Introduction

Presentation Agenda

- Lesson Plan
- Marks Distribution
- Number Representation

About Classes

- Course credit?

- Class duration?

- Number of classes per week and total number of classess?

- Theory and Lab class schedule?

About Classes

- Mark distribution for theory course?
    - Final exam
    - CT
    - Attendance

- Mark distribution for Lab course?
    - Continious assessment or Final exam
    - Attendance
    - Viva

About Classes

- We’ll have 3 CTs

- 2 Assignments

- 2 Quizzes

Lecture 1
Number Representation

যশোর বিজ্ঞান ও প্রযুক্তি বিশ্ববিদ্যালয়

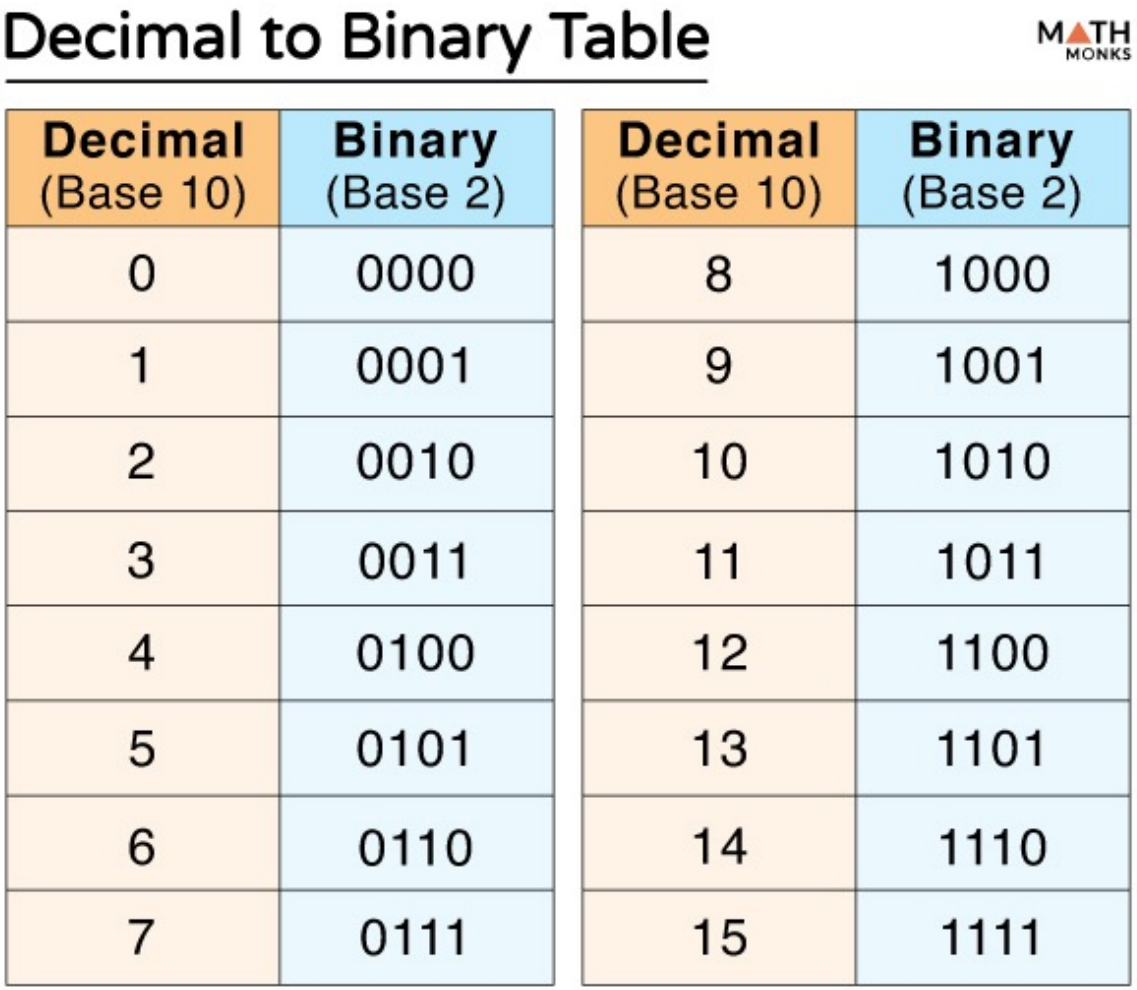
জ্ঞানই শক্তি

2007

JUST

Jashore University of Science and Technology

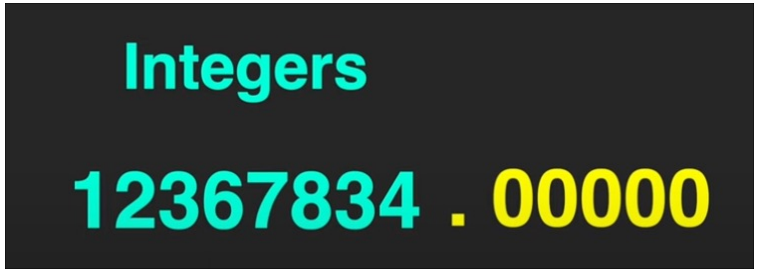
Introduction to Number Systems



Decimal to Binary Table

Decimal (Base 10)	Binary (Base 2)	Decimal (Base 10)	Binary (Base 2)
0	0000	8	1000
1	0001	9	1001
2	0010	10	1010
3	0011	11	1011
4	0100	12	1100
5	0101	13	1101
6	0110	14	1110
7	0111	15	1111

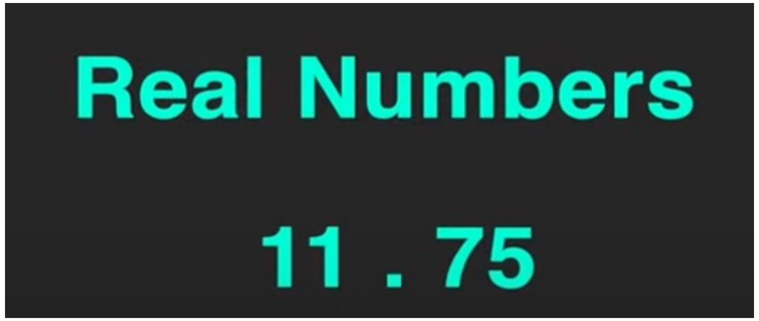
- Integer Number



Integers

12367834 . 00000

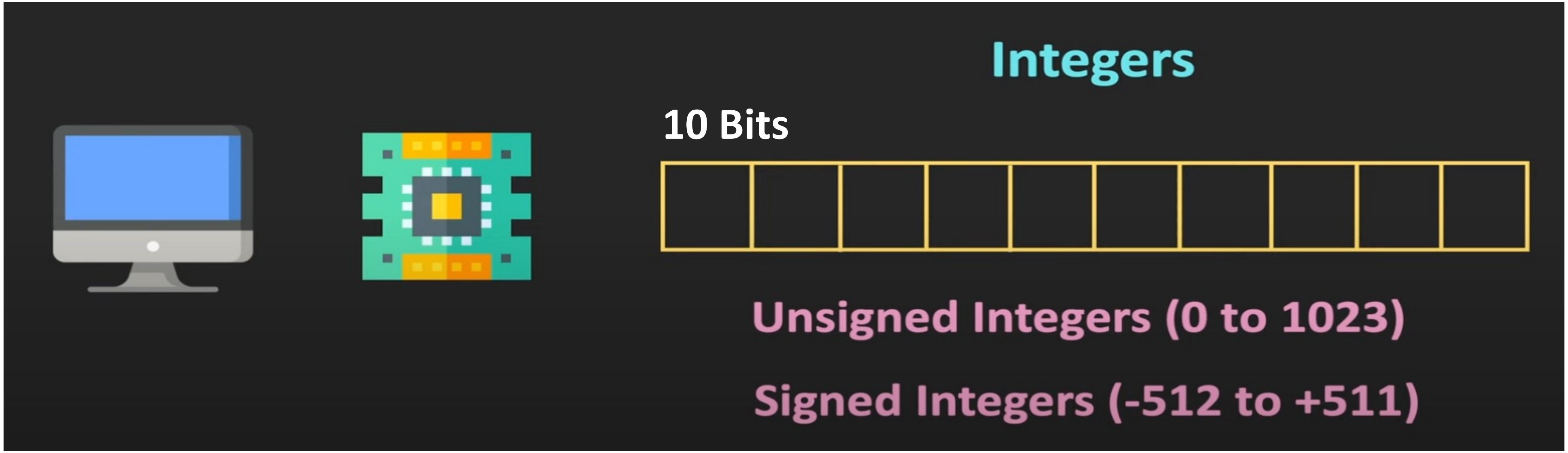
- Floating point number / Real Number



Real Numbers

11 . 75

Is Fixed Point Representation Enough?



