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**TRABAJO FIN DE GRADO**

**Desarrollo e implantación de aplicaciones web para la gestión  
de recursos**

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# **Desarrollo e implantación de aplicaciones web para la gestión de recursos**

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## **Resumen (castellano)**

Este Trabajo Fin de Grado consiste en la creación de una aplicación que se añade a la Intranet de la EPS-UAM para la gestión de tutorandos y espacios. Se deciden realizar esta nueva aplicación ya que la Intranet no contaba con las funcionalidades y, debido a ello, la gestión de tutorandos y espacios se realizaba enviando un documento, cumplimentado por el tutor, que debía llegar a distintas personas y casi siempre terminaba en el olvido con lo que los tutorandos no se daban de alta en la Intranet hasta mucho después de que los profesores realizasen la solicitud. Era un sistema muy tedioso y poco fiable. Con esta nueva aplicación las tareas se realizan de una manera sencilla, rápida y asegurando la información.

Para llevar a cabo cada una de estas páginas se ha trabajado con una base de datos relacional que almacena la información necesaria para las gestiones de las páginas mediante el lenguaje SQL.

Las páginas se han programado utilizando ASP.NET para la interfaz de usuario y C# para la lógica funcional. Se ha trabajado con Visual Studio para la creación, ejecución y depuración de las páginas.

Una parte del proyecto consiste en el envío de correos de forma automática y semanal para lo cual se ha utilizado scripting de PowerShell y el Programador de Tareas de Windows.

Para comprobar el correcto funcionamiento de las páginas se han realizado pruebas de verificación e integración, utilizando el depurador de Visual Studio; pruebas de validación, trabajando sólo con el navegador web; y pruebas de aceptación por usuarios finales, en las que se han publicado las nuevas páginas en la Intranet y se ha permitido que los usuarios accedan a ellas.

## **Palabras clave (castellano)**

Intranet, páginas web, gestión, tutorando, tutor, EPS-UAM, solicitud, vinculación de trabajo, laboratorios, asignación.



## **Abstract (English)**

This Bachelor Thesis consists on the creation of a new application for the EPS-UAM's Intranet used for the management of tutees and spaces. This application has been done because the Intranet didn't have these functionalities. Because of this, the management of tutees and spaces was done sending a document, filled by the tutor, which had to reach different people and almost always ended up forgotten, so the tutees weren't registered in the Intranet until much later. This system was very tedious and not very reliable. With this new application, the tasks are done in a fast and easy way, always making sure the information is not lost.

To carry out the creation of each of the pages that make this application we worked with a relational database which stores the necessary information for the management of the pages using SQL language.

The pages have been programmed using ASP.NET for the user interface and C# for the functional logic. Visual Studio has been used for the creation, execution and debugging of the pages.

One part of the project consists on sending automatic emails every week, we used PowerShell scripting and the Windows Task Scheduler for this part.

To check that the pages worked correctly we carried out verification and integration tests, using the Visual Studio debugger; validation tests, working only with the web browser; and acceptance tests by final users, in which the pages were published in the Intranet and the users could access them.

## **Keywords (English)**

Intranet, web pages, management, tutee, tutor, EPS-UAM, request, job assignment, laboratory, assignment.





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*Finally, I want to thank my family and friends, who supported and encouraged me throughout my years of study and through the process of developing and writing this thesis.*



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# 1 Introduction

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## 1.1 Motivation

The Intranet used in the EPS-UAM until September 2016 was not very reliable and had a structure difficult to manage. This situation complicated the professor's and administrative staff's work.

Because of this, a new Intranet was created from scratch. In this new Intranet the users can do different things depending on their role in the EPS-UAM. Users have access to functionalities such as booking spaces and materials, modifying class schedules, assigning professors to classes, etc.

The old Intranet made the process of registering a person (tutee) in the EPS-UAM's database and assigning them a space to work at very complex. It had to be done by sending a document with the tutee's information to [laboratoriosinvestigacion.eps@uam.es](mailto:laboratoriosinvestigacion.eps@uam.es) asking to register them. The people from "Laboratorios de Investigación" had to send this document to [soporteweb.eps@uam.es](mailto:soporteweb.eps@uam.es) where the webmaster or the web interns had to register this new person into the database. If the document wasn't filled correctly, the professor who asked for the registration had to provide the missing information so something as easy as registering someone into the database turned into something long and tedious.

This project was proposed because of this complicated and difficult situation, to speed up and simplify the process of registering a tutee and assigning them a space to work at.

## 1.2 Objective

The objective of this thesis is to create an application for the new Intranet with which professors can register new tutees into the database, indicating their job category in the EPS-UAM and assigning them a desk to work at in a research laboratory without having to fill in any document or having to wait.

The new process of assigning a new desk starts with the tutor asking for it. After that, this request has to be authorized or denied by the research laboratory's supervisor since each laboratory has its own supervisor, who is in charge of managing the laboratory.

Furthermore, there is a page in which any desk in any space in the EPS-UAM can be assigned to any person with a job registered in the database, as long as it is an active job. Only the people with the role of Space Management can access this page.

### **1.3 Document's Organization**

This document has the following chapters:

- **Chapter 1, Introduction:** this chapter explains the motivation and the objective of this bachelor thesis.
- **Chapter 2, Project Analysis:** in this chapter, the project, the data model used and the essential requirements, functional and not, are defined.
- **Chapter 3, Design:** this chapter shows the architecture of the project, as well as the navigation map.
- **Chapter 4, Development:** in this chapter the implementation is shown and the technologies used are detailed. The developed pages are also displayed.
- **Chapter 5, Integration, Tests and Results:** this chapter describes the tests performed on the project.
- **Chapter 6, Conclusions and Future Work:** this chapter presents the conclusions, the acquired knowledge and the possible future actions of the project.



## 2 Project Analysis

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### 2.1 Project Description

As it was shown in the previous chapter, this project involves creating a new application for the EPS-UAM's Intranet, destined to manage tutees and spaces.

#### 2.1.1 Division into Subsystems

Using the project's description, four main functional groups can be differentiated:

- **Subsystem 1, Registering and Managing Tutees:** allows the registering of tutees into the database, giving them a job category, assigning them a desk to work at and managing all of the user's tutees.
- **Subsystem 2, Management of Research Laboratories:** allows the management of one or more research laboratories by their supervisor.
- **Subsystem 3, Visualization of Research Laboratories:** allows the Department Management members access to view the state of the research laboratories associated to their department.
- **Subsystem 4, Space Management:** allows the management of all the spaces in the EPS-UAM by the staff of Space Management.

#### 2.1.2 User Roles

In this project there are four main user roles according to the functionalities to which they have access:

- **PDI:** Teaching and Research Staff from the EPS-UAM. These users can access the pages to register a new tutee and management of their tutees.
- **Gestor de Laboratorio de Investigación:** EPS-UAM professors with the role of research laboratory supervisor, they can access the page to manage laboratories.
- **Dirección de Departamentos:** Department Management members of each department in the EPS-UAM (II and TEC). They have access to the page where they can view the laboratories.
- **Gestión de Espacios:** Administrative staff with the role of Space Management. These users can access the page of space management.

## 2.2 Data Model

A relational database in SQL language was used for the storage of the information needed for the pages in this project. This allows for the simplification of the development and testing of the pages.

### 2.2.1 Entity-Relationship Diagram

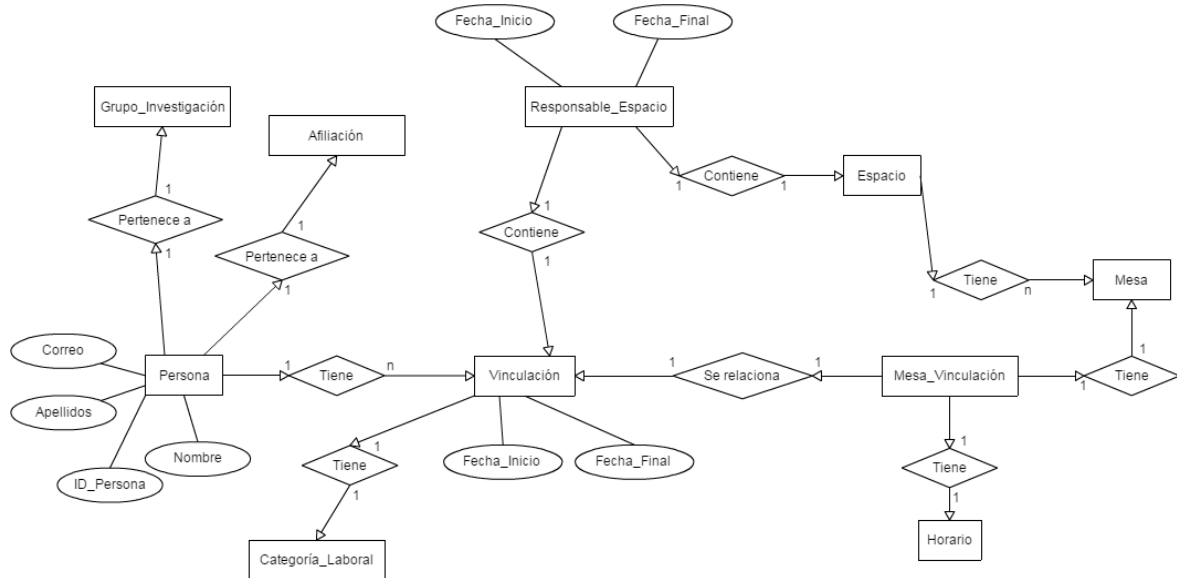


Figure 2-1: Entity-Relationship Diagram of the database

As can be seen in the Figure 2-1, the project uses a series of tables to have everything very modulated and separated.

This project uses ten tables, of which the most important are:

- The table **Persona** contains all the personal data of the people who have access to the Intranet; some of this data is encoded.
- The table **Vinculación** has the information about the jobs the people in the table **Personas** have, having the job category in the table **Categoría\_Laboral**.
- The table **Mesa\_Vinculación** stores the data of the desk assignments of the people in the Intranet using their job and having their work schedule in the table **Horario**.
- The table **Espacio** has all the important data of every space in the ESP-UAM and is associated to the table **Mesa** which has the data of every desk in each space.
- The table **Responsable\_Espacio** contains the information about the space management, associating a space from table **Espacio** with the supervisor's job from table **Vinculación**.



