Programming with C++

COMP2011: Examples on C++ Basics and Controls

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Part I

Guess The Number

Game Description

- The game program picks a random number in the range of 1 to 100.
- Two players take turns to guess the number.
- After each guess, the program should tell the player if the number is correct, larger than or smaller than their guessed number.
- Whoever first guesses correctly wins the game.

Typical Output

```
Player 1, please enter your guess:
15
Sorry, the number is smaller than 15
Player 2, please enter your guess:
9
Sorry, the number is bigger than 9
Player 1, please enter your guess:
10
Player 1, you win!!!
```

Program Requirement

- Validate that a guessed number is in the range set by the program.
  - request a player to enter again until the input is valid.
- Determine if a guess is correct.
- Give suitable feedback to the players.
- Keep running until a guess is correct.

First Attempt: 1 Player and 1 Round

```
1   #include <iostream>      /* File: guess1.cpp */
2   using namespace std;
3
4   int main()               // 1st attempt: 1 player, 1 round
5   {
6       int number = 10;     // The answer is fixed beforehand
7       int guess;
8
9       cout << "Player 1, please enter your guess:" << endl;
10      cin >> guess;
11
12      if (guess == number)
13          cout << "Player 1, you win!!!" << endl;
14
15      else if (guess < number)
16          cout << "Sorry, the number is bigger than " << guess << endl;
17
18      else
19          cout << "Sorry, the number is smaller than " << guess << endl;
20
21      return 0;
22  }
```

Second Attempt: 1 Player and Multiple Rounds

```
1   #include <iostream>      /* File: guess2.cpp */
2   using namespace std;
3
4   int main()               // 2nd attempt: 1 player, multiple rounds
5   {
6       int number = 10;     // The answer is fixed beforehand
7       int guess;
8
9       do                   // Add a loop to implement multiple rounds
10      {
11          cout << "Player 1, please enter your guess:" << endl;
12          cin >> guess;
13
14          if (guess == number)
15              cout << "Player 1, you win!!!" << endl;
16
17          else if (guess < number)
18              cout << "Sorry, the number is bigger than "
19                   << guess << endl;
20          else
21              cout << "Sorry, the number is smaller than "
22                   << guess << endl;
23      } while (guess != number);
24
25      return 0;
26  }
```

Third Attempt: 1 Player, Multiple Rounds, Fixed Range

```
1   #include <iostream>     /* File: guess3.cpp */
2   using namespace std;
3
4   int main()    // 3rd attempt: 1 player, multiple rounds, fixed range
5   {
6       int number = 10;                // The answer is fixed beforehand
7       int guess;
8       int low = 1, high = 100;  // Add 2 variables to record the range
9
10      do // Add a loop to implement multiple rounds
11      {
12          cout << "Player 1, please enter your guess:" << endl;
13          cin >> guess;
14
15          while (guess < low || guess > high) // Input validation loop
16          {
17              cout << "Invalid input, please enter a number between "
18                   << low << " and " << high << endl;
19              cin >> guess;
20          }   // Can this loop be replaced with do-while?
21
22          if (guess == number)
23              cout << "Player 1, you win!!!" << endl;
24
25          else if (guess < number)
26          {
27              cout << "Sorry, the number is bigger than "
```

Third Attempt: 1 Player, Multiple Rounds, Fixed Range ..

```
28                      << guess << endl;
29                  low = guess + 1; // Update the lower bound of the range
30              }
31              else
32              {
33                  cout << "Sorry, the number is smaller than "
34                      << guess << endl;
35                  high = guess - 1; // Update the upper bound of the range
36              }
37          } while (guess != number);
38
39          return 0;
40      }
```

