Graduate Portfolio

By
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Non-Thesis Portfolio

for the degree of

MASTER OF SCIENCE
in
Computer Science

Department of Electrical Engineering and Computer Science

Vanderbilt University
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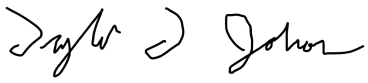
Academic Advisor
Dr. Taylor Thomas Johnson



Introduction

Seung Min (David) Baek is a M.S. in Computer Science at Vanderbilt University under the guidance of academic advisor Dr. Taylor Thomas Johnson. Throughout his academic endeavor, David has acquired a robust understanding of Artificial Intelligence (AI), covering both theoretical aspects and practical developments.

His academic journey from 2022 Fall to 2024 Spring are listed below:

1. Advanced Statistics for Data Science – Dr. Alexander Christensen: A-
2. Social Network Analysis – Dr. Tyler Derr: A
3. Artificial Intelligence – Dr. Meiyi Ma: A-
4. Machine Learning for Dynamical System – Dr. Thomas Beckers: A
5. Advanced Artificial Intelligence – Dr. Gautam Biswas: B
6. Design & Analysis of Algorithms – Dr. Bryan Ward: B+
7. Linear Algebra – Dr. Dietmar Herbert Bisch: B
8. Deep Learning: Representational Learning – Dr. Daniel Cheng Moyer: A-
9. Foundation of Machine Learning – Dr. Soheil Kolouri: B+
10. Deep Learning – Dr. Soheil Kolouri: A-

For access to the **Curriculum Vitae**, please refer to the following link: CV: Seung Min (David) Baek

Statement of Professional Goals and Achievements

A quote "Stay thirsty for knowledge" serves as a guiding principle, and it propels for him to stay formed about the latest development in the field of AI.

Drawing upon his education at Vanderbilt University, he has taken proactive steps to both enhance his own understanding and share knowledge in the field of AI. Specifically, he has curated resources covering fundamental concepts of Linear Algebra, Algorithms for Machine Learning, Deep Learning, and Representational Learning, designed to bridge the gap between theoretical concepts and practical applications. These resources are accessible through the following links: Linear Algebra, Machine Learning, Deep Learning, and Representational Learning.

With a profound motivation to delve into the realm of AI, he is eager to utilize his skill sets to contribute innovative projects. His research endeavors have encompassed diverse areas, including:

1. "Weight Loss Prediction using Social Network Analysis", investigating the hypothesis of weight loss being socially contagious.
2. "Simulating Latent Space Representation of Novices and Experts through Supervised Variational Autoencoders", with a focus on understanding human learning processes and object recognition.
3. "A Dual-Model Approach for Transforming Toxic Comments to Positively-Toned Responses without Information Loss", aimed at fostering a respectful and constructive online communication environment for open expression.

Knowledge and Mastery of Computer Science Concept

This research undertakes a comprehensive investigation into the potential contagion effect within weight loss applications' social frameworks. Prior studies have illustrated how obesity and weight gain can diffuse through social network. However, this study focused on exploring the converse phenomenon within the context of weight loss application. Utilizing data from BOOHEE, a social media platform dedicated to weight management, a comparative analysis of user interactions was conducted employing a Graph Convolutional Network (GCN) model.

Through the application of GCN models and iterative training across five distinct dataset batches, the study achieved a maximum weight loss prediction accuracy of 71.8%. These findings provide robust evidence supporting the assertation that weight loss applications, like BOOHEE, and the social dynamics embedded within their platforms significantly impact users' weight management efforts.

For access to the research paper and accompanying source code, please follow these links: Paper, source code

Communication Skills in Computer Science

One enduring question within the fields of vision science and cognitive psychology is how people learn and recognize categories of objects. Objects can be categorized in various levels of abstraction, from general categories such as "animal" to more specific classifications like breeds of dogs. As individual gain expertise within a particular categorical domain, their discernment becomes adept at distinguishing exemplars at the subordinate levels. However, the potential differentials between novices and experts in underlying cognitive processes within the context of a specific domain remains a matter of ongoing debate. Whether such perceptual expertise is a result of changes in representations or other cognitive processes remains inconclusive.

This study aims to explore one plausible hypothesis that perceptual expertise arises from disparities in representation between novices and experts. To investigate this, this study utilized a Supervised-Variational Autoencoder (SVAE), a variant of the Variational Autoencoder (VAE) incorporating a classification component, to analyze the latent space distributions of novice and expert models. The novice model was characterized as possessing well-distributed latent representation and demonstrating reasonable reconstruction capabilities at the basic-level category (utilizing CIFAR-10 dataset), while expert model was defined by its proficiency in handling subordinate-level categories (utilizing a subset of the CUB-200-2011 dataset).

Despite achieving successful image reconstructions with both novice and expert models, the latent representations learned by these models did not exhibit clear indication of categorical representations. This lack of clarity may be attributed to several factors, including insufficient dataset, information loss in the latent space during compression for visualization, the challenge of acquiring meaningful latent representations while sustaining adequate reconstruction performance, or the phenomenon of catastrophic forgetting while training for expert.

For access to the full paper and accompanying source code, please visit: Paper, source code

Conduct Independent Inquiry in Computer Science

The internet serves as a pivotal platform to share opinions freely, ubiquitously, and anonymously through online. It stands as a remarkable asset to the current era, but it also poses considerable challenges. While the internet enables access to a vast wealth of information, it concurrently contributes to negative phenomena such as the dissemination of fake news and harmful contents. The anonymity afforded by the internet often emboldens individuals to post toxic comments, potentially causing severe psychological harm. Recognizing the importance of preserving the diversity of opinions, this study introduces a Transformer-based Dual-Model Large Language Model (LLM) comprising a “Toxic Detector” and a “Reframing Generator”.

The objective is to achieve the advanced performance of the Chat-GPT 3.5 model without the need for fine-tuning a complex pre-trained model. Instead, the model leverages GPT outputs as training dataset, thereby avoiding the extensive computational costs associated with fine-tuning complex architecture. For the text tokenization process, the Bidirectional Encoder Representations from Transformers (BERT) tokenizer from Hugging Face was employed, ensuring efficient language understanding.

The “Toxic Detector” model was trained using the dataset from the “Toxic Comment Classification Challenge” hosted by Jigsaw on Kaggle. Additionally, a dataset for the “Reframing Generator” model was created by transforming toxic comments from the Jigsaw dataset into comments with a positive tone by utilizing ‘gpt-3.5-turbo-0125’ model via the OpenAI API.

For full access to the research paper and accompanying source code, please visit: Paper, repository