**Portfolio**

1. **Smart devices**

Smart devices based on sensors are an important part of all the devices surrounding us. In this course, we participated in the whole creation process of a gas sensor, from the nano-particle deposition to the signal acquisition on a microcontroller.

* 1. **Description**

This project is part of the 5ISS year formation at INSA Toulouse. We created a nanoparticle gas sensor in the AIME laboratory at INSA Toulouse. Then, we designed the PCB and the code to use the sensor with a LoraWAN protocol and display its data on a dashboard. The Smart Devices module gathers four classes that go over the different steps of production of a nanoparticle-based gas sensor. I summarized them in the table below. Then, I focused on the most relevant experiences: the nano-particle deposition to create the sensor and the M&OSH project.

* + 1. Nanoparticles

The first experience we had in the Smart Devices module was the internship in the AIME cleanroom. It lasted for a week, consisting in different half-day modules where we could oversee and manipulate the different processes involved in the manufacturing of a nano-particle sensor. The end goal was to make a gas sensor from Tungsten nanoparticles, that expresses a variation of resistance when detecting specific gases (in our case Ethanol & Ammonia).

The different steps we followed to make the sensor were the following:

1. Exposing the sensor circuit by photolithography: without going into too much detail about the process of photolithography, we used it to engrave based on a mask on an illicium wafer. As you can see on the adjacent picture, it is a complex mask containing a heating resistance, a temperature sensor, and two interdigitated combs where we will make the deposition.

2. Making and deposing the nanoparticles: the next step was to create the Tungsten nanoparticles and deposit them on the engraved wafer. To do so, we followed an extremely precise chemical process, using pipettes going to a 0.05 milliliter precision. Once we obtained the particles, we deposited them using a process called Dielectrophoretic. What we did was we put a drop of our very diluted solution containing the nanoparticles on the entire sensor circuit, and then put an electrical field only on the interdigitated comb’s part. This resulted in the particles only "sticking" to the desired part when we rinsed the solution in water.

3. Characterizing the sensor for the datasheet: now that we had our sensor, we tried to characterize it by generating some I/V curves, so that all the groups could use their data to create a datasheet.

Once the AIME internship was finished for all the groups and using the concepts we learned during the "Introduction to sensors" class, we were able to redact a datasheet that tries to be as close as possible to the ones you can find in the industry, made by professional manufacturers. You can find the datasheet made by my group in the link below:

* + 1. M&OSH project

In this course, we had a lot of freedom to choose what direction we wanted to take: to follow proposed labs or to start a project directly related to our gas sensor. With my project partner, Asia Nguyen, we chose to start the project to allow us to go further in the development of our sensor. It was a great follow-through since we can now use it with a shield, connect it to The Things Network and see the data on a Node-RED dashboard. The Arduino code used to retrieve and process the data was adapted for both the AIME gas sensor and the industrial grove sensor given to us. We used a ESP32 as a microcontroller. I was very excited to start working on this project since it’s a culmination of what we did during the AIME internship and it showed me the complete process of making a sensor. Our work was divided into different steps:

1. To test the LoRa connexon

2. To implement a code that retrieves and sends data to The Things Network with Lora WAN

3. To conceive a PCB shield with Ki Cad

4. To create a Node-RED dashboard to display the data and the controls of the sensor

As a deliverable for the project, we redacted a quick report in the form of a README file, follow the link below to consult it:

* 1. **Technical challenges**
     1. Microcontroller and Open-Source Hardware (M&OSH)

Because it involved many different skillsets, the M&OSH mini project had different challenges:

Since we never used LoRa communication before, it took us some time to understand how to implement it. We were able to find multiple examples of code online, so it helped us do this part faster.

Another difficulty was to connect our device to The Things Network. In fact, we never used it before. We did not know the process to create a TTN application and to connect our device to it took us some time to figure it out.

I also had difficulties to connect our TTN application to our Node-RED dashboard. Normally, there is a Node-RED node specifically design to receive data from TTN. But, for unknown reasons, it is not working anymore. So, I had to use a MQTT node. It took me some time to configure it. Moreover, since TTN is not always working properly, I thought for a long time that my configuration was wrong when it was just the website not responding correctly.

* + 1. CAD, Manufacturing & Integration of Nano-Technology Sensors (AIME)

We had difficulties obtaining good results when we tested our sensor. As a matter of fact, we had problems integrating the Tungsten nanoparticles into the sensor. When we looked in the microscope to see our particles, we observed that there was a low concentration of nanoparticles. Thus, we tried increasing the concentration of nanoparticles by heating it to evaporate more water. Then, we tried once again to integrate the solution into our sensor, but it was still not enough. Since we were running out of time, we used sensors made by last year students. It was so sad to see our work not functioning.

* + 1. Sensor’s introduction

I chose to group the technical challenges of the last two classes together, because they served a similar purpose. In the introduction to sensors class, we had some theoretical lectures about the general physics principles of sensors, along with some physics practical that brought back notions. It also gave us critical notions on how to design a good datasheet, what metrics to use and what errors to avoid.