**Main course:**

1. Once the user has logged in, they have to access the menu item “PDI” and in the new menu choose the item “Alta Tutorando”.
2. In the first page, the user has to introduce the personal information of the tutee such as name and last name, email and identity document. After introducing all the information, the user must press the button “Siguiente”.
3. In the second page, the user has to choose the job category of the tutee, changing the beginning and end dates so that they match the dates of the tutee’s job and press the button “Dar de alta”.
4. In the third and last page, the user has to ask for a desk assignment for the tutee. This is done by filling in all the necessary data and pressing the button “Solicitar puesto de trabajo”.
5. When the user requests the desk assignment for the new tutee the application sends an email to the research laboratory’s supervisor to notify about the request.

**Alternate courses:**

- 2.a If the tutee has already been registered in the database, the tutor has the possibility of choosing that person from a list of people in the database. The personal information will be filled automatically.
- 3.a If the user has Catedrático, Titular, Titular Interino, Contratado Doctor, Contratado Doctor Interino or Ayudante Doctor as job category there will be a previous page in which the user can choose between assigning the tutee a job as intern or PDIF (Teaching and Research Staff in Training).

**2.3.2.2 Use Case 2: Assigning a Desk from the Role of Research Laboratory Supervisor****Primary Actor:**

Gestor de Laboratorio de Investigación (people with a research laboratory supervisor category).

**Stakeholders and Goals:**

Gestor de Laboratorio de Investigación: this user makes sure that each person is in the right desk in the laboratory.

PDI: this user has requested a desk assignment for a tutee and is waiting for an answer.

**Preconditions:**

The user must be registered in the Intranet and must have logged in.

A PDI has to have made a request for a desk assignment or from Space Management a desk 0<sup>1</sup> has been assigned to someone.

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<sup>1</sup> A desk 0 is a virtual desk used to request a desk assignment in a space.

**Success end conditions (Postconditions):**

The user has authorized a desk assignment and the information was stored in the database.

**Main course:**

1. After logging in, the user has to access the menu item “Gest. Lab. Investigación” and in the new menu choose the item “Gestionar Laboratorios”.
2. In the page that appears, the user has to go to the table labelled “Personas pendientes de asignar mesa” and choose the person to whom to authorize the desk assignment.
3. Once the person has been chosen, the user has to decide and select the desk to assign from a list of desks in the laboratory. To check which desks are free and when, the user needs to look at a box at the beginning of the page in which all the updated information of the laboratory is.
4. Once the desk has been selected, the user just has to press the button “Autorizar” and the assignment will be authorized. The page will refresh and the new assignment will be shown in the box at the beginning of the page.
5. When the user authorizes the desk assignment the application sends an email to the tutor to notify of the action.

**Alternate courses:**

- 2.a If the user is supervisor to more than one laboratory, they have to choose the laboratory to manage from a list at the very top of the page.
- 2.b If the user wants to assign an equipment desk<sup>2</sup> instead of a working desk, they have to choose that option and choose a person to be the person in charge of the desk.
- 3.a If the user wants to assign an equipment desk, they have to choose a desk to assign from the box with the information of the laboratory.
- 4.a To assign an equipment desk, the user has to introduce the beginning and end dates of the assignment and press the button “Asignar Responsable”.

**2.3.2.3 Use Case 3: Assigning a Desk from the Role of Space Management****Primary Actor:**

Gestión de Espacios (people with a Space Management category).

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<sup>2</sup> An equipment desk is a desk where there cannot be a person working, it is a desk where there is shared equipment for research.

**Stakeholders and Goals:**

Gestión de Espacios: this user is in charge of assigning desks in the spaces that don't have a supervisor.

**Preconditions:**

The user must be registered in the Intranet and must have logged in.

**Success end conditions (Postconditions):**

The user has assigned a desk to someone and the information was stored in the database.

**Main course:**

1. After logging in, the user has to access the menu item "Gest. Espacios" and in the new menu choose the item "Gestión de Espacios".
2. In the page that appears, the user has to choose a space from the list of spaces in the EPS-UAM.
3. Once the space has been selected, the user can see the desks and their assignments in a box at the beginning of the page. The user has to select a desk in this box; this desk will be the assigned desk.
4. Once the desk is selected, the user has to choose a person to assign to the desk. The person is selected from a list of people in the database currently with a job.
5. Once the person has been chosen, the user has to introduce end date for the assignment if it is different from the person's job's end date.
6. The last thing to introduce is the person's work schedule in the desk.
7. When the user has done all the previous steps, the only thing left is pressing the button "Vincular" to make the assignment. The page will refresh and the new assignment will be shown in the box at the beginning of the page.

**Alternate courses:**

- 5.a If the chosen person has more than one job category, the user has to select the job category with which to make the assignment.
- 5.b If the person selected already has a desk assignment it will be cancelled and the new desk will be assigned.
- 7.a If the user wants to assign an equipment desk, they have to choose that option and there will be no need to introduce a work schedule.
- 8.a When the user presses the button a pop up window appears asking for confirmation. If the user presses "Cancelar", the assignment is not made.

### **2.3.3 Functional Requirements**

Following are defined the functional requirements of the project, divided into the project's different subsystems.

#### ***2.3.3.1 Subsystem 1, Registering and Managing Tutees***

- *FR1*: Add a new person to the database introducing all the personal data (Name and last name, email y ID).
- *FR2*: Assign a job category to the new tutee with beginning and end dates.
- *FR3*: Request a desk assignment for the new tutee in a research laboratory associated with the research group or the department of the tutor.

#### ***2.3.3.2 Subsystems 2 and 3, Management and Visualization of Research Laboratories***

- *FR4*: See the state of a research laboratory.
- *FR5*: See the pending requests for desk assignments.
- *FR6*: Authorize or deny a request for desk assignment.
- *FR7*: Cancel an assignment.
- *FR8*: Assign a desk as equipment desk and assign the person in charge of it.
- *FR9*: Check the record of the laboratory.

#### ***2.3.3.3 Subsystem 4, Space Management***

- *FR10*: See the state of all the spaces in the EPS-UAM.
- *FR11*: Make a desk assignment.
- *FR12*: Cancel an assignment.
- *FR13*: Assign a desk as equipment desk and assign the person in charge of it.

#### ***2.3.3.4 Other***

- *FR14*: Send an email to the tutor a week before a tutee's assignment is over. With both job and desk assignments.

## **2.3.4 Non-Functional Requirements**

### **2.3.4.1 Usability**

- *NFR1*: Easy and visual design.

### **2.3.4.2 Security**

- *NFR2*: Encoding of password and ID.
- *NFR3*: Restricted access to pages so that only people with the correct job category can access them.

### **2.3.4.3 Reliability**

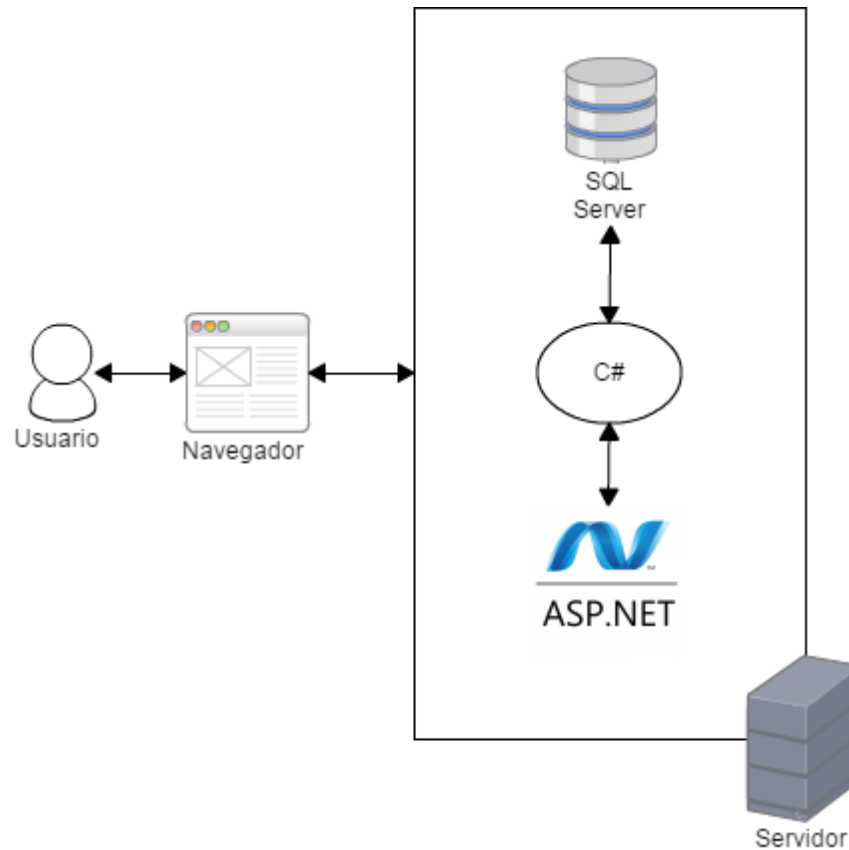
- *NFR4*: If the user tries to do something wrong the application will inform the user by showing a message in the page. The application will also show a message when the action was correct.



## 3 Design

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### 3.1 Project's Architecture



**Figure 3-1: System's Architecture**

This project has been designed following the architecture in Figure 3-1. This architecture is based on a server, in which we can find the database (in SQL Server) and the code (in C# and ASP.NET), and a web browser, in which the user can see the pages obtained from the server.

## 3.2 Sequence Diagrams

In this section the sequence diagrams for the use cases explained previously (Section 2.3.2) will be shown and detailed.

### 3.2.1 Sequence Diagram 1

In Figure 3-2 we can see how a user who has logged in can access a page to register a new tutee. After filling in all the tutee's information correctly, these are stored into the database and the application redirects the user to a new page.

In this second page, the user has to choose the job category assignment for the tutee. When the user introduces the data correctly it is stored in the database and the application redirects he user to another page.

In this new page, the user requests a desk assignment for the tutee and if the data introduced was correct it is stored in the database.

After storing the data, the application shows a message to the user informing that everything was correct and that an email was sent to the research laboratory's supervisor notifying them of the new request.

