ETH
Eidgenössische Technische Hochschule Zürich
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Informatik für Mathematiker und Physiker HS13

Exercise Sheet 5

Submission deadline: 15:15 - Tuesday 22th October, 2013

Course URL: http://www.ti.inf.ethz.ch/ew/courses/Info1_13/

Assignment 1 (4 points)

For this (theory) exercise we assume IEEE standard 754.

a) What is the value of a, and why?

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

b) What is the value of b, and why?

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

c) What is the problem with the following loop?

```
for (float i = 0.0f; i < 100000000.0f; ++i)
   std::cout << i << "\n";
```

d) **Challenge:** What is the value of d, and why?

```
int d = 0;
for (float z = 1.0f; z > 0; z /= 2) ++d;
```

Note: To answer this question you have to read up on the "special numbers" defined in the IEEE 754 standard. (This topic has not been covered in the lecture and is not relevant for the exam.)

Assignment 2 – Skript-Aufgabe 62 (4 points)

How many floating point numbers do the systems $\mathcal{F}^*(\beta, p, e_{\min}, e_{\max})$ and $\mathcal{F}(\beta, p, e_{\min}, e_{\max})$ contain?

Assignment 3 – Skript-Aufgabe 66 (4 points)

Write a program 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 $\beta = 2$.

Assignment 4 - Skript-Aufgabe 83 (4 points)

a) Write a function

```
// POST: return value is true if and only if n is prime
bool is_prime (unsigned int n);
```

and use this function in a program to count the number of *twin primes* in the range $\{2, \ldots, 10000000\}$ (two up to ten millions). A twin prime is a pair of numbers $(i, i+2)$ both of which are prime.

b) Try to find an argument why your program is so slow.

c) Can you think of a better (more efficient) approach than the one used in a)? (You don't have to implement it.)

Hint for a): The function `double sqrt (double x);` from the library `<cmath>` computes the square root of `x`. In order to use this function, you have to

- include the `<cmath>` library (add the line `#include <cmath>` below the `#include <iostream>` command in your code)
- call the function with the command `std::sqrt(x);`

Challenge - Skript-Aufgabe 75

This exercise ask 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`).