PROJECT ASSIGNMENT
ACADEMIC YEAR 2017-2018
1ST EXAM PERIOD

This document describes the project for the course on "Requirements Analysis for Complex Software Systems". The topic of the project is an analysis of requirements for a new system to enroll students at the Wellington university[1]. The project serves as the examination for the course. The first part of this document informally describes the system. That document could be the result of a first contact with local authorities of the city of Wellington. The second part of this document lists a series of practical issues concerning the project.

Deze tekst kan nog lichtjes wijzigen in functie van vragen of opmerkingen die binnenkomen. Vanaf 1 december wordt de tekst finaal afgesloten.

1. Requirements for a New Enrolling System

Your team has been assigned to develop a new enrolling system at the university of the city of Wellington. At the moment, students enroll by filling in all kinds of paper forms. Because of the growing student population, the central administration needs more and more time to process all student registrations. This leads to situations in which students are told that changes are needed in their study programs, weeks after they effectively enrolled. With the new system, students must be able to enroll electronically and lots of basic checks must be performed at the time of enrollment.

1.1. The Structure of the University

Education at the Wellington University is the prime responsibility of faculties. Faculties may offer several study programs in their field of interest. Next to bachelor programs and master programs, faculties may also offer transition programs and preparatory programs can be offered. Transition programs aim at students from high schools wishing to obtain a master degree. Preparatory programs aim at university students whishing to get an additional degree. A study program typically consists of a number of phases. Each phase covers one year of

[1] The description is based on the regulations at the KU Leuven. However, in order to avoid a full match with the complex rules of our university, a fictitious institute has been taken.

study and is divided in two semesters of 17 weeks each. Each semester involves a number of courses, some of which are mandatory for all students taking the program and others are eligible. The load of each course is expressed in terms of study points. One study point represents 25 to 30 hours of work for students. Each course and each study program is under the supervision of exactly one faculty. However, study programs may include courses that are supervised by other faculties.

Faculties will assign lecturers to each of the courses they offer. Students are not allowed to take courses to which no lecturers have been assigned yet. A course may have a single lecturer. In that case, that lecturer must be a professor. A course may also be assigned a team of lecturers. At least one of these lecturers must be a professor. One of the team members is assigned the role of coordinator.

Courses may have entry requirements. Such requirements identify knowledge that is needed in order to be able to follow the course at stake. Entry requirements are always specified in terms of courses in which the required knowledge is taught. Entry requirements can be strong, weak or parallel. A strong entry requirement states that the student must have acquired a credit or a tolerance for the stated course, before he/she is allowed to follow the course at stake. A weak entry requirement states that the student must have followed the required course. In this case, the student must not have finished that course successfully. Parallel entry requirements state that the student must already have followed the required course or is following that course in parallel with the course at stake. A course can specify several entry requirements, each of which must be satisfied. Courses can also specify alternative entry requirements. In the latter case, one of them must be satisfied.

1.2. Registrations

If a student wants to register for the first time, he/she first has to supply some personal information including home address, residence address and phone numbers. The administration then supplies a student card to the student. Apart from an identification of the student, the card also includes a so-called student identification number, which is unique over all current and past students of the university. Students then also receive an e-mail address that they are supposed to use in communicating with members and divisions inside the university. The procedure for first registrations also applies to students that return to the university after one or more years. In such cases, the administration will re-use the old identification number of the student.

Equipped with their student card, students typically register for a study program. This type of contract is referred to as a diploma contract. The first year a fulltime student registers for a study program, he/she must take all the courses of the first phase of that program. Only if such a new student already has credits for some of these courses or if he/she is entitled to exemptions for some of them, he/she can also take other courses of the program. New part-time students can only select a number of courses from the first phase of their study program. If students register to continue a study program they have partially completed in previous years, they must identify all courses they wish to take in the upcoming academic year. Obviously, they must honor all entry requirements imposed on courses they take. As a general rule, students cannot take courses of some phase, if they have not already taken all courses of all preceding phases.

With a so-called credit contract, students subscribe for individual courses rather than for entire study programs. With a credit contract for some course, students are entitled to attend all the contact sessions organized for that course. With an exam contract, students also subscribe for individual courses. With this type of contract, students are only entitled to take exams. Credit contracts and exam contracts do not result in a diploma. Instead, students receive a certificate for each individual course they finish successfully.

