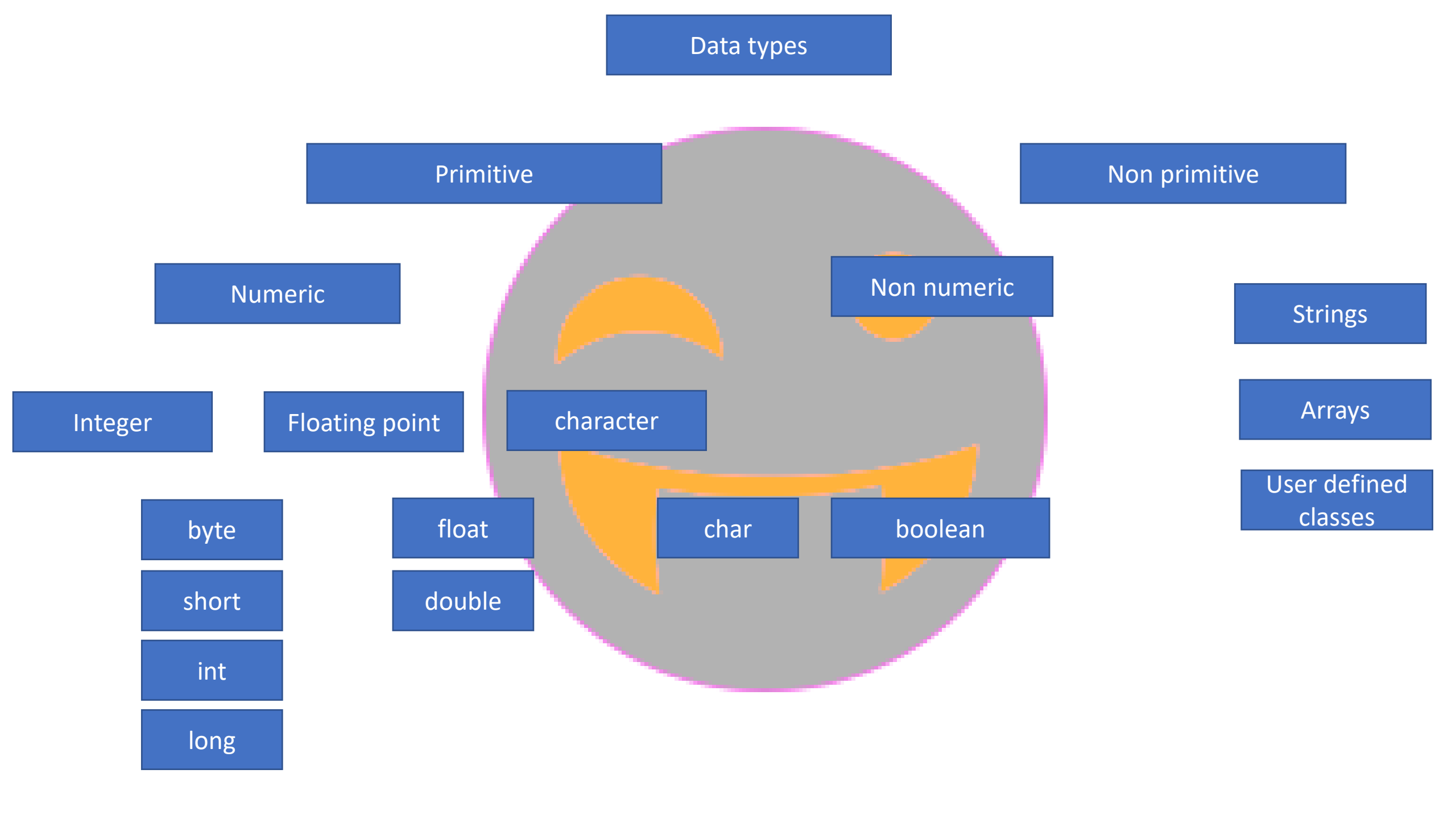
Chapter 19

Data types in Java - Theory


Data types
Primitive
Non primitive
Numeric
Non numeric
Strings
Integer
Floating point
character
Arrays
User defined classes
byte
float
char
boolean
short
double
int
long

What is a data type?

int suitcase1;

data-type variable-name;

int suitcase1

Ex: Rs. 100,000

Variable is like a container which holds some data

It specifies the type of values that the variable can hold

Also, specifies the quantity of values that the variable can hold

```
class CashProgram{
    public static void main(String[] args){
        int suitcase1;
        int suitcase2 = 2000;
        int suitcase3 = 3000;
        suitcase1 = 1000;
```

```
class Viewer{
    String name;
    boolean isLiked;
    boolean isSubscribed;
```


suresh techs సూపర్ మార్కెట్



suresh techs సూపర్ మార్కెట్

A basket is nothing but a container which is used to store cloths

techs సూపర్ మార్కెట్

Fractional numbers
(1.60, 240.9, -7.2999, 8.43)

double

float

Strings
("Suresh is a good boy")

String

basket is nothing but a container which is used to store cloths

Similarly, In programming we use different type of data. And we will choose a specific type of container as per our requirement.

true/false

boolean

Integers
(10, 40, -120, 143)

byte

long

int

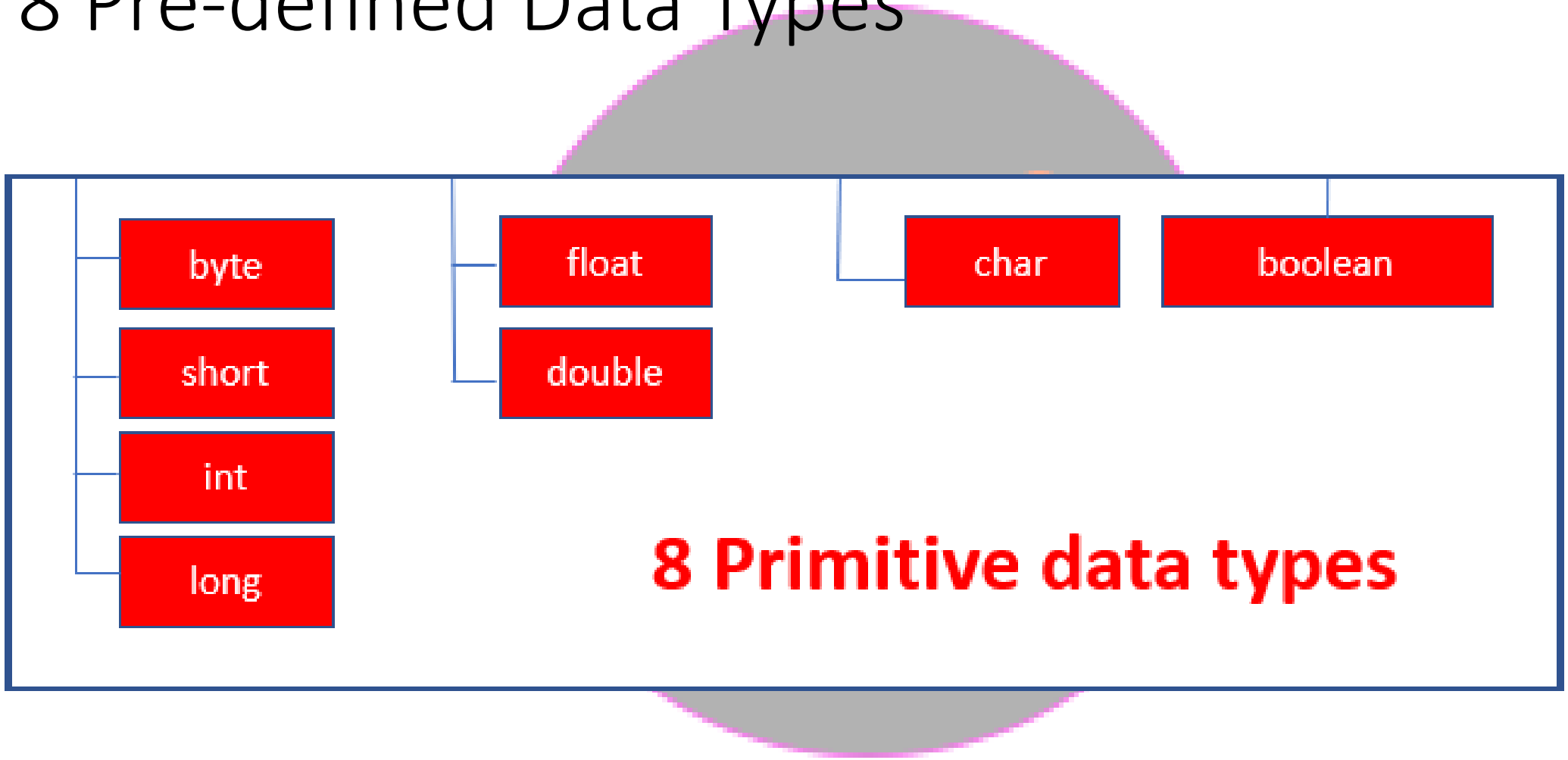
short

('A', '1','&','b','<', ' ')

characters

char

8 Pre-defined Data Types



techs సూపర్ మార్కెట్

Fractional numbers
(1.60, 240.9, -7.2999, 8.43)

double

float

basket is nothing but a container which is used to store cloths

Strings
(“Suresh is a good boy”)

String

true/false

Similarly, In programming we use different type of data. And we will choose a specific type of container as per our requirement.

boolean

Integers
(10, 40, -120, 143)

byte

long

int

short

characters
(‘A’, ‘1’,’&’,’b’,’<‘)

char

Which basket would you pickup?

- Very small, small, medium, or large
- It depends on your requirement

Quantity

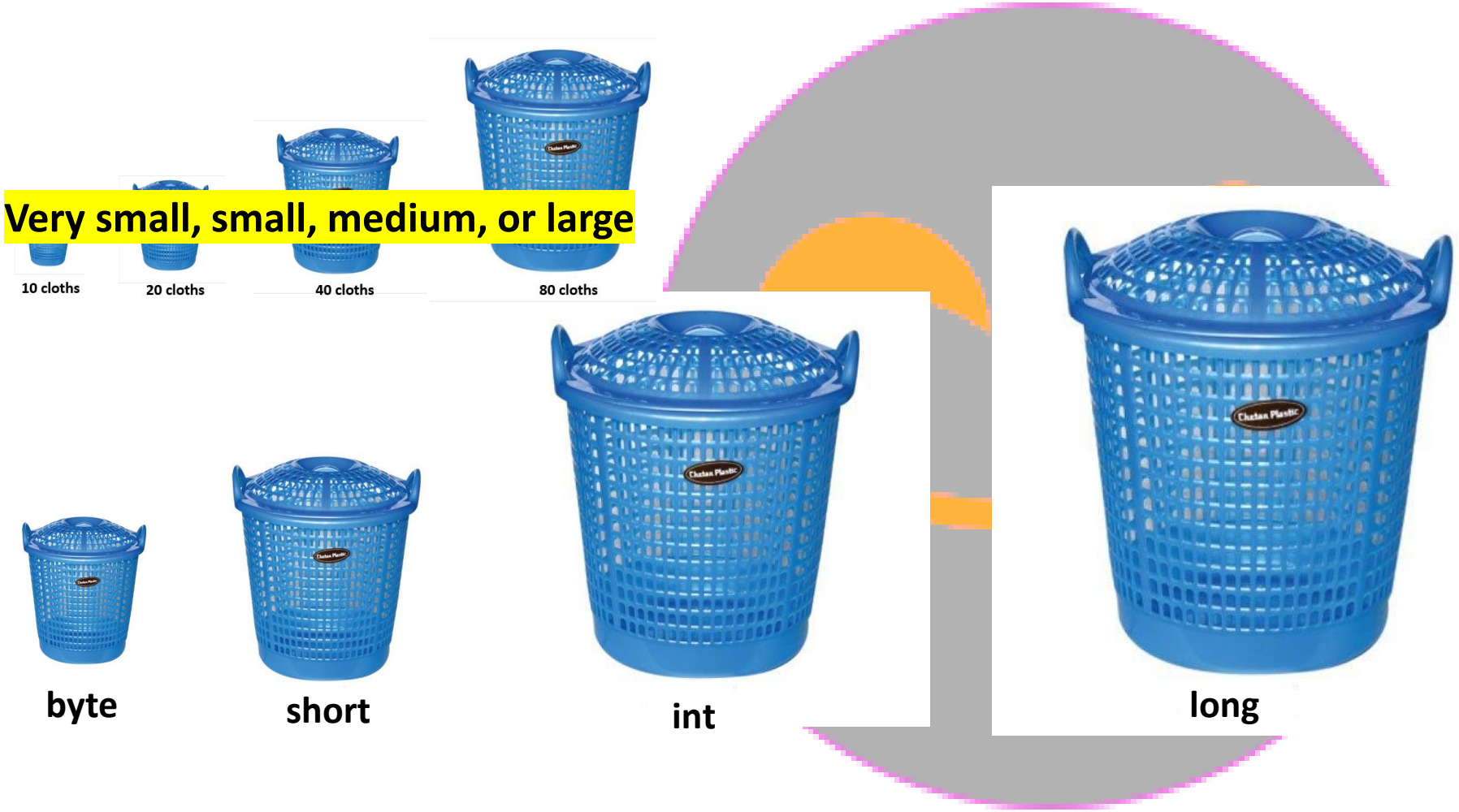
10 cloths

20 cloths

40 cloths

80 cloths

Similarly, we have different integer data types to store different integers(100000, 87, -18819, 9393939939)



How do we calculate quantity here?

Three things

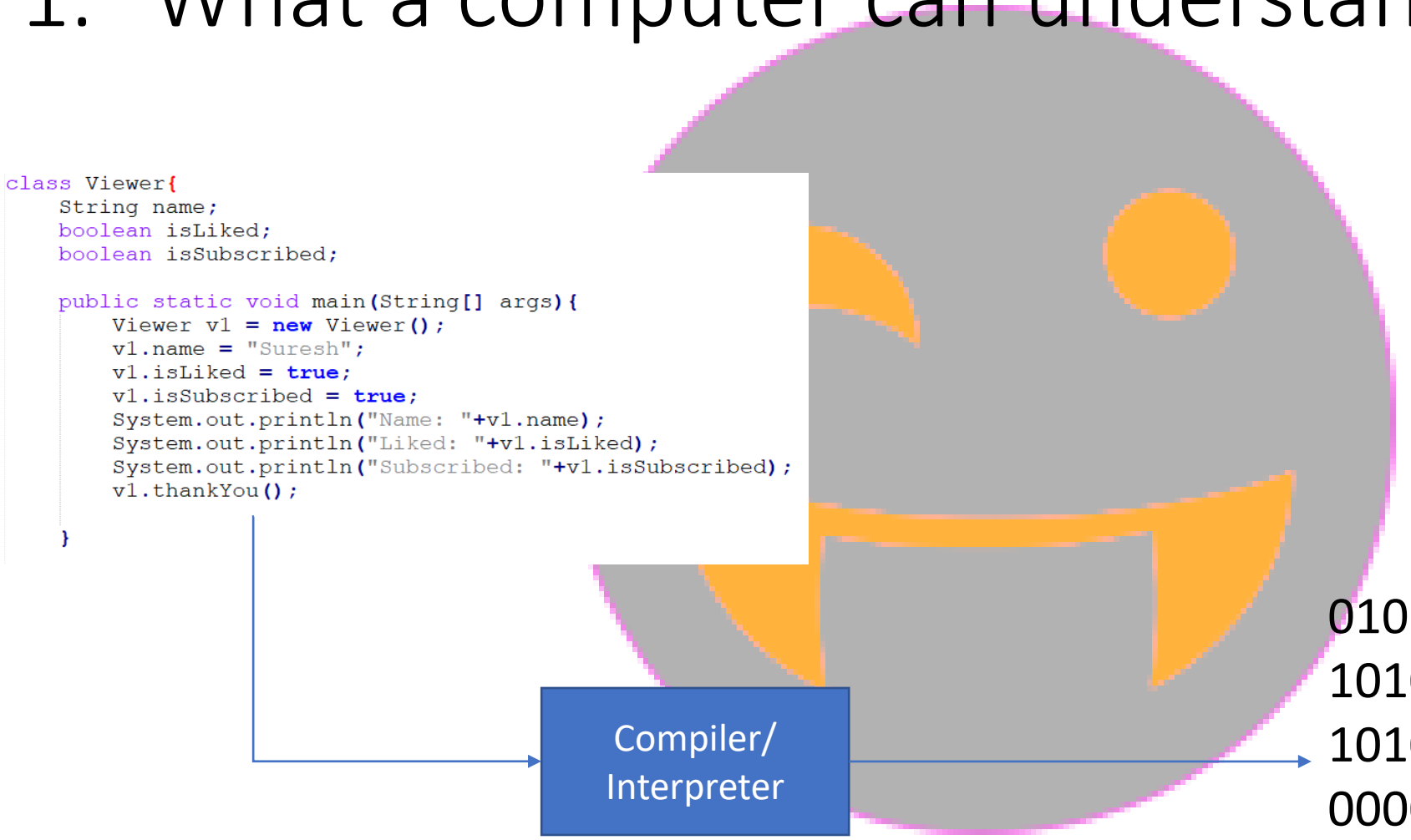
1. What a computer can understand?
2. Where does computer stores the data?
3. What is memory?

