C++ slides - I

Objects and Classes: Structure in C and C++, Class specification, Objects, Data hiding, Encapsulation and abstraction, namespaces, Array of objects, Passing objects as arguments, Returning object from a function, inline functions, Static data member and member function, ‘const’ member function.

Basic program

```
#include<iostream>
using namespace std;
int main(){
cout<<"Hello world"<<endl;
}
```

cin & cout

- cout works similar to printf
- cin works similar to scanf

Example

```
cout<<“Hello and welcome”;
cin>>variable;   //variable could be int, float, char array (without space)
```

cout basics

- ‘\n’ is for new line, or you can use *endl*

  cout << endl << “message”;
- ‘\t’ is for tab
- ‘\a’ is an alarm sound
- ‘\r’ is carriage return to go to the beginning of the current line

Header files and namespace

Header file and more

- #include <iostream> // input-output stream for cin/cout
- using namespace std;

- Namespaces allow us to differentiate same named entities in various libraries. It is just a region of the code or library and not a function.
- ***std*** stands for standard I/O on the console screen.

Need of namespace

```
#include <iostream>
int main() {
    int value;
    value = 0;
    double value; // Error here due to reuse of value
    value = 0.0;
}
```

Example – namespace defines the ***scope***

```
#include <iostream>
using namespace std;
namespace ns1 { int value() {return 5;}}
namespace ns2 { int value() {return -5;}}

int main() {
cout << ns1::value() << '\n';  //5 will be displayed
cout << ns2::value() << '\n';     // -5 will be displayed
}
```

What will be the output?

```
#include <iostream>
using namespace std;
namespace ns1 { int value() {return 5;}}
namespace ns2 { int x=10; int value() {return 4;}}
 int main() {
cout << ns1::value() << endl;
cout << ns2::value() << endl;
cout<< ns2::x<<endl;
}
```

Without namespace could cause :: pollution

```
#include<iostream>

int main(){
std::cout << “Hello there” << std::endl;
return 0;
}
```

using namespace std;

- Thus using namespace std; means cin/cout will be performed through standard console screen.

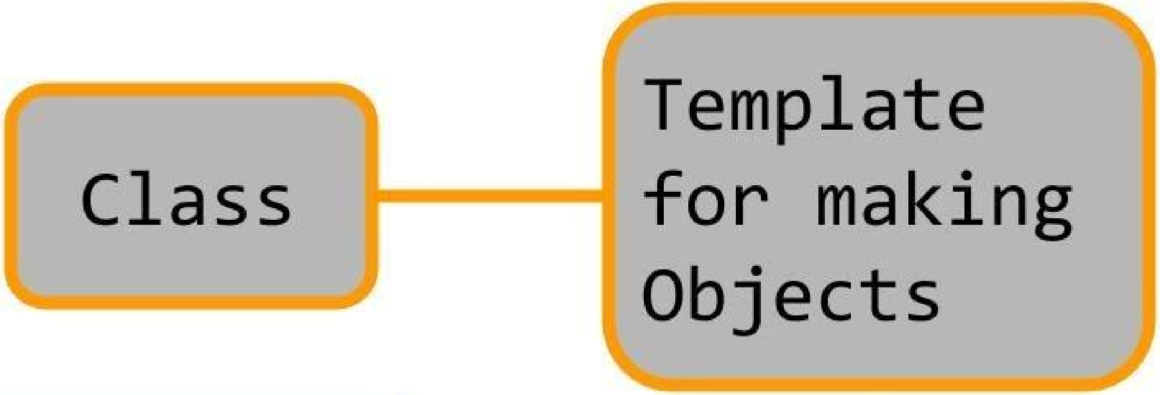
Header file and namespace

- #include<iostream> includes all necessary files required of CIN and COUT opertions.
- using namespace std; allows us to reduce :: pollution for simpler programs

