

LILIAN COELHO DE FREITAS  
(ORGANIZADORA)

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*Collection:*

# APPLIED COMPUTER ENGINEERING

## 3

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LILIAN COELHO DE FREITAS  
(ORGANIZADORA)

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*Collection:*

# APPLIED COMPUTER ENGINEERING 3

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O e-book “*Collection: Applied Computer Engineering 3*” consiste em uma coleção de artigos de diferentes instituições de ensino e pesquisa do país, os quais foram organizados em 08 capítulos. Em cada capítulo o leitor(a) irá conhecer uma aplicação diferente da engenharia de computação.

Em seu terceiro volume, este *e-book* traz temas como: persistência de dados, ensino de programação, geração de documentação a partir do código-fonte, integração das plataformas Alexa e NodeMCU, ferramenta web para gestão de carteira de ações, entre outros.

Aos leitores e leitoras, desejo que façam bom proveito do conhecimento disponibilizado.

Aos autores e autoras, registro nosso agradecimento em nome da Atena Editora, por viabilizarem a construção deste trabalho.

Lilian Coelho de Freitas



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## DEVELOPMENT OF A TOOL FOR MANAGING STOCK PORTFOLIOS

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**ABSTRACT:** In the stock market, it is common for an investor to have diversified investments in a set of assets so that possible losses and gains are offset and a profit is finally obtained. The problem of diversification is the control of all the information that is necessary to consult to make decisions to sell or buy the assets that make up each portfolio. In many cases, this control is carried out manually, consulting the different sources of information, and then carrying out the purchase and sale operations. However, this form of management is not very efficient and does not allow global control of the information. This article presents a tool aimed at making it easier for investors to manage stock portfolios so that they have total control of the information and can manipulate a portfolio to modify it through purchase-sale operations. The information offered to the investor by the application is retrieved in real time from specialized websites using webscraping techniques.

**KEYWORDS:** Web application, stock market management, stock portfolios, investment funds, webscraping.

### DESENVOLVIMENTO DE UMA FERRAMENTA PARA GESTÃO DE CARTEIRAS DE AÇÕES

**RESUMO:** No mercado de ações, é comum que um investidor tenha investimentos diversificados em um conjunto de ativos para que possíveis perdas e ganhos sejam compensados e um lucro seja finalmente obtido. O problema da diversificação é o controle de todas as informações que é necessário consultar para tomar decisões de venda ou compra dos ativos que compõem cada carteira. Em muitos casos, este controle é feito de forma manual, consultando as diferentes fontes de informação, para depois realizar as operações de compra e venda. No entanto, essa forma de gestão é ineficiente e não permite o controle global das informações. Este artigo apresenta uma ferramenta que visa facilitar aos investidores a gestão de carteiras de ações para que tenham total controle das informações e possam manipular uma carteira para modificá-la por meio de operações de compra e venda. As informações oferecidas ao investidor pelo aplicativo são recuperadas em tempo real de sites especializados por meio de técnicas de webscraping.

**PALAVRAS-CHAVE:** Aplicação web, gestão do mercado de ações, carteiras de ações, fundos de investimento, webscraping.

### 1 | INTRODUCTION

An investment fund accumulates (Cuthbertson et, 2010) the money of several investors to invest it in aggregate in stocks and bonds, among other financial assets. The

management of a fund (Da Silva et al, 2021) can be passive if it replicates a stock index or active if a management team selects stocks to try to outperform it. One of the advantages of mutual funds is their exposure to different countries, sectors and companies (Delpini et al, 2020), which allows you to diversify an investment in a simple way to distribute the savings between different assets and reduce the risk of losing money (Zaimovic et al,2021). There are web pages specialized in information on investment funds such as Morningstar (Blake et al, 2000) where information on the funds is shown in great detail. However, a problem that arises is when you have a set of funds, also called a portfolio of funds (Desai et al, 2021). In these cases, a difficulty arises in managing them, since it is necessary to access and process an enormous amount of information so that the purchase-sale operations are carried out efficiently (Jenkinson et al, 2016). And for this it will necessarily be necessary to consult each fund individually, make comparisons of the data, and monitor it. All of these tasks must be performed manually. This situation makes the process slow, inefficient and highly prone to errors in information management (Wahyudi et al, 2020). This article describes a web application that has been developed to meet this need and allow users to manage a set of funds (portfolio) in an aggregate manner.

