Informatics Institute of Technology

In Collaboration With

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*University of Westminster, Coat of Arms*

GenSum

Conclusion

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**Acronyms**

|  |  |
| --- | --- |
| AI | Artificial Intelligence. |
| DL | Deep Learning |
| GUI | Graphical User Interface |
| ML | Machine Learning |
| NLP | Natural Language Processing |
| ROUGE | Recall-Oriented Understudy for Gisting Evaluation. |
| BLEU | BiLingual Evaluation Understudy. |
| T5 | Text to Transfer Transformer. |
| BART | Bidirectional Auto-Regressive Transformers. |
| BERT | Bidirectional Encoder Representations from Transformers. |
| PEGASUS | Pre-training with Extracted Gap-sentences for Abstractive Summarization Sequence-to-sequence |
| ILP | Inductive logic programming. |
| LSTM | Long Short-Term Memory. |
| RNN | Recurrent Neural Network. |
| CNN  SEQ2SEQ | Convolutional Neural Network.  Sequence to Sequence |
| RoBERTa | Robustly Optimized BERT Pre-training Approach |
| GPT-3  REST  GPU | Third Generation Generative Pre-Trained Transformer  Representational State Transfer  Graphical Processing Unit |

# Chapter Overview

This chapter covers the preliminary conclusion of the research project, including the core functionality of its implementation for the MVP. The chapter will also review the achievements of the project's goals and objectives and the obstacles encountered. Additionally, an outline of the author's prior knowledge and modules of the program which helped to support the project will be documented along with any new knowledge and skills acquired.

# 10.2 Achievement of Research Aim & Objectives

## **10.2.1 Achievement of Aims**

**“***The aim of this research is to design, develop and evaluate an optimal generalized transformer architecture from a range of popularly used architectures by fine-tuning via hyperparameter optimization, therefore obtaining the recommended architecture's optimum performance.***”**

The initial core components related to the aim of the research is successfully completed by designing, developing & evaluating a performance adaptive generalized transformer. The core functionality was researched in a way to be automated in order to meet the project requirements. The evaluations for the respective work done is attached in the implementation chapter.

## **10.2.2 Achievement of Objectives**

Appendix G – contains the achievement status related to the research objectives which were mentioned in the Chapter 01. "Completed" is the mark next to tasks that were successfully completed, while "Incomplete" is the mark next to those that weren't.

# 10.3 Utilization of Knowledge from the Course

Table 10.1: Utilization of Knowledge gained from the course

|  |  |
| --- | --- |
| **Module(s)** | **Utilized Knowledge** |
| Machine Learning | Understanding the concept underlying data collection and preprocessing, as well as how to train machine learning models, was extremely helpful in developing the models for this research project. |
| Applied AI | The in-depth understanding of how algorithms interact while building ML models provided an understanding of the theoretical principles. |
| Software Development Group Project | This module served as more of a trial run for the Final Year Project; it provided a basic understanding of how to plan, conduct, and assess the research project, providing students the confidence and knowledge necessary to carry out research in their final year. |
| Object Oriented Programming | The knowledge about creating classes and how objects are important helped to enhance the development side area of knowledge for the project. |
| Python Programming (PP1) | This project has the usage of Flask (Python Programming Language Web Framework), PP1 module helped to get introduced to working with Python. |
| Database Systems | The knowledge and the idea of how queries are used to communicate with the database from the webserver system, helped a lot in order to perform read & write operations. |
| Web Design & Development | The concepts thought from this module was used to build the UI for the prototype and the foundation idea of using HTML, CSS and JS supported a lot to move into working with advanced frameworks like React. |

# 10.4 Use of Existing Skills

* **Full-Stack Web Development** – Throughout his internship, the author worked on a number of R&D projects at 99x, where he was able to use cutting-edge technologies for a full stack web development project.
* **Machine Learning / Deep Learning** – During the internship, the author worked on many data science-related R&D projects and also used a variety of online learning resources for self-learning and developing machine learning projects.
* **Documentation Writing** – During the internship and while working on the SDGP module report, the author gained expertise in creating project documentation.

