Faculty of Engineering Science and Technology

Department of Computer Science and Computational Engineering

UiT The Arctic University of Norway

Improving learning capabilities of chatbots

James Pandey

Thesis for Master of Science in Computer Science

# Problem description

The candidate should explore the domain of text analysis for the purpose of creating more advanced chat bots compared to existing state-of-the-art. This suggests investigation of present systems and the capacity of such systems.

Improvements with regard to feedback and learning should be prioritized. Both supervised and non-supervised methods should be contemplated. This effort should be coordinated with the Municipality of Narvik and the team working on chat bot applications for the benefit of the public. A systematic mapping of the municipal needs and technological possibilities should be performed. An essential feature should be to interpret requests and free form queries and return a knowledge-based answer. Answers should be justified by means of explanations. The use of ontologies should be explored. It is also essential to consider screen scraping of web pages and parse these in order to create ontologies and hyper links that are pertinent to certain topics and that help the public in navigating. The work should be coordinated with parallel initiatives in the ChatBot group.

A demonstrator should be built that should be tested with user-interfaces created by members of the ChatBot team. The tests should be developed together with Narvik Municipality and should benchmark relevance in answers and ability to learn. A loss function based on utilities should be created for this test purpose.

The solution should run on the Microsoft platform of Narvik Municipality

**Dates**

Date of distributing the task: <xx.xx.xxxx>

Date for submission (deadline): <xx.xx.xxxx>

## Contact information

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| Candidate  Advisor at UiT-IVT  Advisor at UiT-IVT | James Pandey  <e-mail>  Bernt A. Bremdal  Bernt.a.bremdal@uit.no  Kristoffer Tangrand  kristoffer.tangrand@uit.no |
| External advisor (optional) | Andreas Dyrøy  aja073@post.uit.no |

# General information

This master thesis should include:

* Preliminary work/literature study related to actual topic
* A state-of-the-art investigation
* An analysis of requirement specifications, definitions, design requirements, given standards or norms, guidelines and practical experience etc.
* Description concerning limitations and size of the task/project
* Estimated time schedule for the project/ thesis
* Selection & investigation of actual materials
* Development (creating a model or model concept)
* Experimental work (planned in the preliminary work/literature study part)
* Suggestion for future work/development

Preliminary work/literature study

After the task description has been distributed to the candidate a preliminary study should be completed within 3 weeks. It should include bullet points 1 and 2 in “The work shall include”, and a plan of the progress. The preliminary study may be submitted as a separate report or “natural” incorporated in the main thesis report. A plan of progress and a deviation report (gap report) can be added as an appendix to the thesis.

**In any case the preliminary study report/part must be accepted by the supervisor before the student can continue with the rest of the master thesis.** In the evaluation of this thesis, emphasis will be placed on the thorough documentation of the work performed.

Reporting requirements

The thesis should be submitted as a research report and could include the following parts; Abstract, Introduction, Material & Methods, Results & Discussion, Conclusions, Acknowledgements, Bibliography, References and Appendices. Choices should be well documented with evidence, references, or logical arguments.

The candidate should in this thesis strive to make the report survey-able, testable, accessible, well written, and documented.

Materials which are developed during the project (thesis) such as software / source code or physical equipment are considered to be a part of this paper (thesis). Documentation for correct use of such information should be added, as far as possible, to this paper (thesis).

The text for this task should be added as an appendix to the report (thesis).

General project requirements

If the tasks or the problems are performed in close cooperation with an external company, the candidate should follow the guidelines or other directives given by the management of the company.

The candidate does not have the authority to enter or access external companies’ information system, production equipment or likewise. If such should be necessary for solving the task in a satisfactory way a detailed permission should be given by the management in the company before any action are made.

Any travel cost, printing and phone cost must be covered by the candidate themselves, if and only if, this is not covered by an agreement between the candidate and the management in the enterprises.

If the candidate enters some unexpected problems or challenges during the work with the tasks and these will cause changes to the work plan, it should be addressed to the supervisor at the UiT or the person which is responsible, without any delay in time.

Submission requirements

This thesis should result in a final report with an electronic copy of the report including appendices and necessary software, source code, simulations and calculations. The final report with its appendices will be the basis for the evaluation and grading of the thesis. The report with all materials should be delivered according to the current faculty regulation. If there is an external company that needs a copy of the thesis, the candidate must arrange this. A standard front page, which can be found on the UiT internet site, should be used. Otherwise, refer to the “General guidelines for thesis” and the subject description for master thesis.

The advisor(s) should receive a copy of the thesis prior to submission of the final report. The final report with its appendices should be submitted no later than the decided final date.

**Abstract**

This report is a preliminary approach starting with the thesis report on the topic of improving learning capabilities of the chatbot. Here it is to be found the head start and plans and schedule of the thesis work for aforementioned problem description. During the 1st month of the it is to dealing with the background information to be prepared with the thesis topic with preliminary studies. Then in the month of February meeting up with the team and working on with the project to finalize the things to be done and work starting with the 2 part of the project to develop the platform for testing the ability.

Then the focus is transferred to the pre-final stage with working with the thesis report during the month of March and April.

