

CS5541-Computer Systems

In-Class Exercise (Bit Representations)

Problem 1:

Consider a 6-bit two's complement representation.

Fill in the empty boxes in the following table:

Number	Decimal Representation	Binary Representation
Zero	0	00 0000
N/A	-1	11 1111
N/A	5	00 0101
N/A	-10	11 0110
N/A	26	01 1010
N/A	-26	10 0110
TMax	31	01 1111
TMin	-32	10 0000
TMax + TMax	-2	11 1110
TMin + TMin	0	00 0000
TMin + 1	-31	10 0001
TMin - 1	31 (TMax)	01 1111
TMax + 1	-32 (TMin)	10 0000
-TMax	-31	10 0001

Problem 2:

Consider the following 5-bit floating point representation based on the IEEE floating point format. There is a sign bit in the most significant bit. The next three bits are the exponent, with an exponent bias is 3. The last bit is the fraction. The rules are like those in the IEEE standard (normalized, denormalized, representation of 0, infinity, and NAN).

As described in the slides, we consider the floating point format to encode numbers in a form:

$$(-1)^S * M * 2^E$$

Fill in missing entries in the table below with the following instructions for each column:

Description: Some unique property of this number like "The largest denormalized value."

Binary: The 5 bit binary representation.

M: The value of the Mantissa written in decimal format.

E: The integer value of the exponent.

Value: The numeric value represented, written in decimal format.

You need not fill in entries marked "---". For the arithmetic expressions, recall that the rule with IEEE format is to round to the number nearest the exact result. Use "round-to-even" rounding.

Description	Binary	M	E	Value
Minus 0	10000	0	-2.0	-0.0
Positive Infinity	01110	---	---	$+\infty$
Largest Number	01101	1.5	3	12.0
Smallest Number > 0	00001	0.5	-2	0.125
One	00110	1.0	0	1.0