Final Code with a Randomly Generated Guess Number

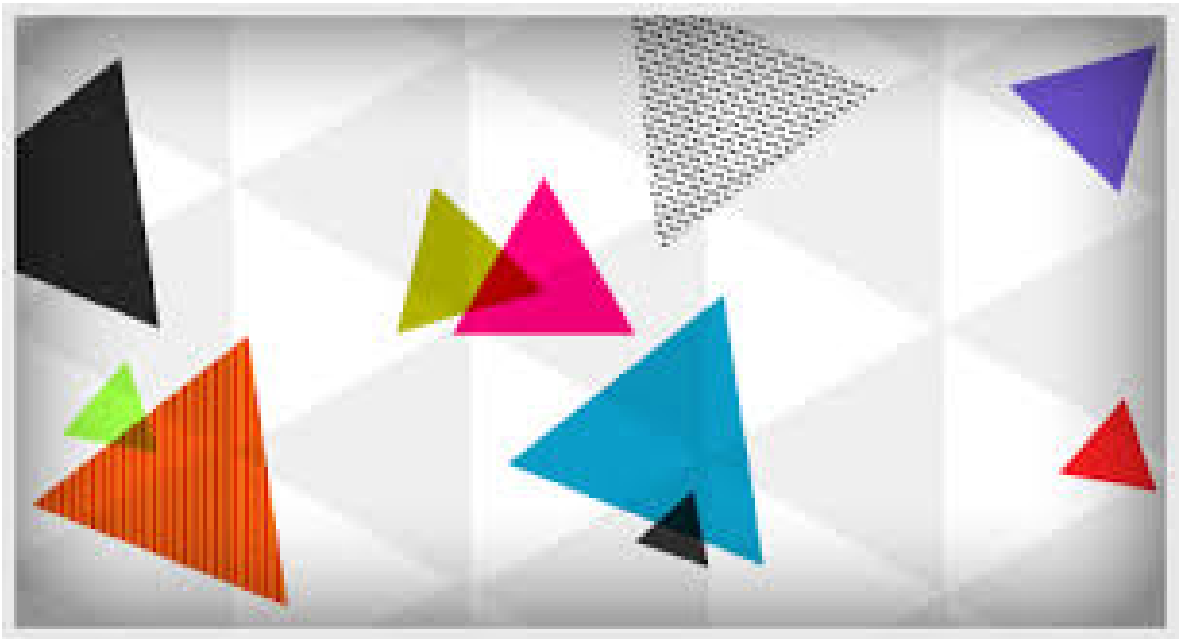
```
1   #include <iostream>     /* File: guess-number.cpp */
2   #include <stdlib.h>     // Needed for calling the rand() function
3   #include <time.h>       // May need for calling the time() function
4   using namespace std;
5
6   int main()   // 2 players, multiple rounds, fixed range, random number
7   {
8       /* Random number generation */
9       srand(time(0));     // Seed the random number generator
10      int number = rand() % 100 + 1;  // Generate a random no. in [1..100]
11
12      int guess;
13      int low = 1, high = 100;
14      int player = 1;     // Set Player 1 as the current player
15
16      cout << "The generated number is: " << number << endl;
17      do
18      {
19          cout << "Player " << player
20               << ", please enter your guess: " << endl;
21          cin >> guess;
22
23          while (guess < low || guess > high) // Input validation loop
24          {
25              cout << "Invalid input, please enter a number between "
26                   << low << " and " << high << endl;
27              cin >> guess;
```

Final Code with a Randomly Generated Guess Number ..

```
28          }
29
30          if (guess == number)
31              cout << "Player " << player <<", you win!!!" << endl;
32
33          else if (guess < number)
34          {
35              cout << "Sorry, the number is bigger than "
36                   << guess << endl;
37              low = guess + 1; // Update the lower bound of the range
38          }
39          else
40          {
41              cout << "Sorry, the number is smaller than "
42                   << guess << endl;
43              high = guess - 1; // Update the upper bound of the range
44          }
45
46          player = (player % 2) + 1; // This makes 1 → 2 and 2 → 1
47
48      } while (guess != number);
49
50      return 0;
51  }
```

Part II

Draw an Isosceles Right-Angled Triangles (RATs)



Draw Triangles

- Design a program that prints some isosceles right-angled triangles (RAT), and allows users to set their size.
- A RAT that has a size of 4 looks like this:

```
*
**
***
****
```

- Furthermore, try the following variations:

Fat RAT	Hollow RAT	Upside-down RAT
*	*	*****
***	**	****
*****	* *	***
*******	* *	**
*********	*****	*

A Single RAT

```
1   #include <iostream>      /* File: one-rat.cpp */
2   using namespace std;
3
4   int main()
5   {
6       cout << "Size of a RAT: " << endl;
7       int size;                                  // height = width = size
8       cin >> size;
9
10      for (int width = 1; width <= size; width++) // #iters=height
11      {
12          // Draw one row of a RAT
13          for (int j = 0; j < width ; j++)        // width of a row
14              cout << '*';
15
16          cout << endl;
17      }
18
19      return 0;
20  }
```

