Agenda

- Virtual Destructor
- Advanced Casting Operators
- Friend Function and class
- Templates
- Exception Handling

Virtual Destructor

- A destructor is implicitly invoked when an object of a class goes out of scope or the object's scope ends to free up the memory occupied by that object.
- Due to early binding, when the object pointer of the Base class is deleted, which was pointing to the object of the Derived class then, only the destructor of the base class is invoked
- It does not invoke the destructor of the derived class, which leads to the problem of memory leak in our program and hence can result in undefined behavior.
- To correct this situation, the base class should be defined with a virtual destructor.
- Making base class destructor virtual guarantees that the object of derived class is destructed properly, i.e., both base class and derived class destructors are called.
- to make a virtual destrictor use virtual keyword preceded by a tilde(~) sign and destructor name inside the parent class.
- It ensures that first the child class's destructor should be invoked and then the destructor of the parent class is called.
- Note: There is no concept of virtual constructors in C++.

Advanced Typecasting Operators:

1. dynamic_cast
2. static_cast
3. const_cast
4. reinterpret_cast

1. dynamic_cast operator

- In case of polymorphic type, if we want to do downcasting then we should use dynamic_cast operator.
- dynamic_cast operator check type conversion as well as inheritance relationship between type of source and destination at runtime.
- In case of pointer if, dynamic_cast operator fail to do downcasting then it returns NULL.
- In case of reference, if dynamic_cast operator fail to do downcasting then it throws std::bad_cast exception.

2. static_cast operator

- If we want to do type conversion between compatible types then we should use static_cast operator.
- In case of non polymorphic type, if we want to do downcasting then we should use static_cast operator.
- In case of upcasting, if we want to access non overriden members of Derived class then we should do downcasting.

- static_cast operator do not check whether type conversion is valid or invalid. It only checks inheritance between type of source and destination at compile time.
- Risky conversion not be used, should only be used in performance-critical code when you are certain it will work correctly.
- The static_cast operator can be used for operations such as converting a pointer to a base class to a pointer to a derived class. Such conversions are not always safe.

```
int main( void )
{
double num1 = 10.5;
//int num2 = ( int )num1;
int num2 = static_cast<int>( num1 );
cout<<"Num2:"<<num2<<endl;
return 0;
}
```

3. const_cast operator

- Using constant object, we can call only constant member function.
- Using non constant object, we can call constant as well as non constant member function.
- If we want convert pointer to constant object into pointer to non constant object or reference to constant object into reference to non constant object then we should use const_cast operator.
- Used to remove the const, volatile, and __unaligned attributes.
- const_cast<class *> (this)->membername = value;

4. reinterpret_cast operator.

- If we want to convert pointer of any type into pointer of any other type then we should use reinterpret_cast operator.
- The reinterpret_cast operator can be used for conversions such as char* to int*, or One_class* to Unrelated_class*, which are inherently unsafe.

Exception Handling

- Following are the operating system resources that we can use in application development
    1. Memory
    2. File
    3. Thread
    4. Socket
    5. Network connection
    6. IO Devices etc.
- Since OS resources are limited, we should use it carefully.
- If we make syntactical mistake in a program then compiler generates error.
- Without definition, if we try to access any member then linker generates error.
- Logical error / syntacticaly valid but logicaly invalid statements represents bug.
- If we give wrong input to the application then it generates runtime error/exception.

- Exception is an object, which is used to send notification to the end user of the system if any exceptional situation occurs in the program.
- If we want to manage OS resources carefully then we should use exception handling mechanism.
- Need of exception Handling:
    1. To avoid resource leakage.
    2. To handle all the runtime errors(exeption) centrally.
- If we want to handle exception then we should use 3 keywords:
    1. try
    2. catch
    3. throw

1. try:

- try is keyword in C++.
- If we want to inspect exception then we should put statements inside try block/handler.
- try block must have at least one catch block/handler

2. throw:

- throw is keyword in C++.
- If we want to generate exception explicitly then we should use throw keyword.
- "throw statement" is a jump statement.

3. catch:

- If we want to handle exception then we should use catch block/handler.
- Single try block may have multiple catch block.
- Catch block can handle exception thrown from try block only.
- With the help of function, we can throw exception from outside try block.
- For thrown exception, if we do not provide matching catch block then C++ runtime gives call the std::terminate function which implicitly give call the std::abort function.
- A catch block, which can handle any type of exception is called generic catch block / catch-all handler.
- Generic catch block must appear after all specific catch block.

```
try
{
}
catch(...)
{
}
```

Template

- If we want to write generic program in C++ then we should use template.
- Using template we can not reduce code size or execution time but we can reduce developers effort.
- It is designed for implementing generic data structure and algorithms
- Types of template:

1. Function Template
2. Class Template

1. Function Template

```
//template<typename T>//T : Type Parameter
template<class T> //T : Type Parameter
void swap_number( T &o1, T &o2 )
{
    T temp = o1;
    o1 = o2;
    o2 = temp;
}
int main( void )
{
    int num1 = 10;
    int num2 = 20;
    swap_number<int>( num1, num2 );
    //Here int is type argument
    cout<<"Num1 : "<<num1<<endl;
    cout<<"Num2 : "<<num2<<endl;
    return 0;
}
```

- Type inference : It is ability of compiler to detect type of argument at compile time and passing it as a argument to the function.

```
template<class X, class Y>
void swap_number( X &o1, Y &o2 )
{
    X temp = o1;
    o1 = o2;
    o2 = temp;
}
int main( void )
{
    float num1 = 10.5f;
    double num2 = 20.5;
    swap_number<float, double>(num1,num2 );
    cout<<"Num1 : "<<num1<<endl;
    cout<<"Num2 : "<<num2<<endl;
    return 0;
}
```

- We can pass multiple type arguments to the function.
- Using template argument list, we can pass data type as a argument to the function.
- Using template we can write type safe generic code.

2. Class Template

- In C++, by passing data type as a argument, we can write generic code hence parameterized type is called template.

```
template<class T>
class Array // Parameterized type
{
    private:
    int size;
    T *arr;
    public:
    Array( void ) : size( 0 ), arr( NULL )
    {
    }
    Array( int size )
    {
    this->size = size;
    this->arr = new T[ this->size ];
    }
    void acceptRecord( void ){
    }
    void printRecord( void ){
    }
    ~Array( void ){ }
};
int main( void )
{
    Array<char> a1( 3 );
    a1.acceptRecord();
    a1.printRecord();
    return 0;
}
```


Friend function & class

- If we want to access private members inside derived class
- Either we should use member function(getter/setter).
- Or we should declare a facilitator function as a friend function.
- Or we should declare derived class as a friend inside base class.
- Friend function is non-member function of the class, that can access/modify the private members of the class.
- It can be a global function.
- Or member function of another class.
- Friend functions are mostly used in operator overloading.
- If class C1 is declared as friend of class C2, all members of class C1 can access private members of C2.
- Friend classes are mostly used to implement data struct like linked lists.