Budapest University of Technology and Economics
Faculty of Electrical Engineering and Informatics
Department of Telecommunications and Media Informatics

Designing and Implementing an Educational Support System

Bachelor's Thesis

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HALLGATÓI NYILATKOZAT

Alulírott *Szepes Nóra*, szigorló hallgató kijelentem, hogy ezt a szakdolgozatot meg nem engedett segítség nélkül, saját magam készítettem, csak a megadott forrásokat (szakirodalom, eszközök stb.) használtam fel. Minden olyan részt, melyet szó szerint, vagy azonos értelemben, de átfogalmazva más forrásból átvettem, egyértelműen, a forrás megadásával megjelöltem.

Hozzájárulok, hogy a jelen munkám alapadatait (szerző(k), cím, angol és magyar nyelvű tartalmi kivonat, készítés éve, konzulens(ek) neve) a BME VIK nyilvánosan hozzáférhető elektronikus formában, a munka teljes szövegét pedig az egyetem belső hálózatán keresztül (vagy autentikált felhasználók számára) közzétegye. Kijelentem, hogy a benyújtott munka és annak elektronikus verziója megegyezik. Dékáni engedéllyel titkosított diplomatervek esetén a dolgozat szövege csak 3 év eltelte után válik hozzáférhetővé.

Budapest, 2015. november 30.

Szepes Nóra
hallgató

Kivonat

honnan->hova
látszon az eredmény

Abstract

Chapter 1

Introduction

During the summer of 2015 my advisor, Sándor Gajdos contacted me to give him a feedback about his subject, Software Laboratory 5. I told him what I thought was good and bad in the subject, not only about the tasks, but also about the administration portal. It really bothered me that the portal did not have e-mail notification, so I told him, that I would like to develop that feature into the current portal. All I knew that it was written in php. I told him about my ideas and he contacted the creator of the old portal, Bence Golda, to ask for some information about the old portal's code and József Márton to create a "noreply" e-mail address for the notification module. József Marton gave us an idea for creating a new portal and other team members, Bence Golda, Gábor Szárnyas and I agreed with the idea.

In the beginning of August we had our first meeting. Before that I decided to look up all the different homework portals I have ever used during my student years. I asked for an account to Zoltán Czirkos's InfoC [5], because that website started after I have finished the subject Basics of Programming 1. After some research I made a small specification for an ideal homework portal and some ideas of how we could use the same portal for more than one subject.

During the meeting, we talked about this, and what others expect from a new portal. It started as a department project but József Marton asked for some ideas about what students want from a portal. I wanted to participate but I said that besides my thesis I will not have that much time to work on the portal. At the end Sándor Gajdos offered me that this could be my thesis topic and he would be my advisor. I accepted his idea because this is an appealing engineering task from designing to implementing and in addition the final portal will be used by hundreds of students.

1.1 The Old Administration Portal

***Bence*: Bence e-mailje:**

- A régi portálról (címszavakban; szóban szívesen mesélek majd róla többet):

* 4-en csináltuk, hálózatos méréssel együtt szglab5 táltosként, 2003 (?) tavaszán, olyan 34-35 kredites félévben, amikor sok másik tárgyból is évközi házi volt,

* előtte kevés szoftver-fejlesztési tapasztalatunk volt, (átfogó tapasztalat gyakorlatilag 0)

* alapvetően Sándor specifikált és megírta / elmondta az igényeit,

* mi meg lázasan kódoltunk,

* használtunk verziókezelőt,

* nem voltak (nincsenek még mindig) tesztek,

* technológiát tekintve: SQL alapokon (Oracle) -> PHP motorral -> XSLT templating rendszer készült

* 2-3 évig változatlanul működött, az egyetlen nagy feature fejlesztés pótmérés volt,

* 5-6. évtől Ruby kódokkal / szkriptekkel egészítettem ki a működést, ami a kapcsolódó feladatokat oldja meg (inicializálás, pótmérések feltöltése, eredmények generálása)

* 1 nagyobb egyetemi és 2 céges (gyakornok) csapat fogott neki már korábban az újraírásnak, kevés sikerrel,

* üzemeltetőként félévente kb. 30-40 órát foglalkozom a feladattal.

*****TODO***: Sándortól: Nem Bence irta meg, hanem Benceek. Az indittatas az volt, hogy felkinaltuk nehany gondosan kivalasztott "taltos" hallgatonak a targy teljesitesenek ezt a formajat, nekik pedig tetszett a lehetoseg/kihivas.**

1.2 Purpose of the Thesis

mit tudok, mit fogok végrehajtani, mi az elérendő cél

1.3 ?

hogy álltam neki a fejlesztésnek - melyik fejezetben mit fogok bemutatni

guid

Chapter 2

Specification

Before the team's first meeting in August, I looked up all the homework portals I've used during my student years to write a small specification [42] about what I expect from a homework portal as a student. Since September we have weekly meetings where we discussed the followings:

- the old portal's features to be kept without modifications
- the old portal's features to be modified
- the old portal's features to be deleted
- new features to be added

After a few meetings we had a list of features as the starting point for our specification. Then I used the 5 Whys technique to find the common roots of the features.

2.1 Test Suite

In this section I introduce what kind of techniques I used to create the final specification. Some of these techniques serve as the basics of testing. I explain the testing in chapter 7.

2.1.1 5 Whys

The 5 Whys is a technique to find the root cause of a problem simply by asking the question "Why?" multiple times. With this technique I can find out what does the user want to achieve with using a feature. Why does the user want to use this feature? Does the user really want to use this or should the portal to this by default instead of the user? The 5 Whys also helps to decide when should I implement only one general feature instead of many specific features. For example, if the user wants to have 15 specific analytic features, I could consider making a general one instead of specific ones.

Example:

The student wants to list his commits from every branch in the laboratory's repository.

- *Why?* – Because the student wants to tag one commit as final version.
- *Why?* – Because the evaluator will know which commit contains his homework.

- *Why?* – Because the evaluator has to correct his homework.
- *Why?* – Because the evaluator has to give the student a grade.
- *Why?* – Because the student has to pass the laboratory to pass the course.

In consequence of the 5 Whys, I also filtered out some features. Then I started to write user stories to have the basics for test automation.

2.1.2 User Story

A user story is a description of how can the user interact with the system, and what does the user have to do to use a certain feature. User stories are written in everyday language, and I can use them to run automated tests with a software tool.

Given When Then

The Given When Then convention for user stories. The *Given* describes a state of the system. The *When* describes an event. The *Then* describes the result. If there are multiple Givens, I can use *And* or *But*. If you have the same Given statement for many stories, you can combine them as a *background* section. A *scenario* is an example of an executable action [28].

Example:

Background:
Given a logged in student named "Jakab"
And the settings page is loaded

Scenario: Setting a new SSH public key
Given I am logged in as "Jakab"
And I have entered a new SSH public key
When I press the save button
Then I should see "Your settings have been saved."

At first I wrote simple user stories without backgrounds and scenarios. I wrote them for all modules, but then as a first step, I focused only on the student module, because that's the first module I will work on. I finished writing scenarios for only that module. The other modules are still only a list of simple user stories. The user stories are in appendix B.

Cucumber

User stories are good basics for testing. For testing I will use Cucumber. Cucumber is a software tool to run automated tests. It uses the Gherkin parser to parse feature files. A feature file contains user stories written in everyday language in a specific structure. In this project I will use English user stories [29]. The usage is described in section 7.1.

2.1.3 Mock Server

API Blueprint

Drakov

TODO: miau2 drakov, api blueprint

2.2 The Final Specification

2.2.1 User Roles

In the new portal there will be four different user roles: student, evaluator, demonstrator and administrator.

Student Role

The student can:

- see general informations about his classes
  - when will it be
  - where will it be
  - who will be the teacher
  - when is the deadline
  - how much time is left until the deadline
  - what is the Git remote URL
    - The portal doesn't have an option to upload files, because students use Git repositories to upload their homeworks.
    - With every laboratory they get a new Git repository in the Database Laboratory GitLab.
- check his results
  - his entry test grade
  - his laboratory report grade
  - his laboratory report review
  - who was the evaluator
  - his laboratory grade
  - his laboratory review
- list his commits from every branch in the laboratory's repository
- tag a commit as a final version
  - When the deadline is over, the back end will tag every branch's last commit.
  - If the student didn't tag any commit as final version, the evaluator will check the solution only the master branch's commit, that was tagged by the back end.
- see a summarized view of his grades

Teacher

The teacher can be a demonstrator and/or an evaluator (see appendix A). If a teacher is both a demonstrator and an evaluator, then the teacher can choose which role's pages the teacher wants to use now.

Demonstrator Role

The demonstrator can:

- see his current class with a list of students, who attended that class
  - This list also contains the students' laboratory report grades and reviews.
- give the students entry test grades
- give the students laboratory grades
- give the students laboratory reviews
- choose another class to list the students, who attended that class
  - save the student's results as a draft
  - continue writing a saved review draft
  - publish the results for the student

Evaluator Role

The evaluator can:

- see maximum 4 lists of homeworks
  - If a list doesn't have any element, it won't appear on the page.
  - The first list contains the homeworks, that are waiting for evaluation and booked by the evaluator.
  - The second list contains the homeworks, that are waiting for evaluation and not booked yet.
  - The third list contains homeworks booked by another evaluator.
  - The fourth list contains the evaluated homeworks.
- book homeworks for himself for evaluation
- choose a homework to start the evaluation
- see the student's name and the Git remote URL as a general information for a homework
- give a laboratory report grade for a homework
- write a review for a homework
  - save the review as a draft

  - continue writing a saved review draft
  - publish the grade and the review for the student
  - If the student didn't tag any commit as final version, the evaluator will check the solution only in the last commit in the master branch.