**Work Plans and Schedule**

January Week 2-4

Signing up the thesis,

Background check

Preliminary studies

February Week 5-6

Meeting up

Discussion

Working with plans

February Week 7-8

Preparing preliminary reports

March -April Week 8-13

Working on with the application and demonstrator

Progress check with supervisors

Starting with the thesis reports

April - May Week 14-18

Working with thesis report

Follow-up with supervisor

Changing up if anything is not working

June

Report submission

**Objectives to be included in the Chatbot**

**(Part 1) Theoretical**

1. Text analysis or Linguistic analysis
2. Investigation of the existing systems their capacity and limitation
3. To improve the feedback and learning mechanism (supervised or non-supervised)
4. Should be able to interpret the question in a meaningful way and provide responses
5. Implement the ontologies to link up with hyperlinks or navigation to respond the request of the user

**(Part 2) Demonstrator**

* + - 1. Coordination with chatbot team
      2. The tests should be developed with Narvik Kommunne
      3. Loss function based on utilities can be created for testing
      4. Solution must run in Microsoft platform

**Improving Learning capabilities of Chat bot**

**What is a chatbot?**

A chat bot is a computer application or a program which will automate replies or conversation according to assisted intelligence system. Programs of these types are a simulated version of human which will behave as how a conversation will take place between two person, it is a bounds between the action and reaction. An activity from the user is to ask with the chatbot and it should respond according to the desired man-to-man conversation alike how a person would answer if he/she have a response according to the question proposed.

To test the human like nature of the bot, a specific type of test is performed which is called Turing Test [1], it is simply a test to distinguish the ability of intelligent respond of the machine or bot which is identical to human. To further exemplify, lest say a person ask a question to A and B, the question will be somehow which determines if A or B is human or a bot.

**Existing Technologies**

From Chatbots journal,

* + - 1. Bot Platform
      2. IBM Watso
      3. Microsoft Bot Framework uses LUIS
      4. Wit.ai
      5. Api.ai
      6. Semantic Machines
      7. Digital Genius
      8. Chatfuel
      9. Pypestream
      10. Pandorabots
      11. Agentbots
      12. Chatscripts

**Newer startups**

Twyla

Msg.ai

Rasa NLU

Reply.ai

Many Chat

KITT.AI

It’s Alive

The learning capability of the bot is can be improved in several ways, just like a human learning process what a child learns from parents, elders, or teachers it is the same with chatbots. They will tell exactly the same thing they know, they don’t have human cognitive concise to deal with the problems and respond them in a proper way, they respond what they learned. If they are incorrect in any way they should be corrected. Here comes the part to improve the learning capability of the chatbot. If a chatbot doesnot know what to answer then it means the conversation must be transferred to the human agent. But after that the conversation is recorded and analyzed by the chatbot to learn from it. This is how we do it.

**Process of learning**

1. Supervised controlled learning

- Neural Networks

- Multi Layer perceptron

- Decision Trees

2. Non-supervised Learning

- Kmeans

- Self Organizing Maps

*\*\*\*Supervised Learning*

*• Training data includes both the input and the  desired results.*

*• For some examples the correct results (targets) are known and are given in input to the model during  the learning process.*

*• The construction of a proper training, validation and  test set (Bok) is crucial.*

*• These methods are usually fast and accurate.*

*• Have to be able to generalize: give the correctresults when new data are given in*

*input without  knowing a priori the target.*

*\*\*\*Unsupervised Learning*

*• The model is not provided with the correct results*

*during the training.*

*• Can be used to cluster the input data in classes on the basis of their statistical properties only.*

*• Cluster significance and labeling.*

*• The labeling can be carried out even if the labels are only available for a small number of objects representative of the desired classes.*

- Cleanup data, sampling, noise reduction, handle missing data, normalization, feature extraction

**Propose of the solution**

Problem area here is to provide virtual assistance to the seeker via chatbot responses, which includes following tasks.

Narrow down in 1st phase with FAQ, Frequently asked questions.

First things to consider with this is to narrow down frequently asked questions to provide assistance, analysis of the keywords and linguistics questions and give response with appropriate answers.

Learning phase, In 2nd phase if a question which could not be found in any responses criteria then a reciprocated question to elaborate the question is asked to the user, or something like guessing keywords to learn from the users question creating ontologies of known and learned keywords. In more advance cases the conversation is forwarded to the live agents to deal with and the bot will be in learning mode to learn from the conversation.

(Target) Advance phase, in 3rd phase it will be able to provide the logical answers of the question various type of question after learning enough for what is needed during testing phases of the 1 and 2.

**Key Benefits to Narvik Municipality**

Lessening or eliminating the unnecessary human interaction to be handeled by chatbots

The chatbot will assist to the user in an appropriate way that no human interaction is needed unless required then this can be overlapped by human agent.

**Reference**

* + - 1. Turing Test
      2. <https://chatbotsjournal.com/25-chatbot-platforms-a-comparative-table-aeefc932eaff>
      3. <https://www.digi.no/artikler/vil-robotisere-kommune-norge/408800> --- Article
      4. <https://chatbotsmagazine.com/three-important-points-about-how-chatbots-learn-fdeed4a58acb> learn

**Appendix A**

Chatbot Journal Comparison Chart