

Binary Numbers & Bitwise Operators Exercises

Re-submit Assignment

Due Feb 4, 2017 by 11:59pm

Points 100

Submitting a file upload

File Types zip

Exercises - Binary Numbers

Solve the following exercises on binary numbers and bitwise operators.

Submission

To submit non-coding exercises:

- Submit a word document showing your work and answers.
 - Include a header with the following format:
 - Name: <name>
 - Date: <date>
 - Assignment: <exercise title>
- Submit a print-out of your word document by our due date.
- Any submissions using any other formats, missing a document header or without a print-out will results in a zero on the assignment.

To submit coding exercises:

- Submit an eclipse project with all exercises solved
- Make sure to apply the same level of style considerations and documentation (including Javadocs) that you would for an assignment

Non-Coding Exercises

1. Convert the following decimal numbers to twos-complement binary numbers. Show your work!

- 61
- 110
- -41

2. Convert the following twos-complement binary numbers to decimal numbers. Show your work!

- 00110011
- 10000111

- 11111111

3. Give the result of the following arithmetic by first converting each decimal number to binary and then performing the binary addition/subtraction. Show the steps of each operation and your final result (in binary). Show your work!

- $99 + 13$
- $90 - 8$
- $101 - 23$

4. Which of the following operations result in overflow with 8-bit twos-complement binary numbers? Show the arithmetic in binary to justify your answers.

- $112 + 20$
- $-90 + 121$
- $91 + 93$

5. Give the result of each of the following logical operations.

10101111	10111001	11101010
& 10110101	00011100	^ 01010011

6. What bit mask and logical operator would you use to "select" the left 3 bits in an 8-bit binary number?

Coding Exercises

1. Write a function call `isSet(int number, int index)` that returns true if the binary digit at the given index is "set" for the input number, and false otherwise. For example:

- `isSet(3, 0)` would return true because the bit at index zero is "1" in the binary version of 3
- `isSet(64, 6)` would return true because the bit at index six is "1" in the binary version of 64
- `isSet(64, 2)` would return false because the bit at index two is "0" in the binary version of 64

2. Write a function called `wordMask()` that accepts a string and integer bit-mask. For example:

```
public void wordMask(String word, int mask)
{
```

```
    //do something  
}
```

Your function should print out the *i*th character of the input word only if the *i*th binary digit of the input mask is "set." For example:

- Given the word "vertical" and the mask 11000011, this function would print "veal"
- Given the word "vertical" and the mask 10001011, this function would print "vial"

Note: You may be able to use your isSet() function to help complete this exercise.

3. There is a well-known mathematical logic problem called the lockers problem. Here is a description of the problem:

A new high school has just opened! There are 30 lockers in the school and they have been numbered from 1 through 30. When the school opens the first student to enter the school walks into the hallway and opens all the locker doors! Afterwards, the second student closes each door whose number is a multiple of 2. Similarly, the third student changes every door that is a multiple of 3 (closing open doors, opening closed doors). The fourth student changes each door that is a multiple of 4 and so on. After 30 students have entered the hallway, which locker doors are open?

Solve the lockers problem by using the BitArray class that we developed in class. You can use each bit of the 32-bit integer to represent the state (open/closed) of one of the 30 lockers. Print out the final state of the lockers after all 30 students have had their fun!

Note: Be careful to avoid the 32nd index of the integer in our BitArray class (the most-significant-bit) as it requires special care to assign and retrieve its binary value.