Numbers

CISC 221 – Assignment 2
Due: February 3, 2022, 11:59pm

Part A

Two's complement encoding (3 marks)

- Implement a C function with the following prototype
  - `int subtract2sc_issafe(int x, int y)`

  which returns 1 when computing two's complement subtraction does not cause overflow, and returns 0 otherwise.
- Do not assume width of type `int`; you should use `sizeof(int)` to find out instead.
- You will need to write your own `main()` function to test your code, but do not submit `main()`.
- Submit the single file `twoscomplement_aux.c`.
  - Ensure that your source code is well-documented and readable.
  - Make sure it is tested on the CASLab machines.

Part B

Meditate

(Not submitted)

1. (Page 88, 3ed) Principle: detecting overflow of unsigned addition
2. (Page 92, 3ed) Principle: detecting overflow in two's complement addition

Short answer questions

(Submitted as a single PDF file, `a2_b.pdf`.)

1. (1 mark) Encode the following decimal numbers with 8-bit two's complement binary, or indicate that number would overflow the range:
   a. 49_{10}
   b. -31_{10}
   c. 120_{10}
   d. -128_{10}
   e. 128_{10}

2. (2 marks, page 140 of CSAPP 3ed) Homework problem 2.91

Around 250 B.C., the Greek mathematician Archimedes proved that $\frac{223}{71} < \pi < \frac{22}{7}$. Had he had access to a computer and the standard library `<math.h>`, he would have been able to determine that the single-precision floating-point approximation of π has the hexadecimal representation `0x40490FDB`. Of course, all of these are just approximations, since π is not rational.

A. What is the fractional binary number denoted by this floating-point value?

B. What is the fractional binary representation of $\frac{22}{7}$? **Hint:** See Problem 2.82.

2.83

C. At what bit position (relative to the binary point) do these two approximations to π diverge?

Deliverables

To OnQ:

1. `twoscomplement_aux.c`, and
2. `a2_b.pdf`