

4. (2.55/2.82/2.83) – Consider the numbers having a binary representation consisting of an infinite string of the form 0.yyyyyy..., where y is a k-bit sequence. For example, the binary representation of 1/3 is 0.01010101... (that is, y = 01, and k = 2), while the representation of 1/5 is 0.001100110011... (that is, y = 0011, and k = 4).

- a. Give a formula in terms of y and k for the value represented by the infinite string. Hint: Consider the effect of shifting the binary point k positions to the right, and do part b. first...

$$\frac{y}{2^k}$$

- b. What is the numeric value of the string for the following values of y? Note that the value of k is implied; e.g., for case i., k = 3, etc.

i. 110

$$\frac{1}{2} + \frac{1}{4} + \frac{0}{8} = \boxed{\frac{3}{4}}$$

ii. 01001

$$\frac{0}{2} + \frac{1}{4} + \frac{0}{8} + \frac{0}{16} + \frac{1}{32} = \boxed{\frac{9}{32}}$$

iii. 010111

$$\frac{0}{2} + \frac{1}{4} + \frac{0}{8} + \frac{1}{16} + \frac{1}{32} + \frac{1}{64} = \boxed{\frac{23}{64}}$$

5. Consider a 16-bit two's complement representation for signed integers. Fill in the empty boxes in the following table. Spaces in the binary representation are just added to enhance readability.

Number	Decimal Representation	Binary Representation
zero	0	0000 0000 0000 0000
Five	5	0000 0000 0000 0101
twenty five	25	0000 0000 0001 1001
TMax	32767	0111 1111 1111 1111
TMin	-32768	1000 0000 0000 0000
TMin + TMin	0	0000 0000 0000 0000
-TMax	-32767	1000 0000 0000 0001
-TMin	-32768	1000 0000 0000 0000
twenty negative five	-25	1111 1111 1110 0111
negative one	-1	1111 1111 1111 1111

Show work. Hint:  $2^{15} = 32768$ ,  $2^{14} = 16384$ , ...,  $2^5 = 32$ ,  $2^4 = 16$ , ...,  $2^1 = 2$ ,  $2^0 = 1$

