**BILKENT UNIVERSITY**

**ENGINEERING FACULTY**

**DEPARTMENT OF COMPUTER ENGINEERING**

**CS 399**

# SUMMER TRAINING REPORT

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**Performed at**

## Meteksan Defense


**08.08.2022-05.09.2022**

# Table of Contents

1 Introduction ..... 3
2 Company Information ..... 3
2.1 About the company ..... 3
2.2 About your department ..... 3
2.3 About the hardware and software systems ..... 3
2.4 About your supervisor ..... 4
3 Work Done ..... 4
4 Performance and Outcomes ..... 8
4.1 Solving Complex Engineering Problems ..... 8
4.2 Recognizing Ethical and Professional Responsibilities ..... 8
4.3 Making Informed Judgments ..... 9
4.4 Acquiring New Knowledge by Using Appropriate Learning Strategies ..... 9
4.5 Applying New Knowledge as Needed ..... 9
4.6 Awareness About Diversity, Equity, and Inclusion ..... 9
5 Conclusions ..... 10
References ..... 11
Appendices ..... 12

# 1 Introduction

Between the dates 08.08.2022 and 05.09.2022, I was able to make my internship in the radar software design department of Meteksan Defense company. Meteksan Defense was established in 2006 and is one of the largest defense companies in Turkey. Therefore, as a Computer Science student in one of the most prestigious universities in Turkey, the motivation for me to do my summer training in Meteksan Defense is to improve my programming skills as well as my vision in such a company where there is no room for mistakes. My desire was to learn what type of projects are being developed, what type of technologies are being used, and how the process of development and operations are being managed in a company of defense industry. I worked for the front-end part of a radar software system that is in production. I was able to use certain technologies, such as React.js, Cesium, QGIS, GDAL, and GeoServer to be coherent with the already-developed project. Contributing to a project in a real production was essential for me to understand what problems an engineer in a company of defense industry can face, and how to overcome such problems throughout my internship. With an experienced and thoughtful supervisor, I was able to learn these concepts by contributing to a real project that is used in such a significant field.

# 2 Company Information

## 2.1 About the company

Meteksan Defense was established in 2006 by collecting the high technology companies that are operating within Bilkent Holding. The main aim of the company is to serve the Military of the Turkish Republic by developing and operating national high-technology radar, sonar, and communication systems. The systems produced by Meteksan Defense are used for command control, communication, reconnaissance, and surveillance purposes in surface and underwater platforms, helicopters, and unmanned aerial vehicles.

## 2.2 About your department

The department I was accepted for my training program is Radar Software and Design. In Meteksan, Radar Software and Design department has various services which are respectively:

- Developing and customizing radar software systems specifically for the project.
- Designing and determining project requirements for a radar system project.
- Customizing and renewing legacy systems according to customer needs.
- Planning and managing the development lifecycle for different radar system projects.

Even though most of the departments of defense companies use the waterfall method to manage a development lifecycle in the department, the Radar Software and Design department adopts a more agile methodology to manage a development lifecycle.

## 2.3 About the hardware and software systems

Meteksan Defense provides its own computers since it is forbidden to use personal computers within the company boundaries. Besides, since the company serves for Turkish Military, there might be sensitive and important data stored in the hardware

systems of the company; therefore, the computers are being differentiated from each other by allowing internet access. There are computers having internet access named internet computers, whereas there are other computers that do not have internet access named intranet computers. However, even though some computers have internet access, the internet comes from specific routers with ethernet cables, not with wireless connections, and all of these computers have limited permissions that are controlled by a software system that provides security inside of the company.

### 2.4 About your supervisor

**Supervisor Name:** Doğancan Şen
**Job Title:** Chief Software Design Engineer
**Bachelor's Degree**:
-**University**: Başkent University
-**Department**: Computer Engineering
-**Graduation Year**: 2009
**Master's Degree**:
-**University**: Middle East Technical University
-**Department**: Software Engineering
-**Graduation Year:** 2018

## 3 Work Done

At the beginning of my training program, my supervisor asked about my interests to understand how I can contribute to the projects that they are developing. According to my interests, my supervisor instructed me to make research on what is GeoServer and why it is used along with what is Cesium. At first, I searched these terms and their usage, and I saw that GeoServer is a java based server that allows processing, storing, and requesting geographical data, whereas Cesium is an open-source JavaScript library for creating customized and processing 3D maps. There was no person that used GeoServer and Cesium before in the company; therefore, my supervisor asked me to discover the process of installing, setup and using GeoServer and Cesium at the same time.

