

UNIVERSITY OF ABERDEEN

CS551H: Natural Language Generation

Assessment 2

Technology Assessment Report

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1 Introduction

The field of artificial intelligence is growing and emerging at a very fast pace with thousands of application in almost every industry. There are many machine learning algorithms which acts efficiently on problems and give a better solutions/decisions but most of the algorithms are black box, so, there is no transparency and no explanation for how machine concluded the decision hence making it unreliable due to lack of accountability. A new technology XAI (Explainable Artificial Intelligence) was introduced to overcome the issue of transparency and interpretability.

In Natural Language Generation technology changed from simple rule-based systems to use of statistical machine learning algorithms. The paper “Investigating Content Selection for Language Generation using Machine” by Colin Kelly, Ann Copestake and Nikiforos Karamanis shows that content selection for NLG using factoid to text alignment as collective classification problem and grouping of statistics improved results over a probabilistic baseline.

NLG can be used for generating narratives for Explainable Artificial Intelligent systems which can then prove helpful in various applications where user needs an explanation for the decision made by a black-box machine learning algorithm (e.g. neural network and deep learning).

Moore and Swartout in 1988, proposed a new framework to explainable AI, this framework take advantage of user feedback and produce more natural language strategies. In the Explainable Expert System user gets conversational explanation.

2 Lowering Development Costs

Development cost of a software depends on various factors such as technology platform, Design, testing and maintenance and reliability. Although some other factors such as product complexity, programmer ability, product size and level of technology play vital role in determining the cost of a software product. As we know that the demand for the transparency of machine learning and deep learning algorithms in market is very high. In NLG, use of rule-based approach is limited with the functionality, not efficient with large systems but it is computationally very cheap. But the statistical machine learning approach in NLG has proved to be efficient, also due to the implementation of Object Oriented Approach it is very easy to structure the knowledge base, reuse the data, secure the data and use it efficiently. Statistical methods help to decide the output text in NLG based on the probability of affecting factors which gives much accurate output.

In terms of software development cost, the cost for software using the cutting edge technology is higher than the traditional software using technologies like rule-based systems. The systems with new technologies are more reliable, secure and efficient making it cost effective. Such software is mainly developed by the team of experienced engineers, needs powerful computer systems to meet the needs of software, Development of a large NLG systems need more time-frame as the systems are complex, hence making it more expensive.

3 Maintaining Text Quality

People naturally think in qualitative terms instead of quantitative terms, describing linguistic information as narrative is the most efficient way. This sounds like an awesome way of describing information, but there is a huge challenge in combining data elements as narrative and generating a meaningful sentence for XAI. (Reiter, 2019)

Attempto Controlled English (ACE) is a system which creates paraphrases for every input string it accepts, hence boosting the overall text quality. (Fuchs, 1999)

Text quality is the primary focus of every NLG system to give the best results and natural linguistics. The main requirements for such systems is that, it should be able to describe quantitative data from ML algorithms in terms of qualitative linguistic narrative so that the developers understand the behaviour and decision made by AI system, another requirement for the real life applications like autonomous driving is that the system should be able to explain the actions to its user. This can also be used for modifying and correcting errors in the program as the systems can tell if the input was wrong or the calculation was wrong.

There are several limitations for generating narrative out of quantitative data, first is the lack of proper linguistics in the database, second is use of vague language and the third is creating effective model to generate narrative. For text quality this are the main constraints and to deal with this Object Oriented representations can be used in Knowledge base. Now how exactly does OOP concept solve the problem, it provides structural and objective view for data in the database, then the data can be categorised based on the similar type of objects, hence linguistic data can be stored in such a way that it is categorised as per problem domain and their use in the sentence structure. Rule based systems will fail to obtain accuracy, it will not be robust and cannot be used for different type of problem domains.

4 User Control

User Control is the flexibility of the system to meet the user requirements effectively so that user gets the exact output for what is desired. For example, system should be able to generate output for the same query in different languages as per the choice of user, it should be able to generate short and long narrative, etc. Use of UX/UI provide users with the ability to give input, read narrative and adjust configuration according to requirement.

The main application of machine learning in the UI/UX is to provide personalized, comfortable and efficient user experience. Use of new technologies like machine learning and deep learning helps in content personalization, adaptive user experience and Voice-user experience. Hence, this algorithms in a system can decide what configuration output should be generated for each user. Normal user interface can offer user with only display and buttons where on another hand ML based UI can offer voice oriented control, voice-oriented output, personalized experience for every user uniquely (i.e. language for different user will be based on their nationality or personal preference).

Toyota has launched concept-I car which is considered as partner and not just a car due to its user interface, The on board AI improves the User experience by connecting with the family on personal level.

5 Integrating with Technologies

Though the machine learning algorithms work efficiently but still we do not trust the machine learning algorithm to make decisions, the problem is that metrics like classification accuracy is an incomplete description for most of the real-worlds applications. So, the concept was XAI was introduced so that the algorithm can explain the process further merging it with NLG to generate linguistic explanation.

Using technologies like IML (Interpretable Machine Learning) can help solving issues related with fairness, privacy, reliability, causality and trust. Let us consider an example of a classifier which classify Husky (dog) and Wolf based on images. So if the classifier misclassifies few husky as wolf then interpretable machine learning methods can tell that misclassification was due to snow on the image. Here main challenge is, IML might sound sensible in this scenario but it does not prove to be very useful in real world applications.

In (James Forrest, 2018), the system to generate natural language expressions for machine learning decisions processed output of LIME generated non-NLG explanation using standard NLG pipeline described by Reiter and Dale (REITER, 1997)

Challenges of merging IML and UI/UX with NLG are developing a precise model to generate narrative structure, communicating uncertainty and vague language challenge are challenges in NLG and explainable AI systems. I think it can be addressed by integrating different technological approaches to create a stable system to be able to generate a high level narrative.

6 Conclusion

Explainable Artificial Intelligent systems are the systems which can explain their decisions to the user. We plan to integrate XAI with Natural Language Generation to generate a narrative for the explanation of decisions given by machine learning and deep learning algorithms.

Cost of creating a system depends on various factors like software complexity, size, used technology, etc. use of new old technologies like rule-based system gives us a solution which is cheap in cost, efficient if the domain is small but it is not robust in nature. System developed with the use of new technology might be expensive with respect to previously discussed system but it is definitely cost-effective solution as it is robust and use of new technologies like machine learning and deep learning produce a reasonable narrative which can explain in much better way.

Text quality is the main aim of any NLG system, but to obtain quality text depends on various factors and it also has many challenges like narrative structure, vague language and suitable linguistic database. When NLG is merged with UI/UX with the help of machine learning, personalizes the output text, language of narrative, appearance hence giving a configurable control to the user.

Integrating NLG with IML and UI/UX can give more control over the output narrative text and precise sentences. There are several challenges for integrating these technologies which can be resolved with the mixed use of old and new technologies.

7 References

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