# 10.5 Use of New Skills

* **Text Summarization Systems –** The author has never before worked in an area involving text summarization systems. The author has investigated a number of techniques for dealing with text summarization using publicly accessible online resources, such as material from YouTube, GitHub, Google Colab, and others.
* **Data Preprocessing Techniques –** The author had to learn new various text preprocessing techniques since the project domain lies under text summarization therefore the data after preprocessing has to be meaningful.
* **Hyperparameter Optimization –** Hyperparameter tuning frameworks were explored and experimented to automated the hyperparameter search. Tutorials and tech articles were refereed in order to implement this with in the project.

# 10.7 Problems and Challenges Faced

Table 10.2: Mitigations to Problems and Challenges Faced

|  |  |
| --- | --- |
| **Problem/Challenge** | **Mitigation** |
| Significant training time and computing resource limitations. | Transformer-based model training demands a lot of GPU power. To get around this problem, the author trains the models using Google Colab. |
| Limited experts for the domain | The author contacted domain experts via LinkedIn in order to conduct interviews for requirement gathering because there weren't many domain experts that could be contacted in person. |
| Due to frequent power outages, there were battery problems and internet connectivity issues. | The author continued working on the project despite the power outages by working late or in the early morning at co-working spaces. |

# 10.8 Deviations

The initial goal of the author was to create an optimized solution for movie review summarization using transformers, but after discussions made with supervisors the research gap of the author for the technical contribution being only hyperparameter tuning of transformer felt small in magnitude, therefore the idea of creating a ***performance adaptive generalized solution*** was considered to continue the research implementation on.

After considering the possibilities of implementation this solution, the experts interviewed for the requirement gathering mentioned it to be challenging with the time frame of the project to execute however the author was able to complete the initial core functionalities for the prototype.

# 10.9 Limitations of the Research

* After the core implementation, the author attempted to implement additional performance improvements such as model hybridization, but due to the limited time available, the amount of research that needed to be done in the area of transformer hybridization was significant, which prevented the author from continuing.
* Due to the limitations of GPUs, various other transformer models weren’t explored for abstractive text summarization.

# 10.10 Future Enhancements

* Making use of transformer hybridization to future improve the performance of the text summarization models.
* Since there is a potential that user reviews entered aren't always accurate, it becomes sense to include text paraphrase models for the user reviews.
* Applying key word extraction for the sentiment classification of the review summary, to identify what key words contributed to the sentiment classification, this will help the domain users improve their service.

# 10.11 Achievement of the Contribution to Body of Knowledge

The author successfully contributed to the problem domain, which was the movie review summarization along with the deviations made (model generalization), the technical contributions in order to increase the performance of the system was also made and lastly the author made additional contributions to the project bringing the research project to a conclusion.

## **10.11.1 Domain Contributions**

The author as able to address the performance gap listed for movie review summarization, in order for the need of advanced approaches to increase the performance and achieve a better result.

Moreover, generalization approach considered here contributions to various other domains facing the similar problem to be address as a common.

## **10.11.2 Technical Contribution**

Using a top-tier explored transformer model, automating hyperparameter search for every domain, and use the newly exposed data to automate model retraining with the searched optimal set of hyperparameters.

Currently, there are no such approaches taken from the research done by the author, and the author believes that this approach would benefit multiple domains at the same time.

## **10.11.3 Additional Contributions**

1. Research-based Data Preprocessing scripts specifically for text summarization issue domains.
2. Sentiment Analysis on the generated review summary
3. Experimented the model training with multiple datasets, to get the best possible set of evaluation results.

# 10.12 Concluding Remarks

The conclusion of this study finds that the author was able to design, build, and evaluate an adaptive generalized abstractive text summarization system using optimized transformers and automated hyperparameter tuning and model retraining. The purpose of this chapter was to determine if the author met the goals and objectives of the project, and to examine the role of the author's prior knowledge and academic background in supporting the research. Additionally, the author discusses the new skills they acquired during the project and the challenges and obstacles they encountered, as well as the deviations taken and the limitations of the research. The author also goes in detail about the opportunities for future improvements and also discusses about the contribution to the body of knowledge which include domain, technical and additional contributions made. The author is currently working on publishing a research paper based on their findings.