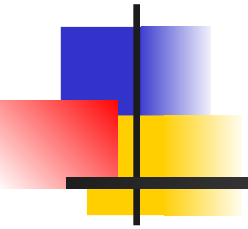


Characters and Strings

James Brucker

Characters

- **`char`** is 2-bytes.
- Java uses Unicode to represent characters.
- Java *does* *not* use Unicode for reading/writing to files unless you tell it to.

```
char c = 'A';
char at = '@';
char gai = 'ก';    // Thai letter
char z = 'a'+25;   // 'z', increment using int
int  n = 'A';      // n = 65
```

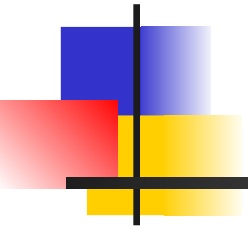
Useful Character Methods

c is a char:

```
boolean Character.isLetter( c )

boolean Character.isDigit( c )

boolean Character.isLetterOrDigit( c )

boolean Character.isLowerCase( c )

char Character.toLowerCase( c )

char Character.toUpperCase( c )

boolean Character.isWhitespace( c )

int Character.getNumericValue( '3' ) --> 3
```

Useful Character Methods

```
String message = "I am trapped in a computer";
char [ ] c = message.toCharArray( );
// c[0]='I', c[1]=' ', c[2]='a', c[3]='m' ...

for(int k=0; k < c.length; k++ ) {
  if ( Character.isLetter( c[k] ) )
       /* c[k] is letter */;
  else if ( Character.isDigit( c[k] ) )
       /* c[k] is a digit 0 ... 9 */;
  else if ( Character.isWhitespace( c[k] ) )
       /* c[k] is space, tab, or newline */;
}
```



Useful String Methods

Useful for Many Text Processing Applications
including the Caesar Cipher problem

Useful String Methods

string.indexOf(char) returns the position of char in the String.

-1 if char is not found in string.

```
String ALPHABET = "ABCDEFGHIJKLMNOPQRSTUVWXYZ";
char c = 'G';
int n = ALPHABET.indexOf( c ); // = 7
```

string.length( ) returns the length of the String.

```
String ALPHABET = "ABCDEFGHIJKLMNOPQRSTUVWXYZ";
int n = ALPHABET.length( ); // = 26
```

string.charAt(k) returns the character at position k (starts at k = 0)

```
String ALPHABET = "ABCDEFGHIJKLMNOPQRSTUVWXYZ";
ALPHABET.charAt( 3 ); // = 'd'
```

Useful String Comparisons

a.equalsIgnoreCase(b) returns true if a and b have same value, ignoring case of letters.

```
String answer = console.next();

if (answer.equalsIgnoreCase("yes")) ...
```

a.compareTo(b) lexical comparison of strings

```
if ("cat".compareTo("dog") < 0)
    print("cat comes before dog");
```

a.compareToIgnoreCase(b) like compareTo ignoring case of letters

```
if ("cat".compareToIgnoreCase("DOG") < 0)
    print("cat comes before DOG");
```

String toCharArray

Problem:

You want to process each character in a string.

Solution:

convert String to a character array

process each character

make a new string from the result

```
String message = "I am trapped in a computer";
// convert String to array of char
char [] c = message.toCharArray( );
// process each character:
for(k=0; k< c.length; k++) c[k] = ...;
// put the result in a new String
String result = new String( c );
```

How to Create a Formatted String

- You can format output using:

  `System.out.printf(` "*format string*", arg1, arg2, ...);

- Example:

```
System.out.printf("p = (%5.2f,%5.2f)\n", x, y);
```

  for x = 12.345, y = 11.519, this prints:

```
p = (12.34,11.52)
```

- System.out.printf( ) is an alias for System.out.format( ) which uses the java.util.Formatter class to format output.
- See Javadoc for Formatter for complete list of format codes and examples.

Using Formatter Objects

- Suppose we have a Point class for 2-dimensional points. We want toString( ) to return a nicely formatted "(x,y)" for the point's coordinates.

```
private double x, y;  // coordinates of the point

Formatter result = new Formatter( );
// use the format( ) method like printf( )
result.format("(%.2f, %.2f)", x, y );
// convert result to a String and return it
String s = result.out( ).toString( );
```

```
// Easier

String s = String.format("(%.2f, %.2f)", x, y);
```

Formatter Methods

`format("`*`format string`*`", obj1, ...)`

format the objects using the format string and *append* to the format object's *Appendable* attribute.

`out( )`

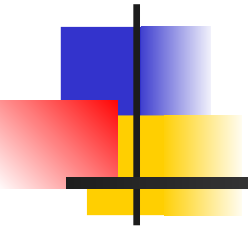
return the contents of the Formatter object as an *Appendable* object.

`out( ).toString( )`

convert the contents of the Formatter object to a String.

Appendable is a Java 1.5 interface for character sequences that can be appended to. Classes the implement ***Appendable*** are StringBuffer, StringBuilder, CharBuffer, PrintStream, StringWriter, ...

The **String** class is **not** *Appendable ! (Strings are immutable.)*



String Types

There is more than one way to store a String.

If you want to append to or modify a String, use a StringBuilder or StringBuffer.

String is Immutable

You can't change a String after it is created.

```
String s = "hello";
s = s + " there";
        // "+" creates a new string.  Old string is now garbage.
s = s + " class";
        // "+" creates another new String
s = s.toLowerCase( );
        // creates another new String
```

Lesson: using "+" to build strings is inefficient/

Can be an issue in Web Servlets that create HTML as strings.

StringBuffer is a mutable String

- StringBuffer and StringBuilder are two classes that "build" strings.
- You can modify and append to them.

```
StringBuffer sb = new StringBuffer( );

sb.append("hello");  // append to same buffer

sb.append(" there"); // doesn't create new objects

sb.append(" class");

// now we are done. Convert to a String for output or return

String s = sb.toString;
```

Exercise: compare run times

1. Choose a text file of size 10KB - 100KB.
2. Open the file as a FileInputStream.
3. Time how long it takes to read file into a String:
    a) Read the file 1 byte at a time using inputStream.read( )
    b) Append each byte to a String
4. Display the time required and the length of String.

Exercise: part 2

1. Repeat previous steps using StringBuffer instead of String.
2. Append each byte using StringBuffer.append( )

StringBuffer or StringBuilder?

- StringBuilder and StringBuffer are nearly the same.
- StringBuffer is *thread safe*, StringBuilder is not.
- Being "thread safe" makes StringBuffer *slower*.
- For a single threaded application, prefer StringBuilder.