

Untitled-1

```
//4
/*
 * logicalNeg - implement the ! operator, using all of
 *               the legal operators except !
 *   Examples: logicalNeg(3) = 0, logicalNeg(0) = 1
 *   Legal ops: ~ & ^ | + << >>
 *   Max ops: 12
 *   Rating: 4
 */
int logicalNeg(int x) {
    // ~x = -x - 1
    // -x = ~x + 1
    int negativeX = ~x + 1;

    // bitwise OR x with -x produces 1111 ... 1111 if x != 0
    // 0000 ... 0000 if x == 0

    // then shift the bitwise OR result by 31 to extract the sign bit
    // 0 if x != 0, -1 if x == 0
    // adding one to those would give 1 if x != 0, and 0 if x == 0 which
    // gives up the effect of logical neg without using !

    return ((x | negativeX) >> 31) + 1;
}
```