

**1.5** Write the number 66.25 in the following forms (in part (c) follow the IEEE-754 standard):

(a) Binary form. (b) Base 2 floating point representation. (c) 32 bit single-precision string.

**Solution**

(a) The largest power of 2 that can be divided into 66 is  $2^6 = 64$ . Next subtract:  $66 - 2^6 = 2$ . Now the largest power of 2 that can be divided into 2 is  $2^1$ . Thus, the number 66 in binary form is 1000010. The number 0.25 in binary form is simply  $2^{-2}$  or 0.01. Thus, the number 66.25 in binary form is simply 1000010.01.

(b) Using part (a), the binary floating point representation of 66.25 is:

$$\frac{66.25}{2^6} \times 2^6 = \frac{66.25}{64} \times 2^6 = 1.03515625 \times 2^6$$

(c) According to the IEEE-754 standard, 66.25 in single precision form is as follows:

- Since the number is positive, the first bit is 0
- From part (b), the exponent is 6. Adding a bias of 127, the value of the exponent that must be stored is  $6 + 127 = 133$ . The number 133 in binary form is  $133 = 1 \times 2^7 + 1 \times 2^2 + 1 \times 2^0 = 128 + 4 + 1$ . Thus the number 133 in binary form is 10000101. In single precision, 8 bits can be used to store the exponent so that 133 is stored as 10000101 without the need for rounding or chopping.
- Next, the mantissa 0.03515625 is converted to binary form:  $1 \times 2^{-5} + 1 \times 2^{-8}$  or, 0.00001001
- Since 23 bits are allocated for the mantissa, the binary number stored is 00001001000000000000000

Thus, the number 66.25 in single precision is stored as: **|0|10000101|00001001000000000000000|**.

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