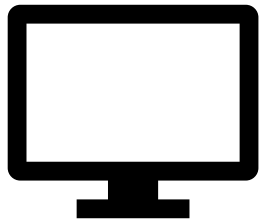
1. What a computer can understand?

```
class Viewer{
    String name;
    boolean isLiked;
    boolean isSubscribed;

    public static void main(String[] args){
        Viewer v1 = new Viewer();
        v1.name = "Suresh";
        v1.isLiked = true;
        v1.isSubscribed = true;
        System.out.println("Name: "+v1.name);
        System.out.println("Liked: "+v1.isLiked);
        System.out.println("Subscribed: "+v1.isSubscribed);
        v1.thankYou();

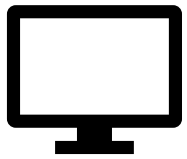
    }
```



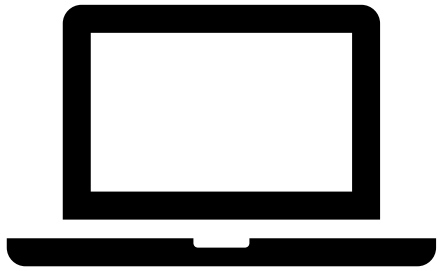


```
01011100101000010000010
10100001010010010000010
10101010100101000000010
00001010101110010000010
10100100110000010000010
```

2. Where does computer stores the program data ?



01011100101000010000010
10100001010010010000010
10101010100101000000010
00001010101110010000010
10100100110000010000010

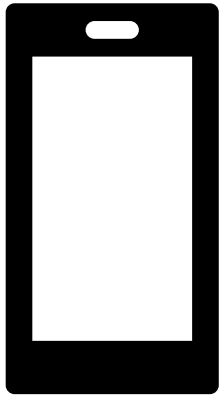


RAM - 4GB, 8GB, 16GB
Hard Disk - 500 GB, 1TB

Primary memory	Secondary memory
Temporary storage	Permanent storage
Directly accessible by the CPU	Not directly accessible by the CPU
RAM(Random Access Memory)	Hard Disk

- Program data will be stored in the **RAM(temporary memory)**
- **0 and 1 are called bits**
- **0 – bit**
- **1 – bit**

3. What is memory?



64 GB (Storage)

4 GB (RAM)

What is a byte?

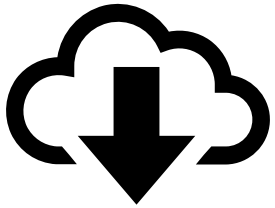
01011100101000010000010
10100001010010010000010
10101010100101000000010
00001010101110010000010
10100100110000010000010

0, 1 are called bits

0100 0010

8 Bits is called a byte

- **0 – bit**
- **1 – bit**
- **Binary system**
- **Binary means to 2**



Tiger **(1.2 GB)**

GB – **G**iga **B**ytes

Ambisara **(800 MB)**

MB – **M**ega **B**ytes

KB – **K**ilo **B**ytes

B - Bytes

Decimal number system (0 to 9)

(0, 1, 2, 3, 4, 5, 6, 7, 8, 9)

24

143

87

99012

139

29

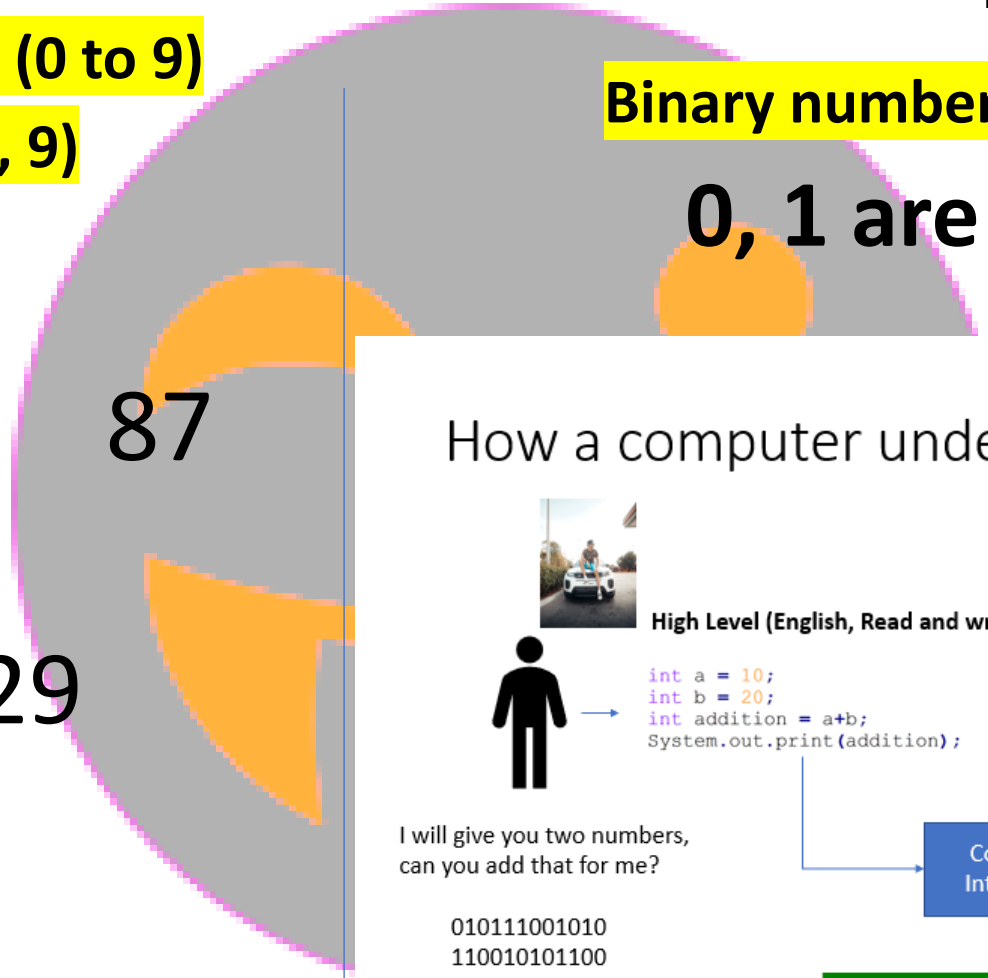
2022

765

1024

Binary number system (0 and 1)

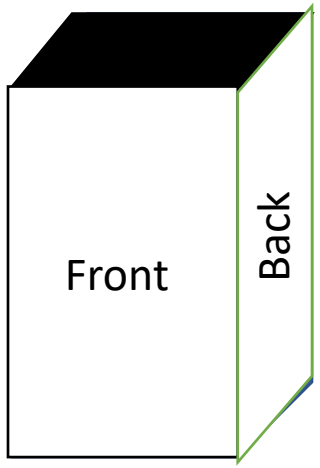
0, 1 are called Bits

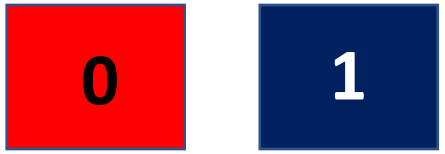


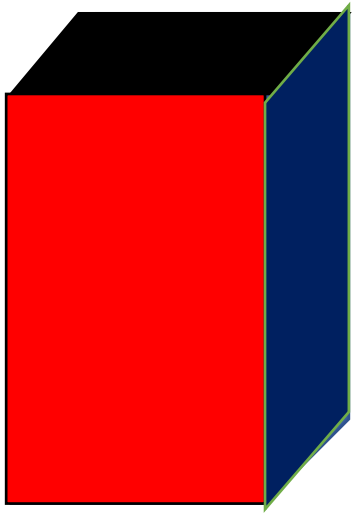
2. High level language

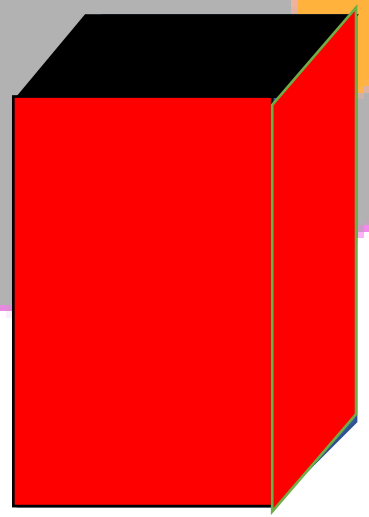
One small task

Different colour combinations to paint a wall front and back(2 sides-bit depth)

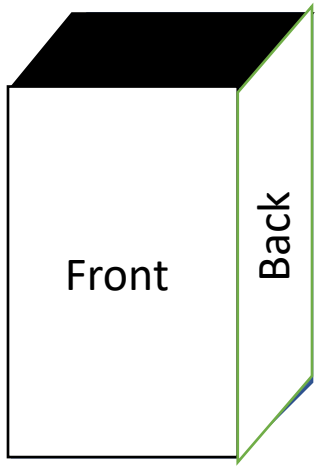


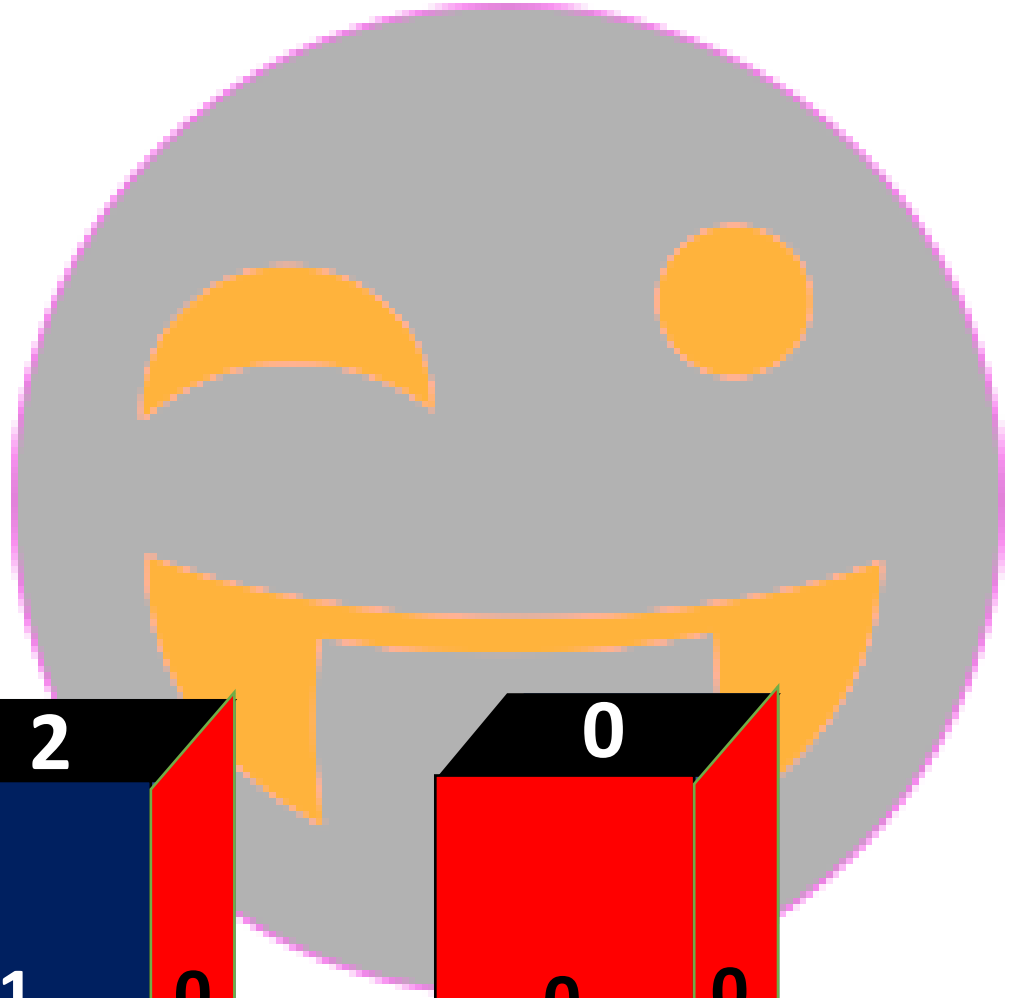


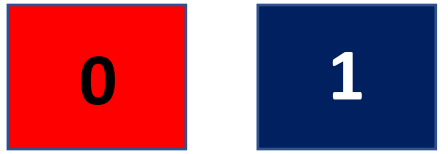


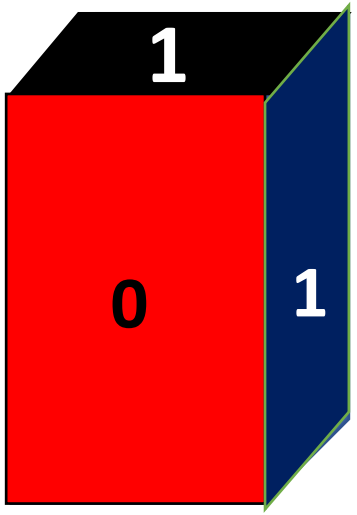


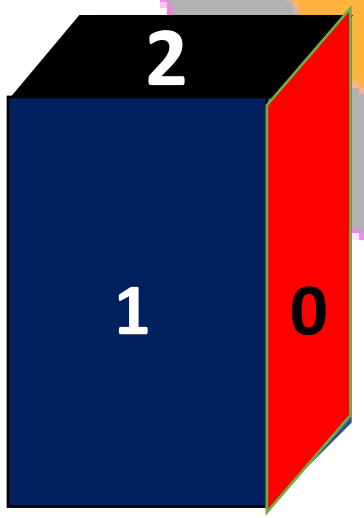
How many numbers can be represented using **two bits?**

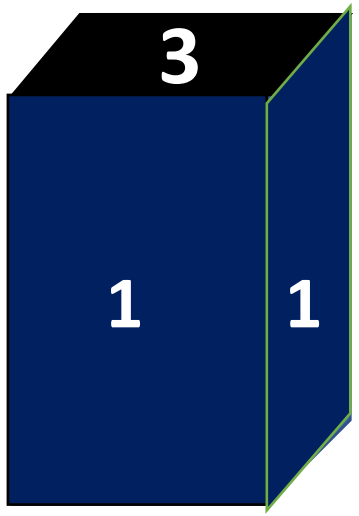










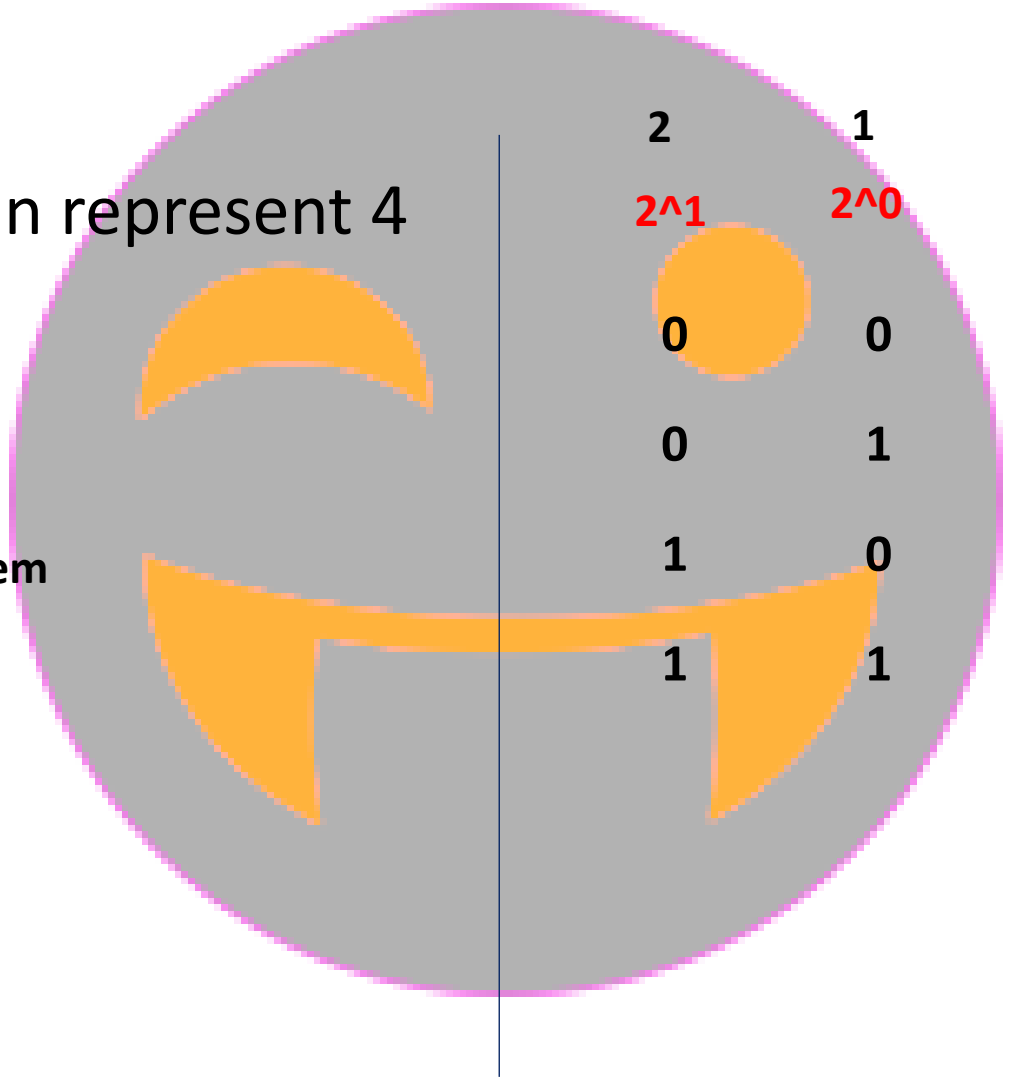


How many numbers can be represented using **two bits?**

- With two bits we can represent 4 combinations
- 00 **0**
- 01 **1**
- 10 **2**
- 11 **3**

