

Coding Standards for C++

Version 6.4

Updated 1/29/17

Why have coding standards?

It is a known fact that 80% of the lifetime cost of a piece of software goes to maintenance. Therefore, it makes sense for all programs within an organization to be as consistent as possible. Code conventions also improve the readability of the software.

This document specifies the coding standards for all computer science courses using C++ at Pacific University. It is important for you to adhere to these standards in order to receive full credit on your assignments.

This document is divided into four main sections:

- Naming Conventions
- Formatting
- Comments
- Printing

Naming Conventions

- Constants

A constant is to be mnemonically defined using all capital letters and underscore characters such as MAX_NAME_CHARS. Separate each word using an underscore character. Further, your program is to contain no "magic constants." That is, all magic constants must be declared **const** to make the program easier to modify and easier to read. In the case below, 100 is a magic constant and if used in several places throughout a program, can create problems if 100 is to be modified for any reason. Also, the meaning of 100 is not obvious.

Poor Program Style

```
ins.open ("message.dat");  
.....  
for (indx = 0; indx < 100; ++indx)  
{  
.....  
}
```

Correct Program Style

```
const int MAX_GRADE_SCORES = 100;
const string INPUT_SCORES = "scores.txt";

inputScores.open (INPUT_SCORES);
.....
for (indx = 0; indx < MAX_GRADE_SCORES; ++indx)
{
.....
}
```

Note: Constants like 0 and 1 are usually acceptable unless they represent values that are changeable for some reason or a constant name better clarifies their use.

- Variable Names

1) A variable name is defined in all lowercase letters unless the variable name contains multiple names such as studentRecord. After the first word, each subsequent word has the first letter capitalized with the remainder of the word made up of lowercase letters and numbers.

2) Variable names are to be mnemonic unless the variable is being used in a for loop in which case the names i, j, k, l, m, n are acceptable names to be used. If however the nested loop is being used in conjunction with a two-dimensional array, then the names row and column should be used.

3) Global variables must begin with g so that a name such as gHashTable denotes a global variable.

4) To aid in identifying the type of a variable, we will use the following prefixes.

5) The prefix order is from highest precedence to lowest precedence, so for example, a mszName is a class member that is a null terminated string.

Type Indicator is a	Text Prefix	Variable Name Example
global	g	char gNumFiles
class member	m	mName
handle	h	void **hWindow
reference	r	char &rSSNum
pointer	p	int *pAge
array	a	char aLetters[26]

null terminated string	sz	char szFileName[10]
structure	s	Home sPerson
class object	c	Identity cPerson
union	u	Salary uPayment
enum	e	Color eColor
boolean	b	bFlag

Note: Declare all variables at the top of the function, no in-code variable declarations EXCEPT for in the initializer in a for loop.

Poor Program Style

```
int L (char n[])
{
    int i;

    for (i = 0; n[i] != '\0'; ++i);

    return i;
}
```

Good Program Style

```
int strLength (char aszName[])
{
    int count;

    for (count = 0; '\0' != aszName[count]; ++count)
    {
    }

    return count;
}
```

- Class, Struct, Union, enum Names

Class, Struct, Union, an enum are programmer-defined data types will follow the regular variable naming conventions except the first letter MUST be capitalized.

Note: Struct definitions do not begin with an s, class definitions do not begin with a c, and union definitions do not begin with a u. Only variables declared using the programmer-defined types begin with an s, c, or u.

Poor Program Style for Structs

```
struct t
{
    int d;
    int h;
    int m;
    int s;
};
```

Good Program Style for Structs

```
struct Time
{
    int mDays;
    int mHours;
    int mMinutes;
    int mSeconds;
};
```

Poor Program Style for Classes

```
class rat
{
    public:
        rat ();
        rat (int, int);
        setvalues (int, int);

    private:
        int n;
        int d;
};
```

Good Program Style for Classes

```
class Rational
{
    public:
        Rational ();
        Rational (int, int);
        int getNumerator () const;
        int getDenominator () const;
        void setNumerator (int);
        void setDenominator (int);

    private:
```

```
    int mNumerator;
    int mDenominator;
};
```

Poor Program Style for Unions

```
union t
{
    int s;
    int m;
    int h;
};
```

Good Program Style for Classes

```
union TimeDuration
{
    int seconds;
    int minutes;
    int hours;
};
```

Poor Program Style for Enums

```
enum c {r, g, b};
```

Good Program Style for Enums

```
enum Color {RED, GREEN, BLUE};
```

Function Names – functions are named using the standard naming convention described for variables where the first word begins with a lowercase letter and each subsequent word has the beginning letter capitalized. There is no need to document a function prototype whose function is clear from the name; however, a function whose use is not clear from the name must be documented properly.

