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Scientific Computing - Homeworks

1.17 Let x be a given nonzero floating-point number in a normalized system , and let y be an adjacent floating-point number , also nonzero.

a) What is the minimum possible spacing between x and y ?

Let radix = β , precision = p (p-1 bits matissa , 1 bit for sign) , exponent range = [L , U] .

The minimum possible spacing between x and y is for the smallest positive number :
$x = 1.0 * \beta^{L}$
and his neighbouring number :
$y = (1.0 + 2^{-(p-1)}) * \beta^{L}$ (-(p-1) , because of 1-bit sign) .
so it is :
$min = y - x = (1.0 + 2^{-(p-1)}) * \beta^{L} - 1.0 * \beta^{L} = 2^{-(p-1)} * \beta^{L}$.

b) What is the maximum possible spacing between x and y ?

The maximum possible spacing between x and y is for the bigest positive number :
$y = 1.0 * \beta^{U}$
and his neighbouring number :
$x = (1.0 - 2^{-(p-1)}) * \beta^{U}$ (-(p-1) , because of 1-bit sign) .
so it is :
$max = x - y = 1.0 * \beta^{U} - (1.0 - 2^{-(p-1)}) * \beta^{U} = 2^{-(p-1)} * \beta^{U}$.