Binary system

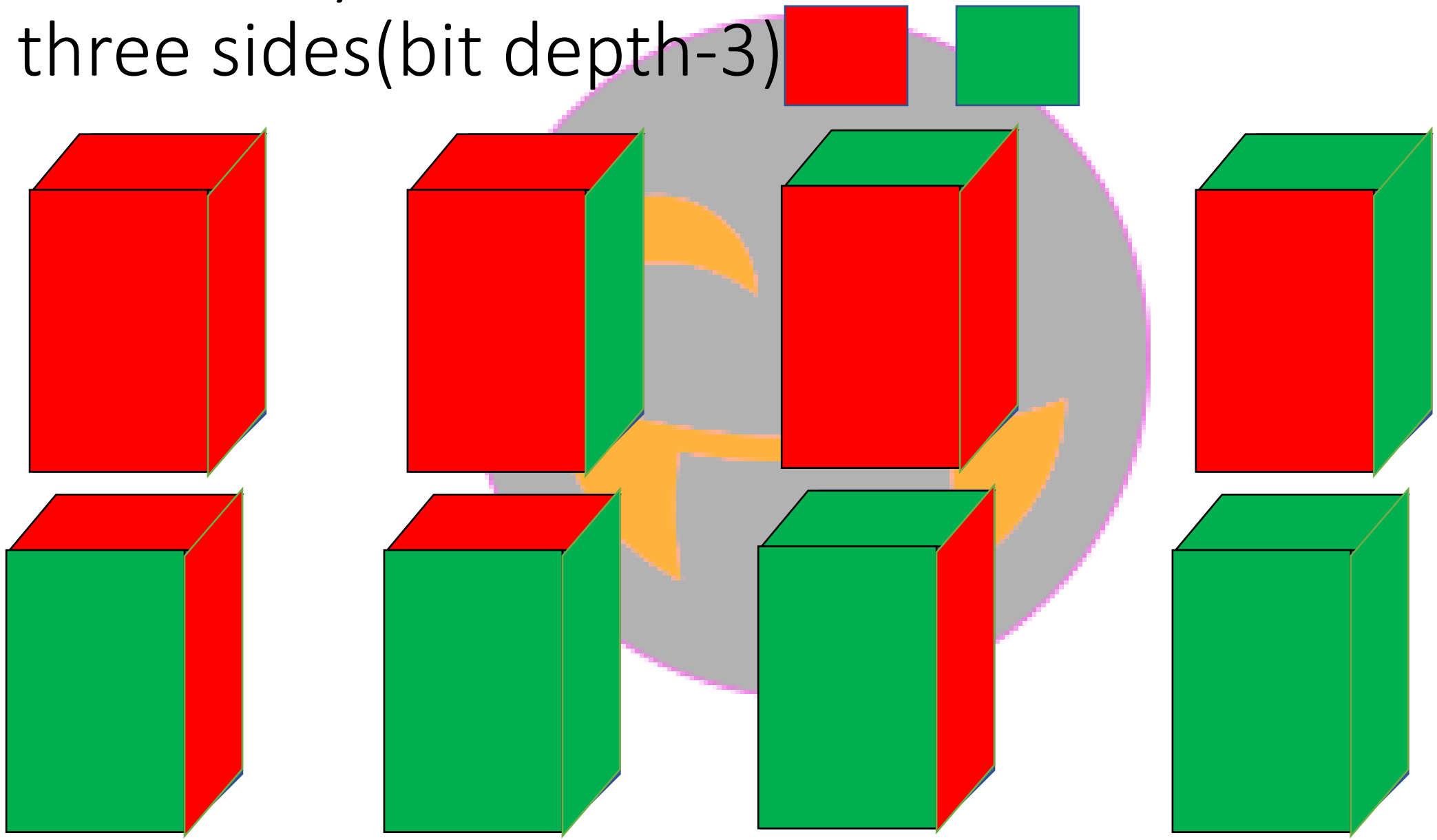
Decimal system



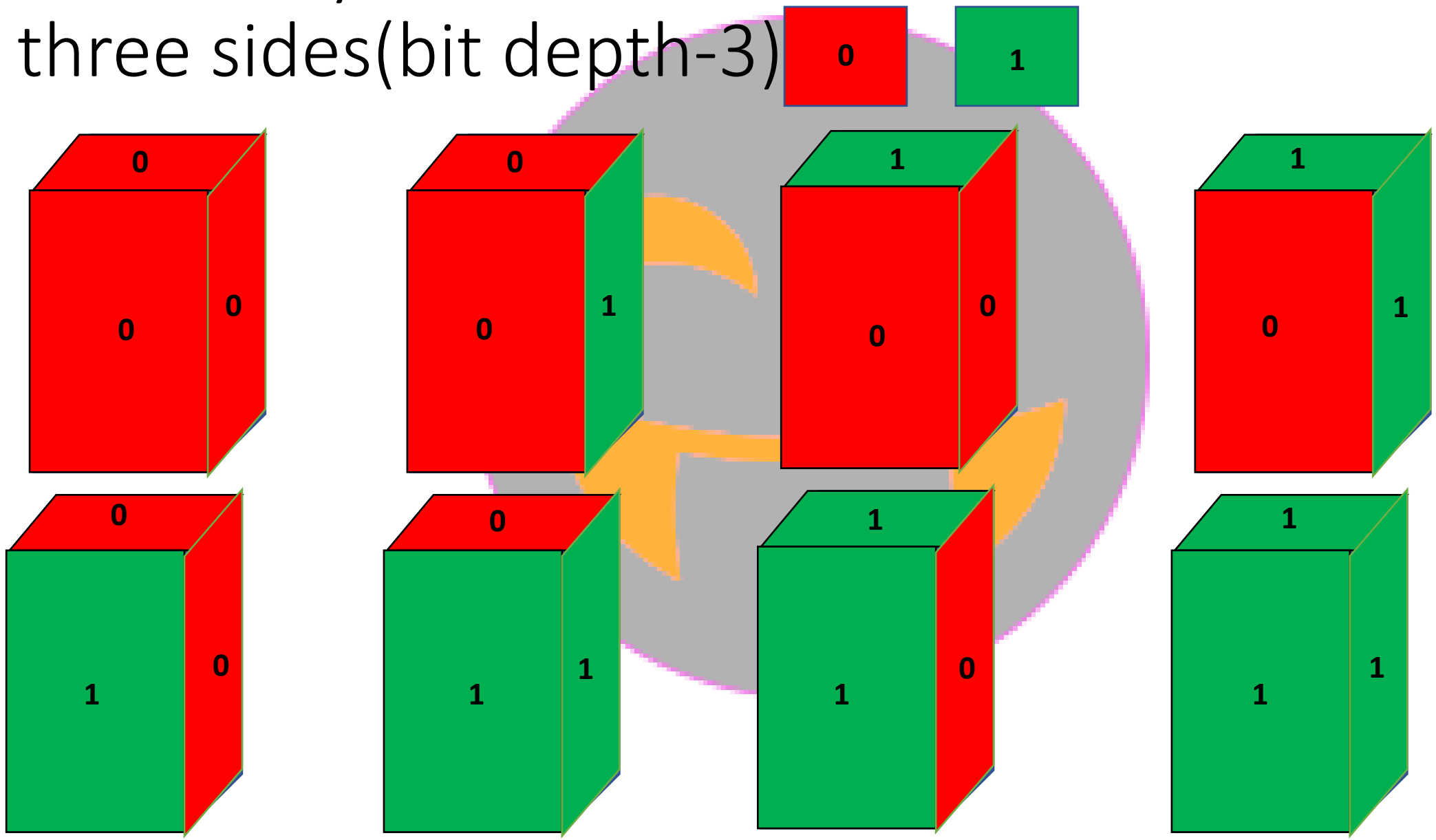
2	1	
2^1	2^0	**Decimal value**
0	0	**1x0 + 2x0 = 0**
0	1	**1x1 + 2x0 = 1**
1	0	**1x0 + 2x1 = 2**
1	1	**1x1 + 2x1 = 3**

With two bits we can represent 4 numbers

How many combinations with 2 colours? On three sides(bit depth-3)



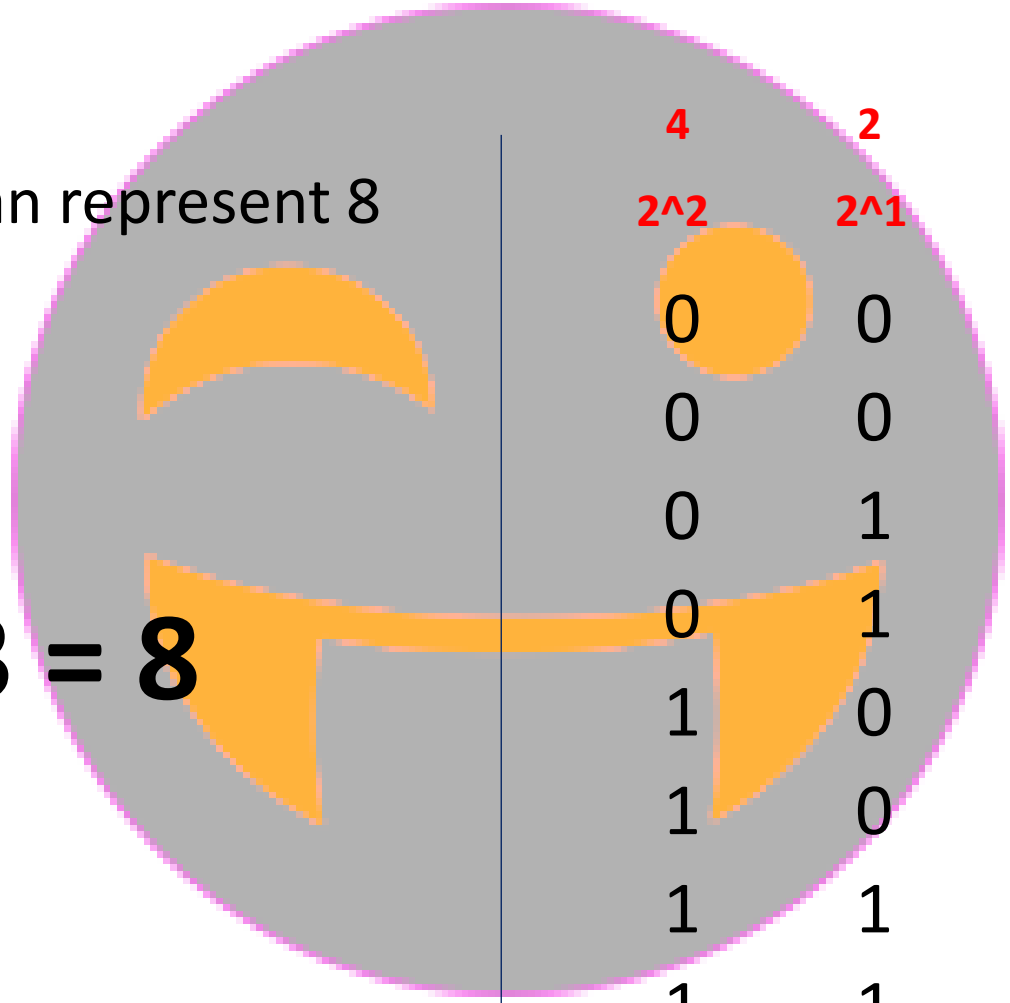
How many combinations with 2 colours? On three sides(bit depth-3)



How many numbers can be represented using bit depth 3

- With three bits we can represent 8 combinations
- 000
- 001
- 010
- 011
- 100
- 101
- 110
- 111

2^3 = 8



4	2	1	
2^2	2^1	2^0	**Decimal value**
0	0	0	**1x0 + 2x0 + 4x0 = 0**
0	0	1	**1x1 + 2x0 + 4x0 = 1**
0	1	0	**1x0 + 2x1 + 4x0 = 2**
0	1	1	**1x1 + 2x1 + 4x0 = 3**
1	0	0	**1x0 + 2x0 + 4x1 = 4**
1	0	1	**1x1 + 2x0 + 4x1 = 5**
1	1	0	**1x0 + 2x1 + 4x1 = 6**
1	1	1	**1x1 + 2x1 + 4x1 = 7**

With a bit depth of 3, we can represent 8 numbers

Why should I understand about 0's and 1's 😒

Decimal number system (0 to 9)

24

143

87

99012

139

29

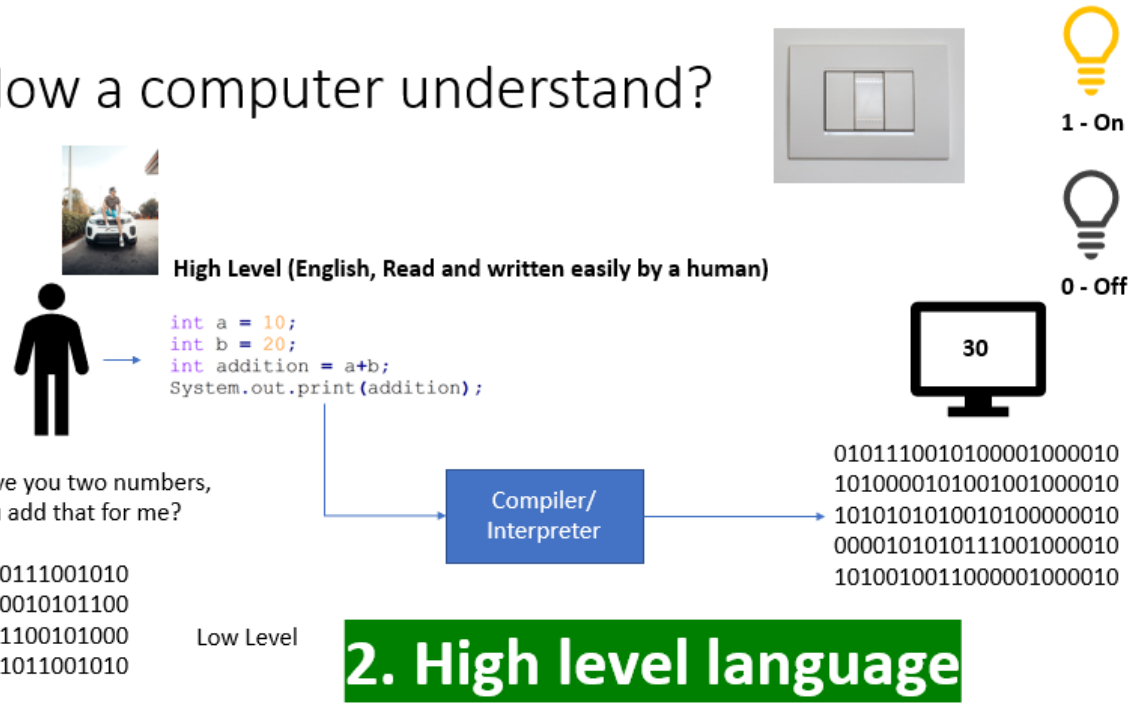
2022

765

1024

Binary number system (0 and 1)

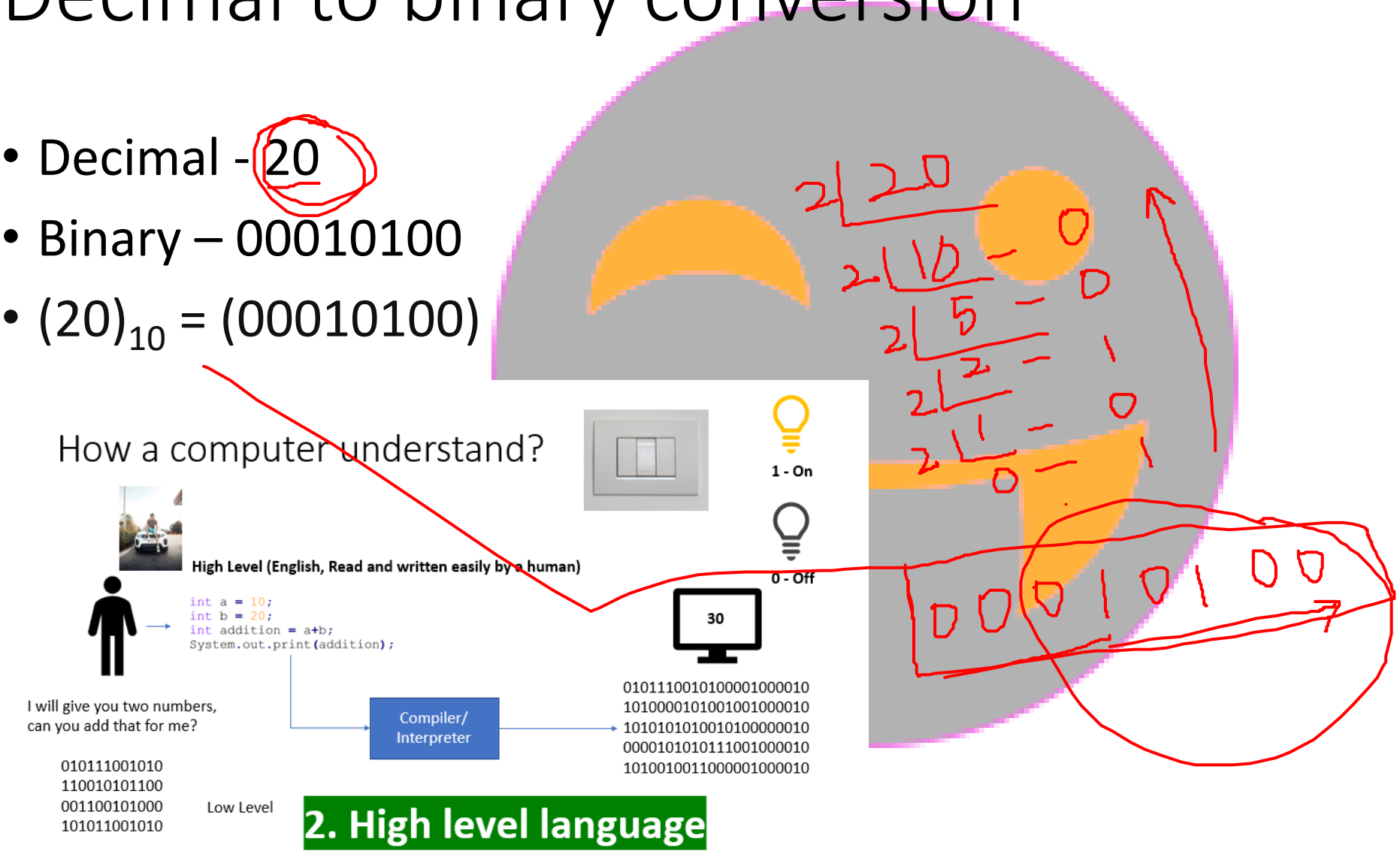
0, 1 are called Bits



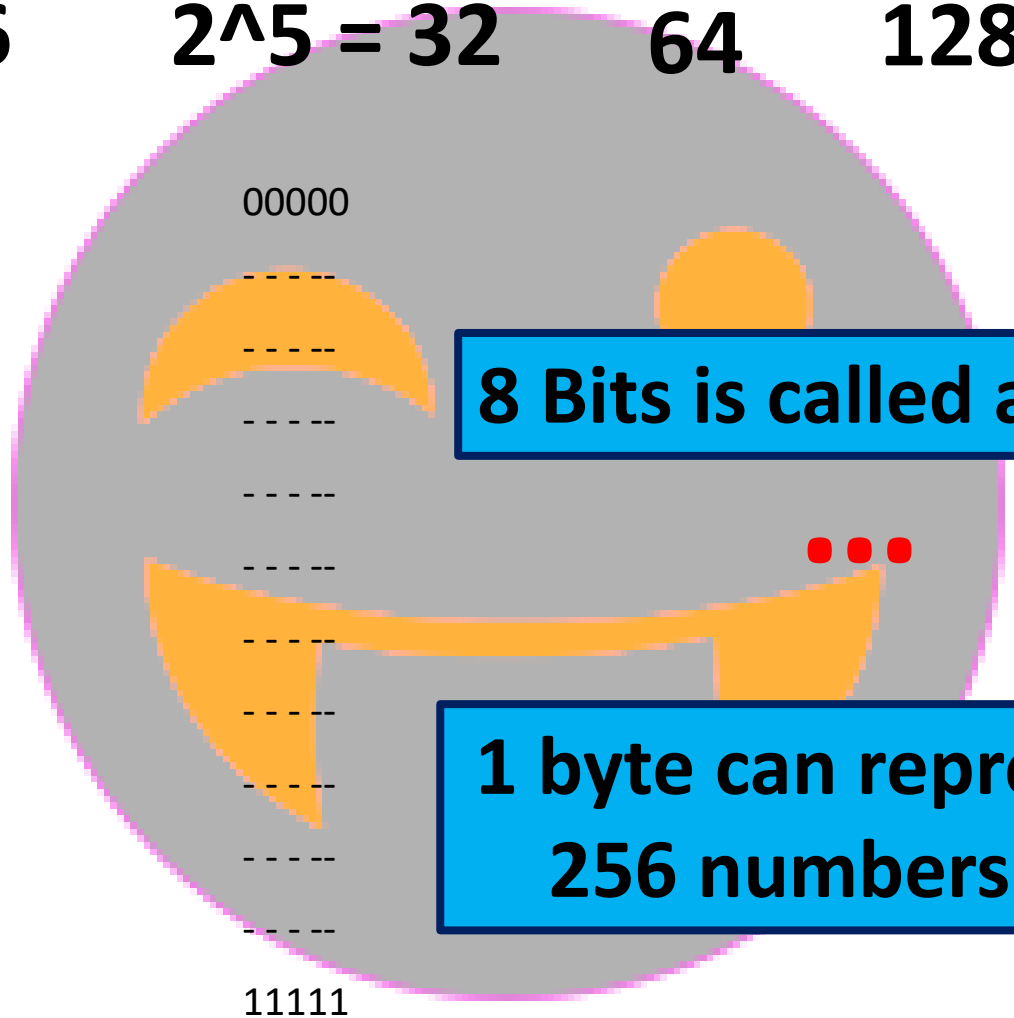
2. High level language

Decimal to binary conversion

- Decimal - 20
- Binary – 00010100
- $(20)_{10}$ = (00010100)



