

Streamlined Book Rating Prediction with Neural Networks

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Abstract: Online book review platforms generate vast user data, making accurate rating prediction crucial for personalized recommendations. This research explores neural networks as simple models for predicting book ratings without complex algorithms. Our novel approach uses neural networks to predict ratings solely from user-book interactions, eliminating manual feature engineering. The model processes data, learns patterns, and predicts ratings. We discuss data preprocessing, neural network design, and training techniques. Real-world data experiments show the model's effectiveness, surpassing traditional methods. This research can enhance user experience, book catalog organization, and aid publishers, simplifying recommendation processes and providing tailored suggestions based on user preferences.

Keywords: Book, rating, prediction, JNN

Introduction

In today's digital age, where an abundance of books is just a click away, choosing the next captivating read can be both exciting and overwhelming. Book enthusiasts heavily rely on ratings and reviews to navigate this vast literary landscape. These ratings provide valuable guidance, offering insights into a book's quality and appeal.

Predicting a book's rating can benefit both readers and authors. It helps readers make informed choices that align with their preferences and expectations. For authors and publishers, it offers crucial feedback for improving future works and marketing strategies.

Traditionally, human readers determined book ratings, which could be subjective and diverse, leading to inconsistency and bias. However, with the emergence of machine learning and neural networks, we now have the opportunity to develop models that can estimate book ratings based solely on the book's content, metadata, or a combination of both.

This project explores the use of machine learning and neural networks to predict book ratings based solely on the book's inherent information. We analyze factors like genre, author, book length, language complexity, and more to create a model for quantitative rating predictions.

In the following sections, we will outline our project's objectives and methodologies, discuss its significance, and explore potential applications in the world of literature. Our ultimate goal is to leverage the power of neural networks to revolutionize book rating predictions, making the quest for the perfect read even more enjoyable for book enthusiasts.

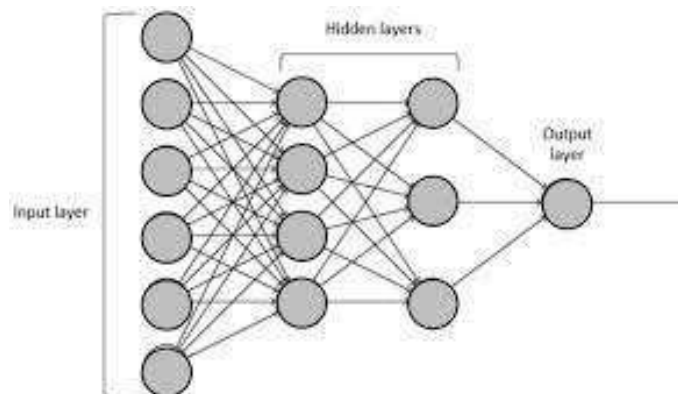


Figure 1: ANN Architecture

1. Literature Review

Artificial Neural Networks (ANNs) find applications in various domains:

In Education:

- Predicting Student Performance in the Faculty of Engineering and Information Technology [5]
- Predicting Academic Warning of Students in the Faculty of Engineering and Information Technology at Al-Azhar University-Gaza [5]
- Arabic Text Summarization Using AraBERT Model with Extractive Text Summarization Approach [6]

In Health:

- Parkinson’s Disease Prediction [7]
- Classification Prediction of SBRCTs Cancers [7]
- Predicting Medical Expenses [8]
- Predicting Antibiotic Susceptibility [8]
- Predicting Liver Patients [7]
- Blood Donation Prediction [9]
- Predicting DNA Lung Cancer [10]
- Diagnosis of Hepatitis Virus [10]
- COVID-19 Detection [11]

In Agriculture:

- Plant Seedlings Classification Using Deep Learning [12]
- Predicting Edibility of Mushrooms Using Back-propagation Neural Network [15]
- Analyzing Types of Cherry Using Deep Learning [21]
- Banana Classification Using Deep Learning [13]
- Mango Classification Using Deep Learning [14]
- Grapefruit Type Classification Using Deep Learning [7]
- Grape Type Classification Using Deep Learning [3]
- Classifying Nuts Types Using Convolutional Neural Network [2]
- Potato Classification Using Deep Learning [3]
- Age and Gender Prediction Through Single User Images Using CNN [5]