* + 1. Analog Electronics Labs

The Analog electronics labs were here to help us design the analog signal treatment part to exploit the values coming from our gas sensor. As said previously, the sensor's output is a resistance variation, which can be expressed as a current variation by imposing V (the tension). However, this current is small, at about 100 nays, and we cannot measure it directly. So, we had to create a signal processing circuit to move the signal in a tension 1.1V to 5V, which corresponds to the range of the ADC of the Arduino Uno. Designing the circuit was challenging, involving signal processing notions and filters that we had not used in a long time. Fortunately, we used the tool Allspice, an electronics circuits simulator, to help us iterate over prototypes and test our results. All the information about this class and the labs subjects can be found here.

* 1. **Analysis**
     1. Self-evaluation

This module was one of my favorite one. It required the widest array of skills in electronics, signal processing, physics, and programming. I really feel that I acquired the skills expected.

For the Introduction to Sensors course, my background in Electronics really helped me understand what was expected of me. The cleanroom sessions were well explained so we could understand every step of the process. The datasheet was more challenging to write but coming from AE helped me since I already knew how to read a datasheet.

As for the M&OSH project, I really felt invested because that is the type of project I really like. Coming from AE and from personal projects, I already had previous experience to help me with this project.

* + 1. Feedbacks

As I already said, this module was one of my favorites of the year. Participating in the entire creation process of a sensor was nice, from the creation in a cleanroom to the implementation of the sensor in a real project. I think that this module was what I expected when I chose to study ISS. I really sensed that I was acquiring or strengthening many skills during this project. I also really liked the freedom we had to choose what we wanted to do. It showed that the professors really tried to adapt this module to every different backgrounds.

I am happy to have chosen the project. I think that all the complementary classes really helped with the main project. I really felt that every classes had a purpose and were useful to carry out the project.

However, I think that the scheduling of this module was not perfect. For example, we directly did the AIME lab sessions before having the Introduction to Sensors class. We also did not have time to print the PCB boards and I wad a little bit disappointed by that. As a matter of fact, I was really enthusiast about fully creating a PCB board. I really invested myself into designing the board. So, it was sad not to have the final product and not being able to use the sensor we manufactured. That being said, it was still a really good experience that I loved doing.

To conclude, I feel that this module was the embodiment of what I wanted to do in ISS. It is one the modules where I was the most invested in. I can positively say that I learn a lot and that I had a lot of fun doing it.

1. **Communication**

Communication protocols are one of the bases of connected objects. Innovation happens with new standards appearing everyday like 5G. It is important for us to be aware of the main technologies used today. In this course, we studied protocols (LoRa, Zigbee, Sigfox, NB-IoT, ...) but also energy problematics, wireless radio methods and security.

* 1. **Description**

The communication module gathers five classes This module is very dense since it deals with a lot of subjects all centered around the Internet of Things. IoT have many problematics: battery, wireless communication, or security. These problematics are studied in the classes of this module. We have the full picture of communication for IoT. You can find a quick summary of the courses content in the adjacent table. The next subsection will focus on one of the most relevant experiences: the Software Defined Radio (SDR) labs.

* + 1. SDR

The main experience I retained from this module is the series of labs that focused on Software Defined Radios (abbreviated SDR). SDR are used to replace hardware component for frequency shift, demodulation, and other operations to receive FM signal. A single device process all these tasks and the signal is decoded through software.

During three labs, we learned the theory behind decoding a FM signal. Then, we used GNUradio to manipulate a radio signal. The goal was to try to get the audio from a recorded radio signal. To do so, we used different treatment elements like frequency shifters, band-pass filters, frequency demodulators, and more. The signal treatment is done entirely with the software. The software is easy to use since you have blocks that you have to link together with the correct parameters. After different treatment steps, we were able to decode the signal and thus, to retrieve a clean audio signal. I think it was a clever way of doing the lab because it was exciting to try to decode the signal and very rewarding to have the result and to listen to the audio. You can consult the report on the like below:

* 1. **Technical challenges**

The main challenge of this module was the number of deliverables and assignments we had to produce.

* + 1. Protocols

In groups of three, we had to present different protocols for Wireless Sensor Network, e.g., LoRA, Sigfox, BLE, ZigBee, NB-IoT or M2M. My group chose to study NB-IoT. It was difficult to find information about the protocol we chose. Certain characteristics were easy to understand thanks to online documentation. However, when we had to find precise information e.g., value of the radio range in a real environment, we ended up doing a lot of unsuccessful research.

This assignment was also challenging for me because I am not really at ease with communication and networking. Thankfully, since I was not alone to do this, I was able to understand a little bit more thanks to my teammates. Watching the presentation of other protocols also helped me understand the one I was working on a bit more, as there are a lot of similarities between the different protocols.

We also conducted a deep study of the MAC layer options for IoT. This assignment was challenging for me as well. Thankfully, there are a lot of resources online that helped me understand the different concepts.