Firstly, I tried to search how to install and set up the GeoServer by reading its own documentation because there are few documents that exist on the internet about GeoServer and its installation. There were three different sources to download the setup respectively: Windows installer, macOS installer, and Web Archive. Since the computers that Meteksan Defense provided were Windows-based computers, at first, I installed the Windows Installer of GeoServer. However, it was not able to work in the first place because when I installed it, the software automatically installs the last version of Apache Tomcat which is a container application for java web applications, whereas the Java (JRE and JDK) versions of the computer that I used was not synchronized with the required Java (JRE and JDK) versions of the last version of Apache Tomcat. Due to the fact that the permissions are not enough to change the Java versions of the computer, I decided that using Web Archive as an Installer for GeoServer would be a more rational choice. Therefore, I installed the Web Archive of the GeoServer and separately installed the 9th version of Apache Tomcat separately to make the Java versions of my computer and Apache Tomcat synchronous. Then I copy the file with the ".war" extension from the installed folder of Web Archive of GeoServer and pasted it into the "webapps" folder inside of the Apache Tomcat folder. Hereby, using the build file of GeoServer I deployed the GeoServer application into the Tomcat which uses the local host and port 8080 as default. After

these actions, I tried to execute Apache Tomcat by executing the “startup.bat” file inside of the bin folder of Apache Tomcat; however, I realized that there was no environment variable called “JAVA_HOME” on my computer. As a result, Apache Tomcat could not view any Java (JRE and JDK) to execute. Then by getting permission from my supervisor, I was able to add a “JAVA_HOME” environment variable to my computer by using the paths of the JRE and JDK that already exist. After adding the required environment variable, Apache Tomcat was executed and GeoServer was deployed on the URL “https://localhost:8080/geoserver”. Then, using the documentation of GeoServer, I tried to understand what type of data can be stored, processed, and uploaded to GeoServer. As demonstrated in Figure 1, there are various types such as shapefiles, PostGIS (PostgreSQL for geographical data), and GeoTIFF.

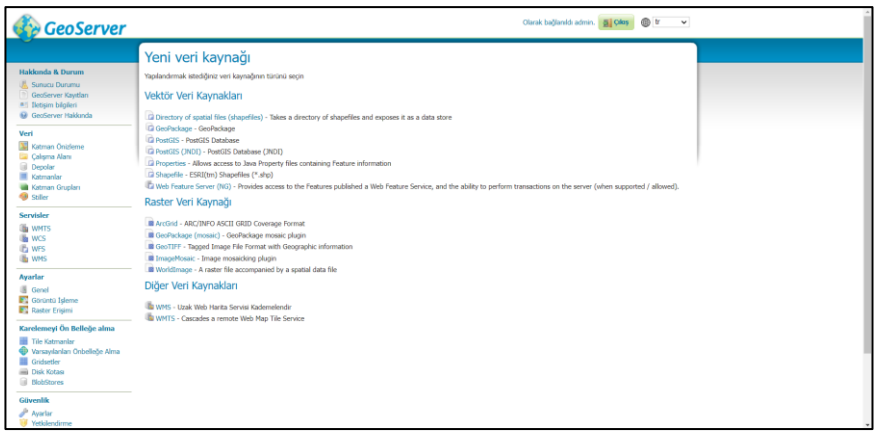


Figure 1

My supervisor stated that they have files with “.tiff” extensions, and they want to store these files. Then, according to my research, GeoServer uses GeoTIFF for the data with the “.tiff” extension, and thus I added GeoTIFF data store to the GeoServer which is evaluated under Raster Data Source in Figure 1. Then, according to the documentation, when a data store is uploaded to the server, a layer should be created for it to be previewed. As demonstrated in Figure 2, these layers are created according to the type of the particular data store.

