Numbers and Strings

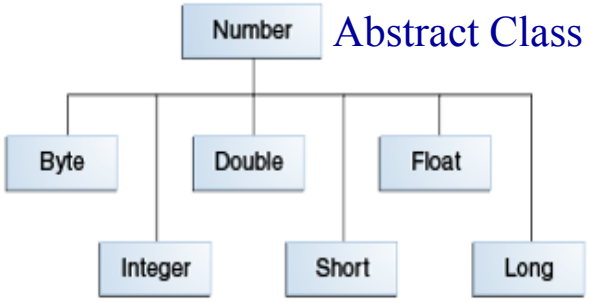
Numbers

- Number class
- PrintStream
- DecimalFormat
- Math

The Numbers Classes

- When working with numbers, most of the time you use the primitive types in your code. For example: int *i = 500*.
- There are, however, reasons to use objects in place of primitives, and the Java platform provides *wrapper* classes for each of the primitive data types.
- These classes "wrap" the primitive in an object.
- Often, the wrapping is done by the compiler—if you use a primitive where an object is expected, the compiler *boxes* the primitive in its wrapper class for you.
- Similarly, if you use a number object when a primitive is expected, the compiler *unboxes* the object for you.

The Numbers Classes



Reasons that you might use a Number object rather than a primitive:

1. As an argument of a method that expects an object
2. To use constants defined by the class, such as MIN_VALUE and MAX_VALUE
3. To use class methods for
   - converting values to and from other primitive types
   - converting to and from strings
   - converting between number systems (decimal, octal, hexadecimal, binary)

Methods Implemented by all Subclasses of Number

- Converts the value of this Numer object to the primitive data type returned
  - byte byteValue()， short shortValue()，int intValue()，
  - long longValue()，float floatValue()，double doubleValue()
- Compare this Number object to the argument
  - int compareTo(Byte anotherByte), int compareTo(Double anotherDouble),
  - int compareTo(Float anotherFloat), int compareTo(Integer anotherInteger),
  - int compareTo(Long anotherLong), int compareTo(Short anotherShort)

Methods Implemented by all Subclasses of Number

- boolean equals(Object obj)
  - Determines wheter this number object is equal to the argument.
  - The methods return true if the argument is not null and is an object of the same type and with the same numeric value.
  - There are some extra requirements for Double and Float objects that are described in the Java API documentation.
  - Each Number class contains other methods that are useful for converting numbers to and from strings and for converting between number systems.

Conversion Methods, Integer Class

Method	Description
static Integer decode(String s)	Decodes a string into an integer. Can accept string representations of decimal, octal, or hexadecimal numbers as input.
static int parseInt(String s)	Returns an integer (decimal only).
static int parseInt(String s, int radix)	Returns an integer, given a string representation of decimal, binary, octal, or hexadecimal (radix equals 10, 2, 8, or 16 respectively) numbers as input.
String toString()	Returns a String object representing the value of this Integer.
static String toString(int i)	Returns a String object representing the specified integer.
static Integer valueOf(int i)	Returns an Integer object holding the value of the specified primitive.
static Integer valueOf(String s)	Returns an Integer object holding the value of the specified string representation.
static Integer valueOf(String s, int radix)	Returns an Integer object holding the integer value of the specified string representation, parsed with the value of radix. For example, if s = "333" and radix = 8, the method returns the base-ten integer equivalent of the octal number 333.

Formatting Numeric Print Output

- We can use the methods print and println to print out an arbitrary mixture of strings and numbers.
- The Java programming language has other methods, allow you to exercise much more control over your print output when numbers are included.
- The java.io package includes a PrintStream class that has two formatting methods that you can use to replace print and println.
- These methods, format and printf, are equivalent to one another.

Formatting Numeric Print Output

- The familiar System.out that you have been using happens to be a PrintStream object, so you can invoke PrintStream methods on System.out.

```
public final class System {
    static PrintStream out;
    static PrintStream err;
    static InputStream in;
    ...
}
public class PrintStream extends FilterOutputStream {
   //out object is inherited from FilterOutputStream class public void
   println() {
      ...
   }
}
```

Formatting Numeric Print Output

- You can use format or printf anywhere in your code where you have previously been using print or println.
- The syntax for these two java.io.PrintStream methods is the same:

  public PrintStream format(String *format*, Object... *args*)

  where *format* is a string that specifies the formatting to be used,

  and *args* is a list of the variables to be printed using that formatting.
- System.out.format("The value of " + "the float variable is " + "%f, while the value of the " + "integer variable is %d, " + "and the string is %s", floatVar, intVar, stringVar);

The printf and format Methods

- The first parameter, format, is a format string specifying how the objects in the second parameter, args, are to be formatted;
  - Format specifiers begin with a percent sign (%) and end with a converter.
  - The converter is a character indicating the type of argument to be formatted.
  - In between the percent sign (%) and the converter you can have optional flags and specifiers.
  - There are many converters, flags, and specifiers, which are documented in java.util.Formatter.