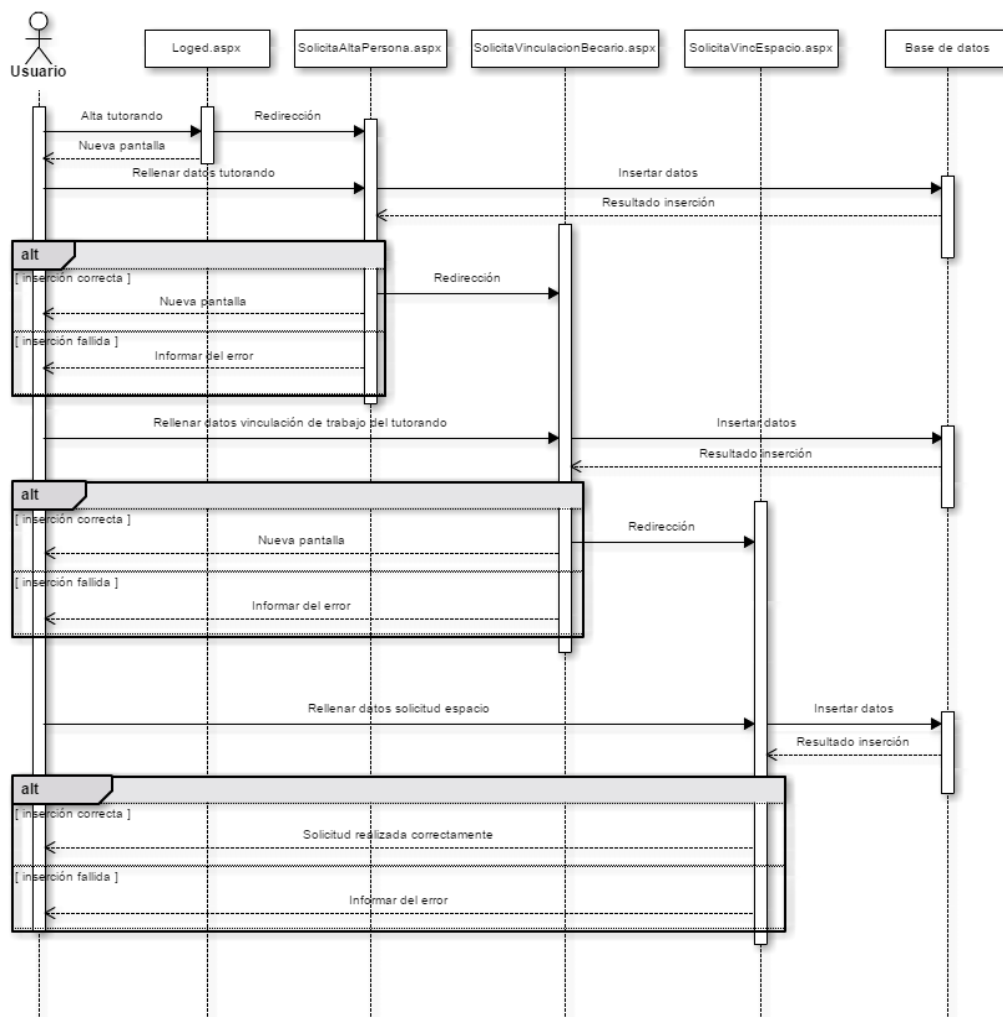


Figure 3-2: Sequence Diagram of Use Case 1: Registering a Tutee

### 3.2.2 Sequence Diagram 2

In Figure 3-3 we can see how a user who has logged in can access a page to manage research laboratories and choose the laboratory to manage between the laboratories of which they are supervisor. Once the laboratory is selected, the user can decide if they want to authorize an assignment request or assign an equipment desk.

To authorize an assignment request, the user has to choose the request from the table of pending requests, select a desk to assign and press the button “Autorizar”.

To assign an equipment desk, the user has to choose that option and after, choose a person and select the person’s job category to assign as in charge of the equipment, fill in the beginning and end dates and press the button “Asignar Responsable” after choosing a desk from the box at the beginning of the page.

In both cases, if the assignments were made correctly, the page will reload and the new assignment will be shown in a box showing the assignments of the laboratory, if not, the page will show a message indicating the error.

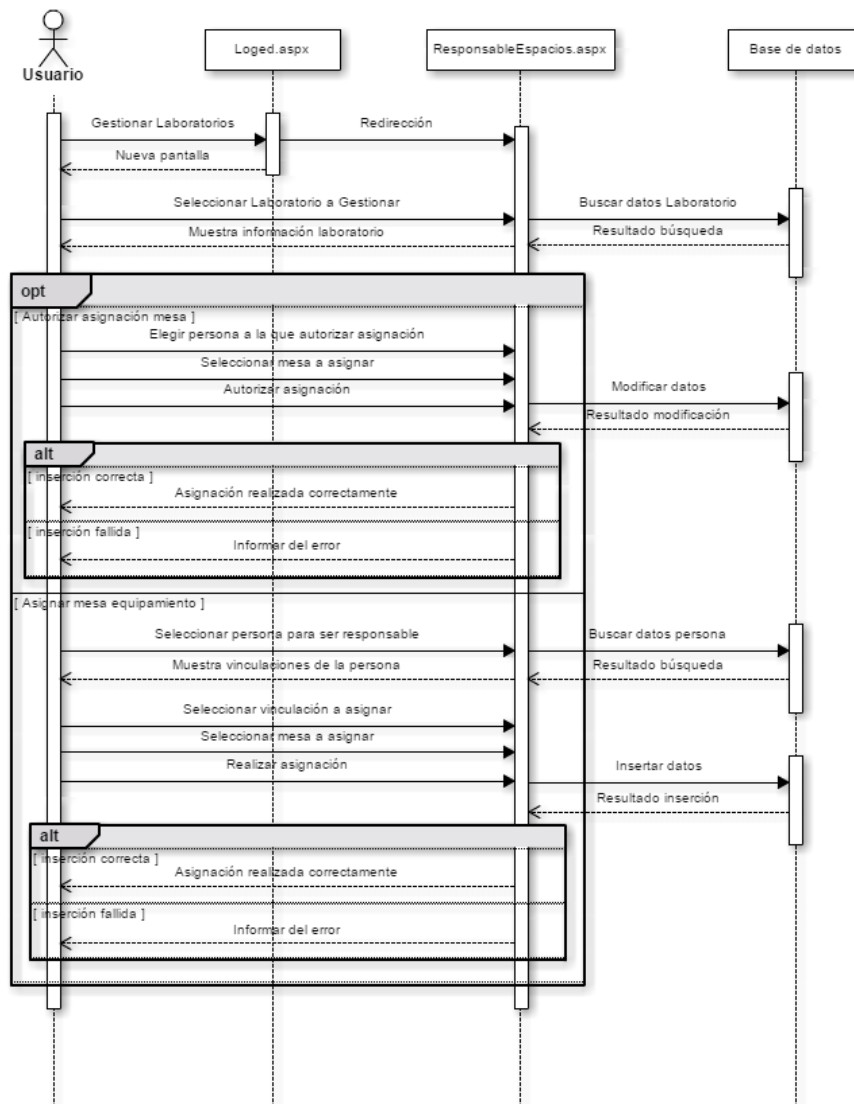


Figure 3-3: Sequence Diagram of Use Case 2: Assigning a Desk from the Role of Research Laboratory Supervisor

### 3.2.3 Sequence Diagram 3

In Figure 3-4 we can see how a user who has logged in can access a page to manage all spaces in the EPS-UAM and choose which space to manage.

Once the space is selected, the user has to choose a desk and a person, choosing a job category assignment if the person has more than one, to assign. The user has to fill in the beginning and end dates of the assignment.

After choosing all the previous things, the user has to decide if the desk to assign is a working desk or an equipment desk. If it is a working desk the user has to introduce the person's work schedule. After the choice, the user has to press the button "Vincular".

If the assignments were made correctly, the page will reload and the new assignment will be shown in a box showing the assignments of the laboratory, if not, the page will show a message indicating the error.

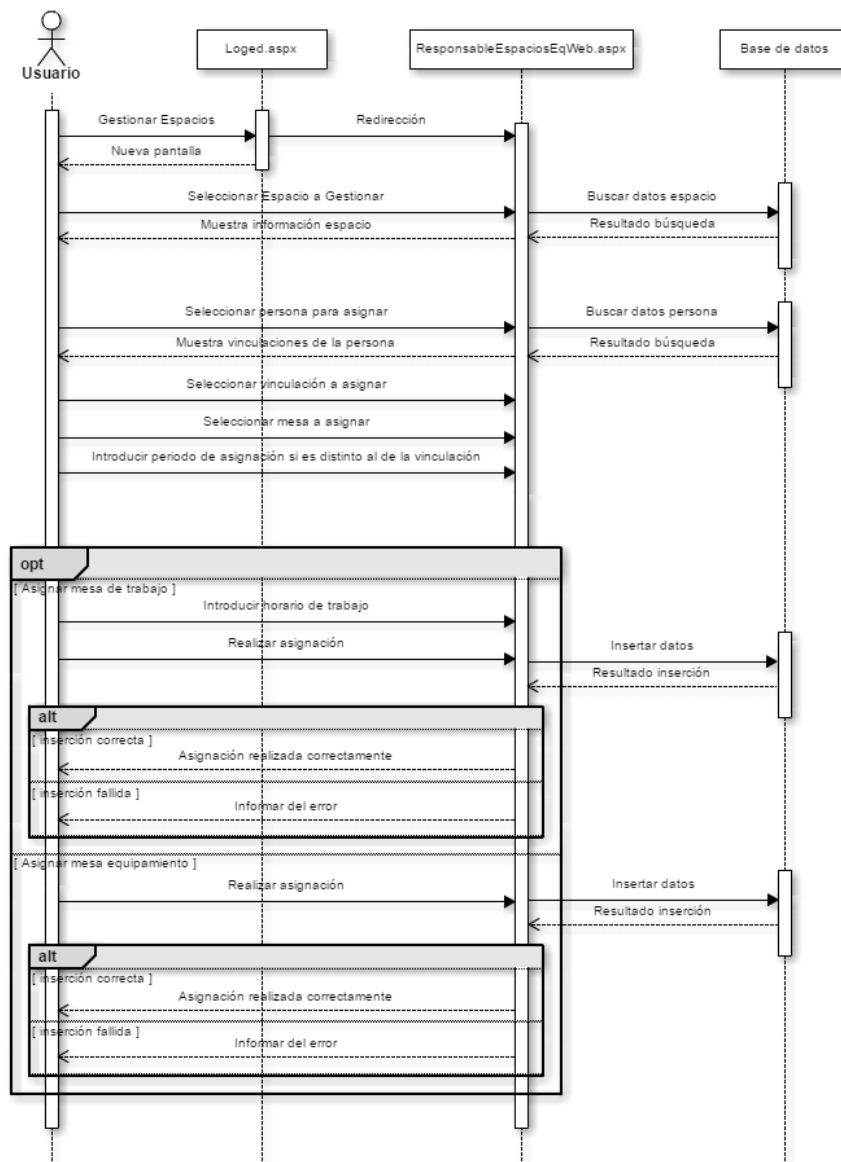


Figure 3-4: Sequence Diagram of Use Case 3: Assigning a Desk from the Role of Space Management

### 3.3 Navigation Map

In Figure 3-5 we can see four navigation maps depending on the user who accessed the application.