3 bits	4 bits	5 bits	6 bits	7 bits	8 bits
2^3 = 8	**2^4 = 16**	**2^5 = 32**	**64**	**128**	**2^8 = 256**
000	0000	00000			00000000
001	- - - -	- - - - -			- - - - - - - -
010	- - - -	- - - - -			- - - - - - - -
011	- - - -	- - - - -			- - - - - - - -
100	- - - -	- - - - -			- - - - - - - -
101	- - - -	- - - - -			- - - - - - - -
110	- - - -	- - - - -			- - - - - - - -
111	- - - -	- - - - -			- - - - - - - -
	1111	11111			11111111



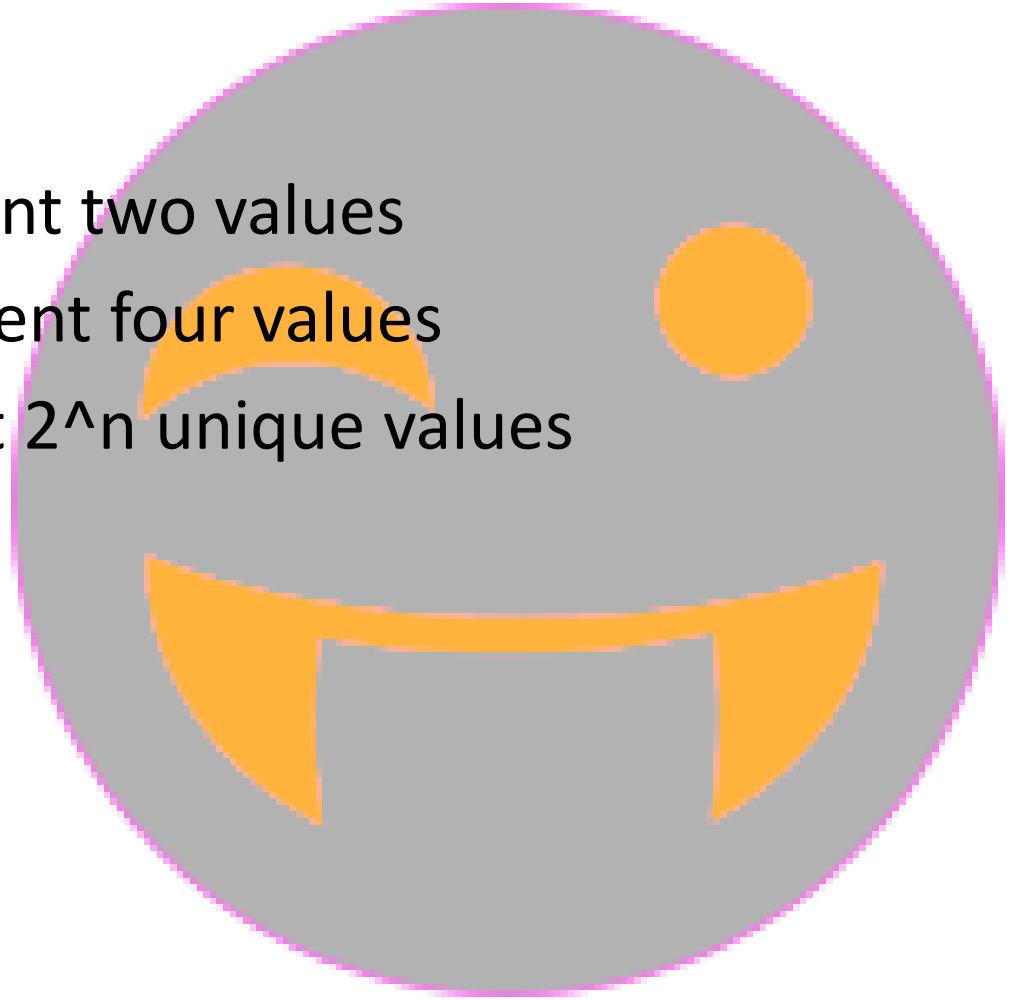
8 Bits is called a byte

1 byte can represent 256 numbers 😄

0, 1, 2, 3, 4, 5, …. 255

NOTE

- One bit can represent two values
- Two bits can represent four values
- n bits can represent 2^n unique values

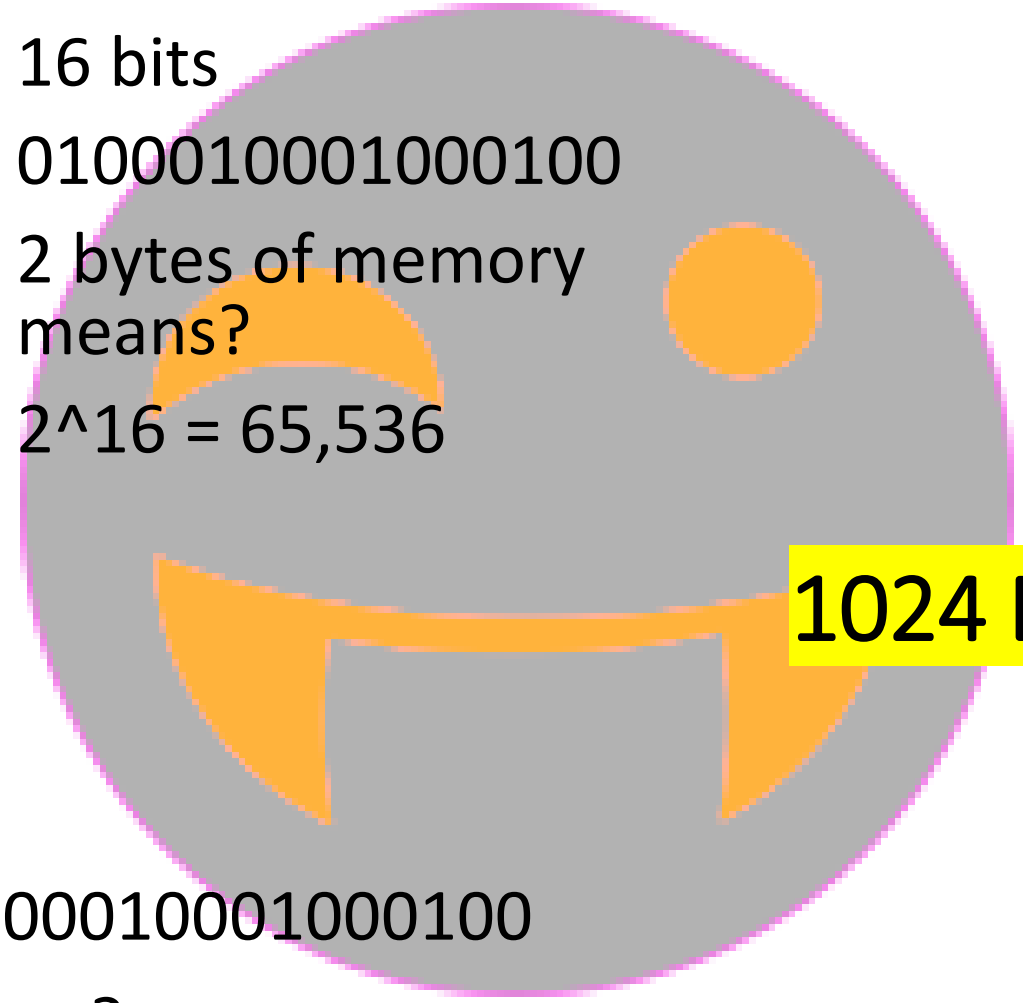


1 Byte

- 8 bits
- 01000100
- 1 byte of memory means?
- 2^8 = 256

2 Bytes

- 16 bits
- 0100010001000100
- 2 bytes of memory means?
- 2^16 = 65,536

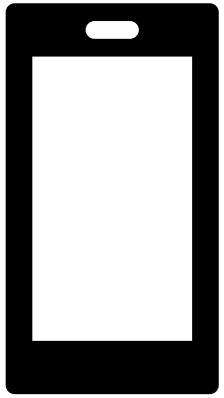


1024 Bytes?

4 Bytes

- 32 bits
- 0100010001000100 0100010001000100
- 4 bytes of memory means?
- 2^32 = 4,29,49,67,296

3. What is memory?



64 GB

What is a byte?

1 byte can store 256 numbers

1024 bytes = 1 KB

1024 KB = 1 MB

1024 MB = 1 GB

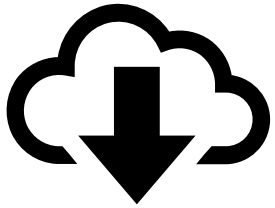
1024 GB = 1 TB (Tera byte)

1024 TB = 1 PB (Peta byte)

1024 PB = 1 EB (Exa byte)

1024 EB = 1 ZB (Zetta byte)

1024 ZB = 1 YB (Yotta byte)



Tiger **(1.2 GB)**

GB – **G**iga **B**ytes

Ambisara **(800 MB)**

MB – **M**ega **B**ytes

KB – **K**ilo **B**ytes

B - Bytes

Memory

Name	Equal To	Size(In Bytes)
Bit	1 Bit	1/8
Nibble	4 Bits	1/2 (rare)
Byte	8 Bits	1
Kilobyte	1024 Bytes	1024
Megabyte	1, 024 Kilobytes	1, 048, 576
Gigabyte	1, 024 Megabytes	1, 073, 741, 824
Terrabyte	1, 024 Gigabytes	1, 099, 511, 627, 776
Petabyte	1, 024 Terabytes	1, 125, 899, 906, 842, 624
Exabyte	1, 024 Petabytes	1, 152, 921, 504, 606, 846, 976
Zettabyte	1, 024 Exabytes	1, 180, 591, 620, 717, 411, 303, 424
Yottabyte	1, 024 Zettabytes	1, 208, 925, 819, 614, 629, 174, 706, 176

But which basket would Suresh pick?

- Very small, small, medium, or large
- It depends on your requirement

Quantity

10 cloths

20 cloths

40 cloths

80 cloths

Similarly to store integers, we have different integer data types

How do we calculate quantity here?

How many values can be stored in 1 byte

2^8 = 256

256 cloths

byte basket1

byte

short basket2

short

int basket3

int

long basket4

long

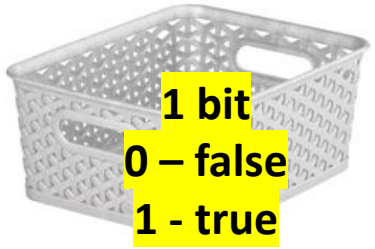
If you know the number of bytes, we can calculate the quantity of values that the container can hold

8 baskets(data types) with different sizes and for different purposes

It specifies the type of values that the variable can hold.

Also, specifies the quantity of values that the variable can hold

char



boolean

```
class Student{
    String name;
    String studyClass;
    int rollno;
    double percentage;
    House h;
    static String college="Suresh Techs College";
    int marks;
    static int totalStudents;
```