Example

Here is a basic example:

```
int i = 461012;
System.out.format("The value of i is: %d%n", i);
```

The %d specifies that the single variable is a decimal integer. The %n is a platform-independent newline character. The output is:

```
The value of i is: 461012
```

The printf and format Methods

- The printf and format methods are overloaded. Each has a version with the following syntax:

  public PrintStream format(Locale l, String format, Object... args)

The printf and format Methods

Converter	Flag	Explanation
d		A decimal integer.
f		A float.
n		A new line character appropriate to the platform running the application. You should always use %n, rather than \n.
tB		A date & time conversion—locale-specific full name of month.
td, te		A date & time conversion—2-digit day of month. td has leading zeroes as needed, te does not.
ty, tY		A date & time conversion—ty = 2-digit year, tY = 4-digit year.
tl		A date & time conversion—hour in 12-hour clock.
tM		A date & time conversion—minutes in 2 digits, with leading zeroes as necessary.
tp		A date & time conversion—locale-specific am/pm (lower case).
tm		A date & time conversion—months in 2 digits, with leading zeroes as necessary.
tD		A date & time conversion—date as %tm%td%ty
	08	Eight characters in width, with leading zeroes as necessary.
	+	Includes sign, whether positive or negative.
	,	Includes locale-specific grouping characters.
	-	Left-justified..
	.3	Three places after decimal point.
	10.3	Ten characters in width, right justified, with three places after decimal point.

Example

```
import java.util.Calendar;
import java.util.Locale;
public class TestFormat {
    public static void main(String[] args) {
        long n = 461012;
        System.out.format("%d%n", n);      //  -->  "461012"
        System.out.format("%08d%n", n);    //  -->  "00461012"
        System.out.format("%+8d%n", n);    //  -->  " +461012"
        System.out.format("%,8d%n", n);    // -->  " 461,012"
        System.out.format("%+,8d%n%n", n); //  -->  "+461,012"
        double pi = Math.PI;
        System.out.format("%f%n", pi);       // -->  "3.141593"
        System.out.format("%.3f%n", pi);     // -->  "3.142"
        System.out.format("%10.3f%n", pi);   // -->  "     3.142"
        System.out.format("%-10.3f%n", pi);  // -->  "3.142"
```

Example

```
    System.out.format(Locale.FRANCE, %-10.4f%n%n", pi); // -->  "3,1416"
    Calendar c = Calendar.getInstance();
    System.out.format("%tB %te, %tY%n", c, c, c); // -->  "May 29, 2006"
    System.out.format("%tl:%tM %tp%n", c, c, c);  // -->  "2:34 am"
    System.out.format("%tD%n", c);    // -->  "05/29/06
  }
}
```

The DecimalFormat Class

- You can use the java.text.DecimalFormat class to control the display of leading and trailing zeros, prefixes and suffixes, grouping (thousands) separators, and the decimal separator.
- DecimalFormat offers a great deal of flexibility in the formatting of numbers, but it can make your code more complex.

Example

```
import java.text.*;
public class DecimalFormatDemo {
  static public void customFormat(String pattern, double value ) {
    DecimalFormat myFormatter = new DecimalFormat(pattern);
    String output = myFormatter.format(value);
    System.out.println(value + "  " + pattern + "  " + output);
  }
  static public void main(String[] args) {
    customFormat("###,###.###", 123456.789);
    customFormat("###.##", 123456.789);
    customFormat("000000.000", 123.78);
    customFormat("$###,###.###", 12345.67);
  }
}
```

The output is:

```
123456.789  ###,###.###  123,456.789
123456.789  ###.##  123456.79
123.78  000000.000  000123.780
12345.67  $###,###.###  $12,345.67
```

Beyond Basic Arithmetic

- The Java programming language supports basic arithmetic with its arithmetic operators: +, -, *, /, and %.
- The Math class in the java.lang package provides methods and constants for doing more advanced mathematical computation.
- The methods in the Math class are all static, so you call them directly from the class, like this:

```
Math.cos(angle);
```

Constants and Basic Methods

The Math class includes two constants:

- Math.E, which is the base of natural logarithms, and
- Math.PI, which is the ratio of the circumference of a circle to its diameter.