In general, the applications that offer information on financial funds are designed to exclusively (Poterba et al, 2002) offer comparison services and analysis of individual investment funds, but not on investment portfolios (set of funds). Some examples of this type of applications are the following. Morningstar is a mutual fund search tool and has a service that generates detailed portfolio reports. It is considered the reference website since it has the most complete and up-to-date database. Portfolio Performance is an open source tool that allows you to manage and analyze a portfolio. Finect (Franco-Riquelme et al, 2021) is a web application to compare and find the best financial products. In this sense, it allows you to search for funds by themes, showing the most popular and the most profitable. Likewise, it allows analyzing the content of a portfolio by connecting the bank where the portfolio is located to said application. Finally, Allfunds (Özyeşil, 2021) is a fund manager that allows access to more than 200,000 investment funds through a search engine, compare funds and monitor fund portfolios. It is only allowed to access to professionals who work for financial companies.

The article is structured as follows. Section 2 describes the objectives of the system. Section 3 presents the architecture and the data model used. Next, section 4 describes the implementation of the functionality carried out. Finally, section 5 presents a set of conclusions and future lines of work.

## 2 | OBJECTIVES

The main objective of the described application is to allow a user to analyze and manage their portfolios of funds that they own. This objective is specified in the following

more specific objectives:

- The application must allow users to search for and save in a wish list the funds that interest users so that they can later create portfolios in an intuitive and simple way.
- The application must store the portfolios that each user has created in a list, allowing each of them to be edited and deleted.
- The application must allow a detailed view of the geographical and sectoral distribution and the ten largest positions (shares) of the portfolios, among other parameters.
- The application should allow users to sort portfolios by parameters such as return, volatility and expenses.
- The application must allow portfolios to be made public so that other users can comment on them.
- The application must have a search engine for public portfolios.

And for this, a web application has been created with 3 types of actors:

- Unregistered user: represents users who are not registered in the application. An unregistered user will only be able to access the registration form and the login form, therefore it is necessary to be registered to use the application.
- Registered user: represents the registered users and will have access to all the features offered by the application, such as creating portfolios, searching for funds and other services.
- Administrator: represents the person in charge of monitoring the application data, reviewing and updating them when necessary.

Functionally, 3 modules have been defined:

- User module. It refers to the functions of the registered user. A registered user will be able to log in, log out, view their profile and that of other users, modify their profile and delete their account. An unregistered user will only be able to register in the application.
- Funds module. It refers to the functions to manage a fund. A registered user will be able to search for a background, add it to her wish list, remove it from her wish list and save her wish list. From the wish list you can add funds directly to the wallets. You will also be able to check the most popular backgrounds in the application.
- Portfolio module. It refers to the functions to manage a portfolio of funds. A registered user will be able to create a portfolio, edit it, delete it, view it in detail and see a list where all their private portfolios are located. All portfolios you create will be private unless otherwise stated when creating or editing them. The portfolios can be sorted by parameters such as profitability or volatility, among others.

A registered user will also be able to see a list of public portfolios, will be able to comment on public portfolios and will be able to search for them by name.

### 3 | ARCHITECTURE OF SYSTEM

In order to implement the application, an architecture based on a three-tier model has been used, in which each of the levels interacts only with those below it. The three layers are:

- Presentation layer: graphical interface.
- Business layer: implementation of functionalities.
- Data layer: connection to the database.

As for the data model, it has been implemented using a MySQL-type database made up of 5 tables: Users, Investment Portfolios, Investment Funds, Comments, and Wishes.

Note that the data is extracted dynamically and in real time using web scraping techniques from a website specialized in financial information called Morningstart. Thus, for each investment portfolio or set of funds, the data is retrieved:

- Accumulated returns (Patimah et al, 2018)
  - Returns at 3 months, 6 months and 1 year of a portfolio.
  - YTD (year to date) return (Jiang et al, 2019), which represents the return from the beginning of the year to the current date.
- Annualized returns at 3 years and 5 years.
- Volatility (Alaali, 2020). It is what varies the profitability of an asset with respect to its average in a given period. Allows you to measure risk.
  - Volatility at 3 years
  - Volatility at 5 years
- Commission. Represents the total commission of the set of funds in the portfolio, calculated taking into account the weights of the funds in a portfolio and the commission of each of them.
- PER (Delpini et al, 2019). It is the ratio that compares the price of a share to the earnings per share of a company. The PER of a fund is the sum of the PER of all its securities, taking into account the weight of each of them. Therefore, the PER of a road is the sum of the PER of all its funds, considering the weight of each one of them on the portfolio that we have created.
- Geographical distribution. It represents in which geographical areas the investments of a portfolio have greater weight.
- Sector distribution. Represents in which sectors the investments of a road have

greater weight

- Ten first actions. They represent the stocks (companies) with the greatest weight in the portfolio

## 4 | IMPLEMENTATION

This section describes the functionalities implemented.

