

Object Life Cycle

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Contents



- Constructors.
- Destructor.
- Static members.
- Class template.

Contents



- **Constructors.**
- **Destructor.**
- **Static members.**
- **Class template.**

Constructors



■ Object initialization:

■ How to initialize object attributes?

```
class Fraction
{
private:
    int    m_num;
    int    m_den;
};
```

```
int main()
{
    Fraction p;
    // Value of p??
}
```

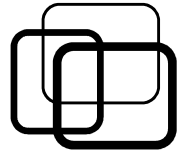
■ Use setters:

```
class Fraction
{
public:
    void setNum( int num );
    void setDen( int den );
};
```

```
int main()
{
    Fraction p;
    p.setNum( 1 );
    p.setDen( 3 );
}
```

Forget to call?!

Constructors



■ Role of constructors:

- “Birth certificate” for object!!
- Mandatory when declaring object.
- Can be overloaded.
- Has no return type.
- Name: <class name> (C++).

```
class Fraction
{
private:
    int    m_num;
    int    m_den;
public:
    Fraction( int num, int den );
    Fraction( int value );
};
```

```
int main()
{
    Fraction  p1(1, 2);
    Fraction  p2( 5 );
    Fraction  *p3 = new Fraction( 2, 3 );
}
```

Constructors



■ Default constructor:

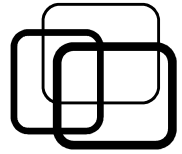
- Default initialization.
- Has no argument.
- If class has no constructor:

→ Compiler will provide default constructor.

```
class Fraction
{
private:
    int    m_num;
    int    m_den;
public:
    Fraction();
};
```

```
int main()
{
    Fraction p;
    Fraction *q = new Fraction;
}
```

Constructors



■ Copy constructor:

- Initialization by copying another object.
- Take object of same class as argument.
- If class has no copy constructor:
→ Compiler will provide one.

```
class Fraction
{
private:
    int    m_num;
    int    m_den;
public:
    Fraction(const Fraction &p);
};
```

```
int main()
{
    Fraction p1(1, 2);

    // Copy p1...
    Fraction p2(p1);
    // Copy p2...
    Fraction p3 = p2;
}
```

Constructors



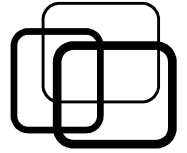
■ Dr. Guru advises:

■ A class should have at least 3 constructors:

- Default constructor.
- Copy constructor.
- Constructor to initialize all attributes.

```
class Fraction
{
private:
    int    m_num;
    int    m_den;
public:
    Fraction();
    Fraction( const Fraction &p );
    Fraction( int num, int den );
};
```





■ Constructor implementation:

■ Syntax:

```
<class name>::<class name>( <arguments> ) :  
    // Simple initialization.  
    <attribute 1>( <value 1> ) ,  
    <attribute 2>( <value 2> ) ,  
    ...  
{  
    // Complex initialization.  
}
```

```
Fraction::Fraction( int value ) :  
    m_num( value ),  
    m_den( 1 )  
{  
}
```

```
Fraction::Fraction( int num, int den ) {  
    if ( den == 0 )  
        throw std::invalid_argument(“Zero den.”);  
    m_num = num;  
    m_den = den;  
}
```

Contents



- Constructors.
- **Destructor.**
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Destructor



■ Memory leak problem:

- Memory allocated to pointer must be deleted.

```
class Student
{
private:
    char    *m_name;
};
```

```
int main()
{
    Student s;
}
// Memory leak: s.m_name!!
```

- Use delete method:

```
class Student
{
private:
    char    *m_name;
public:
    void deleteMemory() {
        delete [ ]m_name; }
};
```

```
int main()
{
    Student s;
    s.deleteMemory();
}
```

Forget to call?!

Destructor



■ Role of destructor:

- “Living will” for object.
- Automatically called when object is dead.
- A class has only ONE destructor.
- Name: ~<class name> (C++).

```
class Student                                int main()
{
private:                                     {
    char    *m_name;                        Student s;
public:                                       Student *p = new Student;
    ~Student() { delete [ ]m_name; }        delete p;
};
```

Contents



- Constructors.
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- **Static members.**
- Class template.