Integers

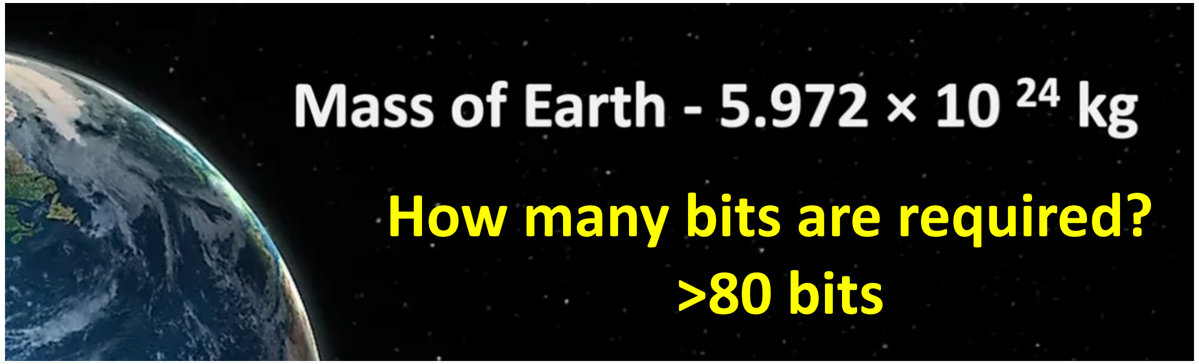
10 Bits

Unsigned Integers (0 to 1023)

Signed Integers (-512 to +511)

- Range – Difference between the smallest and largest number

- How to increase the range?
  - Increasing the number of bits

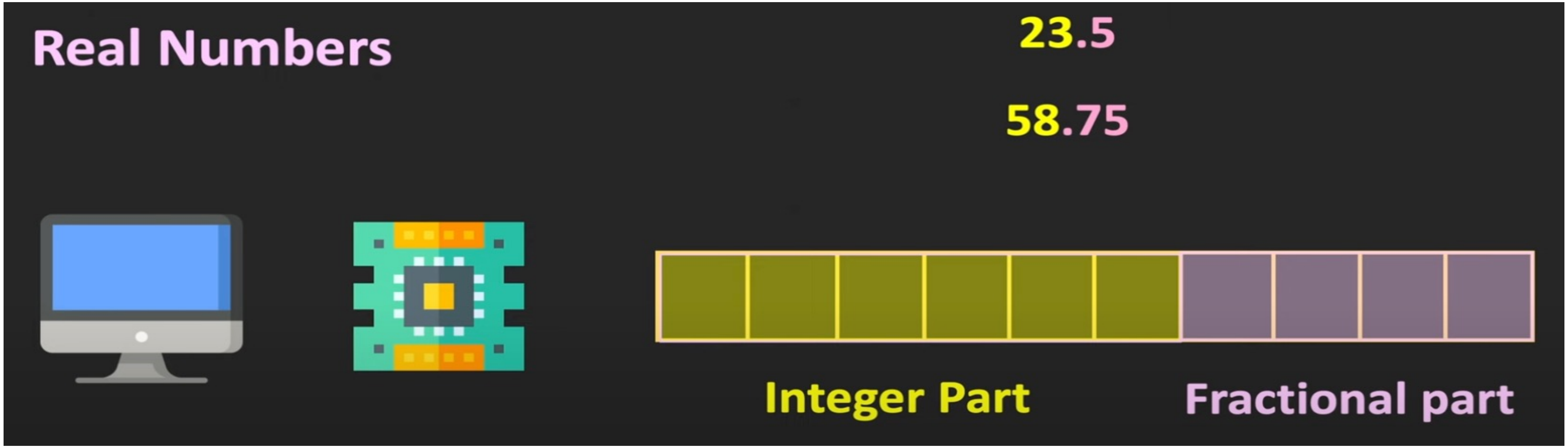


Mass of Earth - 5.972×10^{24} kg

How many bits are required?

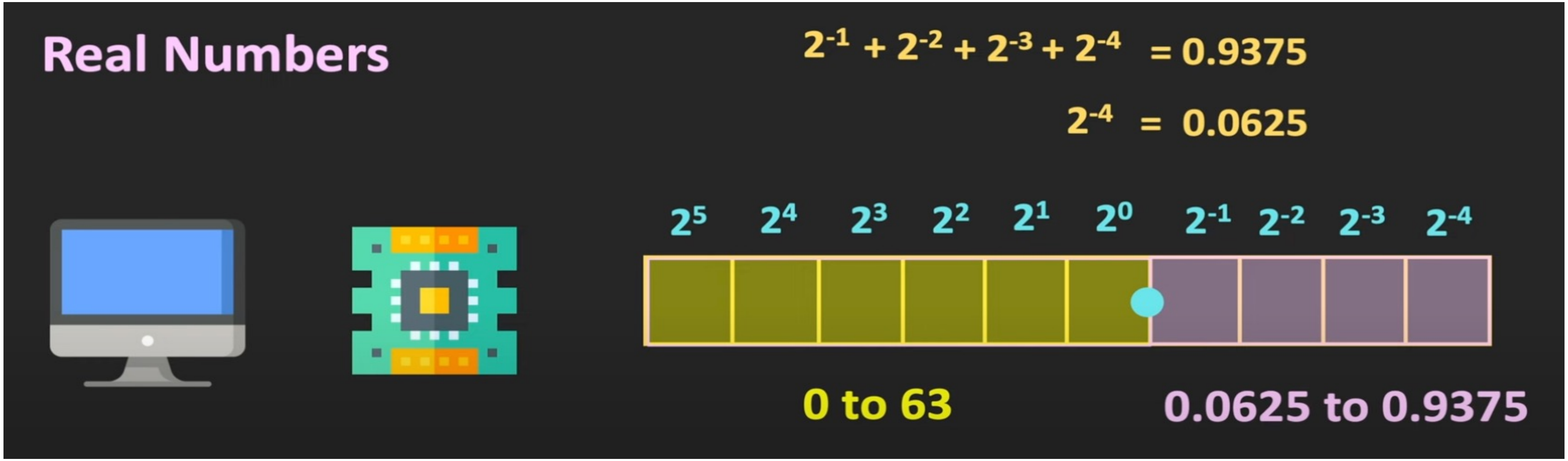
>80 bits

Floating Point Representation



- The radix point position need to be fixed
  - The left side represents integer part
  - The right side represents fraction part

