

Professional residency web system implementing artificial intelligence model

Sistema web de residencia profesional implementando modelo de inteligencia artificial

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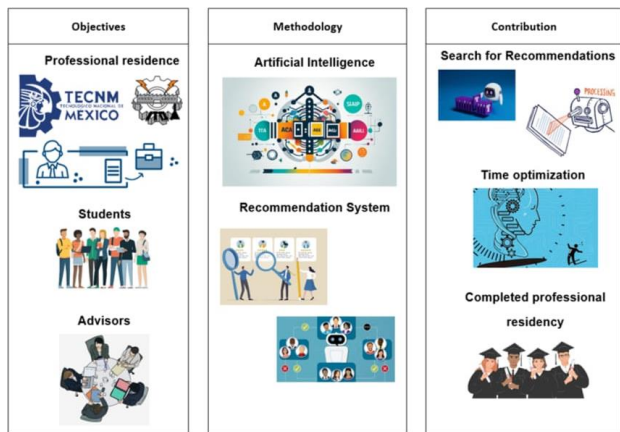


Abstract

Computer Systems Engineering students at the Tecnológico Nacional de México – Instituto Tecnológico de Oaxaca take the Professional Residency subject in semesters nine or ten, which has a value of 10 credits. A project related to their area of study must be developed in a company in 4 to 6 months. To take it, it is necessary to attend different departments and carry out the corresponding process. At the Outreach Projects office, students must submit their Professional Residency preliminary project. A professor from the academy reviews this draft for authorization. Once approved, an Internal Advisor is assigned. Thanks to the Recommendation System based on Artificial Intelligence, a suggestion of teachers who could be assigned as Internal Advisors is provided, thus facilitating the selection process and ensuring better alignment between the project and the consultant's experience.

Resumen

Los estudiantes de Ingeniería en Sistemas Computacionales del Tecnológico Nacional de México – Instituto Tecnológico de Oaxaca cursan la materia de Residencia Profesional en los semestres nueve o diez, la cual tiene un valor de 10 créditos. Se debe desarrollar en una empresa un proyecto relacionado con su área de estudio en 4 a 6 meses. Para cursarla, es necesario asistir a diferentes departamentos y llevar a cabo el proceso correspondiente. En la oficina de Proyectos de Vinculación, los estudiantes deben presentar su anteproyecto de Residencia Profesional. Un profesor de la academia revisa dicho anteproyecto para su autorización. Una vez aprobado, se procede a la asignación de un Asesor Interno. Gracias al Sistema de Recomendaciones basado en Inteligencia Artificial, se proporciona una sugerencia de docentes que podrían ser asignados como Asesores Internos, facilitando así el proceso de selección y asegurando una mejor alineación entre el proyecto y la experiencia del asesor.



AI, Professional residence, System



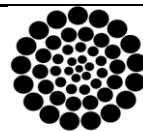
IA, Residencia Profesional, Sistema

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Introduction

The National Technological Institute of Mexico - Technological Institute of Oaxaca, has incorporated the subject of Professional Residency into its various educational programs. This course is taken during the last semester of each program, allowing students to apply their theoretical knowledge in a real professional environment.

To start the professional residency, students attend the departments of Technology Management and Linkage, Division of Professional Studies, School Services and the Academic Department, as indicated in Process 3. Education Management - Professional Residencies Procedure, of the Quality Management System (QMS), in each department must cover the respective process.

In the academic department – Department of Systems and Computing – Liaison Office, the process for students of Computer Systems Engineering begins. Each semester (January-June and August-December) the student is asked for a preliminary project to be reviewed and authorized for Professional Residency.

This administrative task contains the following actions:

- Reception of preliminary projects from students.
- Review and authorization of the preliminary project by the Academy of Systems and Computing.
- Authorization of the application for Professional Residency by the head of the Department of Systems and Computing and/or head of the liaison office of the academic department.
- Reception of: schedule of activities, cover letter, commitment letter, acceptance letter, 1st report, 2nd report, final report, release letter.
- Delivery of the Technical Report of Professional Residency by the students.

To manage the information of the process, the Professional Residency System was carried out by implementing an Artificial Intelligence model.

This system aims to implement Artificial Intelligence through a recommendation system, which will allow one or more reviewers to be suggested for a preliminary project of Professional Residency. In this way, it seeks to optimize the review selection process, ensuring a more appropriate evaluation aligned with the needs of the project.

The role of the reviewer is to carry out a thorough analysis of the document, including the problem approach, objectives, rationale, scope, limitations and schedule of activities. This analysis is carried out taking into account the experience and specialization of the reviewer or reviewers, which guarantees a critical and well-founded evaluation of the content presented.