Basic Math Methods

Method	Description
double abs(double d) float abs(float f) int abs(int i) long abs(long lng)	Returns the absolute value of the argument.
double ceil(double d)	Returns the smallest integer that is greater than or equal to the argument. Returned as a double.
double floor(double d)	Returns the largest integer that is less than or equal to the argument. Returned as a double.
double rint(double d)	Returns the integer that is closest in value to the argument. Returned as a double.
long round(double d) int round(float f)	Returns the closest long or int, as indicated by the method's return type, to the argument.
double min(double arg1, double arg2) float min(float arg1, float arg2) int min(int arg1, int arg2) long min(long arg1, long arg2)	Returns the smaller of the two arguments.
double max(double arg1, double arg2) float max(float arg1, float arg2) int max(int arg1, int arg2) long max(long arg1, long arg2)	Returns the larger of the two arguments.

Exponential and Logarithmic Methods

Method	Description
double exp(double d)	Returns the base of the natural logarithms, e, to the power of the argument.
double log(double d)	Returns the natural logarithm of the argument.
double pow(double base, double exponent)	Returns the value of the first argument raised to the power of the second argument.
double sqrt(double d)	Returns the square root of the argument.

Trigonometric Methods

Method	Description
double sin(double d)	Returns the sine of the specified double value.
double cos(double d)	Returns the cosine of the specified double value.
double tan(double d)	Returns the tangent of the specified double value.
double asin(double d)	Returns the arcsine of the specified double value.
double acos(double d)	Returns the arccosine of the specified double value.
double atan(double d)	Returns the arctangent of the specified double value.
double atan2(double y, double x)	Converts rectangular coordinates (x, y) to polar coordinate (r, theta) and returns theta.
double toDegrees(double d) double toRadians(double d)	Converts the argument to degrees or radians.

Random Numbers

- The random() method returns a pseudo-randomly selected number between 0.0 and 1.0.
- To get a number in a different range, you can perform arithmetic on the value returned by the random method. For example, to generate an integer between 0 and 9, you would write:

```
int number = (int) (Math.random() * 10);
```

- By multiplying the value by 10, the range of possible values becomes 0.0 <= number < 10.0.

Random Numbers

- Using Math.random works well when you need to generate a single random number.
- If you need to generate a series of random numbers, you should create an instance of java.util.Random and invoke methods on that object to generate numbers.

Summary of Numbers

- You use one of the wrapper classes – Byte, Double, Float, Integer, Long, or Short – to wrap a number of primitive type in an object.
- The Java compiler automatically wraps (boxes) primitives for you when necessary and unboxes them, again when necessary.
- The Number classes include constants and useful class methods.
  - The MIN_VALUE and MAX_VALUE constants contain the smallest and largest values that can be contained by an object of that type.
- The byteValue, shortValue, and similar methods convert one numeric type to another.
- The valueOf method converts a string to a number, and the toString method converts a number to a string.

Summary of Numbers

- To format a string containing numbers for output, you can use the printf() or format() methods in the PrintStream class.
- Alternatively, you can use the NumberFormat class to customize numerical formats using patterns.
- The Math class contains a variety of class methods for performing mathematical functions, including exponential, logarithmic, and trigonometric methods.
- Math also includes basic arithmetic functions, such as absolute value and rounding, and a method, random(), for generating random numbers.

Characters

Most of the time, if you are using a single character value, you will use the primitive char type. For example:

```
char ch = 'a';
 // Unicode for uppercase Greek omega character
char uniChar = '\u03A9';
// an array of chars
char[] charArray = { 'a', 'b', 'c', 'd', 'e' };
```

Characters

- There are times, however, when you need to use a char as an object—for example, as a method argument where an object is expected.
- The Java programming language provides a *wrapper* class that "wraps" the char in a Character object for this purpose.
- An object of type Character contains a single field, whose type is char.
- This Character class also offers a number of useful class (i.e., static) methods for manipulating characters.
- You can create a Character object with the Character constructor:

```
Character ch = new Character('a');
```

Characters

- The Java compiler will also create a Character object for you under some circumstances.
- For example, if you pass a primitive char into a method that expects an object, the compiler automatically converts the char to a Character for you. This feature is called autoboxing—or unboxing,
- The Character class is immutable, so that once it is created, a Character object cannot be changed.

