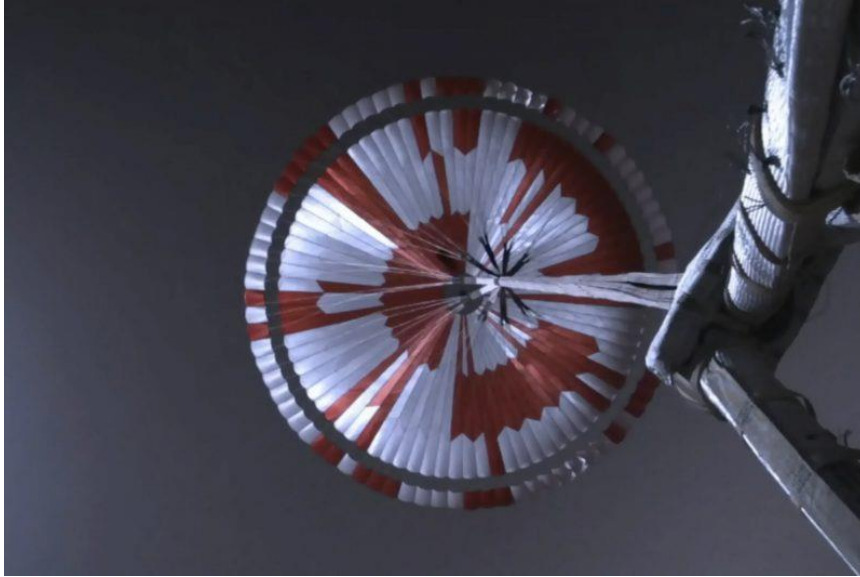


Day85 Decimal to Binary Conversion  
Due Tuesday 5/25/21 by midnight

I assume you reviewed the PDF I posted about the Mars rover's parachute and how it had a hidden message encoded in binary. Here is a picture of that again just for fun:



Here's a [link](#) to an article about it if you want to read more.

Also, in the Google Classroom I attached a lesson plan from NASA all about doing your own encoding. It's fun, but since I can't hand you a worksheet to write on, we're going to do this differently.

You have a choice today, though. If you want, do the activity in the NASA PDF. You need access to a printer (you only need to print page 7, the one you would color in to make your own message). If you do this, take a photo of your final creation and turn that in for this assignment.

If you don't want to print that page out and make a secret message encoded the way the parachute was encoded, then you can do a repl where we do some binary encoding in a different way.

OK, take a deep breath, here is today's assignment (on the next page).

Your task today is to write a program that asks the user for a phrase and then converts the phrase to binary. Here is sample output:

```
Please enter a message to convert to binary: Go Tigers!
```

```
GO TIGERS!
```

```
G  71  1000111
O  79  1001111
   32  0100000
T  84  1010100
I  73  1001001
G  71  1000111
E  69  1000101
R  82  1010010
S  83  1010011
!   33  0100001
```

What you see above is that I typed in a message, and then my program converted the message to call caps, then it printed out each letter, along with its "ASCII" encoding, and its binary encoding. You're going to write all of this. It's actually easier than you might think.

Step 1:

Make a Scanner. Ask the user to enter a phrase. Remember, you have to say "import java.util.Scanner" at the top of the program.

Step 2:

Make the message uppercase (use toUpperCase()). Print the upper case version.

Step 3:

Make a for loop that goes from 0 to one less than the length of the message (use message.length()). Inside the for loop print each letter, followed by a tab, and then the number version of the letter, followed by the word "binary" for now.

You can do this like this:

```
System.out.print(message.charAt(i)+"\t");
System.out.print((int)message.charAt(i)+"\t");
System.out.println("binary");
```

If your message is in a variable called "message" you can just copy the above three lines and paste them into your for loop.

What is going on here? Well, there's a String method .charAt() which grabs a single character and returns it as a char, which is a primitive variable type that holds only one letter. The second line above converts that char (the letter) to its integer version. So the letter A becomes 65, B

becomes 66, and so on. This is using the ASCII encoding system (here's a [link](#) to more on that if you want to read about it, this is optional.)

OK, so this does more than half the work for this assignment. If you typed in "abc" for the message, your code would now print this:

```
Please enter a message to convert to binary: Go Tigers!

GO TIGERS!

G   71  binary
O   79  binary
    32  binary
T   84  binary
I   73  binary
G   71  binary
E   69  binary
R   82  binary
S   83  binary
!   33  binary
```

Step 4:

Write a method called "decimalToBinary" that converts an int to a binary String. I recommend starting with this structure:

```
public static String decimalToBinary(int n)
{
    String temp = "";

    return temp;
}
```

For our purposes, we'll assume that n will be less than 128. Make an empty String variable called temp, and add the binary digits to it one at a time (either 1 or 0) until you've converted the number completely, then return temp. I set up the basic structure for you above.

I talk a bit about converting a decimal number to a binary number on the next page.

If I have a number n that is less than 128 that I want to convert to binary, I would follow this process:

1. Divide by 64 (this is 2 to the 6th). Since we're doing integer math, we'll get 1 if n is larger than 64 or 0 if n is less than 64. This is the first digit of our binary result.
2. Next, we replace n with n%64. This "divides out" the 64, leaving us with the remainder.
3. Next, we divide by 32, which is 2 to the 5th. This gives us our next digit. Then we replace n with modulo 32.
4. We repeat this with 16, 8, 4, 2 and 1 and we're done.

I give you a specific example on the next page. (I also work this out in my video if you just want to get it done.)

Here's a specific example:

Let's say we're trying to convert the letter T to binary. Our program prints a T, then an 84, because that's the integer version of T in the ASCII encoding (I gave you the code for this on the previous page.) Then we have to convert 84 to a binary number.

First, we divide by 64 and get 1 (remember, this is integer math). We add "1" to the variable temp.

Next, we do  $84\%64$  and get 20 (84 divided by 64 has a remainder of 20.)

Next, we divide 20 by 32 and get zero. We add "0" to the variable temp which is now "10".

Next, we do  $20\%32$  which is still 20.

Next, we divide 20 by 16 and get 1. We add "1" to temp, which is now "101". We do  $20\%16$  which gives us 4.

Next we divide 4 by 8 and get 0. We add 0 to temp which is now 1010. We do  $4\%8$  and get 4.

Next we divide 4 by 4 and get 1. We add 1 to temp which is now 10101. We do  $4\%4$  and get 0.

Next we divide 0 by 2 and get 0. We add 0 to temp which is now 101010. We do  $0\%2$  and get 0.

Finally, we divide 0 by 1 and get 0, then end up with 1010100 which is the binary version of 84.

I used `Math.pow(2,x)` to get my powers of two. I started with 7 and went down to 1.

I know I'm not telling you exactly how to do this, it's hard to explain in a PDF without just giving you the code. I work it out nicely in my video, attached to the Google Classroom. Go over there and see what I did if you can't figure out how to do this. It's surprisingly simple once it's done.

After you have the method working, change the line that was printing "binary" to this:

```
System.out.println(decimalToBinary(message.charAt(i)));
```

The above line sends the current character over to the new method you just wrote and then prints the result.

Enter "Go Tigers!" and you should get this:

```
Please enter a message to convert to binary: Go Tigers!

GO TIGERS!

G  71  1000111
O  79  1001111
   32  0100000
T  84  1010100
I  73  1001001
G  71  1000111
E  69  1000101
R  82  1010010
S  83  1010011
!  33  0100001
```

Please test your work. Watch my video if you get stuck. Turn in a share link. Thanks!

