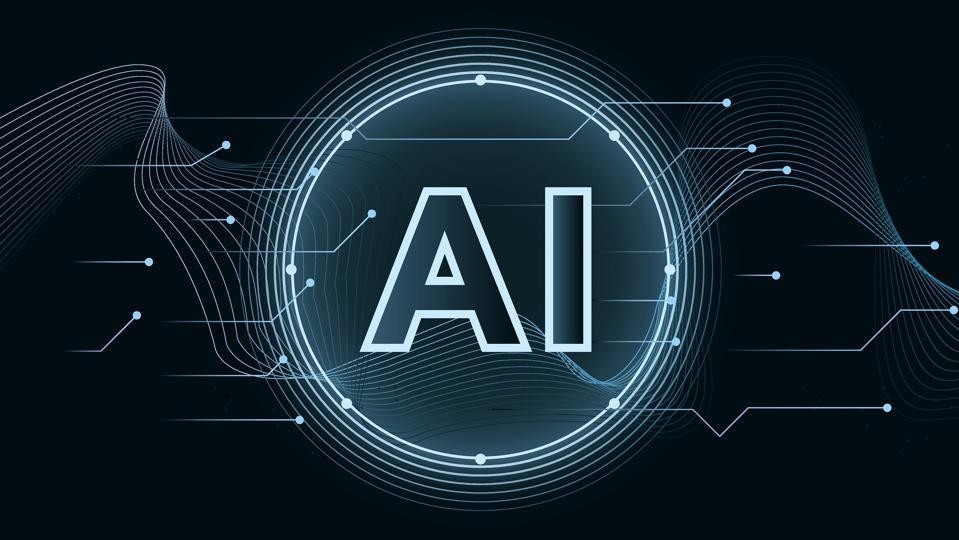
Semester 7 – AI for Society

Personal Development Report

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**Versioning**

|  |  |  |
| --- | --- | --- |
| Version | Description | Date |
| 0.1 | Start PDR | 18-09-2022 |
| 0.2 | Second version | 16-10-2022 |
| 0.3 | Third version | 27-11-2022 |
| 1.0 | Final version | 15-01-2023 |

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# Introduction

The 7th semester of the ICT & Software Engineering course at Fontys is on a minor or specialization that students had to pick themselves. Among the minors, one stood out: **AI for Society**. I picked this minor because I have not explored artificial intelligence that much. I am interested in the possibilities and I want to create a project using AI that is actually useful. This document will note down the estimated learning outcome level, divided by each PDR version.

# GitHub links

This document does not fit the actual work done. Please refer to the GitHub repositories created to read more about the actual work done. These repositories are all public and part of the GitHub Organization:

cafetaria-sleutelbos (<https://github.com/cafetaria-sleutelbos>)

**Documents**

All the documents, including this one, can be found in the GitHub repository:

<https://github.com/cafetaria-sleutelbos/Documents>

For a more detailed document about the work done, please refer to the document FinalDeliver.docx in the documents repository.

**Backoffice**

The GitHub repository for the Backoffice can be found here:

<https://github.com/cafetaria-sleutelbos/backoffice>

**Dashboard**

The GitHub repository for the Dashboard can be found here:

<https://github.com/cafetaria-sleutelbos/dashboard>

**Scanner**

The scanner is hardware and there is only one version/prototype of it, so there is no point in hosting

it currently. However, the code in the GitHub repository can be found here:

<https://github.com/cafetaria-sleutelbos/scanner>

# Learning outcomes

## Societal Impact

*“The student is able to approach the context and impact of their own AI project(s) from different perspectives in a sustainable way. In addition, the student is able to reflect on their own choices, taking into account data legislation and the (possible) impact on society.”*

This learning outcome focusses on societal impact. The student should be able to recognize their influence and reflect on choices made.

