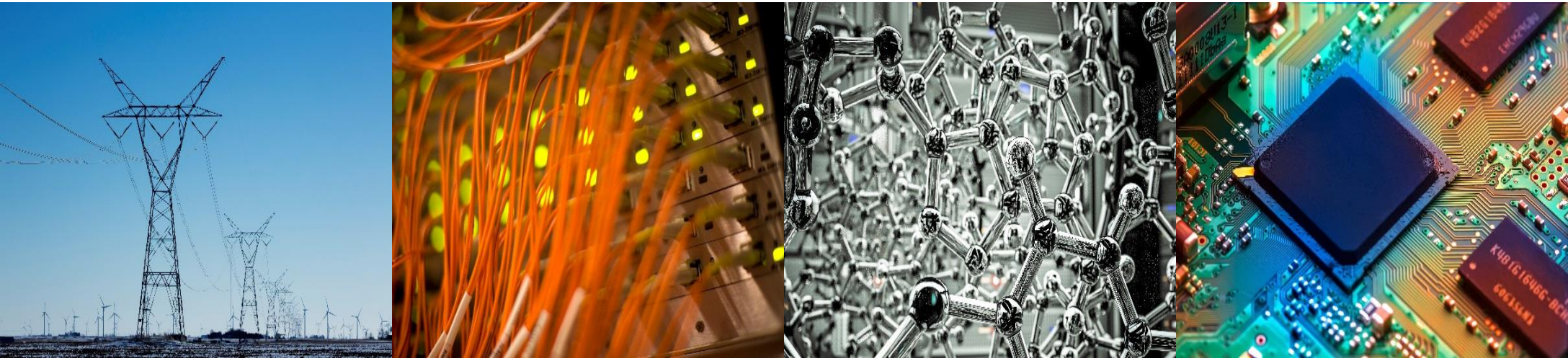
ECE 220 Computer Systems & Programming

Lecture 20 – Introduction to C++

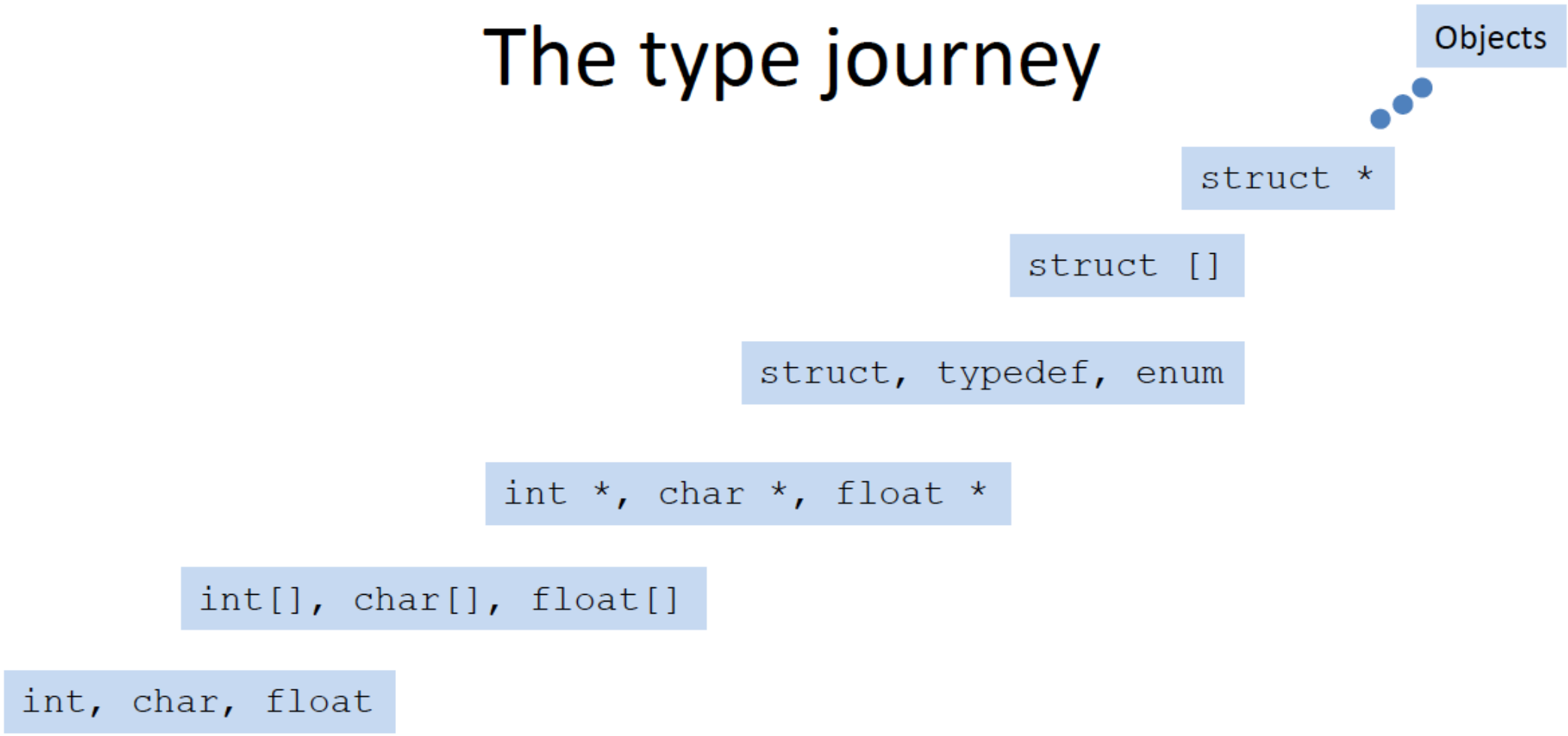
November 7, 2024



- **MT2 regrade deadline is this Sunday**

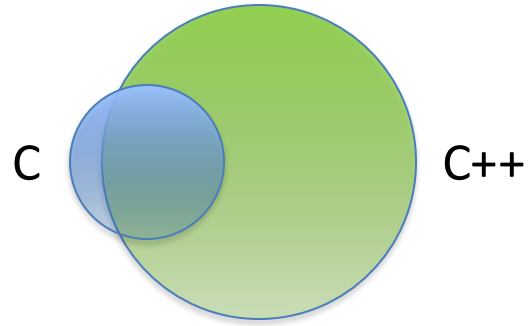
ILLINOIS
Electrical & Computer Engineering
GRAINGER COLLEGE OF ENGINEERING

The type journey



C++ Class & Encapsulation

C++ was created in 1979 by Bjarne Stroustrup at Bell Labs, as an extension to C.