Useful Methods in the Character Class

Method	Description
boolean isLetter(char ch) boolean isDigit(char ch)	Determines whether the specified char value is a letter or a digit, respectively.
boolean isWhitespace(char ch)	Determines whether the specified char value is white space.
boolean isUpperCase(char ch) boolean isLowerCase(char ch)	Determines whether the specified char value is uppercase or lowercase, respectively.
char toUpperCase(char ch) char toLowerCase(char ch)	Returns the uppercase or lowercase form of the specified char value.
toString(char ch)	Returns a String object representing the specified character value — that is, a one-character string.

Escape Sequences

Escape Sequence	Description
\t	Insert a tab in the text at this point.
\b	Insert a backspace in the text at this point.
\n	Insert a newline in the text at this point.
\r	Insert a carriage return in the text at this point.
\f	Insert a formfeed in the text at this point.
\'	Insert a single quote character in the text at this point.
\"	Insert a double quote character in the text at this point.
\\	Insert a backslash character in the text at this point.

Example

- When an escape sequence is encountered in a print statement, the compiler interprets it accordingly.
- For example, if you want to put quotes within quotes you must use the escape sequence, \", on the interior quotes.
- To print the sentence

  She said "Hello!" to me.

  you would write

```
System.out.println("She said \"Hello!\" to me.");
```

Strings

- Strings, which are widely used in Java programming, are a sequence of characters.
- In the Java programming language, strings are objects.
- The most direct way to create a string is to write:

```
String greeting = "Hello world!";
```

- You can create String objects by using the new keyword and a constructor.
- The String class has thirteen constructors that allow you to provide the initial value of the string using different sources, such as an array of characters:

```
char[] helloArray = { 'h', 'e', 'l', 'l', 'o', '.' };
String helloString = new String(helloArray);
System.out.println(helloString);
```

Strings

- The String class is immutable, so that once it is created a String object cannot be changed.
- The String class has a number of methods that appear to modify strings.
- Since strings are immutable, what these methods really do is create and return a new string that contains the result of the operation.

String Length

- Methods used to obtain information about an object are known as accessor methods.
- One accessor method that you can use with strings is the length() method, which returns the number of characters contained in the string object.

```
String palindrome = "Dot saw I was Tod";
int len = palindrome.length();
```

Example

```
public class StringDemo {
   public static void main(String[] args) {
      String palindrome = "Dot saw I was Tod";
      int len = palindrome.length();
      char[] tempCharArray = new char[len];
      char[] charArray = new char[len];

      // put original string in an  array of chars
      for (int i = 0; i < len; i++) {
         tempCharArray[i] =  palindrome.charAt(i);
      }
      // reverse array of chars
      for (int j = 0; j < len; j++) {
         charArray[j] =  tempCharArray[len - 1 - j];
      }
      String reversePalindrome =  new String(charArray);
      System.out.println(reversePalindrome);
   }
}
```

Strings

- The String class includes a method, getChars(), to convert a string, or a portion of a string, into an array of characters so we could replace the first for loop in the program above with

```
palindrome.getChars(0, len, tempCharArray, 0);
```

Concatenating Strings

- The String class includes a method for concatenating two strings:

  ```
  string1.concat(string2);
  ```

- This returns a new string that is string1 with string2 added to it at the end.
- You can also use the concat() method with string literals, as in:

  ```
  "My name is ".concat("Rumplestiltskin");
  ```

- Strings are more commonly concatenated with the + operator, as in

  ```
  "Hello," + " world" + "!"
  ```

  which results in

  ```
  "Hello, world!"
  ```

Concatenating Strings

- The + operator is widely used in print statements. For example:

  String string1 = "saw I was ";

- System.out.println("Dot " + string1 + "Tod"); which prints

  Dot saw I was Tod

- Such a concatenation can be a mixture of any objects. For each object that is not a String, its toString() method is called to convert it to a String.

Concatenating Strings

- The Java programming language does not permit literal strings to span lines in source files, so you must use the + concatenation operator at the end of each line in a multi-line string. For example:

```
String quote =
    "Now is the time for all good " +
    "men to come to the aid of their country. "
```

- Breaking strings between lines using the + concatenation operator is, once again, very common in print statements.