Floating Point Representation

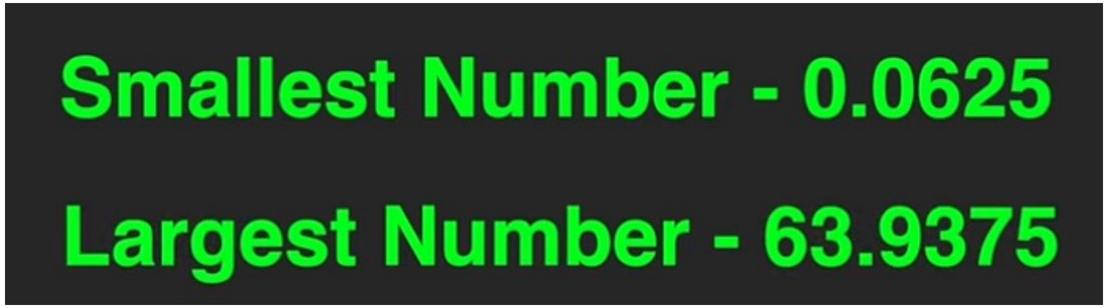


Real Numbers

$2^{-1} + 2^{-2} + 2^{-3} + 2^{-4} = 0.9375$

$2^{-4} = 0.0625$

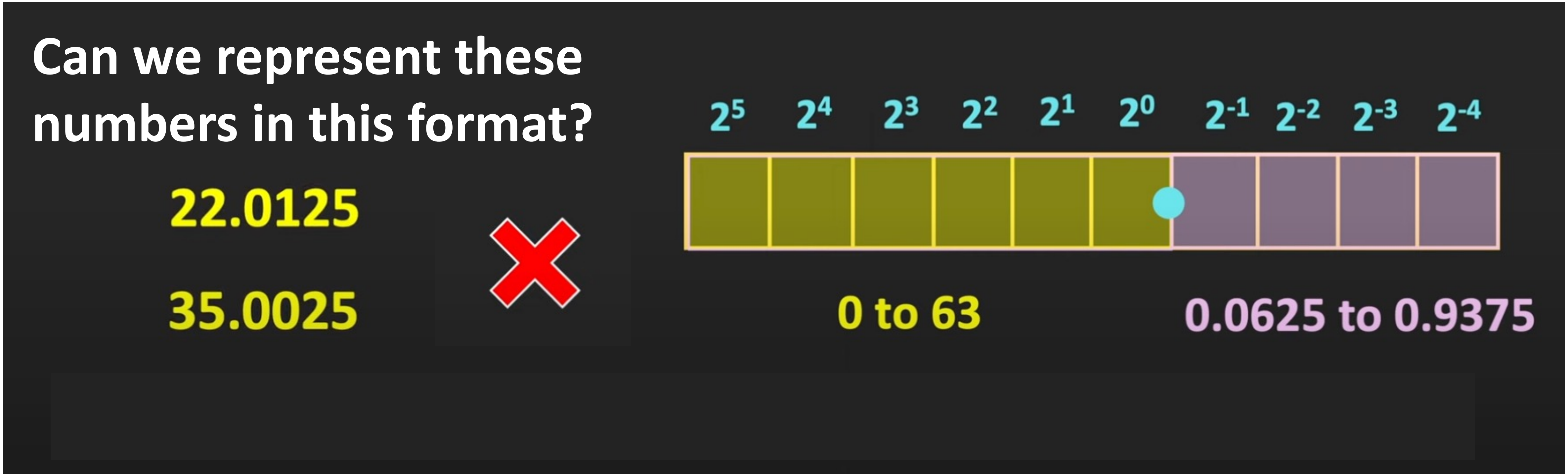
- The fractional part
  - Maximum - 0.9375
  - Minimum – 0.0625



Smallest Number - 0.0625

Largest Number - 63.9375

Floating Point Representation



Can we represent these numbers in this format?

22.0125

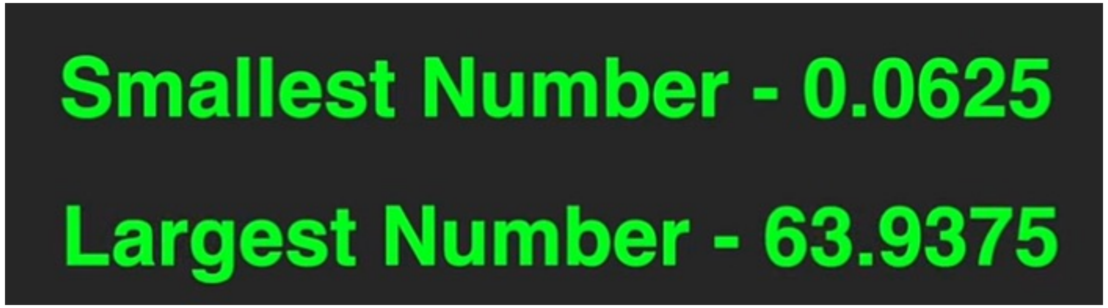
35.0025

✗

0 to 63

0.0625 to 0.9375

- The fractional part
  - Maximum - 0.9375
  - Minimum – 0.0625



Smallest Number - 0.0625

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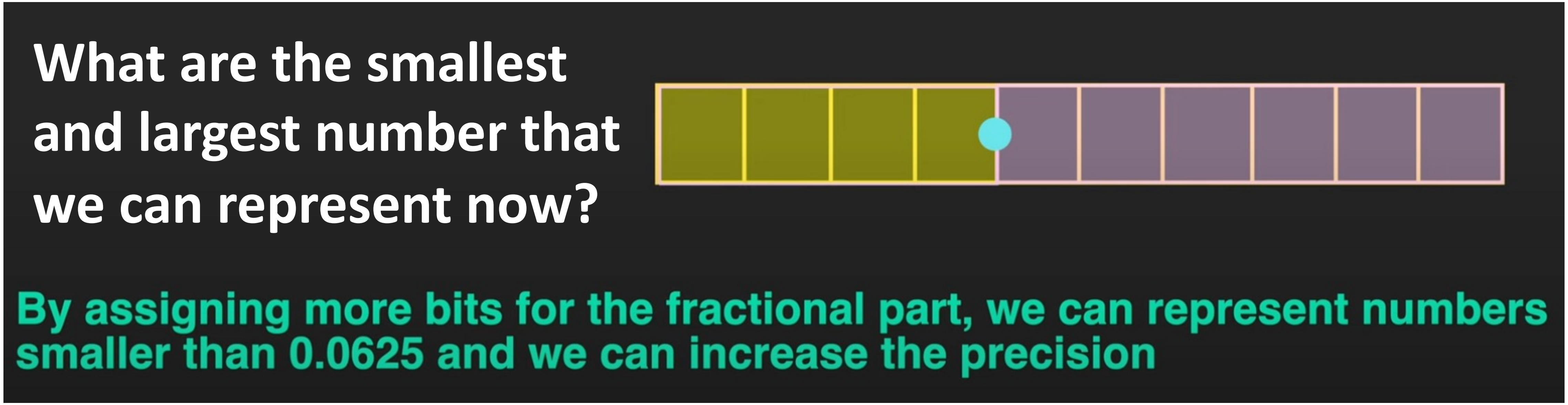
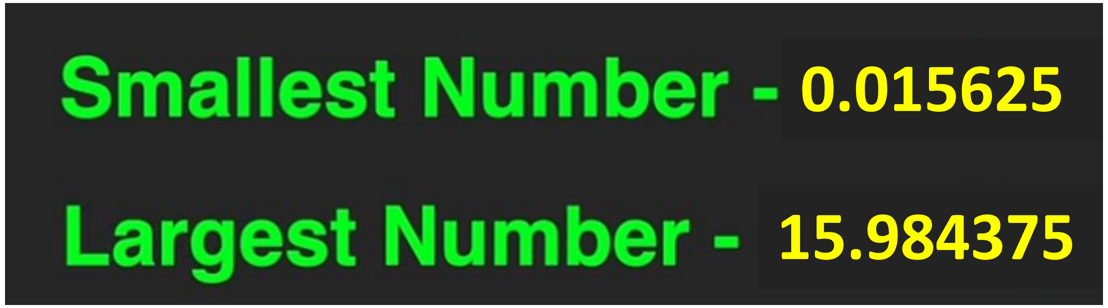
Floating Point Representation



What are the smallest and largest number that we can represent now?

