Group Portfolio - Group J

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Introduction

Smart systems are constantly evolving and taking a huge role in affecting our daily lives in every imaginable way. Throughout the Fundamentals of Smart Systems -course, we have had the opportunity to learn about various key concepts relevant to intelligent systems in software engineering. These learning outcomes were reached through exploring topics, such as principles of smart systems, data and sensor technology, artificial intelligence, and machine learning, along with the ethical and social impacts of these systems.

During the course, we learned to identify intelligent systems, describe different aspects of their "smartness" according to a set of predefined criteria, as well as develop our own basic-level smart systems, such as creating tools to analyze data taken from APIs or training rudimentary chatbots. This course also allowed us to apply the theories and concepts taught to us during the lectures and exercise sessions, and use them in each of our individual assignments as well as our group work.

All in all, taking this course has allowed each of us to develop new skills and explore new areas of interest in relation to the role and use of data in smart systems, machine learning as well as artificial intelligence. Each of us perceived the quality of the course instructions in a unique but positive way that helped us comprehend the overall learning concepts of the course. With the theoretical knowledge gained during the course, we were able to reflect on our learnings of the course's project work.

Reflection

Trieu Huynh Ba Nguyen

As a member of the team responsible for creating the application SustainableUse to track electricity consumption and predict future usage, my primary role was to create a basic demonstration of the app using Java on Android. This involved programming the app to function on a mobile device, as well as to design the user interface, and integrating the various features and capabilities of the app. Although the app remains fairly crude and basic due to time constraints, I have gained valuable experience in how to develop an Android application with a smart system emphasis. More information can be found on my Github.
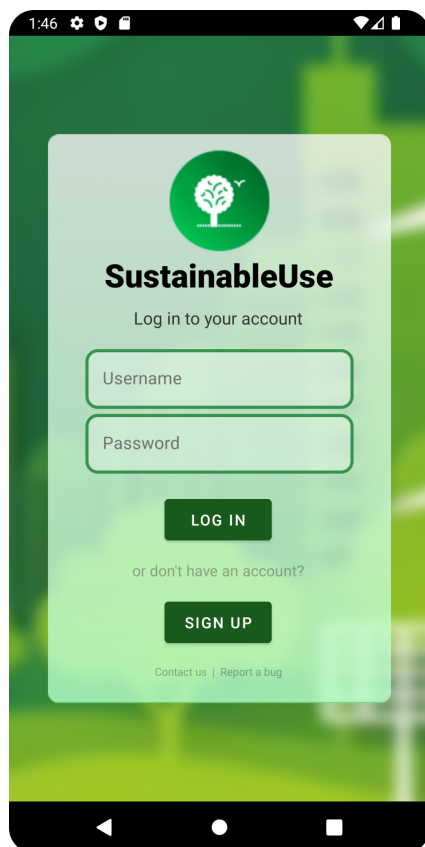
Throughout the course, I found that the lectures and assignments provided a solid foundation for the principles of smart systems and how they can be applied in real-world scenarios. In particular, I gained an understanding of the role of data, sensors, and artificial intelligence in enabling smart systems to function, as well as the ethical and social implications of these systems.

One of the key concepts I learned was the importance of data in smart systems. Smart systems rely on data to function and make decisions, and it is crucial to have accurate and

relevant data in order to obtain meaningful results. In the first assignment of the course, I had the opportunity to analyze a smart system and identify the data sources and data processing methods used. This assignment helped me to understand the different types of data that can be used in smart systems, as well as the methods for collecting and cleaning data to ensure its quality and reliability.

In addition to data, sensors are another key component of smart systems. Sensors allow systems to gather information from the physical world, including data about the environment, movement, and other factors. In the second assignment of the course, I was tasked with collecting data for a smart system using sensors. This assignment helped me to understand the different types of sensors that are available, as well as the challenges and considerations involved in collecting sensor data.

Another important aspect of smart systems is using artificial intelligence and machine learning algorithms. These techniques enable systems to learn from data and make predictions or decisions without being explicitly programmed to do so. In the fourth assignment of the course, I had the opportunity to do a simple machine-learning task using Python. This assignment introduced me to the basics of machine learning, including different types of algorithms, how to train and test models, and how to evaluate their performance. I found this assignment to be particularly interesting and useful, as it gave me hands-on experience with machine learning and allowed me to see the potential of these techniques in action.