Class Implementation

Classes need to be implemented using two files. The first file is a .h file that contains the interface (declaration) of the class. The second file is a .cpp file that contains the actual implementation (definition) of the functions included in the class declaration. The .cpp file includes the .h file at the top of the file.

Rational Class Interface and Implementation Example

```

//*****
// File name:  rational.h
// Author:     Joe Bloggs
// Date:       1/29/17
// Class:      CS250
// Assignment: Rational
// Purpose:    Declares a programmer-defined class Rational for rational
//             numbers
//*****

```

```

#ifndef RATIONAL_H
#define RATIONAL_H

```

```

class Rational
{
public:
    Rational (int = 0, int = 1);
    void setNumerator (int);
    void setDenominator (int);
    int getNumerator () const;
    int getDenominator () const;
    void print () const;
    bool isEqual (const Rational &) const;
    Rational multiply (const Rational &) const;

```

```

private:
    int mNumerator;
    int mDenominator;
};

```

```

#endif

```

```

//*****
// File name:  rational.cpp
// Author:     Joe Bloggs
// Date:       1/29/17
// Class:      CS250
// Assignment: Rational
// Purpose:    Implements constructors & functions of class Rational
//*****

```

```

#include <iostream>
#include "Rational.h"

```

```

using namespace std;

```

```

//*****
// Constructor: Rational
//
// Description: Initializes data members to default values
//
// Parameters:  numerator   - the numerator of the rational number
//              denominator - the denominator of the rational number

```

```

//
// Returned:    None
//*****

Rational::Rational (int numerator, int denominator)
{
    mNumerator = numerator;
    mDenominator = denominator;
}

//*****
// Function:    setNumerator
//
// Description: Changes the value of the numerator to the value input.
//
// Parameters:  numerator    - numerator of the rational number
//
// Returned:    None
//*****

void Rational::setNumerator (int numerator)
{
    this->mNumerator = numerator;
}

//*****
// Function:    setDenominator
//
// Description: Changes the value of the denominator to the value input.
//
// Parameters:  denominator  - denominator of the rational number
//
// Returned:    None
//*****

void Rational::setDenominator (int denominator)
{
    this->mDenominator = denominator;
}

//*****
// Function:    getNumerator
//
// Description: Returns the value of the numerator.
//
// Parameters:  None
//
// Returned:    The numerator value
//*****

int Rational::getNumerator () const
{
    return this->mNumerator;
}

```

```

//*****
// Function:    getDenominator
//
// Description: Returns the value of the denominator.
//
// Parameters:  None
//
// Returned:    The denominator value
//*****

int Rational::getDenominator () const
{
    return this->mDenominator;
}

//*****
// Function:    print
//
// Description: Outputs a rational number in the form numerator / denominator
//              to the screen
//
// Parameters:  None
//
// Returned:    None
//*****

void Rational::print () const
{
    cout << " " << getNumerator() << "/" << getDenominator();
}

//*****
// Function:    isEqual
//
// Description: Compares two objects of Rational returning a value of true if
//              the numerators and denominators of both rational numbers are
//              the same.
//
// Parameters:  fraction - rational object having a numerator and denominator
//
// Returned:    true if objects are equal; else, false
//*****

bool Rational::isEqual (const Rational &fraction) const
{
    return (mNumerator == fraction.mNumerator &&
            mDenominator == fraction.mDenominator);
}

//*****
// Method:      multiply
//
// Description: Multiplies the numerators and denominators of two objects.

