Natural language generated weather forecast from time series of weather data

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TRITA xxx yyyy-nn
Abstract

This thesis intends to determine how people understand and feel about natural language generated sentences, in this case natural language generated forecasts. This was done by building a server that pulled raw weather information from SMHI api, analysed it and generated weather forecasts.

For evaluation, a survey was made and from the result a conclusion was drawn that people are able to both understand and correlate the sentences that was generated to its information.
Referat

Datorgenererade meningar om väder
skapade från tidsserier med väderdata

Rapporten ämnar att avgöra hur människor känner för datorgenererade meningar och i vilken grad de förstår dem. I det här fallet riktar sig rapporten mot väderprognoser. Detta gjordes genom att bygga en server som hämtade väderdata från SMHI:s api och sedan analyserade och genererade meningar.

För att evaluerar arbetet skapades ett frågeformulär från vars resultat vi kom till slutsatsen att människor kan både förstå och relatera meningarna som genererades till dess data.
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Chapter 1

Introduction

Today, much of weather information is presented in pure data. This requires that the person receiving the data can interpret it. By using natural language generating system [4] [1] it’s possible to interpret and translate the information to a easier and more natural information stream. By converting the raw data into a natural language it is also possible to have it converted to voice sound by text to speech system. This is very useful for people that have lost their vision or in situation where you have to focus your vision elsewhere, such as driving a vehicle.

1.1 Purpose

Therefore the idea of this project is to be able to generate sentences about weather in a speaking manor out of raw simple data, in our case temperature and wind speed. We do this in order to see if there’s a possibility that an algorithm that produces sentences about weather can make a difference in understanding and interpret weather unlike to raw weather data in numbers.

1.2 Problem Statement

The general goal of this project is to generate a sentence that is understandable by human readers so that they can be able to correlate to given data for specific day or time. Thus does the following question rise. Does more information such as temperature, wind speed and wind direction make it easier to distinguish the sentences and its correlating information? As sentences, is the speaking part confusing or even misleading to the interpreter? Is a more general forecast with a speaking summary for several hours better preferred than numbers for each given hour?

1.2.1 Scope

The natural language generation field has grown a lot the last years. To limit this field down we use templates to generate the weather forecast sentences with different
amount of indicators. The work will be assessed by letting people try to correlate weather data to corresponding sentences.

1.3 Statement of Collaboration

Both has played a part in all stages of the work phase and almost all decisions have been discussed in between each other. Carl is a more experienced programmer which made him a bigger asset when implementing code and solving the problems we faced. While Carl put in more work in the programming phase, Emil put more work in the testing phase. After the testing phase both sat down to close up the report.

1.4 Summary of Results

The evaluations made might not be comprehensive enough considering the number of questions. The language in the sentences is also something to mention. Since the language is based on our own observations from both speaking meteorologists and sentences written by meteorologists, they might not be in a proper way of speaking about weather and might not be appealing nor familiar. In the discussion it’s spoken about data and conclusions drawn based upon our own assumptions and observations.

1.5 Definitions

1.5.1 Terms

JSON - JavaScript Object Notation
POJO - Plain old java object

1.5.2 Abbreviations

NLG - Natural Language Generation

1.6 Document overview

- Chapter 2 - Information about the area and some previous work that has been done.
- Chapter 3 - This chapter covers how the server was built and how the evaluation of the result is supposed to take form.
- Chapter 4 - Information on how the actual server got built.
- Chapter 5 - The results from the survey is presented.
1.6. DOCUMENT OVERVIEW

- Chapter 6 - Our own thoughts about the result.
- Chapter 7 - Conclusions from the result.
- Appendix A - The survey questions being used for evaluating.
Chapter 2

Background

Today we have sensors in almost anything that has some form of electronic in it. These sensors produce data that can be saved and used as time series.

For humans these time series can take long time to interpret. By using natural language generation on the data, a human readable summary can be produced. Other areas where time series of data can be found for example is stock marketing, the number of people living in a country for the last 100 years and the area that we will explore, weather data.

2.1 Related work

Similar research have been done by the computer science department at University of Aberdeen in their project SunTime [9].

2.1.1 SumTime - Weather

The SunTime weather project goal was to generate weather forecast that contained information about wind speed and direction from time series of data for offshore rigs in the North Sea.

The idea of the SunTime Weather project was to create a corpus based natural language generating system with the condition to be consistent with data-to-word rule. The reason for this was that they wanted to be as consistent as possible and to avoid using words that could be interpreted differently by people.