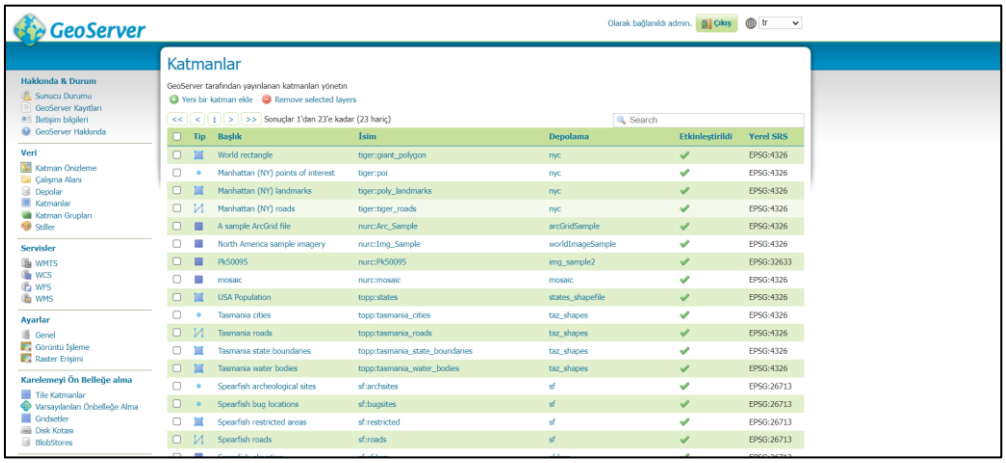


Figure 2

While creating layers for each data store, I observed that the system automatically calculates the borders for these data stores, which indicates that GeoServer automatically determines the coordinates of the data store in the World. After

creating layers for each data store, GeoServer makes this data viewable in OpenLayers which is a JavaScript library that visualizes geographical data, and for this purpose, there is another segment called “Layer Preview” as demonstrated in Figure 3 to preview each layer in OpenLayers.

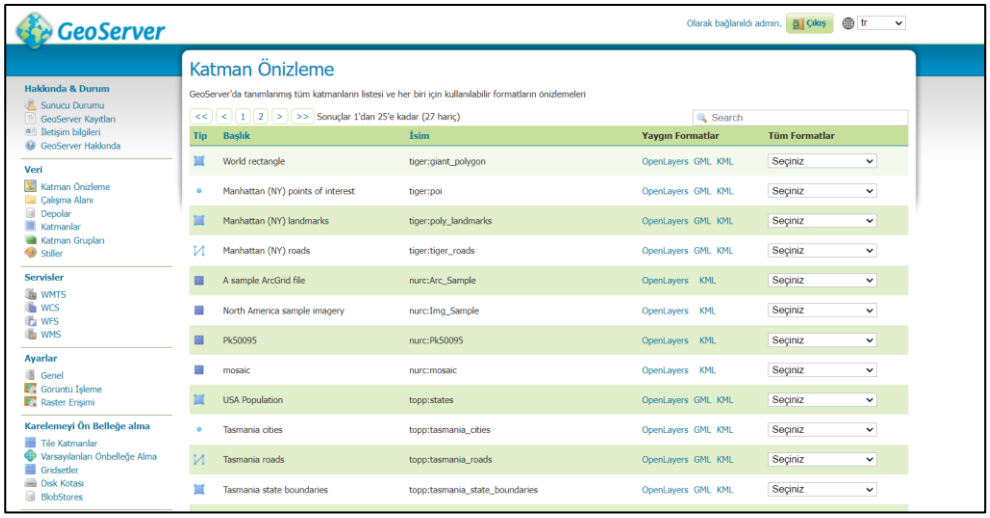


Figure 3

After understanding the Layer Preview section, I previewed all the data that I uploaded; however, I could preview them one by one. I knew that my supervisor wanted me to preview these data not separately but all together. Therefore, according to the documentation, there was a section called “Layer Groups” which enables to create one Layer from the collection of different Layers created by different data stores that is demonstrated in Figure 4.