```



```

//
// Parameters:  fraction - rational object having a numerator and denominator
//
// Returned:   An object of type Rational that contains the result of the
//             multiplication.
//*****
Rational Rational::multiply (const Rational &fraction) const
{
    Rational tempFraction;

    tempFraction.mNumerator = mNumerator * fraction.mNumerator;
    tempFraction.mDenominator = mDenominator * fraction.mDenominator;

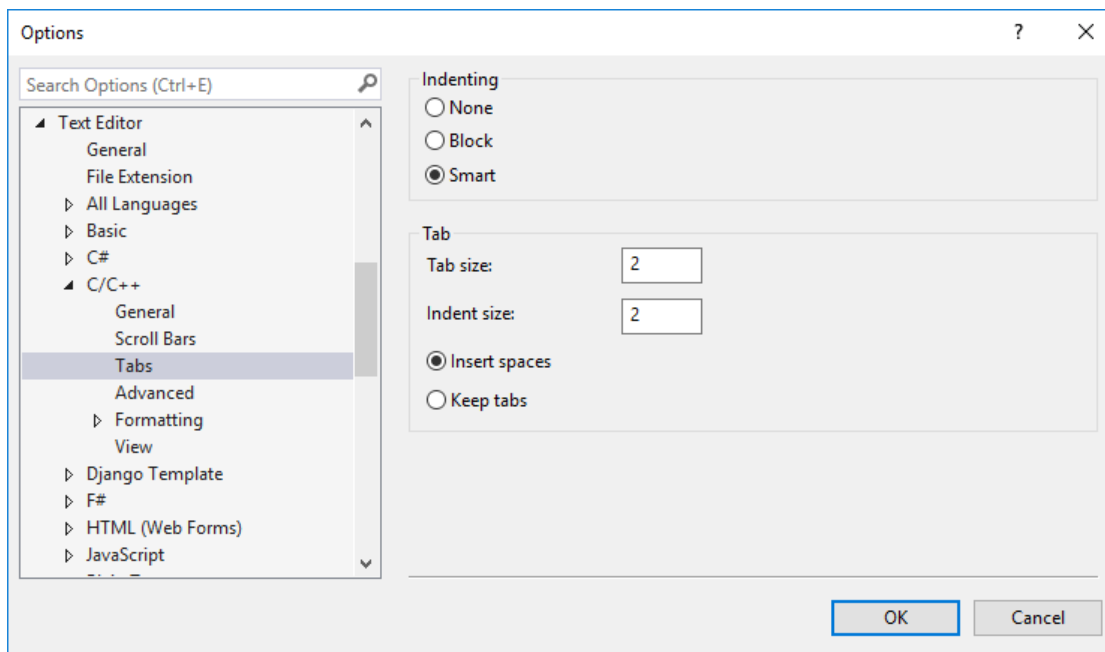
    return tempFraction;
}

```

Formatting

- Indentation

Two spaces must be used as the unit of indentation per tab. Every IDE (Integrated Development Environment) such as Visual Studio includes an option for changing the number of spaces in a tab. These can usually be found in the preferences section. In Visual Studio 2015 go to Tools->Options ->Text Editor->C/C++->Tabs. At this point make sure the Tab Size and Indent Size are 2 and that the radio button for insert spaces is selected. Select these options before typing in any of your code.



- Line Length

Lines must be no longer than 80 characters. Anything longer than 80 characters is normally not handled well in many terminals and tools. Further, a line longer than 80 will not wrap nicely when outputted.

- Wrapping Lines

If an expression cannot fit on a single line then break it:

- After a comma
- Before an operator

Make sure that the new line is aligned with the beginning of the expression at the same level on the previous line. As an example, consider a long cout statement as follows:

```
cout << "The number of females is: " << female << "The number of males is:  
" << male << endl;
```

would be written as:

```
cout << "The number of females is: " << female  
    << "The number of males is: " << male << endl;
```

- Spaces

All arithmetic and logical operators must have one space before and after the operator. The only exceptions are:

- Unary operators
- The period
- No spaces before the comma and only one space after the comma

A single space must precede each left paren.

- Blank Lines

Use blank lines to separate distinct pieces of code. For example, one blank line before and after a while loop helps the code reader. The important thing to remember is that blank lines must be used consistently.

- Braces

Any curly braces that you use in your program (e.g. surrounding classes, functions) must appear on their own lines. Any code within the braces must be indented relative to the braces.

```
class User
{
public:
    User();

private:
    char maszFirstName[MAX_NAME_SIZE];
    char maszLastName[MAX_NAME_SIZE];
};
```

- switch statements

Formatting of a switch statement looks like the following:

```
switch (grade)
{
    case 'A':
    case 'B':
    case 'C': cout << "Pass";
              break;

    case 'D':
    case 'F': cout << "Fail";
              break

    default:  cout << "Invalid Grade";
}
}
```

Comments

Comments are used to explain the purpose of the code fragment they are grouped with. Comments state what the code is doing, while the code itself shows the implementation.