In Other Fields:

- Predicting Software Analysis Process Risks Using Linear Stepwise Discriminant Analysis [14]
- Predicting Overall Car Performance [8]
- Glass Classification [9]
- Tic-Tac-Toe Learning [14]
- Energy Efficiency Prediction [15]
- Predicting Titanic Survivors [14]
- Classification of Software Risks in Software Planning Development Process [13]
- Handwritten Signature Verification [12]
- Email Classification [14]
- Predicting Temperature and Humidity in the Surrounding Environment [12]
- English Alphabet Prediction [9]

2. Methodology

We downloaded a data set from *kaggle* that contains books information from *goodreads* application/website. This dataset created by the user *Soumik* [19]. We did some preprocessing on the data, and then we trained our ANN model and validated it.

3. Original Dataset Description

Table 1: Original Dataset Description

#	Attribute	Description	Type
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1.	bookID	A unique Identification number for each book.	Integer
2.	title	The name under which the book was published.	String
3.	authors	Names of the authors of the book. Multiple authors are delimited with -.	String
4.	average_rating	The average rating of the book received in total.	Real
5.	isbn	Another unique number to identify the book, the International Standard Book Number.	Long
6.	language_code	Helps understand what is the primary language of the book. For instance, eng is standard for English.	String
7.	isbn13	A 13-digit ISBN to identify the book, instead of the standard 11-digit ISBN.	Long
8.	# num_pages	Number of pages the book contains.	Integer
9.	ratings_count	Total number of ratings the book received.	Integer
10.	text_reviews_count	Total number of written text reviews the book received.	Integer

3.1 Dataset Preprocessing

We wanted to use this dataset to build an ANN model to predict the overall rating of the books (attribute number 4).

The first thing we had to do, is choose a suitable factors for this prediction, and delete the unnecessary ones, we chose these factors to be our input to the predictive model: #num_pages, rating_count, text_reviews_count, language_code.

Moreover, the dataset contain 11128 instances. After preprocessing it becomes 11122 which is a large a number to a neuralnetwork to deal with, so, we divided these samples to 7451 training instances, and 3670 validation instances.

In addition, because of the integer numbers of the inputs are too large comparing with the real rate values, we did a normalization to them so all the data are real.

Normalization formula was:

$$\text{Normalized value (xi)} = \frac{xi - X_{min}}{(X_{max} - X_{min})}$$

While checking the instances, it has been noticed that there are a conflict between some instances; which means, there at least two books with the same input values but different rates, we excluded for the secondary ones. Moreover, there were validation instances that are out of range, we converted them to training. Now, the dataset is ready for training and validation.

3.2 Our ANN Model

The resulted predictive ANN model is shown in Figure 2 and Figure 6.

