

# Programming Assignment 1

**Due Date:** April 4, 2021, 23:59

**Note.** Please note that this semester all assignments are group assignments. Further note that for the grading we will apply a “10%” rule, i.e. the maximum number of points for this assignments is 110, but 100 will be counted as 100%. Points that exceed 100 will be stored in a separate counter and used later for compensation of lost points in other assignments or programming assignments or (if not used up this way) the final exam.

The task of this programming assignment is to implement in C++ a **registration, queueing and reporting system** for mass medical treatment (such as vaccination). The system is to support the following operations:

**Registration.** A person can register for medical treatment at a local registry. For the registration the following information is required:

- the *identification* number of the person,
- the *name* and *contact details* (address, phone, WeChat, email) of the person,
- the *profession* of the person,
- the *date of birth* of the person,
- the medical *risk status* of the person.

Each registration record will receive a *timestamp*, i.e. the date and the time of the registration will be stored.

The professions are classified into eight profession categories I to VIII. There are seven age groups: children ( $\leq 12$  years), adolescents ( $\leq 18$  years), young adults ( $\leq 35$  years), adults ( $\leq 50$  years), seniors ( $\leq 65$  years), elderly people ( $\leq 75$  years), and old people ( $> 75$  years). There are four different risk status: no risk (0), low risk (1), medium risk (2), and high risk (3).

Registration records are stored permanently. In addition, records with relevant information such as identification, profession category, age category, risk status, registration date and time are kept in a queue, which twice daily is forwarded to the centralised treatment queue. Data from different local registries is added to the centralised queue in random order, but the order from the local queues is preserved.

**Queueing and assignment of appointments.** The assignment of an appointment for receiving treatment is organised according to *priority*. The most important criterion is the profession category followed by a ranking of age groups, and further followed by data and time of the registration. Only people with no or low risk are considered. For people with medium risk a one month extension is added; people with high risk are only considered when there are no others waiting in the queue.

A person may withdraw from the treatment at any time. Those who have withdrawn and then registered again are considered with additional two weeks waiting time, unless they are in the medium or high risk group.

Furthermore, the profession category and the risk status of a queueing person may change. If this affects increases the priority in the queue, the relevant attributes are updated. A person may also present a priority letter with a deadline for the treatment. At the latest a person is assigned an appointment before the deadline regardless of the other selection criteria.

**Appointment processing.** When a person has highest priority in the priority queue, an appointment location, date and time (usually the next day) is assigned and registered. With this the person leaves the queue. There are several locations for treatment processing each with a daily capacity and associated time slots for the treatment. Usually, the closest location is selected for a person.

The right to withdraw is reserved. When the treatment has been processed at the designated location at the reserved day and time, this is also registered.

**Reporting.** The system shall produce weekly reports comprising

- the people who have been treated including their profession category, age category, risk status and the waiting time from registration to treatment,
- the registered people with a set appointment including their profession category, age category, risk status and their waiting time until now,
- the queueing people without a set appointment including their profession category, age category, risk status and their waiting time until now.

It must be possible to order these reporting lists by name, profession category or age group.

In addition the system shall produce a monthly statistics report showing how many people have registered, how many of them are waiting, how many are waiting in total, how many treatment appointments have been made, the average waiting time, and the number of people who withdrew their registration.

## Programming Tasks

- (i) For the registration records use files for each local registry.
- (ii) Implement data structures for the local queues.
- (iii) Implement a Fibonacci heap for the centralised treatment queue.
- (iv) Implement lists for the appointments at each location.
- (v) Implement the update, selection and reporting functions described above.

**total points: 110**