Use comments as follows:

- File Header

The main purpose of a file header is to explain the purpose of the program as briefly as possible. You must include the following sections in your program header:

- File name
- Your name
- Date
- Class Title
- Assignment Title
- Purpose

```
//*****  
// File name:  main.cpp  
// Author:    Joe Bloggs  
// Date:     1/29/17  
// Class:    CS250  
// Assignment: Rational  
// Purpose:   This program is the driver to test the rational module.  
//*****
```

- Declaration Comments

Variables must be declared one per line. Each variable can have a sidebar comment to the right indicating the variable's purpose if the purpose of the variable is not totally obvious. Do not put any blank lines between the variables being declared. You must also group together variables that are related.

```
int seconds;  
int minutes;  
int hours ;  
char aszFirstName[MAX_NAME_SIZE];  
char aszLastName[MAX_NAME_SIZE];
```

None of the above variables need to be documented because it is obvious what they represent. When your programs become more complicated, some variable names might need a little documentation.

- Sidebar Comments

A sidebar comment appears on the same line as the single statement it is describing. The comment must be brief and not exceed that line. Try and line up your sidebar

comments as much as possible for easy reading. The following is an example of a sidebar comment although experienced C++ programmers know what this statement does, thus, documentation is not necessary.

```
value <<= 1; // multiply value by 2
```

- In-line Comments

In-line comments appear on their own lines and precede the segment of code they describe. You must use in-line comments to describe complex code that is not limited to a single statement. You must use one blank line to separate the comment from the segment of code being described. Every block of code (if statement, for loop, while loop, do-while loop, switch statement, ...) must have an in-line comment preceding the actual code briefly letting the reader know what the code is doing. If the code is totally obvious, then no in-line comment is necessary. Here is an example.

```
int tempInt;

// Euclid's Algorithm for finding the greatest common divisor
while (0 != numTwo)
{
    numOne %= numTwo;
    tempInt = numOne;
    numOne = numTwo;
    numTwo = tempInt;
}
```

- Function Header

In the same way that a program header is used to describe the purpose of the program, the function header must be used to describe the purpose of the function. All your function headers must include the following:

- Function name
- Description
- Parameters
- Returned

```
/**
// Function:    setNumerator
//
// Description: Changes the value of the numerator to the value input.
//
```

```

// Parameters:  numerator    - numerator of the fraction
//
// Returned:    None
//*****
void Rational::setNumerator (int numerator)
{
    this->mNumerator = numerator;
}

```

Program Organization

- Procedural programming solution

- 1) File Documentation
- 2) Any #includes (using the memory leak include code is mandatory when dynamic memory is used)
- 3) using namespace
- 4) all constants to be used in the file
- 5) all programmer-defined data types (structs, classes, unions, enums)
- 6) all function prototypes
- 7) all function definitions beginning with main

- Object-oriented programming solution

Solutions must use classes where the class interface exists in a .h file and the class implementation exists in the .cpp file

Class Interface

- 1) File Documentation
- 2) Any #includes
- 3) using namespace (if necessary ... do not include if not necessary)
- 4) all constants to be used in the file
- 5) a single class interface

Class Implementation

- 1) File Documentation
- 2) Any #includes
- 3) using namespace (if necessary ... do not include if not necessary)
- 4) all constants to be used in the file
- 5) all public functions
- 6) all private functions

Printing

When printing your code, you must use a fixed width font. Courier and Courier New are examples of fixed width fonts. You must also make sure that your lines do not wrap nor do they get cut off when printing. All printing is to be done in Portrait and the printing order for the files is as follows:

- 1) the program file containing main
- 2) class header (.h) / implementation (.cpp) pairs for each class

Note: Each class is to have a separate .h and .c file.

The final output you will turn in is to be printed in color since comments, keywords, strings, etc are highlighted for easy reading. Multiple pages are to be printed double-sided (i.e. the ENTIRE job is printed by the printer double-sided without feeding in additional paper with a different orientation during the print job) and stapled in the upper-left corner.