Students may take several contracts at the same time. First of all, students may take several diploma contracts. A typical example is a student that intends to finish his/her bachelor program in the new academic year, in combination with a first part of a master program following that bachelor program. Students may also combine different types of contracts. However, students may not have several credit contracts or several exam contracts for courses under supervision of the same faculty. Moreover, no unfinished course can be included in different contracts at the same time. The total number of study points of all the courses taken by a fulltime student in one academic year must be at least 40 and may not exceed 75 points. For part-time students, that range becomes 0..30.

1.3. Individual study programs

In all types of contracts, students are given some time to decide on the courses they effectively want to take. Ultimately three weeks after the start of the first semester, students must supply the list of courses they want to take in that semester and in the second semester. At the start of the second semester, students have another three weeks to change their individual study program for that semester, if they want to. Once a student has submitted his/her individual study program, the administration of the organizing faculty will check that it satisfies all rules. If some individual study program violates some rules, the administration will contact the student to make the necessary corrections. If there is no agreement possible, the educational committee of the faculty will take the final decision on the student's program.

Students can apply for exemptions for some of the courses in a study program. For each such course, they must submit a form in which they provide their arguments for the exemption. Typically, they will refer to equivalent courses they have finished successfully at the Wellington university or at some other university. Requests for exemptions must be submitted together with the study program to which they apply. The administration of the faculty decides whether or not the student is granted the exemption. If the faculty rejects an exemption request, it will extensively motivate its decision.

1.4. Credits and Tolerances

The enrollment for some course also implies an enrollment for the examination for that course at the end of the semester. In that process, students are offered a choice of slots at which exam sessions for the course at stake are scheduled. Each slot includes information in terms of date and time of the exam session. It may also impose a maximum on the number of students that can enroll for that session. Obviously, students cannot enroll for sessions that are fully booked. Students should have booked exams for all the courses they have taken at the time they submit their program to the faculty. In case students have failed to do so, the faculty will complete their schudele. The university guarantees that students will not have more than one exam on the same day. Students receive a so-called credit for all the courses they succesfully finish at the end of a semester.

If students fail for an exam at the end of a semester, or if students are not satisfed with their score, they can register for a second chance at the end of the summer holidays. The procedure for booking exams at the end of a semester also applies for booking exams at the end of the summer holidays. As for first attempts, students receive a credit for each successfull re-examination. In any case, students get the best of both scores as their final score for the course at stake.

Students receive a budget of tolerances for each diploma contract they subscribe. That budget amounts to 10% of the total of study points for the program, diminished with the study points for which the student has been granted an exemption. At the end of each academic year, students may use their tolerance budget to get rid of

courses for which they got a score of 8 or 9 on 20 on the exam. Obviously, students cannot go over their tolerance budget. For study programs that span more than one year of studies, students are not allowed to use more than 50% of their budget of tolerances on courses of the first phase. Students automatically receive their diploma as soon as they have succesfully finished or tolerated all courses part of their study program.

Students that have failed to pass the exam for some of the mandatory courses they have taken in a diploma contract, must subscribe for all those courses in the next academic year (at least if they wish to continue their studies for the program at stake). Students that have failed for eligible courses, may replace those courses by other courses. If a student has not finished some course after four examinations, he/she is not allowed to subscribe for any study program or course in the next academic year. For diploma contracts, the number of examinations is increased to six if the CSE (Cumulative Study Efficiency) of the student is not below 50%. If a student has not finished some course after six examinations, he/she is not allowed to subscribe for any study program or course in the next three academic years. The CSE of a student in a study program is the ratio of the number of study points for which the student has acquired a credit or a tolerance in the scope of that study program, over the total number of study points taken by that student in that study program.

2. Practical Issues

You may work out this project together with another student, or you may work it out on your own. You must hand in a document describing your requirements analysis of the new enrolling system for university of the city of Wellington. You may use the structure of the requirements document for the online music store as the outline of your document. You may also use another structure, if you prefer so. The document must be submitted on Toledo in PDF. You may additionally include source documents and diagrams in any format (doc, vpp, ...). However, there is no guarantee that these documents can be opened at the defense.