* + 1. Emerging networks

In this class, we learned how Software Defined Networks (SDN) worked. We participated in labs to manipulate them. The SDN technology we used was OpenFlow switches. This technology uses a networking application which dynamically and automatically writes rules in switching routing tables. These rules are written depending on the topology of the network, its current state, and the traffic. The challenge was to understand the concept and implement it on a network.

1. From 3G to 6G

For this course, we had to present a topic about 5G in teams of two. With my partner, we chose “5G and smart cities”. We found a lot of information online, but the main challenge was to select the right data. We also did not know how technical the presentation had to be.

1. Energy for IoT

In this class, we had different lab session: one lab session about electromagnetic energy harvesting and wireless power transfer and two lab sessions at the AIME. During the first one, the main challenge was the equipment. In fact, we could not finish the rectifier characterization since the rectifiers were not working. We finished the session by watching the professor do the manipulations because of faulty equipment.

1. Security for IoT

The deliverable for this course was a security assessment for our Innovative project. The main challenge was to study a countermeasure with ProVerif. Implementing the code was difficult because we were not acquainted with this method.

* 1. **Analysis**
     1. Self-evaluation

As I said in the Technical Challenge section, the module was vast and dense. The number of classes gave us a lot of information and assignments at the same time. As you can see in the skill matrix, the first section is heavily loaded. This represents the amount of work and skills required in a few weeks.

For the Communication Protocols course, I do not feel that I reached the expected level. I think I did not have enough time to study this class. I felt overwhelmed by the amount of information we were given. This module was clearly not my strength. I still think that I understand the general overview of IoT standards, but I am not really at ease with more technical skills concerning the energy or complex reception process. I think that a lot of students were in a similar situation. We exchanged a lot to try to understand the main concepts of this class.

For the Emerging Networks class, I think that the labs really helped me acquire the skills I needed to reach the expected level. I could manipulate the technology which is my favorite way of learning. I can say the same for the Energy for IoT class.

* + 1. Feedbacks

This module was very vast. We tried to overview a lot of notions in a few weeks and workload was heavy. I feel that I had not enough time to fully understand the concepts and technologies presented to me. The teaching method through student presentations was good because it offers an interesting point of view on the technologies, but it was also not very optimal because we were unsure about the information given.

I think it is too bad to have the AIME labs of Energy for IoT on the last week even though I know that the time schedule is tight in ISS. Also, we could have been more prepared for the first lab of Energy if we had a tutorial session before to go over the theoretical part. Moreover, I think that it would be great to have tutorials or labs for the Security for IoT class to have a better understanding of the notions covered.

Regardless of all that, I enjoyed this module. It deconstructs the IoT into different categories to try to give us a clear and pretty exhaustive picture of the state of Internet of Thing today. It gave me a certain understanding of IoT that I did not have before. IoT was not the main reason I chose ISS but I know now that this area has a lot of fascinating possibilities for the future.

1. **Analysis and data processing**

As we saw during the Communication module, more and more connected objects and systems are appearing every day. With them comes a huge amount of data. In this module, we worked on exploiting and adding value to these data.

* 1. **Description**

This module is composed of three courses. In Big Data and Semantic Data, we studied different way to handle data. The Software Engineering class was more about general skills necessary for software engineering like the Agile method or Continuous Integration. I summarized the classes in the table below. The next subsection will focus on one experience: the data analysis project made using Python and sklearn.

* + 1. Clustering

In this class, we learned how to process data and we saw different clustering methods. We could choose some data sets from a wide choice of data sets to study the different clustering methods. We studied the K-Means, Agglomerative and DBSCAN methods. After establishing the benefits and drawbacks of each methods, we used them to study unknown data sets. Finally, we had to do a full study of a real meteorological data. You can find the report in the link below:

* 1. **Technical challenges**
     1. Semantic

Since it was the first time I had a Semantic Data class, the challenge was to grasp the meaning of the different notions like Ontology, Data Property or Object Property. The first lab really helped with that. The second lab used the ontology we created with a Java application. The main challenge of this lab was to understand how to create an Instance and how to manipulate them in Java. My knowledge in this programming language helped me to implement the different functions I needed for this application.

* + 1. Big data

This class involved theoretical notions about data processing. During the lab sessions, we utilized these notions to analyze a real set of data. The challenges of these labs were to understand the sklearn package and the pandas package used to implement all the clustering methods. The working principle of the different metrics used to evaluate the methods was not as easy as I thought to understand. Thankfully, the documentation provided by scikit-learn website really helped me to fully comprehend all those notions.

* + 1. Software engineering

This class gave us an insight of software development and project management methods. After learning it during theoretical courses, we had to implement these methods to our projects. The main method we had to apply was the Agile method. I already had a class in 4th year called Project Management which addressed this method, so I was already familiar with it. The challenge was to use a tool, the Jira software, to implement the Agile method in our projects. We used it during our Service Oriented Architecture project. It took us some time to get acquainted with this tool. In the end, it was useful to us in order to respect the planning of our project.

Another challenge was to implement a Continuous Integration for our SOA project. It was difficult to use Jenkins since we did not have a server to host it. So, we ended up using GitHub Actions but since we did not see it during the classes, it was a bit difficult to implement.