It's an **object-oriented** language



OOP Concepts:

Encapsulation, Inheritance, Polymorphism, Abstraction

Class in C++ is similar to Struct in C, except it defines the data structure **AND**

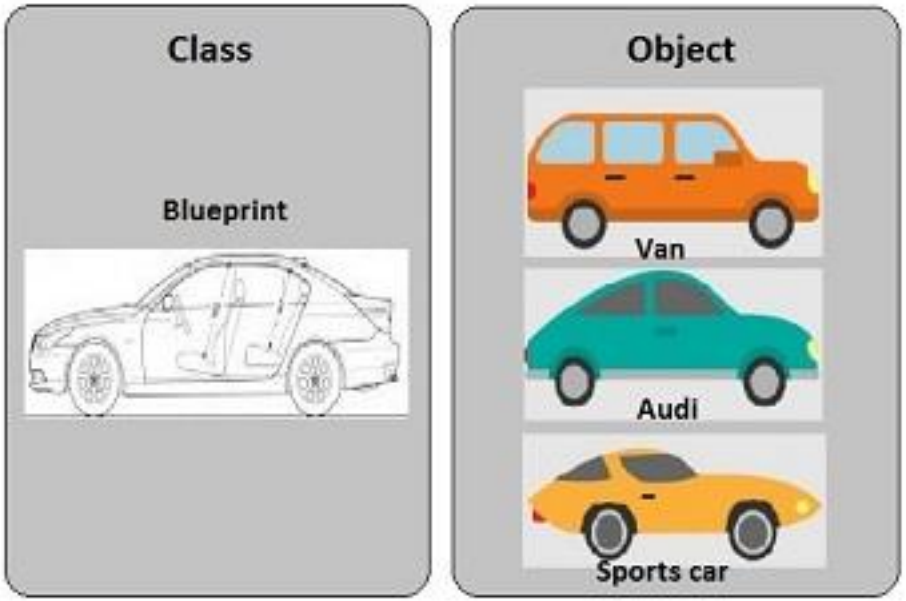
- control "who" can access that data
- provide functions specific to the class

➢ Can you spot the differences in C vs. C++ examples for adding two vectors?

