Software Design Document

Job Offers System

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Semester 3 individual project

Contents

Versions

Versions	Date
SWDD version 1	17 Sep 2021
SWDD version 2	8 Oct 2021
SWDD version 3	5 Nev 2021
SWDD version 4	26 Nev 2021
SWDD version 5	17 Dec 2021

Introduction

Document Purpose

The purpose of this document is to outline the technical aspects of the Job offers System and the technologies used to develop and implement the website. The goal of this document is to give the reader a better understanding of how the application is being developed and implemented through examples of requirements, constraints, and system architecture.

System Overview

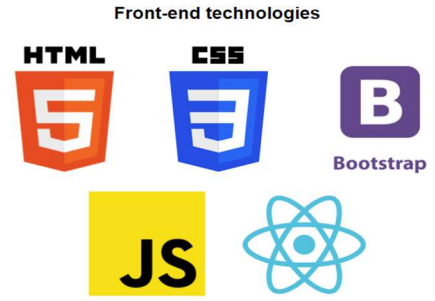
General Description

The job offers website provides many job vacancies for people who are looking for a job, allowing them to easily find a job that suits them. The website also allows companies that are looking for new employees to place job vacancies on the website so that job seekers can see it and apply to it.

Technologies Used

For building this full-stack web application I am using the following tools:

Front-end / Client-Side tools
- HTML5 - CSS3 - JavaScript - Bootstrap - This is HTML and CSS based framework and supports JavaScript. - React.js - progressive JavaScript framework for building user interfaces.



Back-end / Server-Side tools
- Java - MySQL - Spring – Java framework for building web applications with REST APIs - Hibernate – ORM framework for Java - GitLab for version control - GitLab CI/CD for continuous integration and deployment - SonarQube for software quality metrics

Choices

I am using DOT framework to research for the best technologies to use in my application. The DOT framework helps me to structure my research and to communicate about it. It contains 3 important levels: The What of research and Why and How.

So, what is the purpose of my research?

The purpose of this research is to know the best technologies that can be used in my project that will allow me to create a website.

Why I have to research to these technologies?

Because nowadays there are many technologies to use in web development, but not all of them are suitable to use in my project. every technology has pros and cons and that's why I'm doing a research to know which one is better to use. The technologies I research should include as follows:

- backend

1- Best performance.
2- Supports dependency injection.
3- Supports ORM (an object-relational mapping tool).
4- Has a good security libraries to secure my website?

- Frontend

1- Best performance.
2- Supports virtual DOM
3- Has not steep learning curve
4- Allows me to use more UI libraries like “MUI and Bootstrap”

How do I research these technologies?

I will be using the library method in the DOT framework to search for the best technologies to use in my project. Then I will compare each technology to know if it meets the requirements I want for my project.

Backend

I searched for the most popular backend frameworks and I'll put them in the spotlight to decide which one is best to use for the project.

1- Comparison of backend frameworks:

1.1 Laravel / PHP

- Advantages: (Writer, 2021)

- Based on MVC (Model-View-Controller) design architecture.
- It has Eloquent ORM to connect with database.
- uses all the latest PHP features.

- Disadvantage: (Writer, 2021)

- It may seem complicated at first.
- has a few issues regarding versions with long-term supports.

1.2 Spring or Spring Boot / Java

- Advantages (Kushnir, 2021)

- the most popular Java Framework.
- Easy to learn and has a large community support.
- Spring includes Spring Security - a Robust security framework to secure applications.
- Includes Spring Data to connect with database.
- open-source community.

- Disadvantage: (Kushnir, 2021)

- it has high learning curve.

1.3 Express / Node.js

- Advantages: (Kopachovets, 2020)

- High-performance for real-time applications.
- Easy to learn and has a large community.
- allows you to use the same language which is JavaScript both on the back end and front-end.
- open-source community.

- Disadvantage: (Kopachovets, 2020)

- Has lack of library support
- Security issues

2- Back-end choices:

For the Job Offers website I have decided to use Spring boot as a backend because it helps me build API's and it is the most popular Java Framework and has the biggest community support. Also, it makes switching implementations easier by using dependency injection. In addition, Spring boot includes Spring Security - a Robust security framework to secure applications. It focuses on providing both authentication and authorization to Java applications. It has Spring Data JPA to connect to the database.

Frontend

To use the best front-end framework that fits the project very well, I researched the best front-end frameworks. The results are as follows:

1- Comparison of Frontend frameworks

1.1 React

- Advantages: (Grabski, 2020)

- Easy to learn and has a large community.
- open-source community.
- Allows you to create reusable components.
- allows us to create large web applications that can change data, without reloading the page.

