# Informatik für Mathematiker und Physiker HS15

## Exercise Sheet 5

Submission deadline: 15:15 - Tuesday 20th October, 2015 Course URL: http://lec.inf.ethz.ch/ifmp/2015/

### Assignment 1 (4 points)

a) Compute the exact binary value of the decimal value 0.3

- b) Compute the exact binary value of the decimal value 11.7
- c) Assuming IEEE standard 754, what is the value of a, and why?

float x = 1.9f; unsigned int a = x;

d) Assuming IEEE standard 754, what is the value of b, and why?

float y = 0.2f; bool b = 5 \* y == 1.0f;

e) Assuming IEEE standard 754, what is the problem with the following loop?

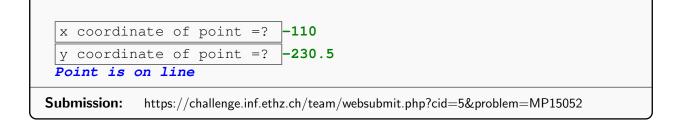
for (float i = 0.0f; i < 10000000.0f; ++i)
std::cout << i << "\n";</pre>

## Assignment 2 (4 points)

Write a C++ program point\_on\_line.cpp that determines if a point (x, y) is on a line g or not. The line g is defined as:  $g(x) = 2.1 \cdot x + 0.5$ . Use floating point variables of type double to do the calculation. Furthermore, since the computer might have to round the floating point numbers, you can not just compare them for equality using ==. Therefore, when you want to compare two floating point numbers, treat them as equal as soon as their difference<sup>1</sup> is less than 0.000001.

Judge Examples	$({\sf Explanation: http://lec.inf.ethz.ch/ifmp/2015/judge\_boxes.html})$
x coordinate of point =? 0.25	
y coordinate of point =? 3.91	
Point is not on line	

<sup>&</sup>lt;sup>1</sup>Remark: This leads to an absolute tolerance. When the numbers were large, this approach would no longer be suitable. But for simplicity, this exercise can be solved with an absolute tolerance.

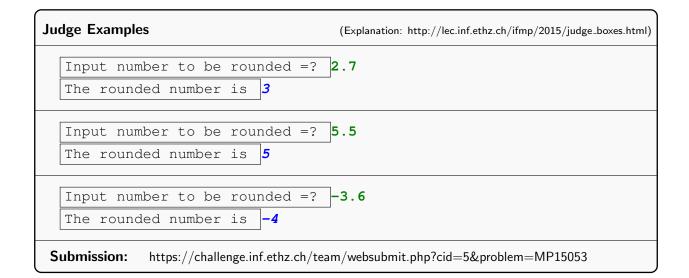


#### Assignment 3 – Skript-Aufgabe 90 (4 points)

a) Implement the following function. You may assume that the type double complies with the IEEE standard 754. The function is only required to work correctly, if the nearest integer is in the value range of the type int.

```
// PRE: x is roundable to a number in the value range of type int
// POST: return value is the integer nearest to x, or the one closer
// to 0 if x lies right in between two integers.
int round (double x);
```

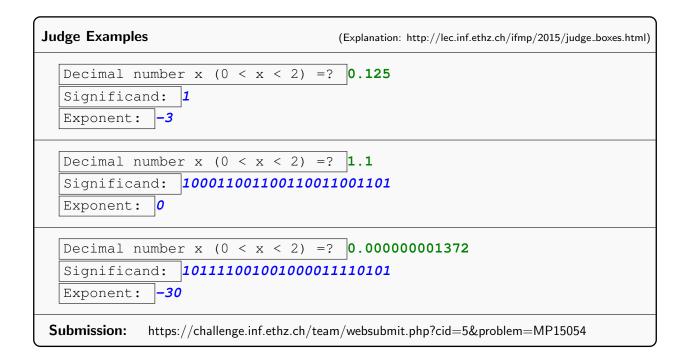
b) Write a program round.cpp which inputs a number of type double from the user, then rounds this number using your function from *a*), and then outputs the rounded number.



#### Assignment 4 – Skript-Aufgabe 67 (4 points)

Write a program dec2float.cpp that outputs for a given decimal input number x, 0 < x < 2, its normalized float value on your platform. The output should contain the (binary) digits of the significand, starting with 1, and the (decimal) exponent. You may assume that the floating point number system underlying the type float has base  $\beta = 2$ .

**Hint:** If you'd like to have more hints, you can find here a code skeleton outlining the structure of a possible solution: http://lec.inf.ethz.ch/ifmp/2015/u5/dec2float\_skeleton.cpp



#### Challenge - Skript-Aufgabe 77

This exercise asks you to draw an approximation to the famous *Mandelbrot set*. You can use the libwindow library to produce the drawing. This library is already installed on your system if you set it up according to the documentation from the webpage (or if you use VirtualBox).

Example code that shows how to draw points (and more complicated objects), can be found in the folder progs/libraries/demo. A small documentation can be found in the folder progs/libraries/doc\_html (open the file contents.html).