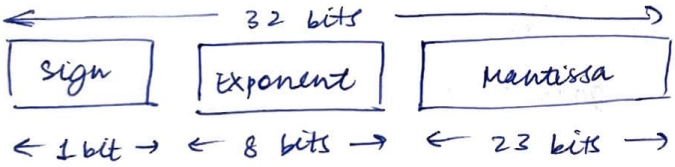
MT2021009
Saisuree Kouda
Tutorial 6

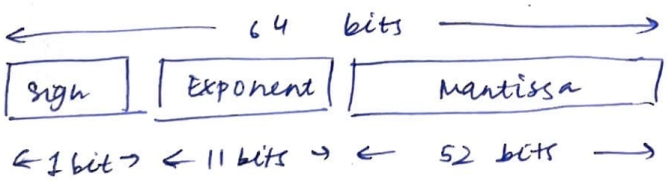
Q1. IEEE standard 754 for floating point arithmetic is a technical standard for floating-point computation.
IEEE 754 has 3 basic components :

- Sign of mantissa –
  0 represents positive number while 1 represents negative number
- Biased exponent –
  The exponent field needs to represent both positive & negative exponents. A bias is added to the actual exponent in order to get the stored exponent.
- Normalised mantissa –
  The mantissa is a part of a number in scientific notation or a floating-point number, consisting of its significant digits.

Single precision IEEE 754



Double precision IEEE 754



Types of IEEE 754	sign	Biased exponent	Normalised Mantissa	Bias
single precision	31st bit	8(30-23)	23(22-0)	127
Double precision	63rd bit	11(62-52)	52(51-0)	1023

Eg: 85.125

$85 = 1010101$

$0.125 = 001$

$85.125 = 1010101.001$

$= 1.1010101001 \times 2^6$ sign = 0

① single precision :

biased exponent $127 + 6 = 133$

$133 = 10000101$

Normalised mantissa = 010101001

We will add 0's to complete the 23 bits.

IEEE 754 single precision is :

= 0 10000101 01010100100000000000000

② Double precision :

biased exponent $1023 + 6 = 1029$

$1029 = 10000000101$

Normalised mantissa = 010101001

We will add remaining 0's to fulfil 52 bits

Q2. In linear algebra, row-major order and column-major order are two ways of storing multi-dimensional arrays in computer memory. Row major order stores the elements of a matrix row by row, while column-major order stores the elements column by column.

Many programming languages and libraries support both row-major and column-major order. These are a few ways to identify the supported order of a language -

① Check the language's documentation : Check the documentation to see if it explicitly states which order is used.

For eg: MATLAB shows that it uses column-order in its documentation

② Test with a simple example : Create a simple matrix and print it out to the console. If the matrix is printed row by row, the language likely uses row-major order. Eg: In C, if we declare a 2D array and initialize it with values and print it, it will print row by row.

③ Check default behaviour : Some languages have default order that can be overridden if necessary. Eg : Numpy defaults to row-major order. If we specify order in function call, it can be overridden.

(#) look at the source code - If language is open-source, you can examine the source code to see how it stores & accesses multi-dimensional arrays.

(#) Be aware of performance considerations: some linear algebra operations may perform better in one order compared to the other. Eg: Matrix multiplication may be more efficient in row-major order on some architectures. Understanding the order used by a language helps write more efficient code.

Q3. The switch statement is a control flow statement in programming languages that allows the programmer to select one of several possible execution paths based on a value that is executed by the statement. In C++, syntax for switch statement is:

```
switch (expression) {
    case 1:
        // code
        break;
    case 2:
        // code
        break;
    .
    .
    default:
        // code;
        break;
}
```

(#) implementation 1

```
int expression = 2;
if (expression == 1) {
    goto label1;
}
else if (expression == 2) {
    goto label2;
}
else {
    goto defaultlabel;
}
```

```
label1:
    // code
    goto endswitch();

label2:
    // code
    goto endswitch;

defaultlabel:
    // code
    goto endswitch;

endswitch:
    // code
```

(#) implementation 2

```
typedef void (*caseFn)();
int expr = 2;
caseFn jumptable[] = {label1, label2, label3};
if(expr >= 1 && expr <= 3)
{
    jumptable[expr-1]();
}
else {
    defaultlabel();
}

void label1() {
    // code
    goto endswitch;
}
void label2() {
    // code
    goto endswitch;
}

void label3() {
    // code
    goto endswitch;
}
void defaultlabel() {
    // code
    goto endswitch;
}

endswitch:
    // code
```

We use an array of function pointers to represent the different cases of the switch statement.