Administrator Role

The administrator role is a teacher role expanded with some extra features.

The administrator can:

- run SQL queries
- search for users
  - with name
  - with username
  - with id
- can change a user's e-mail
- can change a user's password
- can impersonate any user
- modify an evaluator's homework types
- add a new entry test question
- modify an entry test question
- delete an entry test question
- add a new event
- modify an existing event
- delete an existing event
- see the statistics
  - list the unpublished reviews
  - list the homeworks, that are waiting for evaluation

Default Options

Any type of user can:

- upload a new SSH public key
- set a new e-mail address
- set a new password
- change his mailing list subscription
- change his e-mail notifications subscription

2.3 Meh, kene ide egy jo alcim

hibaágak ***Bence*: - 2.3: ha a "hibaágak" tekintetében a specifikáció "zöltutas" megközelítését szeretnéd kiegészíteni hibaágakkal, akkor korábban ezt a megközelítést is definiálnod kéne,**

mi az én feladatom?

Chapter 3

Conceptual System Design

The conceptual system design represents the structure of the system. It contains the conceptual model of the back end. The front end is only a module in this design to make the system design more simple. The front end design depends on which software architecture pattern is used. This project follows the MVC pattern (see section 3.2). In this chapter I introduce the system design and the general MVC pattern. The front end design will be introduced in section 4.7, because it depends on the framework's behavior.

3.1 System Design

*****TODO***: bevezetőszöveg?**

The main components are the followings:

- **Client:** A web portal, that is the communication bridge between the user and the web server. There will be three different modules: student, teacher and administrator. The different client modules can only communicate with the web server, and they cannot communicate with each other.
- **Database:** A database to store the system's data (see subsection 3.1.1).
- **Git:** A database to store the students' homeworks. Every student will get a different git repository for each laboratory.
- **Load Balancer:** It prevents the client from contacting the web server directly and solves the scalability problem. The client sends its requests to the load balancer, that will forward it to one of the web servers, depending on the client module, request type and the web servers' load.
- **Object-relational mapping:** It converts the data between the representation suitable for the implementation and the database.
- **Messaging:** A component, that supports messaging between the different components. The web server, the task manager and the workers will use this to send tasks to each other.
- **Task Manager:** A special worker. It gets tasks from the web server to decide which worker has to process it. After the decision it forwards the task through the message bus.

- **Web Server:** The server that runs the API's implementation. This component processes the incoming requests, creates tasks and forwards them to the task manager. It also provides its clients the data from the databases. The API is written in Ruby on Rails.
- **Worker:** This will process the task, e.g., changes the user's mailing list subscription.

Scalability

Client

To solve the scalability problem, the client's code will run in a web browser for every user. This way, resources for the client's code are provided by the user as he opens the web portal in a web browser.

Web Server

If there were not any load balancer between the client and the web server, then one server would get every request. With thousands of users this could lead to overload and high the response time. With a load balancer, the requests will first arrive at the load balancer, and it will decide which web server will handle that request and forwards it to that web server. The choice depends on the client module, request type and the web servers' load. The load balancer's purpose is to avoid overload and minimize the response time.

*****TODO***: ábrán kijavítani, hogy a web server az külön szó**

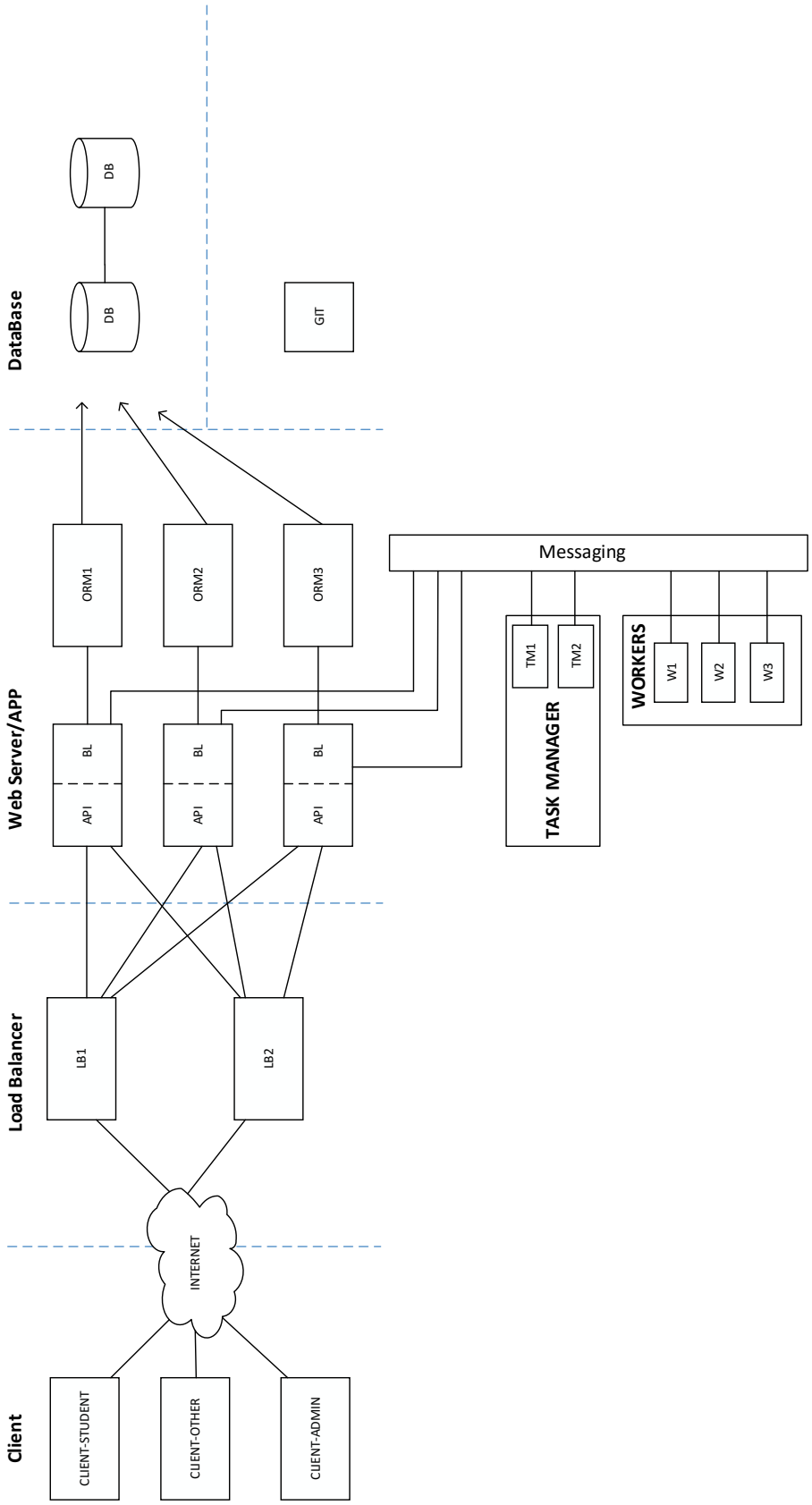

Figure 3.1. Conceptional System Design
Made by the team.