On top of that, I could evaluate the pros and cons of using smart systems in software engineering. This assignment helped me to understand the benefits and challenges of incorporating smart systems into software development, as well as the potential impact on the software development process and the end users.

In conclusion, the course material and assignments have helped me to further my understanding of smart systems and their role in software engineering. My participation in the final project allowed me to apply this knowledge in a practical setting and contribute to the development of a functional application. I am confident that the skills and knowledge I have gained through this course will be beneficial in my future studies or career, and I am grateful for the opportunity to learn about the exciting and rapidly-evolving field of smart systems. I am excited to continue exploring and learning about the various technologies and techniques that enable smart systems to function and to see how these systems will shape the future of our world.

Annalina Wheeler

Within the group project, my responsibility was to gather the required data sets regarding private household electricity consumption from the source, as well as learn more about the sensors supplying the data. Through this, I was able to expand my understanding of how sensors, particularly electricity meters, collect data and connect to different systems in order to forward the data and form large and cohesive datasets. My main role, however, was to refine and clean the data, process it, and use Python to create visualizations that would later be incorporated into the user interface of the final application. The responsibilities of data cleaning, processing, and visualization were split between myself and Serhat. Serhat and I worked closely during this project in order to ensure the correctness and consistency of the datasets, as well as the uniformity of the layout of the final visual graphs. In terms of data cleaning, the datasets originally contained some unexplained measurement errors and outliers, which had to be removed prior to visualizing the data. After this, the data had to be processed according to which parts were the most relevant to our project. For instance, the data in each file had to be processed to only take into account the consumption measurements necessary for the particular visualization depending on whether the visualization would represent daytime consumption, nighttime consumption, or both, as well as according to the duration for which we wanted to create the visualizations. Taking on this role in the project work allowed me to implement the knowledge and skills I had learned in class regarding transforming quantitative datasets into visual representations in order to showcase the past trends of the data in a way that is easily interpretable to the human eye.

I found the first assignment topic to have provided me with a sufficient basis for this course as it gave me a first insight into what "smartness" really means in terms of a smart system, as well as how a single system can be broken down into parts. Through analyzing the different parts and functions of the smart fork I chose to present in my first assignment, I gained a solid foundation of knowledge to build upon in terms of which specific features do or do not make a device a smart system, as well as which functions are required in order for a system to provide a desired result or action following the data/model/action -concept.

Another topic I learned about in the following weeks, which I have found particularly useful, is data collection and the importance of data in relation to smart systems. Data is the foundation of a smart system, and without it, there is nothing on a system to base its decisions. Data can, for instance, be collected from pre-existing data through APIs. I gained first-hand experience during the second assignment as I used the skills learned during the exercise session to access data via an API, as well as manipulate it in order to present it in a structured manner. Alternatively, data can be obtained by gathering newly generated data via sensors. An example of this would be generating positional measurements through a gyroscope embedded in a mobile phone and subsequently analyzing the results to determine the degree to which its holder is tilted, as demonstrated to us during a lecture.

Moreover, through learning about the fundamentals of artificial intelligence and computer vision, I began to see the significance of recognizing the value of the collected data and the potential applications in which a single system can be used. An example of this would be the multiple potential applications of computer vision in image and video analysis, health care, robotics, software testing as well as fraud detection. Although such systems have tremendous potential to positively impact these respective industries, I also learned the value of not only recognizing the positive effects that such smart systems may have but remembering to analyze the possible misuses and negative impacts that they may bring when employed with malicious intent, for instance, in the cases of the weaponization of AI or cyber-attacks.

Finally, I also had some misconceptions of smart systems and particularly of artificial intelligence, which I found I was able to gain more insight into throughout the course. For instance, although I previously understood that no human-made application is ever completely bias-free, I was unaware of exactly how much bias such applications may include. This bias can either be formed through training sets that do not account for all of the possibilities equally or through the use of biased algorithms in the design of the application. As a result, these systems will ultimately result in biased results and actions. Although this is not necessarily one of the core concepts of the course, it is among the most valuable lessons which I will take away from this course.

Serhat Altay

As a team member for our smart system project work, I focused on our smart system's data analysis section, where the main goal was to make the collected, unanalyzed data as valued as possible. The analysis of the data process mainly consisted of making the collected structured data into a meaningful visualization. With the help of our code, our smart system's model was able to create an analysis that finds the correlation between the important data values and visualizes it more systematically. Through this systematic visualization, my teammates and I could realize the past user experience habits and the data distribution between different periods.