double

byte

2^8 = 256

short

2^16 = 65536

int

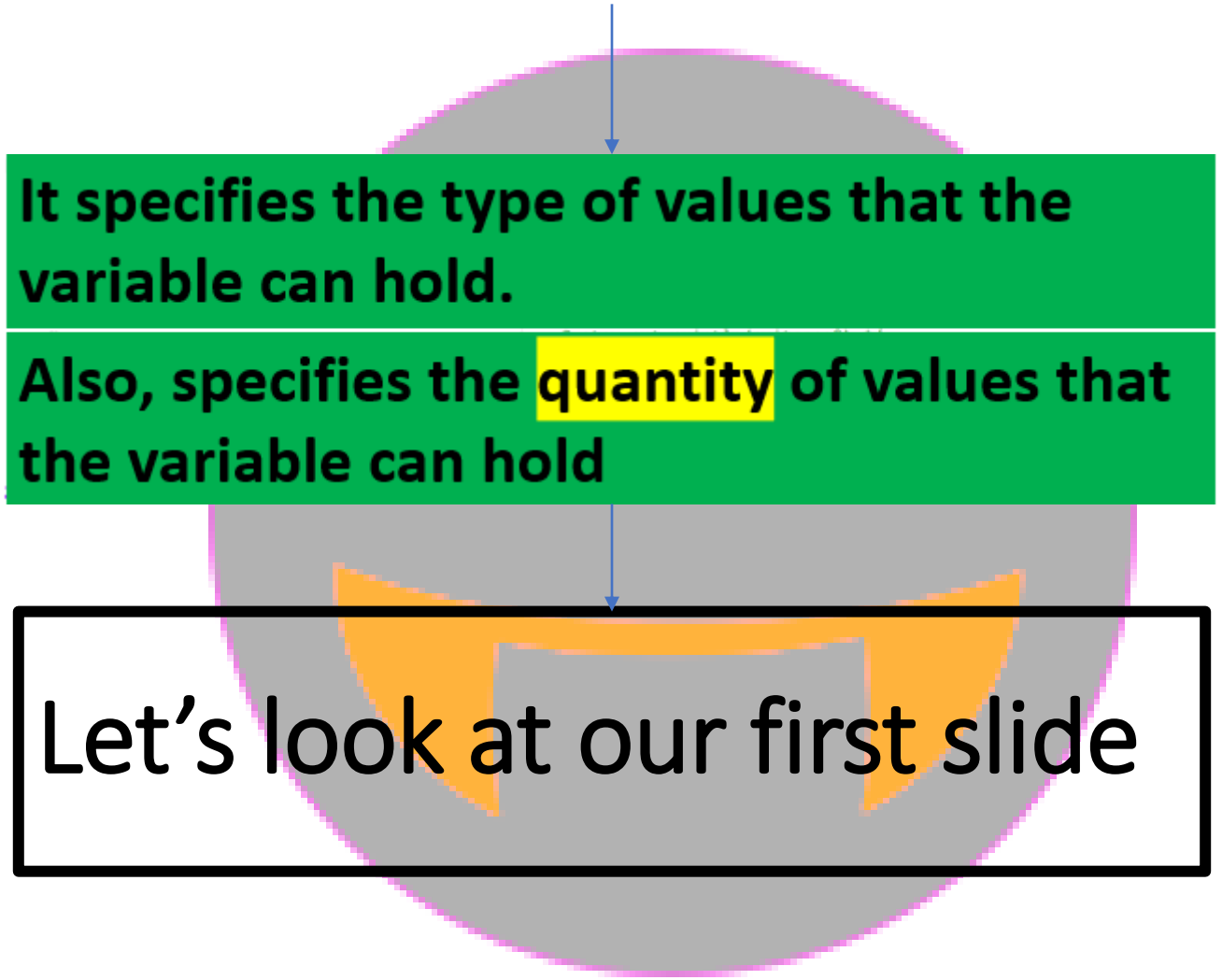
2^32 = 4,29,49,67,296

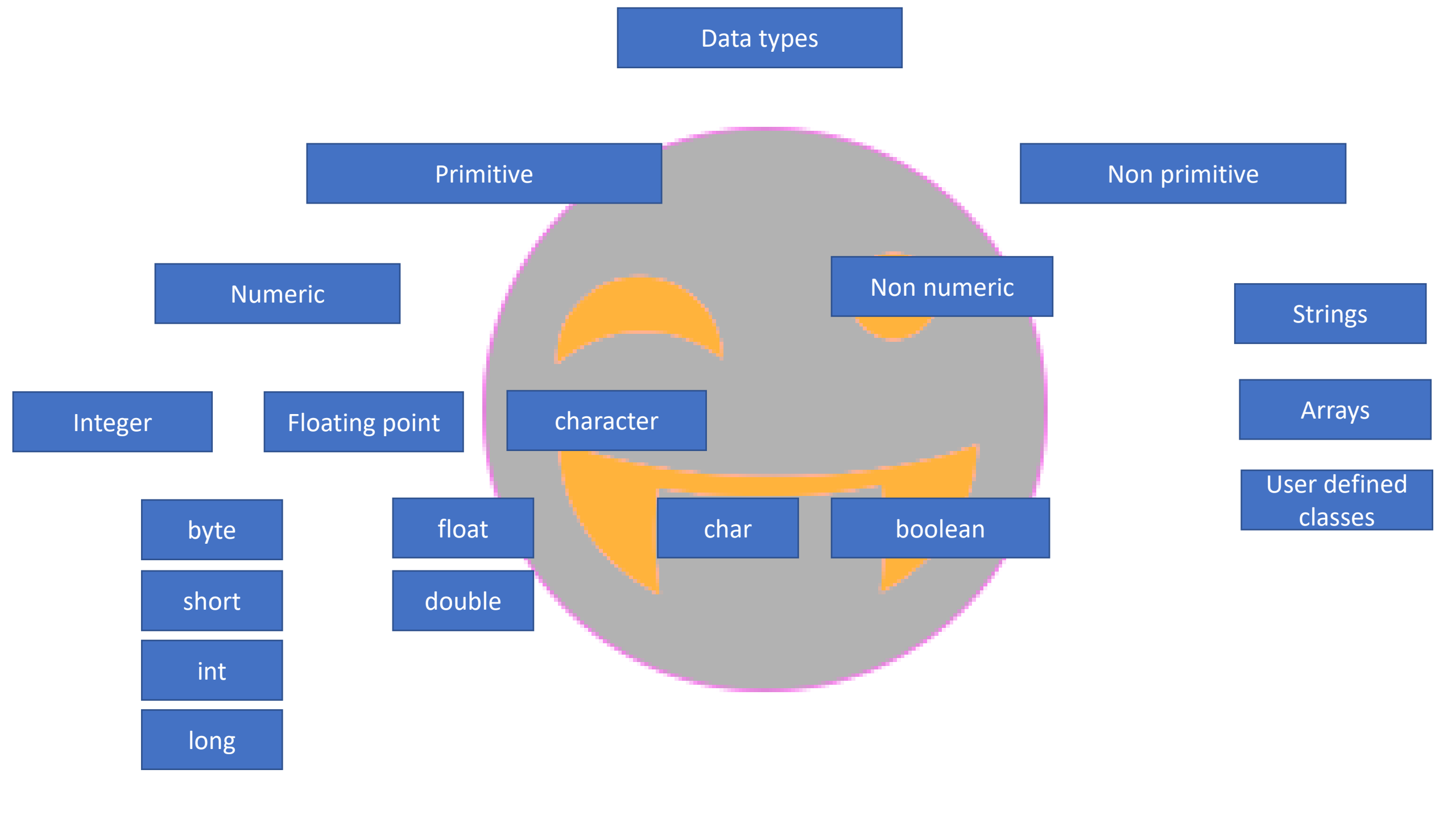
long

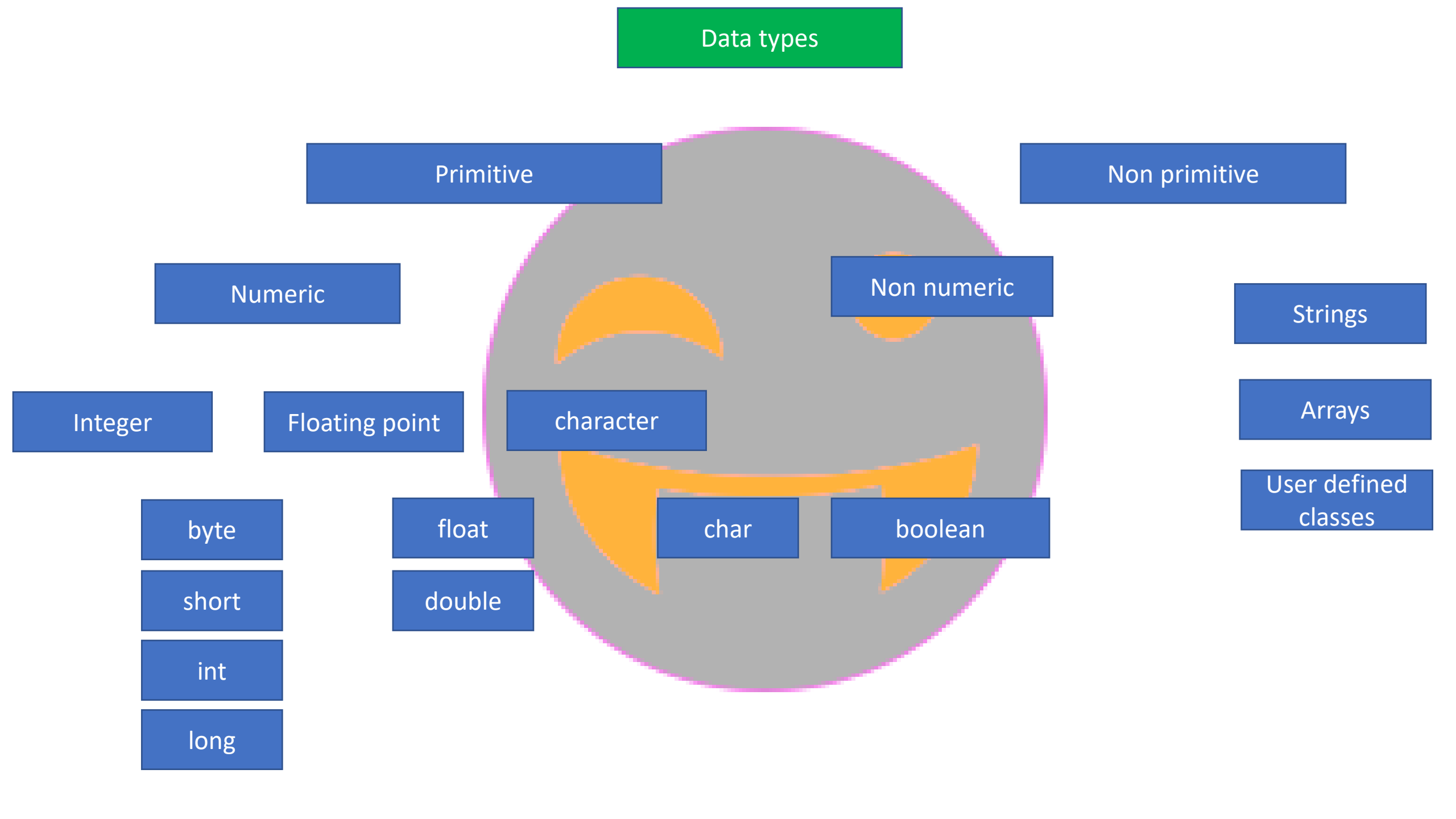
2^64 = 1,84,46,74,40,73,70,95,51,616

float

What is a data type?

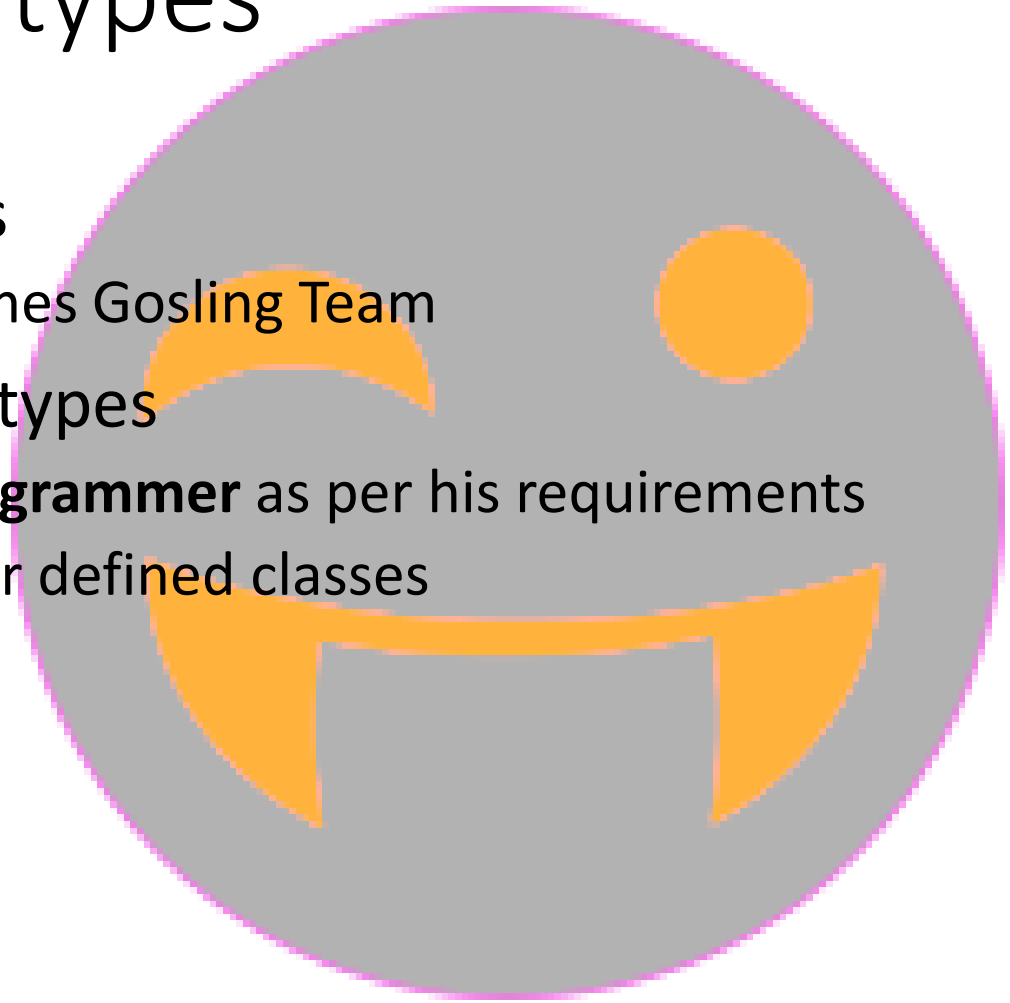


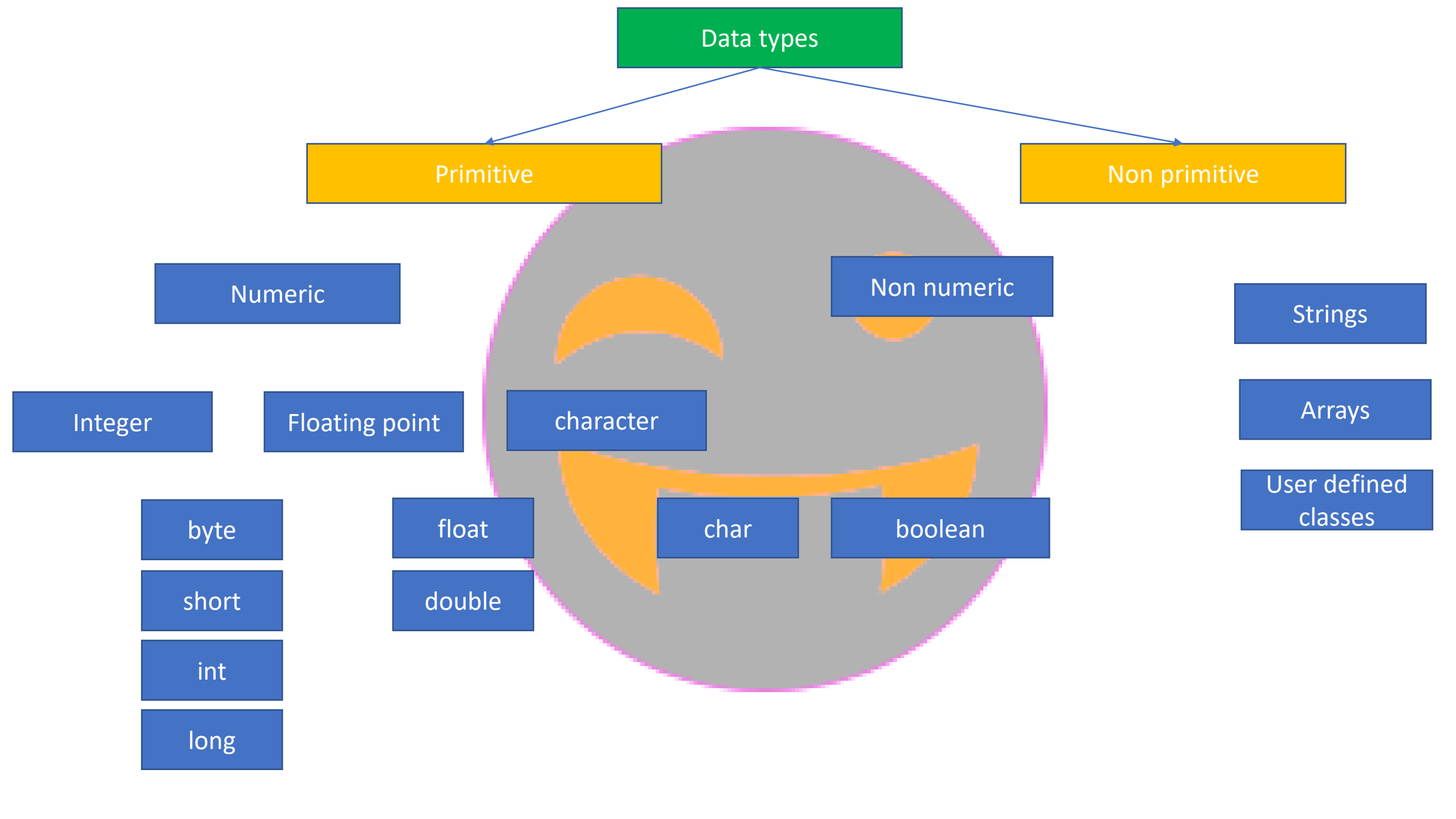

Data types
Primitive
Non primitive
Numeric
Non numeric
Strings
Integer
Floating point
character
Arrays
User defined classes
byte
float
char
boolean
short
double
int
long


Data types
Primitive
Non primitive
Numeric
Non numeric
Strings
Integer
Floating point
character
Arrays
User defined classes
byte
float
char
boolean
short
double
int
long

Types of data types

- Primitive data types
  - **Predefined** - by James Gosling Team
- Non-Primitive data types
  - **Defined by the programmer** as per his requirements
  - Strings, Arrays, User defined classes