3.1.1 Entity–relationship model

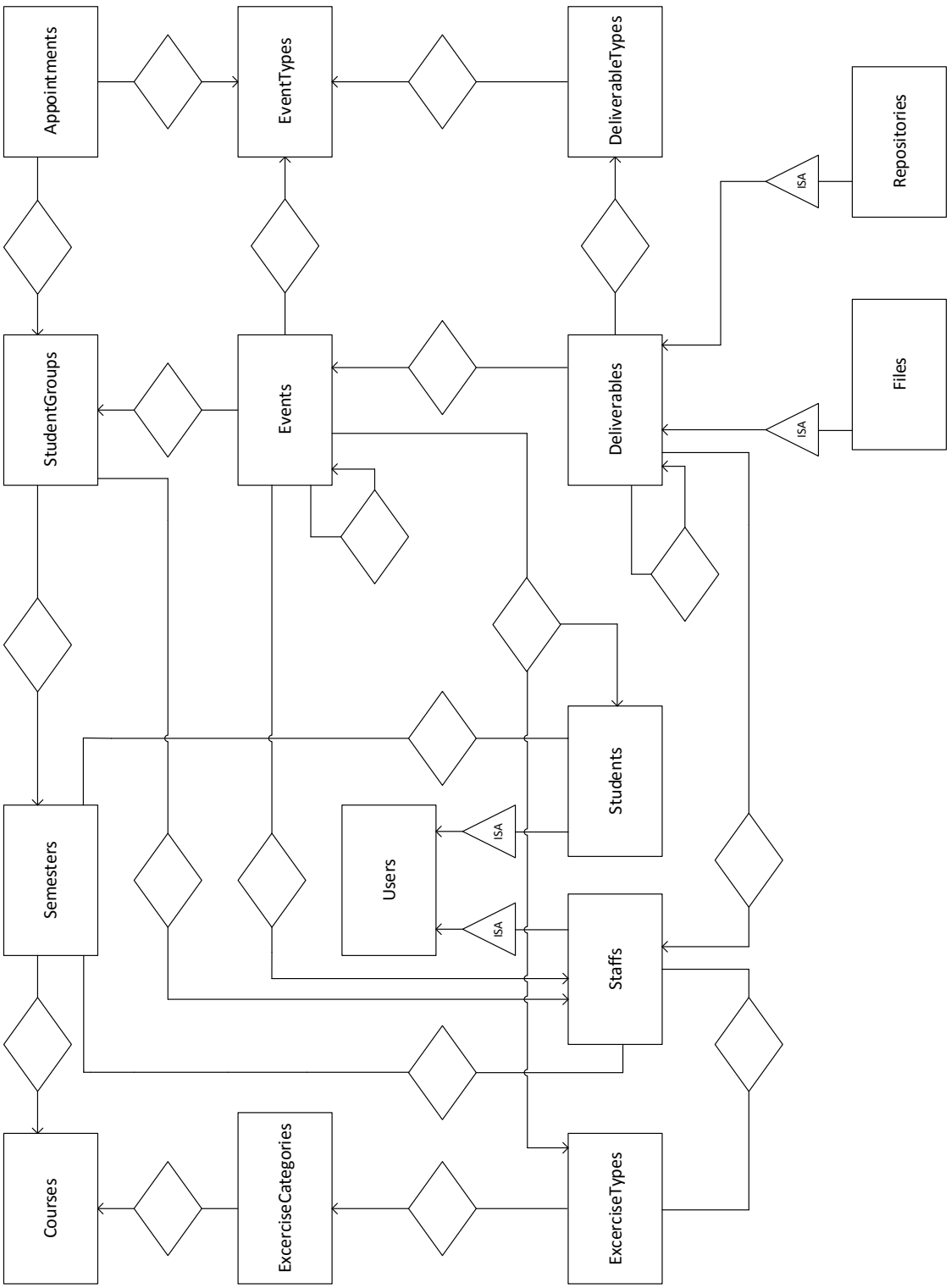

Figure 3.2. Entity–relationship model
Finalized by the team based on my proposal.

*****TODO***: magyarázat**

3.2 MVC Pattern

The Model-View-Controller (MVC) is a software architecture pattern for user interface implementation, where the application logic is separated from the user interface.

In object-oriented programming the Model is the objects where the data from the database is stored. The View is the presentation layer, that the user sees and interacts with. The Controller will process and respond to the user requests and invoke the changes in the Model.

The MVC pattern is memory efficient, because multiple views can share the same underlying data model. Controllers can be separated by events. This lets the developer to create a controller hierarchy, because a controller for a keyboard event is different from a controller for a mouse event. Views implement an instance of a controller, that can be changed at run-time, because we can be disabled and enabled.

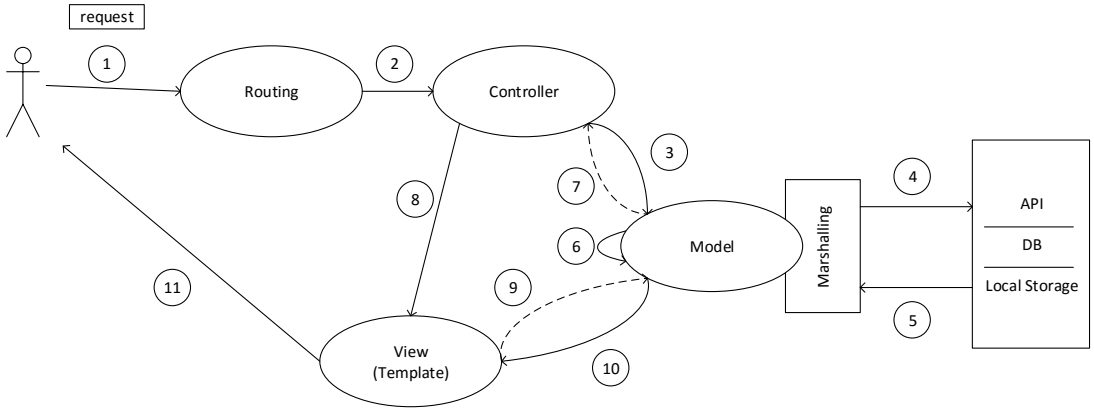

Figure 3.3. Classic MVC Web Application
Made by Bence Golda.

In web applications the browser communicates with a controller. When the user sends a request, routing will decide which controller will handle the request. The chosen controller talks to the model to get the relevant data. If it is necessary, the model will send data to or ask for data from the database, the API or the local storage. During this process, the data has to be transformed via marshalling. Marshalling is the process, that transforms the data between storable and sendable dataformats. When the model returns the desired data to the controller, it will forward the data to the view. The presentation layer will decide which page has to be returned to the browser, binds the data to the view template and returns it.

Chapter 4

Comparing JavaScript Frameworks

For the project I wanted to choose a JavaScript framework for faster development than using plain JavaScript with jQuery. Writing every component from scratch needs a lot of time. Hundreds of developers contribute in open-source frameworks, and developers can utilize their reviewed and tested work. This leads to getting more tasks done in less time. Because this project follows the MVC pattern (see section 3.2), only JavaScript MVC frameworks will be compared. The TodoMVC [1] website helps developers to select a JavaScript MVC framework for their project. It provides the same example written in JavaScript using different JavaScript MVC frameworks.

During comparison I checked the followings:

- **AJAX requests:** the client and the server (see figure 3.1) will communicate via REST using JSON format.
- **data binding:** to connect the data from the model to the view (see figure 3.3).
- **routing:** to build a single-page application.

***Bence*: 4. eleje: amiről még beszéltünk, hogy ellenőrizni kéne: különböző tesztelési módszerek alkalmazhatósága,**

In a single-page application (SPA) when the user opens the web site in a browser, all the resources will be downloaded with a single page load. From that point when the user interacts with the web site, it will dynamically update previously downloaded single page [30].

In JavaScript with *AJAX requests* we can send requests to a server asynchronously without reloading a page. In a SPA we want to make the browser think it is always on the same page. When the user clicks on a new link, the browser will not reload the whole page, it will just simply load the new view into the old frame. Everything happens in the background so the application will not force the user to wait while it sends data to a server. If the application is retrieving data, then when it arrives, the application can process it and show the result to the user.

The classic *data binding* model is when the view template and the data from the model are merged together to create the to be displayed view. Any data changes in the view will not automatically sync into the model. The developer has to write the controller that syncs the changes between the model and the view [13].

Upon URL change an SPA will not download a new page. It will navigate to the right part of the application. *Routing* takes care of this automatically. The SPA needs a routing table to know which URL belongs to which controller or view.

4.1 React

My first choice was React [26]. It is developed by Facebook and Instagram since 2013.

React creates a virtual DOM instead of always updating the browser's actual document object model (DOM) [44]. The DOM provides a structured representation of HTML and XML documents. The objects are the nodes of the tree, and the tree structure is the DOM tree. In this case the DOM connects the HTML page to the JavaScript code. The virtual DOM is like a blueprint of the real DOM. Instead of containing a div[1] element, the virtual DOM contains a React.div element that is just data and not a rendered content. React is able to find out what has changed on the real DOM. It makes changes to the virtual DOM, because that is faster and then re-render the real DOM [27].

To create DOM elements, we can choose between JavaScript and JSX [25]. If we use JavaScript, then the code will render the HTML code for us. If we choose JSX, then we can mix JavaScript and HTML-like syntax, and we can insert the desired HTML code as the return statement.

For data binding React has a one-way data flow called Flux [24]. Flux supports data flow only in a single direction, downstream. This means if something is changed in the component tree, then it will cause the element to re-render itself and all of its descendants.

React focuses only on building views. The core React version does not have an option for routing and AJAX requests. If I want to support those in my application, then React should be combined with other frameworks or libraries to have a full MVC experience.

4.2 AngularJS

AngularJS [10] is one of the most famous JavaScript frameworks nowadays. It has been maintained by Google for 6 years. It focuses mostly on dynamic views in web-applications.

Creating a website is done with an extended HTML vocabulary, like Android Layouts where we declare everything in XML. It uses a two-way data binding template [13] which means whenever either the View or the Model is changed, it will update the other one.

Angular AJAX requests are similar to the AJAX methods in jQuery, but Angular takes care of setting headers and converting the data to JSON string. It can also be used in unit tests with ngMock [11], because it can create a mock server.

For routing Angular uses a special listener. It binds these listeners to links. If the user clicks on a link, Angular will simply push the page to the browser's history and replace the view with the new page. This will even allow the back button to operate. This method works only if the website is loading from a server, because it allows Angular to load into the memory otherwise the listeners cannot navigate through pages [12] [14].

[1] A div is a generic container in HTML. It helps structuring the HTML document [43].

4.3 Mithril

Mithril [16] is a small MVC framework created by Leo Horie. It uses a similar virtual DOM like React, but also implements controller features like routing.

When we are creating a website, Mithril first creates virtual DOM elements, that is a JavaScript object that represents a DOM element. Rendering will create a real DOM element from the virtual one [17] [19]. If we prefer using HTML syntax, we can use MSX [2]. It uses JSX, but transforms the output to be compatible with Mithril.

Mithril has one-way data flow, from the model to the view. It has an auto-redrawing system to ensure that every part of the UI is up-to-date with the data. It uses a diff algorithm to decide which parts of the DOM needs to be updated and nothing else will be changed. Mithril automatically redraws after all controllers are initialized and will diff after an event handler is triggered. It also supports non-Mithril events to trigger auto-redrawing [21]. If we need view-to-model direction, Mithril provides us an event handler factory. This returns a method that can be bound to an event listener [23].

