

***Computer Science Illuminated 8th edition Dale
Solutions Manual***

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Solutions Manual

Computer Science Illuminated, Eighth Edition

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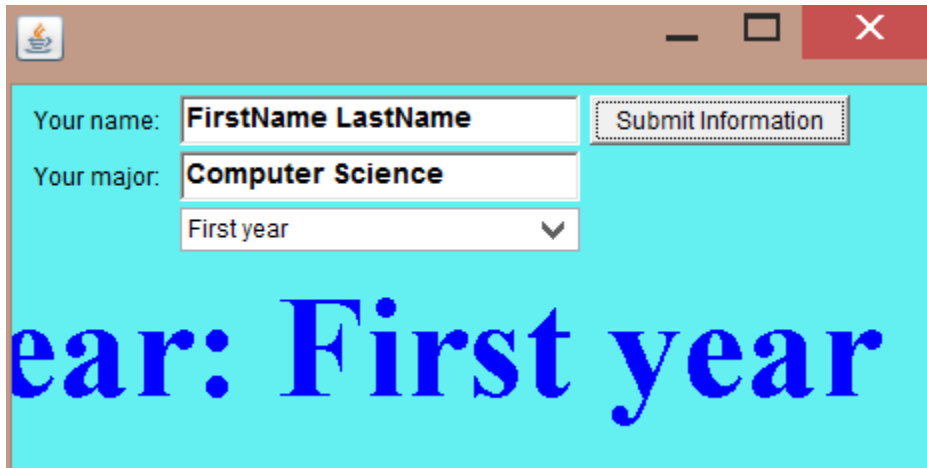
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Laboratory 1 - Introduction to the Labs

Students will enter basic information in the Intro App and take a screen shot.



The screenshot shows a web application window with a brown title bar containing a small icon on the left and standard window controls (minimize, maximize, close) on the right. The main content area has a light blue background. It features a form with three input fields: "Your name:" with the placeholder text "FirstName LastName", "Your major:" with the text "Computer Science", and "First year" with a dropdown arrow. To the right of these fields is a button labeled "Submit Information". Below the form, the text "ear: First year" is displayed in a large, bold, blue serif font.

