

TIE-02207 Programming 2: Basics

Exam 7.2.2019

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.

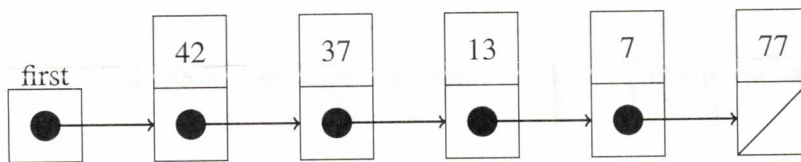
Name: _____ Student number: _____

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) What happens in the next two lines of code? Explain each line separately. (2 p.)

```
Item* new_item = nullptr;  
new_item = new Item;
```

- (b) What is the problem with the following code? (2 p.)

```
1 bool check = false;  
2 Item* a = first;  
3 while( a != 0 ) {  
4     if( a->data == a->next->data ) {  
5         check = true;  
6         break;  
7     }  
8     a = a->next;  
9 }
```

- (c) How can you recognize the problem (error) when you run the program? (1 p.)
- (d) How to fix the error without changing struct Item? Write the correction in C++. You need not rewrite correct lines. (2 p.)

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- (e) Write a piece of code that adds a new element to the above kind of data structure such that the new element is added after an element that has the same data value as the element to be added. If a suitable adding place is not found, nothing happens. (4 p.)
2. (a) Write a recursive function that finds out how many times a certain character appears in a string. How does the call look like, when you call your function from the main program? (4 p.)
- (b) Is your function tail-recursive? Why? (2 p.)
3. (a) What are the benefits of version control? (2 p.)
- (b) What does the parent-child mechanism mean in graphical user interfaces? (2 p.)
- (c) What kind of data structure (constructed from STL and other C++ structures) would you use when implementing a program that lists the author index from the given text. The text (book) consists of several pages, and it contains references to (other) authors (and texts written by them).
- The program counts the amount of those pages that contain a reference to an author. Note that a single page may contain several references to the same author, but such occurrences will be counted only once. It must be possible to list the authors in alphabetical order. In addition, from each author you must list the page numbers, on which the author has been referenced. (3 p.)
4. (a) Consider parameter passing in C++. Which different choices you have? Try to find as many of them as possible. Which situations each different way suits best? (3 p.)
- (b) Give some concrete benefits that modularity provides you when implementing and managing large programs. (3 p.)