### 4.1 Register and login

In order to use the application it is necessary to be registered in the application. A user who is not logged in will only have access to the registration and login forms (Figure 1).

The image shows two side-by-side mobile application screens. The left screen is titled 'Registro' (Registration) and features a form with the following fields: 'Email' (with the placeholder 'name@example.com'), 'Usuario' (with the placeholder 'Usuario'), 'Contraseña' (with the placeholder 'Contraseña'), 'Repetir contraseña' (with the placeholder 'Repetir contraseña'), and 'Foto' (with a 'Choose File' button and the text 'No file chosen'). A green 'Registrarse' button is at the bottom. The right screen is titled 'Login' and features a form with 'Email' (with the placeholder 'Email') and 'Contraseña' (with the placeholder 'Contraseña') fields. A green 'Iniciar sesión' button is at the bottom.

Figure 1. Registration and Login view

In case of trying to access the rest of the menu options, an error message will be displayed and the user will be redirected to the login view. Once registered in the application, you can use the rest of its features.

### 4.2 Fund finder

Through the search engine (Figure 2), a user can find funds of different themes or investment styles. To do this, you can use keywords related to the fund you are looking for or use an identification code or its name. For each search result, the following is displayed: the name of the fund, its identification code, and the accumulated return since the beginning of the year.



Figure 2. Fund finder

### 4.3 Wish list

The wish list is used to keep in memory the funds that the user wants to add to future wallets (Figure 3). The wish list is accessed via the “My Wish List” (“Mi lista de deseos”) link in the menu. The wish list can be modified by removing and adding funds.

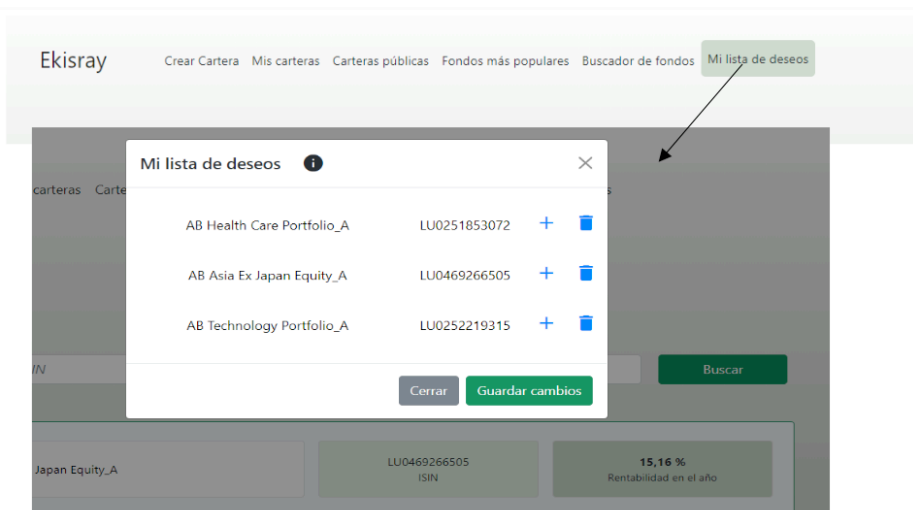


Figure 3. Wish list

The funds are added to the wish list from the application’s search engine (Figure 4).



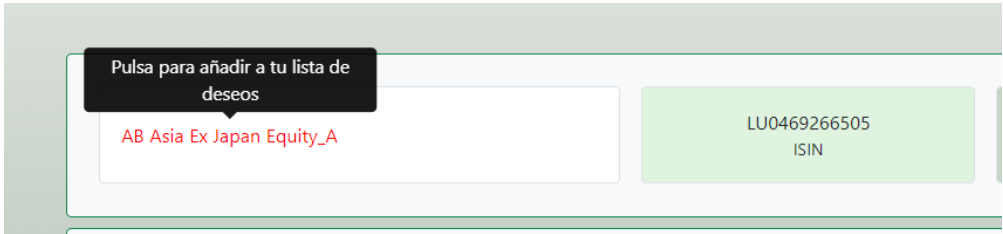


Figure 4. Add to wish list

The list is saved in the system database when the user clicks the “Save Changes” (“Guardar cambios”) button.

