- CPSC 275: Introduction to Computer Systems

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Fall 2025

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Homework 8

NOTE: You are not required to hand in the following exercises, but you are strongly encouraged to complete them to strengthen your understanding of the concepts covered in class.

1. Show that each of the following bit vectors is a two's-complement representation of −5:
   A. `1011`
   B. `11011` [Note that one leading `1` has been added to `1011`.]
   C. `111011` [Note that two leading `1`s has been added to `1011`.]

2. Suppose we truncate a 4-bit value (represented by hex digits 0 through F) to a 3-bit value (represented as hex digits 0 through 7). Fill in the table below showing the effect of this truncation for some cases, in terms of the unsigned and two's complement interpretations of those bit patterns.

Hex		Unsigned		Two's complement	
Original	Truncated	Original	Truncated	Original	Truncated
0	0	0	_____	0	_____
2	2	2	_____	2	_____
9	1	9	_____	−7	_____
B	3	11	_____	−5	_____
F	7	15	_____	−1	_____

3. Consider the following C functions:

```
int fun1(unsigned word) {
   return (int) ((word << 24) >> 24);
}

int fun2(unsigned word) {
   return ((int) word << 24) >> 24;
}
```

   Assume these are executed on a machine with a 32-bit word size that uses two's complement arithmetic. Assume also that right shifts of signed values are performed arithmetically, while right shifts of unsigned values are performed logically. What will be the values of `fun1(w)` and `fun2(w)` if `w` is:

   A. `0x00000076`
   B. `0x87654321`
   C. `0x000000C9`
   D. `0xEDCBA987`

4. Suppose we number the bytes in a *w*-bit word from 0 (least significant) to *w*/8 − 1 (most significant). Write code for the following C function, which will return an unsigned value in which byte `i` of argument `x` has been replaced by byte `b`:

   ```
   unsigned replace_byte (unsigned x, int i, unsigned char b);
   ```

   Here are some examples showing how the function should work:

   ```
   replace_byte(0x12345678, 2, 0xAB) --> 0x12AB5678
   replace_byte(0x12345678, 0, 0xAB) --> 0x123456AB
   ```

- **Welcome: Sean**
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