

Towards impressive titles

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23 februari 2018

Acknowledgements

I am a student blalsadf

Abstract

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Sammanfattning

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Chapter 1

Introduction

The chapter starts with a background describing why road condition monitoring is important and who Trafikverket are, how road condition data is collected today and why the technology behind it needs improvement. An objective for the project is defined followed by its delimitations. Lastly, a thesis structure is presented to simplify navigation through different parts of the project.

1.1 Background

Living in cold areas of the world usually means work for individual people, municipalities and companies in trying to maintain a non-winter-like infrastructure. This of course, also involves winter road maintenance. Salting and plowing roads is an investment in not only saving lives, but also in lowering socio-economic costs: In two scenarios on a road with 2 cm snow and a daily traffic flow of 2000 vehicles, one with a salted and ploughed road taking four hours to drive, and another scenario on the same road without winter maintenance taking five hours to drive. The total socio-economic costs are 3.5% higher in the non-maintained road, mainly due to increased travel time and thus higher accident costs [1].

Despite the socio-economic savings in performing winter road maintenance, it still represents a notable economic cost. Trafikverket, the agency in charge of road state road maintenance in Sweden, reported that winter road maintenance were roughly 18% of the total road maintenance costs in 2013 [2]. Local contractors are hired to carry out the plowing and salting of state roads, with requirements on both ends regarding when to plow, which roads to prioritize etc. Trafikverket has over 800 Road Weather Information Systems (RWIS)(Fig. 1.1) distributed across state roads in Sweden which are used by contractors to carry out winter road maintenance work [3].



Figure 1.1: RWIS Station at sensor site Myggsjön [4].

| Table 1.1 shows | Operation | worst-case cost | time complexity | |
|-----------------|-----------------------|-----------------|-----------------|--------|
| | Insert x into l_i | 2 | $O(1)$ | asdasd |
| | Update $count_i$ | 1 | $O(1)$ | |

1.2 Objective

The objective is to determine if a road surface temperature sensor can be simulated with prediction models based on historic data from road weather information systems.

1.3 Delimitations

1.4 Thesis structure

Chapter 2

Literature Review

The chapter gives both general and specific information on theory used for this project. Mathematical statistics, regression and machine learning are covered in the first three sections, providing a general understanding of the field of study. Specific machine learning models are explained in the final three sections of the chapter.

2.1 Machine learning

Programming is typically about writing explicit sequences of machine instructions, in a certain level of abstraction, for some software application. Once the application is used, it will determine logically what instructions to send to the machine, depending on what input is given from the user, current state of the application etc. But as software applications grow in terms of lines of code, the amount of bugs and software increases which in turn results in reduced software performance and readability [5]. Complexity can be mitigated by programming in programming languages. Instead of writing binary machine instructions, it's possible to write logical statements, expressions etc. in a programming language like C and compile the code back to machine instructions upon execution.

Machine learning is formally defined by Mitchell [6]: A computer program is said to learn from experience E with respect to some class of tasks T and performance measure P if its performance at tasks in T , as measured by P , improves with experience E . What this means is that machine learning algorithms is a way of

Two of the most common machine learning tasks:

- Classification: The computer is asked to specify which category a certain input belongs to. An example of a classification task is
- Regression: asdfsdf

[7] Something that [8]

2.1.1 Neural networks

Chapter 3

Method

The chapter covers strategies and methods used to achieve the objective of the project. Reasons for each choice of method or strategy are motivated and described in the sections, which are ordered chronologically.

3.1 Research purpose

3.2 Research approach

3.3 Research strategy

3.4 Tools

Chapter 4

Implementation and results

Describe the process of collecting data, training and implementing machine learning algorithms with different methods.

4.1 Data collection

4.2 Neural network

4.2.1 First iteration

4.2.2 Second iteration

Chapter 5

Analysis

Analyze data from the implementation with respect to the objective of the study.

5.1 Neural network

Chapter 6

Conclusions and recommendations

6.1 Conclusions

6.2 Recommendations

Chapter 7

Discussion

7.1 Thesis process

7.2 Validity and reliability

Validity and reliability of the conclusions. Needed?

7.3 Future work

Bibliography

- [1] A. Arvidsson, “The Winter Model – A new way to calculate socio-economic costs depending on winter maintenance strategy”, *Cold Regions Science and Technology Volume 136, April 2017, Pages 30-36*, 2017.
- [2] Trafikverket, *Trafikverkets årsredovisning 2015*, 2016.
- [3] ——, (2017). Vinterväghållning, [Online]. Available: <https://www.trafikverket.se/resa-och-trafik/underhall-av-vag-och-jarnvag/Sa-skoter-vi-vagar/Vintervaghallning/> (visited on 02/07/2018).
- [4] Pelpet. (2010). Rwis Station at sensor site Myggsjön, [Online]. Available: https://commons.wikimedia.org/wiki/File:Rwis_station_Myggsjon_01.JPG (visited on 02/06/2018).
- [5] S. Bhatia and J. Malhotra, “A survey on impact of lines of code on software complexity”, in *2014 International Conference on Advances in Engineering Technology Research (ICAETR - 2014)*, 2014, pp. 1–4. DOI: 10.1109/ICAETR.2014.7012875.
- [6] T. Mitchell, *Machine Learning*. McGraw Hill, 1997.
- [7] I. Goodfellow, Y. Bengio, and A. Courville, *Deep Learning*. MIT Press, 2016.
- [8] J. Brownlee. (2017). Difference Between Classification and Regression in Machine Learning, [Online]. Available: <https://machinelearningmastery.com/classification-versus-regression-in-machine-learning/> (visited on 01/29/2018).