- Disadvantage: (Grabski, 2020)

- It is a UI library only and doesn't support MVC design architecture.

1.2 Angular

- Advantages: (shah, 2021)

- Uses TypeScript.
- It supports MVC (Model-View-Controller) design architecture.
- open-source community.

- Disadvantage: (shah, 2021)

- It has steeper learning curve.

1.3Vue.js

- Advantages: (Patel, 2019)

- Easy to use.
- It allows you to build reusable components.
- has the speed and size advantage

- Disadvantage: (Patel, 2019)

- Limited resources because it is still a young framework.
- Lack of support for large projects.

1- Frontend choices

In the Frontend I have decided to work with React JS because it is easy to learn and it allows us to create large web applications that can change data, without reloading the page. It also allows us to create reusable UI components that can be used in various parts of the application to build more than one UI instance.

Database

I have chosen to use MYSQL because I have some experience how to use it. In addition, I have an online MYSQL database from Fontys and it is better than using localhost database. Also, I have decided to use JPA because it allows me to create tables in the backend, it gives me many features I need in order to store data in the database and it saves me time to develop another important things in the project.

System Architecture

Architecture design

The Job offers System application will follow a N-Tier Architecture so that the objects in the system as a whole can be organized to best separate concerns and prepare for distribution and reuse (SOLID principles). A principal advantage to this design is the relative stability of the components. Implementations may change considerably to enhance the performance or in response to changes in the architecture. These changes are less likely to cause major impact to the applications' programs.

C4 Architecture

After careful consideration, the choice was made to work with C4 architecture because the C4 model for software architecture describes a procedure for documenting and designing software architecture through diagrams. The heart of the approach is that you can use no more than four diagrams to represent most systems in enough granularity to implement them.

Level 1: System Context diagram

The system context diagram is the highest level in a data flow diagram and contains only one process, representing the entire system, which establishes the context and boundaries of the system to be modeled. It identifies the flows of information between the system and external entities (i.e., actors).

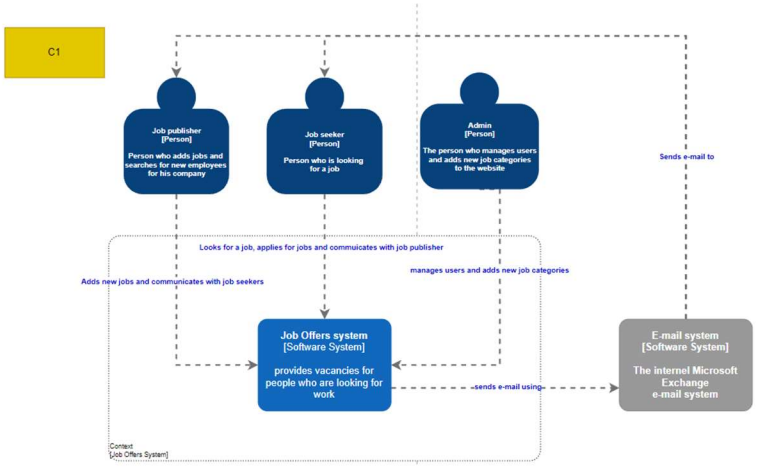


Figure 1: C1 diagram

Explanation C1:

Job offers system: A software system that offers vacancies to job seekers. In addition, the system offers companies the opportunity to post vacancies to find new employees.

E-mail system: An e-mail system is used to notify the users when new vacancies are posted on the website or when they have received new messages.

Job seeker: Person who searches for jobs, can apply to them, send messages to the job publisher (company), see the past applications, and add jobs to their favorite list.

Job publisher (Company): Person who can add and manage vacancies, see the candidates who have applied to the vacancies he has posted on the website and can send messages to job seekers.

Admin: Person who manages users, can add new job categories to the website and checks if the company (Job publisher) to be registered on the website exists and complies with the website terms.

Level 2: Container diagram

The Container diagram shows the high-level shape of the software architecture and how responsibilities are distributed across it. It also shows the major technology choices and how the containers communicate with one another.

