The Australian National University Faculty of Engineering & Information Technology

Department of Computer Science

COMP2300-2007-01

Notes for Tutorial/Laboratory Session 01

1 Preparation Exercises

Complete the following questions on a separate sheet of paper, with your name and student number clearly written. Please ensure your writing is legible. Hand in to your tutor at the *beginning of your tutorial / laboratory session.*

1. How many different values can be represented in a 4-bit word? An 8-bit word? A 16-bit word? In a 32-bit word?

   What range of unsigned integers can be stored in each of these words?

   What range of two's complement numbers can be stored in each of these words?

   Please give all your answers as decimal numbers.

2. Convert the following numbers to decimal:

   - 76_8
   - $B11_{16}$
   - 101010_2 as an UNSIGNED integer.
     This means we are only considering positive binary integers from 000001 to 111111_2.
   - 101110_2 as a SIGNED integer.
     This means we are using two's complement numbers with 000001 to 011111 representing positive numbers and 111111 to 100000 representing negative numbers.

   (as will be discussed, the C language supports both signed and unsigned integers)

3. What is the unsigned binary representation of 231_{10}?

   Convert the result from binary to octal. How many binary digits make up each octal digit?

   Convert the binary value to hexadecimal. How many binary digits make up each hexadecimal digit?

2 Tutorial Questions

After an introduction of the class and going through solutions to the preparation exercises, work through the following questions in your session. Finish any uncompleted exercises for homework.

1. Assuming unsigned numbers, what are the results of the following binary additions / subtractions? (give the result in binary)

   $0101\ 0011_2$ + $0110\ 1110_2$ | $0001\ 0001_2$ + $1101\ 0011_2$ | $0101\ 0011_2$ - $0001\ 0001_2$ | $1010\ 1011_2$ - $1001\ 0110_2$

2. Now assume that ALL numbers in question 1 are in two's complement form. Try to work out all results from question 1 using binary arithmetic. Then convert the numbers and results to decimal. Are the results correct? If not explain why not.

3. What are the octal representations of the following numbers? Comment: you might find it easier to first translate to binary.

   $011\ 110\ 101\ 010\ 011_2$ $1001\ 0111\ 1111\ 0001_2$
   $AE3C9F_{16}$ 30123221_4

4. One byte is defined as 8 bits. Can the value from preparation exxercise 3 (i.e. 231_{10}) be represented as an unsigned integer in a single byte?

   Can the value be represented as a two's complement number in a single byte? Explain your answer.

5. Represent the number -1.125 as an IEEE single precision floating-point number.

   Try to represent pi (π) as an IEEE single precision floating-point number.

6. What are the decimal values of the following IEEE single precision floating point numbers whose bit patterns are represented by the following hexadecimal numbers.

   $42E48000_{16}$ $3F880000_{16}$

7. Can all numbers that can be represented by a finite fractional decimal value be exactly represented using a finite number of binary digits? Concisely substantiate your claim.