* 1. **Analysis**
     1. Self-evaluation

This module contained really different types of skills. The majority of those skills were new to me but I managed to acquired them thanks to these courses.

For the Semantic Data class, I think I met the requirements by doing the labs which were really useful to me to fully comprehend the notions.

For the Big Data class, I was really invested in learning how to cluster the data even though I never did it before. I learned a lot of skills during these labs.

For the Software Engineering class, I already knew the Agile method but learning to use a tool to help implement it is a good skill to have. It was also interesting to acquire a new method of software development, i.e., continuous integration. I think that I met the requirements but that I did not have time to go further.

* + 1. Feedbacks

This module was very interesting. The Semantic Data class was short but precise. I think I learned a lot of interesting notions that I did not know before. I think that it would be stimulating to integrate these notions in a project. I enjoyed the class and I wish I had more labs on the subject.

Next, I was wondering why the Software Engineering class was a part of this module and not in the Middleware and Service one since it was linked to the Service Oriented Architecture project. However, I did not like that we were forced to apply the Agile method to the SOA project. In fact, the project was done in groups of two or three students, which is not really relevant to the use of this method. It probably would have been better to use it to our Innovative project since it was a 4-month long project in teams of at least 5 students.

Finally, the Big Data class was really compelling. It felt amusing to try to analyze data and see the correlations in the analysis of the real data. I liked how the labs were created in a logical order (discovering the methods, using them, analyzing a real data set). It was a refreshing class since I did not have any before.

1. **Middleware and service**

With the number of sensors and connected objects sharing data over the internet, it is important to study how they communicate and how they can work together even though they are different. That is what we will see in this module.

* 1. **Description**

This module gathers three classes which study different technologies used in IoT. The first one, Middleware for IoT, presented the OM2M platform. This platform is used to ensure interoperability between all types of sensors and applications, a prominent problematic of IoT. Then, we had a Cloud computing class in which we learned to use VirtualBox, Docker and OpenStack to host virtual machines. Finally, the Service Oriented Architecture introduced the main standard used today to develop Web Services. I summarized these classes in the tab below:

* + 1. SOA

The main project of this module was the Service Oriented Architecture (SOA) project. It had an interesting premise, because it aimed to bring together the skills learned in both the SOA and OM2M classes into one big project. Unfortunately, we did not have time to use OM2M to simulate the sensors, so we directly simulated them in our Java application.

The goal of this project was to simulate a smart room management for the campus building. We had to think of sensors and actuators that would be relevant in the classrooms to detect danger or control the equipment of the rooms. Then, we had to think about scenarios to use these devices. To implement those scenarios, we created Web Services to perform them.

With my team partner, we chose to implement window, blinds, door and light actuators and temperature, luminosity, ToF, noise, gas and presence sensors. The different Web services were controlled by a global service. It oversaw implementing the scenarios, meaning that it would check the value of a certain sensor by calling its service and then would activate a light or window in response.

We also developed a dashboard using Node-RED to display the data and controls the devices. It allows the user to monitor the room and to modify the threshold if needed. It is by using this that we could verify that the scenarios were indeed working and that changing the value of a sensor above a fixed threshold triggered an actuator.

This project was linked to the Software Engineering class of the Analysis & Data Processing module. We used the Agile method to plan the project, with three sprints of three weeks followed by a team of two students.

* 1. **Technical challenges**
     1. SOA

The main challenge I had for this class was to implement the Continuous Integration in our project. I had a hard time to set up the software needed to use it. By mutual agreement in the group, we decided to change the tool from Jenkins to GitHub Actions and it was a good decision.

* + 1. Middleware

The main challenge of this class was to understand the nomenclature of OM2M because there is not a lot of documentation online. Thankfully, the explanation given by the professors allowed me to use the platform.

Another challenge was when I had to learn how to use Node-RED. I took me some time to fully grasp how to configure every nodes but when I did, I realize how useful this graphic API software is.

* + 1. Cloud

The Cloud and Autonomic Management class consisted of studying mainly two elements: hosted virtual machines and containers using VirtualBox and Docker, and bare virtual machines using the Open stack platform.

Even if I already used VirtualBox to create Linux virtual machines on my Windows laptop, it was very different using them during the labs. But the main challenge for me was to understand the differences between hosted/bare virtual machines and containers. Moreover, OpenStack was a bit difficult at first for me to use. The creation of more complex network topologies was not easy to comprehend at first. It was interesting to change routes between virtual networks and see connectivity between machines that were not on a physical network but on a virtual one. We had to use this method to set up a calculator application, with the front-end of the app accessible from the outside world on a public network, and then all the back-end services hidden in another local network, linked with a virtual gateway.

* 1. **Analysis**
     1. Self-evaluation

Since this module brought really new skills to me, it was really interesting to study. The different classes required a lot of computer science skills.

The SOA class was the biggest one with a vast project. I never use Web services before but the project really helped me acquire the skills expected. My knowledge of Java also helped to implement the services. The concepts presented that I did not know about were clear and well-documented online, so I feel like I will retain these skills and be able to reuse them easily in my career.