- The users with a PDI category can access the pages “Alta Tutorando” and “Gestionar Tutorando” and from those they can access the specific pages to introduce the tutee’s personal information, assign a job category and request a desk assignment.
- The users with a Research Laboratory Supervisor category only have access to the page “Gestionar Laboratorio”.
- The users with a Space Management category can only access the page “Gestión de Espacios”.
- The users with a Department Management category only have access to the page “Ver Laboratorios”.

As can be seen in all four navigation maps, all four users have access to a manual or guide explaining all the pages they have access to.

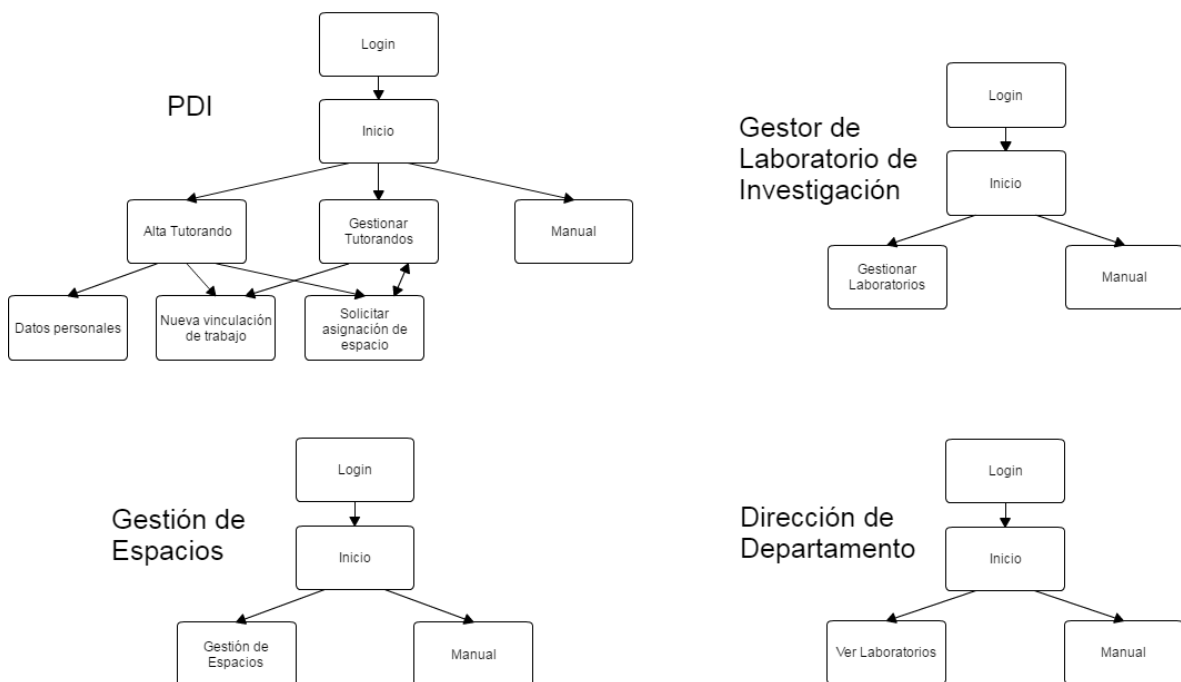


Figure 3-5: Navigation Map of the Different Users in the Project



# 4 Development

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## 4.1 Implementation

After defining the requirements and the design, the project has to be developed. For the development of this project, the pages have been done by adding the requests one by one, testing them and modifying or adding what was needed.

The development has started by understanding the database and the connections between the tables. After, the implementation of each page has been done by testing each new element separately until everyone worked correctly and, when this was done, integrating all the elements to create the complete pages with all the functionalities.

## 4.2 Technologies Used

This project has been developed using Visual Studio 2015, a development environment which helped program in an easy and modulated way, being able to compile the application and debug it in a fast and easy way.

The technologies used are below:

- C# [1, 2, 3, 4, 6]: This language was used to develop the server side of the project, working with the database and being the brain behind the user interface, showing the necessary data in each moment.
- ASP.NET, CSS and JavaScript [1, 2, 3, 4, 5, 7, 8]: These languages have been used for the design of the pages, defining the views, styles, colors, etc, for the user interface.
- SQL Server [1, 2, 9]: The database used in this project is a relational SQL Server database. The program SQL Server 2014 Management Studio was used to work with the database. Using this tool, all of the queries used in the application were tested before adding them to the code since it is easier and faster and different versions of the query can be tested without having to compile the application. This tool has also helped because it is very easy to view the data in a table and change it and modifying the table's structure if needed.
- PowerShell Scripting and Windows Task Scheduler [1, 2]: They have been used to send weekly emails to tutors, using information from the database.
- TortoiseSVN [10]: This subversion client has been used to manage different versions of the code, the documentation and the live version of the Intranet. This tool has permitted us to work on the application on different computers simultaneously without losing any work done. This tool is also used to have different versions of the live application so that it will always have a backup if the new version doesn't work correctly.

### 4.3 Developed pages

In this section the developed pages will be shown and their basic functionalities will be explained. It is divided into the user roles defined in Section 2.1.2 (PDI, Gestor de Laboratorio de Investigación, Dirección de Departamentos y Gestión de Espacios).

#### 4.3.1 PDI

The user with a PDI category will have access to this page once they have logged in. As can be seen in Figure 4-1, these users have access to a series of pages in which they can carry out different actions because this project is only one part of the number of functionalities the Intranet has.

The pages that are going to be explained are “Alta Tutorando” and “Gestionar Tutorandos” because they are the ones developed for this user in this project.

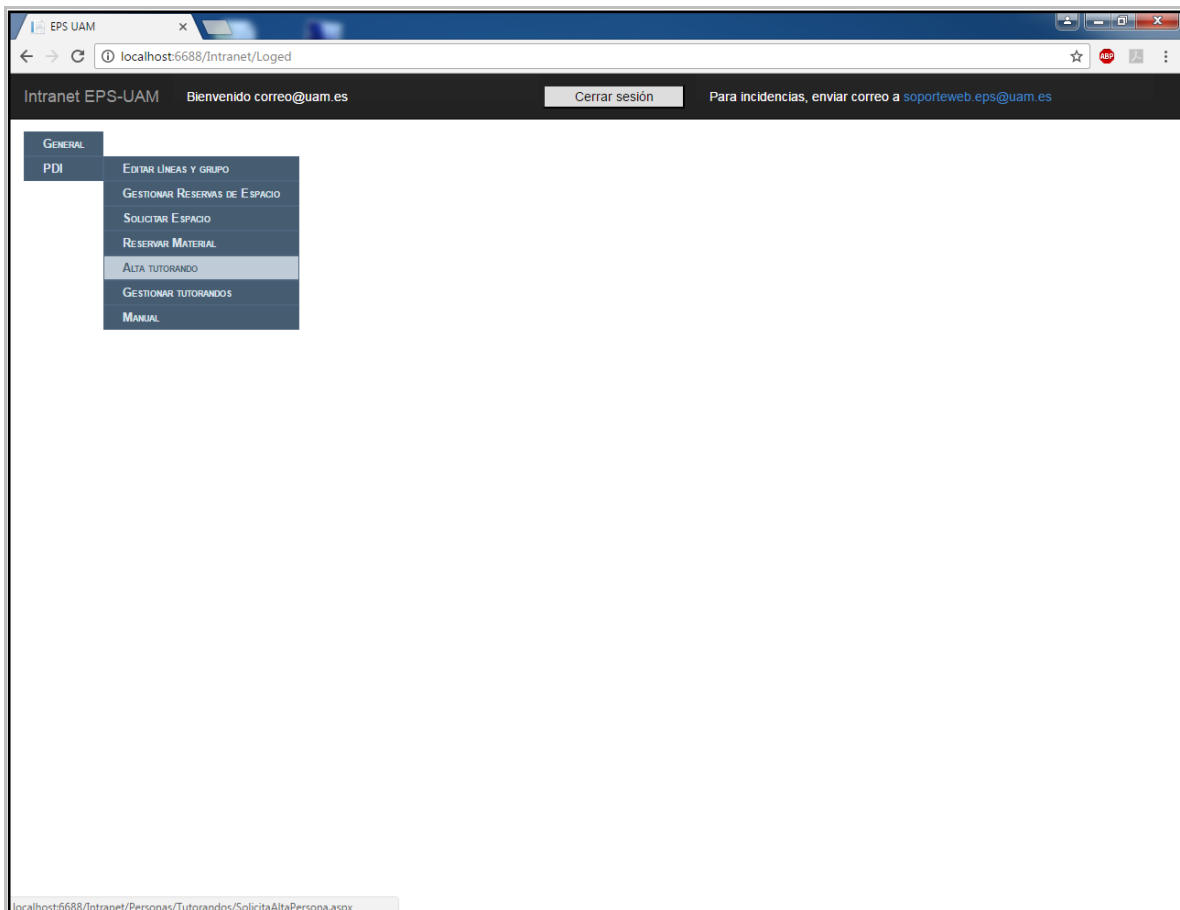


Figure 4-1: PDI's home page



### 4.3.1.1 Register a Tutee (Alta Tutorando)

To register a tutee, the user has to go through the following pages: insert the tutee's personal data, assign the tutee a job category and request a desk assignment.

#### 4.3.1.1.1 Insert Personal Data

The registering starts by introducing the tutee's personal information if the tutee is new to the database or selecting the tutee from a list of the people that are in the database (Figure 4-2).

The information needed is the name and last name, the email and the ID. All the information has to be provided but the second last name. To save the information in the data base the user has to press the button "Siguiente".

