

**A REAL-TIME PERSONALISED RECOMMENDER SYSTEM  
FRAMEWORK FOR ONLINE LEARNING PLATFORMS**

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**DECEMBER, 2022**

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FRAMEWORK FOR ONLINE LEARNING PLATFORMS**

**BY**

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**A DISSERTATION SUBMITTED TO THE SCHOOL OF  
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**DECEMBER, 2022**

## **ACCEPTANCE**

This is to attest that this dissertation is accepted in partial fulfilment of the requirements for the award of the degree of Master of Science in Computer Science in the Department of Computer and Information Sciences, College of Science and Technology, Covenant University, Ota, Nigeria.

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I, **OKUOYO, OTAVIE LOVEDAY (20PCG02182)** declare that this research was carried out by me under the supervision of Prof. Olufunke O. Oladipupo of the Department of Computer and Information Sciences Science, College of Science and Technology, Covenant University, Ota, Ogun State, Nigeria. I attest that this dissertation has not been presented either wholly or partially for the award of any degree elsewhere. All sources of data and scholarly information used in this dissertation are duly acknowledged.

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## **CERTIFICATION**

We certify that this dissertation titled “**A REAL-TIME PERSONALISED RECOMMENDER SYSTEM FRAMEWORK FOR ONLINE LEARNING PLATFORMS**” is an original research carried out by **OKUOYO, OTAVIE LOVEDAY (20PCG02182)** in the Department of Computer and Information Sciences, College of Science and Technology, Covenant University, Ota, Ogun State, Nigeria under the supervision of Prof. Olufunke O. Oladipupo. We have examined and found this work acceptable as part of the requirements for the award of Master of Science (M.Sc.) in Computer Science.

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## **DEDICATION**

I dedicate this dissertation to my saviour, Jesus Christ.

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## LIST OF ABBREVIATIONS

ABSA	Aspect-Based Sentimental Analysis
ACO	Ant Colony Optimization
AI	Artificial Intelligence
ANN	Artificial Neural Network
AI-ML	Artificial Intelligence/Machine Learning
A3C	Asynchronous Advantage Actor-Critic
BMF	Biased Matrix Factorization
CA	Context Awareness
CART	Classification And Regression Tree
CB	Content-Based
CF	Collaborative Filtering
CMN	Collaborative Memory Network
CNN	Convolutional Neural Network
CTR	Click Through Rate
C2C	Consumer-to-Consumer
DBN	Deep Belief Networks
DBPMF	Deep Bias Probabilistic Matrix Factorization
DDPG	Deep Deterministic Policy Gradient
DDQN	Double Deep Q-Learning Network
DE	Distance Education
DeepCoNN	Deep Cooperative Neural Networks
DKN	Deep Knowledge-aware Network
DL	Deep Learning
DPRMF	Dual-Prior Review-based Matrix Factorization
DQN	Deep Q-learning Network
DRL	Deep Reinforcement Learning
ELRA	E-Learning Recommendation Architecture
FM	Factorisation Matrix
FP-growth	Frequent Pattern-growth
GA	Genetic Algorithm

GAN	Generative Adversarial Network
GPU	Graphics Processing Unit
GSP	Generalized Sequential Pattern
HFT	Hidden Factors as Topic
IDE	Integrated Development Environment
IoT	Internet of Things
IT2FLS	Interval Type-2 Fuzzy Logic Systems
KNN	K-Nearest Neighbour
LSTM	Long Short-Term Memory
MDP	Markov Decision Process
MF	Matrix Factorization
ML	Machine Learning
MLlib	Machine Learning Library
MOOC	Massive Open Online Courses
MOOCRC	MOOC Resource Recommendation
NAMN	Neighbourhood Attentional Memory Networks
NARRE	Neural Attention Regression model with Review-level Explanations
NeuMF	Neural Matrix Factorization
NLP	Natural Language Processing
NMF	Nonnegative Matrix Factorization
OCCF	One-Class Collaborative Filtering
PCA	Principal Component Analysis
PCC	Pearson Correlation Coefficient
PMF	Probabilistic Matrix Factorization
PTCCF	Preference Pattern TCCF
RBM	Restricted Boltzmann Machines
RF	Random Forest
RL	Reinforcement Learning
RNN	Recurrent Neural Network
RECSIM	RECommendation SIMulation
RS	Recommendation/Recommender System

SARSA	State-Action-Reward-State-Action
SPM	Sequential Pattern Mining
STD	Standard Deviation
SVD	Single Value Decomposition
SVD++	Single Value Decomposition Plus Plus
SVM	Support Vector Machines
TCC	Time Correlation Coefficient
TCCF	Time Correlation Coefficient Collaborative Filtering
TD	Temporal Difference
TD3	Twin Delayed DDPG
T2FLSs	general Type-2 Fuzzy Logic Systems
URecSYS	Utility-based News Recommendation SYStem
VA	Virtual Agent



## ABSTRACT

Long-tail concerns affect traditional recommender systems. They often recommend identical things, limiting the options available to users. Conventional recommender systems also suffer from lack of real-timeliness. In this work, a recommender system framework for online learning platform is proposed using deep reinforcement learning algorithm. The agent takes action by recommending learning materials to the learners based on the interactions of the recommender agent with the learner. Positive reinforcement (positive reward such as likes, longer dwell time, clicks, etc.) and negative reinforcement (punishment such as dislikes, less dwell time, skips, etc.) are used to teach the recommender agent what to recommend. This enables the agent to iteratively refine its policy via interactivities with the environment, using trial-and-error methods, until the model conforms to an ideal policy that produces suggestions that are most suitable for the users' dynamic preferences. The outcomes of the deep reinforcement learning agent were benchmarked against the performance of a random agent using evaluation metrics such as average episode reward, click through rate, average quality of recommendation and standard deviation of episode reward. The study shows that the average episode reward, click through rate, average quality of recommendation for the DRL agent increased by 2.72, 1.5 and 16.20 percent respectively, while the standard deviation of episode reward for the DRL agent reduced by 20.61 percent. All these are positive indicators of the better performance of the DRL agent.

***Keywords: Recommender System; Reinforcement Learning; Deep Reinforcement Learning; Markov Decision Process; Online Learning; Personalised Learning***