Mithril provides a utility for AJAX requests. We can set an early reference for the asynchronous response and queue up operations to be performed after the request completes. [22] [18].

For routing Mithril needs a key-value map of possible routes and Mithril modules to connect the routes to the modules. Upon routing the module's controller will be called and passed as a parameter to the view. [20].

4.4 Comparison

During the comparison I made a small program in every JavaScript framework to try AJAX requests, data binding and routing. The source codes are publicly available on Github with a gulp file (see chapter 8) and an API blueprint test file for Drakov (see subsection 2.1.3).

React [41]
The components are separated into different JavaScript files. JSX was used to represent the views. Before the concatenation a JSX transformer converts the inline HTML-like JSX to JavaScript code. The React components' states were used as a model. Because React has not got an option for AJAX requests. jQuery was used to download some mock data from the mock server. React Router was used [38] for routing.

Angular [39]
The controllers are separated into different JavaScript files and the views into different HTML templates. The routing connects the right HTML template to the right controller. The JavaScript files are concatenated using gulp. The HTML templates are in different HTML files. Variables inside the controllers were used as a basic model. The routing is not included in the core Angular framework, but Google provides a library for it.

Mithril [40]
A Mithril module contains a model, a controller and a view. A controller is a JS constructor and the view is a function, that returns a virtual DOM. Modules are separated into different

JavaScript files and concatenated with gulp. MSX transformer converts the HTML-like MSX to JavaScript code.

***Bence*: - 4.1 és 4.4 – ezeket páronként össze kéne gyúrni. A 4.1, 4.2, 4.3-ban már nyugodtan leírhatod az összehasonlítással kapcsolatos megjegyzéseidet. Javaslom, hogy legyen egy táblázat valahol, ahol gyorsan át lehet tekinteni az eredményt.**
érdemes lenne egy táblázatban is összefoglalni az áttekinthetőség érdekében

4.5 Conclusion

In performance both React and Mithril are faster than Angular, because they use virtual DOM. Angular's public API interface is much bigger than React's or Mithril's. React does not have routing and AJAX requests in its core library, so it depends on other libraries. I choose Mithril for this project, because it is self-contained, so it does not have to depend on other libraries. It has utilities built-in for routing and AJAX requests. And it has a small API with great documentation.

***Bence*: - 4 és 5 között hiányzik számomra az a rész, ahol az implementáció _előtt_ lefekteted azokat a kritériumokat, amik alapján "elfogadott" (elfogadható) lesz a kezedből kiadott eredmény – és amit a 6/7. fejezetben tesztelsz.**

4.6 Supported Web Browsers

[31] [4] [3].

4.7 Frontend System Design

*****TODO***: frontend ábra visioban**

Chapter 5

Graphic Design

In this thesis I present the implementation of the student module. In the student module I will implement the following features in priority order:

1. see general informations about the classes
1. see the results
2. list of commits and tagging a commit as final version
2. set new password, e-mail and SSH public key
3. summarized view of student's grades

The features with priority level 1. are mandatory, because without these features the portal will be useless for the students.

The features with priority level 2 are important, but the portal is not useless without it. The students can still tag a commit with a Git client, or merge the final commit with the master branch to make it the master branch's last commit.

The features with priority level 3 are not important, but can be useful for the students. The portal is useful without this feature, because the students can check their results on the educational event's page.

In chapter 7 I will test the features with priority level 1 and 2.

5.1 Design Sketches

To be able to draw design sketches, we need to know when will a user login to use the Educational Support System and what kind of informations is he looking for. As a student, there are 5 possible scenarios:

1. Before a laboratory
    - To get informations about the laboratory
        - When will it be
        - Where will it be
        - Who will be the teacher

- To read general informations about the course

2. During a laboratory
    - To upload an SSH public key
    - To get his Git remote URL
3. After a laboratory, before deadline
    - To see the date of the deadline
    - To see how much time is left until the deadline
    - To see the pushed branches, commits and tags
    - To tag a commit as final version
4. After a laboratory, after deadline
    - To check his grades
    - To check his reviews
    - To check the evaluator's name
5. Other scenarios
    - To set a new e-mail address
    - To set a new password
    - To change his mailing list subscription
    - To change his e-mail notification subscription
    - To see a summarized table of his grades

With the scenarios and list of actions, we can see how many pages is needed for the student modules and how many states will one page have.

Before laboratory: For these informations I will use only labels (see figure 5.1).

During laboratory, after laboratory and before deadline: For the informations, like deadline and entry test grade I will use labels. For the list of commits I will use a dropdown menu. When the page is loaded, the last final commit will be the chosen one. If the user did not chose a final commit before, the last commit in the master branch will be the chosen one (see figure 5.2).

After laboratory and after deadline: For these informations I will use labels. The reviews can be long, and I want to keep the design simple. Because of this, there will be a size limit for the label on the view, and the rest of the text will be hidden with an ellipsis. The user can click on the text to show the rest of the review in a pop up window (see figure 5.3).

Other scenarios: The new e-mail address, password and SSH public keys will have input fields. The subscription will be changeable with check boxes (see figure 5.4). The summarized view will be a simple table with the grades in it (see figure 5.5).

Menu: Because the user is looking for a specific set of information, the page will only contain the important informations, and the previous, but still relevant informations will be accessible with tabs on the laboratory page. To be able to switch between the pages, I will use a navigation bar on the top of the page. The bar will have the logo of the portal and one button for each pages.

I drew sketches (see appendix C) for every state with placeholder data.

5.2 Design template

To show only a specific set of information I have decided to use a minimalist design. A minimalist design is a clear design, focusing on typography, space, color and basic design elements. This way the portal will show as much information as the user needs with as few elements as possible.

To look for templates and ideas I read the Designmodo blog [6] and checked all the popular websites, e.g., Facebook, Github, Twitter and Medium. Designmodo also have purchasable website builders, like Slides [7], but I prefer the simple design of the Bootstrap elements [36].

Bootstrap is a free and open source HTML, CSS and JS framework to create responsive design. It was originally a part of Twitter as Twitter Blueprint, but in 2011 it was released as an open source project. Bootstrap contains elements for responsive web design and mobile design. Bootstrap 4 alpha was launched in August 2015 alongside with a new side project, Official Bootstrap Themes [37]. Bootstrap Themes are purchasable redesigned collections of Bootstrap components with new components and plug-ins. Although I really like these themes, I will use the free components, because it does not worth buying any theme if I will change some parts of the included components.

5.2.1 Colors

After deciding what kind of design framework will I use, I had to chose the colors of the portal. Both the Budapest University of Technology and Economics [32] [33] and the Faculty of Electrical Engineering and Informatics [34] [35] have their own Visual Identity Guidelines. A visual identity guideline contains the description of which color is the official color of the institution and in what kind of text which fonts and why that font should be used.

I consulted with my advisor, Sándor Gajdos and he told me that I should not follow any of these visual identity guidelines. Following any of the strict guidelines can be a problem in the future, if anyone would like to use this portal for another course that does not belong to the faculty or the university. Based on a subjective opinion I have decided to use green as the main color of the portal. I used the Google Color palette [15] to choose a nice green, changed it a bit, and I got the final color, #2a623d.

5.3 The Creation of the Graphic Design

As the first step I created a basic HTML page. An HTML page has a head and a body section. All the meta data belong to the head section, and anything I want to display on the page goes to the body section.

In the head section I included a charset option and set it to utf-8 for Unicode character encoding. I added one more important meta data, the *http-equiv="x-ua-compatible"*. I use this meta tag to force Internet Explorer to render in the highest available mode [31] [4]. This solves the problem, that Internet Explorer wanted to open the website in IE10 Compatibility Mode. I also included a title and linked the main CSS file in the head section.

In the body section I created an empty div with an id. I render the pages into this div. After this div, I included the main JavaScript script. I had to put this after the

div, because I render the website with JavaScript, and I can only add components to an element, that has finished rendering.

As the main CSS file I concatenate the Bootstrap CSS file with my own CSS file, called *laboradmin.css*. In the *laboradmin.css* file I overwrite some parts of the Bootstrap CSS, to make some components to have a different appearance than the basic Bootstrap appearance, e.g., background colors and border visibility.

As the main JavaScript file I concatenate all the JavaScript files into one file. This includes the followings: the shim file, because Mithril relies on some features what are not part of the previous Internet Explorer versions, the Mithril framework's minimized JavaScript code, the Bootstrap JavaScript file, because for some components I have to use their JavaScript code, and jQuery, because Bootstrap depends on jQuery.

I separated my JavaScript files based on if it is a part of the model's, the controller's or the view's code. I use MSX in my view codes. To make the inline HTML-like syntax more simple, I created different widgets, and use them as HTML tags. To build a page the followings are needed: a page, that contains the menu and the panel, a panel, that contains all the widgets, and the widgets that contain the basic HTML elements. The MSX transformer converts this HTML-like syntax into Mithril JavaScript code during the concatenation. In the HTML-like code, I add classes for every element. These class attributes will make the element's style look equal. Every class's style is defined in the CSS files.

The controllers load the necessary data from the server and store it in the model. The views will load the data from the model. Because I did not want more dependencies for the project I decided to implement a simple JavaScript class as the model.

For concatenation I use a gulp script. In this script I use gulp tools to concatenate and minify CSS, JS and HTML files and move them to the dist folder (see chapter 8).