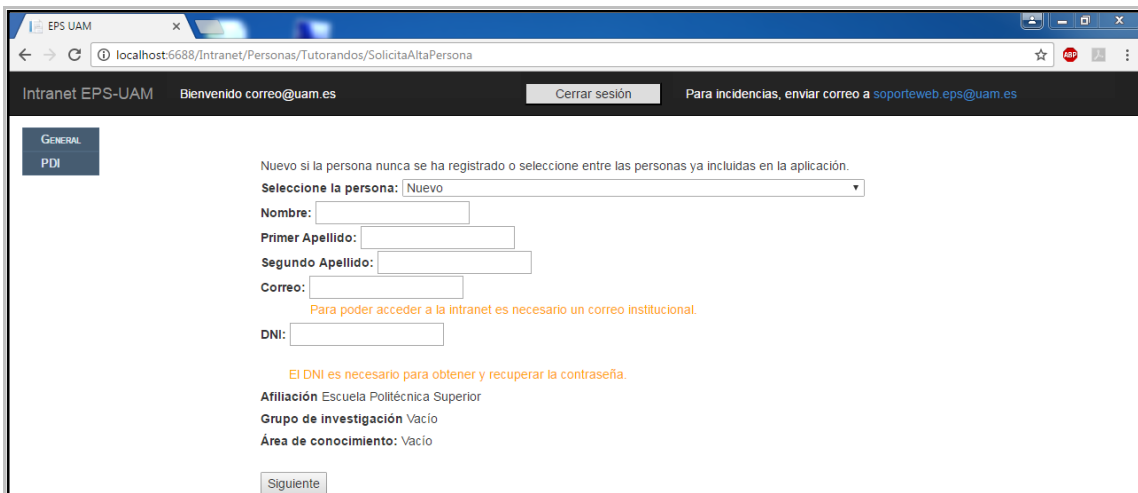


Figure 4-2: Page where the user has to insert the tutee's personal data

#### 4.3.1.1.1 Assign a Job Category

The registering continues by choosing the tutee's job category and the beginning and end dates of the job. Depending on the chosen category there is a maximum period of time the tutee can have a job and it is shown in orange on the page (Figure 4-3).

To save and store the job assignment in the database the user has to press the button "Dar de alta".



Figure 4-3: Page where the user assigns a job category to the tutee

### 4.3.1.1.1 Request a Desk Assignment

The registering ends by requesting a desk assignment for the tutee in a research laboratory. In this page, Figure 4-4, the user has to choose the research laboratory in which the tutee will be working, choose a desk if the user wants the tutee to be in one in particular, introduce the beginning and end dates of the assignment and finally, insert the tutee's work schedule.

If the user does not know the laboratory's distribution, they can see the laboratory's schematics, with all its desks and where they are.

To request the assignment, the user has to press the button "Solicitar puesto de trabajo" after filing in all the information described before. The page will reload and there will be a message telling the user that the request was successful and there will be a new button to access the page "Gestionar Tutorandos" where the user can manage the tutees.

When the request is made, the application sends an email to the laboratory's supervisor notifying about the new request. It also sends an email to the tutor informing of the request done.

The screenshot shows a web browser window with the URL localhost:6688/Intranet/Personas/Tutorandos/SolicitaVincEspacio?id=521. The page title is "Solicitar asignación de despacho de:" and the user is logged in as correo@uam.es. The form fields are as follows:

- Nombre: Primer Apellido Segundo Apellido (correo@uam.es)
- Vinculación: Becario
- En el periodo: 17-02-2017-17-02-2018
- Espacio donde va a estar vinculado: Laboratorio Investigación (C-115)
- Preferencia de mesa: Sin preferencia
- Introduzca la fecha de entrada al despacho: 17-02-2017
- Introduzca la fecha de salida del despacho (dejar en blanco para indefinido):
- Horario options:
  - Horario completo (08:00-21:00)
  - Horario de mañana (08:00-15:00)
  - Horario de tarde (15:00-21:00)
  - Insertar horario específico
- Hora de inicio: 08:00
- Hora de final: 21:00
- Button: Solicitar puesto de trabajo

Below the form is a floor plan of laboratory C-115. The plan shows a rectangular room with several desks arranged in a grid. The desks are numbered 16 through 24. Desk 18 is highlighted in orange. The room has a door on the left side and a window on the right side.

Figure 4-4: Page where the user requests a desk assignment

### 4.3.1.1 Manage Tutees (*Gestionar Tutorandos*)

To manage tutees the user has the page in Figure 4-5. In this page the user can see all of their tutees in a period of time. To see them, the user has to introduce a period of time and press the button “Consultar”. After pressing the button, the page will reload and the user will see the page in Figure 4-6.