Considering the above, the following sections are presented in this research: Methodology used, Development, Results, Acknowledgements, Financing, Conclusions and References. They cover the most relevant points in the Professional Residency Web System implementing an Artificial Intelligence model.

Methodology used

There are different software development methodologies, [Maida & Pacienza \(2015\)](#) they say that the software development methodology is “an integrated set of techniques and methods that allows to approach in a homogeneous and open way each of the activities of the life cycle of a development project”.

Software development methodologies fall into two main categories: traditional methodologies and agile methodologies.

Traditional methodology is one of the fundamental foundations for software development, serving as a reference for other types of methodologies.

[Pressman \(2022\)](#), it indicates that traditional software development methodologies are oriented by planning. They start the development of a project with a rigorous process of elicitation of requirements, prior to the stages of analysis and design. With this they try to ensure high-quality results circumscribed to a calendar.

Navarro Cadavid, Fernández Martínez & Morales Vélez (2013), describe agile methodologies as flexible, these can be modified to fit the reality of each team and project.

Projects are highly collaborative and better adapted to change; changing requirements are an expected and desired feature, as are constant deliveries to the customer and feedback from them.

Box 1

Table 1

Traditional Methodology and Agile Methodology

Pressman, 2002	Agile Approach	Traditional approach
Organizational structure	Iterative	Lineal
Project Scale	Small and medium	Big
Customer Engagement	Register	To remove
Development model	Evolutionary Delivery	Life cycle
Customer engagement	Customers are involved from the moment work starts	Customers are involved early in the project, but not once execution has begun
Modeling preferences	Agile model promotes adaptation	The traditional model favors anticipation
Revisions and adaptations	Reviews are performed after each iteration.	Constant reviews and approvals by project leaders.

Source: Pressman 2002

Methodology by prototypes

(Gerea, 2021) The prototyping methodology is related to continuous improvement and the Deming Cycle which consists of an iterative process focused on designing, implementing, measuring and adjusting a plan.

In the case of a prototype, five stages are applied in the design and implementation of an idea. These stages are:

- Definition of requirements and variables.
- Definition of tools for design and testing.
- Prototype design.
- Prototype testing.
- Analysis of results.

This methodology can be applied in the development of new businesses, web prototyping, app prototyping, among other environments.

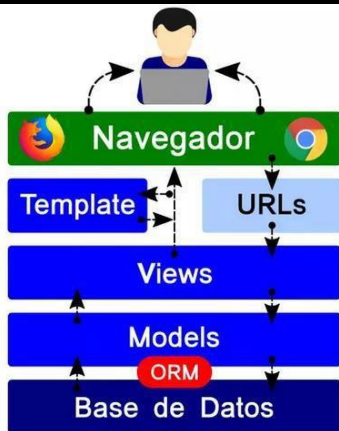
Technology

The technologies used for the development of the Professional Residency System implementing an Artificial Intelligence model were:

- Phyton.
- Django.
- Amazon WEB Services (AWS).
- Figma.
- JavaScript (JS).
- JQUERY.
- SweetAlert2.
- HTML.
- CSS.
- Tailwind.
- Database.
- SGBD.
- Entity-relationship model.

Web architecture

In this pattern, the "Model" refers to access to the data layer, the "View" refers to the part of the system that selects what to display and how to display it, and the "Controller" implies the part of the system that decides which view to use, depending on the user input, and the "Controller" refers to the part of the system that decides which view to use, depending on the user input. accessing the model if necessary (Django 1.0).

Box 2**Figure 1**

Design Pattern MTV

Source: Django 1.0

In practice, the MTV pattern is very similar to the MVC to such an extent that it can be said that Django is an MVC framework.

Artificial Intelligence

Artificial Intelligence is a field of science that focuses on the creation of computers and machines capable of reasoning, learn and act in ways that would normally require human intelligence, or handle data whose scale exceeds the capacity of human analysis (Russell & Norvig, 2016).

Artificial Intelligence is an extensive field covering various disciplines, including computer science, data analysis and statistics, hardware and software engineering, linguistics, neuroscience, as well as philosophy and psychology (Brachman & Levesque, 2004)

Types of intelligence

Artificial intelligence can be classified in a variety of ways, either according to the stages of development or the actions being carried out. According to Russell and Norvig (2016), this classification includes:

- Reactive machines: These are limited AI systems that only respond to different types of stimuli based on programmed rules. "They have no memory or the ability to learn from past experiences".
- Limited memory: This type of AI, which represents most modern applications, "can use past experiences to make future decisions" (Goodfellow et al., 2016).