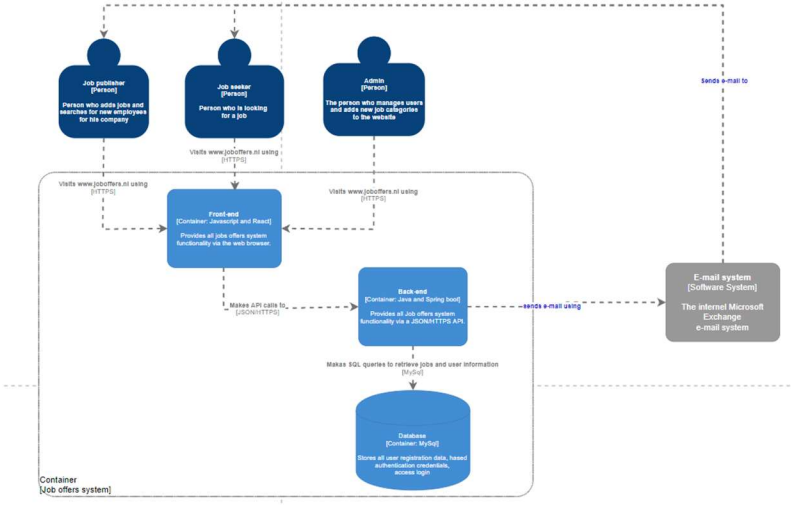


Figure 2: C2 diagram

Explanation C2:

Frontend: The front end of a website is everything the user either sees or interacts with when they visit the website. It is responsible for the total look and feel of an online experience. The frontend provides all jobs offers system functionality via the web browser. The technologies used in front end are React JS, CSS, Bootstrap, and HTML.

Backend: The back end of a website is everything that goes on behind the scenes, from servers to databases, and much more. The backend provides all Job offers system functionality via a JSON/HTTPS API. The technologies used in back end are Java and spring boot.

Database: stores all user registration data and system data.

How does frontend and backend work together?

Frontend and backend communicate with each other via Http requests. The frontend will, for example, send entered data to the backend. The backend might then again validate that data and finally store it in the database.

Level 3: Component diagram

Component diagrams are used to visualize the organization and relationships among components in a system.

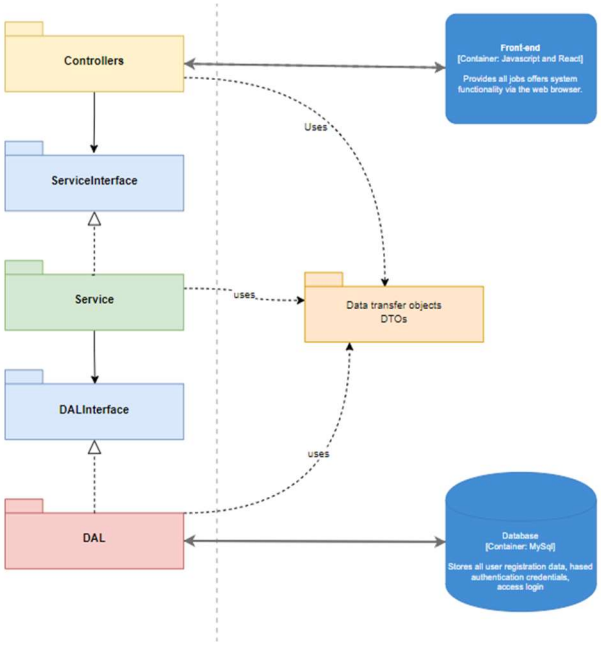


Figure 3: C3 diagram

Explanation C3:

An n-tier architecture has been chosen, with interfaces between layers. DTOs are used on all layers

Controllers or presentation layer: The top-most level of the application is the user interface. The main function of the interface is to translate tasks and results to something the user can understand. it is the endpoint of the backend and it gets HTTP call from Frontend.

Service Interface: The service interface layer is used in the presentation layer using dependency injection.

Service layer: This layer coordinates the application, processes commands, makes logical decisions and performs calculations. It also moves and processes data between the two surrounding layers. The service layer will implement the service interfaces.