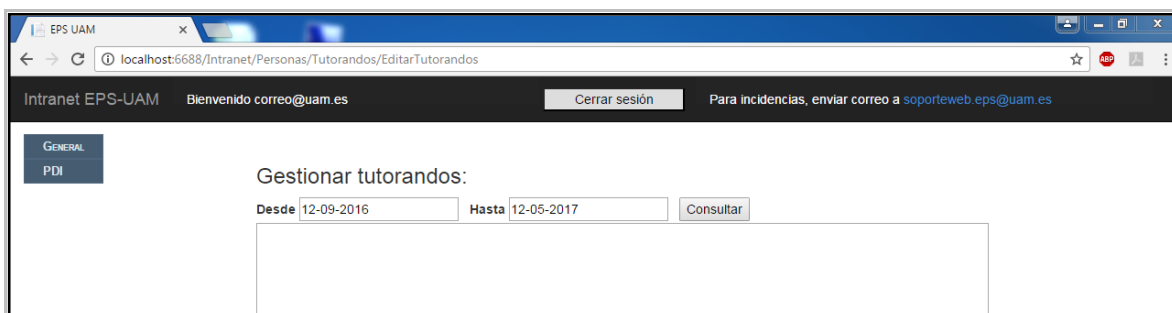


Figure 4-5: Page to manage tutees

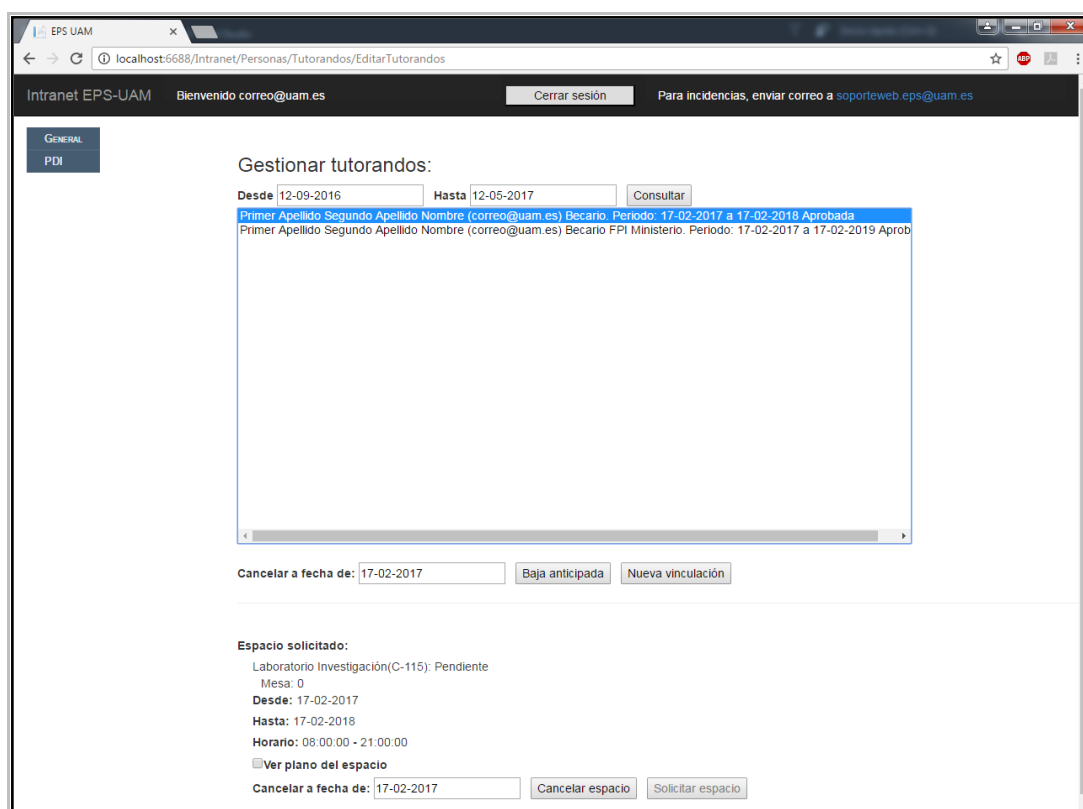


Figure 4-6: Page to manage tutees with the tutee’s information

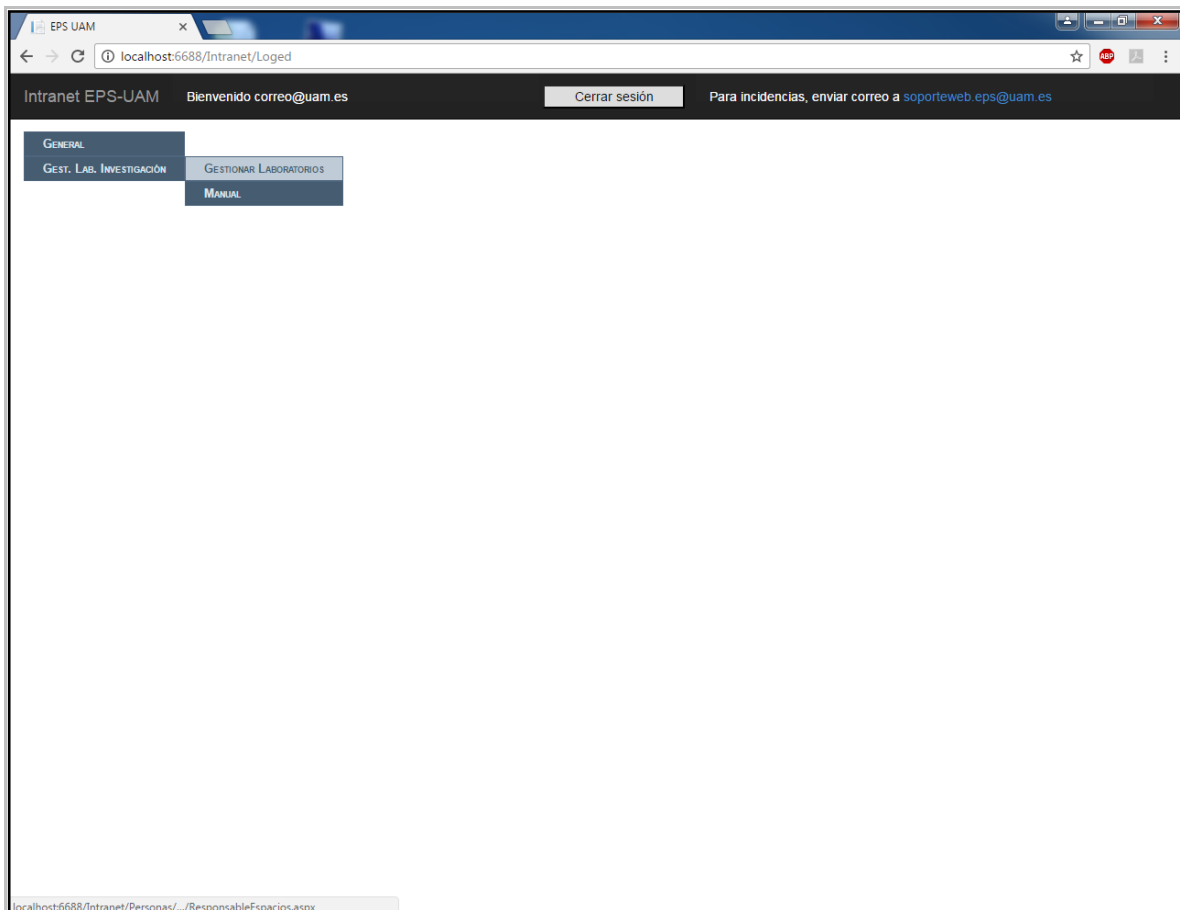
As seen in Figure 4-6, the page shows all the tutee’s information:

- The job category is shown next to the tutee’s name and email. This job assignment can be cancelled by selecting the tutee, choosing the date to cancel the assignment to and pressing the button “Baja anticipada”. If the user wants to assign another job category to the tutee, the user has to select the tutee and press the button “Nueva vinculación”.

- The tutee's desk assignment is shown once the tutee has been selected. The information shown is the research laboratory and the desk number, the status of the request (pending, authorized), the period of time and the work schedule of the tutee in that desk. If the assignment was denied or cancelled there will be no information. There is an option, "Ver plano del espacio", that the user can select to see the laboratory's schematics. Just like with the job assignment, the desk assignment can be cancelled and the user can request another desk assignment but in this case the user can only request a new desk assignment when the tutee does not have a current desk assignment.

### 4.3.2 Gestor de Laboratorio de Investigación

The users with a Research Laboratory Supervisor category can access this page once they have logged in, Figure 4-7.



**Figure 4-7: Research Laboratory Supervisor's home page**

### 4.3.2.1 Manage Laboratories (Gestionar Laboratorios)

The user has the page in Figure 4-8 to manage the laboratories the user is supervisor of.

The screenshot displays the 'Gestión de laboratorios de investigación' interface. At the top, there is a navigation bar with 'GENERAL' and 'GEST. LAB. INVESTIGACIÓN' tabs. The main content area is titled 'Gestión de laboratorios de investigación' and includes a dropdown menu for 'Seleccione el espacio: Laboratorio Investigación (C-115)'. Below this, a list of desks (Mesa 1-16) is shown, with Mesa 4 selected and its details (Zayat Mata, Ana, López Colino, Fernando Jesus, Periodo: 18-04-2017 a 31-05-2017, Horario: 08:00-21:00) displayed. A 'Motivo de la cancelación' field and a 'Quitar mesa a fecha de: 09-05-2017' button are visible, along with a 'Cancelar asignación' button. A red warning message 'Recuerde indicar el motivo.' is present. Below this, there is a section for 'Asignar Responsable de Mesa de Equipamiento' with a checkbox. A table titled 'Personas pendientes de asignar mesa' lists pending assignments with columns for 'Nombre completo', 'Tutor', 'Periodo', 'Horario', 'Mesa solicitada', and 'Mesa a asignar'. The table contains one entry for Ana Zayat Mata. At the bottom, there is a 'Histórico del despacho' section with date filters and a 'Consultar histórico' button. Finally, a schematic diagram of the laboratory layout 'C-115' is shown, with desks 23 and 24 highlighted in orange.

Figure 4-8: Page to manage the research laboratories

In this page the user can see how the laboratory is at the moment, seeing all the authorized desk assignments and the free desks. If the user is supervisor of more than one laboratory then it is necessary to choose the laboratory to manage from a list at the top of the page. The user can see the schematics of the laboratory at the end of the page.

The user can choose one of the authorized desk assignments and cancel it pressing the button “Cancelar asignación” after choosing the date to cancel it and introducing the reason of the cancellation. The application will send an email to the tutor of the person cancelled to notify about the cancellation.

After this, the user has two options: assign an equipment desk, or authorize or deny a pending desk assignment request. The user has to select the option of equipment desk or not.

To make an equipment desk assignment the user has to select the desk from the box with the information of the laboratory, choose a person to be the one in charge of the equipment (if the person has more than one job category, the user has to decide with which the person will in charge of the desk) and introduce the beginning and end dates of the assignment. After that, the user has to press the button “Asignar Responsable” and the new assignment will be saved in the database. The page will reload and the laboratory’s information will be refreshed, showing the new assignment. When the assignment is done, the application sends an email to the person chosen to be in charge of the desk to notify them of the assignment. When the option of assigning an equipment desk is chosen the page shows the Figure 4-9 instead of the pending requests table.

Asignar Responsable de Mesa de Equipamiento

Es necesario seleccionar una vinculación y una mesa

Seleccione la persona:

|   |
|---|
| Vinculación 1: Profesor Titular de Universidad - Despacho C-236 Mesa: 1 (Aprobada). Hasta: -            |
| Vinculación 2: Subdirección de ordenación académica - Sin despacho asignado. Hasta: 31/05/2020 23:59:59 |

Fecha de inicio:

Fecha fin (dejar en blanco para indefinido):

**Figure 4-9: Equipment desk assignment option**

If the user doesn’t want to assign an equipment desk, there is a table showing the pending desk assignment requests.

The user can authorize a request by choosing the desk to assign and pressing the button “Autorizar”.

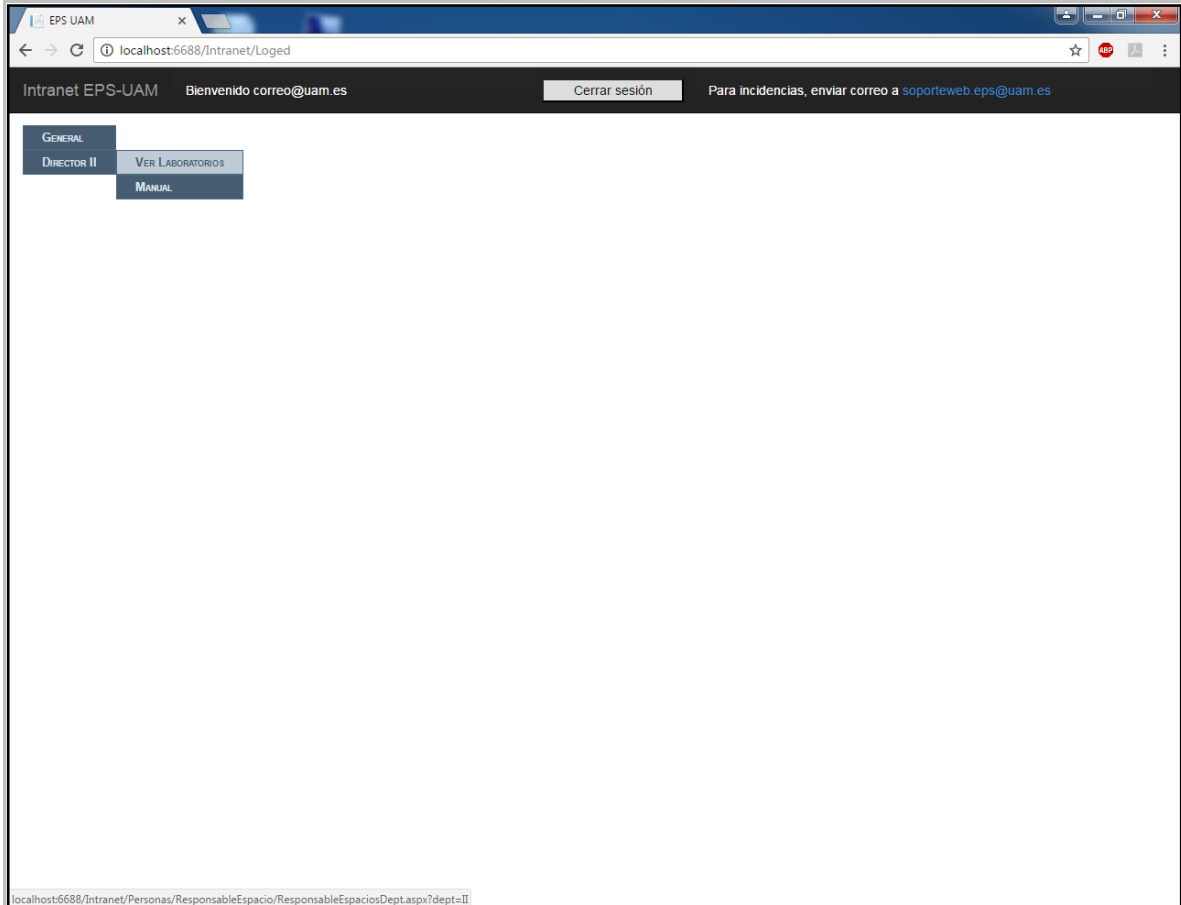
The user can also deny a request by pressing the button “Denegar”. When that button is pressed the user will see a textbox under the table asking for the reason and another button “Denegar”.

In both cases the page will reload and the row will be eliminated from the table. If the user has authorized the request then the laboratory’s information will be refreshed, showing the new assignment. The application sends an email to the tutor notifying them of the action.

Finally, the user can see a record of the people in the laboratory in a chosen period of time pressing the button “Ver historial”.