Data types
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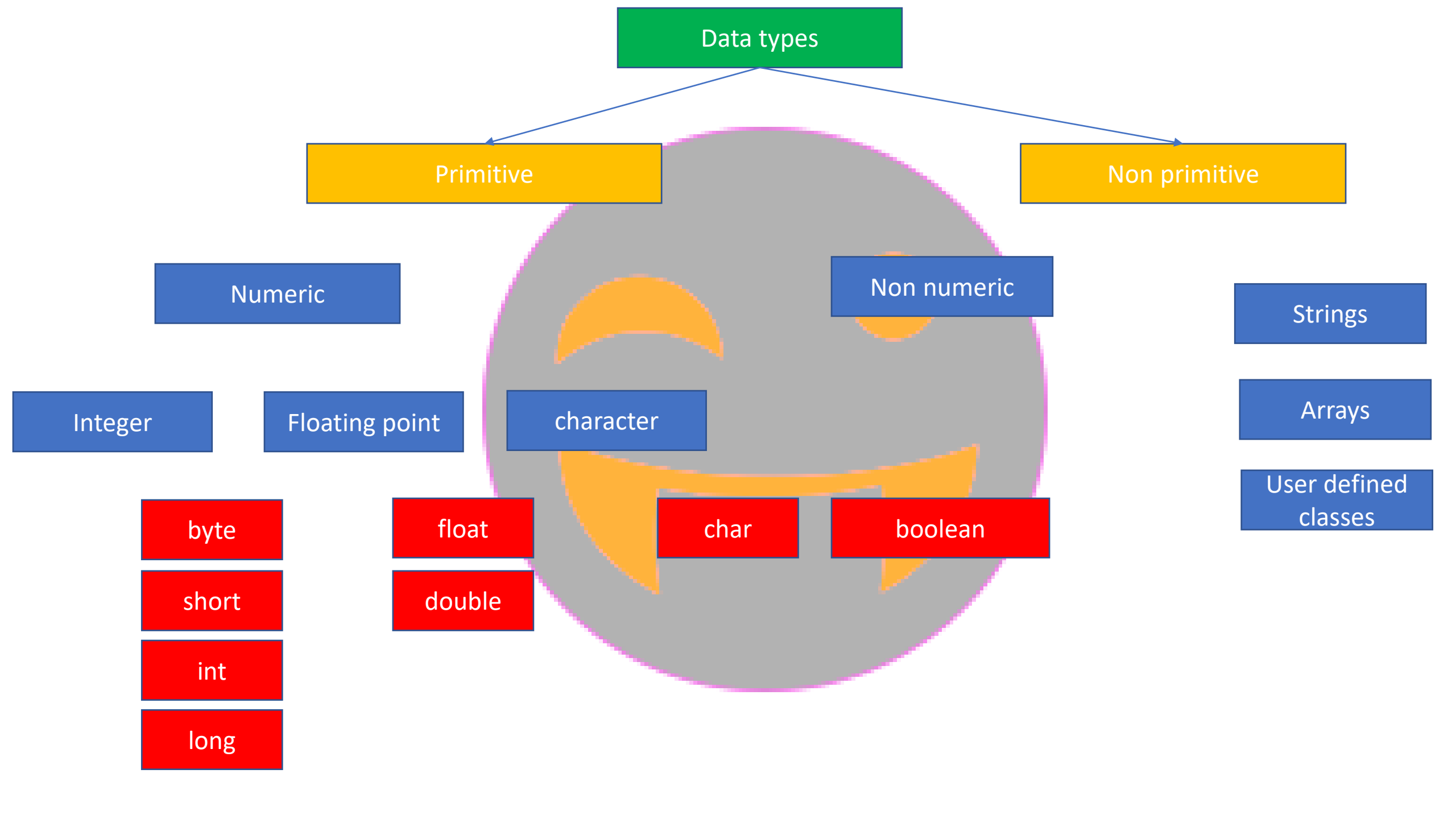
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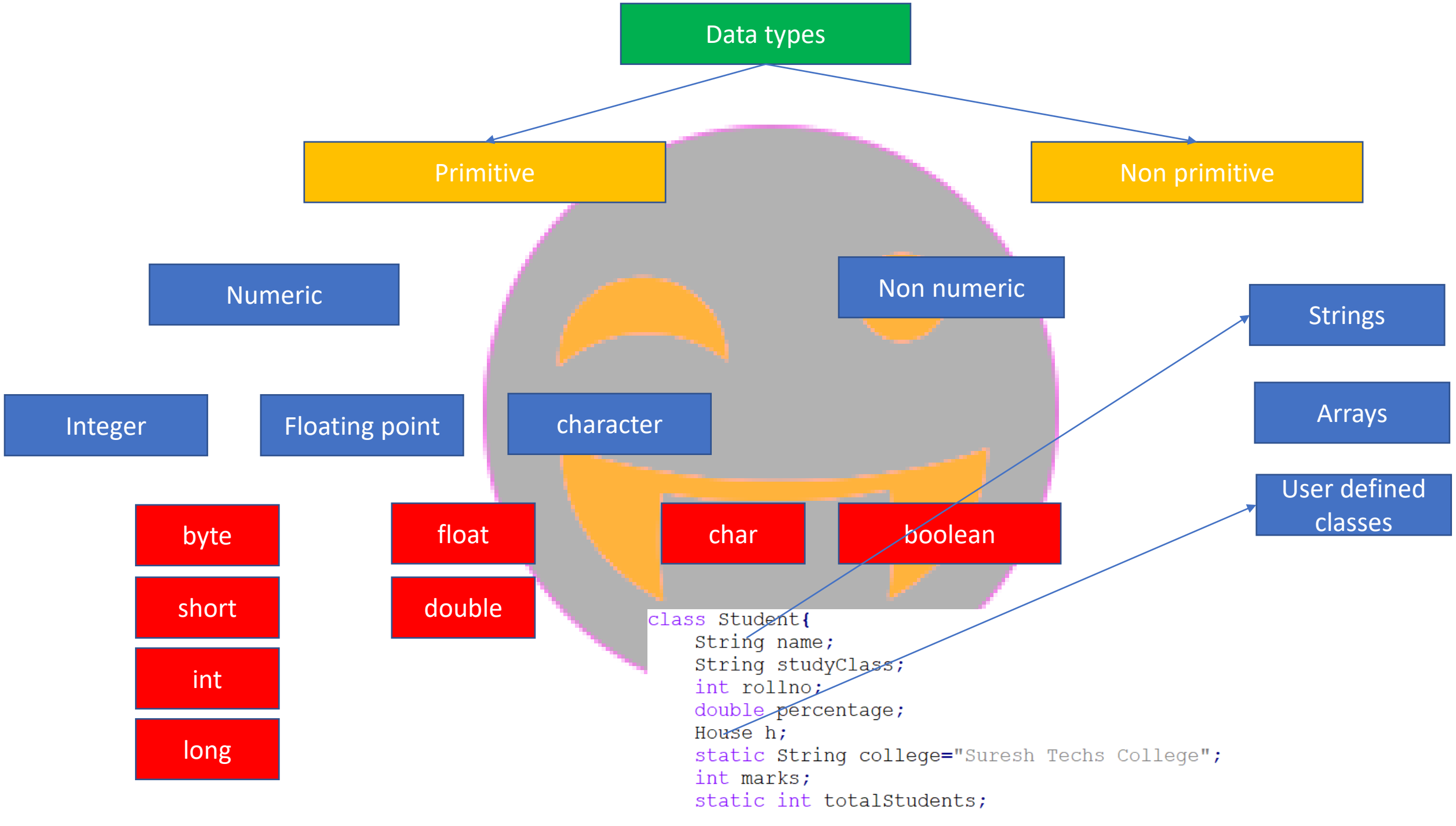
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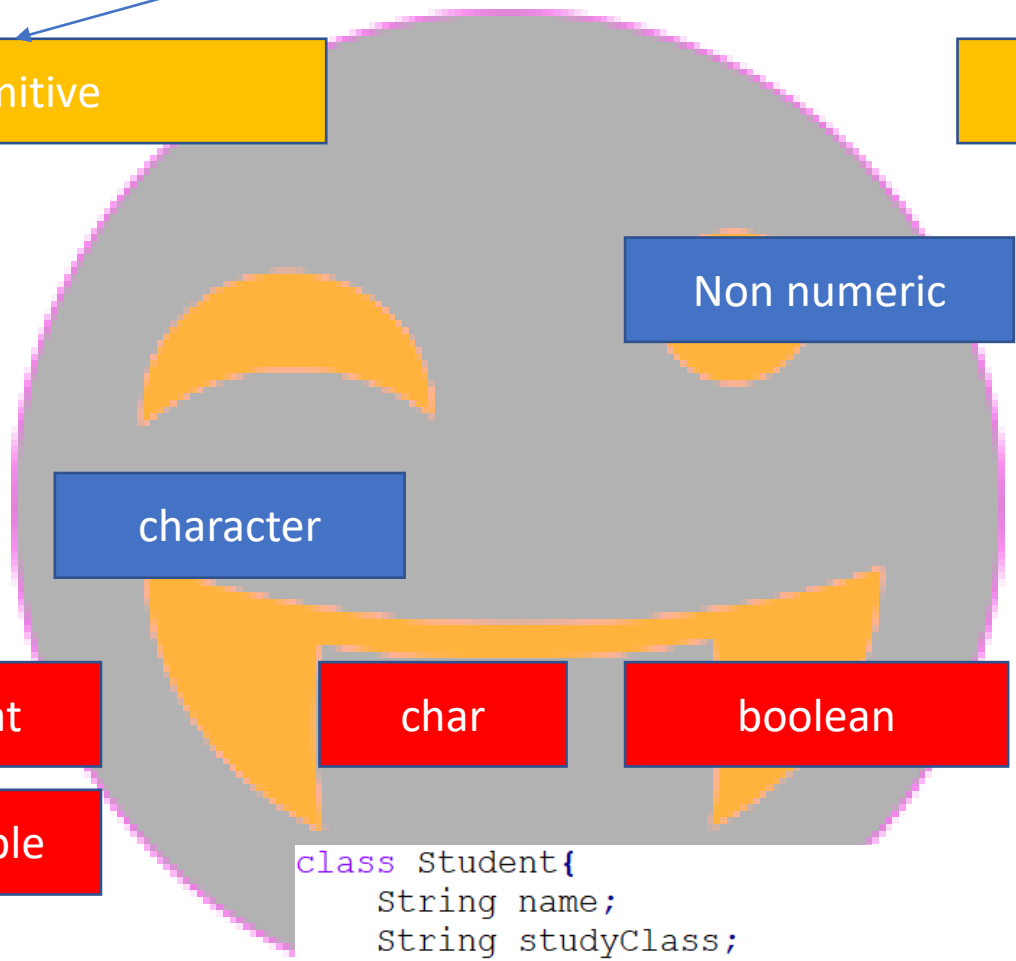
class Student{
String name;
String studyClass;
int rollno;
double percentage;
House h;
static String college="Suresh Techs College";
int marks;
static int totalStudents;

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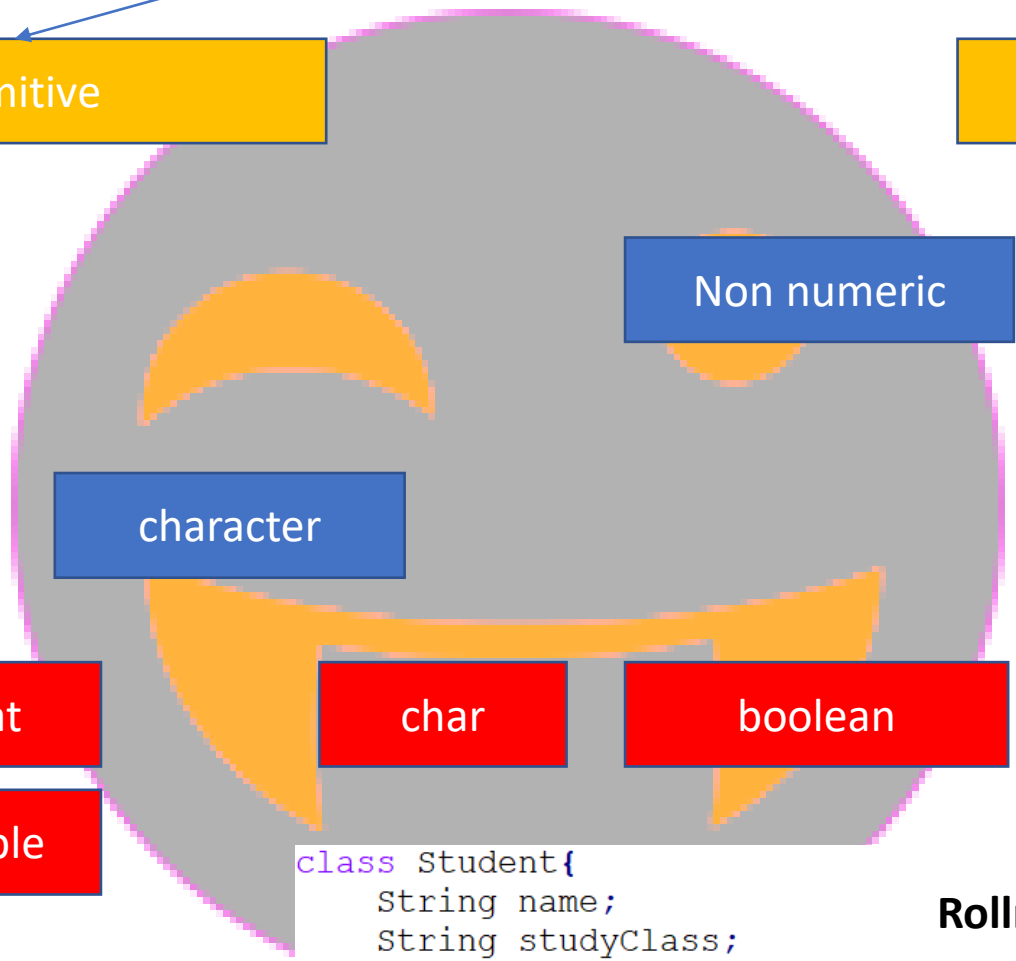