The SunTime project has put a lot of work into identify the correct words used for weather forecasts.

To evaluate their system they did a survey, the results was that the majority of the asked people preferred their computer generated forecast over man made forecast and computer generated forecast with small changes by human afterwards.

From this they state that this may be the first time an evaluation has shown that natural language generated text are better than human-authored texts.
2.1.2 SumTime - Gas turbine

The goal of the SumTime gas turbine project was to generate an easy to read summary of the health status of a gas turbine. A modern gas turbine has around 250 sensors each generating a time series of data. If an operator was to manually analyse all the data, it would be a very time consuming task, this is where the SumTime gas turbine project comes in. By detecting relative primitive pattern in the data they are able to generate a summary for the gas turbine operator. The result of the project is still ongoing but according to the paper the preliminary result is promising[10].

2.2 Raw data

The data that we will base our forecast on is provided by SMHI Opendata[7]. The data will be presented in JSON format[3]. The interval which the data is presented in will be by the hour for about two days. From there on the time interval increases and there is more time between each forecasted point. Each entry contains a lot of information, but our main focus will be on temperature, wind speed and wind direction.

Example data response:

```json
{"lat": 58.548703,
"lon": 16.155116,
"referenceTime": "2014-03-25T07:00:00Z",
"timeseries": [
{
"validTime": "2014-03-25T08:00:00Z",
"msl": 1015.8,
"t": 3.7,
"vis": 28.0,
"wd": 18,
"ws": 4.1,
"r": 72,
"tstm": 0,
"tcc": 6,
"lcc": 0,
"mcc": 0,
"hcc": 6,
"gust": 5.3,
"pit": 0.0,
"pis": 0.0,
"pcat": 0
}
],
```
2.2. RAW DATA

    ... 

    ]

}
Chapter 3

Approach

The main focus when producing the algorithm was to make it in java. The idea would then be to retrieve information from Sweden’s leading weather institute SMHI and with that information generate the sentences. The idea when producing the algorithm is to have pre-built sentences with blank spots which is to be filled with a word or number corresponding to the weather data. In our particular algorithm we make one case for temperature, one for wind speed, one for wind temperature and one for both combined.

3.1 Test approach

When testing the results, there were to be people looking at sentences provided by our algorithm and then they were to refer this to weather data as presented by SMHI. The cases used had data that was both less and more alike. There were also questions about in which way people themselves prefer having weather presented.

When having the results for the questions we made a percentage summary to draw conclusions from. Then there were assumptions made on what the results probably meant and represented.

3.2 Server - G.A.P

This section will cover how the server is implemented. The system follows our own defined G.A.P model. G.A.P is divided into three sections. The G stands for get, which covers fetching the raw data and convert it into a format that the server can utilise. A stands for analyse, this is where the trends are detected. P stands for presentation. This is where the analysed data generates the weather forecast sentence. These are the steps that the server go through to generate a weather forecast.
3.2.1 Get

The first step is to get the raw data. The data is provided from the SMHI opendata api[7]. The api allows external programs to get weather forecast for a specific location based on longitude and latitude coordinates, which is specified in the request url. For the response specification see section 2.2.

The data comes in JSON format, which is structured text. The server parses the input data to POJO’s. This is done with the Jackson library[2].

3.2.2 Analyse

To choose the right word for describing how the weather changes over time we need to identify these trends. This can be a fairly complicated task because, as told in the scope of the project we will not be able to use the same ways the SumTime project solved it due to the complexity in their solution. Instead we will use moving averages algorithm to detect trend changes.

Moving average algorithm

There are different versions of moving average depending on the data. Our system utilise two averages, one that is short and another that is long. The short average is defined as the last two data points. The long average then is defined as the last three data points. A trend is defined as the intersection of the two averages.

