

ENGN2219/COMP6719
Computer Systems & Organization
Problem Set 1

Note: This problem set is optional for your practice only and not part of the assessment scheme.

Question 1:

Briefly explain how software programmers can write programs in their favorite programming language (e.g., Python) without fully comprehending the physics behind transistors (the fundamental building block of a modern computer). How is the microarchitecture abstraction different from the architecture (or ISA) abstraction? Why do we need a transformation hierarchy in computer systems?

Question 2:

What is the smallest (most negative) 32-bit binary number that can be represented with

- (a) unsigned numbers? 0
- (b) two's complement numbers? -2,147,483,648
- (c) sign/magnitude numbers? -2,147,483,647

Question 3:

Convert the following decimal numbers to 8-bit two's complement numbers or indicate that the decimal number would overflow the range.

- (a) 124 01111100
- (b) -63 11000001
- (c) 42 00101010
- (d) -128 10000000
- (e) 133 overflows

Question 4:

Convert the following decimal numbers to 6-bit two's complement binary numbers and add them. Indicate whether the sum overflows a 6-bit result.

- (a) 16 + 9 011001
- (b) -4 + 19 001111
- (c) 3 + -32 100011
- (d) -16 + -9 100111
- (e) -27 + -31 000110 (overflow)

Question 5:

Convert the following decimal numbers to 5-bit two's complement binary numbers and subtract them. Indicate whether the difference overflows a 5-bit result.

- (a) $9 - 7$ 00010
- (b) $12 - 15$ 11101
- (c) $-6 - 11$ 01111 (overflow)
- (d) $4 - -8$ 01100

Question 6:

Convert the following hexadecimal numbers to decimal:

- (a) AB3E 43838
- (b) 776F 30575