By assigning more bits for the fractional part, we can represent numbers smaller than 0.0625 and we can increase the precision

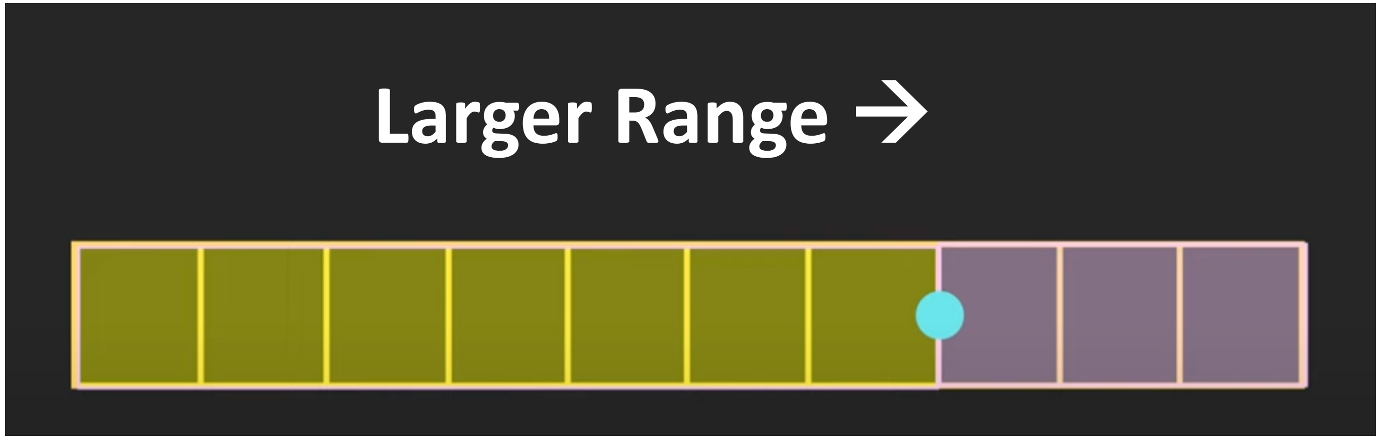
- To represent more smaller fraction part we need to assign more bits for it

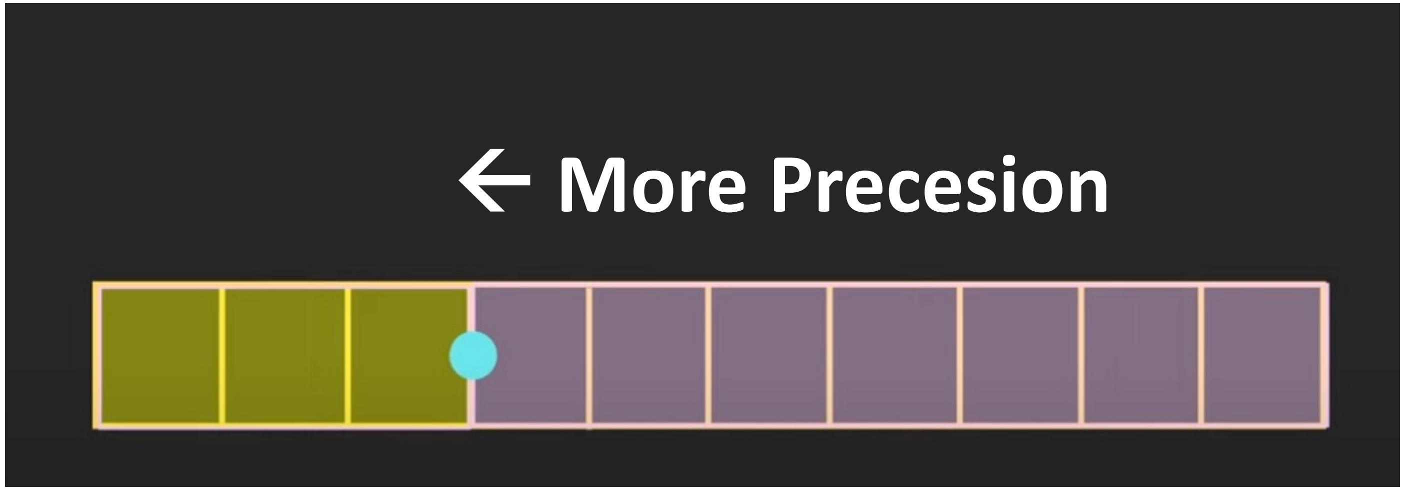


Smallest Number - 0.015625

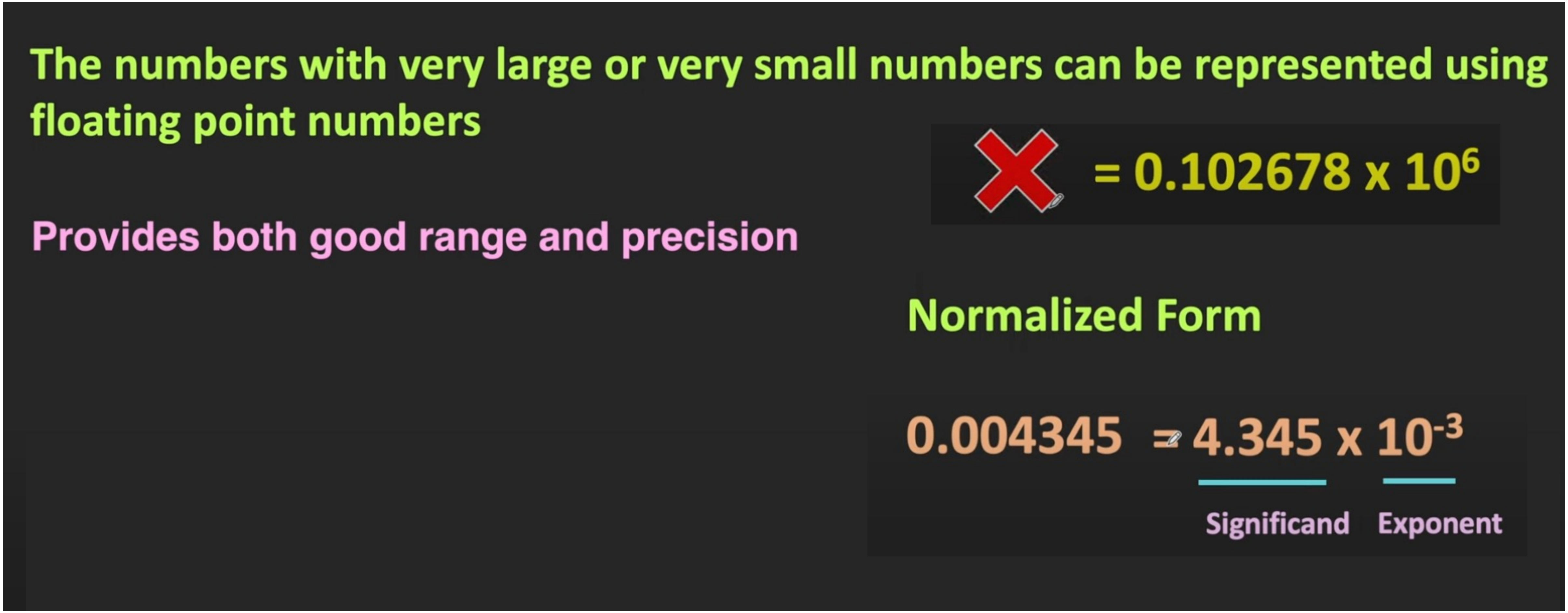
Largest Number - 15.984375

Floating Point Representation





Floating Point Numbers



The numbers with very large or very small numbers can be represented using floating point numbers