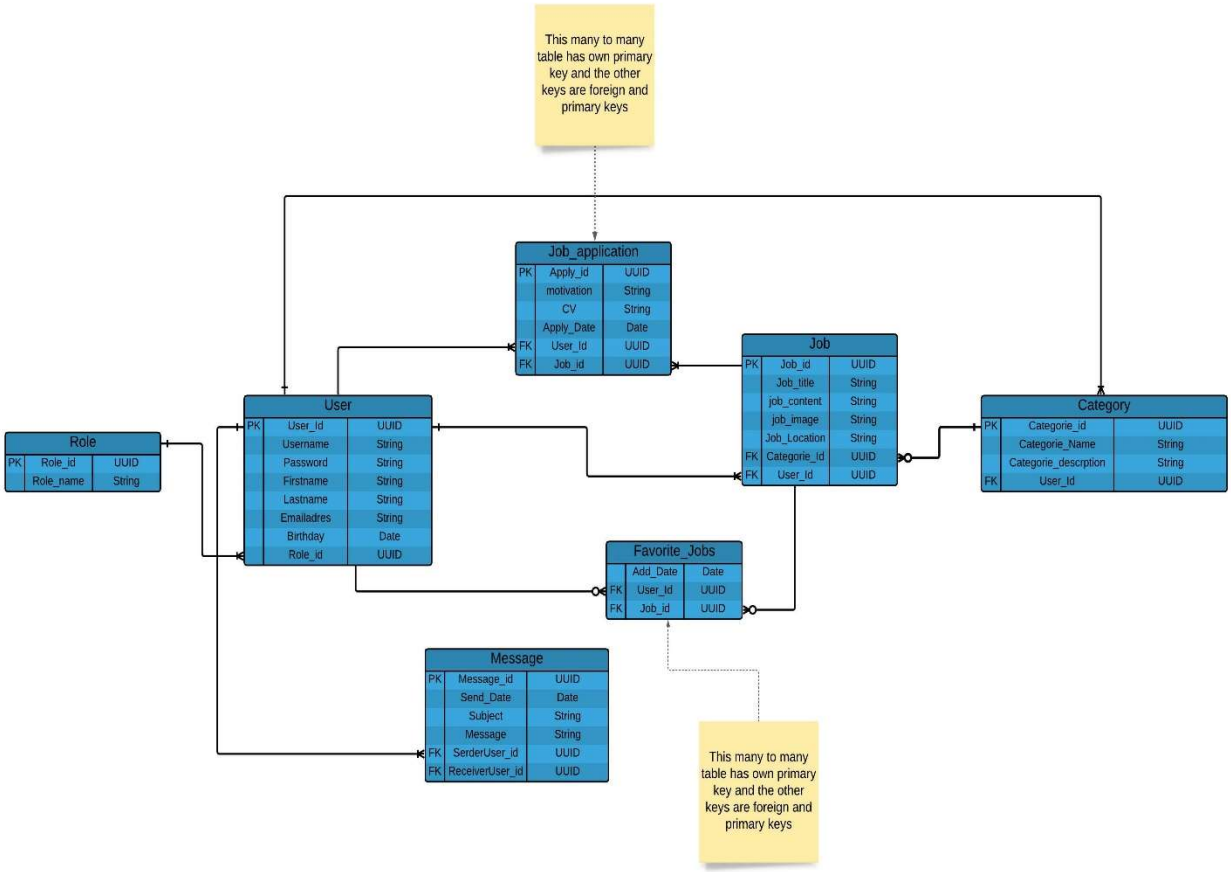
DAL Interface: The DAL interface layer is used in the service layer using dependency injection.

DAL or Data access layer: Here information is stored and retrieved from a database. The information is then passed back to the service layer for processing, and then eventually back to the user.

Data transfer objects DTO: A Data Transfer Object is an object that is used to encapsulate data and send it from one subsystem of an application to another.

Data Design

Entity-Relationship diagram



Design decisions

Using UUID

I have decided to use UUID as primary key instead of int because of security issues. A UUID is more difficult to remember than a simple number. So, someone passing by, having a glance at your screen would not be able to know what file number you are working on. Hacking into a system to retrieve information is more difficult if you don't know what you're looking for or where to look. (Steele, 2019)

Using DTO

A Data Transfer Object is an object that is used to encapsulate data, and send it from one subsystem of an application to another. DTOs are most commonly used by the Services layer in an N-Tier application to transfer data between itself and the UI layer. The main benefit here is that it reduces the amount of data that needs to be sent across the wire in distributed applications.

Storing Files

There are multiple ways to store files, the first way was to save it in my own device. It is a good solution, and it doesn't have any impact on the project, but it takes a lot from the memory of my laptop. The second way is to store the files in the database using @Lob. LOB allows us to store large files in the database, but if the size of the files is too large, it will have impact on the performance of the database and the entire system. The last and the best option I found is to store the files on the cloud file storage (aws.amazon, 2021), but I need some knowledge and experience to work with cloud file storage servers. So, I have decided to store the files in the database, and I will not allow to store the files that have large size, but in the future, I will try to use cloud file storge to store files.