**Algorithm 1 Moving average**

```
function MOVING_AVERAGE
    RawWeatherData rwd = weather data fetched from external server
    WeatherDataLists wdl = moving_average_list(rwd)
    WeatherTrends wt = trend_detection(wdl)
    return wdl and wt
end function
```
3.2. SERVER - G.A.P

Algorithm 2 Generate average lists

function moving_average_list(RawWeatherData rwd)
    for Short and Long series from rwd do
        for i in 1 to currentSeries size do
            result = 0
            for n = i in 1 to currentSeries average do
                if n not out or range then
                    result += currentSeries[n]
                end if
            end for
            Save result
        end for
    end for
    return List with short and long averages
end function

Algorithm 3 Trend detections

function trend_detection(WeatherDataLists wdl)
    Find which trend start lowerst
    for short and long average in wdl do
        if short and long intersect then
            A trend is found, determine if its positive or negative
        end if
    end for
    return List of trends
end function

3.2.3 Presentation

In the presentation section the server generates the corresponding weather forecast. The server uses a template system for this. By inspecting the analysed data and utilise the trends, the server can choose the appropriate words for the template. For example, if the server detects a trend in temperature changing, the word that describe that can be used, i.e the template could look like this 'At *given time* o’clock the temperature will *increase*|*decrease*.'
Chapter 4

Implementation

This part covers the system that generates the weather forecasts. Both the hardware and the software that were used in the forecast generation will be described in detail. The first section will describe the details in the system. This will be followed by a system overview section that presents how the program is working. At the end, some of the limitations of the system will be presented.

4.1 Hardware and software specification

The program is run on a Samsung notebook[6] with Ubuntu 12.04 LTS 32 bit operative system.

1. Intel Core i5 3337U
2. 4GB DDR3 RAM
3. Intel HD 4000 Graphics

The following external programs is running on the server

1. Eclipse version 3.7.2
2. OpenJDK 6

4.2 Program overview

The program communicates with the SMHI api for fetching raw weather data. Thereafter the raw data converts into java objects, so that the data is easy to access. Thereafter the data gets analysed, trends get detected by running a moving average algorithm on the data. The server continues by evaluating the trends and generate a weather forecast sentence. For an UML diagram of the server see figure 4.1
4.3 Limitations

One limitation is precision, this because all of the data comes from one source. Therefore the accuracy of our weather report is based on how well SMHI made their calculations.

Another limitation is in the detection of trends. Our algorithm for trend detection have good performance for finding larger trends in time series of data, with the compromise that small trends stays undetected.
Chapter 5

Results

The charts and questions shown and mentioned in the results are based upon the survey in appendix A.

5.1 Error sources

Due to the number of survey answer being low, the error possibility is rather high. This factor is also greater when considering question four and five since there is no correct answer. Because of the survey being about computer generated sentences, people might also be misled into answering in the computer generated sentences favour in question five.

5.2 Correlation from sentence to SMHI weather table

This section refers to the first three questions in the survey where the participants get a picture of weather over five hours as it’s shown on SMHI website[8].

In figure 5.1 you see the results for question one, here the user got three sentences about temperature from which he or she were to select one answer which they thought to be the one corresponding to the picture. In this case answer two was thought to be the right one and as shown in figure 5.1 79% of all people were able to pick the right answer.
CHAPTER 5. RESULTS

In figure 5.1 you see the results from question one, here the user got three sentences about wind speed with its direction from which he or she were to select one answer which they thought to be the one corresponding to the picture. In this case answer two was thought to be the right one and as shown in figure 5.1 78% of all people were able to pick the right answer.

In figure 5.2 you see the results for question two, here the user got three sentences about wind speed with its direction from which he or she were to select one answer which they thought to be the one corresponding to the picture. In this case answer two was thought to be the right one and as shown in figure 5.2 71% of all people were able to pick the right answer.

In figure 5.3 you see the results for question three, here the user got three pictures from which he or she were to find the one corresponding to a sentence. The sentence
5.3. THOUGHTS ABOUT SENTENCES CONTRA WEATHER TABLES

In this case contained both temperature and wind speed with its direction. In this case answer two was thought to be the right one and as shown in figure 5.3 50% of all people were able to pick the right answer. Another thing to mention in this case is that answer two and three are very much alike which of course made this question a bit more demanding than the previous two.

![Figure 5.3. Results from question 3](image)

5.3 Thoughts about sentences contra weather tables

The following results are for questions four and five in the survey. These are basic straightforward questions about how the persons feel about the sentences and if they prefer the way we choose to present weather data or the way SMHI does on their website[8]. In these questions there is no right answer, it’s all about the person’s experience and feelings.

In figure 5.4 you see the results for question four. In this question the person was asked in which way they prefer a sentence to be built. There were three possible answers, sentences about temperature, sentences about wind with its direction and both temperature and wind information together. We can see in the figure 5.4 that there was a majority for answer one, which was only temperature, scoring 50%. Just slightly behind only temperature we have sentences with both temperature and wind information scoring 43%. Sentences with only wind speed scored merely 7%.
CHAPTER 5. RESULTS

Figure 5.4. Results from question 4

In figure 5.5 you see the results for question five. In this question the persons was asked about in which way they prefer the weather to be presented. They had two options which were either if they liked it presented as computer generated sentences or in the way SMHI present it on their website[8]. We can see in figure 5.5 that SMHI’s way of presenting weather scored the highest with 57% naturally followed by computer generated sentences with 43%.