5.4 Final Graphical Design

*****TODO***: popup screenshot ***TODO***: életlenséggel valamit csinálni kell**

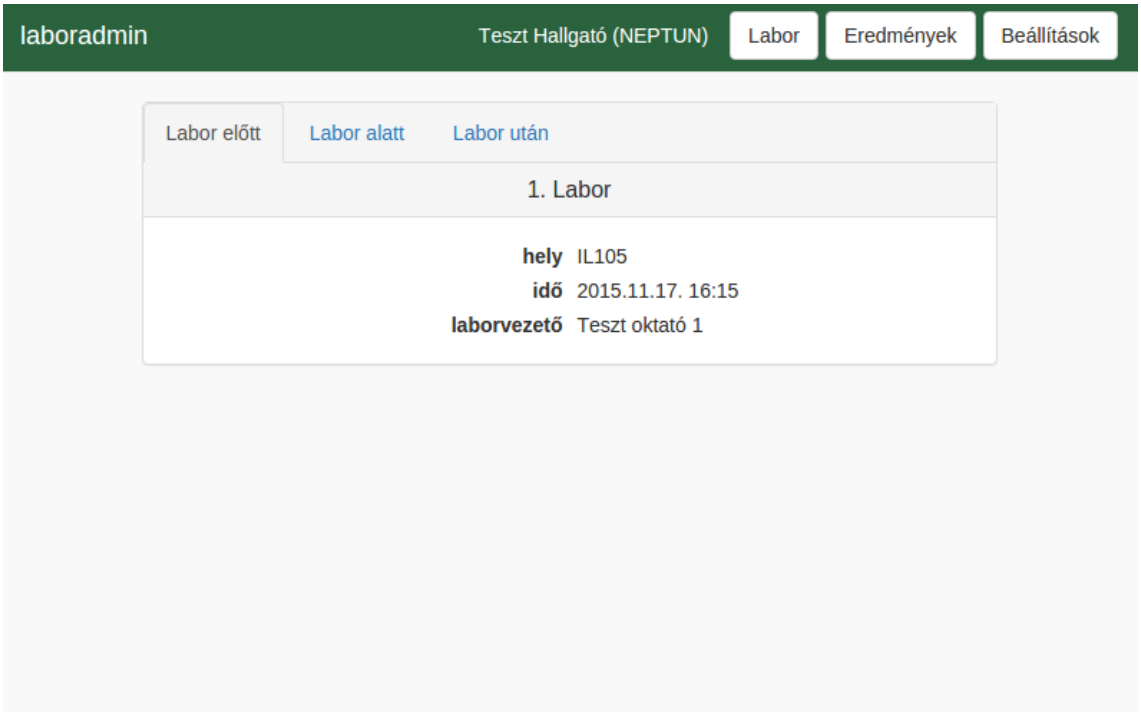

Figure 5.1. Before laboratory

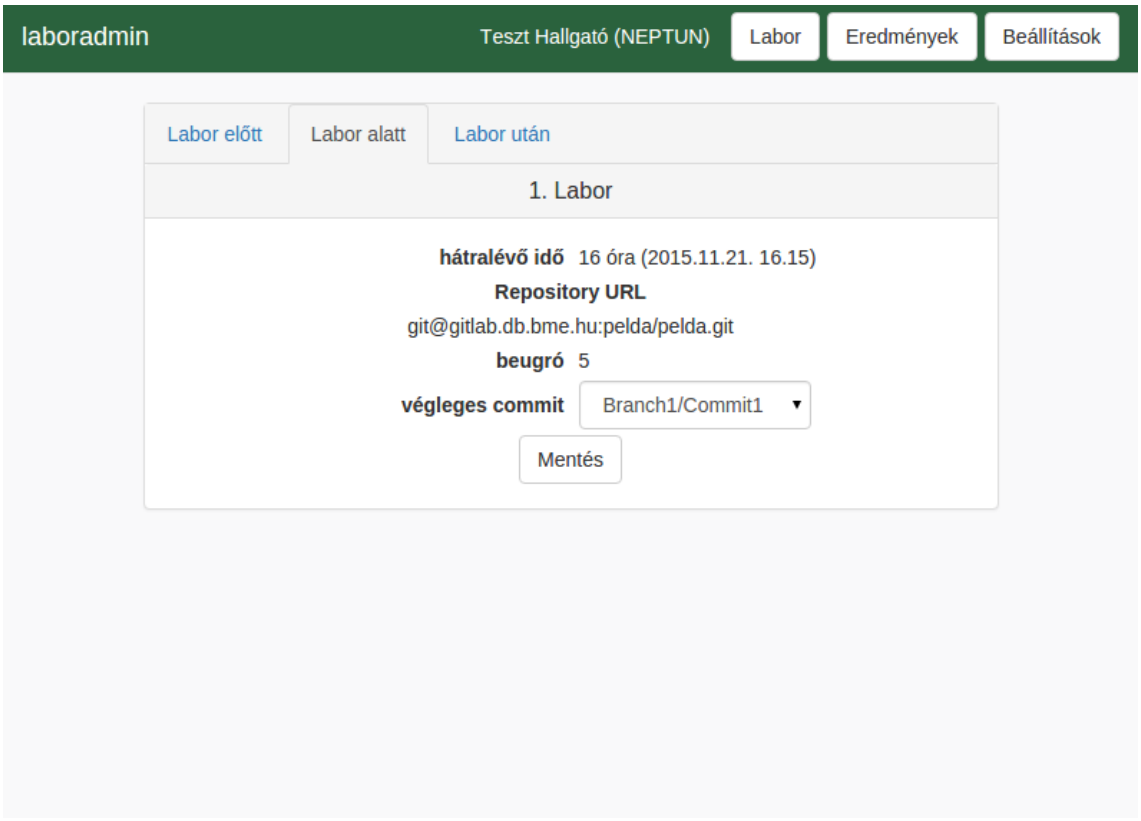

Figure 5.2. During laboratory

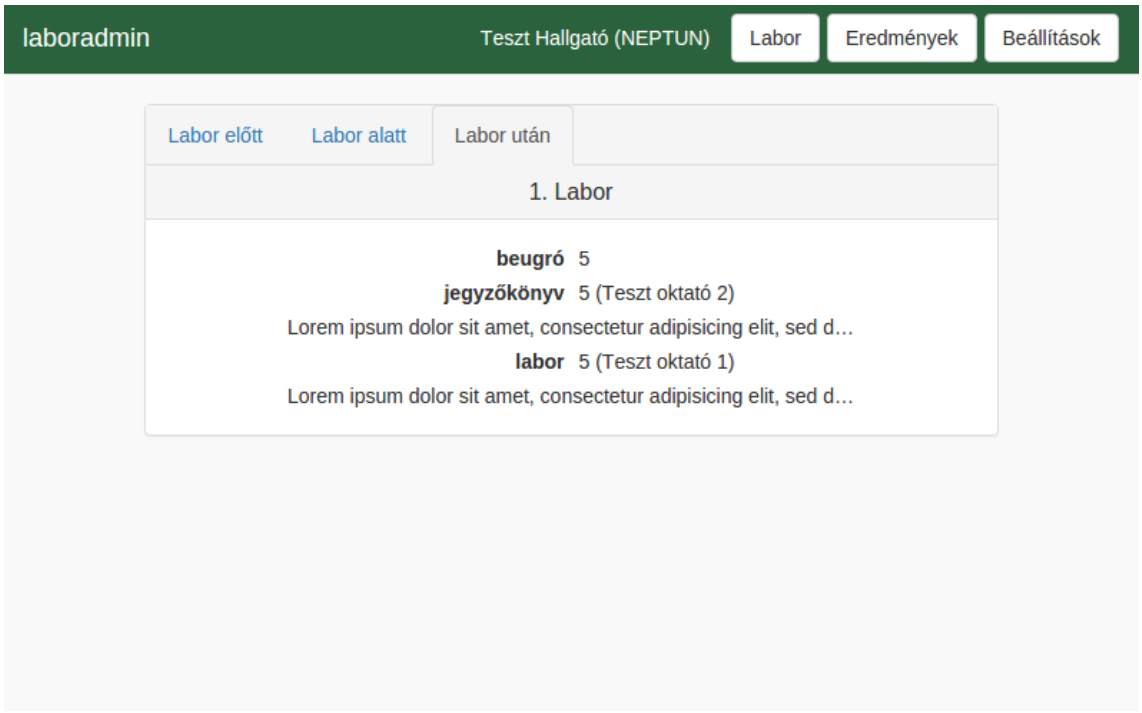

Figure 5.3. After laboratory

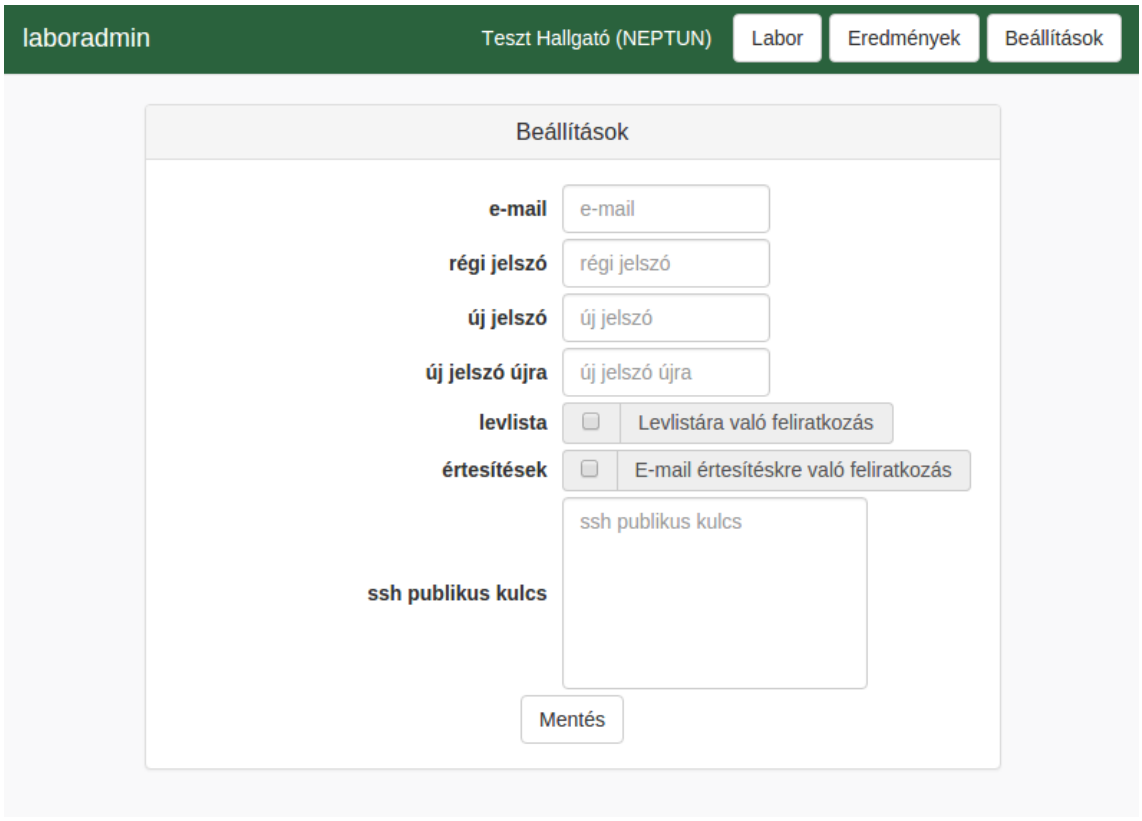

Figure 5.4. Settings

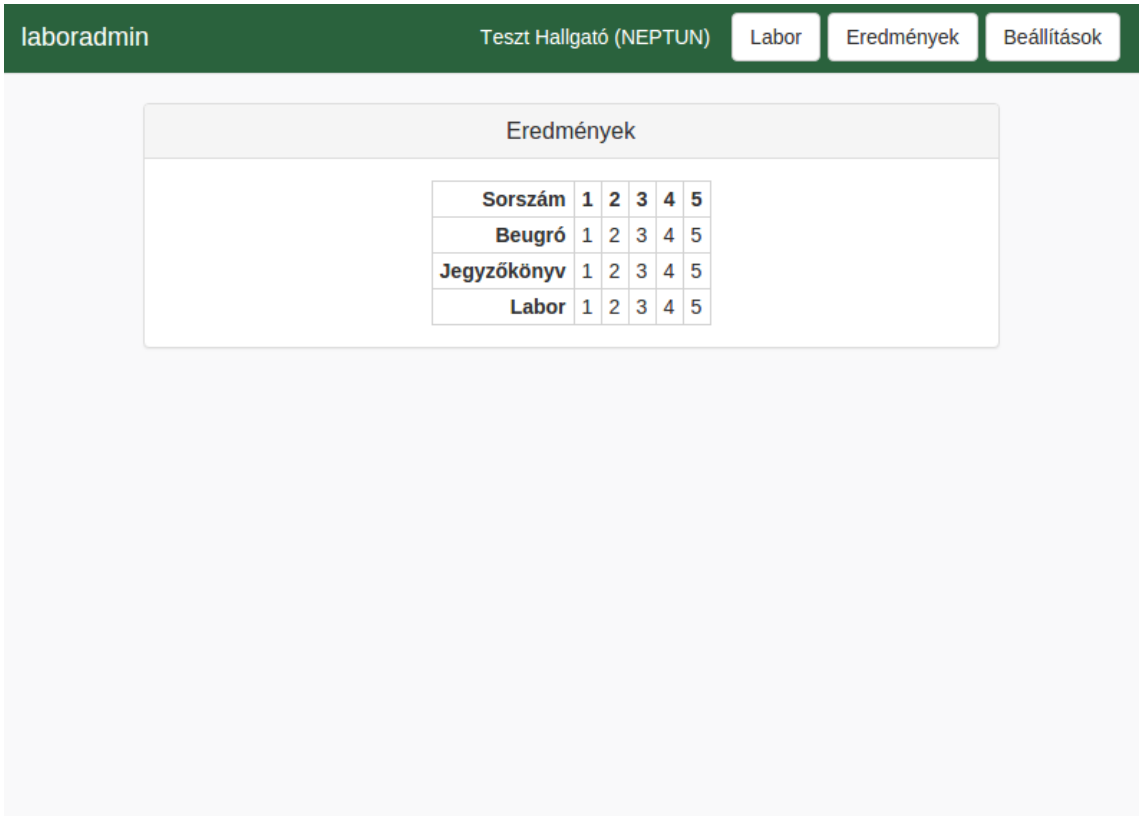

Figure 5.5. Summarized results

Chapter 6

Implementation

6.1 verziókezelés

6.2 mire figyeltem a kódolásnál

6.3 tooles, open source projektek

6.4 kód metrika

6.5 teszt lefedettség

6.6 eredmény

kód hol érhető el, melyik commit verziót mutatom be, gulp

Chapter 7

Test

7.1 Cucumber Tests

szerver oldali api felületek definiálása automata teszthez
automata rendszert keresni - drakov, api blueprint
teszt környezet leírása és használata

Chapter 8

Deployment

hogy érhető el az az állapot, hogy a fájlok összeállnak -> gulp

Chapter 9

Conclusion

9.1 mit értem el

9.2 további tervek

Acknowledgements

leírni, hogy mindenkit nagyon szeretek.

List of Figures

List of Tables

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Appendix A

Data Dictionary

The data dictionary describes the meaning of the words and terms used in the Educational Support System and the Software Laboratory 5 course. To search synonyms and write definitions I used an online synonym dictionary [9], and an online explanatory dictionary [8].

- **Administrator** A person, who is responsible for running the administration system.
- **Course, subject** A program of instruction in a university.
- **Demonstrator** A person, who teaches a group of students.
- **Entry test, short test, quiz** An evidence that verifies the preparedness of the student.
- **Entry test grade, mark** A number indicating the quality of the student's preparedness.
- **Evaluator** A person, who evaluates the laboratory reports.
- **Event, educational event** An educational event is a class with a date for students to participate.
- **Exercises, tasks** A list of exercises that provides experience to a student with a technology.
- **Laboratory** A type of class held in a computer laboratory by a demonstrator to a group of students.
- **Laboratory grade, mark** A number indicating the quality of the student's laboratory work.
- **Laboratory report, documentation** The documentation about how the student solved the list of exercises.
- **Review, remark** The evaluator's assessment of the quality of the solutions and submitted materials.
- **Semester, term** Half of a school year, lasting about five months.
- **Source code** The program code written by a student to solve a list of exercises.
- **Student, pupil** A person, who is responsible for running the administration system.

Appendix B

User Stories

Feature: Student module

As a student
I want to get informations about my laboratories