Static members



■ Object sharing:

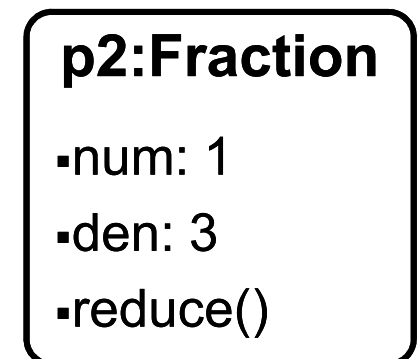
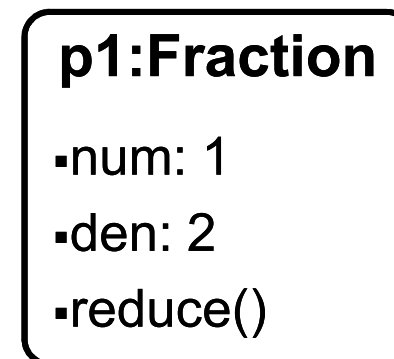
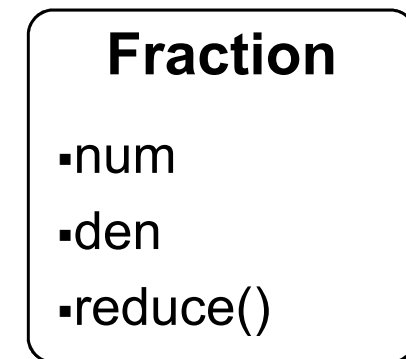
■ Each object has its own:

- Attributes.
- Methods.

➔ Object members.

■ How to share information with other objects?

➔ Static members.



Static members



■ Static members:

- Class-level attributes and methods.
- Shared among objects of same class.
- Usage in C++:
 - Keyword “**static**”.
 - Initialization: outside class.
 - Use `::` to access.

```
class Fraction
{
private:
    static int m_maxValue;
public:
    static int getMaxValue();
};
```

```
int Fraction::m_maxValue = 10000;

int main()
{
    int x = Fraction::getMaxValue();
}
```

Contents



- Constructors.
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- **Class template.**

Class template



■ Consider class Array:

- Elements of integer.
- Abstraction: elements of any type.
 - Parameterize type of elements.
 - Parameterize prototype of methods related to elements.

➔ Class Template.

Class template

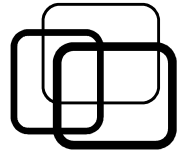


■ Class template usage:

```
template <class T>  
class Array  
{  
private:  
    T *m_data;  
    int m_size;  
public:  
    Array( int size );  
    T& getElement( int i );  
    T findMax( );  
};
```

```
int main()  
{  
    Array<int> m1( 10 );  
    int a = m1.getElement( 5 );  
    int max1 = m1.findMax( );  
  
    Array<Fraction> m2( 5 );  
    Fraction p = m2.getElement( 2 );  
    Fraction max2 = m2.findMax( );  
}
```

Summary



■ Constructors:

- “Birth certificate” of object.
- Mandatory when declaring object.
- Can be overloaded.

■ Destructor:

- “Living will” of object.
- Automatically called when deposing object.
- Has only one.



Summary



- **Static members:**
 - Attributes/methods shared among objects.
 - Keyword “static”.
- **Class Template:**
 - Parameterization class attributes and types.