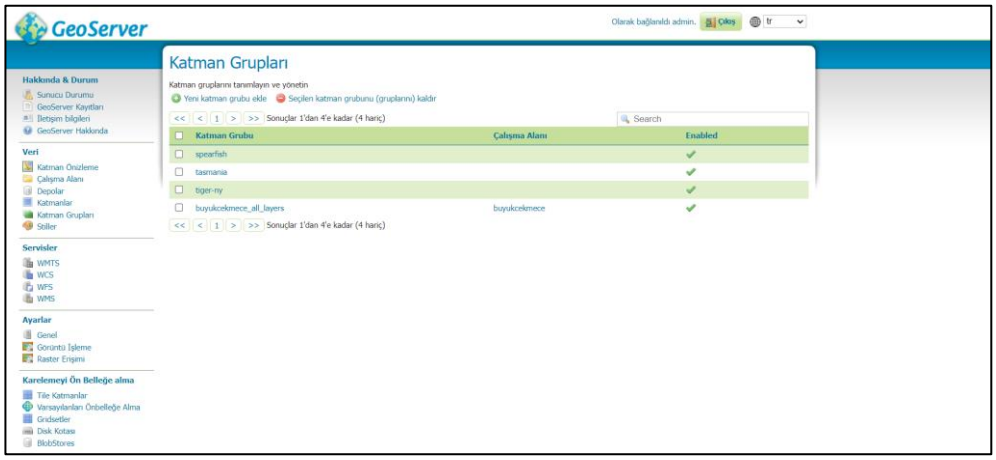


Figure 4

While creating a layer group by using the layers that I have created from the data stores, I observed that GeoServer automatically calculates the coordinates for all layers, as well. The process of creating a layer group requires choosing the already created layers one by one. After creating a layer group, the layer preview section provided a layer preview for the layer group, as well. Then, I previewed the layer all of the layers were located correctly according to their coordinates calculated in layer creation. However, when I showed the layer preview to my supervisor, he noticed that when zooming in to specific parts of the maps, there was a latency issue while requesting and retrieving data. Since there are many GeoTIFF data in one layer group and each of these files has large sizes, the latency problem occurred. Then,

my supervisor instructed me to search for how to optimize the GeoTIFF files and solve the latency problem. In my research, I found that there is a geospatial data abstraction library called GDAL that is used to process vector and raster geographical data. Using this library, two different procedures called tiling and overviewing can be done to optimize the GeoTIFF files. By using these procedures, GeoTIFF files are split into different pieces, and by implementing overviewing procedure, the splatted pieces merged into each other according to the zoom-in and out levels. Hereby, when a GeoTIFF is zoomed in, a specific part of the piece will be requested from the server and thus the latency issue will be solved. According to my research, a geographic information system software with multiplatform support that provides data viewing, editing, and analysis capabilities called QGIS provides GDAL libraries. Therefore, at first, I used the interface of QGIS to execute certain GDAL commands for optimizing the files with the ".tiff" extension. At first, I have done this process one by one for each file and uploaded those files one by one to the GeoServer by using its interface of it. I have done the same procedure again to preview all of the layers, and by using the GDAL commands the latency problem was solved, which means the data was optimized.

After optimizing the data, my new assignment was to demonstrate these data on Cesium. There was limited information about Cesium on the internet again except for its documentation. According to my initial research, Cesium can be used with HTML5 and pure JavaScript. From its documentation, therefore, I found the CDN lines to import the library into my HTML5 code, and I found the necessary methods in JavaScript to retrieve data from a certain URL and demonstrate it on the 3D globe map that Cesium provides. When I showed my work to my supervisor, he pulled the ethernet cable and the whole project stopped working. This indicates that my work was dependent to the internet because I used CDN lines to import the library. Then, I decided to use React.js to download the library and become independent of the internet. I searched about the usage of Cesium in React.js, and I found a library that includes Cesium and provides its all functionality in React.js called Resium. I installed Resium into my React application and wrote all necessary code segments (components and required props coming from Resium Library) and the layers became visible in the 3D globe map. At this step, my new challenge was to use the API that is provided by GeoServer and automize the process of adding the data storage one by one, creating layers one by one, and creating a layer group from these layers. I used the Postman application to monitor the API urls. I created a simple React application that reads all files from an uploaded folder and posts them as a GeoTIFF data storage to GeoServer, creates a layer for each GeoTIFF, and creates a layer group from the created layers. For each action, there is one button, and after creating the layer group, using React context in my application, it becomes visible in the 3D globe map that Resium provides. My next and last challenge was to automize the process of optimizing the files with the extension ".tiff" without using the interface of QGIS and executing GDAL commands one by one for each file. According to my research, I found that there is a command prompt of QGIS and it is able to execute GDAL commands. Therefore, I wrote a batch file that executes the necessary GDAL commands in all files in a specific folder and wrote new files into another directory using the command prompt of QGIS. Hereby, I developed a React application providing the following abilities:

- Works in offline,
- Uploads all files in a folder to GeoServer,
- Creates data stores, layers, layer groups,
- Demonstrates the layer groups on the 3D globe map.

I lastly deployed the React application onto Apache Tomcat server to see whether a problem occurs during the deployed application and documented all of the work that I have done to be a pioneer for the other engineers in Meteksan Defense.

# 4 Performance and Outcomes

## 4.1 Solving Complex Engineering Problems

During my internship, I faced many complex problems such as the latency problem while demonstrating all GeoTIFF data storage in one layer, version mismatch because of the old libraries, and using technologies without knowing what is going on behind the scenes. As mentioned, after uploading all GeoTIFF typed data storage to the GeoServer, a latency problem occurred to retrieve data from the server. The reason behind this latency is that some GeoTIFF data overlap each other while creating a layer group from a collection of layers, and while fetching these data to demonstrate the layer group in OpenLayers, the system requests for all of the overlapped GeoTIFF data. However, if each GeoTIFF is divided into pieces, and these pieces are ordered according to the zoom level, then the system will fetch the necessary pieces instead of fetching all of the overlapped GeoTIFF data. The procedure called tiling means dividing the GeoTIFF into equal pieces according to the size of the file, whereas the procedure called overviewing means arranging those pieces according to the zoom level. Therefore, I overcame this problem by learning how to implement these solutions. I learned a new technology GDAL and use its utilities to implement my logic. As an engineer, I have to create an environment to operate and manage my developments. In this internship, however, I faced a permission problem such as version mismatches to ensure an environment that facilitates my operations and developments. Specifically, the Resium library that I used for accessing the Cesium services in React.js was compatible with the old versions of React and thus the other necessary packages did not work properly. In such a case, the first solution that came to my mind was to downgrade the version of React; however, this time with my supervisor we took risks and force the system by using the command “npm install –force, and it worked. From this experience, I learned that as engineers, sometimes we have to take risks and technical debts to get results. Lastly, while deploying my React application to Apache Tomcat, I could not route between the endpoints. According to my research, since all components in React are connected to one component, and that component is connected to the main “index.html” file, the Apache Tomcat server directs the “index.html” only when the main component is called. Therefore, in such server-side deployment, instead of using the “BrowserRouter” component in React, the “HashRouter” component should be preferred because it uses the history library and hence has access to the “index.html” file.

## 4.2 Recognizing Ethical and Professional Responsibilities

During my summer training program, I was aware of my both ethical and professional responsibilities. I had to acknowledge that the company itself was a living organism with its own attributes and necessities. The working hours were strict and the start time was 7.30 a.m., whereas the end time was 17.30 p.m. I gave my best to not be late for both entry and exit times. The usage of cards was necessary, I gave importance to my card and tried not to lose it. I tried to be sensitive and respectful in the working atmosphere, during common work, I tried to understand other interns and engineers and also be helpful.

## 4.3 Making Informed Judgments

I tried to make informed judgments when I face a problem, or an assignment given to me. From the experience of my supervisor, I learned how to make critical judgments and determine the decision-maker parameters of a problem. For example, as mentioned in section 4.1, sometimes technical debts are beneficial risks to take because it accelerates the development lifecycle, whereas in most cases it is important to deeply understand the concepts while using technology to solve a problem. I learned that to make informed judgments, an engineer should first understand the problem, evaluate the circumstances of the problem, and deeply search for possible solutions while learning about them. I tried to do this method to make informed judgments as an engineer in my internship.