Classes in C++

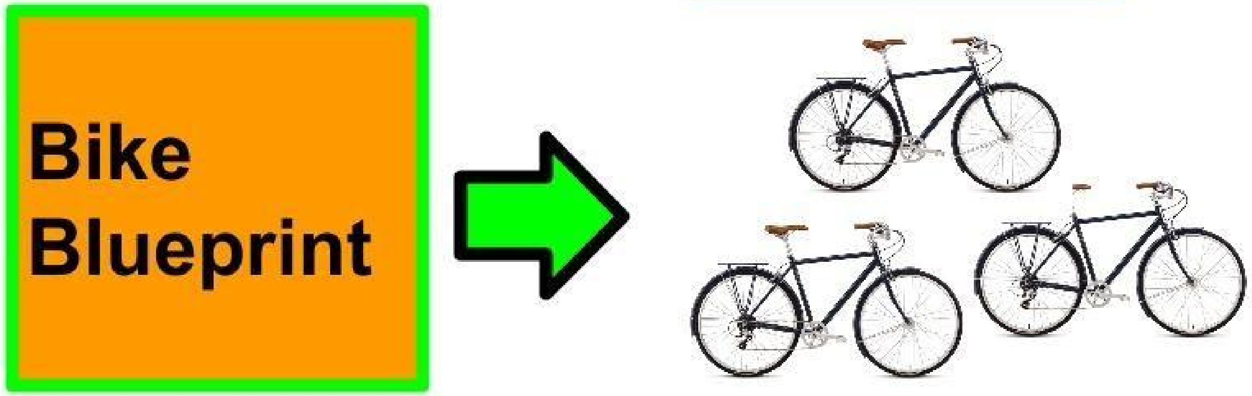
- **Class:** A class in C++ is the building block of object oriented programming
- It is User Defined Datatype (UDT) which has data & functions
- **Object** is an instance of a Class i.e. variable of UDT.

What is an Object?



Class

Template for making Objects



Bike Blueprint

CLASS	OBJECT
Class is a data type	Object is an instance of Class.
It generates OBJECTS	It gives life to CLASS
Does not occupy memory location	It occupies memory location.
It cannot be manipulated because it is not available in memory *(except static class)*	It can be manipulated.

Object is a class in *"runtime"*

Structure in C++

```
#include <iostream>
using namespace std;
struct Person{int age;};
int main(){
    Person p1;    // No need to write struct Person p1 in C++.
    cout << "Enter age: ";cin >> p1.age;
    cout <<"Age: " << p1.age << endl;
    return 0;
}
```

Structures in C++ vs in C

1. Functions can be defined inside structure in C++
2. Using ***struct*** keyword not required in C++
3. C++ structures can have static members
4. C++ allows data hiding by using access modifiers

```
#include <iostream>
using namespace std;
struct Person{
int age;                    //variable
int setAge(int a){age = a;}    //function
int display() {cout <<"Age: " << age << endl;} //function
};
int main(){
    Person p1;
    p1.setAge(20); p1.display();
    return 0;
}
```

Need more knowledge for 3 & 4

1. Functions can be defined inside structure in C++
2. Using ***struct*** keyword not required in C++
3. C++ structures can have static members
4. C++ allows data hiding by using access modifiers

struct vs class

- Classes in C++ are similar to struct for syntax
- *struct* – everything is public by default
- *class* – everything is private by default.

What is the output of the following program?

```
#include <iostream>
using namespace std;
class Person{
int age;
int setAge(int a){age = a;}
int display() {cout <<"Age: " << age << endl;}
};
int main(){
    Person p1;
    p1.setAge(20); p1.display();
    return 0;
}
```

Answer - Output – Compilation Error

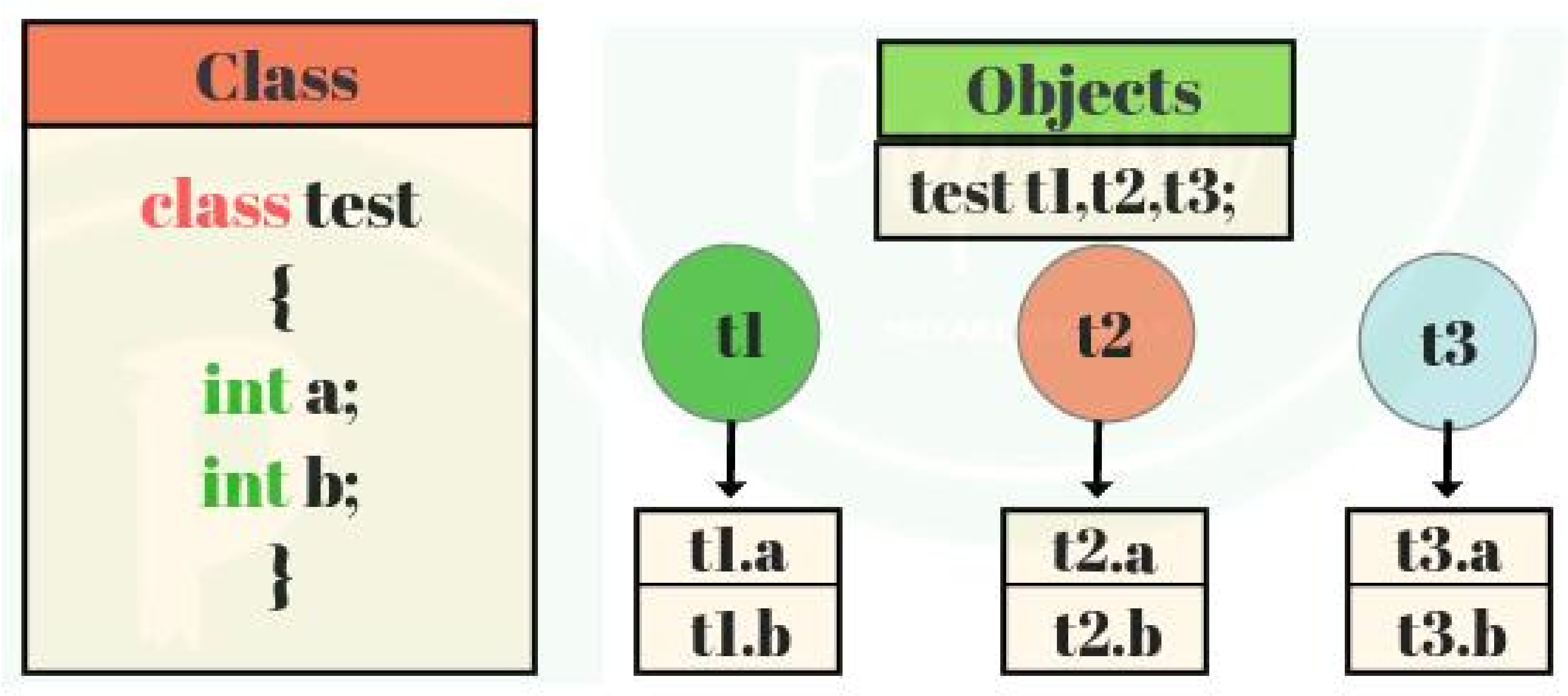
```
[Error] 'int Person::setAge(int)' is private
```

