Static Members

Week 05

Lecture 14

Today's Outline

- Static Variables
- Static Functions

Static Data Member

Definition

"A variable that is part of a class, yet is not part of an object of that class, is called static data member"

Static Variables

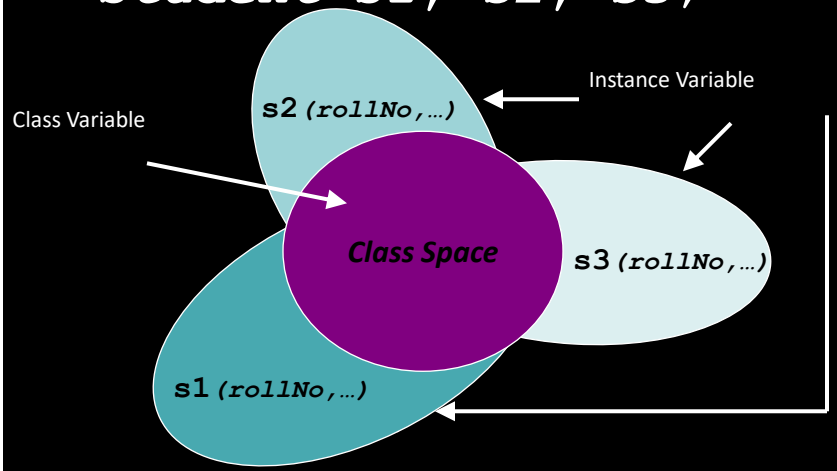
- Lifetime of static variable is throughout the program life
- If static variables are not explicitly initialized then they are initialized to 0 of appropriate type

Static Data Member

- They are shared by all instances of the class
- They do not belong to any particular instance of a class

Class vs. Instance Variable

- **`Student s1, s2, s3;`**



Static Data Member (Syntax)

- Keyword static is used to make a data member static

```
class ClassName{
…
static DataType VariableName;
};
```

Defining Static Data Member

- Static data member is declared inside the class
- But they are defined outside the class

Defining Static Data Member

```
class ClassName{
…
static DataType VariableName;
};

DataType ClassName::VariableName;
```

Initializing Static Data Member

- Static data members should be initialized once at file scope
- They are initialized at the time of definition

Example

```
class Student{
private:
   static int noOfStudents;
public:
   …
};
int Student::noOfStudents = 0;
/*private static member cannot be
accessed outside the class except for
initialization*/
```

Initializing Static Data Member

- If static data members are not explicitly initialized at the time of definition then they are initialized to 0

Example

```
int Student::noOfStudents;

is equivalent to

int Student::noOfStudents=0;
```

Accessing Static Data Member

- To access a static data member there are two ways
  - Access like a normal data member
  - Access using a scope resolution operator '::'

Example

```
class Student{
public:
    static int noOfStudents;
};
int Student::noOfStudents;
int main(){
    Student aStudent;
    aStudent.noOfStudents = 1;
    Student::noOfStudents = 1;
}
```

Life of Static Data Member

- They are created even when there is no object of a class
- They remain in memory even when all objects of a class are destroyed

Example

```
class Student{
public:
   static int noOfStudents;
};
int Student::noOfStudents;
int main(){
   Student::noOfStudents = 1;
}
```

Example

```
class Student{
public:
   static int noOfStudents;
};
int Student::noOfStudents;
int main(){
   {
     Student aStudent;
     aStudent.noOfStudents = 1;
   }
   Student::noOfStudents = 1;
}
```

Uses

- They can be used to store information that is required by all objects, like global variables

Example

- Modify the class Student such that one can know the number of student created in a system

Example

```
class Student{
…
public:
   static int noOfStudents;
   Student();
   ~Student();
…
};
int Student::noOfStudents = 0;
```

Example

```
Student::Student(){
   noOfStudents++;
}
Student::~Student(){
   noOfStudents--;
}
```

Example

```
int Student::noOfStudents = 0;
int main(){
  cout <<Student::noOfStudents <<endl;
  Student studentA;
  cout <<Student::noOfStudents <<endl;
  Student studentB;
  cout <<Student::noOfStudents <<endl;
}
```