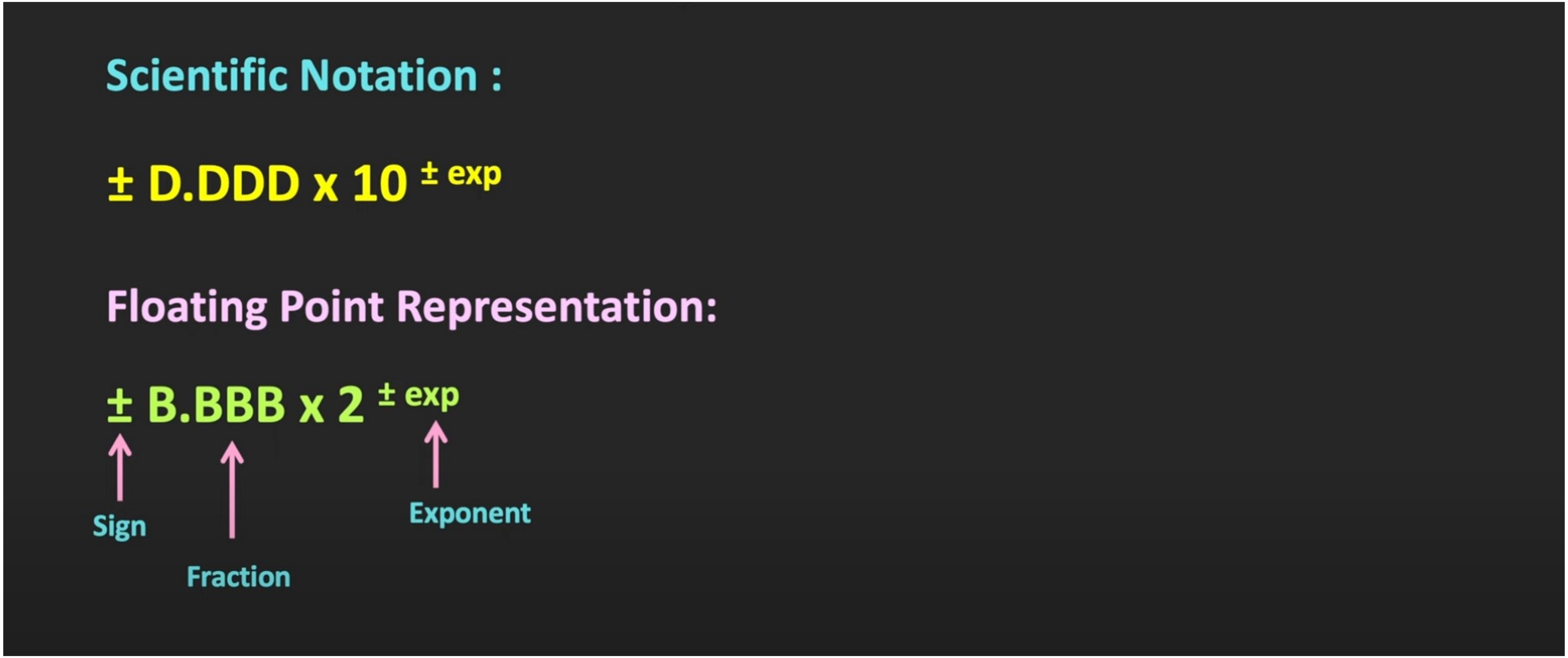
✗ $= 0.102678 \times 10^{6}$

Provides both good range and precision

Normalized Form

$$0.004345 = \underbrace{4.345}_{\text{Significand}} \times 10^{\underbrace{-3}_{\text{Exponent}}}$$

Floating Point Numbers



Scientific Notation :

$$\pm \text{D.DDD} \times 10^{\pm \text{exp}}$$

Floating Point Representation:

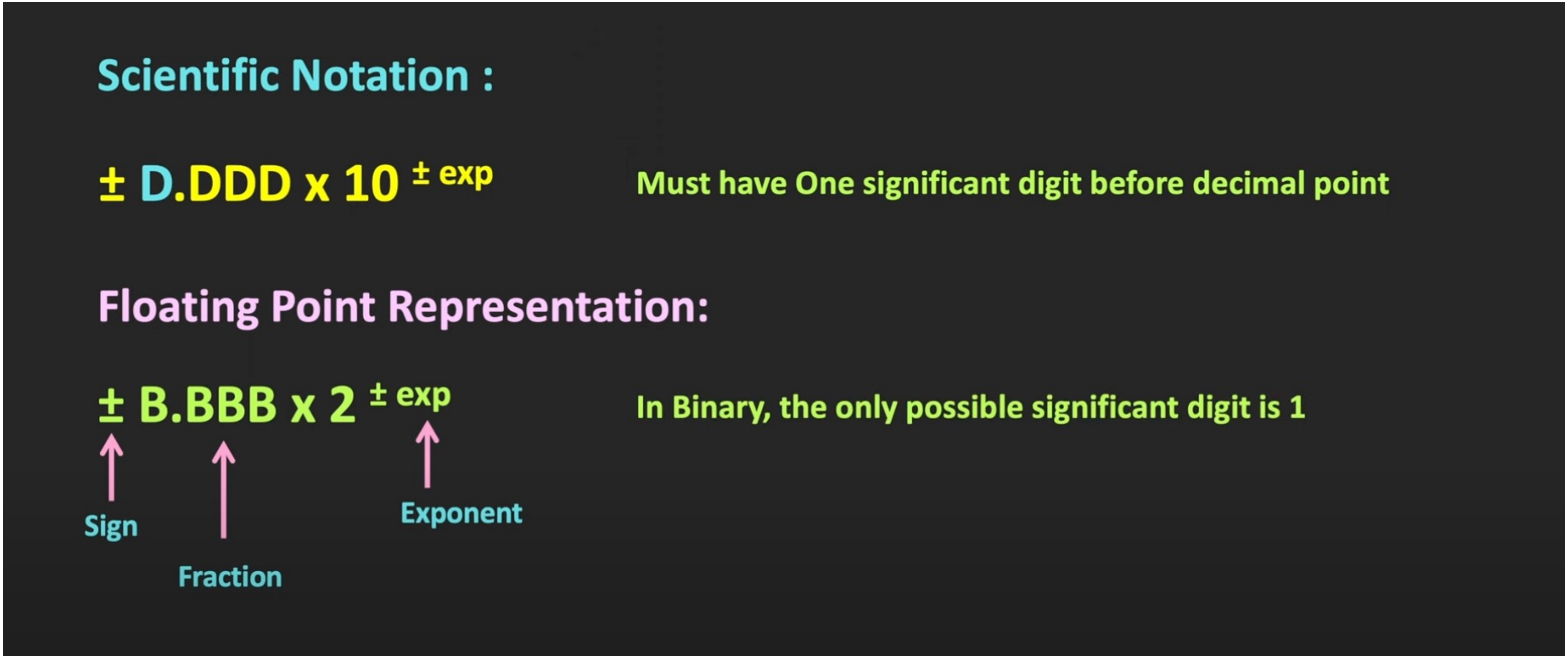
$$\pm \text{B.BBB} \times 2^{\pm \text{exp}}$$