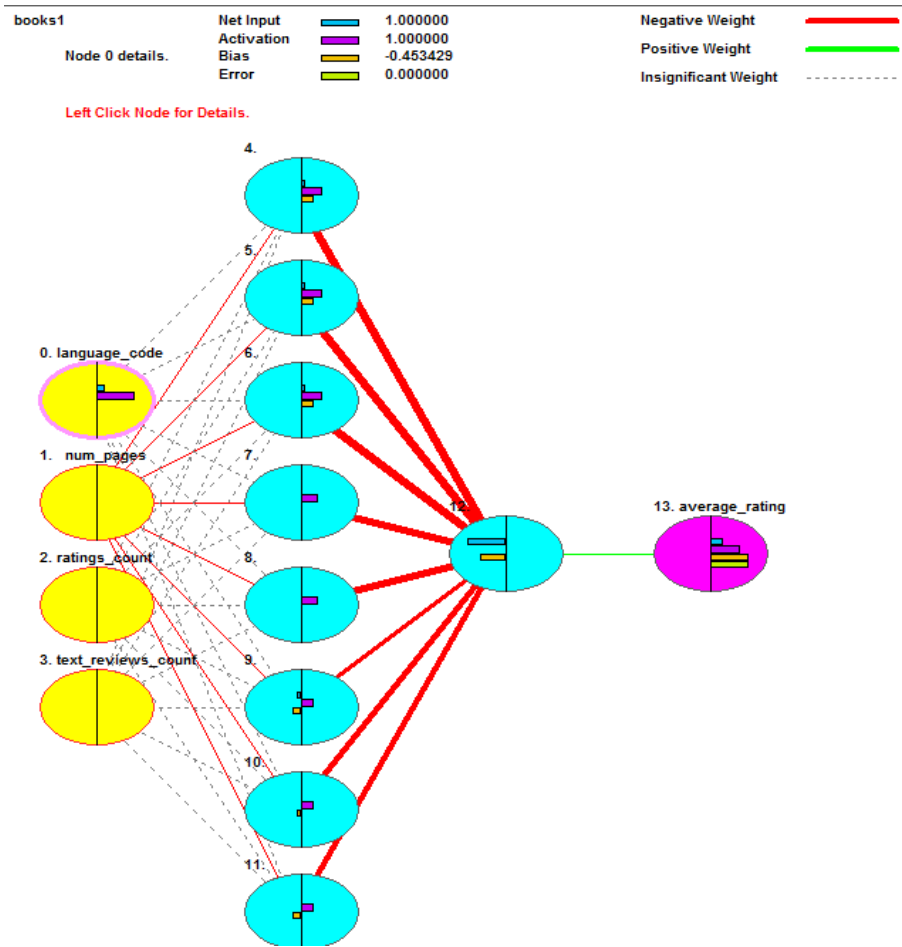


Figure 2: Our ANN Model

3.3 Validation

Our ANN model was able to predict the books' overall rate with 99.78% accuracy, with about 0.005 errors as seen in figure (3). Furthermore, The Model showed that the most effective factor in a book's rate is the rating_count. More details are shown in figure (4).

Figure 3: Validation and Errors

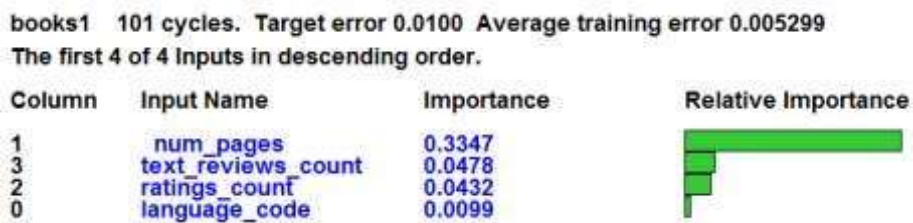


Figure 4: Attributes Importance

	language_co+	num_pages	ratings_co+	text_revie+	average_ra+
#0	0.0000	0.0374	0.0011	0.0054	0.8420
#1	0.0000	0.0414	0.0014	0.0049	0.7960
#2	0.0000	0.0243	0.0009	0.0037	0.8100
#3	0.0000	0.0389	0.0005	0.0019	0.7880
#4	0.0000	0.0318	0.0002	0.0011	0.8340
#5	0.0000	0.0590	0.0010	0.0055	0.7320
#6	0.0000	0.0354	0.0011	0.0016	0.8340
#7	0.0476	0.0991	0.4558	0.2927	0.9140
#8	0.0476	0.1323	0.4683	0.3100	0.8980
#9	0.0476	0.0535	0.0014	0.0026	0.8840
#10	0.0476	0.0661	0.5089	0.3853	0.9120
#11	0.0476	0.4091	0.0090	0.0017	0.9560
#12	0.0476	0.5082	0.0061	0.0086	0.9460
#13	0.0476	0.1239	0.0008	0.0027	0.8760
#14	0.0476	0.1239	0.0543	0.0433	0.8760
#15	0.0476	0.0327	0.0011	0.0049	0.8440
#16	0.0476	0.0009	0.0003	0.0027	0.8440
#17	0.0476	0.1239	0.0006	0.0021	0.8760
#18	0.0476	0.0827	0.0541	0.0997	0.8420
#19	0.0476	0.0084	0.0016	0.0053	0.8880
#20	0.0476	0.0389	0.0005	0.0014	0.7740
#21	0.0476	0.0509	0.0158	0.0450	0.8140
#22	0.0476	0.0462	0.0107	0.0235	0.7800
#23	0.0476	0.0455	0.0099	0.0239	0.7660
#24	0.0476	0.0386	0.0106	0.0237	0.7720
#25	0.0476	0.0493	0.0175	0.0350	0.7820
#26	0.0476	0.0411	0.0062	0.0221	0.7860
#27	0.0476	0.2628	0.0220	0.0164	0.9180
#28	0.0476	0.1800	0.0004	0.0010	0.9000
#29	0.0476	0.0605	0.4630	0.1450	0.8720
#30	0.0476	0.0332	0.0043	0.0005	0.9060