Creating Format Strings

```
System.out.printf("The value of the float " +
                  "variable is %f, while " +
                  "the value of the " +
                  "integer variable is %d, " +
                  "and the string is %s",
                  floatVar, intVar, stringVar);
String fs;
fs = String.format("The value of the float " +
                   "variable is %f, while " +
                   "the value of the " +
                   "integer variable is %d, " +
                   " and the string is %s",
                   floatVar, intVar, stringVar);
```

Converting Strings to Numbers

- The Number subclasses that wrap primitive numeric types (Byte, Integer, Double, Float, Long, and Short) each provide a class method named valueOf that converts a string to an object of that type.

Example

```
public class ValueOfDemo {
   public static void main(String[] args) {
      // this program requires two arguments on the command line
      if (args.length == 2) {
         // convert strings to numbers
         float a = (Float.valueOf(args[0])).floatValue();
         float b = (Float.valueOf(args[1])).floatValue();
         // do some arithmetic
         System.out.println("a + b = " +  (a + b));
         System.out.println("a - b = " +   (a - b));
      } else {
         System.out.println("This program " +
            "requires two command-line arguments.");
      }
   }
}
```

Converting Strings to Numbers

- Each of the Number subclasses that wrap primitive numeric types also provides a parseXXXX() method (for example, parseFloat()) that can be used to convert strings to primitive numbers.
- Since a primitive type is returned instead of an object, the parseFloat() method is more direct than the valueOf() method. For example, in the ValueOfDemo program, we could use:

```
float a = Float.parseFloat(args[0]);
float b = Float.parseFloat(args[1]);
```

Converting Numbers to Strings

There are several easy ways to convert a number to a string:

```
int i;
// Concatenate "i" with an empty string; conversion is handled for you.
String s1 = "" + i;
```

or

```
// The valueOf class method.
String s2 = String.valueOf(i);
```

Converting Numbers to Strings

Each of the Number subclasses includes a class method, toString(), that will convert its primitive type to a string. For example:

```
int i;
double d;
String s3 = Integer.toString(i);
String s4 = Double.toString(d);
```

Example

```
public class ToStringDemo {
    public static void main(String[] args) {
        double d = 858.48;
        String s = Double.toString(d);
        int dot = s.indexOf('.');
        System.out.println(dot + " digits " +
            "before decimal point.");
        System.out.println( (s.length() - dot - 1) +
            " digits after decimal point.");
    }
}
```

The output of this program is:
3 digits before decimal point.
2 digits after decimal point.

Getting Characters and Substrings by Index

- You can get the character at a particular index within a string by invoking the charAt() accessor method.
- The index of the first character is 0, while the index of the last character is length()-1. For example, the following code gets the character at index 9 in a string:

```
String anotherPalindrome = "Niagara. O roar again!";
char aChar = anotherPalindrome.charAt(9);
```

The substring Methods in the String Class

Method	Description
String substring(int beginIndex, int endIndex)	Returns a new string that is a substring of this string. The first integer argument specifies the index of the first character. The second integer argument is the index of the last character - 1.
String substring(int beginIndex)	Returns a new string that is a substring of this string. The integer argument specifies the index of the first character. Here, the returned substring extends to the end of the original string.

Other Methods in the String Class for Manipulating Strings

Method	Description
String[] split(String regex) String[] split(String regex, int limit)	Searches for a match as specified by the string argument (which contains a regular expression) and splits this string into an array of strings accordingly. The optional integer argument specifies the maximum size of the returned array.
CharSequence subSequence(int beginIndex, int endIndex)	Returns a new character sequence constructed from beginIndex index up until endIndex - 1.
String trim()	Returns a copy of this string with leading and trailing white space removed.
String toLowerCase() String toUpperCase()	Returns a copy of this string converted to lowercase or uppercase. If no conversions are necessary, these methods return the original string.

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Searching for Characters and Substrings in a String

Method	Description
int indexOf(int ch) int lastIndexOf(int ch)	Returns the index of the first (last) occurrence of the specified character.
int indexOf(int ch, int fromIndex) int lastIndexOf(int ch, int fromIndex)	Returns the index of the first (last) occurrence of the specified character, searching forward (backward) from the specified index.
int indexOf(String str) int lastIndexOf(String str)	Returns the index of the first (last) occurrence of the specified substring.
int indexOf(String str, int fromIndex) int lastIndexOf(String str, int fromIndex)	Returns the index of the first (last) occurrence of the specified substring, searching forward (backward) from the specified index.
boolean contains(CharSequence s)	Returns true if the string contains the specified character sequence.

