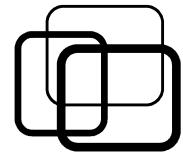


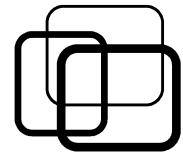
# Course overview

Inst. Nguyễn Minh Huy



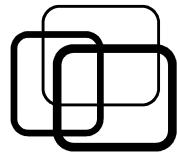
# Contents

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



# Contents

- Coding convention.
- Function overloading.
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# Coding convention

## ■ Why using coding convention?

### ■ Case 1 - Working alone:

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



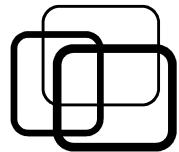
### ■ Case 2 - Team-work:

- 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!!

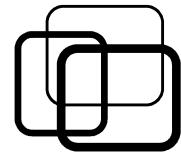
- Depend on programming languages.
- Depend on companies/ communities.

## ■ Common conventions:

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

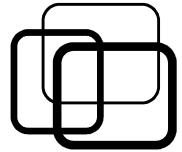
## ■ References:

- *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

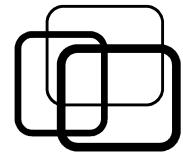
## ■ Function signature/prototype:

- 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!!**

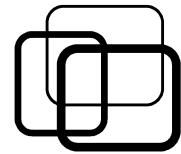
**Function overloading:  
functions differ only by  
argument list.**



# Function overloading

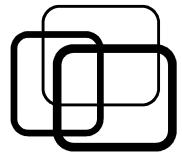
## ■ Invalid function overloading?

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

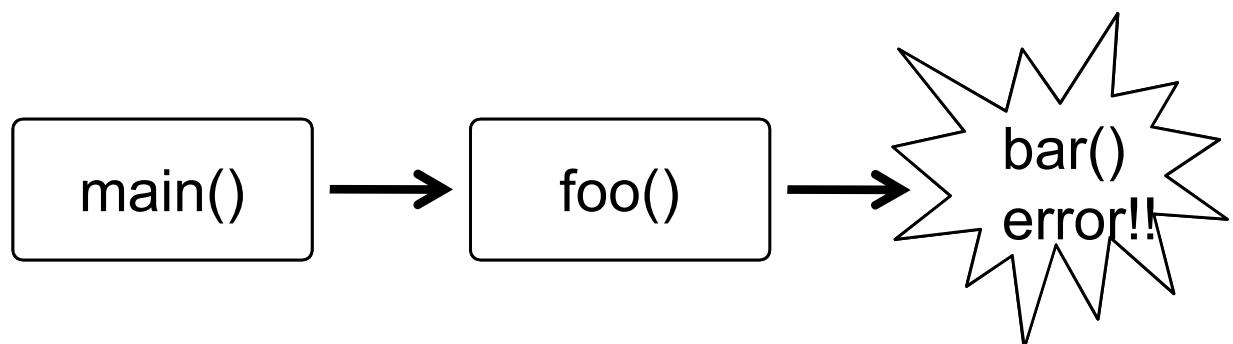
- Coding convention.
- Function overloading.
- **Error handling.**
- Abstract programming.

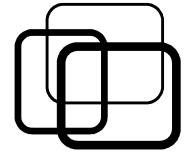


# Error handling

## ■ 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

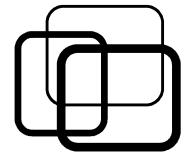
## ■ C-style error handling:

### ■ 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

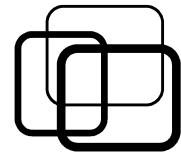
## ■ C-style error handling:

### ■ 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>

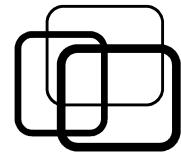
```
int divide( int a, int b ) {
    if (b == 0)
        throw 1; // Raise error.

    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

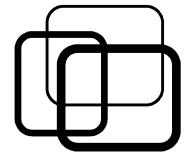
## ■ C++ exception handling:

### ■ 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;
    }
}
```