The Middleware for IoT class was like the SOA class as I did not know anything about what we learned in this course before. I feel that the labs and the Hackathon really helped me to learn how to use the platform.

The Cloud & Autonomic Management class had the more theoretical concepts that I also did not know before. However, I feel like the lab sessions were enough for me to understand the main skills expected. Of course, I do not think that my skills are the same as those of a student coming from Computer Science but thankfully, that is not what was expected of me.

* + 1. Feedbacks

I think that this module was really interesting. The two classes, SOA and Middleware, were linked together. Even though we could not do it, I saw how connected the two were. We can compare this module to the Smart Devices module. You can truly see how the skills learned in one class were directly used in the other. I could also see that with the third class, Cloud, but we did not really link it with the other two in a project. I think it would have been fun to regroup the three classes in a big project.

I appreciated the relation between the classes because they were pretty different in content but still echoed each other. They all rely on the same core concepts as Web services or server constraints for example. The classes did not overlap, so it did not feel like they repeated each other. It made me comfortable with all the concepts of these classes.

I loved the SOA project. As the one we did for the Smart Devices module, I think it was the kind of project I expected to do coming in ISS. It really showed us the link between all the different kinds of technologies and why they are used in the industry. It is often hard to really illustrate technologies and framework in a limited lab environment, but I feel like it succeeded here.

I would really have loved for the Middleware labs and the SOA project to be merged, so we would have a real long-term project with real sensors and actuators. In this way, we would have more hours of tutorials and labs to really go deeper into the project. I would have loved that to be honest. Moreover, this would have more justified the use of the Agile method and Continuous Integration.

However, this project gave me the opportunity to work with a lot of autonomy. I felt really invested in the project and was happy to put time and effort into it. Seeing the final result was an exciting moment.

1. **Hackathon**

Every year, the ISS students must participate in a Hackathon. This year, Mr. Monteil chose the International oneM2M Hackathon managed by the Korean Electronic Technology Institute (KETI) and the European Telecommunication Standards Institute (ETSI).

* 1. **Description**

This Hackathon had international participants from Korea, India, Spain, Germany, USA, and France. It lasted one month from the 30th of September to the 4th of November. The deliverables were a huckster.io project describing the IoT solution we produced and a short demo video. The subject of this event was to build and IoT solution helping citizens with social or environmental issues using the oneM2M standard. Thus, it was a project with a close link to the Middleware & Service module.

With a team of 4 students (2 from AE, 1 from GP and 1 from IR), we decided to create a Smart Crop Monitoring and Growth Management to reduce water consumption. As agriculture represents nearly 70% of the world’s water consumption, a lot of systems have been developed to optimize the watering method. However, plant growth is almost never considered. Moreover, we noticed a significant lack of databases informing us about the parameters influencing the plant growth parameters. It is in this context that we wanted to develop an intelligent monitoring system to fill the gaps identified. The main functionalities of our system are the following:

* Monitor the growth of the plant, water consumption and external parameters (luminosity, temperature, soil humidity, …).
* Remotely control the watering or define some strategic rules to automate plant watering.
* Predict the amount of water to deliver to the plant to achieve a certain growth rate over a given period for a given plant.
  1. **Technical challenges**

During this Hackathon, we encountered many challenges:

* The sensors. As a matter of fact, we used several analogic sensors. Thus, we needed to use a multiplexer since the ESP8266 only has one analogic pin. It took us some time to operate it and we even had to change it. Finally, we succeeded thanks to the help of online documentation.
* The valve. First, we had issues finding one, but we managed to get it one week before the deadline. Then, it was not working with our system and we had to buy hoses to guide the water flow into the valve. Moreover, to have enough pressure to use the valve, we used a cat water fountain motor. In the end, everything was working but it took us some time to understand what was missing and then to collect all the material.
  1. **Analysis**

This project was undoubtedly stimulating. It was nice to work on a big project, with all the equipment at our disposal and on a subject that we cared about. Once again, that is the kind of project I expected to have in ISS. Moreover, having a team composed of students from different background was very refreshing. Working on every aspect of an engineering project was very rewarding.

The only downside was the time allocated to do the project. The deadline was set by the organizers but not knowing early that we will have to participate in a Hackathon did not prepare us. In addition, being required to team with students with different background was a really good idea but it would have been better if we knew it ahead of time. In fact, we did not really know each other so we randomly formed the teams.

Overall, it was a very good experience but a little bit tarnished by the lack of time.

1. **Innovation and humanity**

We all know that being an engineer relies a lot on technical skills but cannot forget the human aspects of this position. This module keeps us aware of all the subjects related to this facet of engineering.

* 1. **Description**

This module gathers six classes that focus on human skills. We had a Team Management class that gave us the perspective of a team manager. We also studied Creativity, Innovation and Social Psychology. In addition, we had the continuation of the Individualized Professional Development course with a mockup job interview. Finally, we cannot forget the Sport part. The variety of the classes makes so that some of the skills learned are directly linked to managing a project as an engineer, but other apply to humans in general and how to live as a citizen in our society. You can find a quick summary of the courses in the table below. The next subsection will focus on the most relevant experiences in more detail.