CharSequence is an interface that is implemented by the String class. Therefore, you can use a string as an argument for the contains() method

Replacing Characters and Substrings into a String

Method	Description
String replace(char oldChar, char newChar)	Returns a new string resulting from replacing all occurrences of oldChar in this string with newChar.
String replace(CharSequence target, CharSequence replacement)	Replaces each substring of this string that matches the literal target sequence with the specified literal replacement sequence.
String replaceAll(String regex, String replacement)	Replaces each substring of this string that matches the given regular expression with the given replacement.
String replaceFirst(String regex, String replacement)	Replaces the first substring of this string that matches the given regular expression with the given replacement.

Comparing Strings and Portions of Strings

Method	Description
boolean endsWith(String suffix) boolean startsWith(String prefix)	Returns true if this string ends with or begins with the substring specified as an argument to the method.
boolean startsWith(String prefix, int offset)	Considers the string beginning at the index offset, and returns true if it begins with the substring specified as an argument.
int compareTo(String anotherString)	Compares two strings lexicographically. Returns an integer indicating whether this string is greater than (result is > 0), equal to (result is = 0), or less than (result is < 0) the argument.
int compareToIgnoreCase(String str)	Compares two strings lexicographically, ignoring differences in case. Returns an integer indicating whether this string is greater than (result is > 0), equal to (result is = 0), or less than (result is < 0) the argument.
boolean equals(Object anObject)	Returns true if and only if the argument is a String object that represents the same sequence of characters as this object.

Comparing Strings and Portions of Strings

Method	Description
boolean equalsIgnoreCase(String anotherString)	Returns true if and only if the argument is a String object that represents the same sequence of characters as this object, ignoring differences in case.
boolean regionMatches(int toffset, String other, int ooffset, int len)	Tests whether the specified region of this string matches the specified region of the String argument. Region is of length len and begins at the index toffset for this string and ooffset for the other string.
boolean regionMatches(boolean ignoreCase, int toffset, String other, int ooffset, int len)	Tests whether the specified region of this string matches the specified region of the String argument. Region is of length len and begins at the index toffset for this string and ooffset for the other string. The boolean argument indicates whether case should be ignored; if true, case is ignored when comparing characters.
boolean matches(String regex)	Tests whether this string matches the specified regular expression.

Example(1)

```
public class RegionMatchesDemo {
   public static void main(String[] args) {
      String searchMe = "Green Eggs and Ham";
      String findMe = "Eggs";
      int searchMeLength = searchMe.length();
      int findMeLength = findMe.length();
      boolean foundIt = false;
      for (int i = 0;  i <= (searchMeLength - findMeLength);   i++) {
        if (searchMe.regionMatches(i, findMe, 0, findMeLength)) {
          foundIt = true;
          System.out.println(searchMe.substring(i, i + findMeLength));
          break;
        }
      }
      if (!foundIt)
         System.out.println("No match found.");
   }
}
```

Example(2)

```
public class Test {
  public static void main(String[] args) {
    String s1 = "hello"; String s2 = "world";
    String s3 = "hello";
    System.out.println(s1 == s3); //true

    s1 = new String ("hello");
    s2 = new String("hello");
    System.out.println(s1 == s2); //false
    System.out.println(s1.equals(s2)); //true

    char c[]= {'s','u','n',' ','j','a','v','a'};
    String s4 = new String(c);
    String s5 = new String(c,4,4);
    System.out.println(s4); //sun java
    System.out.println(s5); //java
  }
}
```

Example(3)

```
public class Test {
  public static void main(String[] args) {
    String s1 = "sun java",s2 = "Sun Java";
    System.out.println(s1.charAt(1));//u
    System.out.println(s2.length());//8
    System.out.println(s1.indexOf("java"));//4
    System.out.println(s1.indexOf("Java"));//-1
    System.out.println(s1.equals(s2));//false
    System.out.println(s1.equalsIgnoreCase(s2));
    //true

    String s = "我是程序员，我在学java";
    String sr = s.replace('我','你');
    System.out.println(sr);
    //你是程序员，你在学java
  }
}
```

Example(4)

```
public class Test {
  public static void main(String[] args) {
    String s = "Welcome to Java World!";
    String s1 = "  sun java   " ;
    System.out.println(s.startsWith("Welcome"));
    //true
    System.out.println(s.endsWith("World"));
    //false
    String sL = s.toLowerCase();
    String sU = s.toUpperCase();
    System.out.println(sL);
    //welcome to java world!
    System.out.println(sU);
    //WELCOME TO JAVA WORLD!
    String subS = s.substring(11);
    System.out.println(subS);//Java World!
    String sp = s1.trim();
    System.out.println(sp);//sun java
  }
}
```