Output:
0
1
2

Problem

- noOfStudents is accessible outside the class
- Bad design as the local data member is kept public

Static Member Function

Definition:

"The function that needs access to the members of a class, yet does not need to be invoked by a particular object, is called static member function"

Static Member Function

- They are used to access static data members
- Access mechanism for static member functions is same as that of static data members
- They cannot access any non-static members

Example

```
class Student{
   static int noOfStudents;
   int rollNo;
public:
   static int getTotalStudent(){
       return noOfStudents;
   }
};
int main(){
   int i = Student::getTotalStudents();
}
```

Accessing non static data members

```
int Student::getTotalStudents(){
   return rollNo;
}
int main(){
   int i = Student::getTotalStudents();
   /*Error: There is no instance of Student,
   rollNo cannot be accessed*/
}
```

this Pointer

- *this* pointer is passed implicitly to member functions
- *this* pointer is not passed to static member functions
- Reason is static member functions cannot access non static data members

Array of Objects

- Array of objects can only be created if an object can be created without supplying an explicit initializer
- There must always be a default constructor if we want to create array of objects

Example

```
class Test{
public:
};
int main(){
  Test array[2]; // OK
}
```

Example

```
class Test{
public:
  Test();
};
int main(){
  Test array[2]; // OK
}
```

Example

```
class Test{
public:
  Test(int i);
};
int main(){
  Test array[2]; // Error
}
```