* + 1. Social psycho

This class was one of the most original one. The professor used a different teaching method. We debated a lot on different subjects, and we learned the core concepts through presentations by the students. We also spent an entire 3-hour class watching the movie Twelve Angry Men, and then analyzing it. It is about a jury of men discussing if they should vote guilty or not guilty during a trial. This movie represents almost all the themes of social psychology like manipulation, social influence or even prejudice.

The main work was a presentation on one of the seven themes of social psychology in groups of two. These presentations were the only theoretical material we had during the class, so we had to include all the key elements while also presenting something fun and interesting. I decided to present the subject of Intercultural Relationships with a Kahoot in the end to present some fun facts. You can find the presentation in the following link:

* + 1. Creativity method

This class also used new teaching methods. It was composed of four tutorials, each of them beginning by a small lecture followed by work on the theme of the lecture. We had to choose an object and try to innovate it by following the TRIZ creativity method. With my team partner, we chose to study the chair. You can find our report in the link below:

* + 1. Polling student sport

Instead of doing the sport internship because of medical issue, I had to write a report about the remarks the general opinions of the participants. I created a poll to ask the students questions about their expectations, their integration to the group, the progress of the internship, their global feelings and the possible improvements.

* 1. **Technical challenges**
     1. Innovation

The Innovation class started with a few theoretical lectures, talking about the main concepts of innovation, project management and teamwork. The real challenge started after these, when the class started to get really close with our main project. What we had to do was to rethink our project development and strategy taking into accounts the elements we had seen. When tasked with a project, most of us jump directly to a technical solution, without paying much attention to market, user acceptability or ethics constraints. We were encouraged and took time to write reports about specific issues from the class, and in the end, we had to present the takeaways from these with our project. We did a project presentation including the advancement at the beginning of December, risk assessment issues, our time management methods and social acceptability analysis. You can watch the slides of our presentation by clicking the link below:

* + 1. Creativity

This class consisted in tutorials where we learn the concepts of the TRIZ method, and then we apply them to a study object of our choice. However, since it is a complex method, applying it correctly was not easy. The object I chose to study is the chair. We were asked to select a simple object, because using TRIZ on a complex object is really complicated. First, we conducted spatial and temporal analysis of the object. Then, we applied it to use the TRIZ resolution matrix.

Applying the method gave us leads that we could apply to find concrete idea on how to improve the chair. In the end, the solution we proposed was to have a levitating chair, so the chair can be moved on every surface while staying as light as possible. You can read the full report of our case-study by clicking the link below

* + 1. Social P

The main challenge of this class was to prepare the presentation about Intercultural Relationships. We had to make the presentation fun, so it took a little time to find original ways of presentation. We settled for a Kahoot to introduce some fun intercultural facts.

* + 1. Team M

This class was composed of classical lectures about team management. The evaluation method was a case-study. That was the main challenge of this course. We had to shift our way of thinking regarding a team project because we had the perspective of a manager. This case-study asked us to deal with conflict, to motivate a team and to ensure good productivity and performance. Studying the theoretical notions is important but applying them to real-life examples helped me a lot to get comfortable with them.

* + 1. PPI

This class was not new to me since I took it since the first year at INSA Toulouse. Over the years, the teaching methods varied quite a lot. This year, the challenge was to be prepared for job interviews since we were looking for our end-of-studies internship. To do that, mockup interviews were organized. I did mine with a Human Resources manager at Celad. I was interviewed for a real job offer, posted by another company. It lasted 30 minutes and overall, I was quite happy with my performance. My interviewer gave me a lot of critical feedback, and it helped me to be more prepared for the actual job interviews I had later during the semester.

* 1. **Analysis**
     1. Self-evaluation

I think that it is harder to specify the skills acquired in non-technical classes.

For the Manage an Innovative project skillset, I think that I obtained these skills thanks to all the projects I was part of during my entire education at INSA Toulouse. They helped me to try to innovate in each of them and taught me how to solve a problem. Having a leading position in some of them was also a benefit to learn these skills.

For the Learning teamwork skill, I can say probably the same. All the projects, and more importantly those of this year, working with students from different backgrounds, contributed to acquire the skill.

For the Be convincing skillset, they were all acquired thanks to all the oral presentations we made this semester but also during all the years at INSA Toulouse. I often thought that there were too much of them, but I can see the results anyway. It gave me much more confidence in presenting my projects and ideas to a public.

* + 1. Feedbacks

Every year at INSA, we have a Human Science module and I think that this year’s module was one of the best. I learned a lot of skills and knowledge about notions useful not only in an engineering context but also in our everyday life. I just wish I had more of this kind of classes before, classes that teach us notions about what it is like to work in a company like we had in Team Management. This class approaches a lot of concepts like trial period or how to read your payroll. I think that seeing all of that really reassure me about my future. The time scheduling was also very on point with this module.