Figure 5: imported pre-processed Dataset

Controls

Learning
 Learning rate: 0.56488 Decay Optimize
 Momentum: 0.63489 Decay Optimize

Validating
 Cycles before first validating cycle: 30
 Cycles per validating cycle: 30
 Select 0 examples at random from the
 Training examples = 7451

Slow learning
 Delay learning cycles by 4 miliseconds

Target error stops
 Stop when Average error is below 0.01
 or stop when Δ errors are below

Validating stops
 Stop when 100 % of the validating examples
 are Within 10 % of desired outputs
 or Correct after rounding

Fixed period stops
 Stop after 20.0000 seconds
 Stop on 0 cycles

OK Cancel

Figure 6: Parameter values of the ANN Model

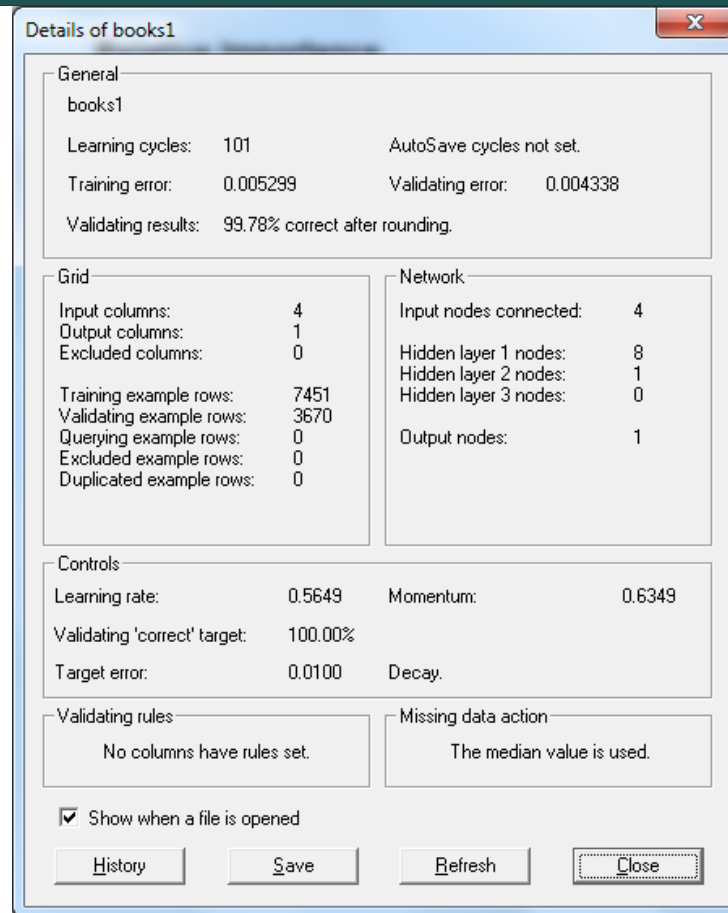


Figure 7: Details of our ANN Model

4. Conclusion

A predictive Artificial Neural Network Model for predicting books' rating was developed. The Model trained and validated using a dataset from the goodreads application/ website. We did some preprocessing on the dataset to make it suitable as input to our ANN model. Validation showed that the model is 99.78% accurate.

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