AP Computer Science
Two Meanings of Plus

In Java, the symbol + can be used to add numbers or to concatenate strings. This exercise illustrates both uses.

When using a **string literal** (a sequence of characters enclosed in double quotation marks) in Java the complete string must fit on one line. The following is NOT legal, it would result in a compile-time error. Try it in Eclipse.

```
System.out.println ("It is NOT okay to go to the next line
                     in a LONG string!!!");
```

The solution is to break the long string up into two shorter strings that are joined using the **concatenation** operator (which is the + symbol). This is discussed in Section 2.1 in the text. So the following would be legal

```
System.out.println ("It is OKAY to break a long string into " +
                    "parts and join them with a + symbol.");
```

So, when working with string literals the + symbol means to concatenate the strings (join them). BUT, when working with numbers the + means what it has always meant—add!

1. **Observing the Behavior of +**
   To see the behavior of + in different settings do the following:

   a. Study the program below, *PlusTest.java*, which is provided in the Google classroom.

```
/**
 * PlusTest.java
 *
 * Demonstrate the different behaviors of the + operator
 */
public class PlusTest
{
    /**
     * main method prints some expressions using the + operator
     */
    public static void main (String[] args)
    {
        System.out.println ("This is a long string that is the " +
                            "concatenation of two shorter strings.");
        System.out.println ("The first computer was invented about" + 55 +
                            "years ago.");
        System.out.println ("8 plus 5 is " + 8 + 5);
        System.out.println ("8 plus 5 is " + (8 + 5));
        System.out.println (8 + 5 + " equals 8 plus 5.");
    }
}
```

b. Add the file *PlusTest.java* to your Unit 2 Java Math notes project.

c. Compile and run the program. For each of the last three output statements (the ones dealing with 8 plus 5) write down the output. Pay attention to spacing.

Statement	Output
`System.out.println ("8 plus 5 is " + 8 + 5);`	
`System.out.println ("8 plus 5 is " + (8 + 5));`	
`System.out.println (8 + 5 + " equals 8 plus 5.");`	

d. The following rules are used for +, explain for each of the last three output statements why the computer printed what it did. Write out complete explanations.

i. If both operands are numbers + is treated as ordinary addition. (NOTE: in the expression a + b the a and b are called the operands.)
ii. If at least one operand is a string the other operand is converted to a string and + is the concatenation operator.
iii. If an expression contains more than one operation expressions inside parentheses are evaluated first. If there are no parentheses the expression is evaluated left to right.

e. The statement about when the computer was invented is too scrunched up. How should that be fixed? Write the corrected version in the space provided.

Original:

```
System.out.println ("The first computer was invented about" + 55 +
                    "years ago.");
```

Corrected:

So that it is not scrunched up.

2. **Writing Your Own Program With +**

Now write your own output statement that prints out the following sentence:

Ten robins plus 13 canaries is 23 birds.

Create a new class in Eclipse called *TenRobins.java.* Using only one statement inside the main method that invokes the *println* method output the sentence above. Your statement **must** use the + operator to do **arithmetic** for the number 23 *(10+13)* and use the + operator to do **string concatenation**.

3. **Applying the Rules**

Without programming any of the following output statement in the computer, utilize the rules for + to determine each of the following outputs without the help of an IDE.

Statement	Output
`System.out.print( 1 + " " + 2 + 3);`	
`System.out.print( 1 + 4 + " " + (2 + 3));`	
`System.out.print( 1 + 2 + 3);`	
`System.out.print( 1 + " " + 2);`	
`System.out.print( 3 + " " + "4 + 5");`	
`System.out.print("1 + 2" + 3 + 4 + "5");`	
`System.out.print( 1 + "2" + (3 + 4));`	
`System.out.print( 2 + ("3" + 4) + 5);`	

You may now code these lines into a project to check your answers.