Now we use **public:** specifier for data and functions in class

```
#include <iostream>
using namespace std;
class Person{
public:        // Everything after public:  becomes public
int age;
int setAge(int a){age = a;}
int display() {cout <<"Age: " << age << endl;}
};
int main(){
   Person p1;    p1.setAge(20);
   p1.display();   return 0;
} // everything public in class means it becomes a struct
```

Output = Age: 20

Each object has its own variables/functions



Access specifiers in C++

- Public
- Private
- Protected (for later until we cover inheritance)

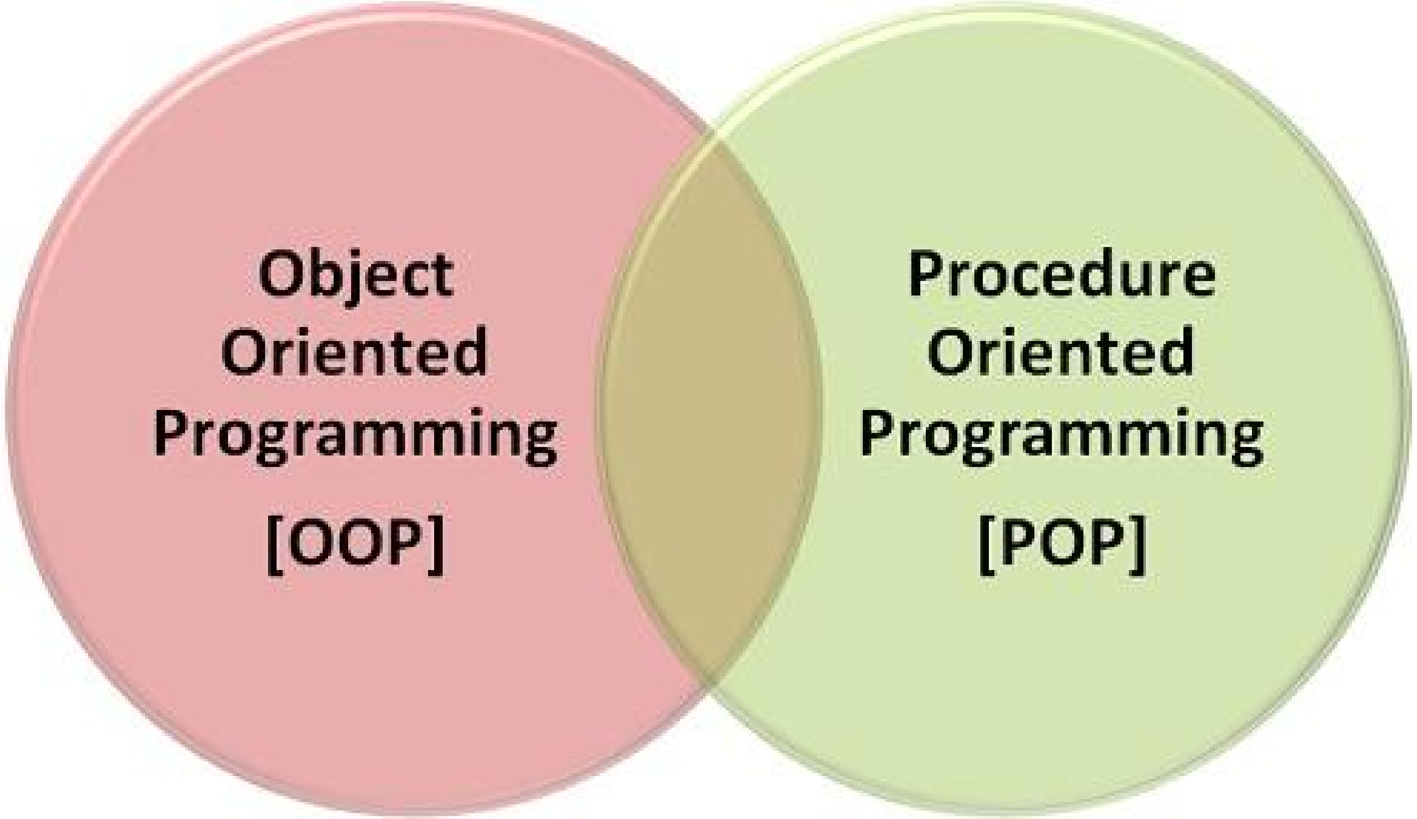
Data private and functions public.