Figure 5.5. Results from question 5
Chapter 6

Discussion

6.1 General

Unfortunately we only managed to get 15 people to answer the survey so the numbers isn’t statistically safe, but we get an idea of how it probably is. Something else to consider is the fact that each person has their own preference, which makes evaluation quite hard.

The result in figure 5.5 indicate a small favour for receiving weather report in table form instead of a sentence. These findings of our study does not concur the previous research report[5] from SumTime project[9], this since the SumTime project got the results the other way around.

With a small sample size from the survey, caution must be applied, as our findings are not statistically significant proven.

Another possible explanation for the result in this study is that people in general tend to favour what they are used to. This could therefore be an explanation for the result in figure 5.5

6.2 Correlation from sentence to SMHI weather table

In question one, which you are able to see in appendix A, we are able to distinguish that the most of the people were able to pick the right answer. Even though answer three being quite similar to answer two which is the correct one, 79% were able to pick the correct answer as seen in figure 5.1. Even with the lack of participants this are to be a really good result in terms of understanding the computer generated sentences about temperature.

Also in question two we can see that the majority of the participants picked the right answer. Here 71% picked the right answer as seen in figure 5.2 but there is an alarming trend here. The right answer should be easier to distinguish in this case due to the big differences between the right and the two other answers, even so there is less people picking the right answer then there was in the first question. This might be an indication that the computer generated sentences about wind
information is harder to understand. This could be a result of the sentences being more complex with both direction and wind speed. It might also be due to the fact that people are more familiar with temperatures and how to speak of it then with wind. Another factor could be the way the language is put together in these sentences, but isn’t necessarily true due to what’s discussed next about question three.

In question three we have a case where 50% of the participants had the right answer, but was quite even with answer three with 43% as seen in figure 5.3. One fact in why they are so is of course the both answers being much alike. Another fact is the order of the question. Here the persons are to pick a table of weather information out of three that is corresponding to a sentence. There’s also another possibility to why this might be. That is that it might be too much information for the user to interpret with both temperature and wind information. Most likely it’s a combination of all three, but we think the biggest factor is the answers being much alike and the information being more complex. To come back to question two and the facts about the language used for wind speed not being correctly put together, we think that it’s more likely that this is due to the comprehension of lots of information and numbers.

6.3 Thoughts about sentences contra weather tables

When asking question four it was done with question one, two and three in consideration. The participants were to choose what kind of information used in sentences helped them the best in their opinion. We can see that sentences containing temperature was the one scoring the most votes with 50% closely followed by sentences with information about both temperature and wind information scoring 43% of the votes. An interesting thing here is that people choose to feel best helped by sentences with both information about temperature and wind, this since we discussed before the possibility that wrong answers could be because of people getting too much information to be able to process. Another interesting thing here is the lack of people choosing only wind information as their favourite with just 7% of the votes. Again there is a big possibility that people lack knowledge or at least feel unfamiliar with information about wind speed and its direction.

So for the last question, we asked straight up if the user would rather have their weather presented as a table of numbers, referring to the way SMHI present it on their website [8], or as computer generated sentences. As seen in figure 5.5 we can see that the SMHI way of showing weather scored the highest number of votes even though it was a close call with 57% and computer generated sentences scoring 43% of the votes. This is interesting since computer generated sentences is something new and that a lot of the participants preferred it. It’s also interesting since people are familiar with SMHIs way of presenting weather and that people in general tend to lean towards things they are familiar with. Because there is still a lot of things to develop further in the work we did, people already preferring it is a great step
forward. Also this survey being about computer generated sentences, might make people feeling they have to choose just that, but it shouldn’t be enough to say that the result is corrupt.
Chapter 7

Conclusions

The conclusions in this report are based upon the results and the discussions, as well as our own thoughts and assumptions.

The first conclusion we made from our results was that people seem to be much more familiar with information about temperature than they were about wind information. This becomes obvious since the questions about wind were easier yet the participants didn’t have as good results as they did with the questions about wind. Also when asking the participants almost none choose to put wind as their number one choice when answering our questions while the majority choose temperature.