### 4.3.3 Dirección de Departamentos

The users with Department Management categories (Director, Deputy Director and Secretary of the II and TEC departments) have access to this page once they have logged in (Figure 4-10). In the examples the user has a category of II Director.



**Figure 4-10: Department Management member's home page**

### 4.3.3.1 Visualize Laboratories (Ver Laboratorios)

The user has the page in Figure 4-11 to visualize the research laboratories associated to their department.

In this page the user can see how the laboratories associated to their department are at the moment (how many desks they have and their desk assignments). The user has to choose which laboratory to see from the list at the top of the page. The user can also see the laboratory's schematics at the end of the page.

After the information about the laboratory, the user can see a record of the laboratory's assignments in a chosen period of time pressing the button "Ver historial".



Figure 4-11: Page to visualize the research laboratories



### 4.3.4 Gestión de Espacios

The users with a Space Management category have access to the page in Figure 4-12 after they have logged in. As can be seen in Figure 4-12, these users have access to a series of pages in which they can carry out different actions because this project is only one part of the number of functionalities the Intranet has.

The page that is going to be explained is “Gestión de Espacios” because it is the one developed for this user in this project.

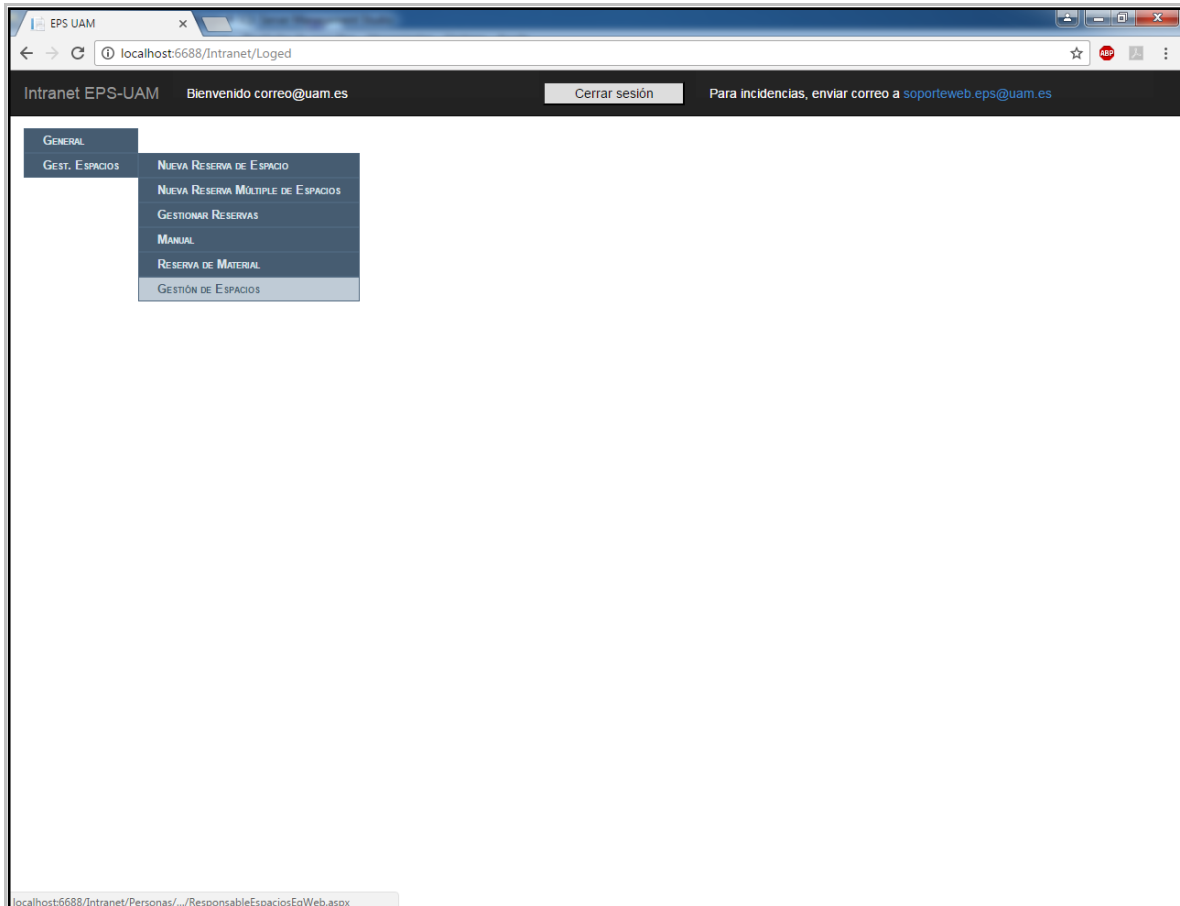


Figure 4-12: Space Management Staff's home page

### 4.3.4.1 Space Management (Gestión de Espacios)

The space management in the EPS-UAM is done through the page in Figure 4-13.

EPS UAM

localhost:6688/Intranet/Personas/ResponsableEspacio/ResponsableEspaciosEqWeb

Intranet EPS-UAM Bienvenido correo@uam.es Cerrar sesión Para incidencias, enviar correo a soporteweb.eps@uam.es

GENERAL  
GEST. ESPACIOS

## Laboratorios de Investigación

Seleccione el espacio: Laboratorio Investigación (C-115)

El gestor del laboratorio es - Ana Zayat Mata - Fernando Jesús López Colino

Mesa 0:  
Mesa 1:  
Mesa 2:  
Mesa 3:  
Mesa 4:  
Mesa 5: Zayat Mata, Ana (López Colino, Fernando Jesús) Periodo: 18-04-2017 a 31-05-2017 Horario: 08:00-21:00  
Mesa 6:  
Mesa 7:  
Mesa 8:  
Mesa 9:  
Mesa 10:  
Mesa 11:  
Mesa 12:  
Mesa 13:  
Mesa 14:  
Mesa 15:

Motivo de la cancelación\*:  Quitar mesa a fecha de: 09-05-2017 Cancelar asignación

Recuerde indicar el motivo.

Seleccione la persona: Zayat Mata, Ana (ana.zayat@estudiante.uam.es)

Vinculación 1: Becario Web - Despacho Web C-120 Mesa: 1 (Aprobada). Hasta: 31/05/2017 23:59:59  
Vinculación 2: Catedrático de Universidad - Sin despacho asignado. Hasta: 29/03/2018 23:59:59  
Vinculación 3: Profesor Contratado doctor interino - Sin despacho asignado. Hasta: indefinido

Nueva asociación a una mesa:  
Es necesario seleccionar una vinculación, una mesa y un horario

Asignar Responsable de Mesa de Equipamiento

Fecha de inicio: 09-05-2017  
Fecha fin (dejar en blanco para indefinido):

Horario completo (08:00-21:00) Hora de inicio: 08:00  
 Horario de mañana (08:00-15:00) Hora de final: 21:00  
 Horario de tarde (15:00-21:00)  
 Insertar horario específico

Vincular

C-115

23  
18  
24  
19 20  
21 22  
16 17

Figure 4-13: Page to manage spaces in the EPS-UAM

In this page, the user can see how a space is at the moment (how many desks it has and its desk assignments). To see a space, the user has to choose it from the list of spaces in the EPS-UAM. The page shows the schematics of some of the spaces (research laboratories).

The user can choose one of the authorized desk assignments and cancel it pressing the button “Cancelar asignación” after choosing the date to cancel it. If the user wants to make a desk assignment they have to choose the desk to assign.

After this, there is a list of all the people in the database who have an active job category assignment. To assign a desk, the user has to choose the person and choose the job category to assign if the person has more than one.

Below, there is an option to choose between assigning a work desk or an equipment desk. If the choice is equipment desk then the user has to introduce the beginning and end dates of the assignment, but if the choice is a work desk, then the user not only has to introduce the beginning and end dates of the assignment, but also the person’s work schedule. Once everything is done, the user has to press the button “Vincular” and the new assignment will be saved in the database. The page will reload and the space’s information will be refreshed, showing the new assignment.

#### **4.4 Script to Send Emails to Tutors**

For the project to contain all the requirements, a script has been created to make two queries against the database, checking if there are any tutees whose job assignment or desk assignment are going to end the next week. Once these queries are executed, the script sends an email to each tutor whose tutee’s assignment (job or desk) will end the following week notifying them of the end of their tutee’s assignment. This way, the tutors can take action and go to the page where they can manage tutees and do what they see fit. In the Figure 1-14 is the email a tutor gets if their tutee’s job assignment is ending the following week.

Hola <Nombre del tutor>,  
La vinculación de trabajo de su tutorando <Nombre y apellidos> finalizará la semana que viene el día <día/mes/año>.  
Desde la página de Gestionar Tutorandos podrá volver a asignarle una nueva vinculación o no. En su defecto, póngase en contacto con [laboratoriosinvestigacion.eps@uam.es](mailto:laboratoriosinvestigacion.eps@uam.es)  
Puede acceder a la intranet entrando en: <https://intranet.eps.uam.es/Intranet/Login>  
Fdo: Equipo web.

**Figure 4-14: Email sent to the tutor**



## **5 Integration, Tests and Results**

---

During the development of this project each page has been tested to make sure they work correctly and to fix or modify what was necessary for them to meet the requirements.

In this section, the testing process will be described, starting with verification tests done during the development of the different components of the pages, following that, the integration and validation tests and finally, the acceptance tests done by the final users.

Most of the problems found during the different tests were fixed by looking for information on the internet [1, 2, 3, 4] or in books [5, 6, 7, 8, 9].

### **5.1 Verification Tests**

To create each page, the elements have been added one by one, each with its own functionality, and these elements have been tested when added to the page to make sure they work correctly. They each have been tested individually.

First, the page has been created with only a title and it was compiled to check it was shown correctly in the application using the development computer. Once the test was done, each element has been added and tested individually, checking not only their functionality but also their interaction with the database.

These tests we done using the Visual Studio debugger, using it to follow the execution and check that the information was correct at all times.

To fix the problems found during these tests, the code was modified until every element worked correctly on its own.

### **5.2 Integration Tests**

Once each element has been tested individually, they have been put together and tested that they worked correctly as a whole. The tests have been done using the Visual Studio debugger. In this step many errors have been found, most of them were incompatibility errors. Because of this, many elements we changed so that they were compatible but had the same functionalities as the previous elements.

Once the new elements have been found and they have passed the verification tests, the integration tests are done again, compiling the page and testing that the elements worked together and the information was not lost from one element to another.

