Fixed Point Numbers - Accuracy and Precision

In any computer system the number of bits available for representing numbers is fixed.

- The range of numbers we can represent is limited.
- The magnitude of a stored number is limited by the number of significant digits to the left of the binary point.
- The precision of a stored number is limited by the number of significant digits to the right of the binary point.

Fixed Point Numbers

If this method were used to store numbers inside a computer, the designers would have had to decide where the binary point should be located. Let's look at three possible formats:

Say we wish to represent the number 1.2 using 8 bits of memory.

64	32	16	8	4	2	1	1 / 2
0	**0**	**0**	**0**	**0**	**0**	**1** ●	**0**

Stored Number = 1.0

This is as close as we can get to 1.2 using this format.

8	4	2	1	1 / 2	1 / 4	1 / 8	1 / 16
0	**0**	**0**	**1** ●	**0**	**0**	**1**	**1**

Stored Number = 1 + 1/8 + 1/16
= 1 and 3/16
= 1.1875

This is more precise, but it is still not exact.

1	1 / 2	1 / 4	1 / 8	1 / 16	1 / 32	1 / 64	1/128
1 ●	**0**	**0**	**1**	**1**	**0**	**0**	**1**

Stored number = 1 + 1/8 + 1/16 + 1/128
= 1 and 25/128
= 1.1953125

This is closer to the value of 1.2, but still not an exact representation. Still, it is more precise than the previous attempts.

Note that although moving the point increases the precision with which we can represent a number, it also reduces the range of numbers we can represent.

First format:	0 to 127	(approx)
Second format:	0 to 15	(approx)
Third format:	0 to 1	(approx)

Also note that in any calculation, the binary points must be aligned – this could lead to a loss of accuracy or precision in one or both of the numbers if they have to be shifted to enable this.