Next we draw the conclusion that too much information makes it harder for the person to interpret the sentences. We made this assumption since wind information contains more information than temperature does. Also the participants struggled with the question where they had a combined sentence with information of both wind and temperature.

The sentences overall seem to be understandable to the participants. We base this conclusion on the amount of participants getting the right answers in the first two questions, also we even got some people preferring the sentences over the way SMHI shows weather data on their website[8].

We don’t think the language is confusing even though it’s not perfect in terms of weather and grammatically. If any of the sentences is to be hard to understand, it’s the ones about wind. But since we got a good score when asking a question with wind information exclusively, we can can make this assumption.

To come back to the problem statement, we feel that the participants were able to both understand and correlate the information to its given data. Because of this we can also tell that the speaking part of the sentences weren’t misleading, at least not to the participants familiar with weather language.

Finally we can say that people in some sense liked the summary of weather as a sentence or at least they didn’t dislike it. Sadly we didn’t see the same results as the SunTime project but we could see something quite like it, as mentioned, our survey wasn’t statistically safe. The participants probably felt good with a summary over time since they were able to correlate the sentences and some even liked it over the
weather information shown in tables for each hour.
Bibliography


[9] SumTime project. URL: http://inf.abdn.ac.uk/research/sumtime/.

Appendix A

Survey questions

Computer generated sentences about weather.
This is a research to see if a computer can generate understandable sentences about weather. Some of the calculations made in the sentences might not be exactly the same as in the pictures since we make our own forecasts about the temperatures and wind speeds. The pictures are taken from SMHI (Swedish Meteorological and Hydrological Institute).

<table>
<thead>
<tr>
<th>Time</th>
<th>Temperature</th>
<th>Wind Direction</th>
<th>Wind Speed (m/s)</th>
<th>Precipitation (mm/h)</th>
<th>Humidity (%)</th>
<th>Pressure (hPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ons 12.00</td>
<td>8°</td>
<td>N</td>
<td>4 (4) m/s</td>
<td>0.0 mm/h</td>
<td>92 %</td>
<td>1003 hPa</td>
</tr>
<tr>
<td>Ons 12.00</td>
<td>8°</td>
<td>S</td>
<td>502 (4) m/s</td>
<td>0.0 mm/h</td>
<td>96 %</td>
<td>1004 hPa</td>
</tr>
<tr>
<td>Ons 13.00</td>
<td>7°</td>
<td>S</td>
<td>502 (3) m/s</td>
<td>0.0 mm/h</td>
<td>97 %</td>
<td>1004 hPa</td>
</tr>
<tr>
<td>Ons 10.00</td>
<td>7°</td>
<td>S</td>
<td>52 (3) m/s</td>
<td>0.0 mm/h</td>
<td>96 %</td>
<td>1003 hPa</td>
</tr>
<tr>
<td>Ons 09.00</td>
<td>6°</td>
<td>S</td>
<td>52 (4) m/s</td>
<td>0.0 mm/h</td>
<td>97 %</td>
<td>1002 hPa</td>
</tr>
</tbody>
</table>

What sentence would you say represent the picture above the best?

☐ At 09:00 o'clock we will have a temperature of 6.1 °C steady rising until about 13:00 o'clock where it will reach its maximum temperature, about 8.3 °C.

☐ At 09:00 o'clock we will have a temperature of 5.6 °C steady rising until about 13:00 o'clock where it will reach its maximum temperature, about 8.7 °C.

☐ At 09:00 o'clock we will have a temperature of 2.6 °C steady rising until about 12:00 o'clock where it will reach its maximum temperature, about 3.7 °C.
## APPENDIX A. SURVEY QUESTIONS

<table>
<thead>
<tr>
<th>Time</th>
<th>Wind</th>
<th>Wind Speed</th>
<th>Rainfall</th>
<th>Confidence</th>
<th>Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>13:00</td>
<td>5°</td>
<td>NV 8 (12) m/s</td>
<td>0.5 mm/h</td>
<td>80 %</td>
<td>1008 hPa</td>
</tr>
<tr>
<td>12:00</td>
<td>5°</td>
<td>NV 8 (13) m/s</td>
<td>0.5 mm/h</td>
<td>80 %</td>
<td>1007 hPa</td>
</tr>
<tr>
<td>11:00</td>
<td>5°</td>
<td>NV 8 (13) m/s</td>
<td>0.5 mm/h</td>
<td>80 %</td>
<td>1006 hPa</td>
</tr>
<tr>
<td>10:00</td>
<td>6°</td>
<td>NV 8 (14) m/s</td>
<td>0.3 mm/h</td>
<td>80 %</td>
<td>1005 hPa</td>
</tr>
<tr>
<td>09:00</td>
<td>6°</td>
<td>NV 8 (13) m/s</td>
<td>0.2 mm/h</td>
<td>89 %</td>
<td>1005 hPa</td>
</tr>
</tbody>
</table>

