboxing should not effect the results of the application.
- **Duration**: 15 minutes

For Each Loop

Working with the enhanced for loop

For-each Loop

- What is it?
  - A variation of a for loop
  - Simplified notation targeted at collections and arrays
- Why does it exist?
  - Remove redundant iteration code
  - Simplify iteration over collections

For-each Loop [cont.]

- How does it work?
  - Functions like a for loop . .
    - Iterate over collection
    - Access each collection element individually
  - . . but has a different syntax
    - Has an initialization “clause” and “expression” clause
      - Initialization clause holds current element in collection
      - Expression clause defines collection
    - Doesn’t have a “test” clause or “increment” clause
    - Clauses separated by `:` instead of `;`
  - Translated into a formal for loop at compile time

Simple For-each Loop Example

```
1   package examples.foreach;
2
3   /**...*/
10  public class SimpleForEach {
11
12    public static void main(String[] args) {
13      //initialization clause - String s
14      //expression clause - args
15      for(String s : args) {
16        System.out.println(s);
17      }
18    }
19  }
20
```

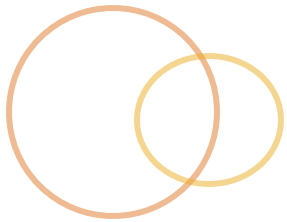
Limitations of For-each Loop

- Limited type support
  - Supports arrays
  - Supports `java.lang.Iterable`
    - Collections support `Iterable` through class hierarchies
    - `Iterable` provides `java.util.Iterator` to the for-each loop
- Limited insight
  - No way to determine “where am I” during iteration
  - No access to iterator or index
- All clauses are required - no “endless loop” abilities

Iterable For-each Loop Example

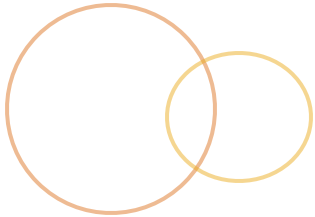
```
1  package examples.foreach;
2
3  import java.util.Arrays;
4  import java.util.List;
5
6  /**
7   * The following illustrates using the for-each
8   * loop with a collection through the Iterable
9   * interface.
10  */
11 public class IterableForEachExample {
12
13   public static void main(String[] args) {
14     //convert the array into a list
15     List argList = Arrays.asList(args);
16
17     //iterate over the list
18     for(Object arg : argList) {
19       System.out.println(arg);
20     }
21   }
22 }
23
```

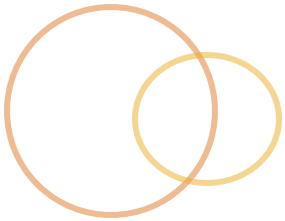
For-each Loop Lab



- **Description**: Use the `Mixer` as your starting point. Where applicable, convert the for-loops in the `Mixer` into the for-each loop syntax. The modification should not change the program's results.
- **Duration**: 10 minutes

Variable Argument Lists

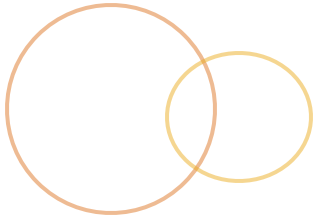


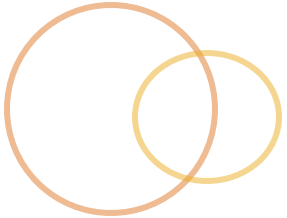


Variable Argument Lists

- What is a Variable Argument List?
  - Associated with a method
    - Makes method argument list dynamic in length
    - Requires modification of method signature
  - Allows dynamic number of arguments to be passed into a method

Varargs





- Why does it exist?
  - Simplifies passing flexible number of arguments
  - Typical argument list notation is inflexible
    - Certain scenarios require flexibility
    - Flexibility was supported through an `Object[]` argument
  - `Object[]` support was cumbersome
    - Required developer to declare method with `Object[]` argument
    - Required developer to convert parameters into an array before passing

Varargs Example [old way]

```
1  package examples.varargs;
2
3  /**...*/
13 public class VarArgsOldWay {
14
15   public static void main(String[] args) {
16     String name = "John Doe";
17     String book1 = "Hooked On Java";
18     String book2 = "The Java Language Specification";
19     //convert arguments into array
20     String [] titles = {book1, book2};
21     //pass arguments as array
22     listBooks(name, titles);
23   }
24
25   private static void listBooks(String name, String[] titles) {
26     System.out.print(name + " likes: ");
27     for(int i=0;i<titles.length;i++) {
28       System.out.print("\"" + titles[i] +"\"");
29       if(i+1 < titles.length)
30         System.out.print(",");
31     }
32     System.out.flush();
33   }
34 }
35
```

Using Varargs

- How does it work?
  - Change method signature to support varargs
    - Include ***ellipse*** notation
    - Must be last argument in argument list
  - Pass varargs either as:
    - An array of objects (like old way)
    - Like normal arguments (comma separated)
  - Varargs automatically converted
    - Signature converted to support [ ]
    - Arguments converted into an array
    - All performed by compiler
  - Work with varargs like any other array

Simple varargs Example

```
1  package examples.varargs;
2
3  /**...*/
11 public class VarArgsNewWay {
12
13   public static void main(String[] args) {
14     String name = "John Doe";
15     String book1 = "Hooked On Java";
16     String book2 = "The Java Language Specification";
17     //pass arguments as arguments
18     listBooks(name, book1, book2);
19   }
20
21   private static void listBooks(String name, String... titles) {
22     System.out.print(name + " likes: ");
23     for(int i=0;i<titles.length;i++) {
24       System.out.print("\"" + titles[i] +"\"");
25       if(i+1 < titles.length)
26         System.out.print(",");
27     }
28     System.out.flush();
29   }
30 }
31
```

Varargs Lab

- **Description**:
  Use `Mixer` as your starting point. Create a method called `print`. `print` should be a variable argument method accepting `Object`. Change `Mixer` to use the `print` method. If it receives two values, `print` the results as name=value. Otherwise, `print` the values as a comma-separated list.
- **Duration**: 20 minutes

Summary

Four basic language enhancements

- **Static Imports** - simplify referencing static members in source code
- **Autoboxing** - simplify boxing / unboxing operations
- **For-each loops** - simplify iterating over a collection
- **Varargs** - simplified mechanics for creating variable length argument list