The data needed to be cleaned and processed to achieve this realization, making it possible to be processed using a programming language to create an appropriate model. Data cleaning involved detecting incorrectly formatted inputs, renaming faulty column names, deleting unnecessary data values, and removing the uncorrelated periods that could make our data analysis less clear over a certain period. After successfully completing data cleaning tasks for all our samples with my team member Annalina, we moved on to the part where the data needed to be considered based on its most important parts for our particular smart system. This consideration involved separating the essential parts of the data to be analyzed, which could make our smart system more comprehensive with the relevant information. Ultimately, we got a result that gave us the needed information and knowledge, eventually realizing the value that could be provided to the user and being source data for the machine learning algorithm in our smart system to predict future consumption habits. Through these tasks, I was able to deepen my knowledge of the course topics and understand the value of data and the needed process that could make the collected data way more understandable and useful. Concepts such as "data - model - action" and "data - information - knowledge - value" are all understood better with the help of practical experience gained during the completion of my tasks.

Defining the smartness of a system might sound like a very straightforward task. However, throughout the Fundamentals of Smart System course lectures and the materials provided, I discovered it is more complex than it sounds. I realized so many details and fundamental concepts that shape the smartness of a smart system which I would never guess with my prior knowledge. This discovery started with the very first lecture, where our task was to analyze a (smart) system based on key characteristics such as Understanding - Learning - Reasoning - Autonomy - Reflection. I understood and distinguished the particular smart system's needs, and my realization was further shaped when we started to learn about smart systems' basic structure: Data - Model - Action. The importance of data is understood after learning about data-driven systems and the way the data are collected with the aid of sensors. These theoretical concepts are further studied with assignments 2 and 3, where our task was to collect the data using APIs and then analyze the data in a meaningful manner. These specific assignments also helped me to create ideas for our project work's smart system as I saw the importance and the value of data. As it is said in the lecture slides, data is the foundation for

smartness; however, it is not information or knowledge. Thus, making the information and knowledge from the data and seeing how data can lead to better consequences and purposes was a fun study in these assignments and the project work. Additionally, I had an extra motivation to study more about the development of data-driven businesses where the Data - Insights - Relevance - Growth idea is the main focus.

My learning journey with the course continued toward new fields that I have always wanted to learn more about but have yet to have a chance to explore. These fields are machine learning and artificial intelligence. Even though the Fundamentals of Smart Systems course have only taught us the fundamentals of these fields, I was thrilled to gain more knowledge and find out more details about these fields. Distinguishing the differences between AI's learning concepts and their impacts on various aspects, such as input data, computational complexity, and accuracy as well as discussing future AI scenarios, helped me to understand not only what AI is but also its possible consequences in the near future. It was exciting when we discussed the current power of AI and its unlimited growth potential and pace. It was a bit scary, but it was promising to see how these concepts could be used for better purposes and how they help the civilization develop in a better way. In contrast, learning about biased algorithmic approaches was also interesting. As a future software developer, I need to learn these realities to better view ethical issues in my field. In addition to AI, machine learning has exciting concepts, such as deep learning, neural networks, and computer vision. Seeing the need for machine learning characteristics made me realize how big this area is and the potential use cases. The examples, such as fraud detection and Netflix research, were beneficial to see the actual mechanisms of this field and its use cases. Assignment 4 also gave me practical experience when I tried to implement the decision tree regression algorithm to decide a potential phone price with old, similar data.

Finally, the last learning concepts of the course, where we learned more about smart systems in software engineering and interactive intelligent systems, boosted my understanding of the smart system more broadly with the aid of assignments 5 and 6. Through these concepts, I could comprehend the interactive and non-interactive smart systems, realize the pros and cons of the smart system in software engineering, and acknowledge the future of automation and augmentation and RPA in smart system development techniques. All of these theoretical understandings and practical experiences helped me develop a smart system for our project work, eventually making the concepts and methods of the smart system more understandable for me. I am happy to learn these topics and apply them practically. I can now say that I know which systems/concepts can be considered smart system/software and which systems/concepts are not even in that category. I am also convinced, after our philosophical and very much enjoyable lectures, that Frankenstein can be considered an AI :) Even though thinking of a human-like machine is still scary and not so ok for me…

Zhuoyi Cao

As part of the team, my main task was to complete the design of the user interface of our smart system application and to participate in the conception of the application functions. The main function of our application is to monitor the electricity consumption of the user's home in real time, visualize the electricity consumption data, and allow the user to choose the time period for monitoring and compare it with the previous time period. Another important function of the application is to give users a basic psychological expectation of their electricity consumption and electricity bills by using machine learning to predict the next period of time based on past data. This allows users to set themselves targets for electricity consumption and provides them with a better incentive to take action to save energy.