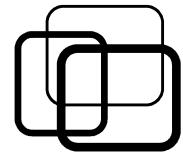
# Error handling

## ■ 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.  
    }  
}
```

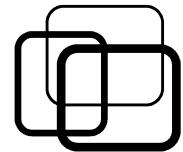
```
// Handle errors first.  
int main( ) {  
    if ( !f1() ) {  
        // Handle f1 error.  
        return;  
    }  
    if ( !f2() ) {  
        // Handle f2 error.  
        return;  
    }  
    if ( !f3() ) {  
        // Handle f3 error.  
        return;  
    }  
    // Expected case.  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

```
// 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.**

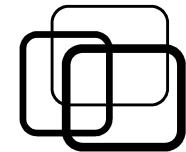


# Abstract programming

## ■ 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

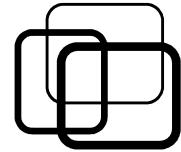


## ■ Data parameterization:

- 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 );  
}
```

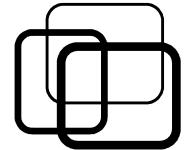


# Abstract programming

## ■ 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 );  
}
```



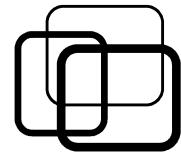
# Abstract programming

## ■ 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>



# Abstract programming

## ■ Process parameterization:

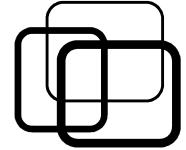
- Abstraction 3: do **any operation** on two integers.  
→ Use function pointer.

// 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 );
}
```



# Abstract programming

## ■ Function pointer:

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

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

- S2: pass function as arguments.

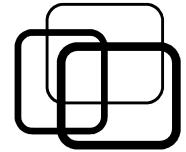
```
int calc( int x, int y, Operation p ) {  
    x = x * x;  
    y = y * y * y;  
    return p( x, y );  
}
```

- S3: create concrete function.

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

- S4: pass concrete function as argument:

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



# Abstract programming

## ■ Function pointer:

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

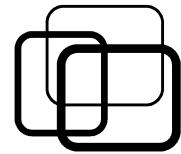
## ■ Notes:

- 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.

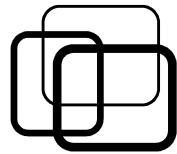
## ■ Function Overloading:

- 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.

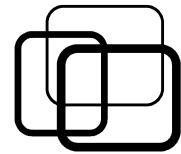
## ■ Abstract programming:

- Not fix to specific case.

- Use parameterization:

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



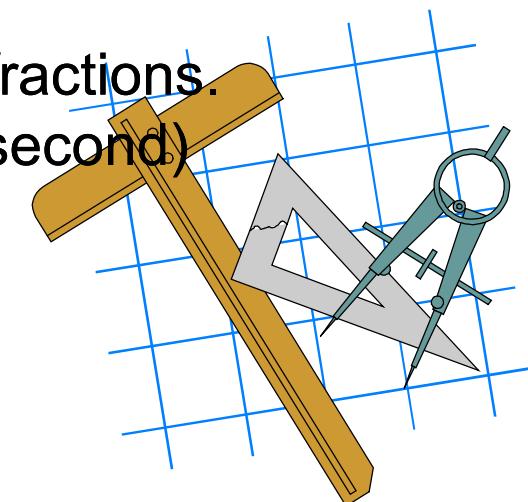


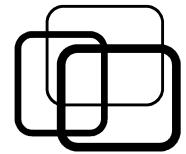
# Practice

## ■ 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)



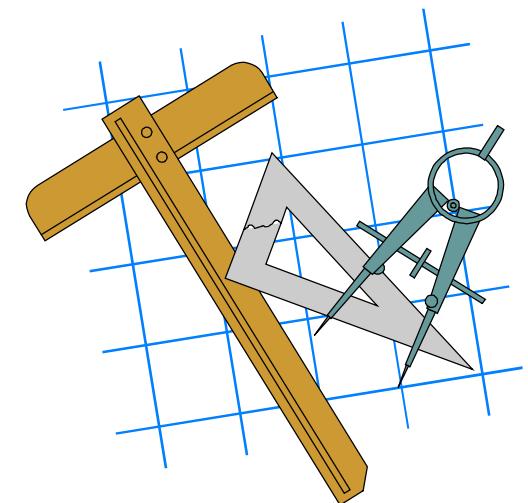


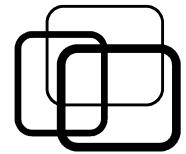
# Practice

## ■ 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

## ■ 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> )**