- Theory of mind: This stage involves the ability to understand that others have beliefs, desires, and intentions that influence their behavior (Müller, 2020).
- Self-knowledge: This more advanced level of AI refers to systems that have an understanding of themselves and their own internal state, allowing them to act more autonomously and thoughtfully (Bostrom, 2014).

Recommendation Systems

Rocca (2021) notes that, in recent decades, the rise of platforms such as YouTube, Amazon, and Netflix has led to recommendation systems playing an increasingly important role in our lives.

These systems are essential in multiple contexts, from e-commerce, where they suggest to buyers products that might interest them, to online advertising, which recommends content to users based on their preferences.

Today, recommendation systems are inescapable in our daily online interactions

Classification of Recommendation Systems:

According to the article "Classifying Different Types of Recommender Systems" (2015), recommendation systems are defined as tools that provide personalized recommendations to users, based on recommendations entries offered by others. These systems not only generate individualized recommendations, but also guide users to interesting options within a wide set of possibilities.

Six types of recommendation systems that are relevant in the media and entertainment industry are mainly identified:

1. Collaborative recommendation system: Relies on the preferences of multiple users to make suggestions.
2. Content-based recommendation system: Use item characteristics to recommend similar ones.
3. Demographic-based recommendation system: Focuses on user demographics to personalize recommendations.

- Recommendation system based on utilities: Considers the perceived usefulness of the items for the user.
- Knowledge-based recommendation system: Uses domain-specific knowledge to make recommendations.
- Hybrid Recommendation System: Combines multiple approaches to improve recommendation accuracy.

Development

In the Professional Residency Web System implementing an Artificial Intelligence model, the following users are identified:

- Super Admin.
- Head of the Systems and Computing Department.
- Head of the Liaison Projects Office of the Department of Systems and Computing.
- Teacher.
- Student.

One of the objectives of the Web System of Professional Residence implementing model of Artificial Intelligence is to make the intelligent decision for the assignment and monitoring of professional residency projects of the Department of Systems and Computing.

Recommendations are made from the candidate teachers to advise the residency based on the characteristics identified in the preliminary project taking into account the academic profile of the teacher, his academic degrees and the area of knowledge he dominates.

Different modules were used for the development of the System:

- Student management module.
- Teacher management modules.
- Module of the head of the office of systems and computing linkage projects.
- Module of the head of the department of systems and computing.
- Super administrator module.

For the development of the solution, 4 iterations were considered:

Box 3

Table 2

Iterations of the model by prototypes

Iteration No.	Estimated time
Iteration 1- Prototyping students and administrators	9 weeks
Iteration 2.- Prototype adding teachers	3 weeks
Iteration 3.- Prototype-adding Artificial Intelligence model	8 weeks
Iteration 4.- Final product	1 week

Source: own elaboration

In each iteration, the 4 corresponding phases are carried out: Phase 1.- Communication, Phase 2.- Rapid Plan, Phase 3.- Modeling and Rapid Design and Phase 4.- Construction of the prototype.

For the iteration 1, the diagram of use case management of teachers is exclusive of the role of the head of the Office of Linking Projects, this module will have the functionalities of adding a new teacher, visualizing teachers, editing teachers and changing the status of a teacher Figure 3.

Box 4

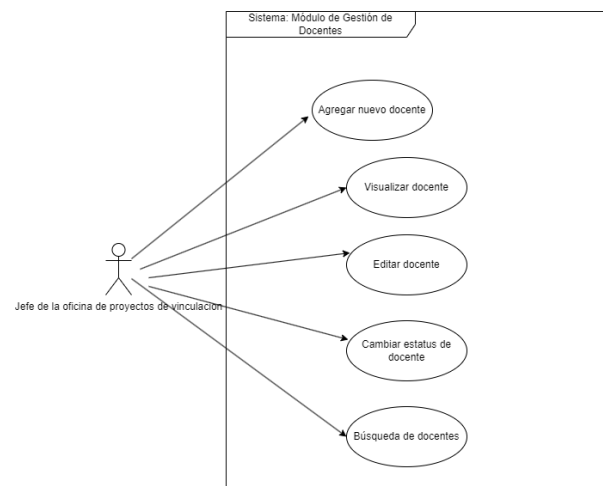


Figure 2

Teacher management module use case

Source: own elaboration

Iteration no. 3 Phase 1 Communication. Model of Artificial Intelligence, reflects the implementation of an Artificial Intelligence model based on machine learning with recommendation systems. These systems are capable of analyzing user behavior patterns and preferences to generate personalized recommendations.