**Development (undefined, orienting, beginning, proficient, advanced)**

|  |  |  |
| --- | --- | --- |
| **ID** | **Description** | **Level** |
| 0 | Week 4 | Undefined |
| 1 | Week 7 | Orienting |
| 2 | Week 12 | Beginning |
| 3 | Week 17 | Proficient |

**Substantiation**

0: Week 4

This first period was mainly used for getting to know the minor, making groups, and setting up the work environments.

1: Week 7

The student has looked at the influence their individual project has to society. The project should be beneficial for the catering industry that fall behind in their technological aspects (in this case snack bars in particular). The student also followed lectures about the legal points of AI and software. This resulted in the student looking at how the data is handled and where legal problems could occur. Since the data is anonymous and sensitive information is not saved, the project should not fall in the scope of GDPR.

2: Week 12

This period, the student has looked into societal impact by finishing an exercise recommended by a teacher. This exercise focused on contemporary philosophy. In the group project, the students have created a TICT quick scan document.

3: Week 17

In this ending period, the student has further developed this learning outcome by thinking about the impact the system has. Out of this, a follow up suggestion document was made, with more projects that could be worked on in the future, with the goal of further improving the current system. The student also has talked to quite some teachers in the last week, which were all positive and thought the project was creative. The focus in the meeting with the moral design teacher Rens was mainly about thinking of possible problems and some other impacts. He thought the project was very real and was impressed from a moral design/problem view.

**Reflection on my progress**

0: Week 4

This learning outcome has not progressed yet, so the level is: **Undefined.**

1: Week 7

This learning outcome has progressed. The student has gained more knowledge and this should result in a better implementation of the application. The amount progressed is between orienting and beginning, but after reconsidering the progress done and to be done, the level is set to: **Orienting.**

2: Week 12

The student has looked into societal impact and is close to proficient level, but can still improve. The level is set to: **Beginning.**

3: Week 17

This period saw quite some improvements, but not all the additional points that could have been done were checked. For this reason, the level is set to **Proficient.**

## Investigative Problem Solving

*“The student is able to critically look at their own AI project(s) from different perspectives, recognize problems and come up with appropriate solutions.”*

This learning outcome focuses on recognizing problems in the project and being able to fix them appropriately.

**Development (undefined, orienting, beginning, proficient, advanced)**

|  |  |  |
| --- | --- | --- |
| **ID** | **Description** | **Level** |
| 0 | Week 4 | Undefined |
| 1 | Week 7 | Orienting |
| 2 | Week 12 | Beginning |
| 3 | Week 17 | Advanced |

**Substantiation**

0: Week 4

This first period was mainly used for getting to know the minor, making groups, and setting up the work environments.

1: Week 7

The student has followed multiple lectures varying from practice exercises to presentations about important information. By following the exercises, the student gained practical experience with adjusting AI under the guidance of a teacher. The presentations from the teachers also played an important part in the progressing the student as an AI developer. The student is currently busy collecting their own dataset, so their own AI has not been tested yet.

2: Week 12

The student is able to solve problems in the project. One of the biggest problems was how to collect the data from the receipts printed. The student was able to solve this problem by using a camera mounted above the printer. Other smaller hurdles have been solved as well.

3: Week 17

These last couple weeks, the student rounded up the project. The initial problem of getting the receipt data was solved by implementing the scanner together with the OCR Python Tesseract and machine learning with Tensorflow. According to Bas, the current algorithm used (classification) is not the best approach. His feedback was to use a Regression algorithm when only two classes are available. He still thought the data received was nicely processed by properly looking at the results given, which is also why the predictions work pretty nicely. The feedback from that was received from Rens was that the project is very real, designed to solve a real problem in a domain the student was familiar with. In this meeting, the teacher and student also talked about some problem solving and possible solutions.