The basic purpose of this project is to convince us that you master all the skills of requirements engineering tackled in this course. This means that your document must not reflect a complete analysis of the envisaged enrolling system. You should try to apply all the important concepts in your requirements document. Examples are *alternate flows*, *normal flows*, *exceptions*, *preconditions*, *postconditions*, *partitions*, *power types*, *association* classes, and *extends* and *include* relations between use cases. Minimal requirements imposed on your solution are:

1. A **context diagram** revealing all the important business events.
2. A **business use case diagram** revealing all the business use cases that you can identify within the scope of the assignment as described above.
3. Detailed descriptions of at least 4 **business use cases** (7 for teams of 2 students). We strongly advise you to select business use cases with rich semantics, such that you can illustrate all the important concepts of use case modeling. In this way, you are able to convince us that you master all aspects of use case modeling. *At least one of your business use cases must apply on the registration for some study program, at least one on submitting the individual study program, and at least one on the process of taking exams and using tolerances.*
4. A **system use case diagram** covering all the business use cases as outlined in the business use case diagram. At least 6 of these system use cases must be worked out by students working individually; at

least 9 of them by teams of 2 students. The document must include a short description of all other system use cases. The business use case diagram and/or the system use case diagram must include at least one application of include, extend or generalization relationships.

5. **User stories and spikes** that further elaborate on system use cases that have been worked out in detail. At least 2 such stories must be worked out by students working individually; at least 3 stories and 1 spike by teams of 2 students.
6. A **domain model** having at least 20 classes (30 for teams of 2 students). The diagram must cover all aspects involved in student registrations, in individual study programs and in the process of taking exams. The diagram must have convincing applications of association classes and of generalizations (partitions), as far as possible.
7. Formal specifications in **OCL** (1) that fulltime students registering for a study program must take at least all the courses of the first phase, (2) that students cannot take courses for which they do not satisfy stated entry requirements, (3) that a student can not take courses of some phase if he/she has not taken all courses of all preceding phases, (4) that a student cannot subscribe for the same course in different contracts, (5) that a student is blocked for 1 year on a diploma contract if he/she has failed 4 times for some course and his/her CSE is below 50%, and (6) that a student can only tolerate courses for which he/she had a score of 8 or 9 and the total number of tolerated study points cannot exceed 10% of the total amount of study points for the program at stake. Teams of 2 students must further formally specify at least 3 additional rules of their own choice. Finally, at least one precondition and one postcondition of a use case must be expressed in OCL.
8. If you want to get a **score of 16 or more**, you must also specify in a formal way that entry requirements for courses must be free of cycles. In addition, you must formally specify a function that calculates the smallest collection of courses that a student still needs to take to finish his/her study program.

You may assume that OCL fully supports the data types `Time` and `Period`. You may further assume that all possible relational operators are defined for these data types, as well as the operators `Time+Period:Time`, `Time-Period:Time`, `Time-Time:Period`. In case you need other operators for these data types, you must briefly introduce them in a footnote.

We expect you to work on this project for a maximum of 30 hours (not including the 16+ part), assuming that you fully master all the principles of requirements engineering. As explained before, you are not expected to work out a complete solution for the assignment in that period of time. Within that time span, you must be able to hand in a project that is sufficiently far completed to convince us that you know to apply all the basic principles of requirements engineering as explained in this course.

You must hand in your solution on the Toledo-site of the course before January 12, 2018 at noon. If you have worked out the project together with another student, both you and your colleague must hand in (the same) solution. You must defend your project between January 15 (10h) and February 2 (16h). If you have worked out the project together with another student, you must come and defend the project as a team. The defense takes about half an hour if you have worked out the project on your own, and 45 minutes if you have worked it out with another student. Around December 1, a list of possible slots for the defense will be published on Toledo.

This assignment is incomplete in the sense that it does not reveal all the details concerning enrollment for study programs and individual courses. You are free to fill in these details in the way you prefer. You may inspire yourself on the regulations as they apply at the KU Leuven. In fact, we will be unwilling to fill any details that are irrelevant in convincing us that you master the principles of requirements engineering. If you have other

questions concerning this assignment or concerning the practical issues, you can send an e-mail to Prof. Steegmans. You may expect an answer in a period of 3 working days.

Lots of success,

Eric Steegmans,
Christopher Verhulst,
Stijn Van den Enden