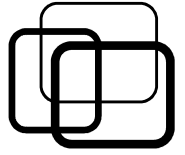


Course overview

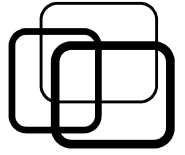
Inst. Nguyễn Minh Huy

Contents



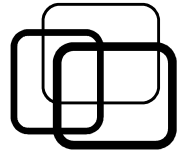
- Coding convention.
- Function overloading.
- Error handling.
- Abstract programming.

Contents



- **Coding convention.**
- Function overloading.
- Error handling.
- Abstract programming.

Coding convention



■ Why using coding convention?

■ Case 1 - Working alone:

- Self understanding.
- **Understand your stuff last year?**



■ Case 2 - Team-work:

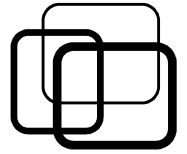
- Work shared among members.
- **How to gather work?**
- **How to understand each other?**



For effective collaboration!!

Apply discipline!!

Coding convention



■ Rule #0: no universal standard!!

- Depend on programming languages.
- Depend on companies/ communities.

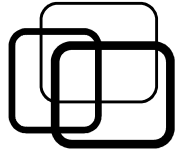
■ Common conventions:

- Naming convention.
- Statement convention.
- Comment convention.

■ *References:*

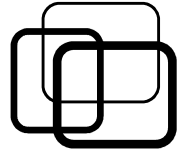
- *Course Coding Conventions on Moodle.*
- *Google C++ Styles Guide:*
<https://google.github.io/styleguide/cppguide.html>

Contents



- Coding convention.
- **Function overloading.**
- Error handling.
- Abstract programming.

Function overloading



■ Function signature/prototype:

- To identify a function.
- C/C++ function signature:

- Function name.

- Argument list.

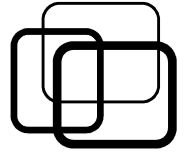
`double sort(int a[], int size);`

`double sort(float a[], int size);`

- **Return type is not counted!!**

**Function overloading:
functions differ only by
argument list.**

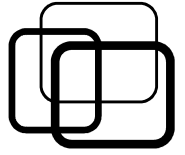
Function overloading



■ Invalid function overloading?

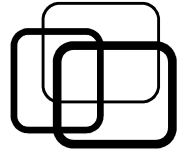
1. `int add(int a, int b);`
2. `int add(int x, int y);`
3. `int add(int a, float b);`
4. `float add(int u, int v);`
5. `int add(int a, long b);`

Contents



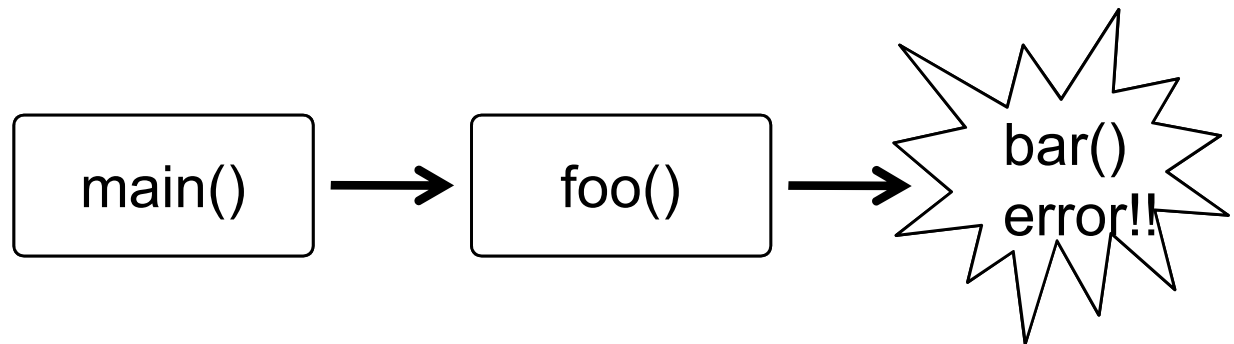
- Coding convention.
- Function overloading.
- **Error handling.**
- Abstract programming.