Paging the data

In the background I will be using pagination. Pagination is used to avoid loading too much data in one web request. This means only displaying a portion of the items, not all at once. The use of pagination is very important to the performance of the website.

Security-related design decisions

For authentication and authorization, JobOffers website uses Spring Security. Spring Security is a framework that provides authentication, authorization, and protection against common attacks. With first class support for both imperative and reactive applications, it is standard for securing Spring-based applications. Before users can make a request with the API, they will need to authenticate the request by providing a JWT token in the request's header. JobOffers website uses Bearer JWT token authentication instead of Basic. The name "Bearer authentication" can be understood as "give access to the bearer of this token." The bearer token is a cryptic string, usually generated by the server in response to a login request, unlike the Basic authentication which is the user ID and the password being passed over the network as a base64 encoded text. Base64 is a reversible encoding, therefore the basic authentication scheme is not secure.

WebSockets

I have decided to add WebSockets to my website because WebSockets allows me to have an interactive and real-time chat between users. WebSockets API is an advanced technology that makes it possible to open a two-way interactive communication session between the user's browser and a server. With this API, you can send messages to a server and receive event-driven responses without having to poll the server for a reply.

Test Strategies

- Why you test

We must test the software that we made thoroughly to check if there are any bugs or errors in the software so that we can identify them early and fix them before the software product is delivered. So, it is very important to ensure product quality to save time, customer satisfaction, etc.

- What you test

First of all, it is very important to test the code (C4 part of C4 architecture) of the system to ensure that the units are working as defined and are integrated in a correct way and working together as expected. We test the code using Unit testing.

Secondly, we have to check if all components of the system to make sure that the code works fine and doesn't have any errors or bugs. This kind of test called integration testing.

Thready, we have to test the behavior of whole system to ensure that the system is correctly behaving as defined in the requirements and user stories. (System testing)

Finally, we have to do the last test before the software product is delivered to the customer. This is acceptance testing which means that we have to test with respect to user needs, requirements and business processes, which is conducted to determine if the system satisfies the acceptance criteria (defined as part of the stakeholder's requirements)

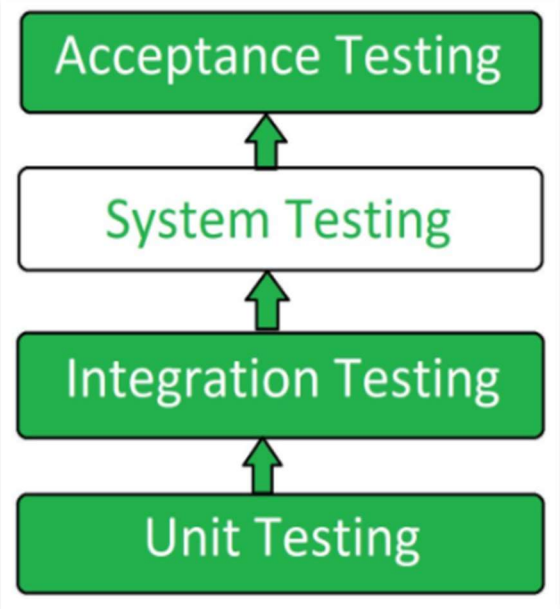
- How to test

For unit testing I have decided to use Junit5 and Mockito to mock the data so that I can test the Service layer and for Data access layer I am going to use Dependency injection and Junit5 to test this layer.

If all units are working fine, I start doing integration testing for the whole backend, but the question is which tool do I need for integration testing. I saw many tools that can use, but I have decided to use Newman with postman because it is easy to use and I can have it in my Gitlab CI/CD pipeline. Also, I will test to the most important controllers using Mockito and Junit5.

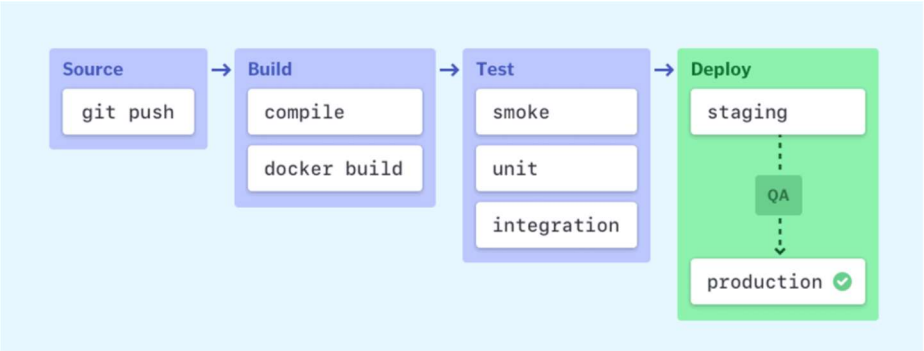
When Unit testing and integration testing are finished successfully, I am going to start with system testing where I have to test the entire system. I already made test cases to test the user stories and its acceptance criteria. So, in this test I am going to see if the test cases are passed or failed.