I liked the Creativity class as well because it was something that I have never seen before and the teaching method was truly nice and interesting. Trying to apply the TRIZ method on a simple object was a perfect way for me to understand the principles of this method.

These classes, even if they do not teach us technical skills, are very important for our career but also for our personal growth. They give us the tools to guide ourselves as engineers and as humans. It is even more important at this time as we start a new stage of our life.

1. **Project and portfolio**

This semester is centered around a large-scale project. This project is a culmination of all the education we received at INSA. It brings together the skills and knowledge acquired during the semester. It puts us in the situation of leading and managing a project going over several months.

* 1. **Description**

This module gathers three classes. This is an important module because it includes the biggest project of the semester. We improved our English with this project since every deliverable must be in English. Moreover, the portfolio is the completion of the semester since it regroups every skills and knowledge we acquired during the semester.

* + 1. RTK

Everyone is used to standard GPS geopositioning in their car, in their phone or in their computer. Standard GPS receivers have an accuracy between 2 to 10 meters, and only in outdoor conditions. As a group of 5 students, we teamed up to answer a problem raised by our tutor, professor Guillaume Auriol: to geolocate meteorological balloons in association with a Paul Sabatier team led by Professor Hassan Sabbah. As you can guess, the standard GPS is not accurate enough to precisely locate the balloon. So, our tutor was interested in a Real-Time Kinetics (RTK) solution since its accuracy is far more precise. The launch of the ArduSimple starter kit LR offered a relatively low-cost RTK module. Therefore, the aim of our project is to assess this solution to see if it is compatible with the needs of the project. As you can in the picture below, we were in possession of an ArduSimple starter kit LR composed of:

* 2 simpleRTK2B boards (Rover and Base Station)
* 2 Radio Modules LR (Long Range) with Xbee + 2 radio antennas
* 2 u-blox ANN-MB-00 Antenna for GNSS Dual Band with cable (IP67)
* Base and Rover preconfiguration
  1. **Technical challenges**
     1. Project

The first challenge we encounter was to assimilate the new notions. We had to do a lot of research to understand the RTK technology and architecture. These notions are truly complex and took us a lot of time to comprehend. Moreover, we used some new technologies to build a database and display a map on our website. After all, we still managed to do everything we wanted and learned a lot of new skills.

Even if the kit in our possession was supposed to be “plug & play”, we had a hard time finding the right configuration to obtain an RTK positioning. First, we had difficulties reading the raw frames obtained with the XCTU software. So, we created a program using an ESP32 to recover the frames and parse them. Then, to find the root of our problem, we linked the base and the rover’s board together. In doing so, we realized that it was the Xbee module that were not properly configured. So then, we configured the Xbee module the right way, with the good baudrate. This solution was found thanks to research and strategic thinking. It truly was a team effort.

One of the main challenges was to find the right time and place to do the experiments. As a matter of fact, to have a RTK positioning, you need an open-sky view. If we do not have that, it is impossible to have an accuracy of a few centimeters. Moreover, since we are in winter, it was difficult to test outside because our computers would not hold long enough to really test our solution.

* + 1. English

The entire semester is provided in English. It is an important part of the 5ISS classes, but it was mostly linked to the Innovative project since every deliverable was to be in English. We had two project reviews in English to present the progress we made throughout the semester. Moreover, the report must be written in English. Thus, we had a lot of opportunities to improve our English, both oral and written. Moreover, we had English class since the first year at INSA Toulouse, so we made huge progress since the beginning of our school days. Obviously, there are still many ways that we can improve it, but I really feel like I had made progress on my presentation skills in English, having a better energy and fluidity in my speech.

* + 1. Portfolio

The first challenge was to decide how to display my portfolio. I already decided to do a website, so I can learn new skills. The main challenge of course is writing the content of the portfolio, but this will be the focus of the analytical part. I chose to use a fun template for my portfolio. That is why I decided to use this template. It represents a Visual Studio Code page. I used it because to me, it symbolizes all my projects since I used VS Code for almost all of them.

This website was realized using React, TypeScript, JSON, Markdown and HTML5. While I used a template, the change I mage in the layout and choice of content really improved my web design skills. Even though it is not a domain really taught at INSA, I personally enjoy doing it. Moreover, it allowed me to prepare a little bit for my internship since I will be using React to do some web development. Thus, I really like the opportunity to improve my skills thanks to the portfolio. I just wished I had more time to completely create my website from scratch instead of using a template.

* 1. **Analysis**
     1. Self-evaluation

Even though none of the skills expected of this module were technical skills, I think that they were all very important for our career and our personal growth.

I was really invested in the Innovative project because I was interested in the subject. It was full of challenges, but we managed to overcome them all and even going further than I even would have imagined at the beginning of the semester. Thus, I am very proud of my team for doing so. With this project, I feel that I truly improved my technical skills but also my presentation and communication skills.