Example(5)

```
public class Test {
    public static void main(String[] args) {
      int j = 1234567;
      String sNumber = String.valueOf(j);
      System.out.println
          ("j 是"+sNumber.length()+"位数。");
      String s = "Mary,F,1976";
      String[] sPlit = s.split(",");
      for(int i=0;i<sPlit.length;i++) {
          System.out.println(sPlit[i]);
      }
    }
}
```

Output:
J是7位数
Mary
F
1976

The StringBuilder Class

- StringBuilder objects are like String objects, except that they can be modified.
- Internally, these objects are treated like variable-length arrays that contain a sequence of characters.
- At any point, the length and content of the sequence can be changed through method invocations.
- Strings should always be used unless string builders offer an advantage in terms of simpler or better performance.
  - For example, if you need to concatenate a large number of strings, appending to a StringBuilder object is more efficient.

Length and Capacity

- The StringBuilder class, like the String class, has a length() method that returns the length of the character sequence in the builder.
- Unlike strings, every string builder also has a capacity, the number of character spaces that have been allocated.
- The capacity, which is returned by the capacity() method, is always greater than or equal to the length (usually greater than) and will automatically expand as necessary to accommodate additions to the string builder.

StringBuilder Constructors

Constructor	Description
StringBuilder()	Creates an empty string builder with a capacity of 16 (16 empty elements).
StringBuilder(CharSequence cs)	Constructs a string builder containing the same characters as the specified CharSequence, plus an extra 16 empty elements trailing the CharSequence.
StringBuilder(int initCapacity)	Creates an empty string builder with the specified initial capacity.
StringBuilder(String s)	Creates a string builder whose value is initialized by the specified string, plus an extra 16 empty elements trailing the string.

Length and Capacity

```
// creates empty builder, capacity 16
StringBuilder sb = new StringBuilder();
// adds 9 character string at beginning
sb.append("Greetings");
```

will produce a string builder with a length of 9 and a capacity of 16:

- A string builder's length is the number of characters it contains;
- A string builder's capacity is the number of character spaces that have been allocated.

Length and Capacity Methods

Method	Description
void setLength(int newLength)	Sets the length of the character sequence. If newLength is less than length(), the last characters in the character sequence are truncated. If newLength is greater than length(), null characters are added at the end of the character sequence.
void ensureCapacity(int minCapacity)	Ensures that the capacity is at least equal to the specified minimum.

Length and Capacity Methods

- A number of operations (for example, append(), insert(), or setLength()) can increase the length of the character sequence in the string builder so that the resultant length() would be greater than the current capacity().
- When this happens, the capacity is automatically increased.

StringBuilder Operations

- The principal operations on a StringBuilder that are not available in String are the append() and insert() methods, which are overloaded so as to accept data of any type.
- Each converts its argument to a string and then appends or inserts the characters of that string to the character sequence in the string builder.
- The append method always adds these characters at the end of the existing character sequence, while the insert method adds the characters at a specified point.

Various StringBuilder Methods

Method	Description
StringBuilder append(boolean b) StringBuilder append(char c) StringBuilder append(char[] str) StringBuilder append(char[] str, int offset, int len) StringBuilder append(double d) StringBuilder append(float f) StringBuilder append(int i) StringBuilder append(long lng) StringBuilder append(Object obj) StringBuilder append(String s)	Appends the argument to this string builder. The data is converted to a string before the append operation take

Various StringBuilder Methods

Method	Description
StringBuilder delete(int start, int end) StringBuilder deleteCharAt(int index)	The first method deletes the subsequence from start to end-1 (inclusive) in the StringBuilder's char sequence. The second method deletes the character located at index.

Various StringBuilder Methods

Method	Description
StringBuilder insert(int offset, boolean b) StringBuilder insert(int offset, char c) StringBuilder insert(int offset, char[] str) StringBuilder insert(int index, char[] str, int offset, int len) StringBuilder insert(int offset, double d) StringBuilder insert(int offset, float f) StringBuilder insert(int offset, int i) StringBuilder insert(int offset, long lng) StringBuilder insert(int offset, Object obj) StringBuilder insert(int offset, String s)	Inserts the second argument into the string builder. The first integer argument indicates the index before which the data is to be inserted. The data is converted to a string before the insert operation takes place。

Various StringBuilder Methods

StringBuilder replace(int start, int end, String s) void setCharAt(int index, char c)	Replaces the specified character(s) in this string builder.
StringBuilder reverse()	Reverses the sequence of characters in this string builder.
String toString()	Returns a string that contains the character sequence in the builder.

