Numbers and Computers (practice)

ICS312
Machine-Level and
Systems Programming

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(q13) Two's complement

- What is the **2-byte** representation of signed integer -153_{10} in hexadecimal?

(q13) Solution

- What is the 2-byte representation of signed integer -153_{10} in hexadecimal?
  - $153_{10} = 0099_{16}$
  - complement: FF66
  - add 1 to get the answer: **FF67**

(q14) Two's complement

- What is the 2-byte representation of signed integer 96_{10} in hexadecimal?

(q14) Solution

- What is the 2-byte representation of signed integer 96_{10} in hexadecimal?
  - $96_{10} = 60_{16}$
  - It's a positive number, so its 2's complement representation is simply it's 2-byte binary representation
  - answer: **0060**

(q15) Two's complement

- What is the decimal value of $FF4A_{16}$, which we know to be a 2-byte signed number?

(q15) Solution

- What is the decimal value of $FF4A_{16}$, which we know to be a 2-byte signed number?
  - FF4A = $1\ldots._2$
  - Therefore it represents a negative number, let's invert it
  - Invert: 00B5
  - Add 1: 00B6 = B6
  - $B6_{16} = 11*16 + 6 = 176 + 6 = 182_{10}$
  - Therefore, in 2's complement representation, FF4A is -182_{10}

(q16) Two's complement

- What is the 1-byte representation of signed number -81_{10} in hexadecimal?

(q16) Solution

- What is the 1-byte representation of signed number -81_{10} in hexadecimal?
  - $81_{10} = 51_{16}$
  - complement: AE
  - add 1: AF

(q17) Two's complement

- What is the decimal value of 76_{16}, a 1-byte signed number?

(q17) Solution

- What is the decimal value of 76_{16}, a 1-byte signed number?
  - It's a positive number, so 76 is simply the hex value of the integer
  - Answer: $7*16^1 + 6*16^0 = 118_{10}$

(q18) Ranges of numbers

- What is the largest **unsigned** decimal number that can be encoded with 8 bits?
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- What is the largest **signed** decimal number that can be encoded with 8 bits?
- What is the smallest **signed** decimal number that can be encoded with 8 bits?
- What is the 2's complement representation of -1_{10} with 32 bits?

(q18) Solutions

- What is the largest **unsigned** decimal number that can be encoded with 8 bits?
  - 255 (i.e., FF in 2's complement representation)
- What is the smallest **unsigned** decimal number that can be encoded with 8 bits?
  - 0 (i.e., 00 in 2's complement representation)
- What is the largest **signed** decimal number that can be encoded with 8 bits?
  - Largest that isn't negative: 7F in 2's complement representation = 127_{10}
- What is the smallest **signed** decimal number that can be encoded with 8 bits?
  - Smallest that isn't positive: 80 in 2's complement representation = -128_{10}
- What is the 2's complement representation of -1_{10} with 32 bits?
  - 1 = 00000001; complement: FFFFFFFE; add one: FFFFFFFF

More Practice?

- This module contains a sample homework assignment with more practice, if you need it