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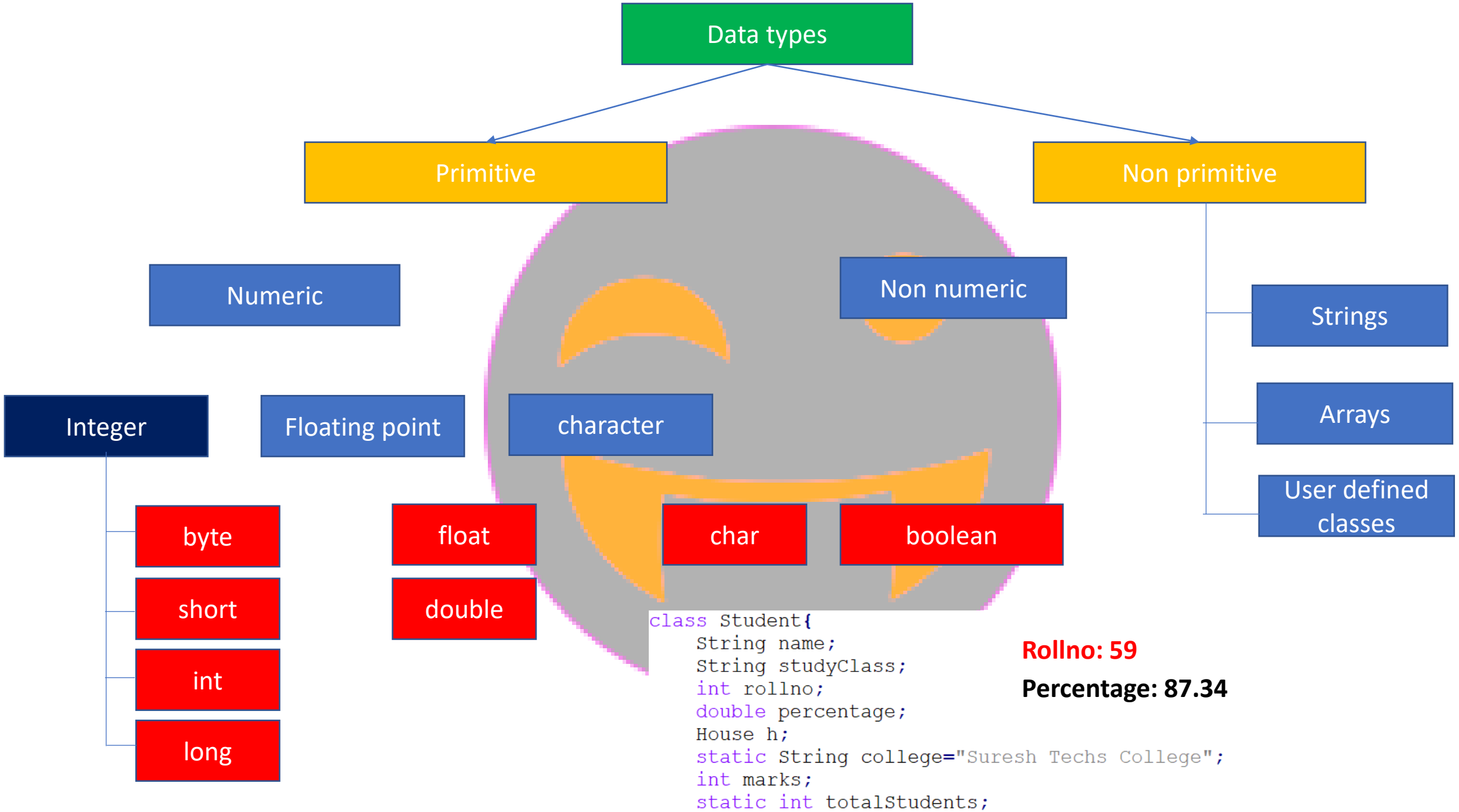
```

Rollno: 59 Integers

Percentage: 87.34 Fractions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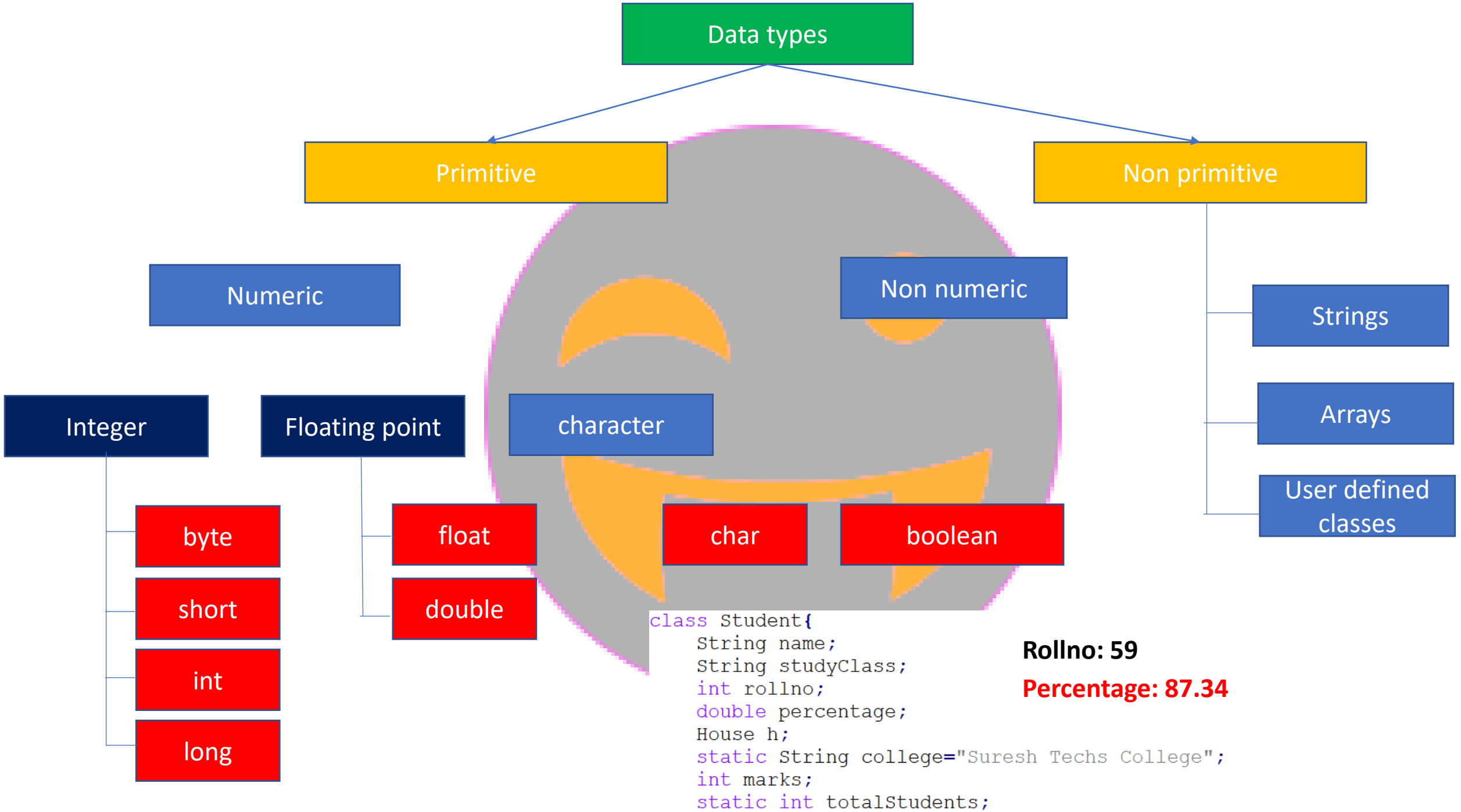
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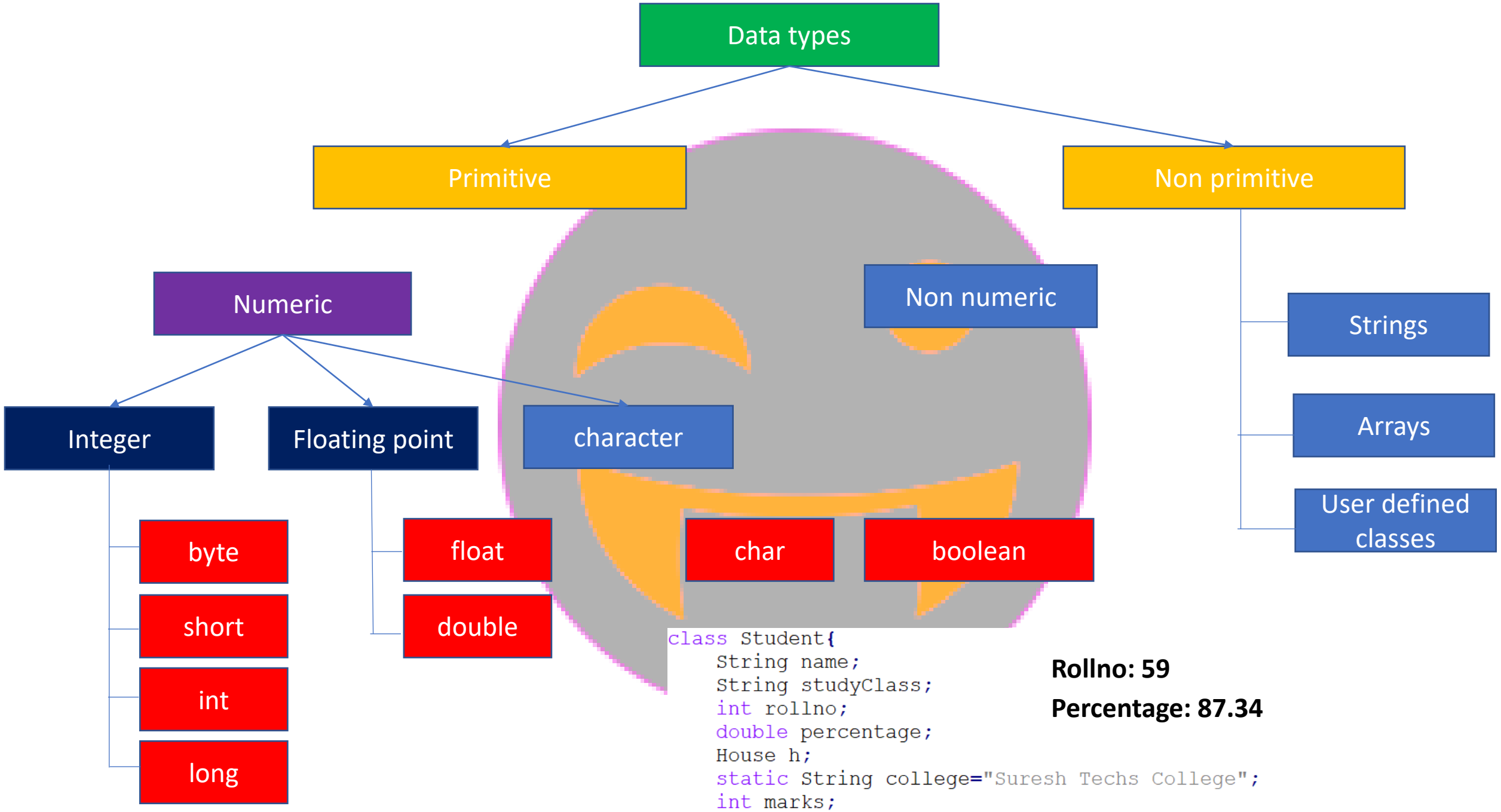


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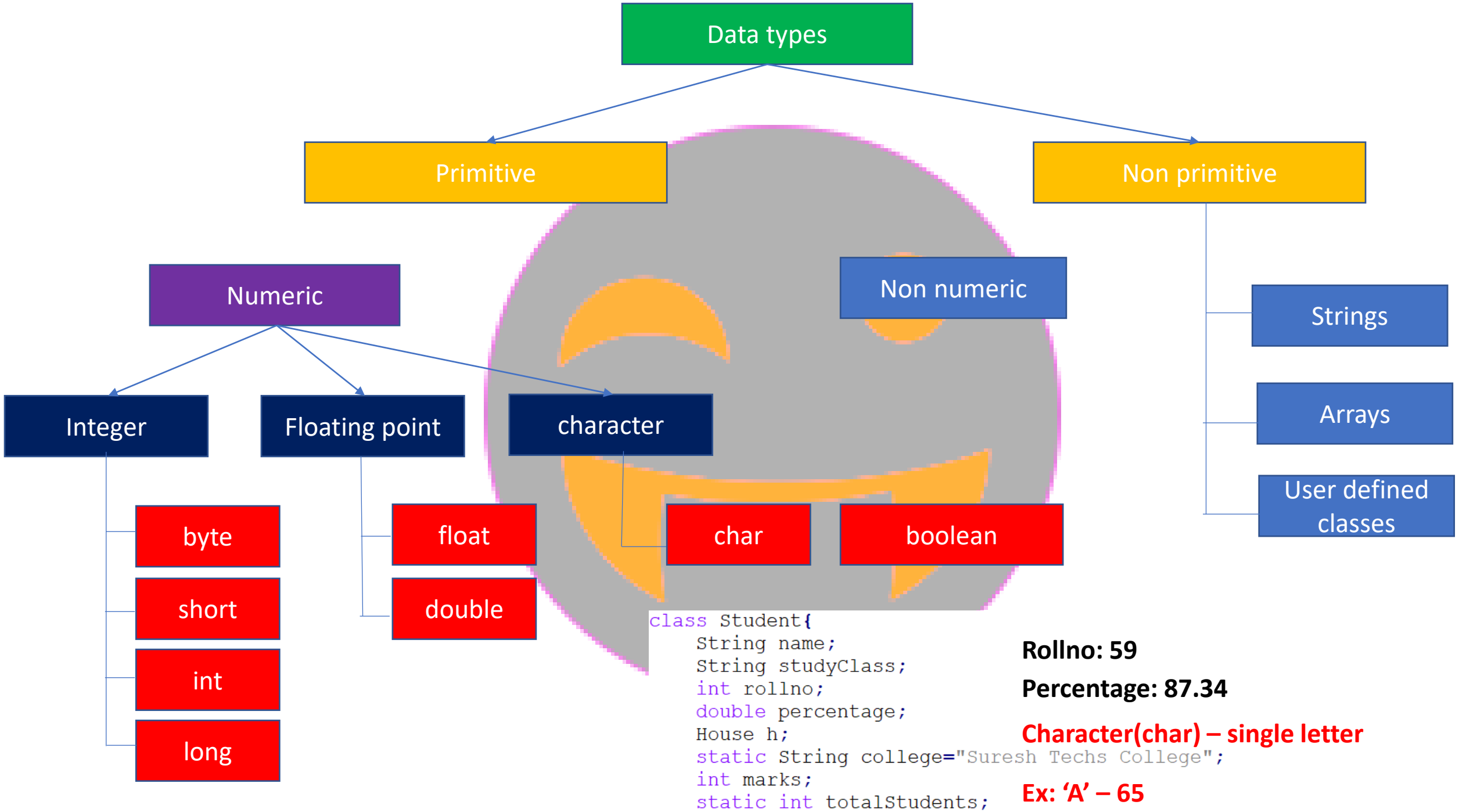
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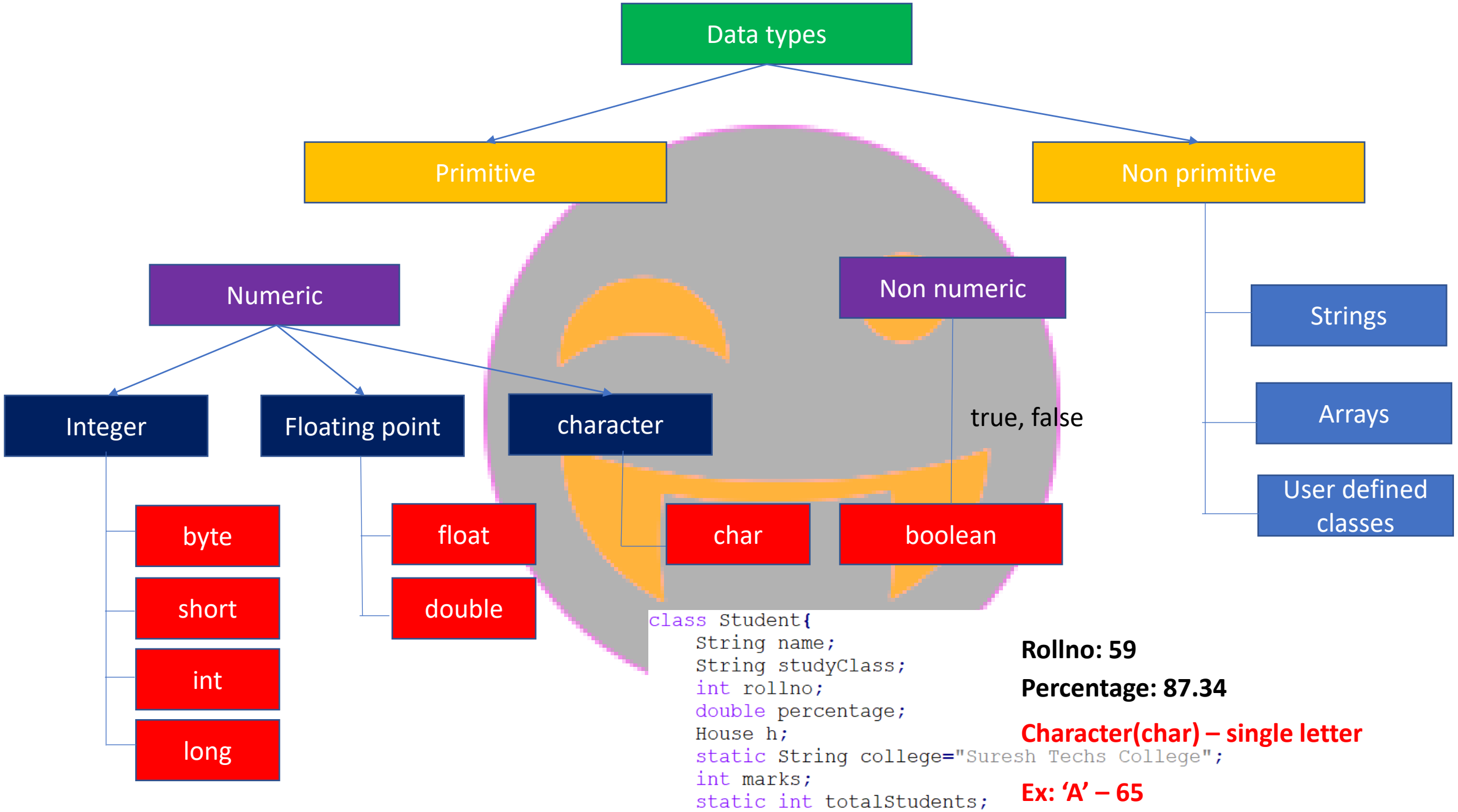
Percentage: 87.34
Character(char) – single letter
Ex: 'A' – 65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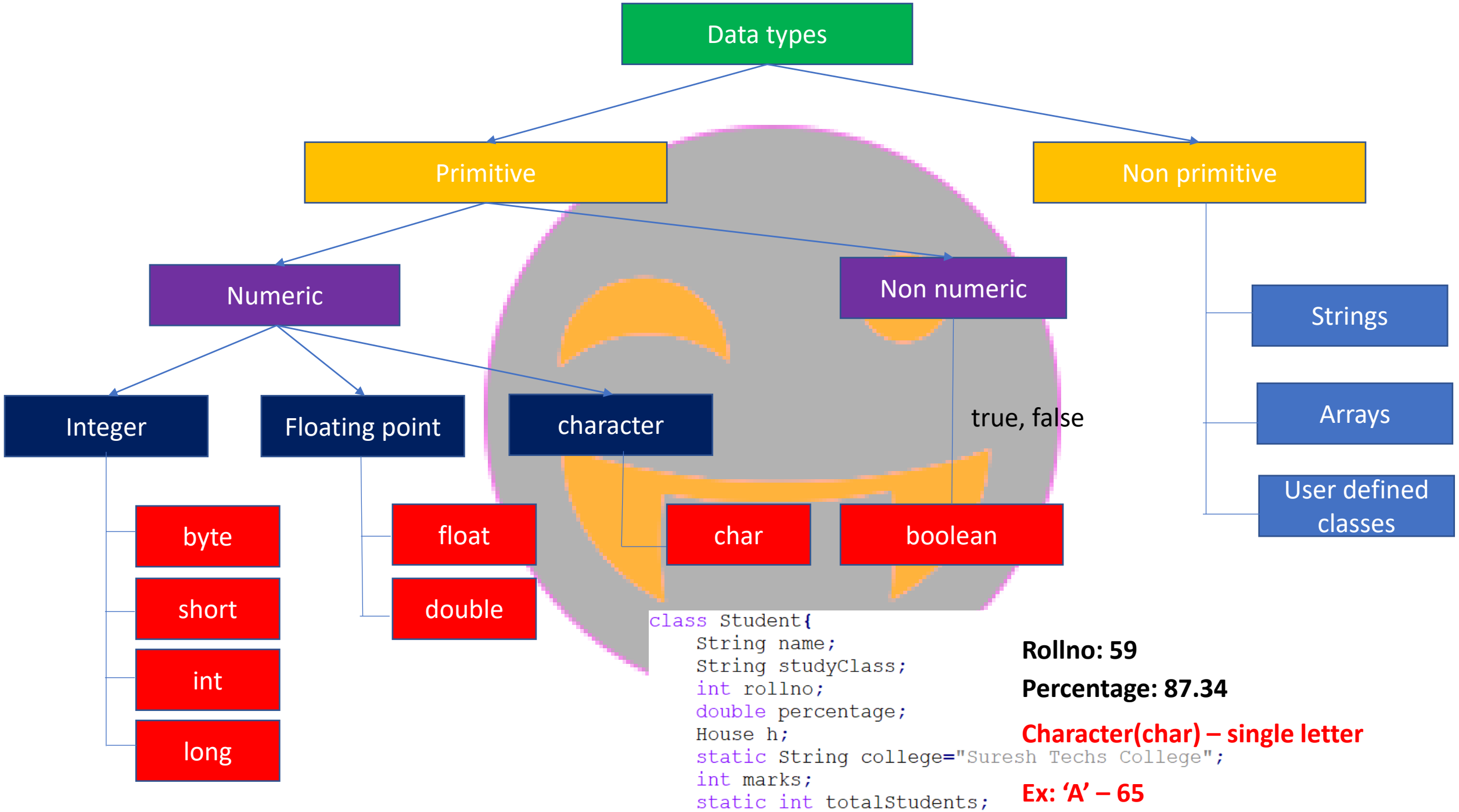
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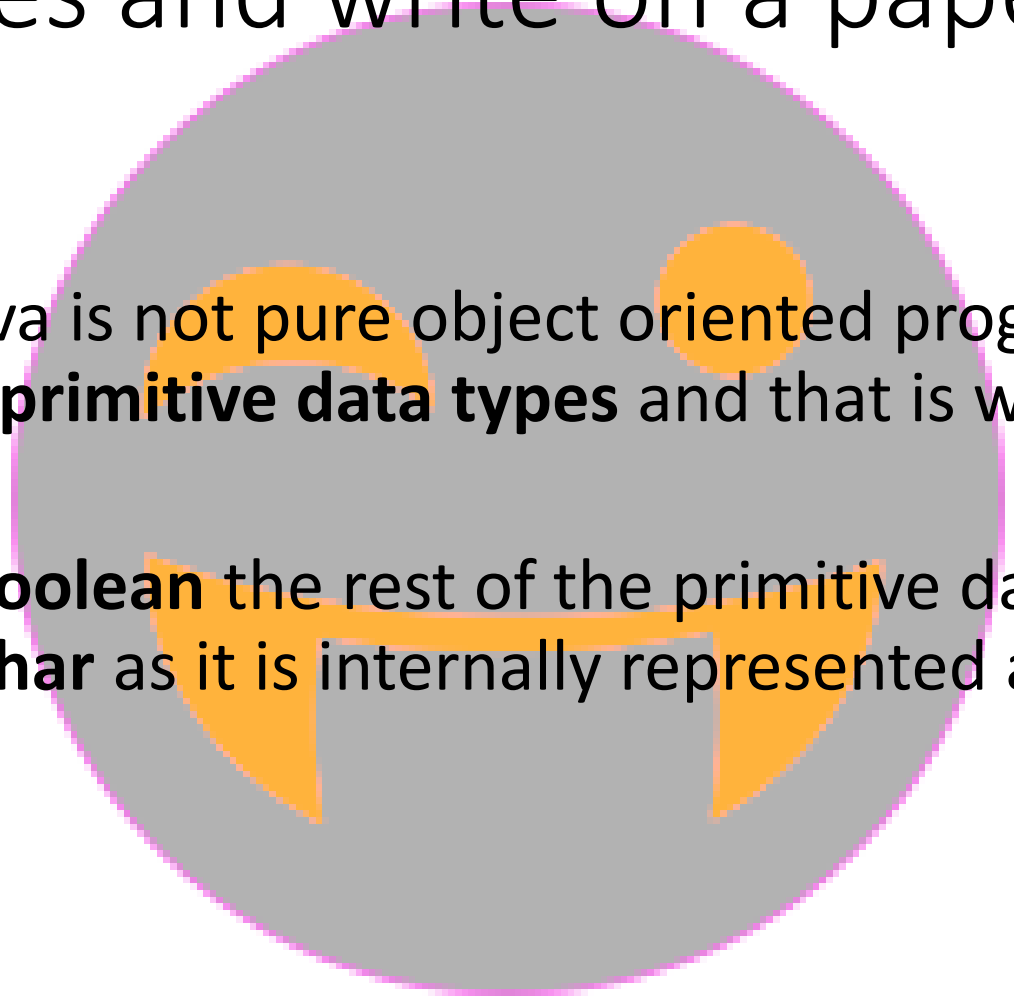
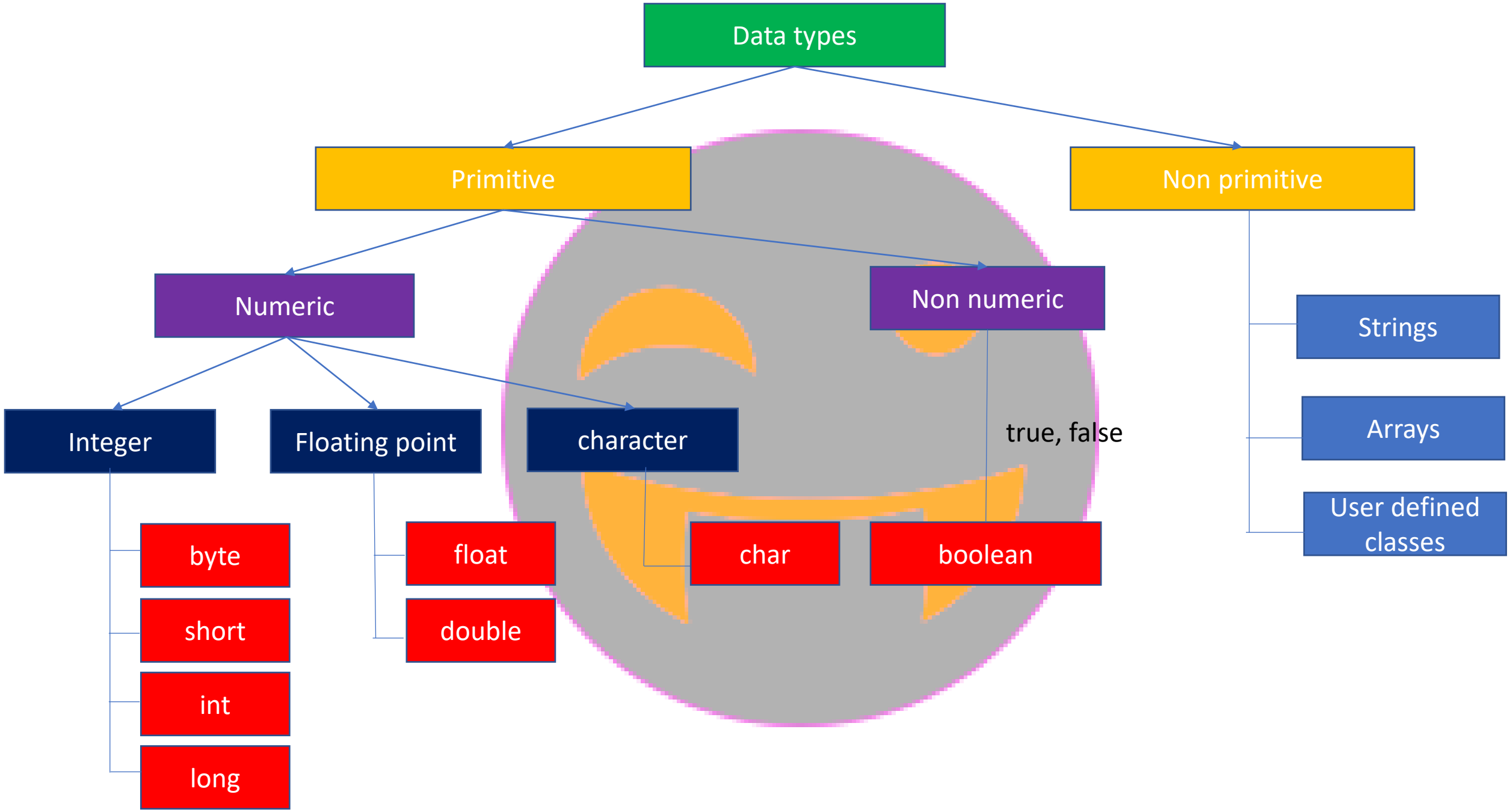
Close your eyes and write on a paper



- I will try myself
- Earlier I told that java is not pure object oriented programming because it includes **primitive data types** and that is what we are learning now 😍 😍
- NOTE: **Except the boolean** the rest of the primitive data types are of numeric **even the char** as it is internally represented as an **unsigned integer(number)**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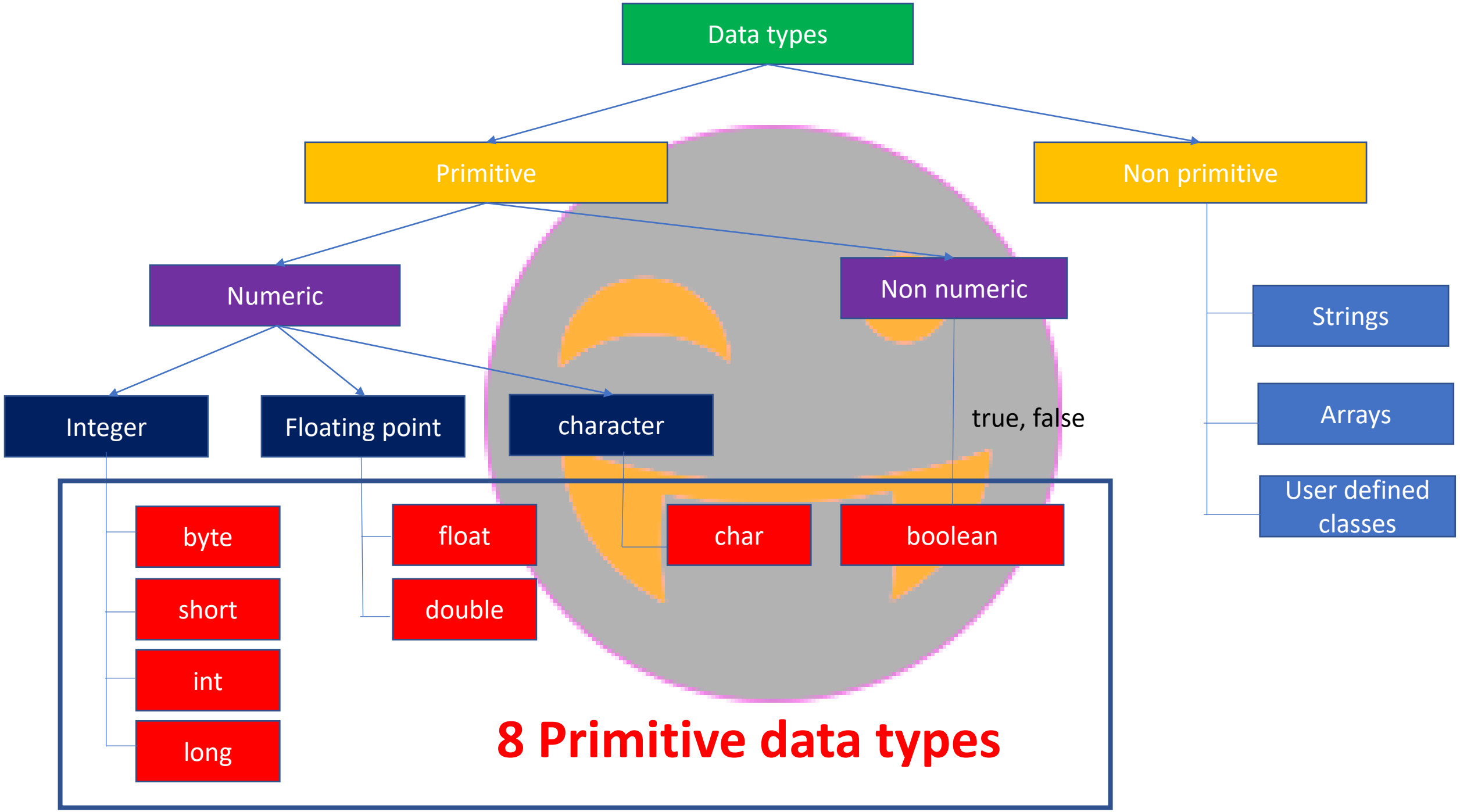
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8 Primitive data types