**Reflection on my progress**

0: Week 4

This learning outcome has not progressed yet, so the level is: **Undefined.**

1: Week 7

This learning outcome has progressed. Just like the last learning outcome, the student has gained more knowledge from lectures. Unfortunately, their own AI has not been tested yet, so the level is set to: **Orienting.**

2: Week 12

This period has shown improvements in this learning outcome. The level is set to: **Beginning.**

3: Week 17

The student has repeatably encountered a variety of problems and solved them. From easy difficulties, like minor bugs in the code, to bigger ones, like how to get the order data from the receipts. In one of the meetings with the teachers, there was also some discussion about the possible problems in the future. The level is set to: **Advanced.**

## Data Preparation

*“The student is able to collect data and estimate its quality and usability. The student is also able to adjust the data if necessary for proper usage in their project(s).”*

This learning outcome focusses on gathering data and being able to decide which data is usable and the quality of it.

**Development (undefined, orienting, beginning, proficient, advanced)**

|  |  |  |
| --- | --- | --- |
| **ID** | **Description** | **Level** |
| 0 | Week 4 | Undefined |
| 1 | Week 7 | Beginning |
| 2 | Week 12 | Proficient |
| 3 | Week 17 | Advanced |

**Substantiation**

0: Week 4

This first period was mainly used for getting to know the minor, making groups, and setting up the work environments.

1: Week 7

The student is currently collecting their own dataset from a live environment. The data collection system is a Raspberry PI 4 connected to a camera that scans receipts and sends them to a back office. In this back office, entries can be adjusted (so outliers can be removed and edited).

2: Week 12

This period, the parts of the system has been connected to each other. The data received from the scanned receipts are sent to the back office. In this back office, all orders and items can be shown and adjusted if necessary. These orders can also be interacted with on the dashboard by an employee.

3: Week 17

The dataset was continuously growing during the last period. The difficulty of creating the dataset was that for each entry, a physical receipt is necessary which then has to be properly scanned. The scans are not always as accurate as the student hoped to be, so a string matching algorithm called Levensthein was used. This algorithm matches the given input with a value in a given list of possible answers/values. In the meeting with Hans, he was impressed with the amount work done and there was discussion about minor problems with solutions for the data preparation part of the system.

**Reflection on my progress**

0: Week 4

This learning outcome has not progressed yet, so the level is: **Undefined.**

1: Week 7

This learning outcome has progressed. The student has created their own system to collect their dataset. This system sends the data to a back office where the data can be shown in an overview. From here, the outliers in the dataset can be edited or removed. Since the learning outcome has progressed a lot, the new level is set to: **Beginning.**

2: Week 12

This learning outcome has progressed. Instead of getting data from the internet, the student created his own device to scan the receipts. These receipts are then scanned and sent to a back office for further adjustments or visualizations. For these reasons, the level is set to: **Proficient.**

3: Week 17

In the meeting with Hans, he told the student that the work done was more than sufficient. He not sure if the grade should be proficient or advanced for this learning outcome. But considering that just for the data preparation itself the following was created makes the student want to set to Advanced:

* a 3d printed receipt holder
* camera holder
* main python code for Raspberry Pi
* preparing frame screenshot for scan
* whole backoffice with the Levensthein algorithm

Since a lot was done for the data preparation, the grade is set to: **Advanced.**

## Machine Teaching

*“The student is able to use data to train models in a way that fits the intended purpose. The student is also able to test whether the models have been adequately trained”*

This learning outcome focusses on training models using data. It should also be tested to see if the model is working properly.

**Development (undefined, orienting, beginning, proficient, advanced)**

|  |  |  |
| --- | --- | --- |
| **ID** | **Description** | **Level** |
| 0 | Week 4 | Undefined |
| 1 | Week 7 | Orienting |
| 2 | Week 12 | Beginning |
| 3 | Week 17 | Proficient |

**Substantiation**

0: Week 4

This first period was mainly used for getting to know the minor, making groups, and setting up the work environments.

1: Week 7

The student is currently collecting their own dataset from a live environment, so their AI has not been used yet. However, during lectures, there has been practice assignments using test datasets to train an AI.

2: Week 12

This period, the student mainly worked on the scanning of receipts part. The technology used for getting the images are a raspberry pi and a webcam. The image gets processed in Python by using the packages Opencv and tesseract.