What will be the output of following program?

```
#include <iostream>
using namespace std;
class Person{
int age;
public:         // Everything before public:  is private
void setAge(int a){age = a;}
int display() {cout <<"Age: " << age << endl;}
};
int main(){
    Person p1;    p1.setAge(20);
    p1.display();   return 0;
}
```

```
#include <iostream>
using namespace std;
class Person{
int age;
public:
void setAge(int a){age = a;}  //setter function
int getAge() {return age;}  //getter function
};
int main(){
    Person p1;    p1.setAge(20);
    cout <<"Age: " << p1.getAge() << endl;
}
```

C++ versus C language



Object Oriented Programming

[OOP]

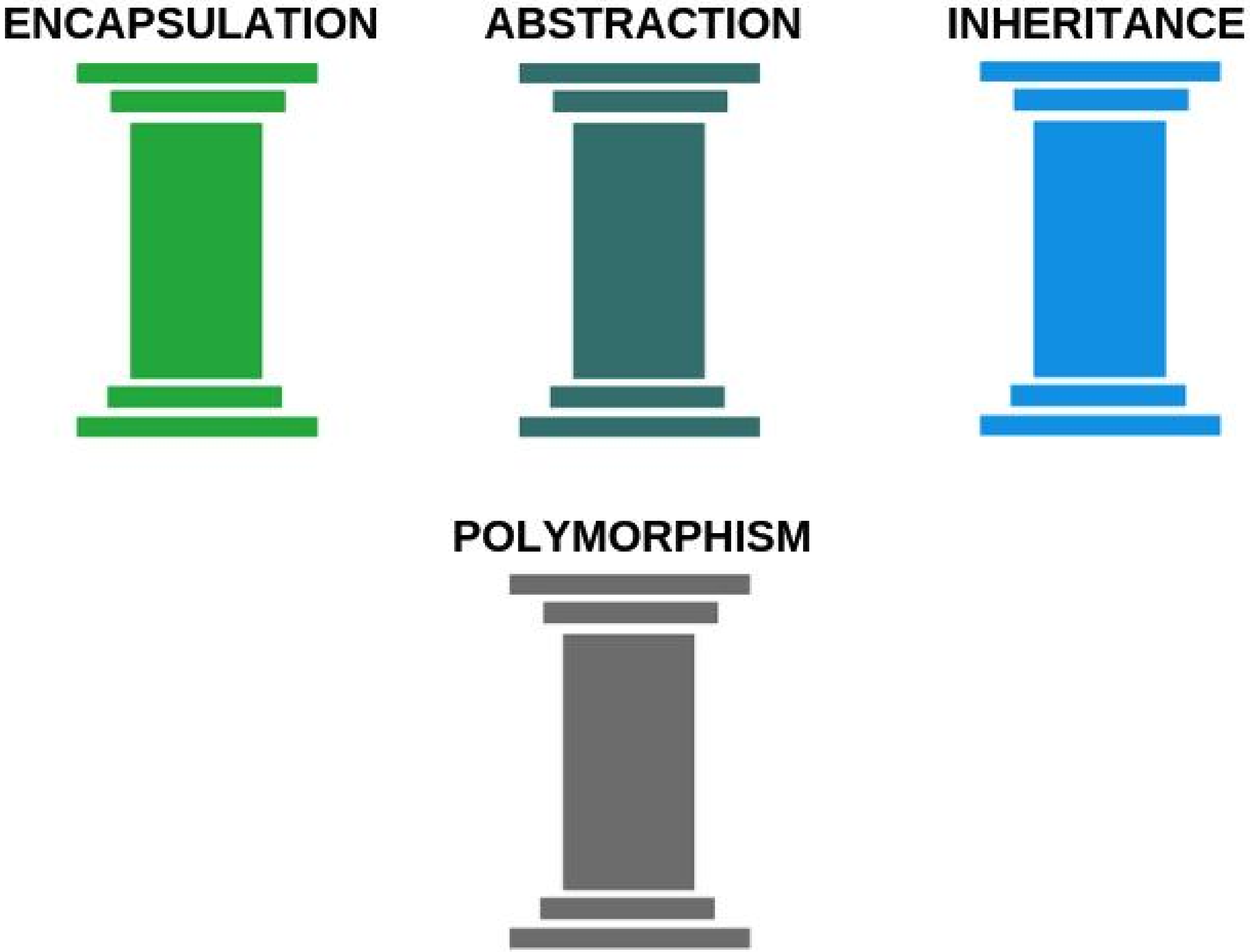
Procedure Oriented Programming

[POP]

Sr.	C language	C++
1	Functions are basic elements	Classes are basic elements
2	Focus on global functions	Focus on encapsulation (data+functions)
3	Functions share global data	Data and function access is controlled
4	Data moves openly	Data is bounded with classes
5	Top down approach (break down into functions)	Bottom up (clubbing of data and functions together)

