

Digital Electronics Practical 1 - Number Systems (Week 2)

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Solutions will be uploaded at the end of week 2.

Objectives: The main objectives of this practical are to reinforce and then build on your understanding of positional number systems and binary arithmetic. This is done by providing you with the opportunity to practice the techniques introduced in the lectures. These are pen and paper exercises and it is important that you confirm your understanding by showing your work to a demonstrator.

Feedback: Formative feedback is given by the demonstrators in the lab. Please make sure that you show all your work to a demonstrator and make any suggested improvements to the work.

If you would like to review the techniques, look over the lecture notes, or view the online tutorials (<http://courses.cs.vt.edu/~csonline/NumberSystems/Lessons/index.html>).

Questions

There are four questions in each exercise (except for Exercise 5). You must attempt the first two in each set. The third and fourth are available as additional practice should you need it - it is up to you to decide whether you are comfortable with the concepts or not.

Exercise 1 (Demonstrate your understanding of the binary number system)

Convert each of the following binary numbers to decimal. Show how you reasoned the answer.

1. 10001_2
2. $0011\ 0101_2$
3. 0.0101_2
4. 1101.11_2

Exercise 2 (Demonstrate your understanding of the binary number system and translation from other bases)

Convert each of the following decimal numbers to binary. Show all your working.

1. 22
2. 14.625
3. 121
4. 0.425 (no more than an 8 bit representation)

Exercise 3 (Demonstrate your understanding of the hexadecimal number system and translation between bases)

Convert the following binary numbers to hexadecimal. Show all your working.

1. 0101_2
2. 10011_2
3. 1000000001110_2
4. 101010110101001_2

Convert the following decimal numbers to hexadecimal numbers. Show all your working.

1. 22
2. 72
3. 109
4. 842

Convert the following hexadecimal numbers to decimal. Show all your working.

1. 163_{16}
2. $A23C_{16}$
3. FFF_{16}
4. $DEED_{16}$

Convert the following hexadecimal numbers to binary. Show all your working.

1. 57_{16}
2. $C3B_{16}$
3. $AA97_{16}$
4. $BEEF_{16}$

Exercise 4 (Demonstrate your understanding of translations between different bases)

Do each of the following conversions. Show all your working.

1. Convert 15_6 to base 3
2. Convert 587_9 to base 6
3. Convert 13_4 to base 5
4. Convert 324_7 to base 8

Exercise 5 (Binary arithmetic) - **you can save any parts we have not covered in lectures yet for next time!**

Compute the binary addition of the following:

1. $01101100_2 + 10101011_2$

2. $11101011_2 + 00110111_2$

By first converting the following binary numbers to twos complement notation then adding compute

1. $01101100_2 - 00101011_2$

2. $01001011_2 - 00110111_2$

Check that the process above has worked by converting all numbers to decimal.

Compute the following multiplications

1. $01101100_2 \times 00101011_2$

2. $01001011_2 \times 00110111_2$

Reading: Look up endianness (<https://www.google.co.uk/search?q=endianness>) and magic words (<http://en.wikipedia.org/wiki/Hexspeak>).