Introduction to Computer Systems and Platform Technologies

Week 1 Tutorial
Introduction and Number Systems

Tutorial

The tutorial is more about understanding the broad concepts. Typically, we shall use a 1 hour online chat to discuss the tutorial questions but you are encouraged to take part in group discussions about recent items posted on Canvas. There may be some questions for individual solution as well, if the subject matter requires it (for example, in doing binary calculations on paper).

Getting Started

Each week, you should make a tutorial / practical solution record (e.g. as a "Word" or "Notepad" document). In this way, this should make the exam revision easier. It is desirable to do the tutorial before the practical.

The questions on these sheets are for the tutorials. There will be practical document each week. Where you get up to depends on your progress. There may well be too many questions to do in 1 hour. You should do the remainder in your own time. Tutorial solutions will be given later. For some of the tutorial questions there may not be a 'right answer'. This will be indicated as such.

In order to answer some of these questions, you may be required to look up some information on your own. You are encouraged to discuss these questions and share useful links you've found with others in the discussion forums on "Canvas".

Number Systems

In the week 1 Module material on Canvas this week, you were introduced to different number systems. We shall go through some examples together. Note that there are Quizzes each week. This is beneficial practise of each weekly topic.

One question involves conversion between different bases e.g. decimal to binary, decimal to hexadecimal. There are many methods but the more important thing is to show your working in assignments and the exam.

In the exam, there are no calculators allowed!

If you show your working, a slight slip will result usually in a minor deduction.

After laying out your working, you can check your solution with:

All Programs-> Accessories-> Calculator (Programmer)

Method 1

If you use the division method of base conversion e.g. suppose you are 29 next birthday, 29 is a decimal number and be written 29_{10} where the base is 10.

As an example, let us converse 29_{10} to base 5. The division method involves repeated division of 29_{10} by 5 and noting the remainders:

	Remainder
29/5 = 5	4
5/5 = 1	0
1/5 = 0	1

You stop when 0 is obtained.

Then you read up the remainder column to obtain the answer.

So $29_{10} = 104_5$

As a check $104_5 = 1x5^2 + 0x5^1+4x5^0 = 25+0+4 = 29_{10}$

What is 5^0 ?

Note that base 5 has 5 digits 0,1,2,3,4. There is no digit 5.

Method 2

Another method could have been using the powers of 5:

$5^2 = 25$	$5^1 = 5$	$5^0 = 1$
1	0	4

If you consider 29_{10}, it is made up of one $25 = 5^2$, zero 5 and 4 ones or units

So again $29_{10} = 104_5$

You can use any mathematical method.

Tutorial Questions

Number System Conversions

Question 1 - Decimal to Other Base Systems (binary, octal, and hexadecimal)

Convert the following decimal numbers to binary and hexadecimal:

a) 117_{10}
b) 127_{10}
c) 128_{10}
d) 255_{10}

Question 2- Other Base Systems (binary,octal, and hexadecimal) to Decimal

a) Convert 1101_2 to decimal
b) Convert 7014_8 to decimal
c) Convert $7DE_{16}$ to decimal

Question 3 Binary<-> Octal, Binary<->Hexadecimal

a) Convert 1 1100 1010 1110 1111 1111_2 to octal
b) Convert 1010 1001 0101 1111 1000_2 to hexadecimal
c) Convert 671_8 to binary
d) Convert $DEADFACE_{16}$ to binary

Question 4- Other Base Systems (decimal, binary,octal, and hexadecimal) to Non-Decimal

a) Convert 217_{10} to base 7
b) Convert 1101_2 to base 5
c) Convert 7014_8 to base 9
d) Convert $7DE_{16}$ to base 6

Question 5 Some special conversions

Perform the following conversions:

a. Binary to decimal, octal and hexadecimal:

a) 01111111_2 =
b) 10000000_2 =
c) 11111111_2 =

Question 6

What is the largest number that you can get with 4 bits, with 8 bits and 16 bits?

Question 7

a) Jim is 29 years old. Convert Jim's age to binary and hexadecimal by a mathematical method on paper – not a calculator!

b) Now convert your age to binary and hexadecimal by the same mathematical method. Add the 2 binary ages show your working.

c) Suppose the "simple" ALU (Arithmetic Logical Unit) handles 4 bits only (nibbles), is your addition "valid"?

Binary Addition

Question 8

Add the following 8 bit numbers and state whether the answer is valid to 8 bit arithmetic. Show your working especially any "carries".

a) $1111\ 0000_2 + 1111\ 1111_2$

b) $0111\ 1111_2 + 0011\ 1111_2$

c) $0111\ 0000_2 + 1111\ 0000_2$

Question 9 — Binary Negative Numbers

a) To get the two's complement negative notation of an integer, you write out the number in binary. You then invert the digits, and add one to the result.

b) Show how -27_{10} would be expressed in two's complement notation.

Our numbers are 8-bits long, suppose we want to subtract 27_{10} from 115_{10}, show how to perform binary subtraction using the two's complement method.

c) Our numbers are 8-bits long, suppose we want to subtract 115_{10} from 27_{10}, show how to perform binary subtraction using the two's complement method. Show how to convert the result to decimal using the two's complement method.

Hexadecimal Addition

Question 10

Add the following hexadecimal numbers and state whether the answer is valid to 16-bit arithmetic. Show your working especially any “carries”.

a) $1ABC_{16} + 1234_{16}$
b) $ABBA_{16} + CAFE_{16}$