to know where to upload my homework
And read the remarks of my homeworks
And change my basic settings

Before laboratory:

Background:

Given a student named "Jakab"
And his password and username are entered in the login fields
And it is one day before the laboratory
And a finished homework uploaded to the Git repository

Scenario: Getting informations about the next laboratory

Given I open the Laboradmin page
When I press the login button
Then I should see the date of my next laboratory
And I should see the room number of my next laboratory
And I should see the name of my teacher

During laboratory:

Background:

Given a student named "Jakab"
And his password and username are entered in the login fields
And he is sitting at the laboratory

Scenario: Getting a Git remote URL

Given I open the Laboradmin page
When I press the login button
Then I should see a Git remote URL

Scenario: Check how many hours I have left

Given I open the Laboradmin page
When I press the login button
Then I should see a timer with a number between 96 and 92

After laboratory, before deadline:

Background:
Given a student named "Jakab"
And his password and username are entered in the login fields
And it's one day before the deadline
And a finished homework uploaded to the Git repository

Scenario: Getting a list of Git commits
Given I open the Laboradmin page
When I press the login button
Then I should see a list of branches, commits and tags

Scenario: Check how many hours I have left
Given I open the Laboradmin page
When I press the login button
Then I should see a timer with a number between 24 and 0

Scenario: Marking a commit as final
Given I open the main page
And I see a list of branches and commits
When I click on one of the commit in the list
Then I should see "The commit was marked as final."

Scenario: Removing a final mark
Given I open the main page
And I see a list of commits
And one commit is already marked as final
When I click on the master branch in the list
Then I should see "You have succesfully removed your final mark."

After laboratory, after deadline:

Background:
Given a student named "Jakab"
And his password and username are entered in the login fields
And it's one day after the deadline

Scenario: Getting my grade and review
Given I open the Laboradmin page
When I press the login button
Then I should see my grade and review

Other situations:

Background:
Given a student named "Jakab"
And his password and username are entered in the login fields

Scenario: Getting a summarized list of my grades
Given I am logged in as "Jakab"
When I press the summary button
Then I should see all of my grades

Background:
Given a logged in student named "Jakab"
And the settings page is loaded

Scenario: Setting a new SSH public key
Given I am logged in as "Jakab"
And I have entered a new SSH public key
When I press the save button
Then I should see "Your settings have been saved."