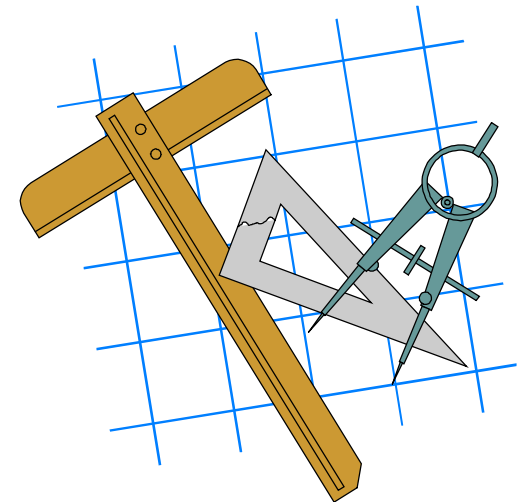


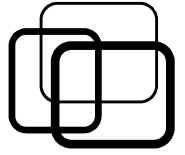


■ Practice 3.1:

Provide class **Fraction** with the following constructors to:

- Default initialize a fraction = 0.
- Initialize a fraction with num and den.
- Initialize a fraction = integer value.
- Initialize a fraction from another fraction.

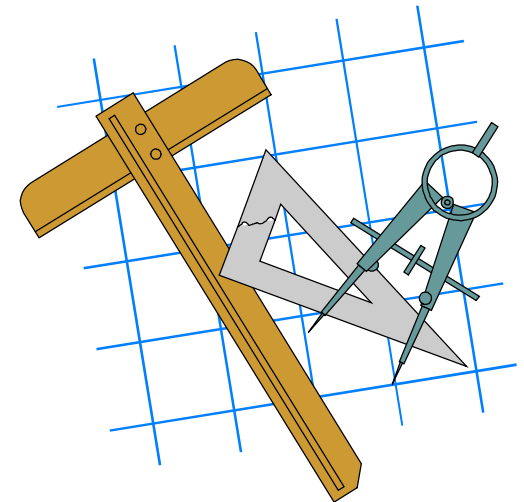




■ Practice 3.2:

Construct class **Student** with constructors and destructor to:

- Initialize a student with name, math, literature points.
- Initialize a student with name, math = literature = 0.
- Initialize a student from another student.
- Dispose a student without memory leak.

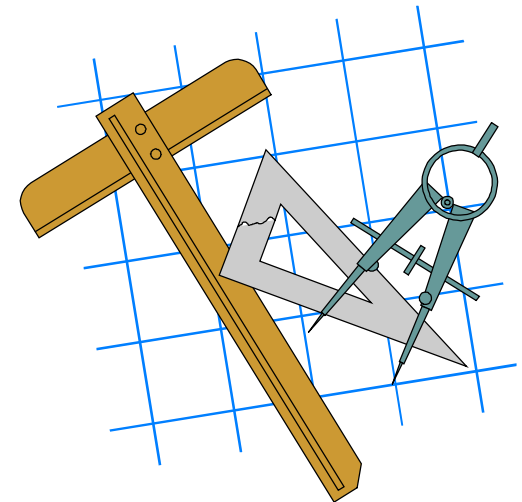




■ Practice 3.3:

Construct class **Array** (of integers) with the following constructors and destructor to:

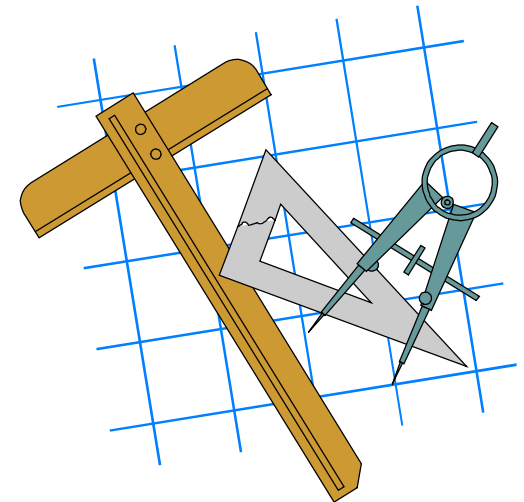
- Default initialize an array with zero-length.
- Initialize an array with length, all elements = 0.
- Initialize an array with int [] and length.
- Initialize an array from another array.
- Depose an array without memory leak.





■ Practice 3.4:

Based on practice 3.3 construct class **Array** with elements of any type.



Practice



■ Practice 3.5 (*):

Provide class **Fraction** an ability to count number of fraction objects created in `main()` function.