Likewise, I am proud of my portfolio. During all the semester, I was pretty frustrated because I felt like I did not have time to really invest myself into the different deliverables we had to produce. So, I knew that I wanted to spend a lot of time on this portfolio. I wanted to make it as good as I could. Even though I started late, like most part of the students, I wanted to end over all of my other reports before the Christmas holidays to be sure to have time to work on my portfolio during this time. The layout of the website was very important but the content of it was even more. I chose to only talk about my 5th year modules and my 4th year internship because of the density of the 5th year. I thought there was already enough notions and skills to present to fill the entire portfolio.

* + 1. Feedbacks

I wanted, for this feedback, to make a conclusion of this semester. I really liked how the semester was built with all the modules given to us to help us with our Innovative project. We clearly saw that all the classes, the tutorials, the labs, and the side projects helped us with the final project. I think that the modules really succeeded to convey that feeling.

I was very satisfied with my choice to go in ISS. I really the kind of module like Smart Devices as it depicted exactly what I expected from ISS. Every class and lab were working together toward a bigger project. I have no doubt about the difficulty to establish this kind of module. So, I am very happy that I could beneficiate of all the feedbacks the older students made and the work of the professors and tutors which made this quality teaching possible.

Coming from Electronics and being always torn apart between Electronics and Computer Science, the ISS module was the best I choice I could make, and I will never regret choosing it. It was the bridge between the two domains and was exactly how I imagined my last semester would be. I truly feel like the focus of this year was not really on reaching expert levels in every skill, but rather know how to make all these domains work together in engineering projects. One of the most important skill this semester, in my opinion, was not a technical skill but instead a managerial and problem-solving skill. In fact, we had to integrate different problematics from completely distinct domains. To me, the term Innovative was truly illustrated by that.

I feel like I learned a lot during this short period of time. The semester was undoubtably dense was it in terms of deliverables, deadlines, projects, and notions. I think that I had to rush some assignments due to that and it saddens me because I would have sincerely like to go deeper in each project. I think that I was not able to show everything I am able to do in so little time. I am particularly thinking about the Communication module and I feel sad because it is one of the domains where I am the least confident with, but unfortunately, I did not find time to invest myself in it as much as I would have wanted to.

If someone asks me if I would do it again if I could, I will answer positively without hesitation. This semester was truly interesting and fun and the only thing that I regret is not having enough time to fully exploit all the projects. Having only one exam and working on so many different projects was intense and all-consuming, but also honestly satisfying. The end of the year was a real rush, especially for our Innovative project, but I am happy with how it all came out in the end. I am very grateful that had the opportunity the experience this kind of formation and I think it was a wonderful way to prepare us for the next chapter of our life.

1. **Internship**

I wanted to talk about my 4th year internship in this portfolio because I think it was an important part of my education. Even though it lasted only 3 months, I learned a lot during this internship.

* 1. **Description**

I did my internship at Vitesco Technologies within the Mechatronic Sensor Module (MSM) where Vitesco is developing Door Handle Sensor (DHS). The product is based on the CANoe communication network. In addition, many tests must be carried out to guarantee the correct functioning of the product. During this internship, my goal was to collect the testing needs of the DHS project and to use the CANoe tool to develop a generic interface while providing a library that can be used by future projects.

My work was deconstructed into different steps:

1. Familiarize with existing technologies (capacitive sensor / BLE/ NFC) and with the CANoe software.
2. Collect the project needs and read the documentation to understand what was expected of my work.
3. Normalize the already existing code.
4. Develop the modules based on CAPL and create panels to test the NFC. They needed this panel to test the NFC protocol quickly without having to modify the code each time.
5. Upgrade the routine control SFD UDS panel.
6. Perform the tests and training.
7. Present my work to the team.

Why CANoe? This software can emulate the sensor's interface on a vehicle. It makes it possible to develop, test and analyze individual ECU or a network of ECU.

NFC: NFC or Near-Field Communication is a proximity-based wireless communication standard.

SFD: SFD, Security Fahrzeug Diagnosis, means Vehicle Diagnosis Protection. It is the procedure recovering a certified token to use UDS services.

UDS: UDS or Unified Diagnostic Services is a communication protocol used for ECU diagnosis, debugging and configuration.

* 1. **Technical challenges**

I faced multiple challenges during this internship, but I succeeded to overcome them all. That is what was satisfying about this internship.

The first challenge was to arrive in the middle of a project. It took me some time to get familiar with the goals of this project, the equipment used, and the code already written. But with a lot of research, by reading the documentation and questioning my tutors.

Another challenge was to understand the technologies used: CAN networks, NFC protocols, etc. Like the first challenge, I resolve my problem the same way.

The biggest challenge was to learn how to use the CANoe software. This is a very complete and complex software that emulates the CAN network of a vehicle. It also allows the creation of controls panels and tests. Due to its complexity, it took me a long time to understand how to manipulate it.

* 1. **Analysis**

During this internship, I had the opportunity to do and experiment a lot of things:

* Discovery of the CANoe software
* Development of programming skills (CAPL)
* Familiarization to design and UI
* Engineer approach to problem solving and using code already written
* Adaptability to an already started project
* Understanding the needs of the team
* Reflection to answer these needs
* Creativity and autonomy with requirement specifications
* Teamwork and synthesis capability to present the results
* Overview of a large company