When all the elements worked correctly together, checking with the Visual Studio debugger, the validation tests started.

## 5.3 Validation Tests

The validation tests have been done with the application compiled and running, accessing it only through the web browser and not the code since the code should be correct after passing the previous tests.

The validation tests for each page have been done based on every possible use case of each page. In this document there is an example of the steps taken to do a validation test on the space management page.

The validation tests have been done on the development computer as well as the testing server and for each problem that has appeared the problematic element has been modified or changed and has had to pass the verification and integration tests again before doing the validation test.

### 5.3.1 Validation Test on the space management page (Gestión de Espacios)

1. Use Case to Validate:

Use Case 3: Assigning a Desk from the Role of Space Management

2. Test Case Design:

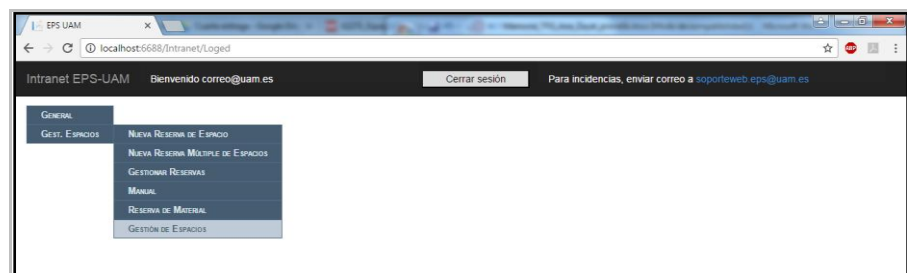
Preconditions: The user has to be registered in the Intranet and has logged in.

Scenario:

1. The user accesses the menu item “Gest. Espacios” and in the next menu the item “Gestión de Espacios”.
2. In the page, the user chooses a space from the list of spaces in the EPS-UAM.
3. The user selects the desk to assign.
4. The user chooses the person from a list of people and selects the job category with which to assign the person to the desk.
5. The user does not select the option of assigning an equipment desk. The user has to introduce the person’s work schedule.
6. The user presses the button “Vincular” and in the pop up window the button “OK”.
7. The page reloads showing the new assignment.

3. Results:

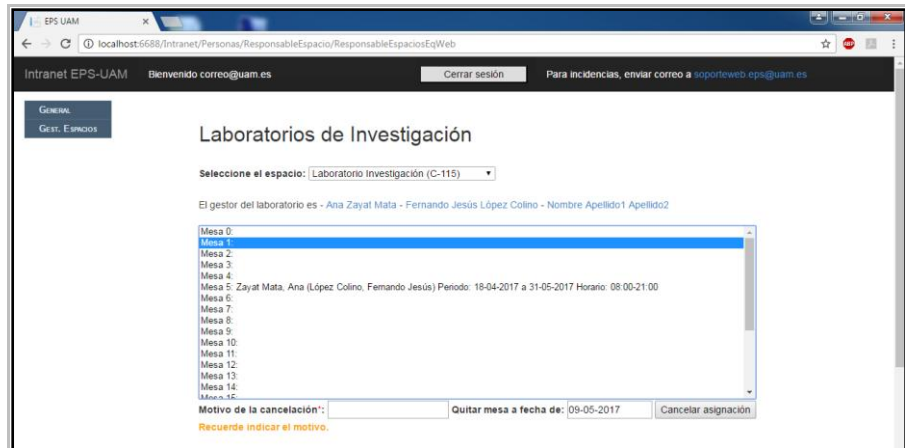
1.



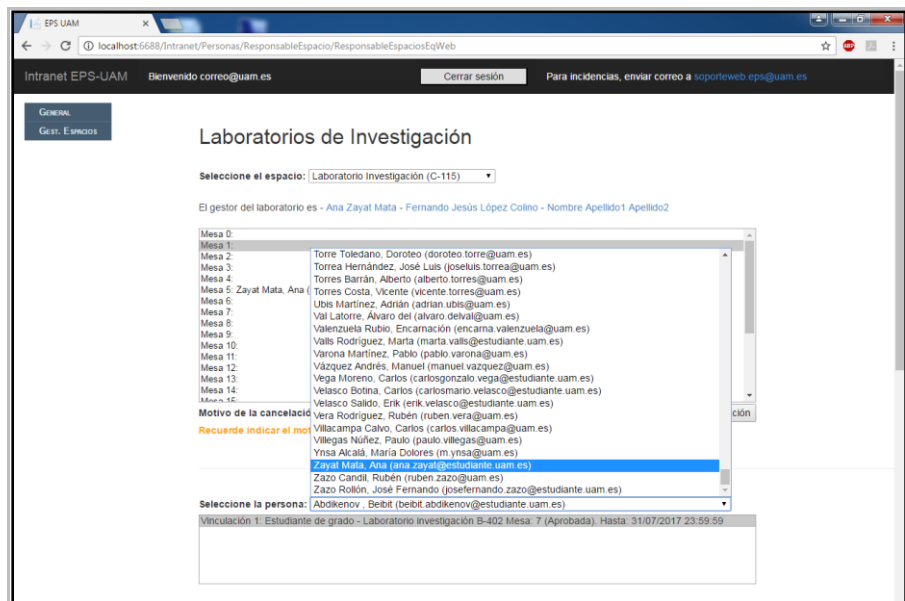
2.



3.



4.



5.

Seleccione la persona: Zayat Mata, Ana (ana.zayat@estudiante.uam.es)

Vinculación 1. Becario Web - Despacho Web C-120 Mesa: 1 (Aprobada). Hasta: 31/05/2017 23:59:59  
Vinculación 2. Catedrático de Universidad - Sin despacho asignado. Hasta: 29/03/2018 23:59:59  
Vinculación 3. Profesor Contratado doctor interino - Sin despacho asignado. Hasta: indefinido

Nueva asociación a una mesa:  
Es necesario seleccionar una vinculación, una mesa y un horario

Asignar Responsable de Mesa de Equipamiento

Fecha de inicio: 09-05-2017  
Fecha fin (dejar en blanco para indefinido):

Horario completo (08:00-21:00) Hora de inicio: 08:00  
 Horario de mañana (08:00-15:00) Hora de final: 21:00  
 Horario de tarde (15:00-21:00)  
 Insertar horario específico

Vincular

6.

localhost:6688 says:  
¿Está seguro de que desea aceptar dicha vinculación?

OK Cancel

7.

Seleccione el espacio: Laboratorio Investigación (C-115)

El gestor del laboratorio es - Ana Zayat Mata - Fernando Jesús López Colino - Nombre Apellido1 Apellido2

Mesa 0:  
Mesa 1: Zayat Mata, Ana (ana.zayat@estudiante.uam.es) Periodo: 09-05-2017 a - Horario: 08:00-21:00  
Mesa 2:  
Mesa 3:  
Mesa 4:  
Mesa 5: Zayat Mata, Ana (López Colino, Fernando Jesús) Periodo: 18-04-2017 a 31-05-2017 Horario: 08:00-21:00  
Mesa 6:  
Mesa 7:  
Mesa 8:  
Mesa 9:  
Mesa 10:  
Mesa 11:  
Mesa 12:  
Mesa 13:  
Mesa 14:  
Mesa 15:

Motivo de la cancelación: Quitar mesa a fecha de: 09-05-2017 Cancelar asignación

Recuerde indicar el motivo.



## **5.4 Acceptance Tests by Final Users**

Once all the previous tests were done and the pages passed them, the application was uploaded to the production server and the Intranet was updated. The final users could access the new pages and use them. If there is a problem in one of the pages (format, usability or data), the users can report it and the process of modifying and testing starts again.

## **5.5 Other Tests**

This section explains the tests done for the script to send emails to the tutors.

The script was created in different scripting languages but the winner was PowerShell because of its simplicity and the fact that it is very easy to work with it from the Windows Task Scheduler [1, 2].

The first thing was creating a script to send a test email to a specific email address. There were a lot of tries and many ways of sending an email until the correct one was found [1, 2].

The next thing was creating the queries and testing them using SQL Server Management Studio until they were correct.

When both things were done and correct, they were integrated and the script was tested as a whole. When the script worked correctly, a new task was created in the Windows Task Scheduler in the development computer so that the script was executed at a specific day and time.

When everything was working correctly in the development computer it was uploaded to the test server and all the tests were done a second time. Once the tests were successful in both development computer and test server, it was uploaded to the production server and set to execute every Monday at a specific time.



## **6 Conclusions and Future Work**

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### **6.1 Conclusions**

This project was created to make the tasks of registering and managing tutees and managing spaces easier and simpler. This project consists of a new application for the Intranet where professors can register a new tutee, introducing their personal information, assigning them a job category and requesting a desk assignment and manage all their tutees; research laboratory supervisors can manage a research laboratory by authorizing or denying a desk assignment request, cancelling an already authorized desk assignment and assigning an equipment desk; department managers can see how their department's research laboratories are (who is in which desk); and the staff in space management can manage any space in the EPS-UAM.

All the stated objectives and requirements of the project have been achieved, allowing the creation of an application that speeds up routine tasks for the EPS-UAM's staff. This application is currently running, being used and working correctly.

Also, during the development of this Bachelor Thesis, I have acquired new knowledge on web programming languages that are rising, I have used the Windows Task Scheduler and scripting and I have strengthened my web page designing abilities.

### **6.2 Future Work**

The application created in this project can be modified in many different ways. One way it could be modified is if the job category assignments the tutors make now have to be authorized or denied by a specific person in the EPS-UAM like, for example, the managing director. If this is a new requirement then the tutor can only request a job category assignment and the application would have to send an email to the people who had the power to authorize it. There would have to be a new page for the authorization or denial of job category assignment requests in which the user could see all the pending requests and authorize or deny them, sending an email to the tutor notifying about the decision made.



# References

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- [1] StackOverflow, <https://es.stackoverflow.com/> and <https://stackoverflow.com/>
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## **Glossary**

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| EPS-UAM            | Escuela Politécnica Superior de la Universidad Autónoma de Madrid.   |
| Intranet (EPS-UAM) | Web application used for the internal management of the EPS-UAM. <a href="https://intranet.eps.uam.es/Intranet/Login">https://intranet.eps.uam.es/Intranet/Login</a> . |
| Query/queries      | A request for information from a database.   |
| SQL                | Structured Query Language. Domain-specific language used in programming and designed for managing data held in a relational database                                   |