Laboratory 2 – Exploring Number Systems

Exercise 1

1. Convert the binary number 11011101 to decimal by hand, showing all steps.

Answer = 221

$$128 * 1 = 128$$

$$64 * 1 = 64$$

$$32 * 0 = 0$$

$$16 * 1 = 16$$

$$8 * 1 = 8$$

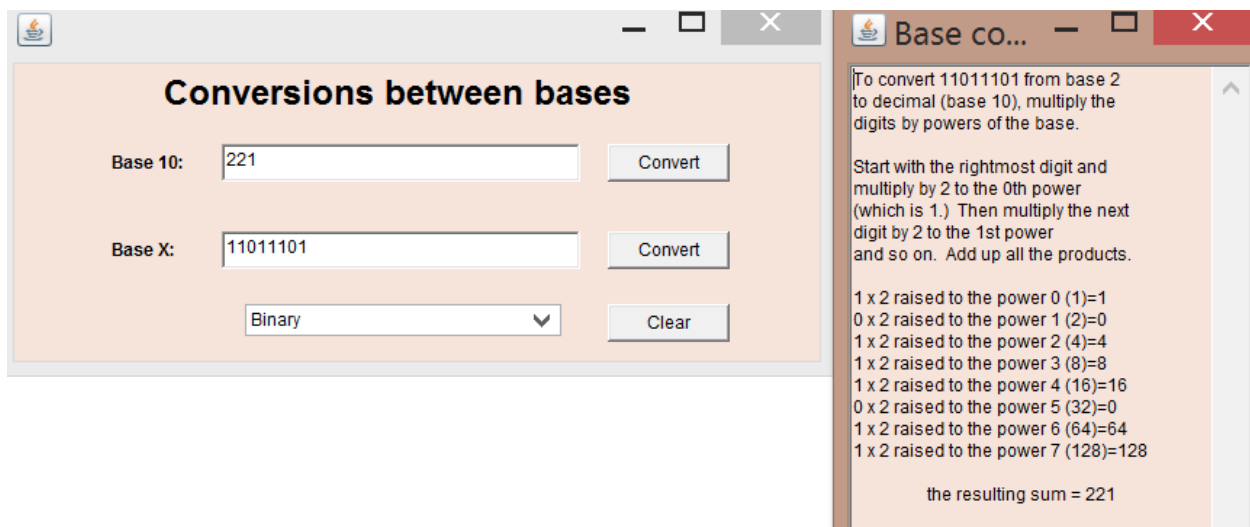
$$4 * 1 = 4$$

$$2 * 1 = 2$$

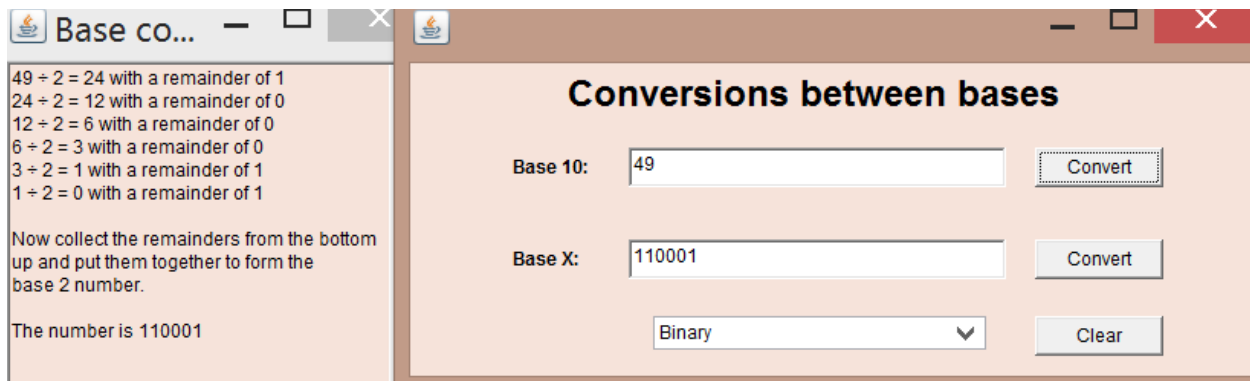
$$1 * 1 = 1$$

221

2. Using the “Number systems” app, type 11011101 into the Base X text area. Verify your answer above. Take a screenshot.



3. Example for 49



- To learn how to do this yourself, convert the decimal number 77 to binary using this method of repeated division, just like the app did.

$77 \div 2 = 38$ with a remainder of 1

$38 \div 2 = 19$ with a remainder of 0

$19 \div 2 = 9$ with a remainder of 1

$9 \div 2 = 4$ with a remainder of 1

$4 \div 2 = 2$ with a remainder of 0

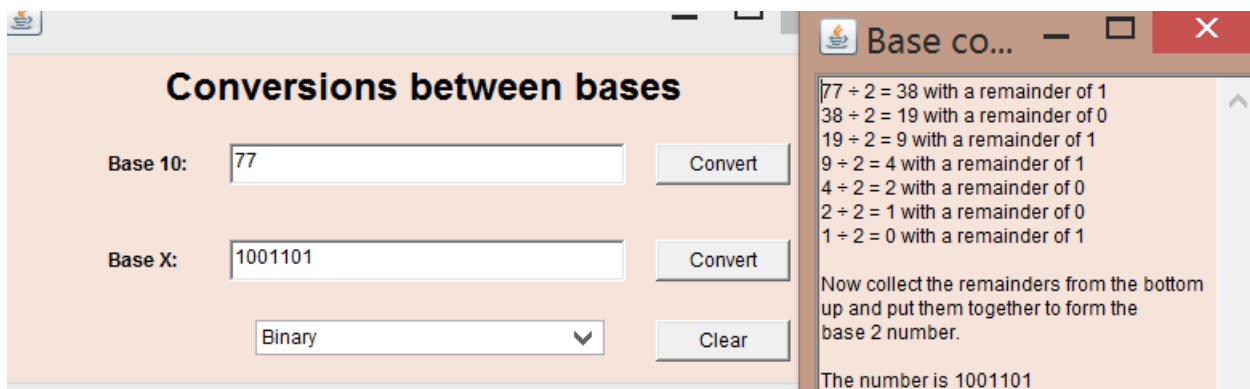
$2 \div 2 = 1$ with a remainder of 0

$1 \div 2 = 0$ with a remainder of 1

Now collect the remainders from the bottom up and put them together to form the base 2 number.