Through the design of the smart system app, I was able to deepen my understanding of a smart system, how the software I use is linked to the big data behind it, and also to develop my user interface design skills. The image below shows my UI design in Figma:
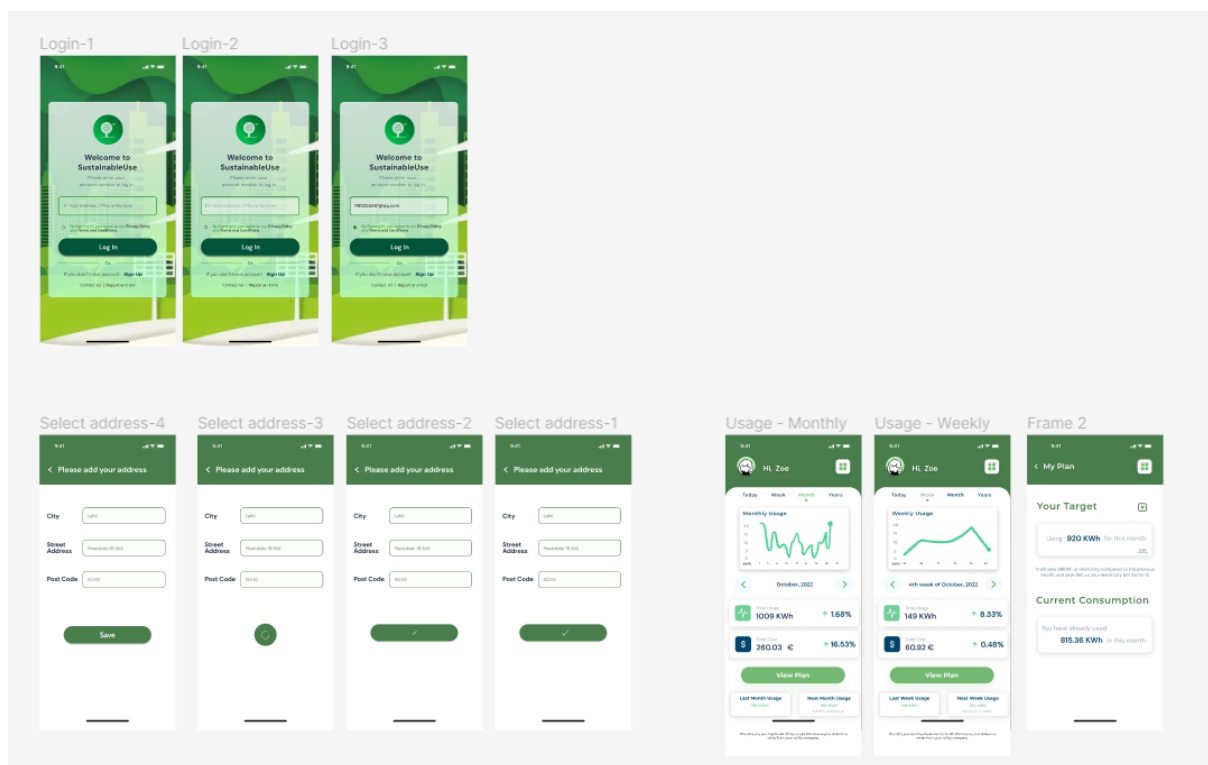
Through the course, I have gained a more comprehensive understanding of how a smart system is constructed. Through chapters 1 and 2, I gained a first understanding of what a smart system is. I know some of the characteristics of a smart system, such as autonomy, the possibility of reflection and adaptation, the possibility of cognition, etc. And the basic structure of a smart system is Data-Model-Action, which means analyzing the data and then

building a model to train the data to take action. This has helped us a lot in our project work, and our smart has been built step by step according to this structure.

And through Week 3 and Week 4, I also learned a lot about the ways to get data, such as sensors, API, and so on. This has given me a clearer idea of where data comes from. I was also able to gain an initial understanding of how to obtain data through the example of the Twitter API in the exercise session. Week 6 gave me a better understanding of the concept of AI and the history of AI. And in Week 9, I learned more about the application of artificial intelligence in the software development process, such as automated testing of software, automatic code generation, and automatic compilation. It made me more aware of the extent and importance of AI in the field of software engineering now and the rapid development of AI.

