

Informatik für Mathematiker und Physiker HS15

Exercise Sheet 7

Submission deadline: 15:15 - Tuesday 3th November, 2015

Course URL: <http://lec.inf.ethz.ch/ifmp/2015/>

Assignment 1 - Exam Winter 2015, Problem 9

```

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1

```

```

#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, and your task is to determine the output of the program for each of these combinations.

- | | |
|--------------------------|---------------------------|
| a) A=int, B=int, H=int | e) A=int&, B=int, H=int |
| b) A=int, B=int, H=int& | f) A=int&, B=int, H=int& |
| c) A=int, B=int&, H=int | g) A=int&, B=int&, H=int |
| d) A=int, B=int&, H=int& | h) A=int&, B=int&, H=int& |

¹If you have copy-paste problems, you can find a txt-version here: <http://lec.inf.ethz.ch/ifmp/2015/u7/phrase.txt>

Assignment 2 (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.

```
// 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 reads a sequence of movements from the user. You may assume that at least one movement is input. 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 $(0, 0)$.

Judge Examples	(Explanation: http://lec.inf.ethz.ch/ifmp/2015/judge_boxes.html)
Number of steps =? <input type="text" value="5"/>	
Input steps: <input type="text" value="llddd"/>	
Robot is now at (<input type="text" value="-2"/> , <input type="text" value="-3"/>)	
Number of steps =? <input type="text" value="10"/>	
Input steps: <input type="text" value="urururddl"/>	
Robot is now at (<input type="text" value="1"/> , <input type="text" value="1"/>)	
Number of steps =? <input type="text" value="16"/>	
Input steps: <input type="text" value="rrrruullddddlluu"/>	
Robot is now at (<input type="text" value="0"/> , <input type="text" value="0"/>)	
Submission: https://challenge.inf.ethz.ch/team/websubmit.php?cid=5&problem=MP15072	

Assignment 3 - Skript-Aufgabe 102 und 103 (4 points)

- a) Write a program `read_vector` that reads a sequence of n integers from standard input into a vector. The number n is the first input, and then the program expects you to input another n values. After reading the n values, the program should output them in the same order.

Judge Examples	(Explanation: http://lec.inf.ethz.ch/ifmp/2015/judge_boxes.html)
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```
Input: 6 4 -3 4 6 1 2
       4 -3 4 6 1 2
```

```
Input: 0
```

Submission: <https://challenge.inf.ethz.ch/team/websubmit.php?cid=5&problem=MP15073a>

- b) Enhance the program from part a) so that the resulting program `sort_vector.cpp` sorts the vector elements into ascending order before outputting them. Your sorting algorithm does not have to be particularly efficient, the main thing here is that it works correctly.

Judge Examples

(Explanation: http://lec.inf.ethz.ch/ifmp/2015/judge_boxes.html)

```
Input: 6 4 -3 4 6 1 2
       -3 1 2 4 4 6
```

Submission: <https://challenge.inf.ethz.ch/team/websubmit.php?cid=5&problem=MP15073b>

Assignment 4 - Skript-Aufgabe 88 (6 points)

Let us call a natural number k -composite if and only if it is divisible by exactly k different prime numbers. For example, prime powers are 1-composite, and $6 = 2 \cdot 3$ as well as $20 = 2 \cdot 2 \cdot 5$ are 2-composite. Write a program `k_composite.cpp` that reads numbers $n \geq 3$ and $k \geq 0$ from the input and then outputs all k -composite numbers in $\{2, \dots, n - 1\}$.

Judge Examples

(Explanation: http://lec.inf.ethz.ch/ifmp/2015/judge_boxes.html)

```
k =? 1
n =? 15
1-composite numbers in {2, ..., 14}:
2 3 4 5 7 8 9 11 13
```

```
k =? 3
n =? 100
3-composite numbers in {2, ..., 99}:
30 42 60 66 70 78 84 90
```

```
k =? 0
n =? 75
0-composite numbers in {2, ..., 74}:
```

Submission: <https://challenge.inf.ethz.ch/team/websubmit.php?cid=5&problem=MP15074>

Challenge – Skript-Aufgabe 99 (8 points)

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.