Various StringBuilder Methods

- You can use any String method on a StringBuilder object by first converting the string builder to a string with the toString() method of the StringBuilder class.
- Then convert the string back into a string builder using the StringBuilder(String str) constructor.

Example

```
public class StringBuilderDemo {
    public static void main(String[] args) {
        String palindrome = "Dot saw I was Tod";
        StringBuilder sb = new StringBuilder(palindrome);
        sb.reverse();  // reverse it
        System.out.println(sb);
    }
}
```

StringBuffer

- There is also a StringBuffer class that is exactly the same as the StringBuilder class, except that it is thread-safe by virtue of having its methods synchronized.

Summary of Characters and Strings

- Most of the time, if you are using a single character value, you will use the primitive char type.
- There are times, however, when you need to use a char as an object—for example, as a method argument where an object is expected.
- The Java programming language provides a wrapper class that "wraps" the char in a Character object for this purpose.
- An object of type Character contains a single field whose type is char.
- This Character class also offers a number of useful class (i.e., static) methods for manipulating characters.

Summary of Characters and Strings

- Strings are a sequence of characters and are widely used in Java programming.
- In the Java programming language, strings are objects.
- The String class has over 60 methods and 13 constructors.
- Most commonly, you create a string with a statement like

  ```
  String s = "Hello world!";
  ```

  rather than using one of the String constructors.
- The String class has many methods to find and retrieve substrings; these can then be easily reassembled into new strings using the + concatenation operator.

Summary of Characters and Strings

- The String class also includes a number of utility methods, among them split(), toLowerCase(), toUpperCase(), and valueOf().
- The latter method is indispensable in converting user input strings to numbers.
- The Number subclasses also have methods for converting strings to numbers and vice versa.

Summary of Characters and Strings

- In addition to the String class, there is also a StringBuilder class. Working with StringBuilder objects can sometimes be more efficient than working with strings.
- The StringBuilder class offers a few methods that can be useful for strings, among them reverse().
- In general, however, the String class has a wider variety of methods.
- A string can be converted to a string builder using a StringBuilder constructor.
- A string builder can be converted to a string with the toString() method.

Autoboxing and Unboxing

- Autoboxing is the automatic conversion that the Java compiler makes between the primitive types and their corresponding object wrapper classes. For example, converting an int to an Integer, a double to a Double, and so on.
- If the conversion goes the other way, this is called unboxing.
- Here is the simplest example of autoboxing:

```
Character ch = 'a';
```

Autoboxing

```
List<Integer> li = new ArrayList<>();
for (int i = 1; i < 50; i += 2)
  li.add(Integer.valueOf(i));
```

- Converting a primitive value (an int, for example) into an object of the corresponding wrapper class (Integer) is called autoboxing.
- The Java compiler applies autoboxing when a primitive value is:
  - Passed as a parameter to a method that expects an object of the corresponding wrapper class.
  - Assigned to a variable of the corresponding wrapper class.

Example

```
public static int sumEven(List<Integer> li) {
    int sum = 0;
    for (Integer i: li)
        if (i % 2 == 0)
            sum += i;
        return sum;
}
```

The compiler invokes the intValue method to convert an Integer to an int at runtime:

```
public static int sumEven(List<Integer> li) {
    int sum = 0;
    for (Integer i : li)
        if (i.intValue() % 2 == 0)
            sum += i.intValue();
        return sum;
}
```

Unboxing

- Converting an object of a wrapper type (Integer) to its corresponding primitive (int) value is called unboxing.
- The Java compiler applies unboxing when an object of a wrapper class is:
  - Passed as a parameter to a method that expects a value of the corresponding primitive type.
  - Assigned to a variable of the corresponding primitive type.

Example

```
import java.util.ArrayList;
import java.util.List;
public class Unboxing {
   public static void main(String[] args) {
      Integer i = new Integer(-8);
      // 1. Unboxing through method invocation
      int absVal = absoluteValue(i);
      System.out.println("absolute value of " + i + " = " + absVal);
      List<Double> ld = new ArrayList<>();
      ld.add(3.1416);    // Π is autoboxed through method invocation.
      // 2. Unboxing through assignment
      double pi = ld.get(0);
      System.out.println("pi = " + pi);
   }
```

Output:
absolute value of -8 = 8
pi = 3.1416

Autoboxing and unboxing

Primitive type	Wrapper class
boolean	Boolean
byte	Byte
char	Character
float	Float
int	Integer
long	Long
short	Short
double	Double