Four *features* of object oriented programming

1. Encapsulation
2. Abstraction
3. Inheritance
4. Polymorphism



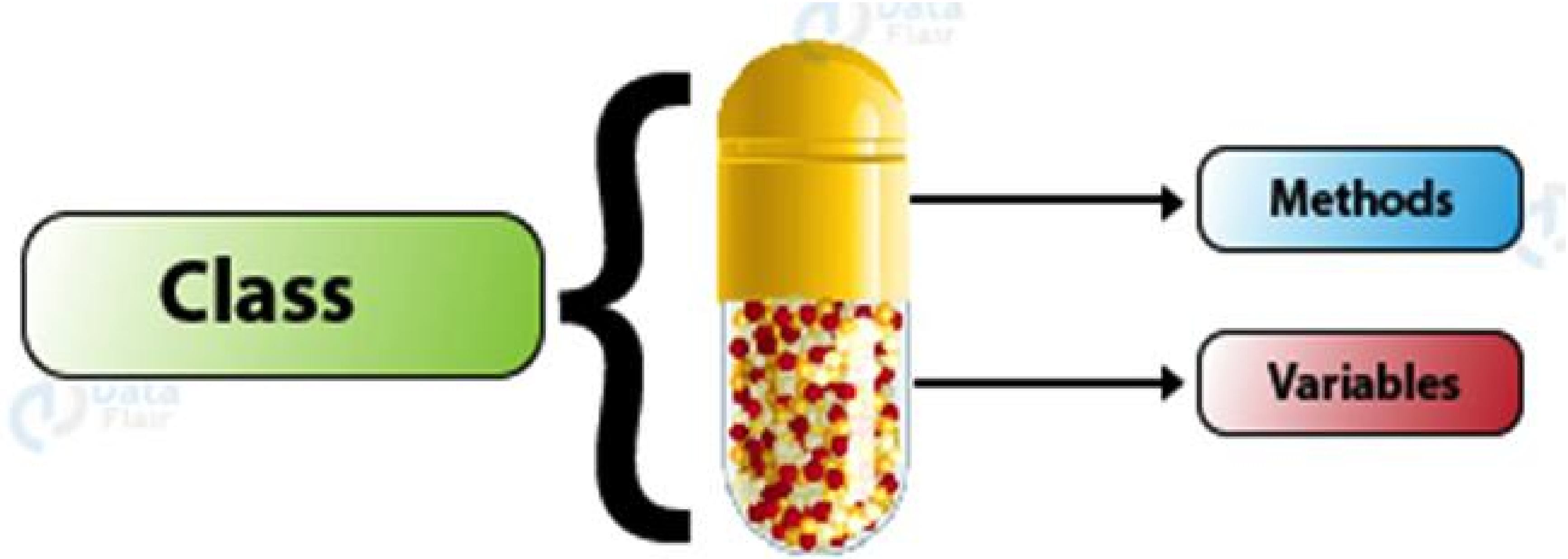
