Towards impressive titles

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Acknowledgements

I am a student blalsadf

Abstract

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Sammanfattning

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Contents

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 invididual 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 contracters 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 contracters 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	$O(1)$
Update $count_i$	1	$O(1)$

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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

Machine learning is formally defined by Mitchell [5]: "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". This means that machine learning algorithms are used to solve a set of problems, measure its performance in doing so and ultimately improve in some way from previous experiences. For example, imagine a program designed to determine if a human face is in a photo or not. Since photos are taken at different distances, angles and faces have different characteristics such as eye color, skin color, distance between eyes and nose shape, implementing this "manually" may prove cumbersome. Instead of programming an algorithm to recognize faces, it can be programmed *to learn to recognize faces*. If the algorithm is allowed to analyze a dataset with thousands of photos of human faces, it could learn to distinguish a human face by recognizing parts of the face such as eyes, nose, mouth and where those parts are most likely placed to oneanother.

Machine learning algorithms can be broadly categorised as having either supervised- or unsupervised learning [6]. In supervised learning, the algorithm is fed instance(s) of desired output y along with its corresponding k input parameters $x = x_1, x_2, ...x_k$ and the goal is to build a mapping function $y = f_{map}(x)$ such that when new input data is used, f_{map} is able to predict the correct output y_{new} [7]. Learning this way typically involves updating a mathematical model which defines a relationship between input and output Examples of tasks, performance measures and experiences are found in the following sections.

2.1.1 Machine learning tasks

It's important to distinguish the task from the process of learning. For example, programming a robot to walk means that walking is the task. This can be achieved "manually" by programming instructions on how to walk, or by programming the robot *to learn to walk* [6]. Some popular machine learning tasks are presented in the following sections.

Classification

Classification involves deciding in which of k categories a certain input belongs to. This is usually done with classifi

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

[6] Something that [8]

2.1.2 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

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