Concepts Related to Class

An **object** is an instance of the class

- shares the same functions with other objects of the same class
- but each object has its own copy of the data



Concepts Related to Class

Member functions (also called **methods**) - functions that are part of a class

Private vs. Public members

- private members can only be accessed by member functions (**default access**)
- public members can be accessed by anyone

Constructors & Destructors

- Constructor – a special member function that _____ (initiates) a new object
- Destructor – a special member function that _____ an object (when it goes outside of scope)

Basic Input / Output

cin – standard input stream
cout – standard output stream

namespace –
"using namespace" directive tells compiler the subsequent code is using names in a specific namespace (otherwise we need to use std::identifier)

Example:

```
#include <iostream>
using namespace std;
int main(){
        char name[20];
        cout << "Enter your name: ";
        cin >> name; //cin.getline(name, sizeof(name));
        cout << "Your name is: " << name << endl;
}
```

Exercise – Writing Constructors

```
class Rectangle{
      int width_, height_;
  public:
      Rectangle();
      Rectangle(int, int);
      int area() const {return width_*height_;}
};
Rectangle::Rectangle(){
//set both width_ and height_ to 0

}
Rectangle::Rectangle(int w, int h){
//set width_ to w and height_ to h


}
```

Exercise – Accessing Members in an Object

```
#include <iostream>
using namespace std;
int main(){
      Rectangle rect1(3,4);
      Rectangle rect2;

      //print rect1's area


      //print rect2's area


      return 0;
}
```

- What is the area of object rect1? How about rect2?
- How do we get the width/height of each object?

Dynamic Memory Allocation

new – operator to *allocate* memory (similar to *malloc* in C)

delete – operator to *deallocate* memory (similar to *free* in C)

Use **delete[]** to deallocate an array

Example:

```
int *ptr;
ptr = new int;
delete ptr;

int *ptr;
ptr = new int[10];
delete [] ptr;
```

Exercise – Accessing Objects Through Pointers

```
#include <iostream>
using namespace std;
int main(){
        Rectangle rect1(3,4);
        Rectangle *r_ptr1 = &rect1;
        //print rect1's area through r_ptr1

        Rectangle *r_ptr2 = new Rectangle(5,6);
        //print area of rectangle pointed to by r_ptr2
        if(r_ptr2 != NULL){                                                    }
        Rectangle *r_ptr3 =
                    new Rectangle[2]{Rectangle(),Rectangle(2,4)};
        //print area of the 2 rectangles in the array
        if(r_ptr3 != NULL){


                                                                               }
        //deallocate memory



        return 0;
}
```

Function Overloading

- In C, each function has exactly one type
- C++ allows overloading – multiple implementations for **different parameter types**
- Compiler chooses implementation based on the types chosen

Example:

```
int getmin(int a, int b){
   return (a<b)?a:b;
}

double getmin(double a, double b){
   return (a<b)?a:b;
}
```

Operator Overloading

Redefine built-in operators such as +, -, *, <, >, = in C++ to do what you want

Example:

```
class vector {
 protective:
   double angle_, length_;
 public:
   //constructors & other member functions
   …
   vector operator +(const vector &b) {
       vector c;
       double ax = length_*cos(angle_);
       double bx = b.length_*cos(b.angle_);
       double ay = length_*sin(angle_);
       double by = b.length_*sin(b.angle_);
       double cx = ax+bx;
       double cy = ay+by;
       c.length_ = sqrt(cx*cx+cy*cy);
       c.angle_ = acos(cx/c.length_);
       return c;}
};
```

```
vector a(1.5,2);
vector b(2.6,3);

//before operator overload
vector c = a.add(b);

//after operator overload
vector c = a + b;
```