Moreover, what I found most impressive was the learning in Weeks 5 and 7, that is, how to make some simple data processing and how to use machine learning to process data and train models. Through these two weeks of lessons and practice sessions, I have gained an initial understanding of what machine learning is and how to do it, as well as a better understanding of the importance of machine learning for the smart system. In Assignment 4, I applied a linear regression model to analyze the relationship between the horsepower of a car and its engine size. Machine learning also played an important part in our project work, enabling us to achieve electricity predictions. The Chatterbot covered in the Week 11 practice session and Assignment 6 was also based on machine learning. This gave me the basic knowledge of Chatterbots that I usually encounter in my life, such as voice assistants for mobile phones, intelligent customer service, and so on. Also, the process of creating my own Chatterbot was very interesting. All of this made me realize the importance of machine learning in processing data. I hope to go deeper into machine learning in the future and explore more uncharted territory to get a better grasp of how to process data to achieve more results.

Finally, I know there is still a lot of knowledge about this field that I have not covered, and I hope to continue to be exposed to more aspects of machine learning and smart systems in the future, to explore more deeply and to better understand the impact of big data in this era.

Chuanzhang Chen

My primary duty as a team member on our smart system project is to choose the best-fit machine learning model from the obtained processed data. Since I had some experience in machine learning before the course, particularly with regard to some of the fundamental models, our group decided to let me train the models. In this project, I intend to train a machine learning model that will eventually be able to forecast future power usage by analyzing the vast quantity of household electricity consumption data that has been collected.
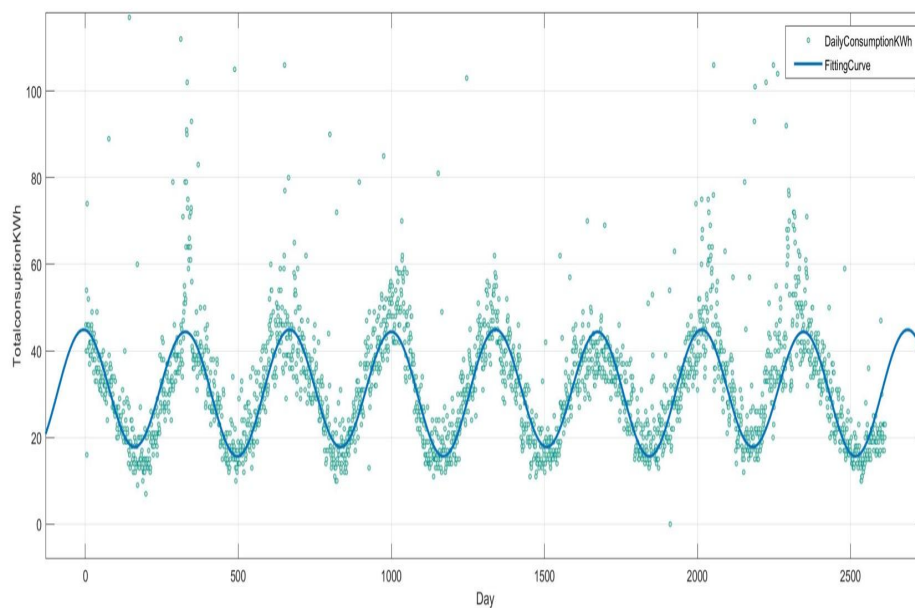
In the first lecture and the first practice session, I got a deep understanding of what a "smart system" is. A smart system can make decisions based on sensing the environment, analyzing and understanding the data, and finally, making predictions. This provided us with the theoretical support to define a "smart system" in this project, and of course, in this class, we also learned what a "model" is and the importance of data, so we trained our model based on "data - model - action", by getting a lot of data. Through the lecture in week 7, I got a deeper understanding of machine learning and neural networks and a series of concepts, and I have acknowledged that machine learning is like an umbrella in which there are other fields such as unsupervised learning, supervised learning, reinforcement learning, and so on. Therefore, in Assignment 4, I tried to use linear regression models to analyze and predict the average house price and average income in the UK, which was a good opportunity to practice. Also, in our project, the first thing I thought of was applying a linear regression model. Overall, with the knowledge of machine learning, I have been able to solve problems and choose the most appropriate machine learning model according to the needs of the project. In week 9, I learned about the application of AI in the whole software engineering cycle. AI can improve our code by understanding natural language or writing code for us in the Design and