ENCAPSULATION

ABSTRACTION

INHERITANCE

POLYMORPHISM

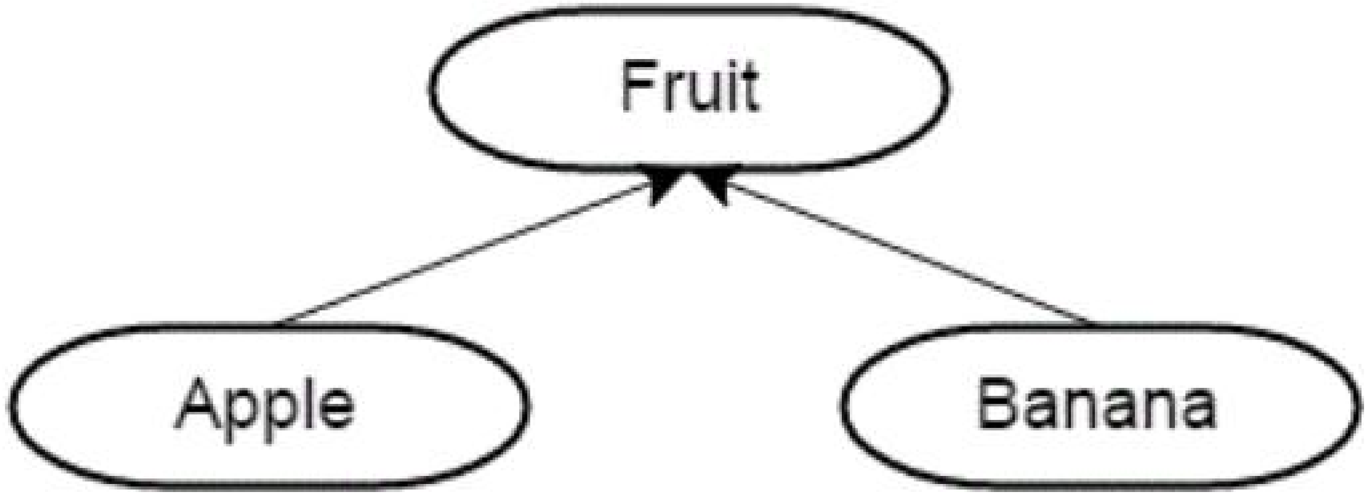
Encapsulation