Ortega-Gines, Héctor Bernardo, Hernández-Guzmán, Julieta, Colmenares-Olivera, Esperanza and Curioca-Varela, Yedid. [2024]. Interactive business card prototype: promoting brands with augmented reality on social networks. Journal Computational Simulation. 8[19]-1-9: e40819109. <https://doi.org/10.35429/JCS.2024.8.19.1.9>

User profile. It refers to the set of subjects that each preliminary draft has. These subjects are chosen by the students at the time of registering their preliminary project. The total number of subjects is 32, so we work on a 32-dimensional plan.

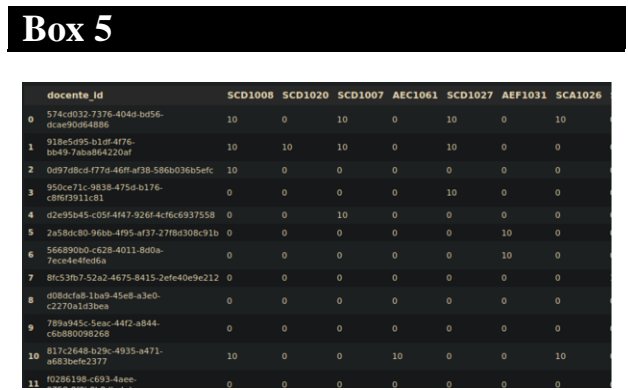


Figure 3
AI Teacher Utility Matrix

Source: own elaboration

On the other hand, in the construction of the prototype, the Login is shown, requesting the username, the password, the Create account option and Forgot your password? Figure 3.

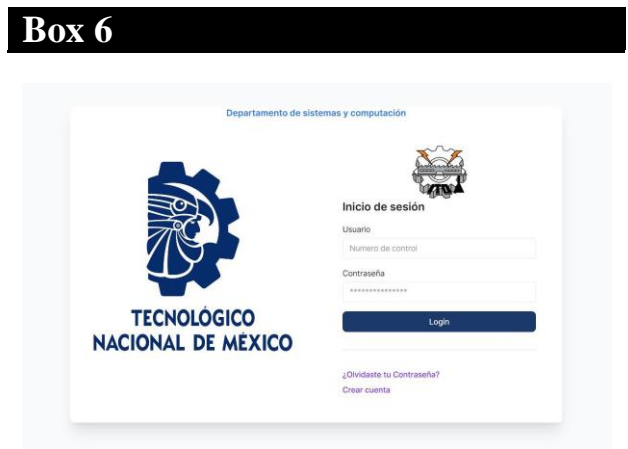


Figure 4
Prototype construction

Source: own elaboration

Results

Students must register the preliminary project, make corrections if required, register or join a dependency within the system.

It is important to identify the teacher's activity, to know the Preliminary Projects or Active Residencies, General Information and Academic Profile Figure 5

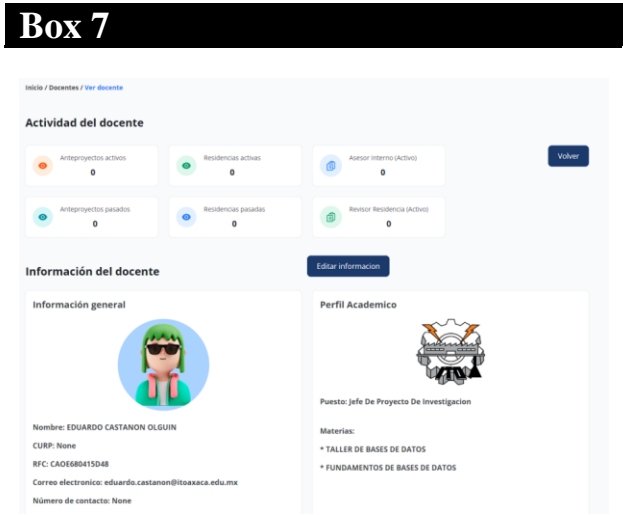


Figure 5
Teacher data

Source: own elaboration

You must also select the subjects related to your preliminary project. Figure 6. The system will make a recommendation from the Professional Residency Advisor.