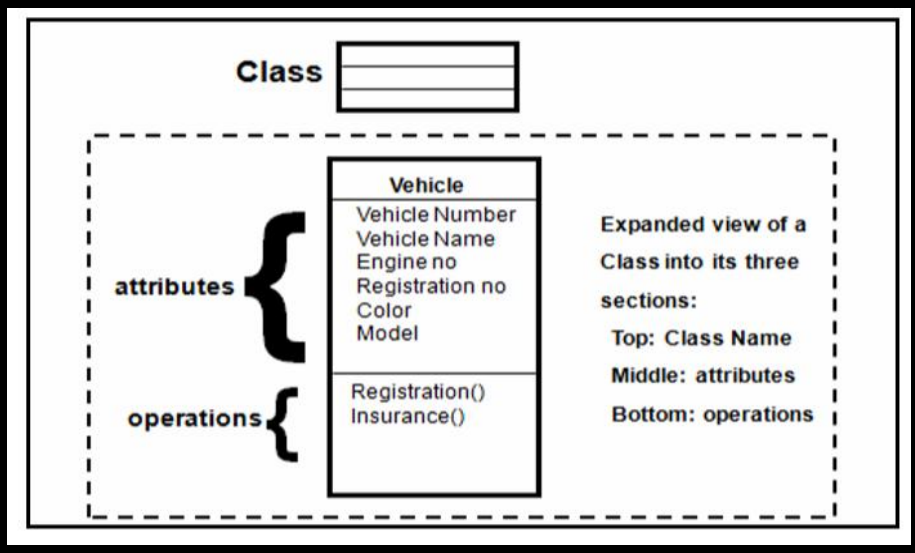
Example

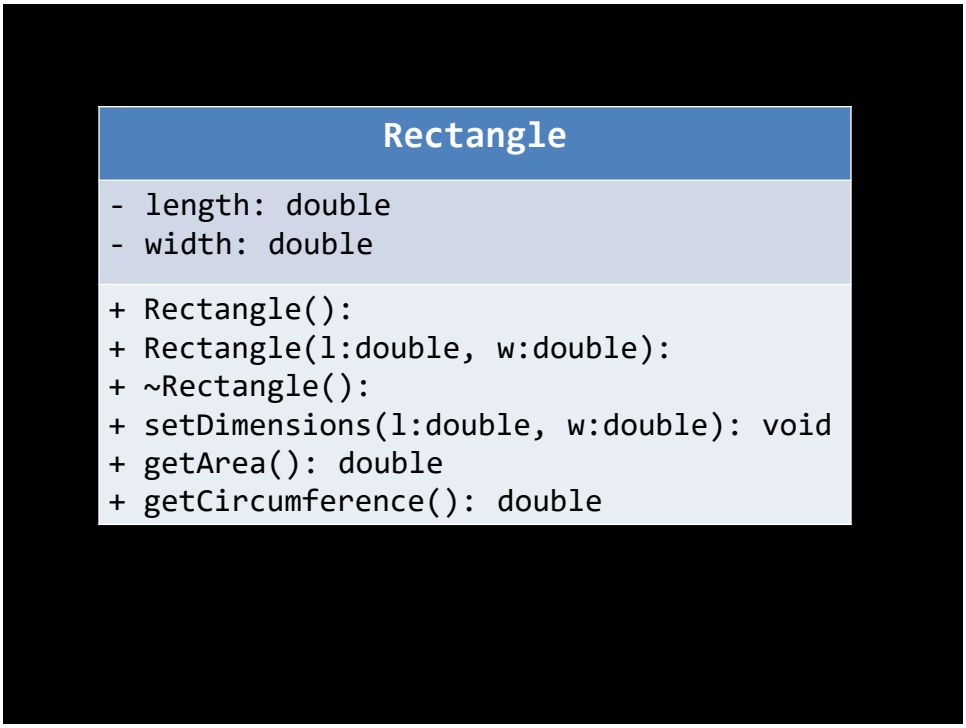
```
class Test{
public:
  Test(int i);
}
int main(){
  Test array[2] =
         {Test(0),Test(0)};
}
```

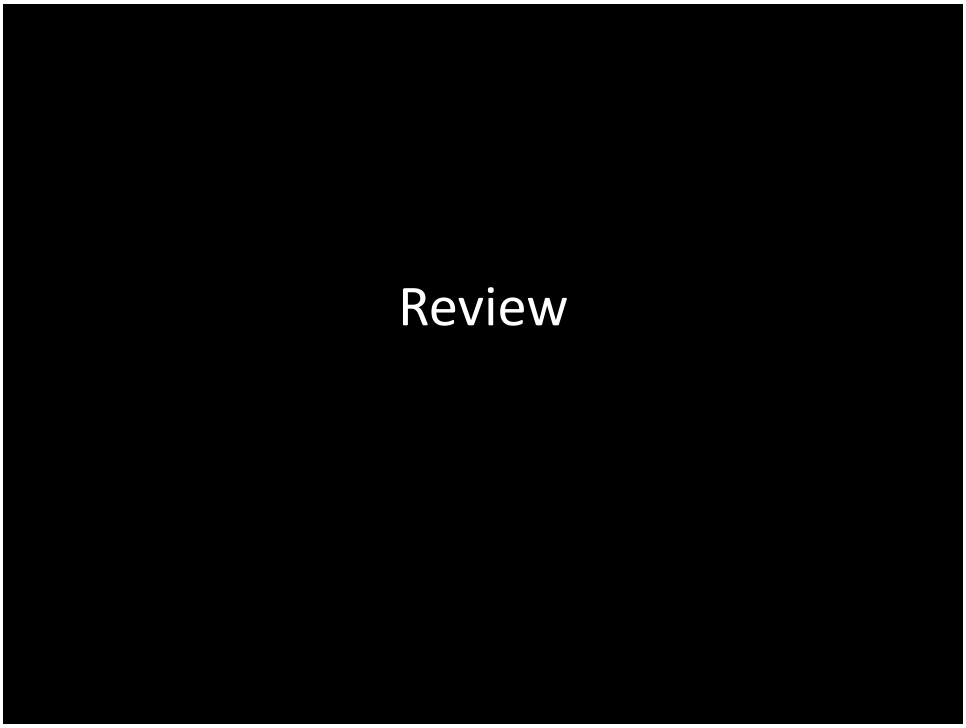
Example

```
class Test{
public:
  Test(int i);
}
int main(){
  Test a(1),b(2);
  Test array[2] = {a,b};
}
```

UML Class Diagram




Rectangle
- length: double
- width: double
+ Rectangle():
+ Rectangle(l:double, w:double):
+ ~Rectangle():
+ setDimensions(l:double, w:double): void
+ getArea(): double
+ getCircumference(): double


Review