Error handling

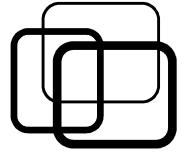


■ Basic concept:

- Errors are unexpected cases in code.
- Errors can come from:
 - User input.
 - External data.
 - Previous code result.
- Code must be guided to deal with predictable errors:
 - Resolve in-place.
 - Raise error, handle later.



Error handling



■ C-style error handling:

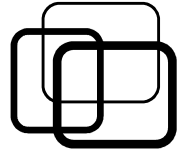
■ Function return:

- Simple.
- Interfere function signature.

```
bool divide( int a, int b, int &result ) {  
    if (b == 0)  
        return false; // Raise error.  
    result = a / b;  
    return true;  
}
```

```
int main( ) {  
    int x, y, z;  
  
    // Input x, y...  
  
    if ( !divide( x, y, z ) ) // Handle.  
        fprintf(stderr, "Division error");  
    else  
        printf("Result = %d", z);  
}
```

Error handling



■ C-style error handling:

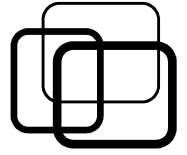
■ Use **errno** (library `<errno.h>`):

- Before function call: set **errno** = 0.
- After function call: check **errno**.

```
int divide( int a, int b ) {  
    if (b == 0) {  
        errno = 1; // Raise error.  
        return 0;  
    }  
    return a / b;  
}
```

```
int main( ) {  
    int x, y, z;  
  
    // Input x, y...  
  
    errno = 0;  
    z = divide( x, y );  
    if ( !errno ) // Handle.  
        fprintf(stderr, "Division error");  
    else  
        printf("Result = %d", z);  
}
```

Error handling



■ C++ exception handling:

■ Raise error: **throw** <error value>.

- <error value>: simple or complex type.

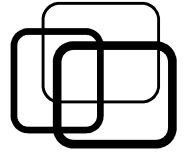
■ Receive and handle:

- **try** { <examined code> }
- **catch** (<error value>) {
 <handling code>
}

```
int divide( int a, int b ) {  
    if ( b == 0 )  
        throw 1; // Raise error.  
  
    return a / b;  
}
```

```
int main( ) {  
    int x, y, z;  
  
    // Input x, y...  
  
    try { // Receive.  
        z = divide( x, y );  
        printf("Result = %d", z);  
    }  
    catch (int &e) { // Handle.  
        fprintf(stderr, "Division error");  
    }  
}
```

Error handling



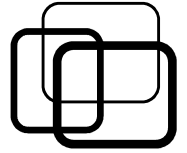
■ C++ exception handling:

■ Built-in exception type:

- `std::invalid_argument`.
- `std::out_of_range`.
- `std::overflow_error`.
- `std::bad_alloc`.

```
int * create_array( int length ) {  
    if ( length <= 0 )  
        throw std::invalid_argument("Error: length is negative or zero");  
  
    try {  
        return new int [ length ] { 0 };  
    catch ( std::bad_alloc &e ) {  
        return nullptr;  
    }  
}
```

Error handling



■ Multiple handlers:

// Ugly nested if-else.

```
int main() {  
    if ( f1() ) {  
        if ( f2() ) {  
            if ( f3() ) {  
                // Expected case.  
            } else {  
                // Handle f3 error.  
            }  
        } else {  
            // Handle f2 error.  
        }  
    } else {  
        // Handle f1 error.  
    }  
}
```

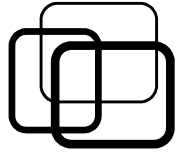
// Handle errors first.

```
int main( ) {  
    if ( !f1() ) {  
        // Handle f1 error.  
        return;  
    }  
    if ( !f2() ) {  
        // Handle f2 error.  
        return;  
    }  
    if ( !f3() ) {  
        // Handle f3 error.  
        return;  
    }  
    // Expected case.  
}
```