Implementation phase of the project. In the Testing and Integration phase, we can also use AI to automate testing processes, such as generating test cases or identifying defects in the code. Additionally, AI can be used in the Maintenance and Retirement phase to monitor and optimize the performance of the software. Overall, using AI in the software engineering cycle can greatly improve efficiency and reduce the time and effort required to develop and maintain software. I am excited to learn more about how AI can be applied in the software engineering process and to see how it will shape the future of software development. The more interesting part was Assignment 6, where I was able to create my own chatbot through the lecture on natural language processing. I enjoyed putting my knowledge into practice by building my own chatbot. The process of creating the chatbot involved several steps, including training the model on a dataset of conversations and testing and debugging the chatbot to ensure that it was functioning correctly. It was challenging but also very rewarding to see my chatbot come to life and be able to hold conversations with users. Through the above knowledge, I fundamentally understand and practice the project to create a system that can be described as "smart."

Finally, after the practice session in Week 6, I am more determined than ever to make artificial intelligence technology that aims to make our lives better. I am confident that with dedication and hard work, I can learn the necessary skills and become an expert in machine learning and deep learning. These technologies have the potential to solve a wide range of problems and improve many aspects of our lives, and I am excited to be a part of this field. After this class, I will continue to learn about machine learning and deep learning in order to stay up-to-date on the latest developments and further develop my skills. I am determined to make a positive impact with artificial intelligence technology, and I am committed to continuing my learning journey in this field.

Cheng Xiao

In our team, I am responsible for explaining the value of our project and summarizing the project as a whole, sorting out and expressing why we are doing this project and what is the meaning of doing this project. I was also responsible for creating and optimizing the slides for each presentation in the group to make our presentations more fluent and clearer so that our work could be better communicated to the audience.

Before taking this course, my concept of intelligent systems was very vague. Through this course, I have gained an in-depth understanding of intelligent systems performance and roles, especially in software engineering. Through the introduction to intelligent systems in the first few classes, I understood what intelligent systems are, their characteristics, and related technologies, and I learned the importance of data and how to obtain them. Through tutorials and post-class assignments, I learned to explain the intelligent functions of a system based on data/model/operation concepts, and for the first time, I was exposed to and used APIs to obtain data, etc. These laid the foundation for my study of intelligent systems.

Then, I learned how to analyze the data and how to get valuable information from the huge database collected. It is worth mentioning that the visualization of data facilitated my learning motivation, and the variety of data presentation methods made the boring data intuitive and vivid and allowed people from different professions to communicate easily and efficiently. The next part of the course led me to explore the field of machine learning and artificial intelligence, and the more basic knowledge helped me a lot to understand and be interested in these fields. The concepts of neural networks and deep learning were interesting to me, and many of the cases mentioned in class reinforced my motivation to continue exploring the field. In addition, the discussion of the future of AI has made my mind see further. The current AI shows us its infinite future possibilities, and I believe this technology will help people create more spiritual and material wealth. The corresponding tutorials and post-class assignments expanded and implemented my learning in these areas, and there is still a lot of way forward for AI systems in software engineering. The final week's assignment had us implement a simple robot interaction, which was a fun and hands-on experience that greatly benefited me.

The group project was definitely an important part of the course, and it helped me integrate all the learning, and all the previous theoretical learning and practical assignments became my support. And it was very meaningful and fun to work with the group to create a valuable and creative practical outcome. All the course points have become a strong support for my learning path in Smart System, and they support me in exploring higher and farther in a broader and deeper way. I will relentlessly learn new knowledge and create more positive and meaningful values with my efforts.

Conclusion

In conclusion, the course Fundamentals of Smart Systems was a valuable learning experience for the team. It provided a comprehensive introduction to the field of smart systems and their role in software engineering, covering a range of concepts and technologies. The lectures and assignments helped to deepen the team's understanding of these topics and provided a solid foundation for the principles of smart systems. The course also emphasized the ethical and social implications of smart systems, encouraging the team to think critically about their potential impact on society. Overall, the team gained valuable skills and knowledge through this course and feel well-prepared for future studies or careers in the field of smart systems.

Furthermore, the final group work provided us with a comprehensive understanding of the development process of a smart system application, from gathering and analyzing data to designing and implementing the user interface and various features. The group work was a highlight of the course, as it allowed us to apply our knowledge and skills in a practical setting and contribute to the development of a functional smart system application. We gained valuable experience in working as a team and were able to see the potential of smart systems in action.