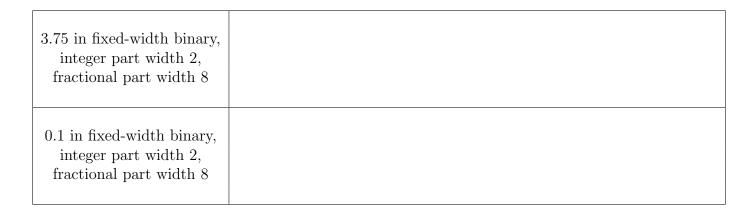
**Definition** For b an integer greater than 1, w a positive integer, w' a positive integer, and x a real number the base b fixed-width expansion of x with integer part width w and fractional part width w' is  $(a_{w-1} \cdots a_1 a_0.c_1 \cdots c_{w'})_{b,w,w'}$  where  $a_0, a_1, \ldots, a_{w-1}, c_1, \ldots, c_{w'}$  are nonnegative integers less than b and

$$x \ge \sum_{i=0}^{w-1} a_i b^i + \sum_{j=1}^{w'} c_j b^{-j}$$
 and  $x < \sum_{i=0}^{w-1} a_i b^i + \sum_{j=1}^{w'} c_j b^{-j} + b^{-w'}$ 



Note: Java uses floating point, not fixed width representation, but similar rounding errors appear in both.