- CPSC 275: Introduction to Computer Systems

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Fall 2025

- Syllabus
- Schedule
- Resources
- Upload
- Solution

Solution to Homework 11

1.
   A. overflow
   B. overflow
   C. overflow

2.
   A. overflow
   B. `110`
   C. overflow

3.
```
K   Shifts  Add/Subs  Expression
6     2        1      (x<<2) + (x<<1)
31    1        1      (x<<5) - x
-6    2        1      (x<<1) - (x<<3)
55    2        2      (x<<6) - (x<<3) - x
```

4.
   A. False. Let `x` be −2,147,483,648 (T_{Min}). We will then have `x-1` equal to 2,147,483,647 (T_{Max}).
   B. True. If `(x & 7) != 7` evaluates to `0`, then we must have bit x_2 equal to 1. When shifted left by 29, this will become the sign bit.
   C. False. When x is 65,535 (`0xFFFF`), `x*x` is −131,071 (`0xFFFE0001`).
   D. True. If `x` is nonnegative, then `-x` is nonpositive.
   E. False. Let `x` be −2,147,483,648 (T_{Min}). Then both `x` and `-x` are negative.
   F. True. Two's-complement and unsigned addition have the same bit-level behavior, and they are commutative.
   G. True. `~y` equals `-y-1`. `uy*ux` equals `x*y`. Thus, the left hand side is equivalent to `x*-y-x+x*y`.

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