

# Computational Geometry - Exercise 1

This is the first exercise for the Computational Geometry class. After having installed the CGAL library you will test whether this has been done correctly. Furthermore, you will have the opportunity to test the Qt Designer which is available through the Qt Visual Studio Add-in.

## 1 Qt Designer

As the first step you must download and install the Qt Visual Studio Add-in from Nokia<sup>1</sup>. It is listed under "Other Downloads".

## 2 IEEE 754-2008

Read the third chapter of the IEEE 754-2008 standard about numerical precision. It can be found in the IEEE digital library<sup>2</sup> and it is accessible from within the CVUT network. There is also a "light" version which can be found on wikipedia<sup>3</sup>.

## 3 Compilation & Testing

Download the .rar package for the first exercise (exercise\_1.rar) from the course website and unpack it. Then open the exercise\_1.sln and compile it. If there are any errors then you should check if you have set the environment variables for Boost, CGAL, and Qt correctly or if perhaps you are using a different sub-directory relative to the environment variables. The additional include and library directories can be found under "Projects->exercise\_1 Properties" (default shortcut: ALT+F7). On the properties pane expand the "Configuration Properties" and check the corresponding paths.

Once the program is up and running, you should test it in order to see how it works. It is quite simple. There is a menu called "Precision" where you can choose the data type to be tested and you can set the exponent of the epsilon value. As shown in the first lecture, we will try to reproduce the picture which shows the precision error. For this, we will test three points  $(p, q, r)$  whether they lie on a line or if they form a left or right turn. We use the colors yellow, red, and blue for these three cases, respectively. The epsilon value determines the step of deviation of the point  $p$  from the line defined by  $q$  and  $r$ .

There are two data types already present in the program. For both of these types, search for the epsilon exponents which create errors, e.g. a yellow pattern starts to appear along the diagonal line defined by  $q$  and  $r$ . Hint: The information given in the IEEE standard tells you which values you should be testing.

<sup>1</sup><http://qt.nokia.com/downloads/>

<sup>2</sup><http://ieeexplore.ieee.org/>

<sup>3</sup>[http://en.wikipedia.org/wiki/IEEE\\_754-2008](http://en.wikipedia.org/wiki/IEEE_754-2008)



## 4 Programming

Your task is the following: Extend the small program in order to include at least two additional data types besides the existing ones `CGAL::Cartesian<float>` and `CGAL::Cartesian<double>`. One of them should be homogeneous. You will have to use the Qt Designer to add the corresponding menu entries. As in step three find the corresponding epsilon exponents which show an error and explain why this error occurs at these particular values.

You have to hand in your code and the created executable. Please do so in the same structure as in the given `exercise_1.rar`. Finally, also hand in a short `.txt` where you list and explain the epsilon exponents found for steps three and four. You will be given five points if all task are fulfilled.

