The accuracy of computer's representing real numbers

Real numbers are numbers that include fractions/values beyond the decimal place.

The binary representation is carried out using **Two's Compliment** and the floating point numbers are stored by a computer system using a **Mantissa** and an **Exponent.**

- A **decimal point is NOT stored** in the binary number (we tend to sue it in working out for simplicity). The imaginary decimal point always begins **just after to most significant bit** and is moved by the number of places stated by the value of the exponent.

- **The mantissa** holds the detail of the number, so increasing its storage size results in more precision.
- **The exponent** is used as a multiplier to move the mantissa to the correct 'size', so increasing its storage size results in a larger range of possible numbers
- A larger Mantissa is needed (more bits) to store really precise decimal numbers (many digits after the decimal place), increasing the accuracy.
- Conversely, larger numbers with less precision will require a larger exponent (more bits), larger range of numbers

There will generally be a compromise between the accuracy of a floating point number and the range using mantissa/exponent notation; there will always be a set number of bits allocated to storing real numbers, with the potential to increase or decrease the number of bits used for the mantissa against the number of bits used for the exponent.

Although a large mantissa and large exponent could be used, this would require a lot of storage space which becomes an issue when using multiple numbers.

The standard 32-bit computer

Single-precision floating-point format is a computer number format that occupies **4 bytes** (**32 bits**) in computer memory and represents a wide dynamic range of values by using a floating point.

With 32-bit binary, the accuracy of real numbers can be stored in floating point binary to a substantial precision.

With this amount of bits, all real numbers with fewer than 6 significant decimal digits can be stored accurately in a computer system. Some versions allow for up to 9 significant decimal digits of precision. Beyond this, the numbers are no longer accurate.