BRAC UNIVERSITY
Inspiring Excellence

CSE330 Section 20, Spring 2026
Quiz 1 Solutions, 19 February 2026
Time: 10 Minutes

/15

Name: **ID:**

Question 1 ($1.5 + 1.5 + 2 = 5$ **points):** Suppose your faculty is inputing your final exam marks on Connect, which uses a base-10 floating-point system, where $m = 3$ significant digits are used for the mantissa, the exponent range is $[1, 2]$, and only positive numbers are allowed (there is no 0 or ∞ here, since the values are your final marks).

(a) Write down the largest and the smallest positive numbers representable in this system.

(b) Compute the maximum possible relative rounding error in this system.

Solution. The floating point system is

$$(0.d_1d_2d_3) \times 10^e, \quad d_1 \neq 0 \text{ and } e \in \{1, 2\}.$$

(a) Largest number:

$$(0.999) \times 10^2 = 99.9$$

Smallest number:

$$(0.100) \times 10^1 = 1.00$$

(b) Maximum possible relative rounding error is the machine epsilon $\varepsilon_M = \frac{1}{2}\beta^{1-m}$.

$$\varepsilon_M = \frac{1}{2}\beta^{1-m} = \frac{1}{2}\,10^{1-3} = 0.005$$

■

MCQs, $1 \times 10 = 10$ points. Tick/circle the best answer:

1. In an N-bit signed integer representation, the maximum positive integer that can be stored is:

   (a) 2^N (b) 2^{N-1} (c) ✓ $2^{N-1} - 1$ (d) $2^N - 1$

2. Which of the following best explains why integer arithmetic is exact (within range)?

   (a) Integers use scientific notation
   (b) Integers have infinite precision
   (c) ✓ Every representable integer corresponds to a unique bit pattern
   (d) Integers are stored using floating-point representation

3. Consider a base-10 floating-point system with $m = 3$ significant digits and rounding to nearest. Which of the following real numbers is stored *exactly* in this system?

   (a) 0.1234 (b) ✓ 0.0123 (c) 12.34 (d) 1.2345

4. In a fixed-point number system, the radix (decimal) point:

   (a) Moves depending on the exponent
   (b) Is stored explicitly in memory
   (c) ✓ Is fixed in position
   (d) Depends on the magnitude of the number

5. Floating-point numbers are said to be "floating" because:

   (a) They use base 10 arithmetic
   (b) ✓ Radix point location is adjusted using an exponent
   (c) They are stored approximately
   (d) Their precision increases with magnitude

6. In a normalized floating-point system with base β, which condition ensures uniqueness of representation?

   (a) The exponent must be zero
   (b) The fraction must terminate
   (c) ✓ The leading digit of the fraction is non-zero
   (d) The number must be positive

7. In floating-point arithmetic, underflow occurs when:

   (a) A number exceeds largest representable value
   (b) A number is rounded incorrectly
   (c) Two nearly equal numbers are subtracted
   (d) ✓ A non-zero result is smaller than the smallest representable magnitude

8. The IEEE 754 standard uses "round to nearest even" primarily to:

   (a) Maximize speed
   (b) Avoid overflow
   (c) ✓ Reduce statistical bias in rounding
   (d) Increase representable range

9. The machine epsilon ε_M is best described as:

   (a) The smallest positive floating-point number
   (b) ✓ The largest relative rounding error possible
   (c) The absolute rounding error of all computations
   (d) The distance between zero and the smallest subnormal number

10. Loss of significance most commonly occurs when:

    (a) Multiplying very large numbers
    (b) Dividing by a small number
    (c) ✓ Subtracting two nearly equal numbers
    (d) Rounding to nearest even