3: Week 17

The student has used Tesseract to effectively read the receipt data, which is used to create order models. This however is a pretrained machine learning model. The student also wanted to teach a ML model himself, so Tensorflow was used to predict if a receipt is adjusted manually by an employee with a pen. The initial test accuracy of this model was around the 87%. This was eventually improved to 100%, however, this is not the “real” accuracy, since the results graph, the validation accuracy was a bit lower, around 95%.

**Reflection on my progress**

0: Week 4

This learning outcome has not progressed yet, so the level is: **Undefined.**

1: Week 7

This learning outcome has not progressed as much as the student wanted to, but there was some practice in training AI during lectures. There are still quite some steps to take, so the level is set to: **Orienting.**

2 Week 12

This learning has progressed by one level. The student has collected their data themselves, but can still improve on other levels. The steps to be taken have lessened, but there are still some left. The level is set to: **Beginning.**

3: Week 17

In the meetings with the teachers, the student heard multiple times that the ML part of this project is not as impressive as the rest. However, according to the feedback from Georgiana, it is sufficient. This is why the level is set to: **Proficient.**

## 5 Data Visualization

*“The student is able to use data to create an interesting, informative and compelling story in an (interactive) data visualization product, tailored to the right target group.”*

This learning outcome focusses on displaying results in an interesting and informative way.

**Development (undefined, orienting, beginning, proficient, advanced)**

|  |  |  |
| --- | --- | --- |
| **ID** | **Description** | **Level** |
| 0 | Week 4 | Undefined |
| 1 | Week 7 | Orienting |
| 2 | Week 12 | Beginning |
| 3 | Week 17 | Advanced |

**Substantiation**

0: Week 4

This first period was mainly used for getting to know the minor, making groups, and setting up the work environments.

1: Week 7

The student is currently working on a back office, where the dataset can be displayed and/or edited. This back office should get the data live from the receipt scanning system, so the graphs will also update real time. Alongside this back office, there will also be a dashboard for the employee with the items that came out of the results of the AI. This display will most likely be a list view with buttons.

2: Week 12

The page to visualize the data has been created in the back office. All the orders can be shown in a table, and individual orders can also be adjusted. The next step is to make the data prettier by using graphs and colors.

3: Week 17

Each word that tesseract scans comes with a probability of how correct the scan was. This was displayed in the Backoffice with colors. The dashboard displayed a lot of visual data received from the backoffice. There is a function to highlight special orders, but this is not implemented, although it is added in the design. Results from the Tensorflow ML model was also displayed in the dashboard.

The student is a full stack developer, but designing is not his strongest suit. feedback was received from the teachers about color usage and the layout, which will be updated in the future.

**Reflection on my progress**

0: Week 4

This learning outcome has not progressed yet, so the level is: **Undefined.**

1: Week 7

This learning outcome has progressed. The back office and dashboard is currently being worked on, so it is not finished yet. The student has practiced with graphs during lectures. The level of this learning outcome is: **Orienting.**

2: Week 12

This learning outcome has progressed. The back office and dashboard are functional and connected to each other. The student has been working with graphs during his part time job at a software company. These skills can be taken to the individual project. The level of this learning outcome is: **Beginning.**

3: Week 17

This learning outcome has progressed. In the meeting with Hans, he was uncertain about the level proficient and advanced. The work done for this point was also not minimal.

* Dashboard that displays and highlights specials orders/items
* Display all scans with their data
* Show individual scans with probability true Tesseract.
* Display all orders created from the scans
* Show individual orders with result Tensorflow
* Graphs in notebook

Given all this work done, the level is set to: **Advanced.**

## Reporting

*“The student is able to report in a methodologically sound manner on (the outcome of) own AI projects (project proposal, process documentation, reporting of final results, etc.).”*

This learning outcome focusses on reporting and documenting progress in a professional way.