```
void setPercentage(double percentage){
    this.percentage = percentage;
}

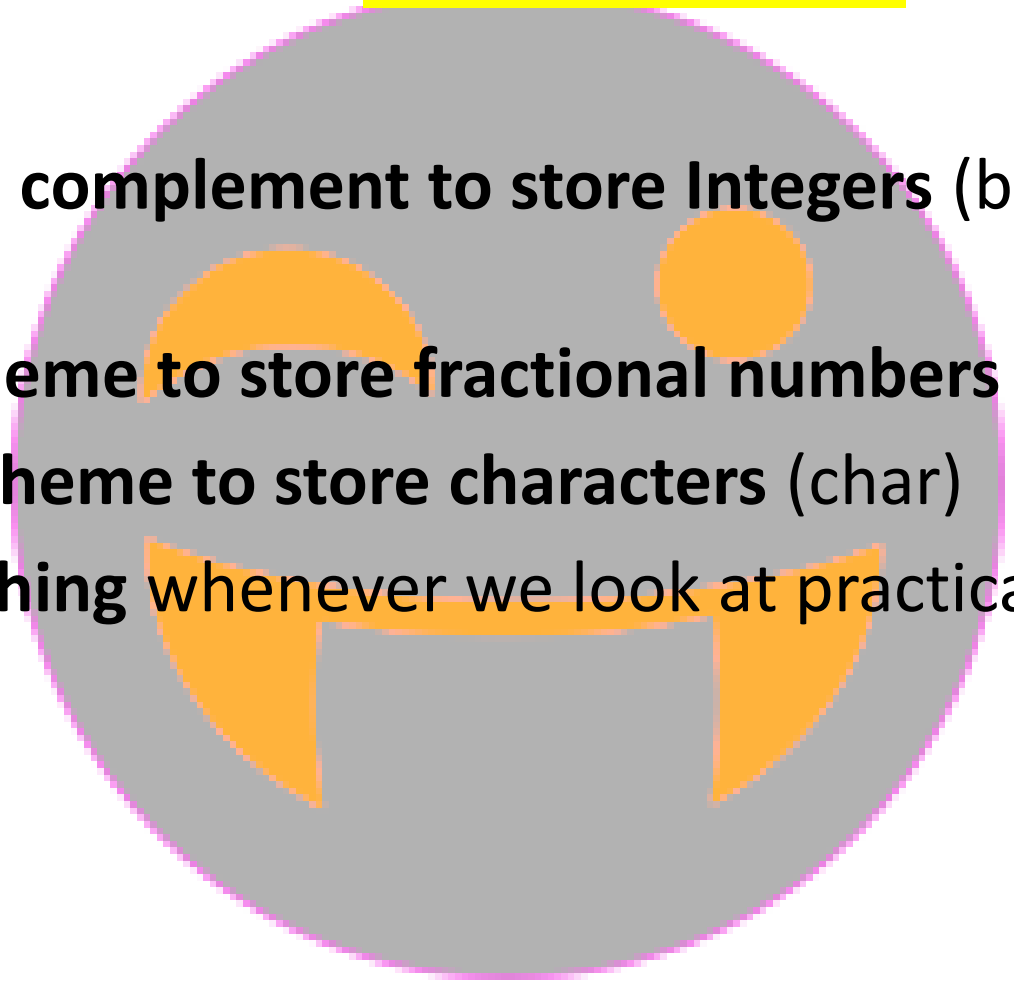
String getName(){
    return name;
}

String getStudyClass(){
    return studyClass;
}

int getRollno(){
    return rollno;
}
double getPercentage(){
    return percentage;
}
```

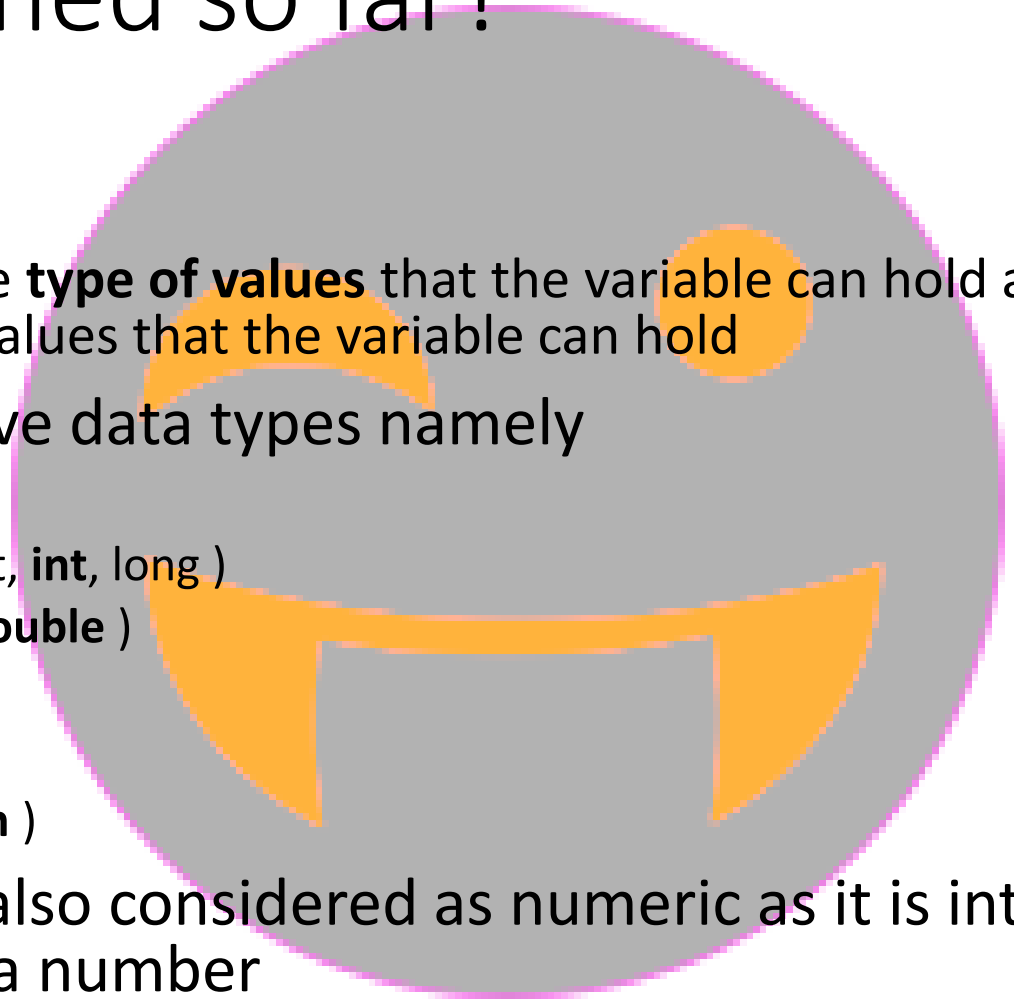
void is a special data type which will not have any quantity/size

Just remember – but don’t worry



- Java uses **signed 2’s complement to store Integers** (byte, short, int, long) numbers
- Java uses **IEEE 7 scheme to store fractional numbers** (float, double)
- Java uses **UTF-16 scheme to store characters** (char)
- I will explain **everything** whenever we look at practical **examples** ☺☺☺

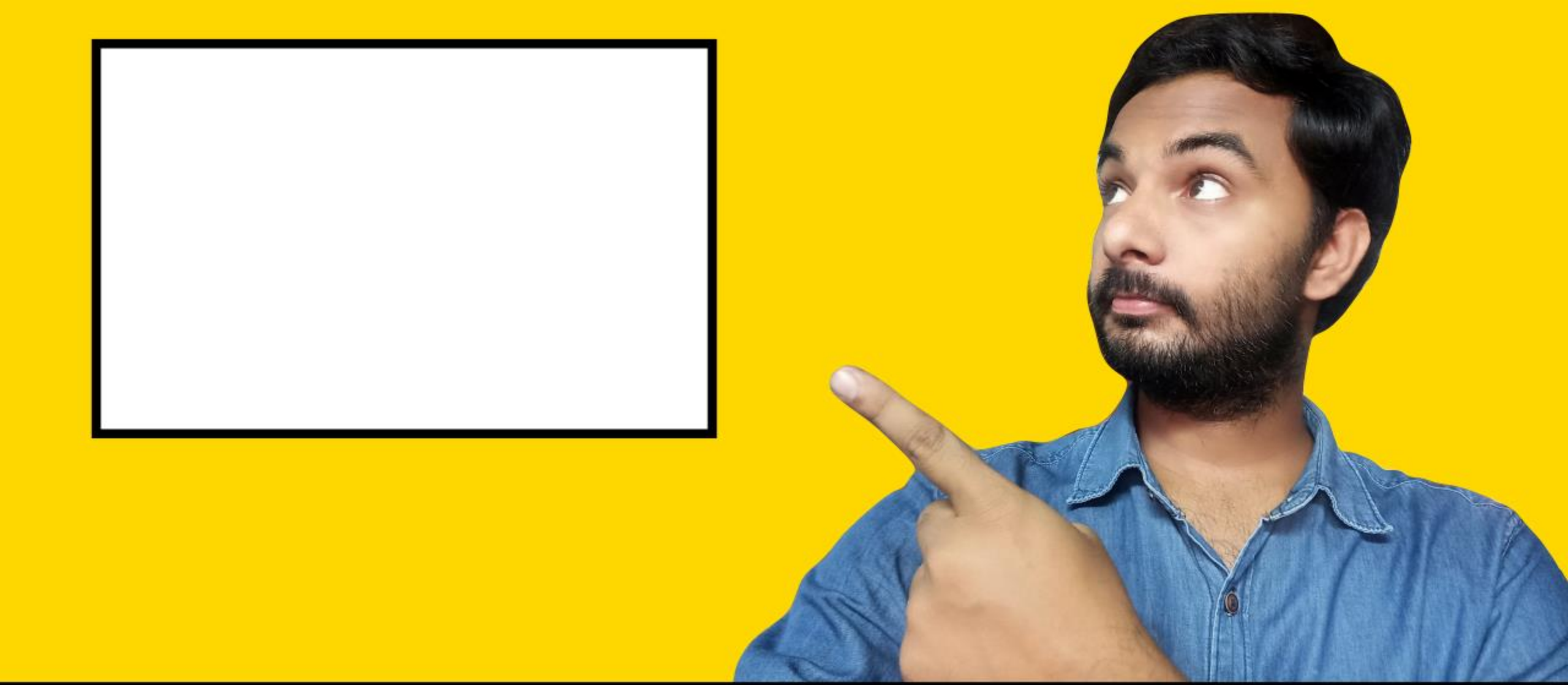
What we learned so far?



1. What is data type?
   - Data type defines the **type of values** that the variable can hold and it also specifies the **quantity** of the values that the variable can hold
2. There are 8 Primitive data types namely
   - Numeric
     - Integer (byte, short, **int**, long)
     - Fractional (float, **double**)
     - Character (**char**)
   - Non-Numeric
     - true/false (**boolean**)
3. Character(char) is also considered as numeric as it is internally represented using a number

What next?

Data types – Practical



చిన్న బ్రేక్ చిటికలో వచ్చేస్తా