#### 4.4 Portfolio creation

In order to create a portfolio, a form is used (Figure 5) where it is necessary to enter the ISIN codes of the funds that are to be included in it, and the weights that each fund is going to represent in its set (the sum of the weights of the set of funds of a portfolio must always be 100, otherwise the system does not allow it to be created). The code of a fund can be entered by searching for the ISIN code that identifies it on the web or by adding it directly from the wish list (by pressing the + sign that appears at the bottom of the wish list).

Figure 5. Portfolio creation

Depending on the number of funds that a portfolio is made up of, there are two buttons on the form that allow us to add and delete rows.

Once the funds and the weights that are going to represent in the portfolio have been added, then the name of the portfolio, the description and whether the portfolio will be public or private (by default) are entered. If it is public, it will be accessible by all users. To implement the creation of portfolios, it is necessary to collect information from morningstar (website that contains detailed information about investment funds). Specifically, from each fund is extracted: the name, the management fees, and the code that identifies it in morningstar. The codes that identify the funds in morningstar are necessary to generate the portfolio reports.

## 4.5 List portfolios

The user can access a list of the portfolios that they have created in the “My portfolios” (“Mis carteras”) section (Figure 6). This view contains a list with all the portfolios created, showing the 4 funds with the greatest weight for each portfolio and their most relevant parameters. The list can be sorted by each and every parameter, making it very useful for comparing portfolios. Also in this list you can edit or delete any portfolio.



Figure 6. List Portfolio

The following information is available for each portfolio: name of the portfolio, date on which it was created, label that indicates if it is public, and 3 icons: the first icon accesses the details of a portfolio, the second allows you to edit it, and the third delete it. The 4 funds with the greatest weight are shown in the first quadrant, returns in the second, and volatility, commissions and PER in the third. The return, volatility, fees and PER of a portfolio, among

other data, are obtained by calling a URL that generates a report with detailed information on a portfolio or group of funds. To call the URL, you need the code that identifies each fund in morningstar (extracted from its website when creating the portfolio) and the weight of said fund in a portfolio. Once the report is generated, the necessary information is extracted and eliminated.

The screenshot shows a dashboard for 'Cartera Tecnológica' (Public) as of 2021-08-31. It is divided into three main sections: 'Fondos', 'Rentabilidades', and 'Datos'.

Fondos	Rentabilidades			Datos	
25 % - Next Generation Technology Fund A2 EU...	<b>3 meses</b> 12,83 %	<b>6 meses</b> 8,18 %	<b>1 año</b> 39,31 %	<b>Comisión</b> 1,85 %	<b>PER</b> 41,88
25 % - World Technology Fund A2 (EUR)					
25 % - International Technology Portfolio A Acc ...	<b>YTD</b> 14,19 %	<b>3 años/an</b> 33,39 %	<b>5 años/an</b> 33,15 %	<b>Volatilidad 3a</b> 22,66 %	<b>Volatilidad 5a</b> 19,20 %
25 % - US Technology Fund A (acc)					

Figure 7. Information of a fund of the portfolio

#### 4.6 View details of a portfolio

The user can access the details of each portfolio in their list by clicking on the first icon that appears in each portfolio in the list (Figure 8). From the details of a portfolio you can view the geographical and sectoral distribution in two sector diagrams, the first 10 stocks (companies) with the greatest weight in the portfolio and the list of funds that make up the portfolio.