Various RATs

```
1   #include <iostream>     /* File: various-rats.cpp */
2   using namespace std;
3
4   int main()
5   {
6       cout << "Size of a RAT: " << endl;
7       int size;
        ↪  // height = width = size
8       cin >> size;
9
10      cout << "A fat RAT" << endl;
11      for (int i = 1; i <= size; i++)          // #iterations = height
12      {
13          for (int j = 0; j < i*2 - 1 ; j++) // width of a row
14              cout << '*';
15          cout << endl;
16      }
17
18      cout << "A hollow RAT" << endl;
19      for (int i = 1; i <= size; i++)
20      {
21          for (int j = 0; j < i ; j++)
```

Various RATs ..

```
22              cout << ((j == 0 || j == i - 1 || i == size) ? '*' :
                ↪  ' ');
23          cout << endl;
24      }
25
26
27      cout << "An upside-down RAT" << endl;
28      for (int i = size; i >= 1; i--)
29      {
30          for (int j = 0; j < i; j++)
31              cout << '*';
32          cout << endl;
33      }
34
35      return 0;
36  }
```

A Bug in a RAT: What's Wrong?

```
1   #include <iostream>     /* File: one-bad-rat.cpp */
2   using namespace std;
3
4   int main()
5   {
6       cout << "Size of a RAT: " << endl;
7       int size;
8       cin >> size;
9
10      cout << "A simple RAT:" << endl;
11      for (int i = 0; i < size; i++)
12      {
13          for (int j = 0; j <= i; j++)
14              cout << '*';
15          cout << endl;
16      }
17
18      cout << "Is this a RAT?" << endl;
19      for (int i = 1; i <= size; i++)
20          for (int j = 0; j < i * 2 - 1 ; j++)
21          {
22              cout << '*';
23              cout << endl;
24          }
25
26      return 0;
27  }
```

A Row of RATs

Now try this:

```
*     *     *     *     *     *     *     *     *     *
**    **    **    **    **    **    **    **    **    **
***   ***   ***   ***   ***   ***   ***   ***   ***   ***
****  ****  ****  ****  ****  ****  ****  ****  ****  ****
**********************************************************
```

You'll need to measure the width of your screen first.

Bugs in RATs: What's Wrong?

```cpp
#include <iostream>     /* File: row-of-bad-rats1.cpp */
using namespace std;

int main()
{
    cout << "Size of a triangle: " << endl;
    int size;
    cin >> size;

    // Find out the number of RATs in a row
    const int TOTAL_NUM_COLUMNS = 105; // Assumed screen width
    int num_RATs = TOTAL_NUM_COLUMNS / size;

    for (int i = 1; i <= size; i++)
    {
        for (int n = 0; n < num_RATs; n++)
            for (int j = 0; j < i ; j++)
                cout << '*';

        cout << endl;
    }

    return 0;
}
```

Bugs in RATs Again: What's Wrong?

```
1  #include <iostream>     /* File: row-of-bad-rats2.cpp */
2  using namespace std;
3
4  int main()
5  {
6      cout << "Size of a triangle: " << endl;
7      int size;
8      cin >> size;
9
10     const int TOTAL_NUM_COLUMNS = 105; // Assumed screen width
11     int num_RATs = TOTAL_NUM_COLUMNS / size;
12
13     for (int i = 1; i <= size; i++)
14         for (int n = 0; n < num_RATs; n++)
15         {
16             for (int j = 0; j < i ; j++)
17                 cout << '*';
18             for (int j = 0; j < (size-i); j++)
19                 cout << ' '; // Print enough spaces after a RAT
20
21             cout << endl;
22         }
23
24     return 0;
25 }
```

A Row of Good RATs

```
1   #include <iostream>                /* File: row-of-rats.cpp */
2   using namespace std;
3
4   int main()
5   {
6       cout << "Size of a triangle: " << endl;
7       int size;
8       cin >> size;
9
10      // Find out the number of RATs in a row
11      const int TOTAL_NUM_COLUMNS = 105; // Assumed screen width
12      int num_RATs = TOTAL_NUM_COLUMNS / size;
13
14      for (int i = 1; i <= size; i++)
15      {
16          for (int n = 0; n < num_RATs; n++)
17          {
18              for (int j = 0; j < i ; j++)
19                  cout << '*';
20              for (int j = 0; j < (size-i); j++)
21                  cout << ' '; // Print enough spaces after each RAT
22          }
23          cout << endl;
24      }
25
26      return 0;
27  }
```