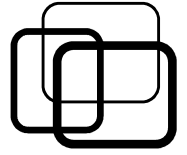
// Use C++ exception.

```
int main( ) {  
    try {  
        f1();  
        f2();  
        f3();  
        // Expected case.  
    } catch (<f1 error>) {  
        // Handle f1 error.  
    } catch (<f2 error>) {  
        // Handle f2 error.  
    } catch (<f3 error>) {  
        // Handle f3 error.  
    }  
}
```

Contents

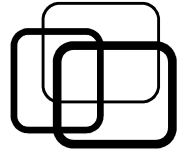


- Coding convention.
- Function overloading.
- Error handling.
- **Abstract programming.**



- What is an abstract program?
 - Not fix to a specific case.
 - Can apply to different context.
 - Write once, use everywhere.
 - Parameterization:
 - Data parameterization (passing arguments).
 - Type parameterization (function template).
 - Process parameterization (function pointer).

Abstract programming



■ Data parameterization:

- Problem: add two integers 12345 and 67890.
- Abstraction 1: add two integers of ***any values***.

// Fix to specific case:

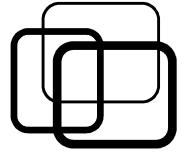
// Hard code.

```
int calc( ) {  
    return 12345 + 67890;  
}
```

// Abstraction 1:

// Passing arguments.

```
int calc( int x, int y ) {  
    return x + y;  
}  
  
int main( ) {  
    calc( 12345, 67890 );  
    calc( 49381, 97723 );  
}
```



■ Type parameterization:

- Abstract 2: add two numbers of *any types*.

➔ Use Function Template.

// Abstraction 2:

// Passing type as arguments.

template <class T>

T calc(T x, T y) {
 return x + y;

}

int main() {

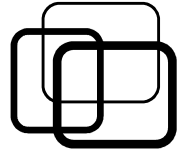
 int x = **calc**(3, 5);

 float y = **calc**(4.2, 6.3);

 Fraction p1, p2;

 Fraction p3 = **calc**(p1, p2);

}

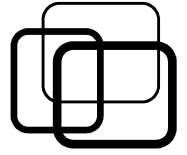


■ Function Template:

- A way to parameterize type.
- Pass type as arguments into function.

■ Notes:

- Keyword “**class**” can be replaced by “**typename**”.
- Template declaration must be in both function declaration and implementation.
- Function implementation must be in the same file:
 - With function declaration.
 - With calling function.
- Template FAQ: <https://isocpp.org/wiki/faq/templates>



■ Process parameterization:

- Abstraction 3: do **any operation** on two integers.

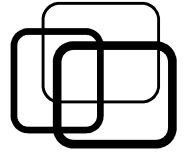
➔ Use function pointer.

// Abstraction 3:

// Passing function as arguments.

```
typedef int ( * Operation )( int, int );  
int calc( int x, int y, Operation p ) {  
    x = x * x;  
    y = y * y * y;  
    return p( x, y );  
}
```

```
int add( int x, int y ) {  
    return x + y;  
}  
int mul( int x, int y ) {  
    return x * y;  
}  
int main( ) {  
    int x = calc( 3, 5, add );  
    int x = calc( 4, 6, mul );  
}
```



■ Function pointer:

- S1: use **typedef** to create alias for function pointer.

```
typedef int (* Operation) ( int, int );
```

- S2: pass function as arguments.

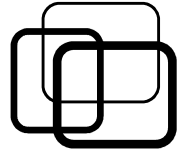
```
int calc( int x, int y, Operation p ) {  
    x = x * x;  
    y = y * y * y;  
    return p( x, y );  
}
```

- S3: create concrete function.

```
int add( int x, int y ) {  
    return x + y;  
}
```

- S4: pass concrete function as argument:

```
calc( 3, 5, add );
```



■ Function pointer:

- A way to parameterize command.
- Pass function as argument into another function.