**Development (undefined, orienting, beginning, proficient, advanced)**

|  |  |  |
| --- | --- | --- |
| **ID** | **Description** | **Level** |
| 0 | Week 4 | Undefined |
| 1 | Week 7 | Orienting |
| 2 | Week 12 | Beginning |
| 3 | Week 17 | Proficient |

**Substantiation**

0: Week 4

This first period was mainly used for getting to know the minor, making groups, and setting up the work environments.

However, the student already had to make a couple of documents which have been submitted on canvas.

1: Week 7

The student has needed to document their progress for both the individual project and group project. The student also has made simple diagrams to show what the final system looks like.

2: Week 12

The student has been keeping track of his documents in a separate GitHub repository inside the project organization. The documents inside this repository range from this PDR to 3D models used for mounting the scanned above the receipt printer.

3: Week 17

This final period, a lot of documents have been created. The previously mentioned GitHub repository was cleaned out and restructured. This document, including the Final delivery were updated. New documents were also created and pushed to the repository.

**Reflection on my progress**

0: Week 4

This learning outcome has progressed a little bit, but not enough to change the level. The level is:

**Undefined.**

1: Week 7

This learning outcome has progressed. Although the documents are done, the styling could use some more attention. The level is: **Orienting.**

2: Week 12

This learning outcome has progressed. The student has kept up their documents and added more. The level is: **Beginning.**

3: Week 17

The documents created were all delivered in the final delivery. The styling however could use some more attention and some document could’ve been more detailed. For these reasons, the level is set to: **Proficient.**

## Personal Leadership

*“The student shows an entrepreneurial mindset regarding their own AI project(s) and personal development, while being aware of their own learning capacity and keeping in mind professional ambitions in their future work field.”*

This learning outcome focusses on personal development. Being able to see where you stand and how much can still be learned.

**Development (undefined, orienting, beginning, proficient, advanced)**

|  |  |  |
| --- | --- | --- |
| **ID** | **Description** | **Level** |
| 0 | Week 4 | Undefined |
| 1 | Week 7 | Orienting |
| 2 | Week 12 | Beginning |
| 3 | Week 17 | Proficient |

**Substantiation**

0: Week 4

This first period was mainly used for getting to know the minor, making groups, and setting up the work environments.

1: Week 7

The student is currently a little bit behind track, with the focus on the receipt scanner. The scanner is currently about halfway done, but ideally a first version should’ve been completed which would start collecting the data set.

In regards of the future work field, the student has updated their cv and LinkedIn. The student has been looking for companies and has written down a couple interesting ones.

2: Week 12

The student is currently looking for a graduation internship. The cv, LinkedIn and personal website have been updated. Besides this, the student has been keeping up schoolwork and the part time job at a software company. This part time job is also helping the personal development by building up experience in a real company and improving their coding capabilities.

3: Week 17

Since the last period, the student has found and secured a place to do his graduation internship. The student has also been thinking about how to improve the current project after the semester is over. The ideas are documented in a follow up suggestion document.

**Reflection on my progress**

0: Week 4

This learning outcome has not progressed yet, so the level is: **Undefined.**

1: Week 7

This learning outcome has progressed. Even though the student is a little bit behind track, the project should still be fine. The progress lost can still be gained back in the coming holidays or during extra hours after lectures. The student will start applying to companies soon after talking to their mentor. The current level is set to: **Orienting.**

2: Week 12

This learning outcome has progressed. The student has caught up a bit and is progressing well. The student is currently also focusing on their graduation internship. The current level is set to: **Beginning.**

3: Week 17

The student has found a place to do his graduation internship. The student also made a document with follow up projects that built on top of the system made in this semester. The level is set to: **Proficient.**

## Personal Goal

*“<With this learning outcome, the student can set its own goal in relation to their future field of work. Describe this Learning Outcome in your PDR.>”*

The student can improve an already existing system or progress by adding AI or replacing components with AI.

**Development (undefined, orienting, beginning, proficient, advanced)**

|  |  |  |
| --- | --- | --- |
| **ID** | **Description** | **Level** |
| 0 | Week 4 | Undefined |
| 1 | Week 7 | Orienting |
| 2 | Week 12 | Beginning |
| 3 | Week 17 | Advanced |

**Substantiation**

0: Week 4

This first period was mainly used for getting to know the minor, making groups, and setting up the work environments.

