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# TIE-02207 Programming 2: Basics

Exam 13.12.2018

Write your answers to questions 1 and 2 on a single grid paper and those to questions 3 and 4 on a **different grid paper**. Remember to write your name and student number on the grid papers. You can use either English or Finnish. You need not care about the exact syntax when writing C++ code.

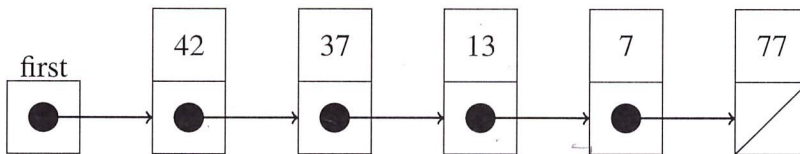
Name: \_\_\_\_\_ Student number: \_\_\_\_\_

1	2	3	4

1. Assume that all necessary include directives and other program parts are available. Consider the following data type.

```
struct Item {
    int data;
    Item* next;
};
```

Assume that the above data type has been used to create the following data structure:



where the diagonal line at the last element depicts nullptr.

- (a) Which action does the following program code perform to the data structure, if the value of `test_data` is 13? Do not explain each code line in English (or in Finnish), but describe the action as a whole in one sentence. In addition, draw a figure of the data structure after the action. (3 p.)

```
1  Item* a = first;
2  if(a->data == test_data) {
3      first = a->next;
4  } else {
5      Item* prev = a;
6      a = a->next;
7      while(a != nullptr) {
8          if(a->data == test_data) {
9              prev->next = a->next;
10         } else {
11             prev = a;
12         }
13         a = a->next;
14     }
15 }
```

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- (b) The above code contains errors related to memory management (at least two different errors). What are these errors? (2 p.)
- (c) How to fix the errors without changing `struct Item`? Write the correction in C++. You need not rewrite correct lines. (3 p.)
2. (a) Mention at least two important things that you must remember when writing a recursive function. (2 p.)
- (b) Write a recursive function that finds out the greatest element, still less than hundred, from a vector. (4 p.)
3. (a) What are the most essential differences between static and dynamic typing? Which of them is used in C++? (3 p.)
- (b) What are the most essential differences between value semantics and reference semantics? Which of them is used in C++? (3 p.)
- (c) What kind of data structure (constructed from STL and other C++ structures) would you use when implementing a membership register, i.e. a program that stores information about members of a society? The program must be able to handle/search/print membership data both in the order according to the names of the members and in the order according to the dates, when the members have joined the society. In addition to the above mentioned data, the program must be able print the address and email address of each member. (4 p.)
4. Suppose that you are writing a C++ program managing airports. An airport has at least flights, which again have at least arrival and departure times. Which classes do you have, and what are their public and private interfaces? Write the class definitions in C++. If you want, you can also draw a picture. What are the benefits of dividing a program into classes? (6 p.)