The number is 1001101

- Use the "Number systems" app to check your result. Type 77 into the Base 10 text area and press Convert. Take a screenshot.



- Use the "Number systems" app to convert 123 from base 5 to decimal. Type 123 into the Base X text area, select Base 5 from the choices in the pull-down menu, and click Convert. Does this

make sense to you? Why? Take a screenshot and write on the paper why 123_5 equals whatever the app shows you.

Conversions between bases

Base 10:

Base X:

To convert 123 from base 5 to decimal (base 10), multiply the digits by powers of the base. Start with the rightmost digit and multiply by 5 to the 0th power (which is 1.) Then multiply the next digit by 5 to the 1st power and so on. Add up all the products.
 3×5 raised to the power 0 (1)=3
 2×5 raised to the power 1 (5)=10
 1×5 raised to the power 2 (25)=25
 the resulting sum = 38

7. Add the two binary numbers together by hand, showing all carries:

$$\begin{array}{r}
 01110010 \\
 101010011 \\
 +000111010 \\
 \hline
 110001101
 \end{array}$$

8. Now type the numbers 10101001 and 00111010 into the Binary column of the “Binary addition” app. Click Add and verify your answer with the app’s result. Take a screenshot.

Binary addition

	0	0	1	1	1	0	0	0	Binary	Decimal
	1	0	1	0	1	0	0	1	10101001	169
+	0	0	1	1	1	0	1	0	00111010	58
	1	1	1	0	0	0	1	1	11100011	227

9. Finally, what are the limits of the “Binary addition” app? What are the largest numbers it can add? What is the largest result it can produce? Record your answers below, in both binary and decimal values.

Largest numbers it can add 128 + 127 are largest two numbers

Largest result it can produce 11111111 255

8. Now type in -127 and convert. Write down the values. What is the difference between +127 and -127 in 2's complement form?

For +127 the 2's complement came out to: 01111111

For -127 the 2's complement came out to: 10000001

For the positive it had much more 1's instead of zeros like the negative did, however it still retains the first digit sign bits of zero for positive and 1 for a negative number. The difference between +127 and -127 is zero in any form.

9. Type 4 into "number of digits in binary." Then convert the number 8. What do you see? Does this seem right?

No, because the number can't fit into 4 bits.

Exercise 2

1. Start the "Real number representations" app
2. Type in a fairly large number, like 8673491502, and press *Return*. Write down the value in scientific notation and in binary.

Scientific notation: 8.673491502000001 x10⁹

Binary: 0 0.1000000100 0100010

3. Experiment with a few other numbers. What generalization can you make about the powers of 10 and 2 that you see? (Hint: Which power is bigger? Is it always bigger by the same amount? Try dividing the bigger by the smaller. Is this ratio always the same or close to the same?)

The POWER of base 2 is LARGER. It is not always larger by the same amount. The ratio of the two powers is not the same. $7/1 = 7$, $10/3 = 3.33$, $13/3 = 4.33$, $17/4 = 4.25$

4. How many bits does the binary representation at the bottom of the screen devote to the mantissa (the part after the binary point and separated by a space from the binary power)? What would be the smallest mantissa that could be represented? (Hint: You may need a calculator.)

The smallest mantissa would be 10 digits which is 2^{-10}

Now search the internet for "negative powers of 2" which should return a table. In the table of negative powers of two, when $n=10$, the number is 0.0009765625 which would be the smallest number given a mantissa of 10.

5. Type a number such as 0.00000000495 and press *Return*. What is the sign of the exponent?