CS215: Introduction to Program Design, Abstraction and Problem Solving
(Fall, 2015)
Programming Assignment 2
(100 points)
Today's Date: Thursday, September 24
Due Date: Sunday, October 11
No late submission will be allowed!

Problem Statement:
In a game named Nim, two players alternately take marbles from a pile. In each turn, a player must make a legal move taking at least one but at most half of the marbles from the pile and then let the other player take a turn. The player who is to take the last marble loses the game.

You will write a C++ program that enables the computer to play against a human opponent. Begin with generating a random integer between 10 and n (which is a user input >= 10) to denote the initial pile size. Then generate 0 or 1 randomly to decide which player takes the first turn. When the computer takes its turn, it makes the following legal move: take off enough marbles to make the size of the remaining pile a power of two minus one (1, 3, 7, 15, 31 are some examples of the power of two minus 1) if the current pile size is not one of those power of two minus 1. When the current pile size is already a 2's power – 1, make a random move taking at least one but at most half of the marbles. When human takes his/her turn, your defined function will ask how many marbles the user wants to remove and verify if it is legal.

The following are some examples when you run the program:

```
Welcome to the game of Nim.
To start, please enter a number greater than 10 to serve as
the max range of the pile size.
7
Welcome to the game of Nim.
To start, please enter a number greater than 10 to serve as
the max range of the pile size.
a
Welcome to the game of Nim.
To start, please enter a number greater than 10 to serve as
the max range of the pile size.
7a
Welcome to the game of Nim.
To start, please enter a number greater than 10 to serve as
the max range of the pile size.
99
Computer plays first.
The size of the pile is 50
The Computer removed 19 marbles.
The size of the pile is 31
```

```
How many marbles would you like to remove?
45.53
Illegal move. You must remove at least 1 or at most half of
the marbles.
a
How many marbles would you like to remove?
a7
How many marbles would you like to remove?
16
Illegal move. You must remove at least 1 or at most half of
the marbles.
15
The size of the pile is 16
The Computer removed 1 marbles.
The size of the pile is 15
How many marbles would you like to remove?
3
The size of the pile is 12
The Computer removed 5 marbles.
The size of the pile is 7
How many marbles would you like to remove?
8
Illegal move. You must remove at least 1 or at most half of
the marbles.
aaaa
How many marbles would you like to remove?
3
The size of the pile is 4
The Computer removed 1 marbles.
The size of the pile is 3
How many marbles would you like to remove?
1
The size of the pile is 2
The Computer removed 1 marbles.
The size of the pile is 1
How many marbles would you like to remove?
1
The game is over!
You lose!
Thank you for playing this game.

Press ENTER to continue.
```

Running your program again:

```
Welcome to the game of Nim.
To start, please enter a number greater than 10 to serve as
the max range of the pile size.
29aaa
```

```
Computer plays first.
The size of the pile is 15
The Computer removed 6 marbles.
The size of the pile is 9
How many marbles would you like to remove?
2
The size of the pile is 7
The Computer removed 2 marbles.
The size of the pile is 5
How many marbles would you like to remove?
x
How many marbles would you like to remove?
5
Illegal move. You must remove at least 1 or at most half of
the marbles.
2
The size of the pile is 3
The Computer removed 1 marbles.
The size of the pile is 2
How many marbles would you like to remove?
1
The size of the pile is 1
The Computer removed 1 marble.
The game is over!
You win!
Thank you for playing this game.

Press ENTER to continue.
```

Running your program again:

```
Welcome to the game of Nim.
To start, please enter a number greater than 10 to serve as
the max range of the pile size.
29
You play first.
The size of the pile is 29
How many marbles would you like to remove?
many
How many marbles would you like to remove?
five
How many marbles would you like to remove?
14.69
The size of the pile is 15
The Computer removed 6 marbles.
The size of the pile is 9
How many marbles would you like to remove?
two
How many marbles would you like to remove?
```

```
two
How many marbles would you like to remove?
two
How many marbles would you like to remove?
2
The size of the pile is 7
The Computer removed 2 marbles.
The size of the pile is 5
How many marbles would you like to remove?
5
Illegal move. You must remove at least 1 or at most half of
the marbles.
two
How many marbles would you like to remove?
5
Illegal move. You must remove at least 1 or at most half of
the marbles.
4
Illegal move. You must remove at least 1 or at most half of
the marbles.
3
Illegal move. You must remove at least 1 or at most half of
the marbles.
2
The size of the pile is 3
The Computer removed 1 marbles.
The size of the pile is 2
How many marbles would you like to remove?
1
The size of the pile is 1
The Computer removed 1 marble.
The game is over!
You win!
Thank you for playing this game.

Press ENTER to continue.
```

In order to keep your program's window from closing, instead of calling system("pause"); before returning from main, now we can call the following function right before the return statement in the main function. Remember to declare the function before you can call the function.

```
void pause_215(bool have_newline)
{
    if (have_newline) {
        // Ignore the newline after the user's previous input.
        cin.ignore(256, '\n');
    }
```

```
  // Prompt for the user to press ENTER, then wait for a newline.
    cout << endl << "Press ENTER to continue." << endl;
    cin.ignore(256, '\n');
}
```

Your program must compile and execute without any errors or warnings.

Submission:
Open the link to csportal (http://www.cs.uky.edu/csportal), and login to your account using your linkblue user id and password. Please zip the inside folder (project), and submit (upload) the zip file through link "PA2". Note that only one file is allowed to upload and it should be your zip file. It is a good idea to check that your file is already uploaded successfully. If not, go back and submit again.

(Grading sheet can be found at the next page)

Grading Sheet for Programming Assignment 2

Total: 100 points.

	Points	Deducted Points
Correctness	68	
Program generates the initial pile size in the correct range.	7	
Program makes the random decision of taking the first turn between the user and the computer.	6	
Allow the user to choose how many marbles to remove and validate the user input: either it is invalid input or it is beyond the correct range.	15	
When it is computer's turn, your program should implement two cases from the description correctly:		
Case 1, if the current pile size is already a 2's power minus 1;	7	
Case 2, if the current pile size is not a 2's power minus 1.	8	
Program makes the correct judgment on the winner of the game.	7	
Program checks the invalid user input and handle accordingly	10	
Program displays error message if the input value is invalid	3	
Define functions to implement the user play and the computer play of the game.	5	
Style	12	
Lay out your program in a readable fashion	4	
Include comments as specified in the lecture notes	5	
User-friendliness in I/O design	3	
Testing (No Documentation is required)	20	
Pass testing cases of valid user input, such as the computer plays first, the user plays first, the computer wins the game, the user wins the game.	10	
Pass testing cases of invalid user input, such as: Case 1, the user types a integer which is not in the right range; Case 2, the user types a string when an integer is being expected; Case 3, the user types a double floating point number when an integer is being expected; Case 4, the user types an integer followed by a letter when an integer is being expected.	10	
Your Score		