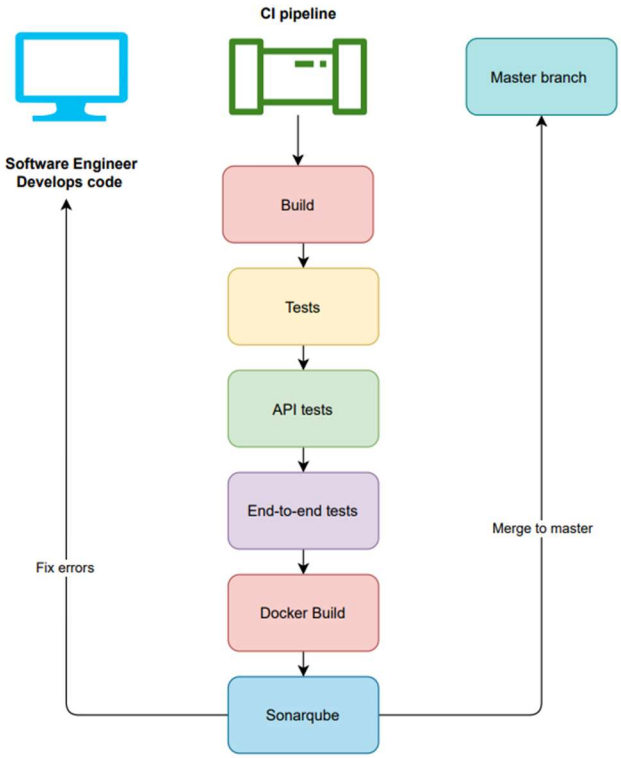
Finally, the last test is acceptance testing. Here we have to test with respect to user needs, requirements and business processes, which is made to determine if the requirements of the end customer are satisfied.



CI/CD setup

I have decided to use CI/CD environment as a test environment on Gitlab because this allows us to receive and respond to customer feedback much faster than before. Updates could be deployed and made live for the user in as little as just minutes after the developer has written the code. This picture below describes the CI/CD environment of the project.





Explanation:

The CI/CD pipeline contains 4 stages (Build, Test (Unit testing), SonarQube and integration testing). Failure in each stage typically triggers a notification via email to let me know about the cause. Otherwise, I receive a notification after each successful deployment to production.

1- The first stage is the source code. That is the code you push to the Gitlab repository.
2- The second stage is the build stage. You build the project to see if it works fine without any problems.
3- The third stage will be the test stage. You need to see if the testing of the project works fine without having bugs and errors. You have to use unit testing, integration test and SonarQube to ensure product quality of the project.
4- The last stage will be the deployment stage. Once you have built a runnable instance of your code that has passed all predefined tests, you're ready to deploy it. I will use Docker to run my application and deploy it.

Bibliography

Anon., MAY 23, 2015. *GoodWorkLabs*. [Online]
Available at: https://www.goodworklabs.com/top-6-advantages-of-php-over-other-programming-languages/

Grabski, T., 2020. *Pagepro*. [Online]
Available at: https://pagepro.co/blog/react-js-pros-and-cons-in-2020/

Kopachovets, O., 2020. *Pro Coders*. [Online]
Available at: https://procoders.tech/blog/advantages-of-using-node-js/

Kushnir, A., 2021. *Bamboo Agile*. [Online]
Available at: https://bambooagile.eu/insights/pros-and-cons-of-using-spring-boot/

Patel, R., 2019. *Ronak Patel*. [Online]
Available at: https://ronakataglowid.medium.com/pros-and-cons-of-the-vue-js-framework-8015dcbc05ef

shah, K., 2021. *ThirdRock*. [Online]
Available at: https://www.thirdrocktechkno.com/blog/limitations-and-benefits-of-using-angular-in-your-project/

Writer, A. R., 2021. *Light of the future*. [Online]
Available at: https://light-it.net/blog/why-use-php-main-advantages-and-disadvantages/

The C4 model for visualizing software architecture: https://c4model.com/

Software Architecture Patterns book: https://www.oreilly.com/library/view/software-architecture-patterns/9781491971437/