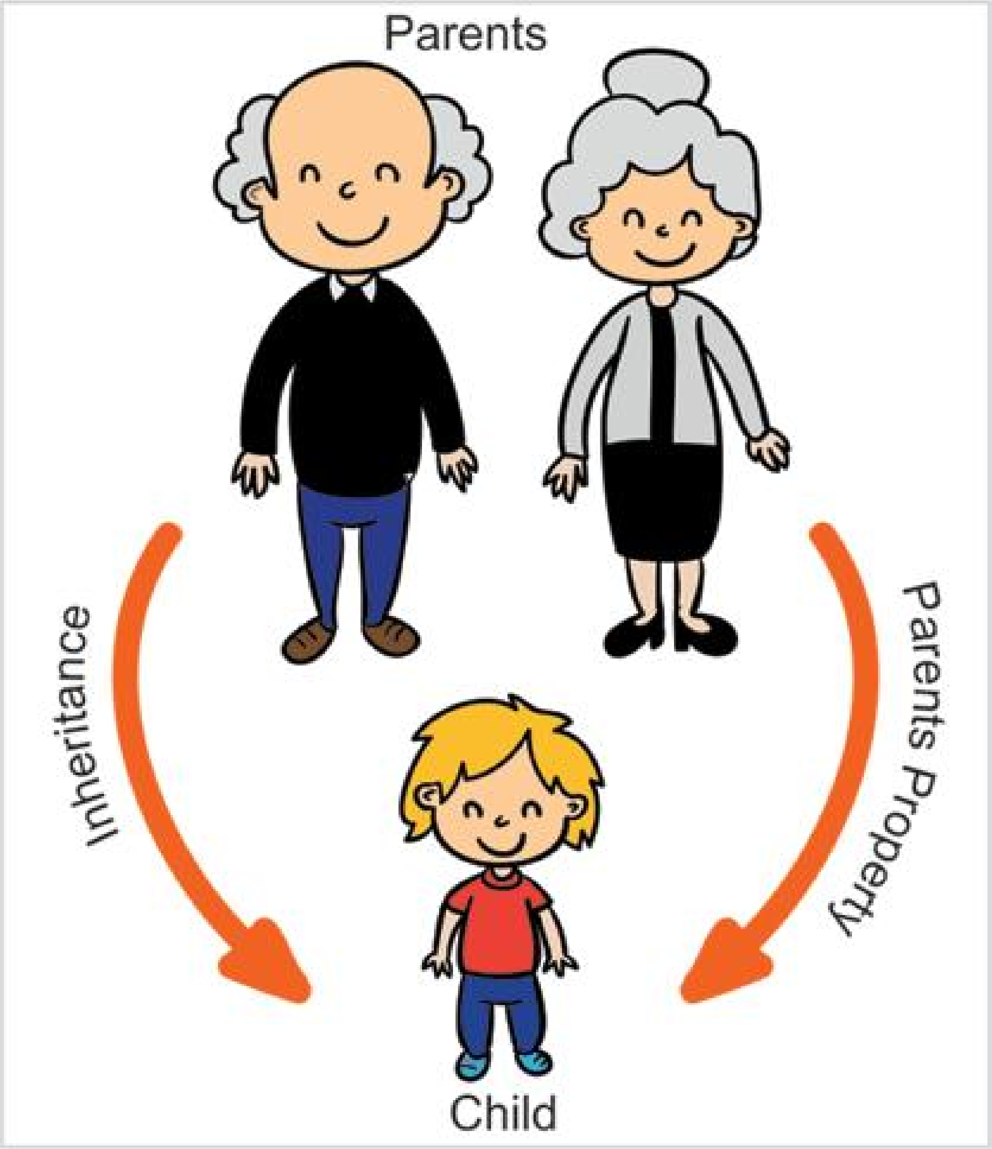


Abstraction

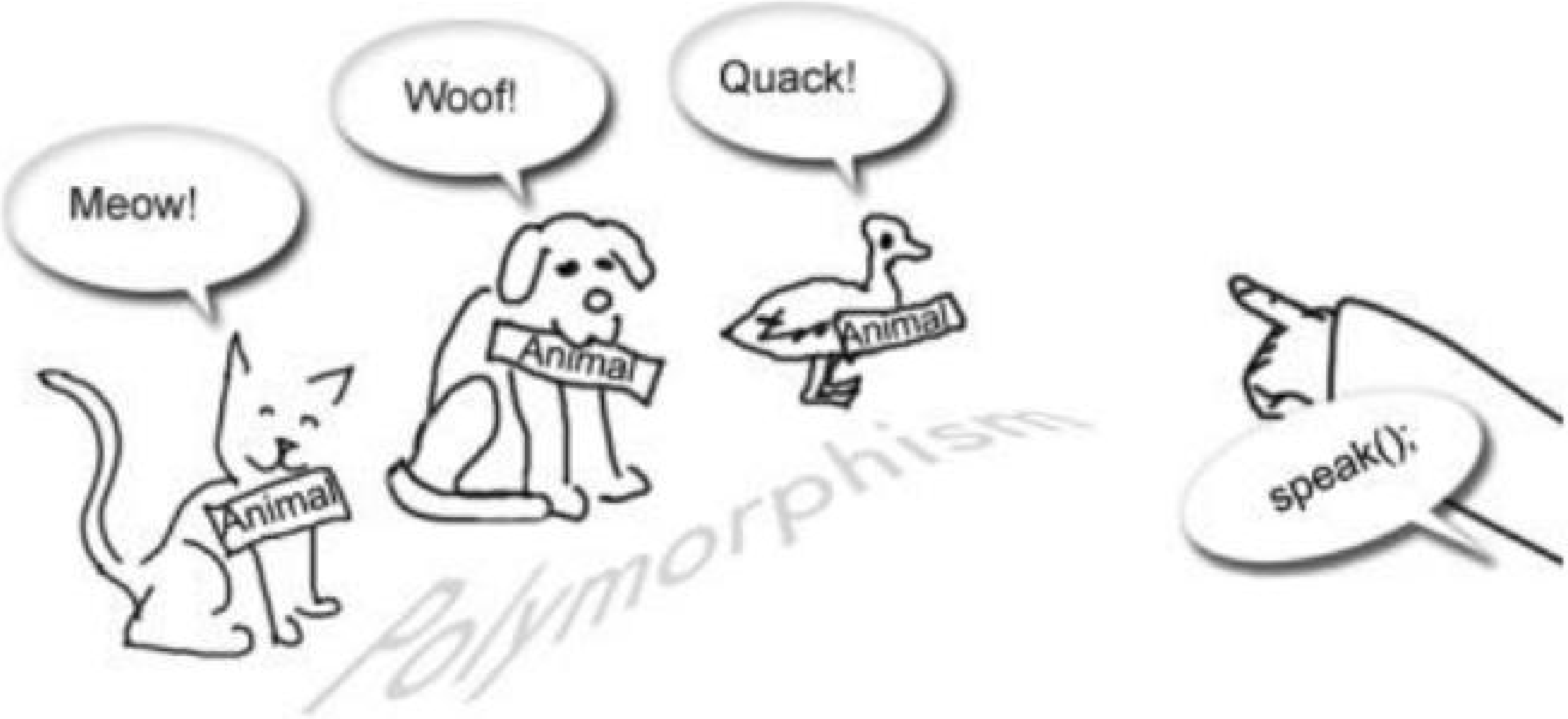
Using Abstraction
Tutorial4us
Without Abstraction