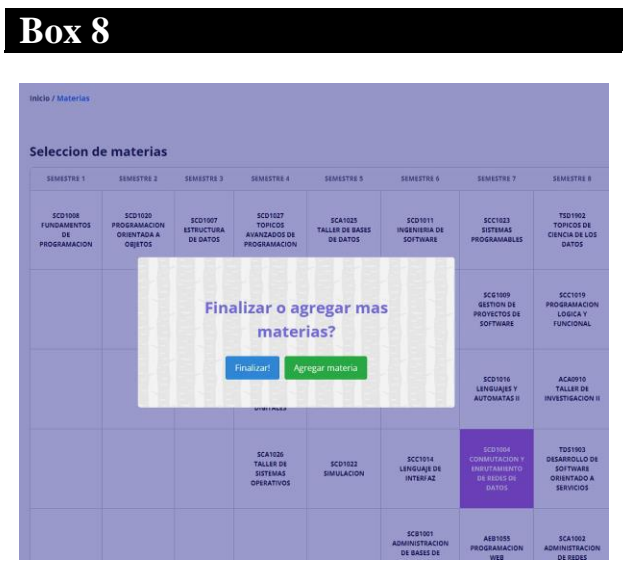


Figure 6
Subject Matter Compatibility

Source: own elaboration

Once the preliminary project has been reviewed and authorized, the data of the project of residence are registered, in them the name of the project, the type of project, the start date, date of completion, number of members are considered Figure 7.

Box 9

Inicio / Residencia

Datos del proyecto de residencia

Nombre del proyecto de Residencia:
PRUEBA DEL SISTEMA

Tipo de Proyecto:
PROPUESTA PROPIA

Fecha inicio:
03/Abril/2023

Fecha Fin:
08/Sep/2023

Numero de integrantes:
2

Figure 7
Residency Project Data

Source: own elaboration

It is also a requirement to capture the Data of the Organization or Company: name, RFC, money order, cell phone number, email, mission, among others. Figure 8

Box 10

Datos de la Organización o Empresa

Nombre:
PRUEBA

RFC:
12312

Giro:
INDUSTRIAL

Numero de Celular:
1241241234

Correo Electronico:
pruebasacorreos@gmail.com

Mision:
DASDASD

Direccion de la Organización o Empresa.
Calle:
PRUEBA

Colonia:
PRUEBA

Municipio:
PRUEBA

Código Postal:
73123

Estado:
Chiapas

Titular de la Organización o Empresa.
Nombre:
PRUEBA PRUEBA PRUEBA

Puesto:
PRUEBA

Asesor Externo
Nombre:
PRUEBA PRUEBA PRUEBA

Puesto:
Prueba

Figure 8
Organization or Company Data

Source: own elaboration

Conclusions

The development of the Web System of Professional Residence, through the implementation of an artificial intelligence model, has been an enriching experience in terms of knowledge, techniques and methodologies. This process has benefited the students involved, as well as the advisors and teachers who use the system.

The system created optimizes the Professional Residency procedure, allowing more efficient management.

Thanks to the integration of a recommendation model based on artificial intelligence, the time required for the selection of reviewers who analyze the preliminary projects has been significantly reduced, thus improving the efficiency of the process.

Throughout the different stages of the project, there were challenges and obstacles that had to be overcome, such as the definition of the requirements and functionalities of the system, the selection of the appropriate technology and the integration of various components.

However, as progress was made, it was possible to overcome these drawbacks and advance in the implementation of the system. In the third prototype, all the required functionalities were completed, resulting in a robust and efficient system, capable of managing large volumes of information and offering a personalized experience for each user.

In short, the implementation of this system has been a success, not only for the final result achieved, but also for the learning and growth that it has promoted in the team involved. This experience has strengthened the team's skills and laid the groundwork for future projects.

Declarations

Conflict of interest

The authors declare no interest conflict. They have no known competing financial interests or personal relationships that could have appeared to influence the article reported in this article.

Author contribution

Díaz-Sarmiento, Bibiana: Comprehensive support in the development of the project, evaluation and optimization of the development methodology used.

Román-Hernández, Esteban Daniel: Exhaustive analysis of the requirements to understand the processes of the Liaison Office of the Systems and Computer Department, those related to the Professional Residency.

Morales-Hernández, Maricela: Comprehensive analysis of requirements to understand the needs in the Systems and Computing department – Linking Office, system development with a focus on quality and functionality, system implementation, ensuring a smooth transition, and detailed evaluation to measure its performance and effectiveness.

Salinas-Hernández, Fabiola: Initial and final evaluation of the project, methodology to be used; meetings with the team; Comparative analysis of methodologies, proposals for improvement and documentation of results.

Availability of data and materials

The data handled in the research of the Professional Residency Web System implementing an Artificial Intelligence model are available for consultation.

Funding

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To the teachers who spent time entering and testing the data. Evaluating the System and making the pertinent observations.

Abbreviations

MVC. Model View Controller.
RFC. Federal Taxpayer Registry

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