Smart Campus Herning Prize 2019

Submission deadline: 1 February 2019
Document language: English is mandatory
Submission guidelines: five pages including the cover page (Times New Roman 11 pt. at default margins); it is recommended that you use at least one page per main heading.
You are allowed to remove the highlighted italic text in the document to save space.
Submit your document in a PDF format before 1 February 2019 to Head of Secretariat Mikkel Nørgaard (mikkeln@btech.au.dk).

Publishable Abstract

This section will be published as part of the Smart Herning Campus Prize.

Title of the submission	Reduce waste of food with Machine Learning
Authors of the submission (first name and last name for each author)	Emil Andreasen (201606620)
Abstract (maximum 500 words)	Food waste regularly occur in the cantina at Campus Herning, this submission aims at formulating a solution to this problem through the use of Machine Learning. By applying this technology, a computer software would, with the appropriate data input, be able to predict the necessary amount of food the cantina staff would need to prepare for lunch each single day with an increasing accuracy. The implementation of the solution will require a variety of sensors and data input for the software to utilize. The result would be reduced cost, production time and waste of food, along with a positive reputation regarding social responsibility by taking on a leading and inventive role in the effort to reduce waste.

Excellence (maximum score: 5)

The Cantina at AU Herning is currently producing and offering a variety of sandwiches and "lunch-boxes" containing hot meals. However, the sales in the cantina are fluctuation and they often produce too many or too few sandwiches and lunchboxes resulting in either a shortage of sale or a waste of food and time.

In recent years we have seen a huge increase in the social and political focus on food waste, and it seems to me that a "Smart-Campus" ought to offer a smart solution to this problem as it would save resources, help protect the environment and send a positive signal that AU Herning cares about it's legacy.

The solution

A way to accomplish this goal is to utilize one of the most revered technologies on the market today, here I am referring to Machine Learning with the help of sensor technology. Through the utilization of this technology, a computer would be able to accurately predict the required amount of food needed each day. This would of course require that the computer is fed with the right information, gathered through sensors. The exact information and parameters required would need a deeper investigation and most likely have to be tested through trial and error. A few obvious examples of the information needed could be:

- Date
- Day of the week
- Amount of People currently on the facility
- The menu options of the day
- Previous consumption of food based on these factors

The technology

By analyzing and learning from these, and other, datapoints the computer would, in time, be able to predict the necessary amount of sandwiched and lunch boxes for each day. This is possible through what is known as machine/deep learning algorithms.

This is possible because modern computers are exceedingly adept at finding and recognizing patterns in vast and complex amounts of data, enabling them to learn from these patterns and use them to predict future patterns based on further inputs. In short, if a computer with the right deep learning algorithm are fed the right information, including sales from the cantina, it will be able to find patterns in the sales based on the other parameters.

The discovery and evolution of deep learning in recent years is one of the major factors that have affected the development and commercialization of self-driving cars (Massachusetts Institute of Technology, u.d.). Much like this proposal the cars software is able to learn to navigate the traffic and recognize obstacles thanks to machine learning and deep learning.

Impact (maximum score: 5)

The primary impact of this idea will relate to the cantina staff and, as earlier mention, it would have a positive impact on Campus Herning's reputation in regard to social responsibility.

The cantina staff would be able to optimize time spent on making and preparing food as the solution would ensure that there won't be prepared an overly excessive amount of food. This would furthermore reduce the costs of maintaining as less food would have to be bought in order to secure enough food is made every day.

Regarding the social reasonability, the impact will most likely be far more indirect. It is however, worth noting that this solution is aligned with current trends along with political and global debates. Once the solution has been implemented and proven effective it can also be expanded to other of AU's facilities or be used in other fields to predict different behavior amongst students and staff.

As earlier mentioned, the solution will require certain sensors and other date (More about this in the final section – Implementation) and as such these senores could also be used for other smart initiatives, aiding in anything from monitoring to research. Could this solution prove impactful on a rather small campus that is Campus Herning, imagine the impact it could have in other facilities or even other companies with varying needs for food from day to day. It could potentially combat food waste on a national of even global scale, with the first step taken right here at Campus Herning.

Impact Summary

1. Cost reduction of Production
2. Social Responsibility
3. Scalability

Implementation (maximum score: 5)

In order to implement the proposed solution a variety of sensors and data collectors would need to be installed around campus, for a successful implementation the type of data needed would have to be considered thoroughly. The following is my take on what kind of sensors and data would be required to implement this solution:

Primary sensors and data:

- Sensors on entrances and exists to track people coming in and out
- Sensors in the Cantina tracking number of visitors
- Date and weekday
- Menu options
- Lecture Schedule – What courses are being taught and when

Secondary Sensors and data

- Weather conditions
- Indore climate (humidity, CO_2 levels, temperature, noise etc.)

The primary sensors and date are to be considered direct influencers on purchase behavior while the secondary sensors and data are to be considered indirect or perhaps even insignificant. With the above sensor and data feed to the software, a solution will be obtainable, note that an introduction time of up to year might be required for the software to fully analyze and predict purchase behavior.

Technological feasibility

The solution is technologically feasible as it can be compared to similar algorithms, examples of this could be customer lifetime value or Chun rates, which both relies on deep learning to calculate and predict how many times a customer returns or perhaps when and if they shift to a competitor.

Economic feasibility

Economically, it can be profitable for Dinnerdelux since the Danish health service dictates that all food with fresh raw materials must be sold within a 12-hour period. This means that all food that has not been sold is a direct cost.

The actual cost of preparing such an algorithm can be high, since large parts of the data must be processed between two instances (dinnerdelux and Aarhus university) since the sensor data should not be synchronized with Dinnerdelux's cash register system and app based order, the actual start-up costs will be between 130.000 DKK and 200.000 DKK - as an Ai consultant costs 1200 DKK ex. VAT per hour (GlobeCom, 2019).

Furthermore, a backend developer must be included to ensure that ongoing data for Dinnderdelux's cash register system and the app is integrated continuously in the algorithm for continuous optimization. Attorney salary must also be considered for the preparation of contracts between the two bodies. For these reasons, it is believed that an investment of 500.000 DKK will be sufficient for a fully functional concept.

Obstacles

One immediate concern about this IRS solution would be the question of privacy and ‘Surveillance’ inaccordance with the newly instated data protection law by the EU (European Commission, 2019). This concern should, be eliminated by the fact that any given data will be anonymous as the sensors only need to track the number of people and not the specific identity of anyone on campus.

Another obstacle is the fact that this solution implies a partnership between a public institute and private company regarding a continuous flow of date shared by both stakeholders for the solution to work. Due to this factor, securing the possibility of such a partnership should be the first order of business in a possible implementation process.

References

(2019). Hentet fra GlobeCom: https://globecom.eu/da/

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