Inheritance





Polymorphism – late binding flexibility



:: for global variable

```
#include<iostream>
using namespace std;
int x=100;
int main(){
        int x=-100;
        cout<<"x = "<<x<<endl;
        cout<<"x = "<<::x<<endl;
        return 0;
}
```

:: for function def

```
class A{
public: void fun();   //only declaration
};
void A::fun(){      //function definition
cout<<"in fun()"<<endl;
}
int main(){
A obj;  obj.fun();
}
```

Constructor and Destructor functions

- Constructor/Destructor is a member function which has to be public.

- They are called automatically to construct (initialize) and destruct (delete) the object variables.

Constructor - basics

- Same name as the class
- No return statement
- Automatically called when object is created
- Compiler uses default empty constructor if no constructor is defined

Destructor

- C++ destructors are used to de-allocate the memory allotted by constructor.
- It has same name as class preceded by a tilde sign ~

Basic constructor and destructor

```
class Test {
public:
   Test() {cout<<“in constructor”<<endl;}
~Test() { cout << “In destructor” << endl; }
};
int main() {
Test c;   cout <<“In main”<<endl;;
}
```

Static variable in Class

```
class X{
static int i;
public:void show(){cout<<"i ="<<i<<endl;}
};
int X::i=1;
int main(){
X obj; obj.show();
}
```

Static function in Class

```
class X {
public:
static void f(){cout<<"In static f()"<<endl;}
};
int main(){
    X::f();   // direct call without an object
}
```

Array of objects

```
#include<iostream>
using namespace std;

class A{
        int a; char c;
        };
int main(){
A a[3];         // each of a[i] will have an int and a char
}
```

Passing and returning an object

```
class A{
int i;
public:  A(){i=10;}
void show(){cout<<"i = "<<i<<endl;}
A makedouble(A obj){A temp; temp.i = 2*obj.i; return temp;}
};
int main(){
A a1,a2;  a1.show();  a2 = a1.makedouble(a1);  a2.show();
}
```

Inline functions

```
inline int cube(int s){ return s*s*s; }
int main() {
cout << "The cube of 3 is: " << cube(3) << endl;
}
```

Inline function properties

- Reduces function-call overhead
- Asks the compiler to copy code into program instead of using function call
- Compiler can ignore inline
- Should be used for small, often used functions

‘const’ member function

```
int main(){
    const int i = 10;
    const int j = i + 10;     // works fine
    i++;    // this leads to Compile time error
}
```

Const class variable

```
class Test{
    const int i;
    public:
    Test(int x):i(x) {}   //initialized using constructor
    void show(){cout<<"i="<<i<<endl;}
};
int main(){Test t(190);t.show(); }
```

Const function

- The idea of *const* functions is not to allow them to modify the object on which they are called.
- It is recommended to make as many functions *const* as possible so that accidental changes to objects are avoided.

Const class *member* function

```
class A{
public:  int x;
void func() const{
                        x = 0; // [Error] can’t modify object variable
                  }
};
int main(){}
```

Extra concepts

Const function and object

const function should be a member function

```
#include<iostream>
using namespace std;
int i = 99;
void fun() const{}
int main(){}

//What will be the output?
```

Output

- [Error] non-member function 'void fun()' cannot have cv-qualifier

- Since there is no class where this function belongs to, you will get an error.

const class object

- In *const* class object, member variables cannot be modified
- Calling member functions that change the value of member variables is also prohibited.

```
// Example of const object
class Test{
public:
    int i;
    Test(): i(0) {}
    void setValue(int a) { i=a;}
};
int main(){
    const Test t; // calls default constructor
     //t.i = 5; // [Error]
    //t.setValue(5); // [Error]
}
```

String basics - 1

```
int main(){
string name;
cout<<"Enter name: ";
getline(cin,name);  // cin>>name; will only take first word
if(name.compare("rocky sharma")==0)
 cout<<"Same"<<endl;
 else cout<<"Different"<<endl;
}
```

String concat (connect)

```
int main(){
string name1,name2;
cout<<"string 1: "; cin>>name1;
cout<<"string 2: "; cin>>name2;
cout<<"String concat = "<<name1+", "+ name2;
}
// + means connect strings together
```