What sentence would you say represent the picture above the best? (only one answer is corresponding)*
- At 09:00 o'clock this morning we'll see wind speeds of up to 1.3 m/s blowing in south direction; the wind speed will then build up until about 13:00 o'clock with speeds of up to 2.5 m/s blowing in the east direction.
- At 09:00 o'clock this morning we'll see wind speeds of up to 10.6 m/s blowing in northwest direction, the wind will then decrease until about 13:00 o'clock with speeds of up to 10.3 m/s blowing in the northwest direction.
- At 09:00 o'clock this morning we will see wind speeds of up to 6.7 m/s blowing in south direction, the wind will then decrease until about 13:00 o'clock with speeds of up to 4.5 m/s blowing in the south direction.

1

<table>
<thead>
<tr>
<th>Time</th>
<th>Wind</th>
<th>Wind Speed</th>
<th>Rainfall</th>
<th>Confidence</th>
<th>Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>13:00</td>
<td>-1°</td>
<td>S 6 (10) m/s</td>
<td>0.0 mm/h</td>
<td>47 %</td>
<td>1020 hPa</td>
</tr>
<tr>
<td>12:00</td>
<td>-2°</td>
<td>S 6 (10) m/s</td>
<td>0.0 mm/h</td>
<td>40 %</td>
<td>1020 hPa</td>
</tr>
<tr>
<td>11:00</td>
<td>-2°</td>
<td>S 6 (9) m/s</td>
<td>0.0 mm/h</td>
<td>47 %</td>
<td>1020 hPa</td>
</tr>
<tr>
<td>10:00</td>
<td>-3°</td>
<td>S 5 (7) m/s</td>
<td>0.0 mm/h</td>
<td>43 %</td>
<td>1020 hPa</td>
</tr>
<tr>
<td>09:00</td>
<td>-3°</td>
<td>S 5 (7) m/s</td>
<td>0.0 mm/h</td>
<td>44 %</td>
<td>1020 hPa</td>
</tr>
</tbody>
</table>

2

<table>
<thead>
<tr>
<th>Time</th>
<th>Wind</th>
<th>Wind Speed</th>
<th>Rainfall</th>
<th>Confidence</th>
<th>Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>13:00</td>
<td>4°</td>
<td>NO 6 (10) m/s</td>
<td>0.5 mm/h</td>
<td>92 %</td>
<td>1008 hPa</td>
</tr>
<tr>
<td>12:00</td>
<td>4°</td>
<td>NO 6 (10) m/s</td>
<td>0.7 mm/h</td>
<td>92 %</td>
<td>1007 hPa</td>
</tr>
<tr>
<td>11:00</td>
<td>4°</td>
<td>NO 6 (9) m/s</td>
<td>0.5 mm/h</td>
<td>92 %</td>
<td>1006 hPa</td>
</tr>
<tr>
<td>10:00</td>
<td>4°</td>
<td>NO 5 (9) m/s</td>
<td>0.3 mm/h</td>
<td>92 %</td>
<td>1005 hPa</td>
</tr>
<tr>
<td>09:00</td>
<td>4°</td>
<td>NO 5 (8) m/s</td>
<td>0.4 mm/h</td>
<td>93 %</td>
<td>1004 hPa</td>
</tr>
</tbody>
</table>
Which picture would you say correspond this information?
At 06:00 o’clock we will have a temperature of 3.8 °C slowly decreasing until about 12:00 o’clock where it will reach its lowest temperature, about 3.4 °C. and at 09:00 o’clock this morning we’ll see wind speeds of up to 4.6 m/s blowing in northeast direction, the wind speed will then build up until about 12:00 o’clock with speeds of up to 5.1 m/s blowing in the northeast direction.

- 1
- 2
- 3

Which one of the questions before did you feel the most comfortable with answering?
- Only temperature
- Only wind speed and wind direction
- Forecast with both temperature and wind information

Which type of forecast do you prefer?
- Computer generated sentence
- Table of numbers

Figure A.1. The survey used for evaluation