Sign

Fraction

Exponent

Floating Point Numbers



Scientific Notation :

$\pm \text{D.DDD x } 10^{\pm \text{exp}}$

Must have One significant digit before decimal point

Floating Point Representation:

$\pm \text{B.BBB x } 2^{\pm \text{exp}}$

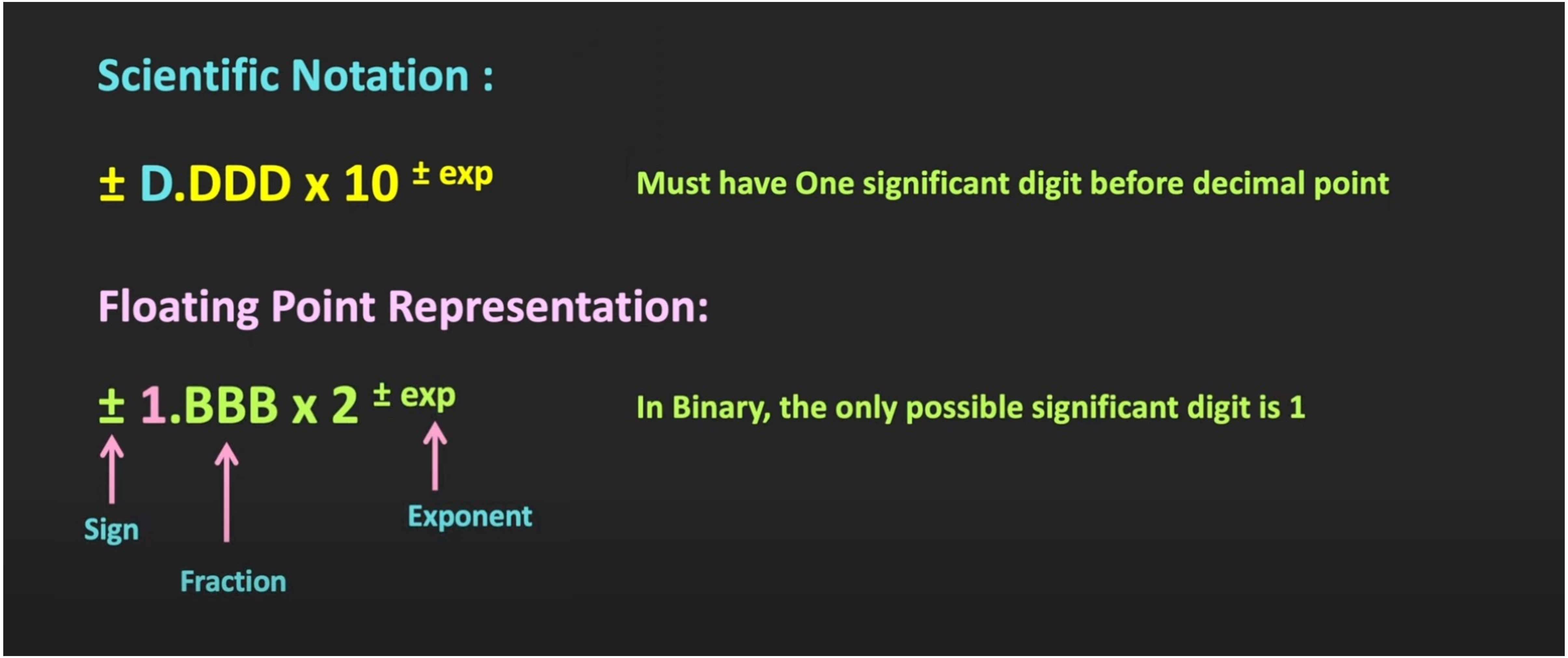
In Binary, the only possible significant digit is 1

Sign

Fraction

Exponent

Floating Point Numbers



Scientific Notation :

$\pm \text{D.DDD} \times 10^{\pm \text{exp}}$

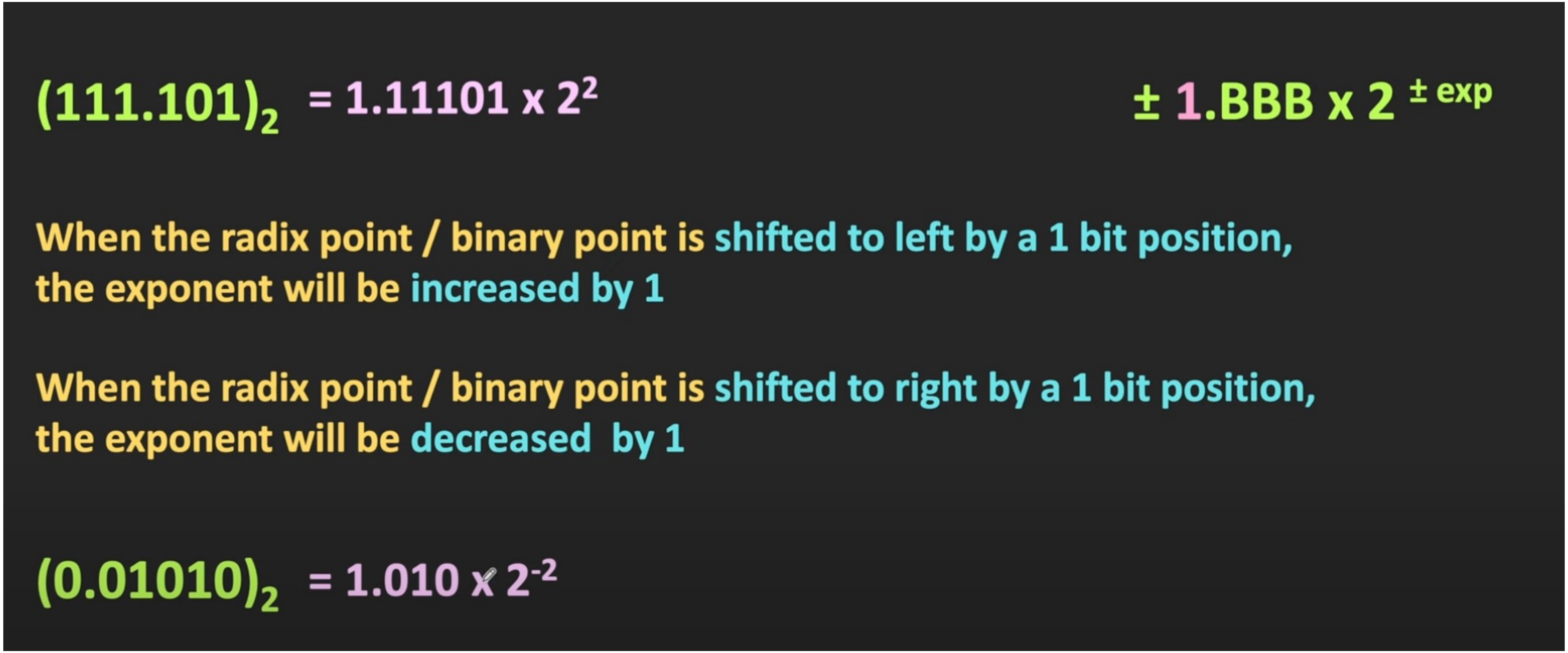
Must have One significant digit before decimal point

Floating Point Representation:

$\pm 1.\text{BBB} \times 2^{\pm \text{exp}}$

In Binary, the only possible significant digit is 1

Normalization in Floating Point Numbers



$(111.101)_2 = 1.11101 \times 2^2$

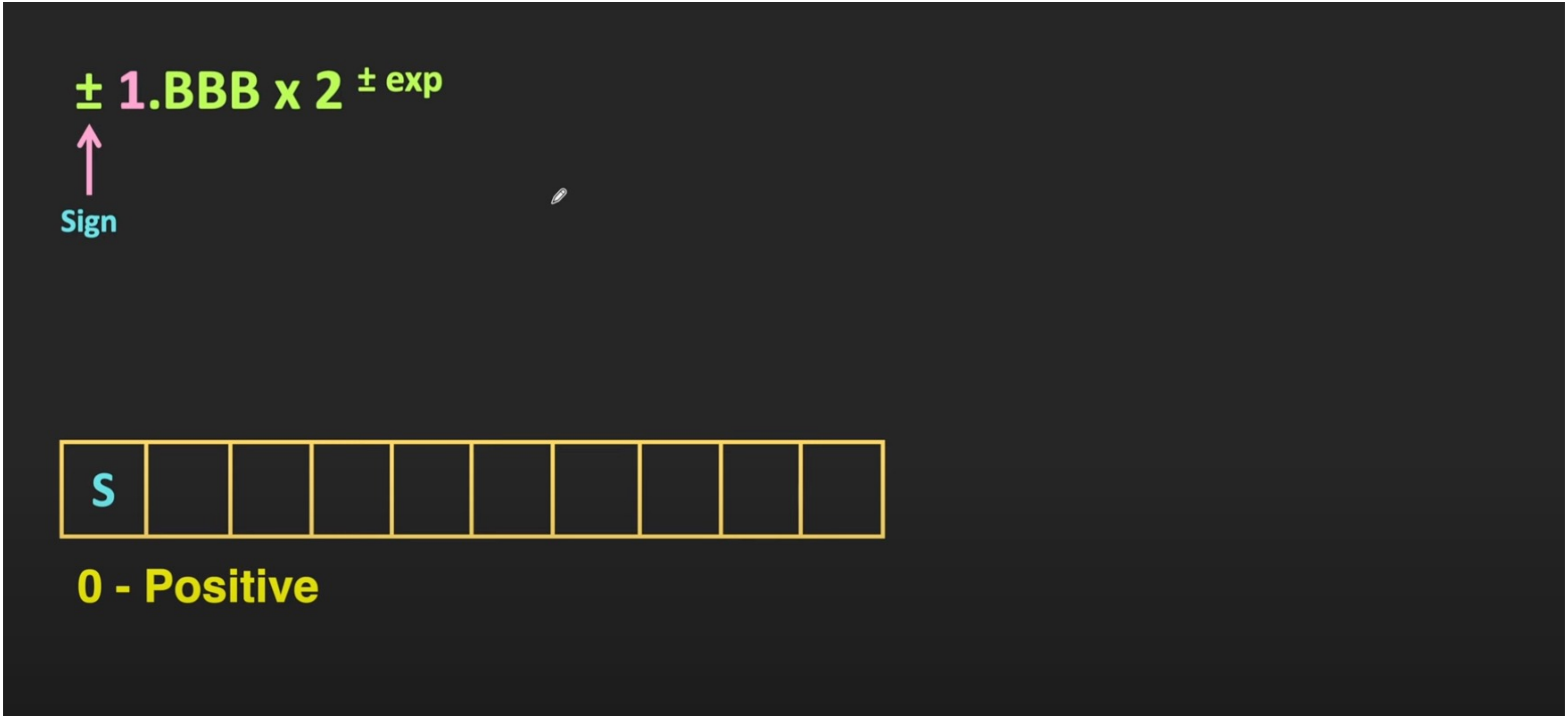
$\pm 1.\text{BBB} \times 2^{\pm \text{exp}}$

When the radix point / binary point is shifted to left by a 1 bit position, the exponent will be increased by 1

When the radix point / binary point is shifted to right by a 1 bit position, the exponent will be decreased by 1

$(0.01010)_2 = 1.010 \times 2^{-2}$

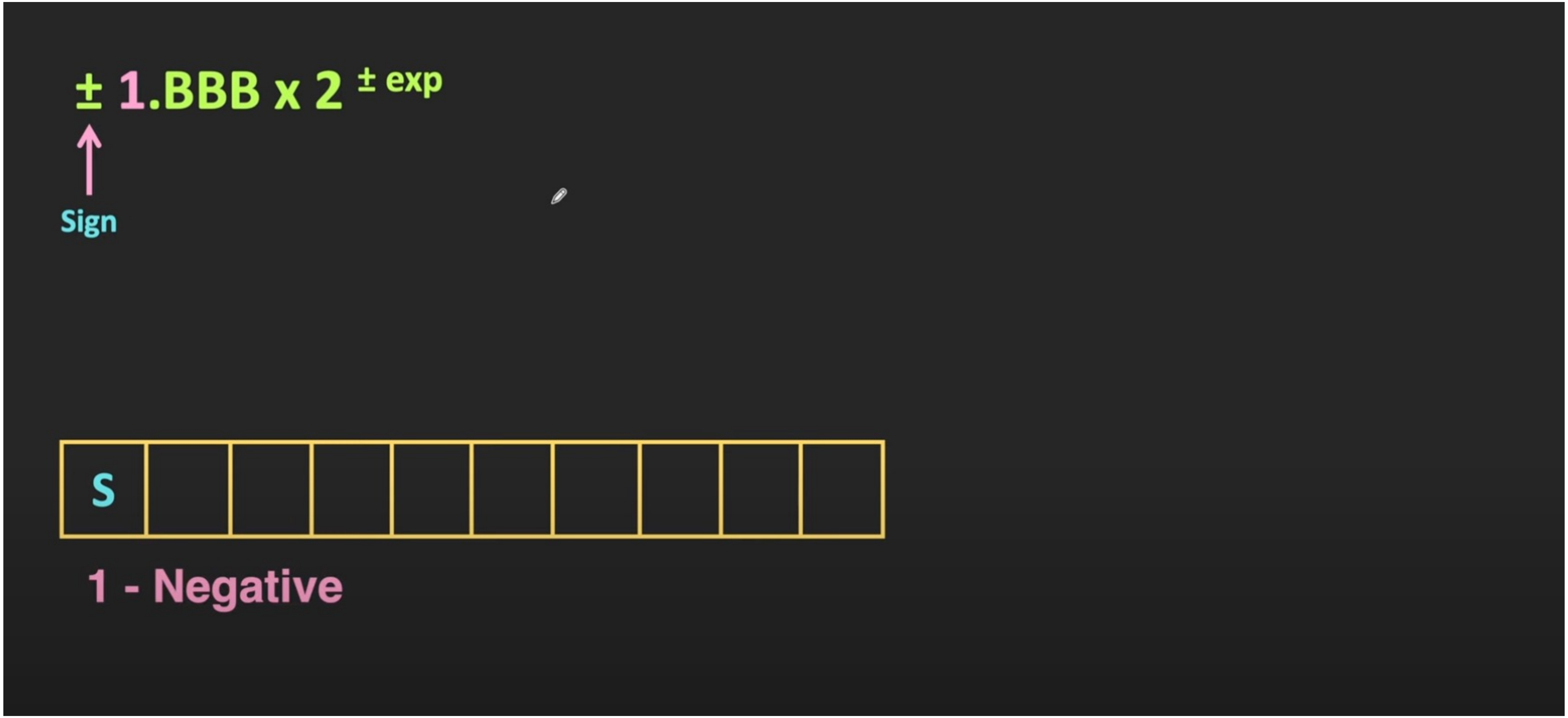
How Floating Point Numbers are Stored in Memory?



$\pm 1.BBB \times 2^{\pm exp}$

0 - Positive

How Floating Point Numbers are Stored in Memory?