## 4.4 Acquiring New Knowledge by Using Appropriate Learning Strategies

To acquire new knowledge, the best way for a computer science student is to look over coding forums like StackOverflow, stackgis, etc. However, the assigned works were niche concepts to learn from such websites. Therefore, in such cases, the most appropriate learning strategy is to read the documentation provided by their developers. Besides, there are some academic papers that exist on the internet that provides solutions to particular problems. I tried to acquire new knowledge by using the appropriate for each case. While solving any problem or working on any assignment, I read some sources and tried to understand the concepts, and then I tried to implement what I learned from these sources. Therefore, in this internship, my basic learning strategy was to search, understand, and implement.

## 4.5 Applying New Knowledge as Needed

Learning new knowledge is important; however, it is valuable if and only if the new knowledge is applied to solve a problem. Therefore, applying new knowledge is a complementary requirement for engineers. As mentioned in section 4.4, my methodology to solve a problem during my internship was to first read and learn, and then apply my knowledge to implement a solution because sometimes the solution that is proposed in internet sources did not work in my case. Environmental parameters might be different; therefore, it was important to apply the knowledge and solve a problem in a customized way. Besides React.js, almost all technologies that I used were new technologies for me; nevertheless, from the knowledge acquired from my theoretical background and research, I tried to implement my knowledge to overcome the problems that I face.

## 4.6 Awareness About Diversity, Equity, and Inclusion

In Meteksan Defense, all ideas were valuable regardless of the rank, status, or gender of people. Even though interns have less experience, our supervisor gave importance to our ideas and thoughts and assigned real production jobs to us, and made us feel valuable. I saw every meeting of the department with all team members including the manager, and the atmosphere was genuine; therefore, every employee tries to work full of energy and passion.

# 5 Conclusions

Meteksan Defense will have a significant value for not only my educational life but also my whole career because I learned so much both technical concepts and managerial concepts. During my internship, I had an opportunity to observe my supervisor and the team while they work and make some talk sessions with the manager. From such experiences, I understood that I have an interest in the management methodologies of the application development lifecycle as well as the technologies that I used. Being in real software and engineering production environment changed my vision during my internship. Hereby, I learned new technologies such as GeoServer, Resium, GDAL, and QGIS, I also learned how to approach a problem to solve it in the most optimal and easy way, and lastly how a process of developing software should be evaluated from a wider perspective and what kind of methodologies should be used.

## References

[1] “Ülkemizin Savunması ve Güvenliği için Yüksek Teknoloji ürünler geliştiriyoruz,” *Meteksan*. [Online]. Available: https://www.meteksan.com/tr/kurumsal/hakkimizda. [Accessed: 11-Oct-2022].

[2] “REACT router configuration - apache HTTP server, Nginx, Tomcat,” *Learninjava*. [Online]. Available: https://www.learninjava.com/react-router-apache-nginx-tomcat/. [Accessed: 11-Oct-2022].

[3] “Raster data optimization¶,” *Raster Data Optimization - GeoServer Training*. [Online]. Available: https://docs.geoserver.geo-solutions.it/edu/en/enterprise/raster.html. [Accessed: 11-Oct-2022].

## Appendices

Since Meteksan Defence is a company in defence industry, it is not allowed for interns to share code any work done in the boundaries of the company.

## Self-Checklist for Your Report

*Please check the items here before submitting your report. This signed checklist should be the final page of your report.*

- ☑ Did you provide detailed information about the work you did?
- ☑ Is supervisor information included?
- ☑ Did you use the Report Template to prepare your report, so that it has a cover page, has all sections and subsections specified in the Table of Contents, and uses the required section names?
- ☑ Did you follow the style guidelines?
- ☑ Does you report look professionally written?
- ☑ Does your report include all necessary References, and proper citations to them in the body?
- ☑ Did you remove all explanations from the Report Template, which are marked with yellow color? Did you modify all text marked with green according to your case?

Signature: