# Informatik für Mathematiker und Physiker    HS16

# Exercise Sheet 7

Submission deadline:    15:15 - Tuesday 8th November, 2016
`Course URL`: http://lec.inf.ethz.ch/ifmp/2016/

## Assignment 1 - References as Arguments [from: Exam Winter 2015, Problem 9]

```cpp
#include<iostream>

void foo (A a, B b) {
  H h = a;
  a = b;
  b = h;
}

int main() {
  int a = 2;
  int b = 3;
  foo (a, b);
  std::cout << a << b;
  return 0;
}
```

Consider the program above, with placeholders A, B, and H, for which we can independently substitute either the type int, or the type int&. Hence, there are 8 possible combinations of types. What is the output for each of the following combinations?

a) A=int, B=int, H=int

b) A=int, B=int, H=int&

c) A=int, B=int&, H=int

d) A=int, B=int&, H=int&

e) A=int&, B=int, H=int

f) A=int&, B=int, H=int&

g) A=int&, B=int&, H=int

h) A=int&, B=int&, H=int&

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This exercise can be handed in via Codeboard! To do so, click on the **Submission**-link at the bottom of this box. This opens a Codeboard-project. There, click on `ex1.txt` on the left side and write your answers. **When you are done, first save your file, then click on Compile, and then click on Submit.**

However, if you prefer, you can also hand in your solutions on paper as before.

**Submission:**    https://codeboard.ethz.ch/ifmp16E7T1

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## Assignment 2 – Robot Path (4 points)

In this exercise you will compute the position of a robot based on the sequence of its movements. The robot can walk upward u, downward d, to the left l, or to the right r, and it walks 1 unit per movement. For example, if the robot is at position (3, 5) and moves up (u), then it will be at position (3, 6) afterwards. If it moves left (l) from there, it will be at position (2, 6).

a) Write the following function move which updates the position of the robot according to a given movement direction.

```cpp
// PRE: dir is one of 'u', 'd', 'l', 'r'
// POST: robot position (x, y) is updated according to dir
void move (int& x, int& y, char dir);
```

b) Write a program robopath.cpp which first reads the number of movements to make, and then reads a sequence of movements from the user. Then it shall use your function from part *a*) to compute and output the final position of the robot, given that it starts at position (0, 0).

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**I/O-Examples**          (Explanation: http://lec.inf.ethz.ch/ifmp/2016/codeboard.html)

```
5
llddd
```
Robot is now at ( -2 , -3 )

```
10
urururddll
```
Robot is now at ( 1 , 1 )

**Submission:**     https://codeboard.ethz.ch/ifmp16E7T2

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## Assignment 3 - Computing with Arrays and Vectors (4 points)

Determine the following outputs!

a) What does the following code output?

```cpp
bool arr[5] = {false, true, false, true, false};
for (int i = 0; i < 5; ++i)
    std::cout << !arr[i] << " ";
```

b) What does the following code output?

```cpp
unsigned int arr[5] = {1, 2, 3, 4, 5};
unsigned int s = 0;
for (int i = 0; i < 5; ++i)
    s += arr[i];
std::cout << s << "\n";
```

c) What does the following code output?

```cpp
std::vector<int> vec (10, 3);
for (int i = 0; i < 5; ++i)
    vec[i] = i;
for (int i = 0; i < 10; ++i)
    std::cout << vec[i] << " ";
```

d) What does the following code output if the user inputs 8?

```cpp
int n;
std::cin >> n;
std::vector<int> vec (n, 0);
vec[n-1] = 1;
for (int i = n-1; i > 0; --i)
    vec[i-1] = 2*vec[i];
for (int i = 0; i < n; ++i)
    std::cout << vec[i] << " ";
```

This exercise can be handed in via Codeboard! To do so, click on the **Submission**-link at the bottom of this box. This opens a Codeboard-project. There, click on `ex3.txt` on the left side and write your answers. **When you are done, first save your file, then click on `Compile`, and then click on `Submit`.**

However, if you prefer, you can also hand in your solutions on paper as before.

**Submission:**    https://codeboard.ethz.ch/ifmp16E7T3

# Assignment 4 - Using Arrays (3 points)     [amongst others: Skript-Aufgabe 102]

a) Write a program `read_array.cpp` that reads a sequence of 10 ints from standard input into an array. Then the program shall output them in the same order. For technical reasons, the output shall include a star before the first and after the last int (separated from the actual output by at least one space).

**I/O-Examples**                    (Explanation: http://lec.inf.ethz.ch/ifmp/2016/codeboard.html)

```
9 8 7 6 5 4 3 2 1 0
* 9 8 7 6 5 4 3 2 1 0 *
```

**Submission:**    https://codeboard.ethz.ch/ifmp16E7T4a

b) Write a program `how_often.cpp` that inputs 10 ints from the user and outputs how often the last int appears among all ints.

c) Write a program `narrowing_sum.cpp` that reads a sequence of $10$ `int`s and outputs these $5$ sums:

```
(first + last) (second + second-to-last) ...
```

For technical reasons, the output shall include a star before the first sum and after the last sum (separated from the actual output by at least one space).

# Challenge – Cubic Equations (8 points)                    [Skript-Aufgabe 99]

How many solutions does the equation $x^3 = 1$ have? Just one? Then you haven't heard about complex numbers yet. In this challenge, you will learn about them, and in the end you will know all the solutions of the aforementioned equation. This week's challenge is exercise 99 from the script.

To implement your program, please refer to the description on how you can write your own programs.