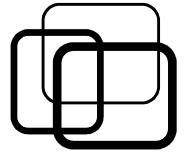
■ Notes:

- Pass function pointer directly, no **typedef**:

```
int calc( int x, int y, int ( *p ) ( int, int ) );
```

- Function pointer with function template must be passed directly.
- ➔ Abstraction 4: do any operations on two numbers of any types.

Summary



■ Coding Convention:

- Apply discipline to collaborate efficiently.
- Naming convention.
- Statement convention.
- Comment convention.

■ Function Overloading:

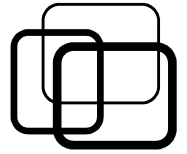
- Functions differ only by argument list.

■ Error handling:

- Errors: unexpected cases.
- Code must be guided to deal with errors.



Summary



■ Error handling:

■ Raise error, handle later:

- C-style: return type, errno (<errno.h>).
- C++style: throw, try, catch.

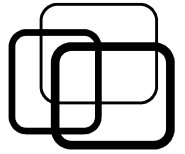
■ Abstract programming:

■ Not fix to specific case.

■ Use parameterization:

- Data parameterization (passing arguments).
- Type parameterization (function template).
- Command parameterization (function pointer).

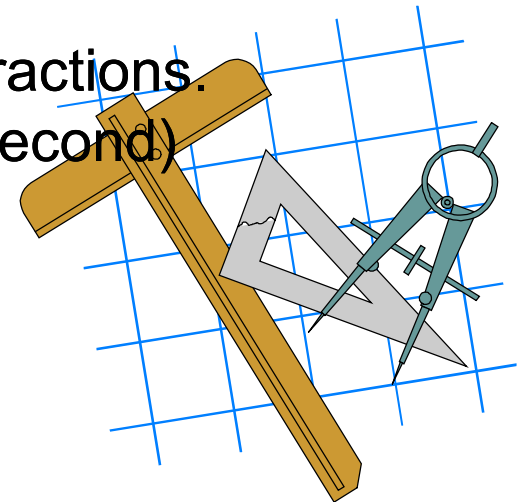


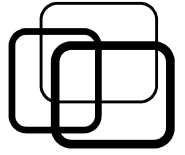


■ Practice 1.1:

Write C++ program to do the followings on type **Fraction**:
(use appropriate error handling)

- **input**: enter fraction from keyboard.
- **output**: print fraction to screen.
- **reduce**: return the reduction of fraction.
- **inverse**: return the inversion of fraction.
- **add**: return the sum of two fractions.
- **compare**: return the comparison result of two fractions.
(0: first = second, -1: first < second , +1: first > second)

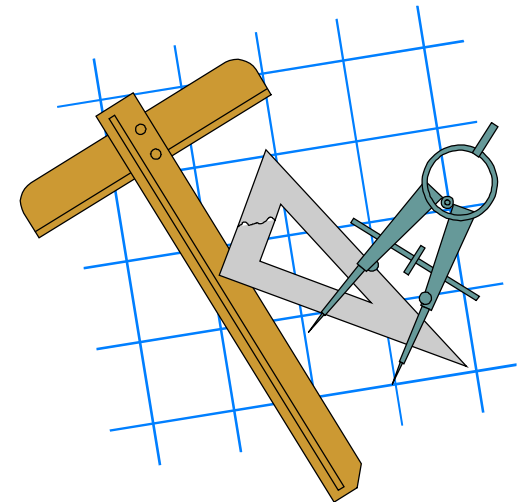


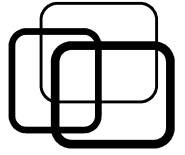


■ Practice 1.2:

Write C++ function to sort an array of **Fraction**, the sort criteria can be customized by user.

Hint: void **sort** (**Fraction** *arr, int size, <sort criteria>)





■ Practice 1.3:

Upgrade function in practice 1.2, so that it can sort an array of elements **of any types**, the sort criteria can also be customized by user.

Hint: void **sort** (**<any type>** *arr, int size, **<sort criteria>**)

