

Fixed-Point Number Representation

Definition: Fixed-point number representation represents real numbers, where the integer and fractional parts are represented with a fixed number of digits. The term *fixed point* suggests a specific and unchanging position for the decimal point (or “decimal colon” in non-Anglo-Saxon regions). This position does not shift, unlike in floating-point representation.

Hardware Simplicity

One key advantage of fixed-point representation is that it does not require a Floating-Point Unit (FPU) in the processor. An FPU is specialized hardware for complex arithmetic operations on floating-point numbers. By avoiding the need for an FPU, fixed-point arithmetic can be performed on *older, cheaper*, or optimized processors, making this method efficient for specific applications, particularly in embedded systems and real-time applications where floating-point arithmetic may be too costly or unnecessary.

Example:

To represent a real number like 3.45 in fixed-point format, the fractional part can be encoded by multiplying the number by a fixed scaling factor. For example, instead of storing 3.45 directly, we can store the integer 345 and assume that this value is scaled by $\frac{1}{100}$. This means that the stored value is implicitly multiplied by $\frac{1}{100}$ to recover the original number.

Uniform precision

One of the main weaknesses of fixed-point representation is that it assigns the same number of digits to represent the fractional part of all numbers. This can be inefficient, as some numbers may require more decimal places for accuracy (e.g., scientific measurements), while others may need less (e.g., currency values).

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