Scenario: Setting a new e-mail address
Given I am logged in as "Jakab"
And I have entered a new e-mail address
When I press the save button
Then I should see "Your settings have been saved."

Scenario: Changing my subscription for the mailing list
Given I am logged in as "Jakab"
And I clicked the checkbox next to "Subscription for mailing list
When press the save button
Then I should see "Your settings have been saved."

Scenario: Changing my subscription for notifications
Given I am logged in as "Jakab"
And I clicked the checkbox next to "Subscription for notification"
When press the save button
Then I should see "Your settings have been saved."

Appendix C

Design Sketches

I didn't use a tool, because the design is not standardized, and it's easier and faster drawing by hand then by a tool.

*****TODO***: szebben lerajzolni vonalzóval!!!!! vagy megcsinálni az egészet egy tool-lal, mert ez így csúnya és nem azért, mert nem tudok rajzolni, hanem mert scannelve van**

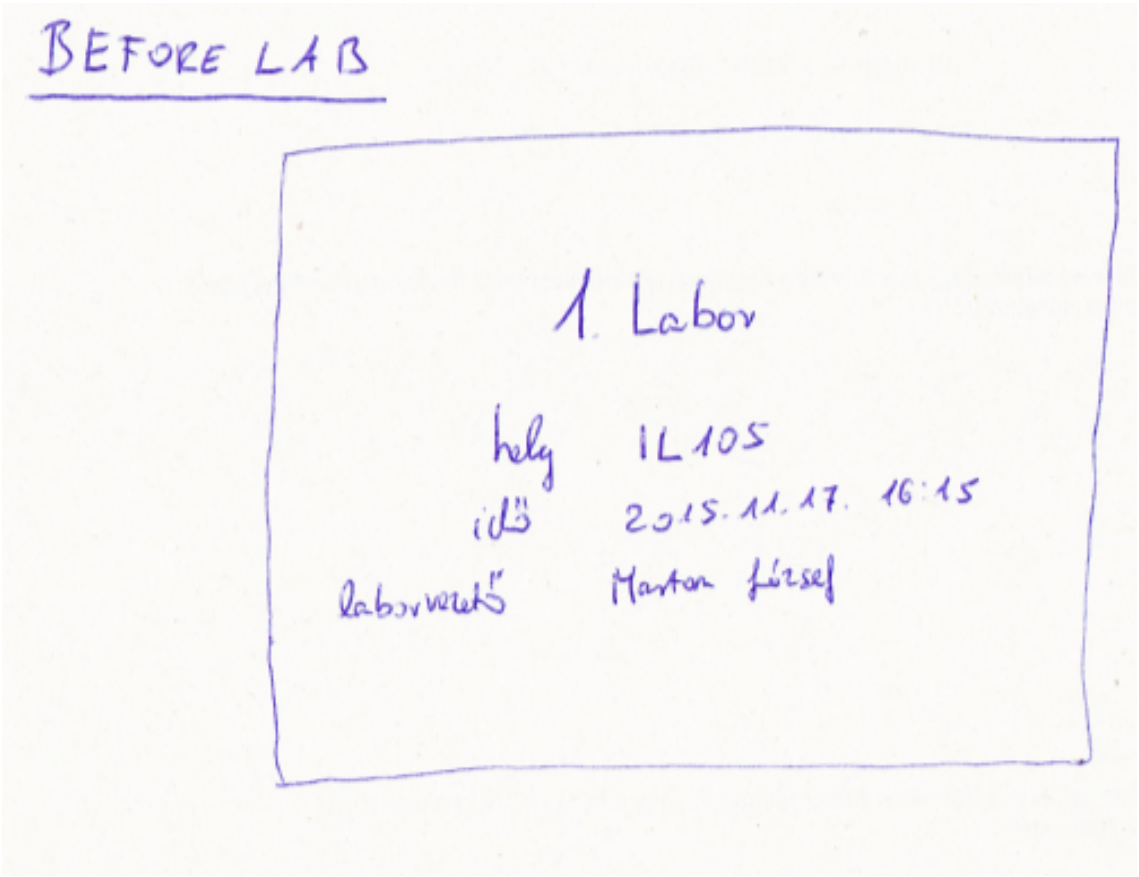

Figure C.0.1. Laboratory page sketch, before lab

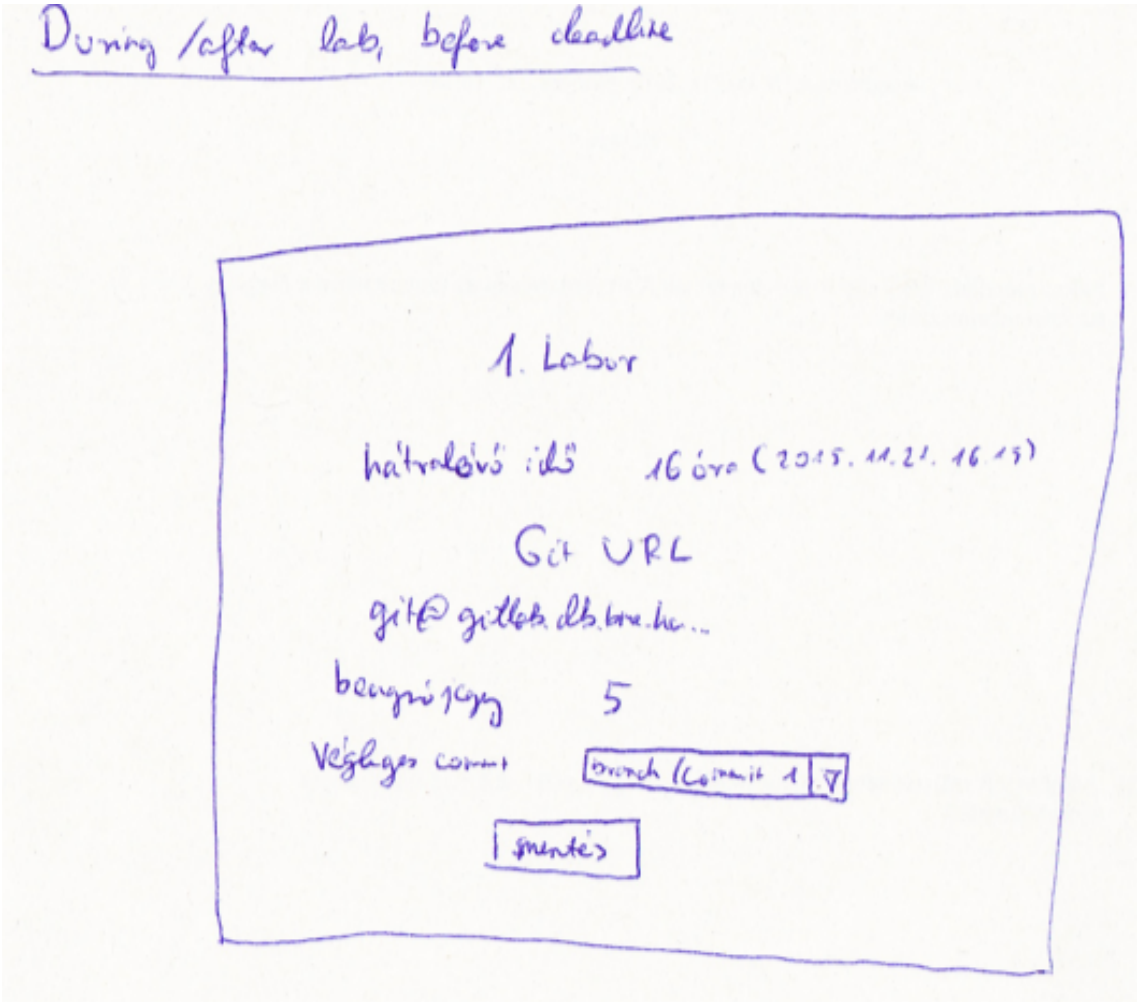

Figure C.0.2. Laboratory page sketch, during/after lab, before deadline

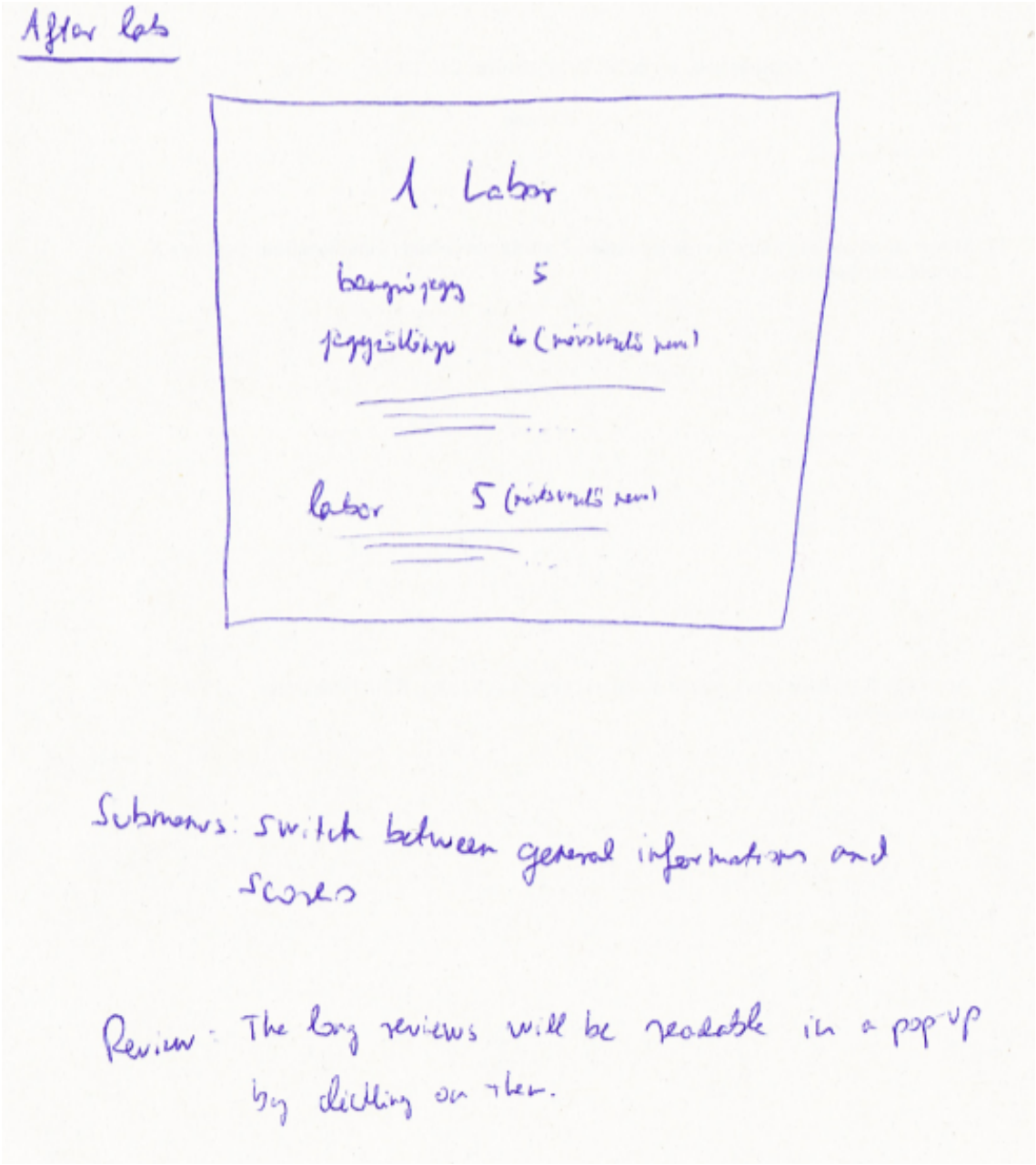

Figure C.0.3. Laboratory page sketch, after lab

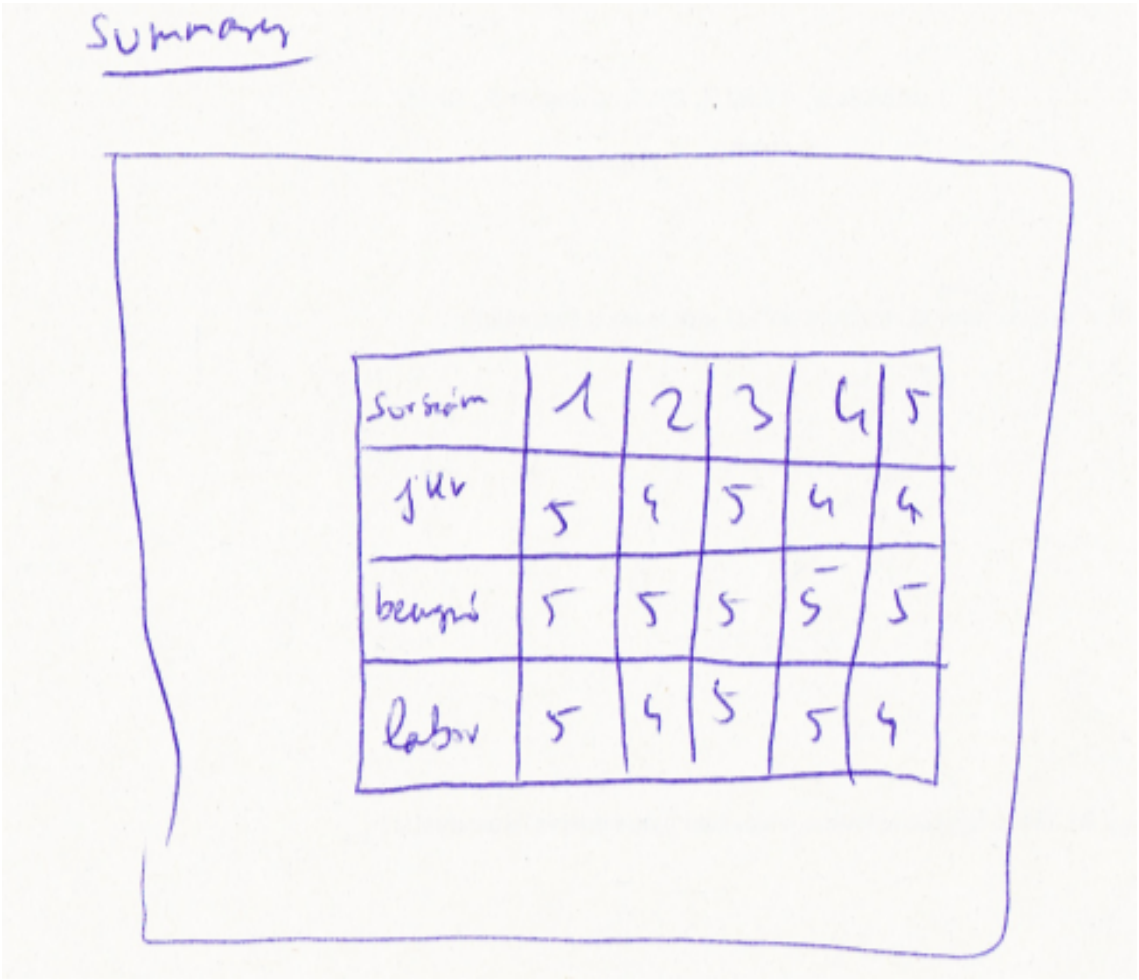

Figure C.0.4. Summary page sketch

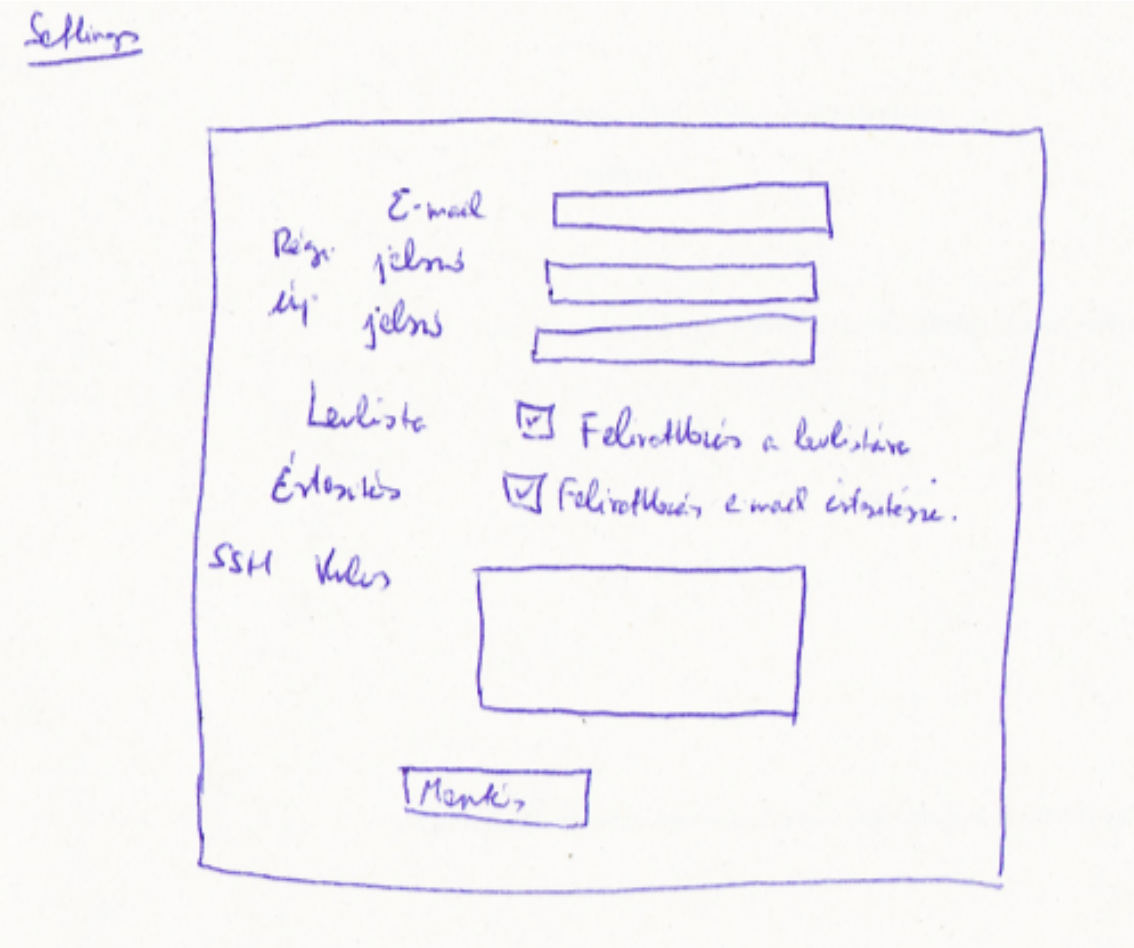

Figure C.0.5. Settings page sketch