1: Week 7

The student has looked at the bottlenecks in the flow of the snack bar. The student found the biggest bottleneck that could be solved by using AI that is big enough for a semester project. A project proposal was submitted to canvas which was accepted. The student is currently working on the implementation of the system.

2: Week 12

The system has been tested a couple times in a real environment, but not at the busy stages. It is not ready yet for rush hours, but the feedback received from the employees has been positive.

3: Week 17

A final prototype has been made with live connections for real-time data, so the page does not have to be refreshed every couple seconds. A demo video was made and documented in the final delivery document. The current dashboard effectively shows what items should be gotten from the back or should be dropped in the fryer sooner. There are still some points that should be improved before it can actually be fully integrated with the snack bar.

**Reflection on my progress**

0: Week 4

This learning outcome has not progressed yet, so the level is: **Undefined.**

1: Week 7

This learning outcome has progressed. The plan has been set, but the system itself is not yet ready. The level is set to: **Orienting.**

2: Week 12

This learning outcome has progressed. The system has been testing live in a snack bar, but due to some problems, it did not work perfectly. The level is set to: **Beginning.**

3: Week 17

Although the prototype cannot be permanently used in its current state, it still effectively showed the special items that required more attention. This did make the process a bit easier, but the system is still a bit error prone. This was to be expected, though, since it is not realistic to make a perfect system consisting of three components: hardware, backend, and frontend. In the meetings with the teachers, they were all impressed and positive about the final prototype. The student is proud of what he made, and the level is set to: **Advanced.**

# Retrospective

In this semester, I learned how to develop projects with elements of AI, which was the main goal of mine. I enjoyed the more technological lectures, but unfortunately, those were pretty scarce. I am used to having more structured courses, but this semester was very free and students were more independent. Unfortunately, I choose Course-based in the first semester, thinking I would like a bit more structure. Wanting more structure indeed was the case, but going through the semesters, this structure started to randomly disappeared, caused by having different study structure.

Unfortunately, I do not have a personality that initiates a lot of meetings or talks. In turn, the communication part of the personal project was not all that good. Until nearly the last moments, the feedback was lacking. Although in the last week, the student eventually got a total of 8 feedback points in Feedpulse. All the teachers were pleasantly surprised by the projects and were positive about the project. In hindsight, I also see now that it is not good to keep on working without communicating with the teachers, who are here to help us. In the meetings that I did have, I got some good feedback and points to think about

Next time, I would for sure start asking for feedback way sooner. I would also choose a less challenging or large project, since the tasks in this project were too complex and too much for one person to tackle.

# Conclusion

This semester, the student followed the minor AI for Society. A group and individual project was worked on, with artificial intelligence being the main focus.

Unfortunately, The group project did not deliver the promised stress patches, which was one of the main reasons for picking this project. However, the group still tried to make the best out of the project. The team switched directions from the actual application with the AI to ethics and documentation. We discussed this shift with the respective stakeholders, which also agreed. Not much machine learning was done, but not nothing. A dataset online was found on Kaggle, which we used to do some basic machine teaching. The group project was finished up with a final presentation with the stakeholders and other students.

For the individual project, the process went pretty smoothly. There were moments when not everything wanted to fit into place, but eventually, everything worked out. A final system was created with a scanner, Backoffice and dashboard. Besides the actual hardware and software, some documentation and diagrams were made to explain the application. Refer to the chapter “**GitHub Links**” for the link to these documents.

In this individual project, I created a system that has the potential to grow into a system that will be used permanently. Many different projects that can be built on top of this project.

Overall, the semester could’ve been easier if I had talked more to the teachers. However, I am working on it personally, even at the part time job at a software company I am working at. I am trying to improve my team working and reporting skills in a work environment. Next semester, I will be doing my graduation internship, where I can further develop my communication skills.