

Q 1.

- As per IEEE 754 standard the exponent part defines the precision of a floating-point number representation.
- In the case of $\exp(x)$ i.e. e^x expansion series the general term $(X^a)/(a!)$ gets smaller with progression and finally converges to zero. So, to hold more smaller numbers between 1 and 0 a larger size exponent is required.
- That's the reason double precision (64-bit) representation has higher precision than single precision (32-bit) representation because double precision has 11 bits in exponent whereas single precision has only 8bits in its exponent part

Q 2.

- In IEEE 754 standard for normal values, the exponent part goes from 0x01 to 0xFE.
- Whereas subnormal values have exponent part with all bits zero. This is very useful in cases where number approaches zero i.e. in between 1 and 0.
- Numbers with value much nearer to zero requires very high precision and can undergo underflow condition where subnormal values come to help.

Q 3.

Five methods defined by IEEE 754 standard for rounding up floating-point numbers are:

- Round toward zero: In this the numbers are rounded to the first integer while moving towards zero on the number line for example 3.2 is rounded to 3, 8.5 is rounded to 8 and -6.9 is rounded to -6.
- Round down: In this the number is rounded to the first integer while moving towards the negative infinity on number line. For example, 3.2 is rounded to 3, 8.5 is rounded to 8 and -6.9 is rounded to -7.
- Round up: In this the number is rounded to the next integer while moving towards the positive infinity on number line. For example, 3.2 is rounded to 4, 8.5 is rounded to 9 and -6.9 is rounded to -6.
- Round-to-nearest: In this the number is rounded to the nearest integer value. For example, 3.2 is rounded to 3 and -6.9 is rounded to -7. But this case has problem with the numbers such as 8.5 which re half-way between two integers 8 and 9.
- Round-to-even: In this the numbers are rounded to the nearest even numbers. This is the default rounding mode for IEEE floating point numbers. For example, 3.2 is rounded to 4, 2.3 is rounded to 2, -1.5 is rounded to -2.