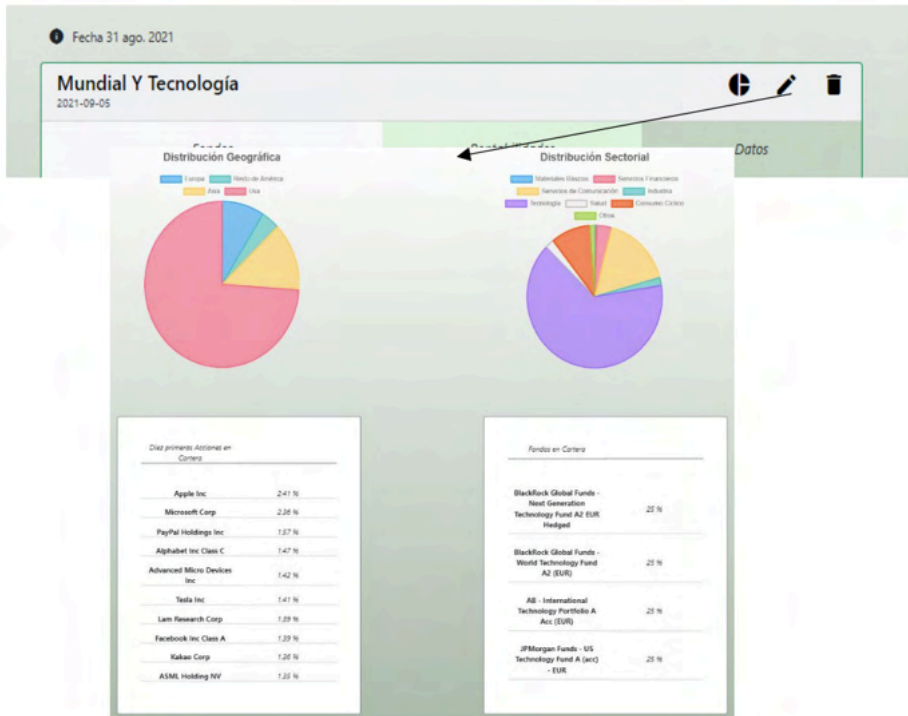


Figure 8. Details of fund of a portfolio

#### 4.7 Public portfolios and investor social network

A user can make their wallets public so that other users will have access to it in the list of public wallets. To see the public portfolios of the rest of the users, we can access the “Public Portfolios” (“Carteras públicas”) menu option (Figure 9). The list of public wallets can be sorted by different parameters and filtered by name.

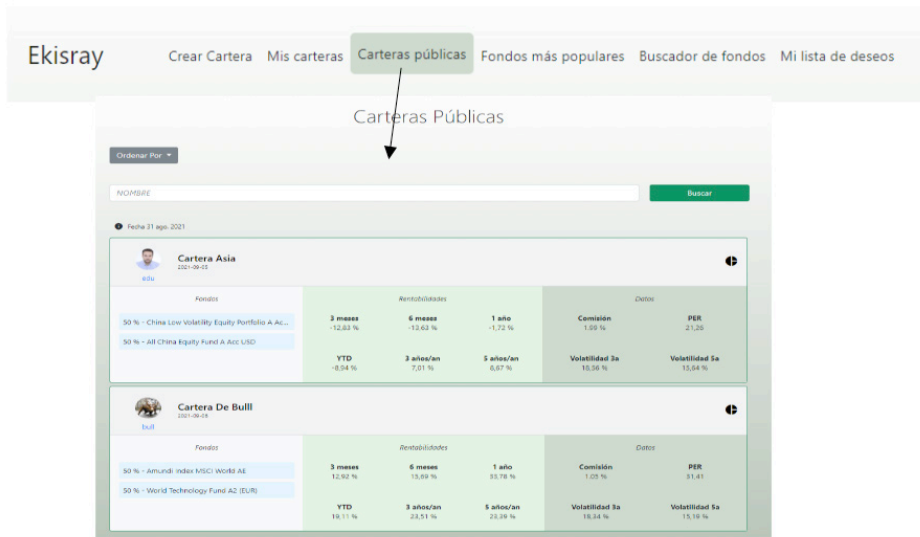


Figure 9. List of public portfolios

In a public portfolio, its composition is specified, as well as the user who created it (being able to access their profile: email, username and list of published portfolios), and add comments (Figure 10).



Figure 10. Add comment to public portfolio

Finally, from the “Most popular backgrounds” option in the menu (Figure 11), you can see the most popular backgrounds of the application.



Figure 11. List of top funds

## 5 I CONCLUSIONS AND FUTURE WORK

This article has presented a web application that aims to help investors manage portfolios of active investment funds so that they can carry out purchase-sale operations with real-time information obtained from specialized websites. In this sense, the application offers tools for searching and retrieving information, creating portfolios, adding new funds or modifying portfolios. In this way, investors have access to information in a global and updated way that allows more efficient decisions to be made. Likewise, the application allows users to make comments about a portfolio, share comments, make suggestions, share assets and/or portfolios and perform analysis and statistics with stock information.

However, the application can be improved. In this sense, there are the following lines of future work:

- Development of an API for data extraction that automates the process and is easily configurable for new sources of information. In addition, the use of APIS would allow the creation of value-added services and the reuse of the services created from other different applications.
- Expand the type of analysis and statistics that are generated to exploit the information more efficiently.
- Add new functionalities so that the application can manage stock portfolios instead of investment funds, replicating the same type of functionality that was implemented for fund portfolios.

- Implement a recommender that proposes to the user the purchase-sale operations of their assets according to the information retrieved by webscraping, thus facilitating the management of investments for users.
- Implement a functionality that allows simulating the behaviour of a portfolio or investment fund before a user creates the portfolio.

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