HW1.6. Bias

While 2's complement are useful in most cases, there are situations in which you'd like to sort your negative and positive numbers with a comparator that is meant for unsigned numbers. If you try to sort two's complement numbers with this comparator, you'll find that negative numbers are mistaken to be the largest.

In these situations, it may be preferable to encode your number in a biased notation. In biased notation, you can read your binary number as if it is unsigned, and then add a set value, called the bias, to find the intended meaning.

Ex: For these 4-bit integers, assume we're using biased notation with bias = `-8`. Then:

```
0b0000 -> 0 - 8 = -8
```

```
0b1111 -> 15 - 8 = 7
```

```
0b1010 -> 10 - 8 = 2
```

As such, the 4-bit binary stored as `0b0000` would be interpreted as -8, the 4-bit binary stored as `0b1111` would be interpreted as +7, etc.

You could also think of this as shifting the original number line into our desired number line.

If we have 4 bits, the original number line range is [0,15]. If our desired number line is [-7,8], then we simply apply a bias of -7 to our original number line to do so. [-7,8] is now our biased number line.

Q1.1: If you wanted an `n` bit number that can represent exactly one more positive number than it can represent negative numbers (in other words, if the maximum value of this representation is x, then the minimum value is $-(x-1)$), what would you set the bias to be, in terms of `n`?

Hint: How many numbers are positive? Negative? How many numbers can an n-bit number represent? Reminder: the bias is negative.

- (a) $-2^{n-1}-1$
- (b) $-2^{n}+1$
- (c) -2^{n-1}
- (d) $-2^{n-1}+2$
- (e) 2^{n}
- (f) None of the above

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Homework 1

Assessment overview

Total points: 100/100

Score: 100%

Question

Value: 4

History: 4

Awarded points: 4/4

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