



UNIVERSITY OF CAPE TOWN
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MASTER'S DISSERTATION

**A Hybrid Multi-Modal Recommender System using Neural Collaborative
Filtering and Content Based Filtering**

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A dissertation presented for the degree of
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from the

Department of Statistical Sciences



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Declaration of Authorship

I, Pavan SINGH, declare that this dissertation titled, “A Hybrid Multi-Modal Recommender System using Neural Collaborative Filtering and Content Based Filtering” and the work presented in it are my own. I confirm that:

- This work was done wholly while in candidature for a research degree at this University.
- The contents of this thesis has not been previously submitted for a degree or any other qualification at this University or any other institution.
- Where I have consulted the published work of others, this is always clearly attributed.
- Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work.
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Abstract

Department of Statistical Sciences

Master of Science Advanced Analytics

A Hybrid Multi-Modal Recommender System using Neural Collaborative Filtering and Content Based Filtering

by Pavan SINGH

Online shopping has become a ubiquitous aspect of modern life, and recommender systems have become a crucial tool for e-commerce platforms such as Amazon. Recommender systems aim to provide users with personalized product recommendations based on their preferences and behaviors. They analyze user data, such as their browsing history, purchase history, and ratings, to understand their preferences and make recommendations that align with those preferences. They have become fundamental applications in electronic commerce and information access, providing suggestions that effectively prune large information spaces so that users are directed toward those items that best meet their needs and preferences. Due to recommender systems being a crucial tool for e-commerce platforms, studies in this domain has been growing rapidly and has become a very active area of research.

This paper aims to develop a hybrid recommender system model which incorporates data from multi-modalities, textual data and explicit ratings data. The hybrid model is composed of a neural collaborative filtering component and content based filtering component. The goal is to examine the impact of incorporating textual features and sentiment in potentially enhancing recommendation accuracy. We further explore the development of our proposed hybrid model by comparing its performance against the individual filtering models and several other popular filtering algorithms for recommendation systems. Our model shall be trained and deployed on the Amazon Reviews dataset, which contains millions of user reviews and feedback on thousands of different products. The data set also provides a large corpus of metadata making it adequate for exploring both dimensions of filtering approaches. Our methodology is based on a literature analysis and aims to clearly extrapolate on our singular models to develop a hybridized recommender system.

Empirical results indicate that the hybrid NCF and CBF model performed with a root mean square error (RMSE) of xyz with random data splits and sentiment features included. The model evidently outperformed all the benchmark models tested and shows that there exists scope for a hybridised multi-modal model incorporating NCF and CBF to benefit e-commerce industry to better modelling consumer preferences. Moreover, there is great support for including textual features and sentiment to further enhance models. Additionally, we found that the deep learning recommendation models consistently outperformed their classical counterparts. The algorithm, models and techniques developed and used in this paper are not problem-specifics and can be applied to different recognition and prediction problems.

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