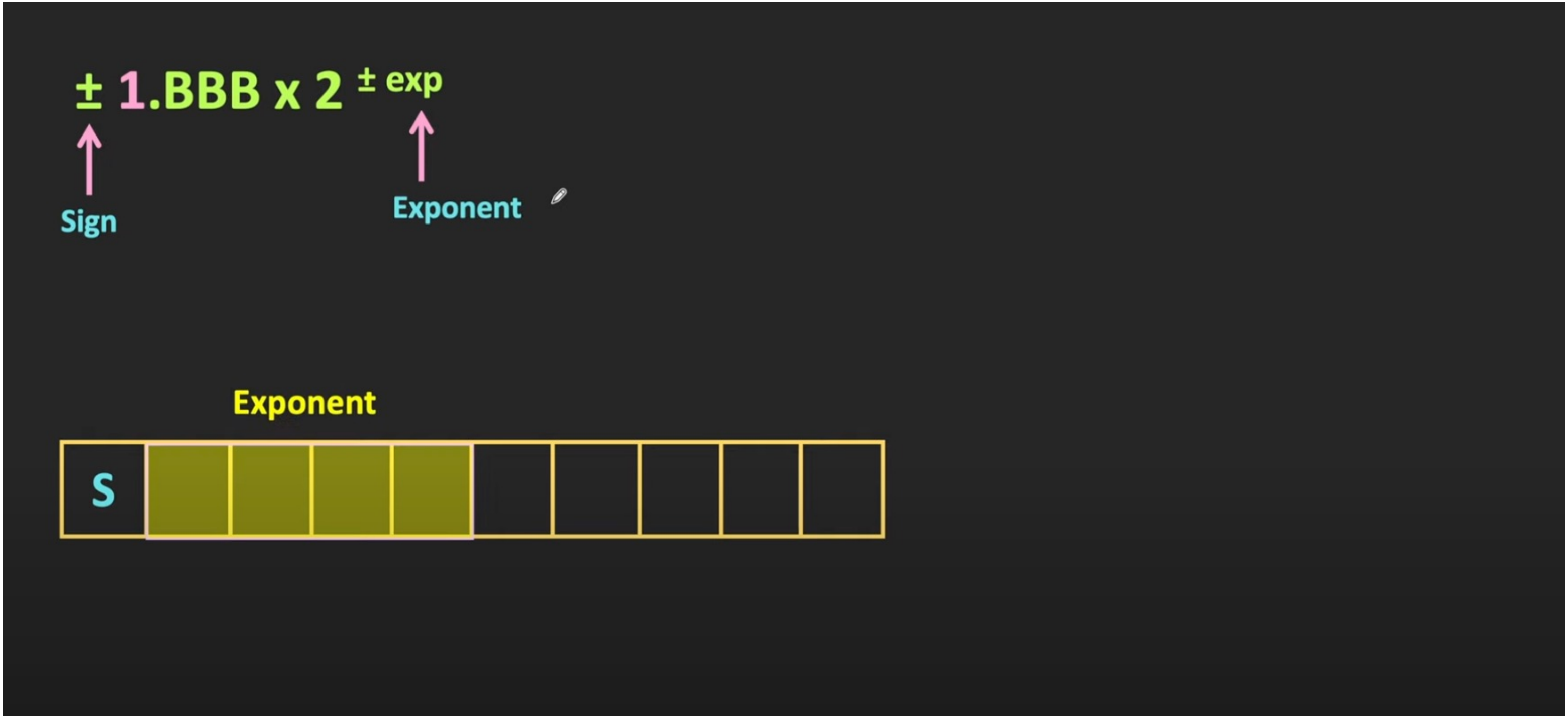
$\pm 1.BBB \times 2^{\pm exp}$

Sign

S									

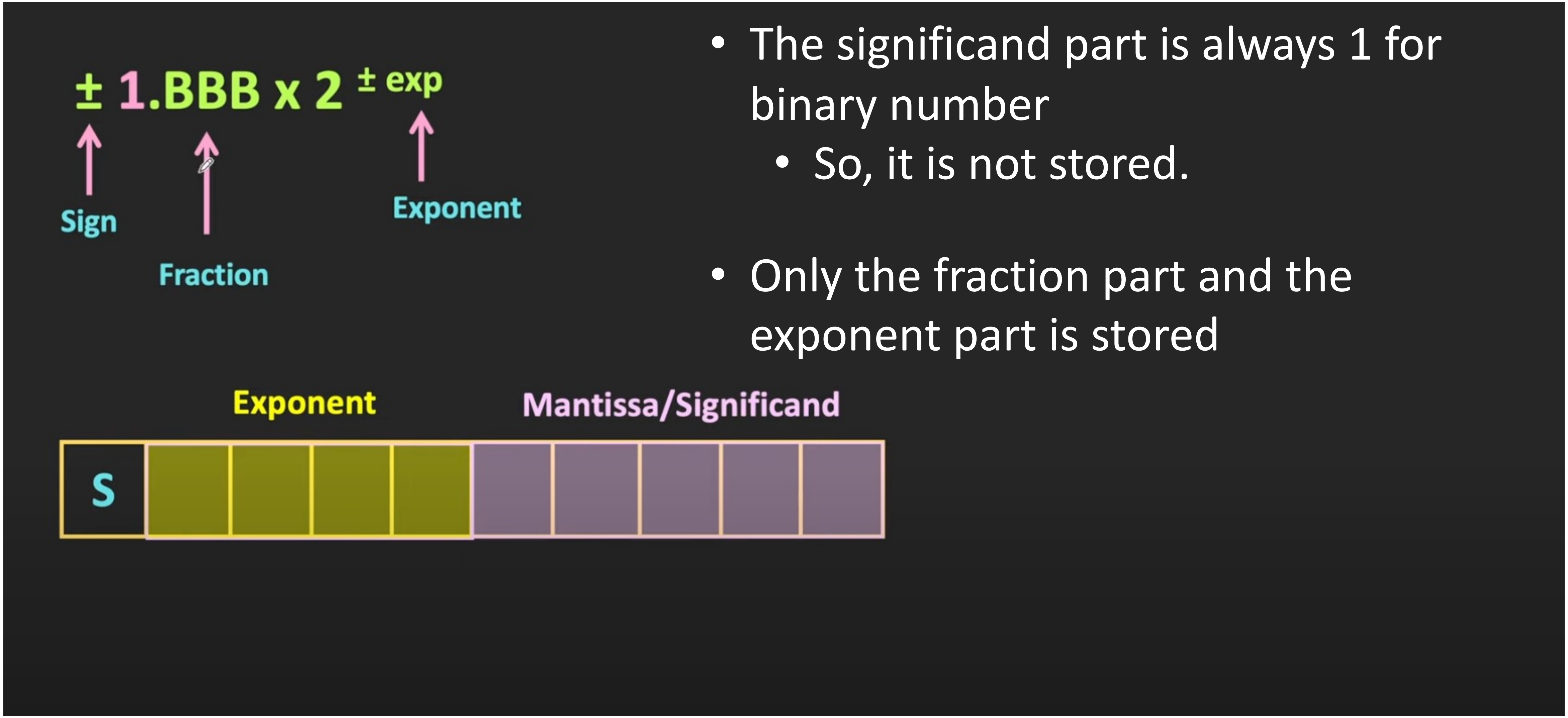
1 - Negative

How Floating Point Numbers are Stored in Memory?



$\pm 1.BBB \times 2^{\pm \exp}$

How Floating Point Numbers are Stored in Memory?



$\pm 1.BBB \times 2^{\pm exp}$

- The significand part is always 1 for binary number
  - So, it is not stored.
- Only the fraction part and the exponent part is stored

How Floating Point Numbers are Stored in Memory?

- How many bits for Mantissa and exponent?
- How to store the mantissa and exponent?

- We need standards
  - IEEE 754 (Next Class)

Thank you

Question and Suggestion

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